Yukon Pacific LNG Project

March 1995

Final Environmental Impact Statement

FERC/EIS-0071
Yukon Pacific Company L.P.

Docket No. CP88-105-000

Federal Energy Regulatory Commission
Office of Pipeline Regulation
Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D. C. 20426

In Reply Refer To:
OPR/DEER/ERC I
Yukon Pacific Company L.P.
Docket No. CP88-105-000

TO THE PARTY ADDRESSED:

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has made available a final environmental impact statement (FEIS) on the construction and operation of the liquefied natural gas (LNG) liquefaction plant, LNG storage and marine loading facilities, and LNG tanker transport proposed in the above-referenced docket.

The staff prepared the FEIS to satisfy the requirements of the National Environmental Policy Act. The staff concludes that approval of the proposed action, with appropriate mitigating measures as recommended, including receipt of necessary permits and approvals, would have limited adverse environmental impact. The FEIS evaluates alternatives to various components of the proposal.

Yukon Pacific Company L.P. (Yukon Pacific) is seeking approval of a specific site at Anderson Bay, Port Valdez, Alaska to export LNG to destinations in Japan, Korea, and Taiwan. The proposed action involves construction of:

- a 2.1 billion cubic feet per day LNG liquefaction plant;
- four aboveground 800,000-barrel LNG storage tanks;
- a marine facility to load two tankers within a 12-hour period; and
- a cargo/personnel ferry docking facility.

In addition, Yukon Pacific proposes to operate a fleet of 15 LNG tankers, each having 125,000 cubic meters of cargo capacity. The fleet would make 275 trips per year. Construction of the project would take 8 years with a peak work force of nearly 4,000 workers in the fifth year.

The FEIS will be used in the regulatory decision-making process at the FERC. While the period for filing interventions in this case has expired, motions to intervene out-of-time can be filed with the FERC in accordance with the Commission's Rules of Practice and Procedures, 18 CFR 385.214(d). Further, anyone desiring to file a protest with the FERC should do so in accordance with 18 CFR 385.211.

The FEIS has been placed in the public files of the FERC and is available for public inspection in the:

Federal Energy Regulatory Commission
Division of Public Information
Room 3104
941 North Capitol Street, N.E.
Washington, DC 20426

Copies of the FEIS have been mailed to Federal, state, and local agencies, public interest groups, libraries, newspapers, individuals who have requested the FEIS, and other parties to this proceeding.

Limited copies of the FEIS are available from:

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Lois D. Cashell,
Secretary

The Yukon Pacific LNG Project Final Environmental Impact Statement (FEIS) has been prepared by the staff of the Federal Energy Regulatory Commission (FERC or Commission) to fulfill the requirements of the National Environmental Policy Act. Among its other responsibilities, the FERC has authority under Section 3 of the Natural Gas Act to approve or disapprove the place of export and the construction and operation of facilities at this place of export. The U.S. Coast Guard, U.S. Department of Transportation, U.S. Army Corps of Engineers, the Alaska State Pipeline Coordinator's Office, Alaska Department of Fish and Game, and the City of Valdez are cooperating Federal, state, and local agencies for this FEIS.

The Draft Environmental Impact Statement (DEIS) for this project was issued in May 1993 and a 45-day public comment period followed. During that time, we received numerous comments from regulatory agencies as well as public groups, private individuals, and other concerned parties. Responses to comments received have either been incorporated into the revised text of this FEIS as new or additional information, or have been included in separate responses in appendix E. It was determined during review of the comments that there was insufficient data available from Yukon Pacific Company L.P. (Yukon Pacific) to address a number of comment areas including air quality, wetlands, and spoil disposal issues.

To obtain the information required to address these comments, we requested additional information from Yukon Pacific in September 1993. A data response was prepared and a technical conference was held in March 1994 for further clarification of the additional information. The conference was attended by Region 10 of the U.S. Environmental Protection Agency, the FERC, the Alaska Department of Environmental Conservation, and Yukon Pacific. Yukon Pacific followed up this meeting with the preparation and submittal of an Issues Resolution Document summarizing all new information. A Final Issues Resolution Document, incorporating agency comments, was filed in July 1994 and the information incorporated into the FEIS.

PROPOSED ACTION

Yukon Pacific is seeking approval of a specific export site at Anderson Bay, Port Valdez, Alaska. Yukon Pacific proposes to construct and operate facilities to liquefy natural gas delivered to Port Valdez via pipeline from the North Slope; briefly store the liquefied natural gas (LNG); and transfer the LNG at a marine terminal in Anderson Bay to LNG tankers for export to various Asian Pacific Rim countries.

The Yukon Pacific LNG facility would receive and liquefy 2.1 billion cubic feet per day of conditioned natural gas delivered by pipeline from Prudhoe Bay. The entire plant site would occupy a land area of about 390 acres. Major facilities in the plant would include four LNG process trains consisting of gas pretreatment and liquefaction, four 800,000-barrel aboveground LNG storage tanks, and a marine facility to load two tankers of 125,000 cubic meters capacity within a 12-hour period. At planned capacity, a fleet of 15 double-hulled LNG tankers would transport the LNG through U.S. territorial waters to receiving terminals in the Pacific Rim, making about 275 loaded voyages per year.

Construction of the proposed facilities would permanently affect approximately 426 acres of predominantly spruce-hemlock forest, wetland, and non-wetland subtidal marine habitats. The site, because of its steep topography, would require extensive recontouring, through excavation and filling, to create bedrock benches on which the facility structures would be constructed. This would result in about 3.3 million cubic yards of excess excavated materials requiring disposal (2.6 million cubic yards of overburden and 0.7 million cubic yards of rock).

The period of construction would be about 8 years, with a peak workforce of 4,000 anticipated in the fifth year. Yukon Pacific proposes to house this workforce at the east end of the construction site, on the banks of Seven Mile Creek, using only marine access for the transportation of all materials, supplies, and personnel. A dam and 3.5-acre reservoir on Seven Mile Creek would supply both potable and construction water needs.

From a resource perspective, impacts are expected to be localized and minor overall. Resident freshwater fish resources are limited in distribution at the site and are not expected to be impacted. Impacts on wildlife are expected to be minor: waterfowl and shorebirds are limited by a lack of suitable habitat; raptors are known to nest in the area, but none at the site itself; large mammals occur in low numbers in the vicinity of the project and impacts on small mammals and furbearers would be limited to the loss of forest habitat through site clearing and preparation. The prospect of human/bear encounters has been identified and Yukon Pacific will be required to submit a mitigation plan before beginning construction. Site development would result in the loss of about 35.7 acres of estuarine and palustrine wetlands and 13.1 acres of non-wetland subtidal marine habitats, for which specific mitigation plans will be required before construction. Estuarine spawning areas at the mouths of Seven Mile and Nancy Creeks would require protection through the avoidance of in-stream or near-stream activities during sensitive periods. Measures to ensure that marine mammals are not present, and therefore not affected by construction, have been recommended. No federally listed or proposed endangered or threatened plant or wildlife species have been reported in the vicinity of the site.

No previously recorded or newly identified cultural resource sites were identified. Subsistence use of fishery and marine mammal resources would be minimally affected from increased shipping in Prince William Sound. The Yukon Pacific LNG Project would significantly increase total employment and population in the City of Valdez during construction and operation of the plant and would stimulate economic activity both in the short and long term.

ALTERNATIVES CONSIDERED

We reviewed the No Action Alternative, which would avoid all of the environmental effects of the project, but which would result in the entire Trans-Alaska Gas System (TAGS) Project, including the pipeline, not being built. This FEIS summarizes the analysis of alternative sites in the TAGS FEIS which supported the U.S. Department of Energy's disapproval of all sites other than the proposed Valdez (Anderson Bay) location for the place of export (DOE, 1989).

We examined six alternatives to the proposed construction camp at Seven Mile Creek, including other locations within or adjacent to the construction site as well as use of the existing camp site in Valdez, in combination with different modes of transport of workers. Of the onsite alternatives, none offered environmental advantages over the proposed Seven Mile Creek site and therefore did not warrant further consideration. The Valdez camp site alternative, however, did offer environmental opportunities which the staff further examined and for which public comment was sought. As a result of these comments and further analysis, the onsite camp location at Seven Mile Creek was determined to be preferable.

We also examined six potential sites for the disposal of the rock and overburden materials excavated in excess of fill requirements during site preparation. These included onshore, open-water, and combination disposal options. Means to reduce impacts on intertidal and subtidal wetlands featured prominently in the review. Following public consultation on the DEIS and additional information developed by Yukon Pacific, a combination of land and marine disposal methods was found preferable.

AREAS OF CONCERN

On January 31, 1992 the FERC issued a "Notice of Intent to Prepare a Draft Environmental Impact Statement on the Yukon Pacific LNG Project and Request for Comments on Environmental Issues" (NOI). The NOI was sent to Federal, state, county, and local agencies; newspapers; libraries; and individuals. Public scoping meetings were conducted on May 19, May 21, and May 26, 1992 in Anchorage, Fairbanks, and Valdez, Alaska, respectively. Additional public meetings following the issuance of the DEIS were conducted on June 8, and June 10, 1993 in Anchorage and Valdez, Alaska, respectively.

Issues raised during scoping and through letters included concerns about: the seismic design criteria being applied for the site in view of historic records of seismic activity in the area; the effects of surface and groundwater withdrawals on local flowages, with secondary effects on anadromous fish; disturbance to the marine shoreline habitat during construction and filling; impacts on sport and subsistence hunting and fishing during construction and operations; avoidance and mitigation of wetlands; cumulative effects of LNG operations, tanker operations and existing Alyeska Marine Terminal and refinery operations, on local air quality; loss of recreation, aesthetics, and usage of Anderson Bay; impact of large influx of construction and permanent workers on local resources; effect of increased ship traffic on the Prince William Sound Vessel Traffic Service Area; and the safety of LNG tankers in addition to the existing crude oil tanker traffic in Prince William Sound.

ENVIRONMENTAL STAFF'S CONCLUSIONS AND RECOMMENDATIONS

Information provided by Yukon Pacific and further developed from data requests, field investigations, literature research, alternatives analyses, and contacts with Federal, state, and local agencies and individual members of the public indicates that construction of the proposed Yukon Pacific LNG Project would result in a limited adverse environmental impact during construction and operation. As part of our analysis, we have developed specific mitigation measures, including additional studies and field investigations, that we believe to be appropriate and reasonable for the construction and operation of the LNG production and shipping facilities to proceed. We believe that these measures would substantially reduce the environmental impact that would result from construction and operation of the project and ensure the safety of the facility as proposed. Where additional studies or field investigations are recommended, significant impacts that are identified would either be avoided or mitigated to non-significant levels.

We (the Commission staff) conclude that if our recommended mitigation measures to reduce the anticipated environmental impact are adopted and if the appropriate permits and approvals are obtained, the construction and operation of the proposed facilities would be an environmentally acceptable action. We evaluated several alternatives associated with various aspects of the proposed facility in our efforts to establish those most environmentally preferable in both the short and long term. We are therefore recommending that our mitigation measures be attached as conditions to any authorization issued by the Commission for a place of export and the construction and operation of facilities at this place of export.

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
AASHTO	American Association of State Highway and Transportation Officials
ACHP	Advisory Council on Historic Preservation
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADGC	Alaska Division of Governmental Coordination
ADNR	Alaska Department of Natural Resources
ADOL	Alaska Department of Labor
ADSSE	Automated Dependent Surveillance Shipborne Equipment
AHRS	Alaska Heritage Resource Survey
Alyeska	Alyeska Pipeline Service Company
ANGTA	Alaska Natural Gas Transportation Act
ANGTS	Alaska Natural Gas Transportation System
ANILCA	Alaska National Interest Lands Conservation Act
Applied Technology	Applied Technology Corporation
APUC	Alaska Public Utilities Commission
AQCR	Air Quality Control Region
ARPA	Archeological Resources Protection Act
BACT	best available control technology
bcfd	billion cubic feet per day
BLM	Bureau of Land Management
BMPM	Erosion Control Best Management Practices Manual
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene, and xylene
Btus	British thermal units
CAA	Clean Air Act
CBI	Chicago Bridge and Iron
CCA	Copper Country Alliance
CDP	census designated place
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
Coast Guard	U.S. Coast Guard
COE	U.S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
CWA	Clean Water Act
dBA	decibels of the A-weighted scale
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DOE/FE	U.S. Department of Energy, Office of Fossil Energy
DOI	U.S. Department of the Interior
DOI/EA	U.S. Department of the Interior, Office of Environmental Affairs
DOT	U.S. Department of Transportation
DWT	deadweight ton
EIS	Environmental Impact Statement

ACRONYMS AND ABBREVIATIONS (cont'd)

EMS	emergency medical services
EPA	U.S. Environmental Protection Agency
ERA	Economic Regulatory Administration
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FPC	Federal Power Commission
FS	U.S. Forest Service
FWS	U.S. Fish and Wildlife Service
g	acceleration due to gravity
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
hp	horsepower
HRSG	heat recovery steam generator
JPO	Joint Pipeline Office
kJ/W-hr	kiloJoule/Watt-hour
kW	kiloWatt
Ldn	day-night sound level
Leq(24)	24-hour equivalent sound level
LNG	liquefied natural gas
m	meter
MDE	Maximum Design Earthquake
mg/L	milligrams per liter
MLA	Mineral Leasing Act
MLLW	Mean Lower Low Water
mm	millimeter
MR	mixed refrigerant
μmoles/l	micromoles per liter
M_w	moment magnitude
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NFPA 59A	National Fire Protection Association 59A LNG Standards
NGA	Natural Gas Act
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOI	Notice of Intent to Prepare a Draft Environmental Impact Statement on the Yukon Pacific LNG Project and Request for Comments on Environmental Issues
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSA	noise-sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
NTU	nephelometric turbidity units

ACRONYMS AND ABBREVIATIONS (cont'd)

NWF	National Wildlife Foundation
NWI	U.S. Fish and Wildlife Service National Wetlands Inventory
NWS	National Weather Service
OBE	Operating Basis Earthquake
OPLAN	Operating Plan
OPR	Office of Pipeline Regulation
OSHA	U.S. Department of Labor, Occupational Safety and Health Administration
PAH	polynuclear aromatic hydrocarbon
PE	precipitation-evaporation
PERC	Powered Emergency Release Coupler
PM_{10}	particulate matter
ppm	parts per million
ppmv	parts per million by volume
ppt	parts per thousand
Preload	Preload Incorporated
PSD	Prevention of Significant Deterioration
psig	pounds per square inch gauge
PWSAP	Prince William Sound Area Plan
Quest	Quest Consultants, Inc.
RCRA	Resource Conservation and Recovery Act
RP	return period
Secretary	Secretary of the Commission
SERVS	Ship Escort Response Vehicle System
SGHMP	Solomon Gulch Hatchery Management Plan
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SPCC Plan	Spill Prevention, Containment, and Countermeasure Plan
SPCO	State Pipeline Coordinator's Office
SSE	Safe Shutdown Earthquake
7Q10	Seven-day, 10-year recurrence
TAGS	Trans-Alaska Gas System
TAPS	TransAlaska Pipeline System
TCU	transportation, communication, and utilities
TDS	total dissolved solids
TERC	TAGS Environmental Review Committee
TPH	total petroleum hydrocarbons
tpy	tons per year
TSS	total suspended solids
TSS	Traffic Separation Scheme
UBC	Uniform Building Code
USGS	U.S. Geological Survey
UV/IR	ultraviolet/infrared
VAMS	Valdez Air Monitoring System
VDCMP	Valdez District Coastal Management Program
VMS	Visual Management System
VOC	volatile organic compounds
VPs	viewing points

ACRONYMS AND ABBREVIATIONS (cont'd)

VTC	Vessel Traffic Center
VTS Area	Vessel Traffic Service Area
WEWG	Wetland Evaluation Working Group
WS	The Wilderness Society
Yukon Pacific	Yukon Pacific Corporation
Yukon Pacific	Yukon Pacific Company L.P.
ZPA	zero period acceleration

1.0 INTRODUCTION

The Federal Energy Regulatory Commission (FERC or Commission) has prepared this Final Environmental Impact Statement (FEIS) to assess the environmental effects of a proposal by Yukon Pacific Company L.P. to liquefy and export liquefied natural gas (LNG) from a site at Anderson Bay, Valdez, Alaska to destinations in Japan, South Korea, and Taiwan. On December 3, 1987, Yukon Pacific Corporation filed an application with the Commission in Docket No. CP88-105-000 for authorization for a place of export and the construction and operation of facilities at this place of export at Anderson Bay. On March 9, 1992, Yukon Pacific Corporation filed an amendment with the Commission in Docket No. CP88-105-001 to substitute its new ownership structure, Yukon Pacific Company L.P., as the applicant in the proceeding (both are referred to in this FEIS as Yukon Pacific)1/. The project consists of the site of export, including the liquefaction plant, the marine terminal, the LNG tankers, and the transit of LNG by ship through U.S. territorial waters and is referred to in this FEIS as the Yukon Pacific LNG Project.

1.1 RELATIONSHIP TO PREVIOUS ACTIONS

On December 5, 1986, Yukon Pacific filed an application with the Bureau of Land Management (BLM) and the U.S. Army Corps of Engineers (COE) to construct a large diameter, buried, chilled gas pipeline between Prudhoe Bay, Alaska and Anderson Bay, Valdez, Alaska for export purposes. This application, including the downstream liquefaction and transportation facilities, is known collectively as the Trans-Alaska Gas System (TAGS) Project.

On December 18, 1986, Yukon Pacific filed a petition with the Commission for a Declaratory Order in Docket No. GP87-16-000 on whether the Commission has jurisdiction over the TAGS Project under Section 3 and/or 7 of the Natural Gas Act (NGA). On May 27, 1987, the Commission issued its Declaratory Order determining in part that the Commission has authority under Section 3 of the NGA to approve or disapprove the place of export for the Yukon Pacific LNG Project, but declined at that time to exercise any discretionary authority it may have under Section 3 to regulate the siting, construction, and operation of the TAGS pipeline from Prudhoe Bay to Anderson Bay.

On December 3, 1987, Yukon Pacific also filed an application with the Economic Regulatory Administration (ERA) of the U.S. Department of Energy (DOE) in Docket No. 87-68-LNG for authority to export up to an average of 14 million metric tons of LNG annually for 25 years to Japan, South Korea, and Taiwan. A Presidential Finding was issued on January 12, 1988, which determined that the effects of the exports of Alaska natural gas on American consumers would comply with Section 12 of the Alaska Natural Gas Transportation Act (ANGTA) in the context of current and protected future energy markets, and that this finding should not hinder the completion of the Alaska Natural Gas Transportation System (ANGTS) which was previously authorized to transport North Slope natural gas to the lower-48 states.

Since the BLM and the COE were already preparing an Environmental Impact Statement (EIS) on the entire TAGS Project, the BLM requested the FERC on June 5, 1987 to participate in the BLM/COE EIS as a cooperating agency. Although applications were not yet filed with the FERC or the DOE, the FERC agreed to participate as a cooperating agency on July 1, 1987. The DOE also participated as a cooperating agency. A "tiered" process was agreed upon using an

1/ The vertical line in the margin identifies text that has been modified in this FEIS and differs from the corresponding text in the DEIS.

initial overview EIS of the entire project from its North Slope gas conditioning facility to tanker transport of the LNG. The EIS examined alternative terminal locations and accompanying pipeline route variations. It was understood that additional detailed environmental work would be required on specific elements of the project when permits and approvals were requested and acquired. In June 1988, the TAGS FEIS was issued.

The Department of Energy, Office of Fossil Energy (DOE/FE), successor to the ERA, granted authorization for the export under Section 3 of the NGA in Opinion and Order Number 350, issued November 16, 1989. The DOE Order relied on the TAGS FEIS in assessing the environmental consequences of granting the proposed export. Condition F of the order requires that all aspects of the export be implemented in accordance with all applicable environmental procedures, requirements, and mitigative measures imposed by Federal and state agencies. Further, the order directs "... the FERC to consider the safety and environmental aspects of the export site and facilities, including the liquefaction plant, the marine terminal, the LNG tankers and their routes in Prince William Sound and U.S. territorial waters, prior to approving any export site or facilities" (DOE, pg 37, 1989).

The DOE Order also concluded:

a) "With respect to the place of exportation for the LNG..., all locations other than Port Valdez, Alaska are rejected"2/

b) "Except for the authority under DOE Delegation Order 0204-112 over the export site, including the liquefaction plant, marine terminal, and related transportation of LNG, the Federal Energy Regulatory Commission (FERC) shall exercise no authority over the export project....."

In accordance with the tiered process, the FERC Declaratory Order, and the DOE Order 350, the Commission has prepared this FEIS for the place of export and the construction and operation of facilities at this place of export.3/ The issues addressed are limited to the four issues mandated by the DOE Order and confined to the FERC's jurisdiction described in the Declaratory Order. Issues associated with conditioning plant(s) on the North Slope, the TAGS pipeline, and reconsideration of previously studied locations for the export site or new locations are not addressed in this FEIS.

1.2 PURPOSE AND NEED

The Yukon Pacific LNG Project is a major component of the overall TAGS Project. Yukon Pacific asserts that a significant opportunity exists in the mid-1990s to market Alaska North Slope natural gas in the Asian Pacific Rim nations. The TAGS Project would respond to that market in the sale of up to an average of 14 million metric tons of LNG annually for 25 years (equivalent to 660 billion cubic feet of natural gas). The LNG from the TAGS Project would be marketed in Japan, the Republic of South Korea, and Taiwan. Yukon Pacific proposes to sell LNG

2/ This action was not to be interpreted as approval of the Valdez site. The DOE required that "the FERC conduct its own examination of the health, safety, and environmental impacts associated with Yukon Pacific's use of the Valdez site."

3/ It should be noted that the DOE/FE authorization to export is under appeal by Alaskan Northwest Natural Gas Transportation Company in the U.S. Court of Appeals for the District of Columbia Circuit, and that on May 10, 1991, Circuit Judges Silberman and Williams ordered that the appeals be held in abeyance pending disposition by the FERC of Docket Nos. CP88-105-000 and GP87-16-000.

to all three nations but contends that the need for the TAGS Project could be demonstrated in Japan alone, where forecasted increases in total demand for energy in the year 2000 are more than eight times that provided by the TAGS Project.

1.3 PURPOSE AND SCOPE OF THIS STATEMENT

The FERC is the lead Federal agency for the preparation of this FEIS in compliance with the requirements of the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508). The FERC will consider the application for authorization for a place of export and the construction and operation of facilities at this place of export for LNG under Section 3 of the NGA. The assessment of environmental impacts is an important and integral part of the decision. An authorization for a place of export and the construction and operation of facilities at this place of export will be granted only after examining the health, safety, and environmental impacts associated with the Anderson Bay site.

This FEIS was prepared by the FERC staff in compliance with NEPA and the Commission's implementing regulations under Chapter I, Title 18, CFR Part 380. The U.S. Coast Guard (Coast Guard), the U.S. Department of Transportation (DOT), the U.S. Army Corps of Engineers (COE), the Alaska State Pipeline Coordinator's Office (SPCO), the Alaska Department of Fish and Game (ADFG), and the City of Valdez are cooperating Federal, state, and local agencies for this project. Our principal purposes in preparing this FEIS are to: 4/

- Identify and assess potential impact on the natural and human environment that would result from the implementation of the proposed action.
- Assess reasonable alternatives to the proposed action that would avoid or minimize adverse effects on the environment.
- Identify and recommend alternatives and specific mitigation measures to minimize the environmental impact.
- Facilitate public involvement in identifying significant environmental impact.

This FEIS addresses the environmental impact of the proposed LNG facilities on the Anderson Bay site, the marine terminal, the LNG tankers, and transit of LNG by ship through U.S. territorial waters only.

1.4 ALTERNATIVES TO THE PROPOSED ACTION

The Commission can take one of three basic courses of action in processing an application such as this. It may grant the application with or without conditions; postpone action pending further study; or deny the application. Implicit in this determination is an examination of alternatives to the proposal and of modifying options.

In preparation of this FEIS the Commission has considered alternatives to the proposed action on several levels. These are described in detail in sections 2.2 to 2.4. The DOE previously concluded that the Valdez export site (Anderson Bay) is preferable to all other export sites that

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4/ Pronouns "we," "us," and "our" refer to the environmental staff of the Office of Pipeline Regulation.

were considered in the TAGS EIS and disapproved all sites other than the Valdez site (DOE, 1989). This decision was made after evaluation of the Valdez site and other alternative sites evaluated during preparation of the TAGS EIS. Accordingly, further consideration of alternative sites is outside the scope of this FEIS. We will, however, summarize and incorporate by reference the relevant sections of the TAGS FEIS on this issue in this FEIS.

During the course of the scoping discussions and in further exchanges with the public and agencies, features of the proposal on the Anderson Bay site raised concern. The most notable of these were the location of the construction work camp and the disposal of excess excavated materials. We evaluated several alternatives to reduce their impact. Yukon Pacific proposes to locate the construction camp along the bank of Seven Mile Creek. We considered other locations, including the City of Valdez. Yukon Pacific proposes to dispose of excess rock at locations onsite which would affect wetland and intertidal areas. Alternatives for disposal of excess rock at several other onsite locations and ocean disposal were evaluated. Finally, we considered denial or postponing the action pending further study.

1.5 PUBLIC REVIEW AND COMMENT

The Commission issued a Notice of Intent to Prepare a Draft Environmental Impact Statement on the Yukon Pacific LNG Project and Request for Comments on Environmental Issues (NOI) for the proposed Yukon Pacific LNG plant on Anderson Bay in Port Valdez, Alaska on January 31, 1992. At this time the FERC requested comments on the environmental issues associated with the construction of Yukon Pacific's proposed LNG plant site. Scoping meetings were held in Anchorage, Fairbanks, and Valdez, Alaska on May 19, 21, and 26, 1992, respectively, to solicit input from interested individuals concerning issues to be addressed in the Draft Environmental Impact Statement (DEIS). The notice of scoping meetings was published in a separate Notification of Public Scoping Meetings on Environmental Issues, issued by the FERC on April 28, 1992.

A mailing list for the NOI was prepared by the FERC identifying individuals and organizations having a potential interest in the project and the development of the DEIS. The mailing list included City of Valdez representatives, state agency representatives, state and local conservation organizations, elected officials (U.S. Representative, Senators, Governor), and Federal agency representatives. The NOI mailing list for the Yukon Pacific LNG Project included approximately 280 individuals and organizations.

Comments on the proposed project were received in response to the NOI and during the scoping meetings. Issues and concerns raised include:

- Seismic Concerns. Seismic criteria for the site and the design of plant facilities to withstand seismic events. Large, locally produced waves due to seismic slumping impacting tankers at berth.

- Water Resources. Impacts of utilizing potential groundwater and surface supply sources and in-stream flow determinations for surface water supply streams utilized by anadromous fish, including the impact on Seven Mile Creek and beach.

- Marine Habitat. Construction and fill would disturb and cover marine vegetation, estuarine areas, salmon spawning habitat, and nursery habitat utilized by outmigrating salmon fry in Anderson Bay.

- Wildlife. Construction and operations could impact resident and migratory birds and other species and the increased human population could impact sport and subsistence hunting and fishing.

- Wetlands. Delineate wetlands, provide adequate mitigation and compensation for loss of wetlands and estuary/rearing/spawning habitat, and make a thorough evaluation of practicable alternatives to avoid wetlands.

- Air Quality. The combined effect of all LNG plant and tanker emission sources on air quality, the need to describe control technologies to reduce or prevent emissions, the impact of thermal releases on air circulation and weather patterns in the basin.

- Land Use/Recreation. Loss of recreation, aesthetics, and fishing usage in Anderson Bay and compensation for the public for exclusive use of Chugach National Forest land.

- Socioeconomic Impact. The impacts caused by the construction and permanent workforce on the City of Valdez and use of public resources, including fish, wildlife, birds, wood gathering, campgrounds, as well as the impact of the project on subsistence resources (including Native harvest of sea otters).

- Effects of Increased Shipping. The adequacy of radar and other communication systems to control increased traffic, conflicts with glacial ice, and increased shipping in Prince William Sound could affect sea lion rookeries, fish, and marine mammals. The impact on any alternative LNG tanker anchorage separate from the anchorage TransAlaska Pipeline System (TAPS) tankers presently use, in terms of the effect an alternative site's security, safety, and exclusion zones, on present use of the area.

- Public Safety. Probability and consequences of a major LNG spill resulting in a vapor cloud release. Consequences of an accident at the Alyeska Pipeline Service Company (Alyeska) Marine Terminal on the LNG tankers impacting the LNG tankers at berth or enroute and vice versa. The nature and costs of environmental restoration required in event of a worst-case LNG accident.

- Alternatives. The proposed site at Anderson Bay had been previously rejected by the Federal Power Commission (FPC) in a 1976 DEIS.

- Cumulative Impact and Indirect Effects. Air and water quality in Port Valdez basin would diminish due to addition of an LNG terminal in combination with Alyeska's Marine Terminal at Jackson Point and other industrial facilities such as the Petro Star Refinery.

- Mitigation. Measures to mitigate project impacts be contained in the FEIS.

However, as stated in the January 31, 1992 NOI, issues associated with conditioning plant(s) on the North Slope, the TAGS pipeline, and alternative locations for the export site are outside the scope of this FEIS. The above issues were addressed in the TAGS FEIS or DOE Order 350.

The FERC issued the DEIS on May 14, 1993 and initiated a 45-day comment period. Approximately 280 copies of the DEIS were circulated for comment to various Federal, state, and local government agencies; elected officials; environmental groups and organizations; local libraries; private citizens; and other potentially interested parties. Seventeen comment letters were received from various agencies and interested parties. In addition, public meetings to receive comments on the DEIS were held on June 8, and June 10, 1993 at Anchorage and Valdez, Alaska, respectively. Comments on the DEIS and the FERC staff's responses to those comments appear in appendix E of this document. The concerns expressed during the scoping process and others identified during the preparation of the FEIS are addressed in the appropriate sections of the FEIS.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 PROJECT DESCRIPTION

The proposed LNG plant and marine terminal would be located at Anderson Bay, approximately 3 miles east of the Valdez narrows on the south shore of Port Valdez. This site is located 3.5 miles west of the existing TAPS oil terminal (Alyeska Marine Terminal) and 5.5 miles west-southwest of the City of Valdez (figure 2.1-1). When completed, the facilities would occupy approximately 390 acres of a 2,630-acre site owned by the State of Alaska. The remaining 2,240 acres would be preserved as a buffer zone. During plant construction, about 426 acres would be located within the construction limits—392 acres on land, and 34 acres in adjoining tidal and subtidal areas. The land is moderately steep bedrock generally covered with layers of saturated organic material and overburden, which supports a dense, old-growth forest and scattered wetlands. The majority of land surrounding the site is within the Chugach National Forest, and the small amount of land contiguous to the site on the east and west sides which is not within the Chugach National Forest, is owned by the State of Alaska.

The proposed project consists of a 2.1 billion cubic feet per day (bcfd) natural gas liquefaction plant, four 800,000 barrel LNG storage tanks, a marine loading facility, and a cargo/personnel ferry dock facility. An artist's concept of the proposed plant is presented on figure 2.1-2. The general arrangement of the LNG plant and marine terminal is presented on figure 2.1-3. Site details are provided on figure 2.1-4, sheets 1 through 3.

In addition to the shore facilities at full planned capacity, a fleet of 15 LNG tankers, each having 125,000 cubic meters of cargo capacity, would transport LNG beyond U.S. territorial waters to destinations in Japan, Korea, and Taiwan. Full project development would require about 275 tanker loadings per year.

Figure 2.1-5 presents a simplified process flow diagram showing the various components of the project. For design and discussion purposes, these are subdivided into three broad categories: 1) the LNG plant, which would consist of four LNG process trains for gas pretreatment and liquefaction, and four 800,000-barrel aboveground cryogenic storage tanks (the plant would be designed for the future addition of a fifth process train and storage tank); 2) the marine facilities, which would consist of two LNG tanker berths and loading arms, and a cargo/personnel ferry dock; and 3) the LNG tankers.

2.1.1 LNG Plant

Natural gas that has been conditioned on the North Slope would enter the LNG plant through a 42-inch-diameter pipeline at a rate of up to 2.3 bcfd and a pressure of 1,300 pounds per square inch gauge (psig). After removing about 0.2 bcfd for fuel gas utilization by system equipment, the feed gas would be split into four 20-inch lines, each going to one of the separate but identical parallel liquefaction trains. The first stage is pretreatment, whereby the feed gas is cleaned to remove undesirable components remaining after initial gas treatment on the North Slope.

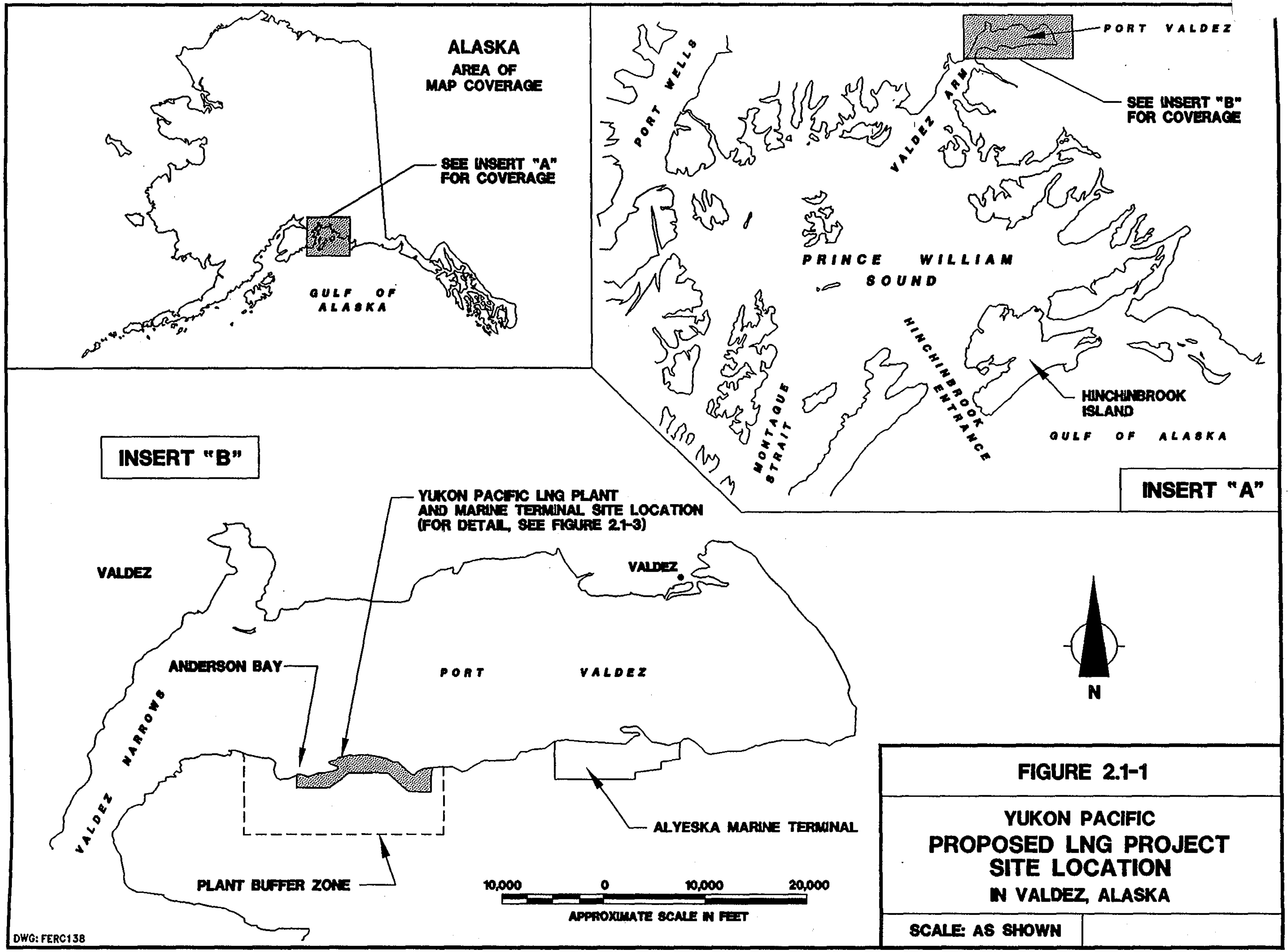


FIGURE 2.1-1

YUKON PACIFIC
PROPOSED LNG PROJECT SITE LOCATION
IN VALDEZ, ALASKA

SCALE: AS SHOWN

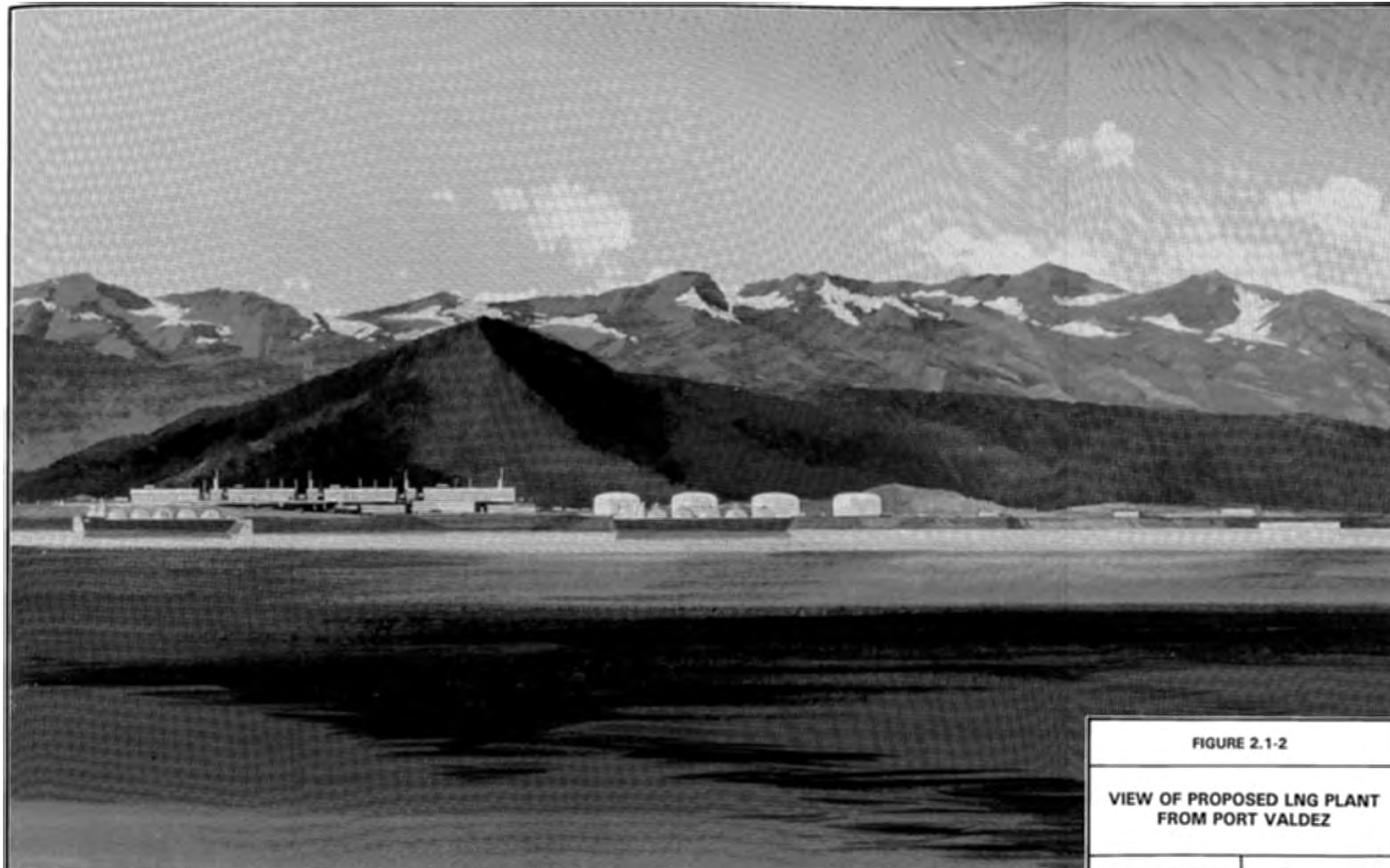


FIGURE 2.1-2

VIEW OF PROPOSED LNG PLANT FROM PORT VALDEZ

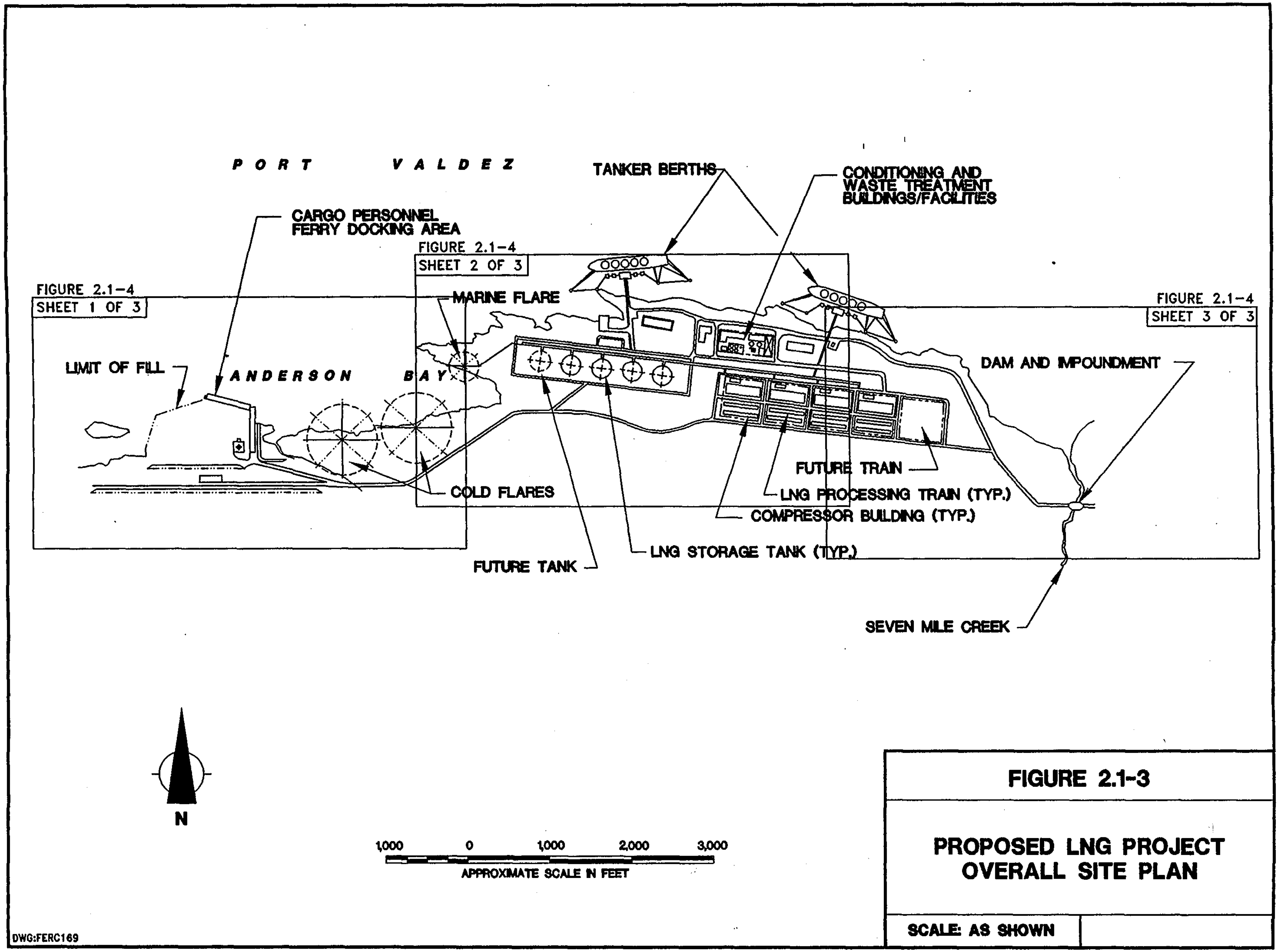


FIGURE 2.1-3

PROPOSED LNG PROJECT OVERALL SITE PLAN

SCALE: AS SHOWN

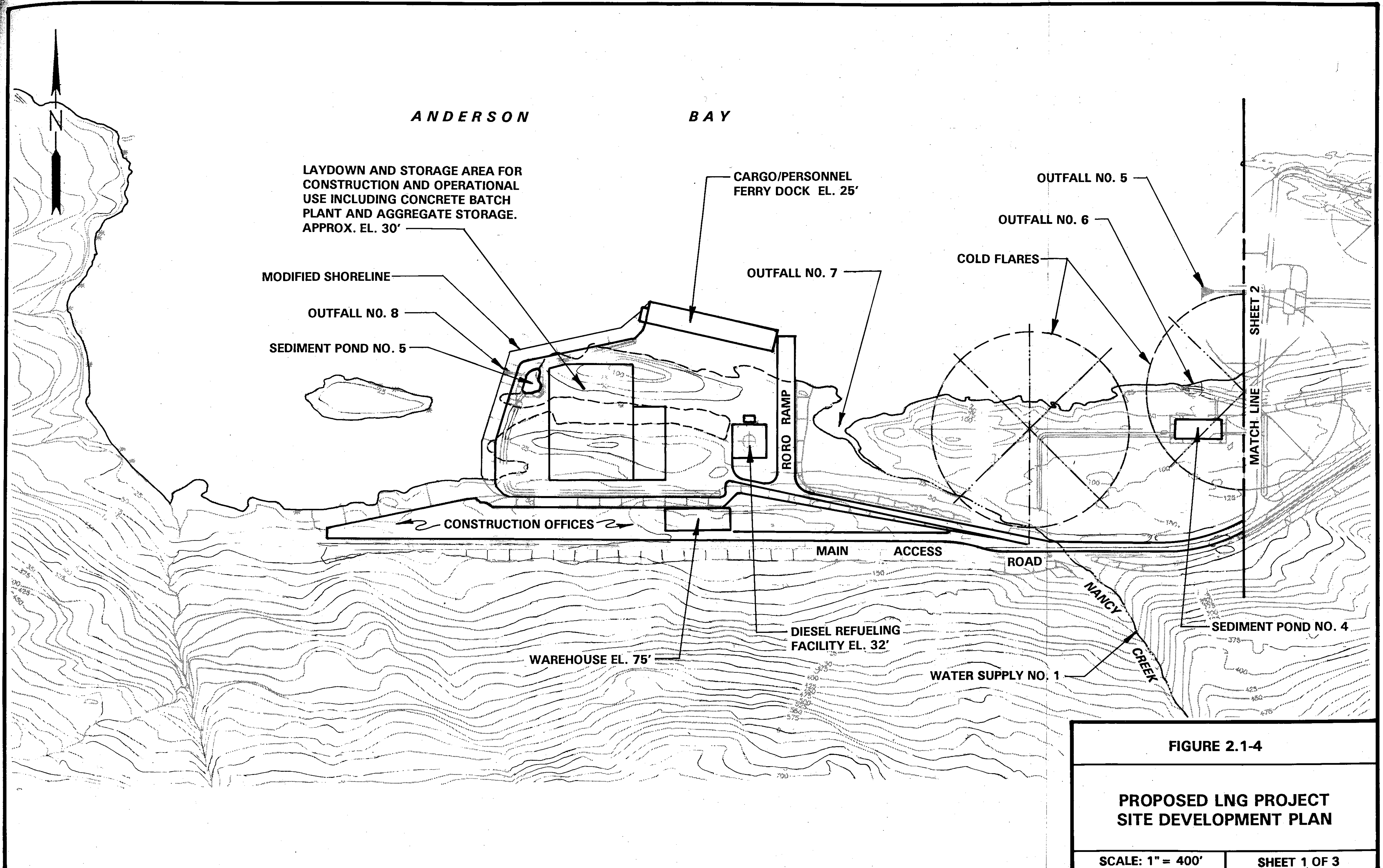


FIGURE 2.1-4

PROPOSED LNG PROJECT SITE DEVELOPMENT PLAN

SCALE: 1" = 400' | SHEET 1 OF 3

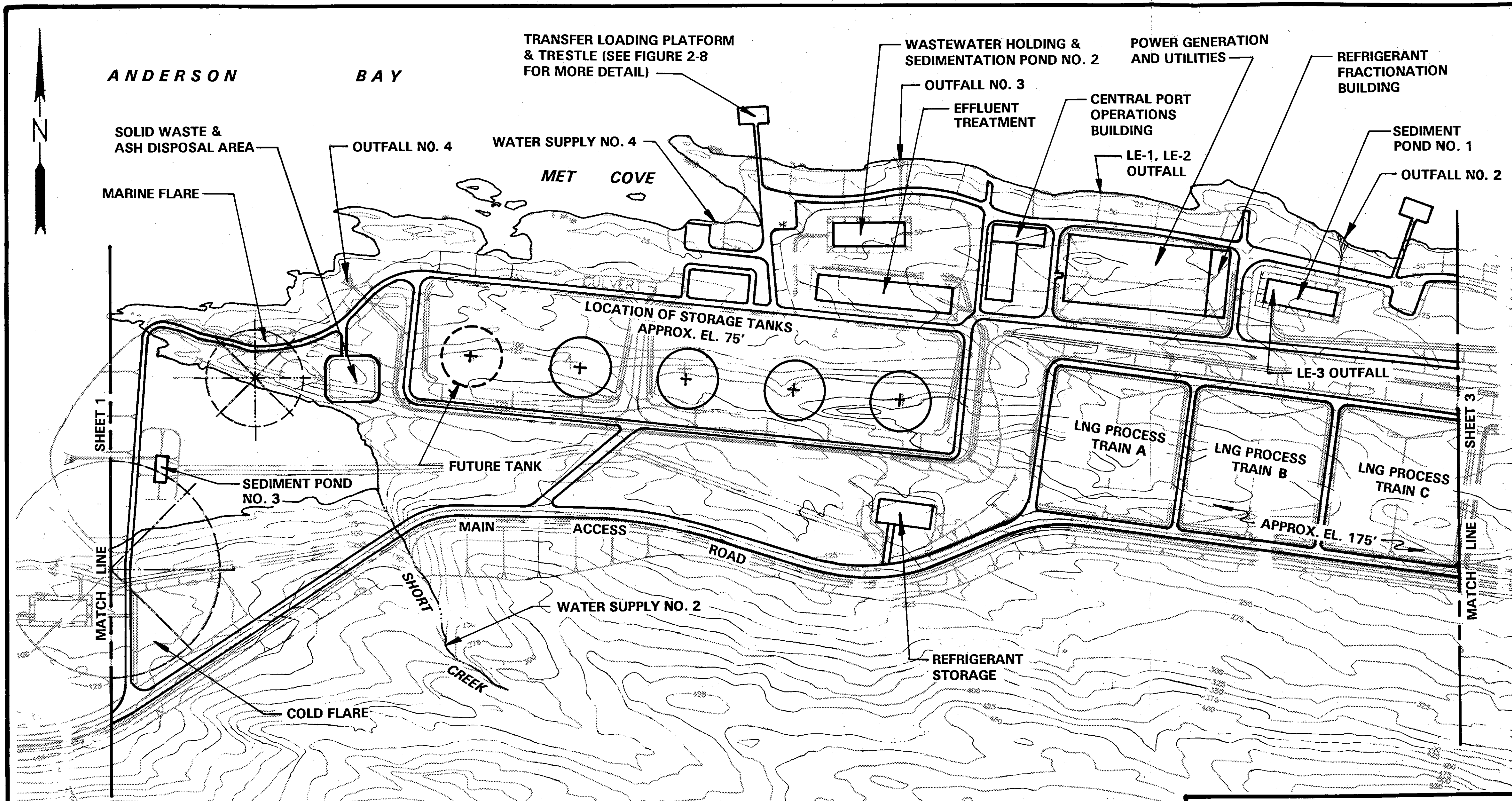


FIGURE 2.1-4

PROPOSED LNG PROJECT SITE DEVELOPMENT PLAN

SCALE: 1" = 400' | SHEET 2 OF 3

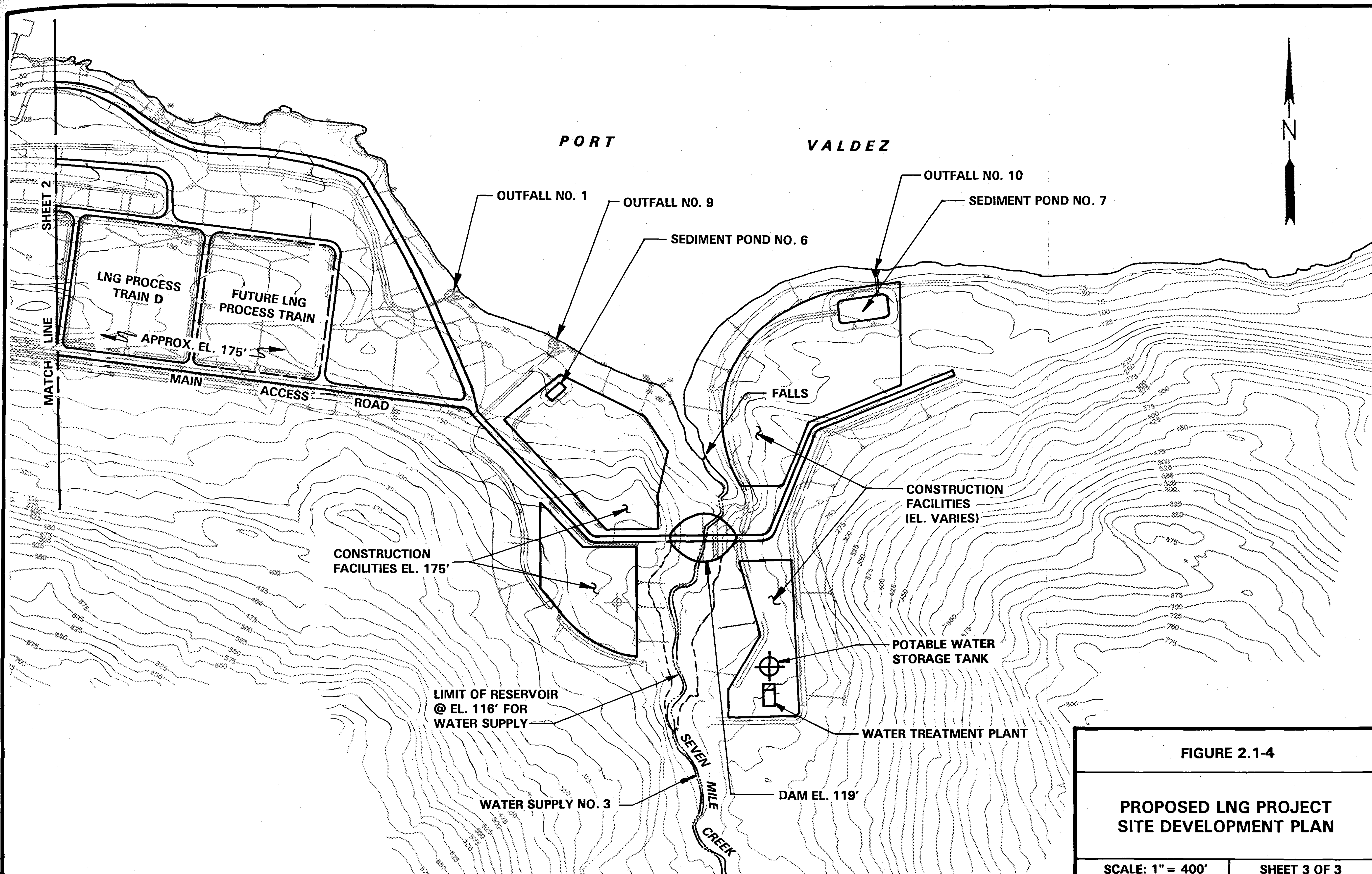


FIGURE 2.1-4

PROPOSED LNG PROJECT SITE DEVELOPMENT PLAN

SCALE: 1" = 400' | SHEET 3 OF 3

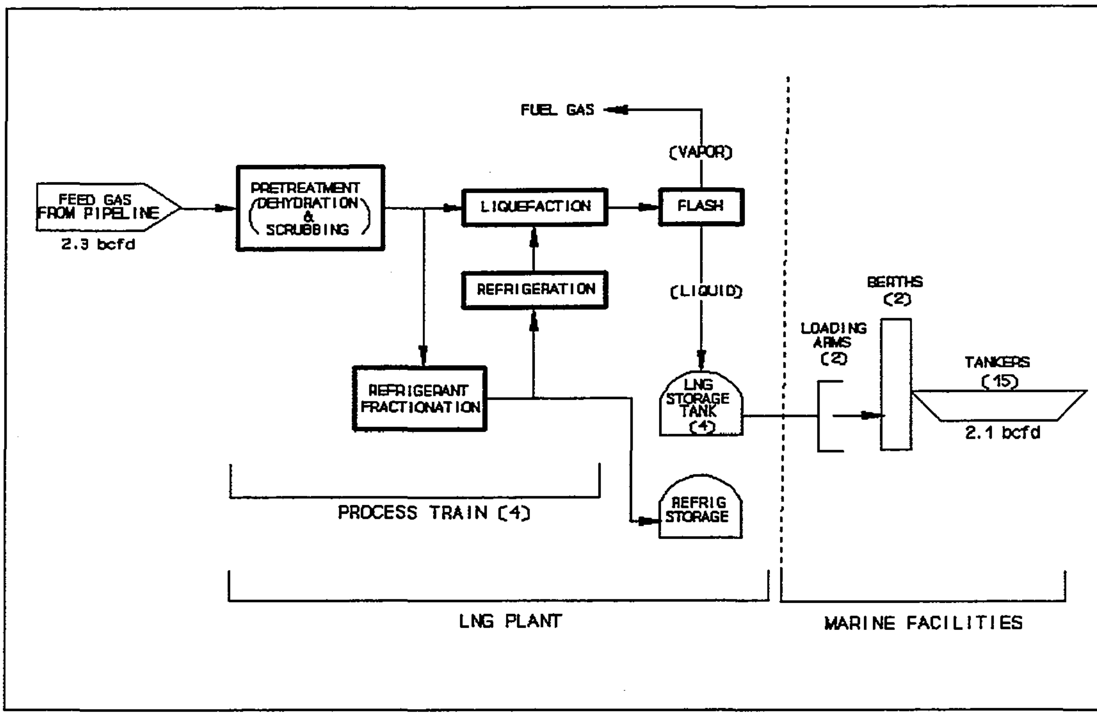


FIGURE 2.1-5 **Process Flow Diagram**

The estimated composition of the feed gas (units in mole percent) is as follows:

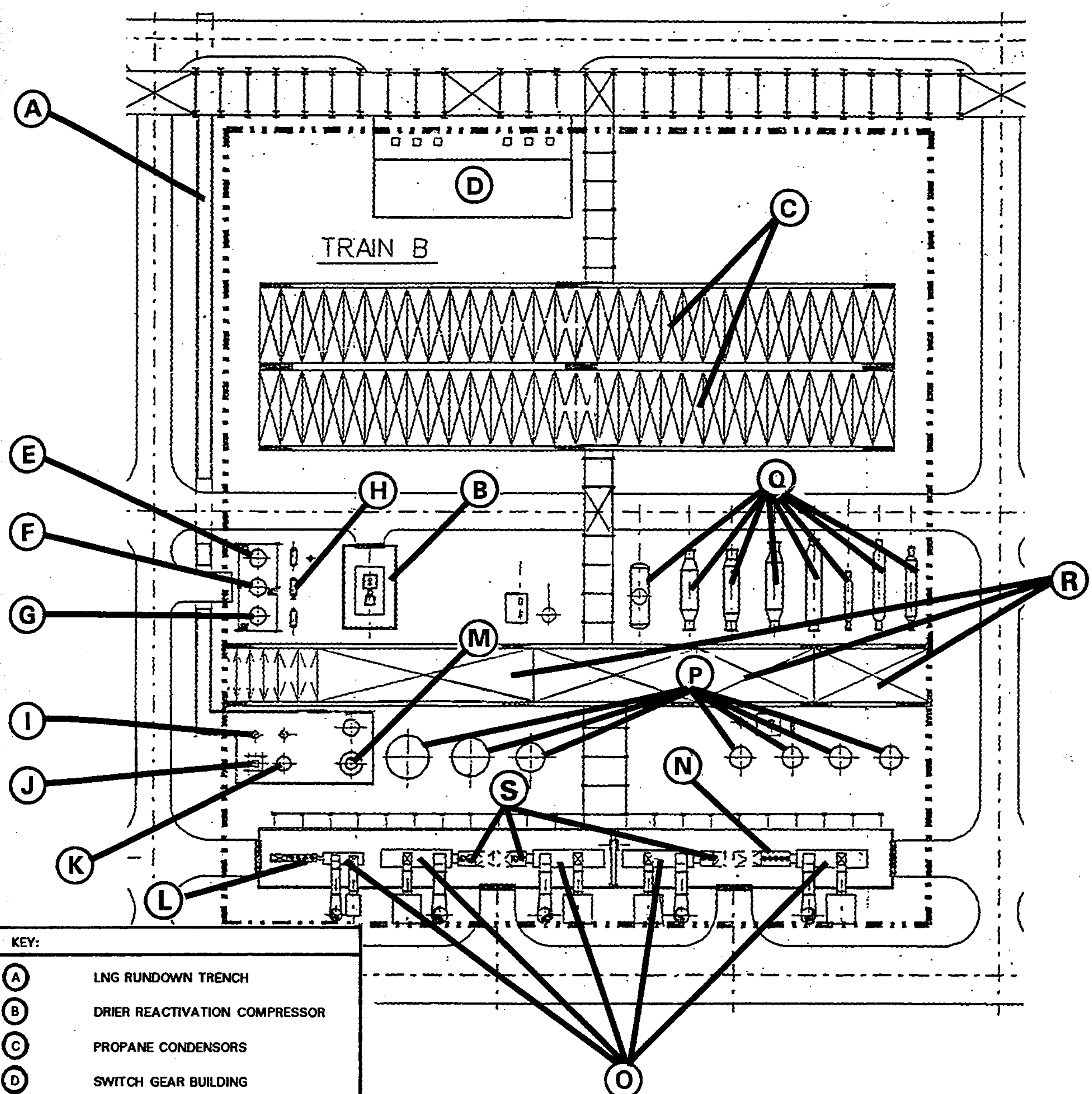
Design Feed Gas Composition

Nitrogen	0.70	n-Butane	0.82
Methane	89.87	i-Pentane	0.02
Ethane	5.94	n-Pentane	0.01
Propane	1.88	n-Hexane	0.01
i-Butane	0.75		

The pretreatment and liquefaction processes would occur in the liquefaction trains located on a bench at elevation 175 feet toward the east end of the site (see figure 2.1-4). Each train would occupy an area 600 feet by 550 feet. The major facilities associated with each train are shown on figure 2.1.1-1.

2.1.1.1 Pretreatment

The feed gas would first enter a feed separator to remove pipeline liquids, followed by drying in one of two parallel feed driers to reduce water content from an estimated 4 parts per million by volume (ppmv) to 1 ppmv. The driers contain molecular sieves which would be



KEY:

- (A) LNG RUNDOWN TRENCH
- (B) DRIER REACTIVATION COMPRESSOR
- (C) PROPANE CONDENSORS
- (D) SWITCH GEAR BUILDING
- (E) MERCURY GUARD VESSEL
- (F) FEED DRIERS (2)
- (G) FEED SEPARATOR
- (H.) DRIER REACTIVATION SEPARATOR
- (I) LNG PRODUCT PUMPS (2)
- (J) MR/FLASH GAS HEAT EXCHANGER
- (K) LNG FLASH DRUM
- (L) FLASH GAS COMPRESSOR
- (M) MAIN CRYOGENIC HEAT EXCHANGE
- (N) PROPANE COMPRESSOR
- (O) TURBINE DRIVERS (6)
- (P) REFRIGERANT SUCTION DRUMS
- (Q) REFRIGERANT EVAPORATORS
- (R) REFRIGERANT COMPRESSOR AFTER COOLERS
- (S) MR COMPRESSORS (3)

FIGURE 2.1.1-1

TYPICAL LNG MODULE LIQUEFACTION TRAIN

NOT TO SCALE

reactivated by a drier reactivation heating and cooling cycle. The molecular sieves would also remove any minor volumes of carbon dioxide, although most or all of this would be removed at a gas conditioning facility located at Prudhoe Bay. The exiting gas would then be filtered to remove adsorbent dust before being passed through a Mercury Guard Vessel to adsorb mercury to prevent mercury-induced corrosion in subsequent process steps.

Feed gas impurities removed by these pretreatment processes typically include particulates, dust, iron oxide, lubricant oils, and possibly some petroleum liquid condensates. Effluent from the feed gas separator would be collected at a lift station, combined with other oily wastewater, and pumped to the LNG plant/marine terminal's oil/water separator. This effluent then would receive further treatment at the site's wastewater treatment plant (see section 2.1.1.5).

2.1.1.2 Liquefaction

Pretreated feed gas from the dehydration system would enter the liquefaction system within the process train. The feed gas ultimately would be liquefied using a mixed refrigerant (MR) cycle. The constituents of the MR fluid would be nitrogen, methane, ethane, and propane in appropriate proportions. Multi-stage precooling both for the MR and for the feed gas would be provided by a closed-cycle propane refrigeration system. The feed gas would be precooled in successive propane evaporators prior to entering the MR refrigeration portion of the system. Final refrigeration, resulting in the LNG product, would occur in the main cryogenic heat exchanger. Yukon Pacific's contractor studied four cases to determine the benefits of seawater cooling versus air cooling for the propane and MR cooling requirements and recommended air cooling for the total plant.

The refrigerant in the closed-cycle MR system would be circulated by three centrifugal compressors, each driven by a 37,000-horsepower (hp) gas turbine. The compressors would be operated in series, progressively increasing the pressure. The high pressure refrigerant after precooling by propane evaporators would flow to a liquid/vapor separator. The propane refrigeration system would use a four-stage propane compressor driven by a 37,000-hp gas turbine. The separated streams would provide refrigeration and ultimately liquefaction and subcooling of the feed gas within the main cryogenic heat exchanger.

The LNG exiting the main cryogenic heat exchanger would be expanded to 18 psig. An LNG flash drum would separate flash gas which would be warmed and compressed by a 6,400-hp gas turbine-driven compressor and sent to the fuel gas system. Finally, the LNG from the LNG flash drum would be pumped to one of the four LNG storage tanks at a design flow rate of 0.55 bcfd.

2.1.1.3 Refrigerant Separation

Refrigerants required in the refrigeration system for the liquefaction portion of the facility consist of nitrogen, methane, ethane, and propane. Nitrogen would be obtained from an onsite air separation plant, while methane would be obtained directly from the feed gas process stream. The other hydrocarbon refrigerants (ethane and propane) would be extracted from the feed gas by a fractionation system. Only one fractionation system would be provided for the entire facility but it would be capable of using treated feed gas from any of the four trains.

Feed gas for the fractionation system would be taken as a slipstream of about 0.235 bcfd. This would enter a feed gas expander suction drum for fluid separation, then would be expanded in a fractionation feed gas expander. The cooled gas would then enter a scrub column where the more volatile components (primarily nitrogen and methane) would be separated from the heavier hydrocarbons. The condensibles from the scrub column would be sent to a deethanizer column where gaseous ethane would be extracted from the top of the column, condensed, and transferred to one of two insulated 26,000-gallon ethane storage tanks. The bottoms from the deethanizer column flow to the depropanizer column where propane would be separated, condensed, and transferred to one of two 430,500-gallon propane storage tanks. The refrigerant storage tanks would be located south of the easternmost LNG storage tank. The extracted refrigerants would amount to about 1 percent of the total slipstream. Ethane would be produced at about 5.7 gallons per minute (gpm) and propane would be produced at about 35.9 gpm.

2.1.1.4 LNG Storage Tanks

The plant would have four insulated, double-walled, suspended roof, aboveground storage tanks, each with a capacity of 800,000 barrels. Spatial provision would be made to accommodate a fifth tank in the future. The tanks would be located centrally onsite between the LNG process trains and the cargo docking facilities on a cut bedrock bench at elevation 75 feet. The site is in Uniform Building Code (UBC) Seismic Zone 4, and Yukon Pacific has used a 0.6 g horizontal and 0.4 g vertical acceleration to verify the feasibility of 800,000-barrel LNG tanks at the site. The combined storage capacity of 3,200,000 barrels would provide approximately 5 days of LNG storage at the design liquefaction rate.

After conducting a study of seven different types of LNG storage and impoundment systems, Yukon Pacific's contractor narrowed its preference to four for further consideration:

Type T-1	Conventional metal tank with low wall dike
Type T-2	Conventional metal tank with high wall dike
Type T-4	Double-integrity tank with concrete inner and outer tank wall
Type T-6	Double-integrity tank with metal inner tank wall and concrete outer tank wall

After further evaluation, Yukon Pacific's contractor concluded that:

1. The LNG storage tank and impoundment system should be the double-integrity type; and
2. Final selection between the inner concrete tank and the metal tank (T-4 and T-6) should be made at the time of purchase quotation, considering cost and construction schedule.

Unlike conventional metal storage tanks, both the inner <u>and outer</u> tank walls of a double-integrity tank are capable of containing LNG. Thus the outer wall provides impoundment for any liquid spill or leakage from the primary inner vessel. Type T-4 by Preload Incorporated (Preload) would use prestressed concrete for both inner and outer tank walls, the walls either being precast or cast-in-place. Type T-6 by Chicago Bridge and Iron (CBI) would use a 9 percent nickel steel inner tank and a prestressed concrete outer tank wall.

Subsequently, in an August 10, 1992 letter to Robert Arvedlund of the FERC, Yukon Pacific stated it favors three storage tank configurations—Types T-4 and T-6 selected by its contractor, as well as Type T-2. Typical tank cross-sections for Types T-2, T-4 (precast design), and T-6 are shown on figure 2.1.1-2 and principal design features are compared in table 2.1.1-1.

TABLE 2.1.1-1

LNG Storage Tank Design Comparison

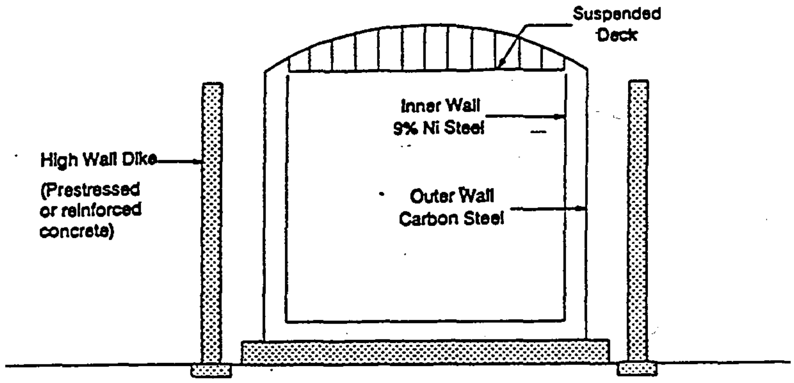
	T-2	T-4	T-6
Outer tank diameter	280'	250'7"	285'
Outer tank height	96'	111'6.5"	91'
Inner tank diameter	270'	240'5"	270'
Inner tank height	87'6"	106'1.5"	87'6"
Maximum liquid height	79'9"	101'	79'9"
Anulus insulation	48" perlite 12" fiberglass	44" perlite	48" perlite 12" fiberglass
Deck insulation	24" perlite	26" fiberglass	24" perlite
Floor insulation	20" foamglass	12" foamglass	20" foamglass
Dike wall diameter	310'	same as outer wall	same as outer wall
Dike wall height	90'9"	same as outer wall	same as outer wall

Although Yukon Pacific has not made a decision on the final storage tank design or selected the tank fabricator, it has established preliminary design criteria and process configuration to be used in the final design. The tanks would have a design pressure of 2.0 psig and a normal operating pressure of 0.5 psig. The design vacuum pressure would be 0.05 psig, with replacement pad gas automatically supplied by a 4-inch line from the fuel gas header. The number, size, and spacing of vacuum and pressure relief valves would be determined during final design.

All process piping would enter or exit through the roof of each LNG storage tank; there would be no penetrations of the bottom or side walls of either the inner or outer tank. The 24-inch liquid bottom fill line would terminate at the top of a larger-diameter standpipe. The flashbreak at the top of the standpipe would release vapor from the incoming liquid, and allow the bottom-filled liquid to equilibrate to tank ullage pressure. Each tank would also have a 24-inch top fill line terminating at the center of the tank above an inverted funnel-shaped splash plate. This line would permit tank recirculation, circulation between tanks, thermal relief, and cool down. A 30-inch boiloff line would remove normal tank boiloff and flash gas from liquefaction.

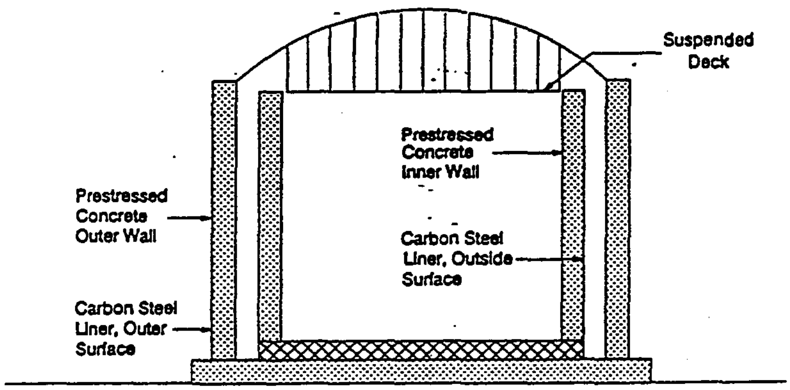
Each tank would have four submerged 7,500-gpm centrifugal pumps, located at the bottom of individual columns, to withdraw tank inventory. Pump discharge would be through separate 16-inch lines combining with a 24-inch header. Each tank would also have a single 500-gpm liquid circulating pump. The plant piping configuration would provide various pumping options: a) circulation through marine loading lines, b) recirculation within a storage tank, and c) inter tank liquid transfer.

Storage tank instrumentation would include temperature elements attached to the shell and floor of the inner vessel, in the annular space, and in the vapor space between the tank roof and



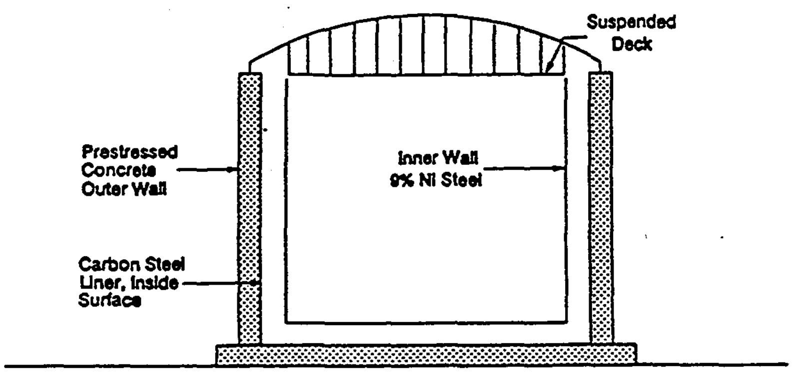
TYPE T-2

CONVENTIONAL METAL TANK, HIGH WALL DIKE



TYPE T-4

DOUBLE INTEGRETY TANK, DOUBLE CONCRETE WALL



TYPE T-6

DOUBLE INTEGRETY TANK, CARBON STEEL ROOF

FIGURE 2.1.1-2

TYPICAL LNG STORAGE TANK CONFIGURATIONS

NOT TO SCALE

suspended dock. The number, location, and type of elements would be determined in the final design. Liquid level would be measured by both a differential pressure instrument, and a combined level, density, and temperature traveling probe. Alarm and shutdown features on the level gauges would include low-level alarm, pump shutdown, high-level alarm, and fill valve closure. Linear and rotational inner tank movement indicators would also be provided for each tank.

2.1.1.5 Plant Utility Systems

The main area, located north of the first liquefaction train at 100 feet elevation, would contain the power generation system, steam generation system, water and wastewater treatment systems, and the compressed air and nitrogen plants.

Power Supply

Electricity for the proposed plant would be provided by seven 8,840-kiloWatt (kW) gas turbine generators. One unit would generate most of the plant steam by cooling the turbine exhaust gases in a heat recovery steam generator (HRSG). Two of the units would also be able to use diesel oil as an alternative fuel to provide operation in the event of a fuel gas supply interruption.

Water Supply

Water supply for both construction and operation would be obtained from a combination of sources depending upon the use and relative quantities available from each source. Primary sources proposed include stored surface waters from onsite streams and waters barged in from offsite. A desalination plant would be used as a secondary source of water for industrial operations and potable uses, but would not be used for construction water.

Water requirements for plant operations would be obtained from Seven Mile Creek. Yukon Pacific has proposed to construct a 40-foot-high, gravity dam approximately 400 feet upstream from the waterfall at the mouth of this stream to pool and store water for use during construction and operation. While the exact location of the dam would be determined after a detailed geologic survey, Yukon Pacific has developed a conceptual design for the water impoundment and withdrawal. The dam would result in the creation of a small reservoir of approximately 3.5 acres.

Water required for operations, both potable and industrial, would be obtained from the same source. Total water requirements for operations are estimated at about 75 gpm average and 200 gpm peak, with little seasonal variation. Potable water derived from surface water sources would be treated at a Trident package water treatment plant located in the main utility area.

Liquid and Solid Wastes

Much of the liquid and solid wastes generated on the site would be handled by the Waste Treatment Plant and Incinerator. These would be designed to:

- receive, treat, and dispose of all the oils and grease removed from the plant's oily wastewater system;

- receive and treat all of the sewage from the plant's sanitary sewage collection system and to dispose of all of the sewage treatment sludge produced from the effluent of the biological waste treatment plant;

- receive and incinerate all waste oils (e.g., spent crankcase and hydraulic oils) generated during construction and to receive and incinerate all spent lubricating and other oils generated during permanent plant operations;

- receive and incinerate all general construction material and shipping material that cannot be disposed of in open pit burning;

- receive and incinerate all garbage and filters generated onsite during construction and permanent plant operations; and

- receive and incinerate all heavy hydrocarbon waste streams generated in the process.

Wastewater Treatment System - Wastewater from LNG plant facilities would be comprised of potentially oily wastewater from washdown and marine facilities, including support vessels, and sanitary wastewater from personnel facilities. Oily wastewater could contain significant amounts of oil and grease, grit, and other settleable solids, as well as various suspended solids composed of organics and inorganics. The sources of oily wastewater include compressor buildings for the four liquefaction trains, boiloff compressor building, fractionation compressor building, compressed air building, dieseling fueling, bilge water from marine support vessels, warehouse, and waste treatment. Floor drains from the power plant and fuel storage areas are expected to yield about 3 to 10 gpm, based on data from six other power plant facilities (Ebasco, 1982). The oil and grease content would be variable, but may average around 10 to 20 milligrams per liter (mg/L). Occasional spills and other incidents could increase that concentration up to 1 percent temporarily. In general, the floor drainage is expected to be relatively oil free, with the highest concentrations attributed to shop areas and truck parking areas. Equipment with the potential for oily runoff would not be in the docking areas. The Spill Prevention Plan and Best Management Practices Plan required to be completed and approved prior to construction and operation of these facilities will address these issues.

Oily water would not be directly discharged into the wastewater treatment system. Instead, this water would be pretreated with an oil separation process, and the oily portion would be incinerated and not routed to the wastewater treatment plant. After the oil-water separation process, the treated water, which would contain less than 10 mg/L oil and grease (probably closer to 1 mg/L), would then be combined with domestic wastewater for biological secondary treatment to remove organics, some trace metals, and remaining settleable and suspended solids.

Domestic wastewater from personnel facilities is anticipated to be of standard sewage strength, although it could be somewhat stronger based on the state's experience with camp-type settings. Collection systems would be relatively short and well controlled; no excessive infiltration or inflow sources of wastewater are anticipated. Secondary treatment would be accomplished using a packaged aerobic treatment unit. The system would include a complete mixed aeration tank for biological treatment followed by a settling tank (clarifier) for solids removal. Some solids would be recycled into the aeration process to provide a fresh supply of bacteria for the aerobic treatment. The remainder would be dewatered and incinerated.

Yukon Pacific has also proposed to supply fresh water during operation of the plant by use of a desalination process when necessary. The desalination process would withdraw from Port Valdez approximately 803 gpm average and 2,510 gpm maximum to produce between 75 and 200 gpm of fresh water. Desalination operations would produce a discharge of between 657 gpm (average) and 1,503 gpm (maximum). Yukon Pacific has indicated that the effluent from desalination operations would be about 100° F, and be independent of the temperature of water obtained from Port Valdez.

Solid Waste and Ash Disposal - Much of the solid wastes generated on the site would be handled by an onsite incinerator. Both the preheat burner and the main combustion burner of the incinerator would be designed to burn either fuel gas, diesel oil, or waste lubricating oil and hydraulic fluids. During the construction phase of the project, diesel oil, waste lubricating oils, and hydraulic fluids from vehicles would be used as incinerator fuels. Once the plant is in operation, waste lubricating oil and hydraulic fluid from vehicles and stationary equipment or fuel gas would be used as incinerator fuels. No substances with hazardous characteristics would be incinerated. General construction and shipping waste materials and all garbage generated onsite during construction would also be incinerated.

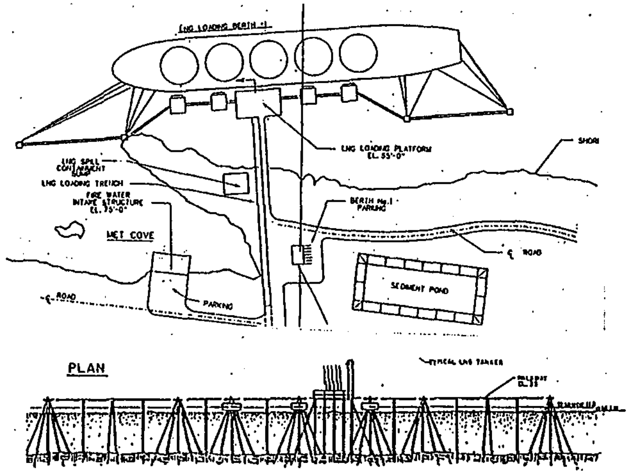
Solid effluents produced during normal operations would also include spent molecular sieve from the feed driers and spent sulfur impregnated activated carbon from the mercury guard vessels within the process trains. The life of the molecular sieve should exceed 3 years. Spent molecular sieve is not expected to be hazardous and would either be landfilled onsite or shipped offsite for regeneration. The life of the sulfur-impregnated activated carbon, a function of the mercury content of the feed gas, would probably exceed 3 years. If feasible, the activated carbon would be regenerated at an offsite facility. If this is not feasible, the activated carbon would be landfilled offsite in an approved facility. Ash from the incinerator and incinerator scrubber would be disposed in a permitted landfill located on the plant site. The solid waste and ash disposal area as shown on figure 2.1-4 (sheet 2) is located to the west of the LNG storage tanks and would occupy an area of about 0.6 acre. The Alaska Department of Environmental Conservation (ADEC) under 18 Alaska Administrative Code (AAC) 60 governs the licensing of solid waste disposal areas through a public permitting process.

2.1.2 Marine Facilities

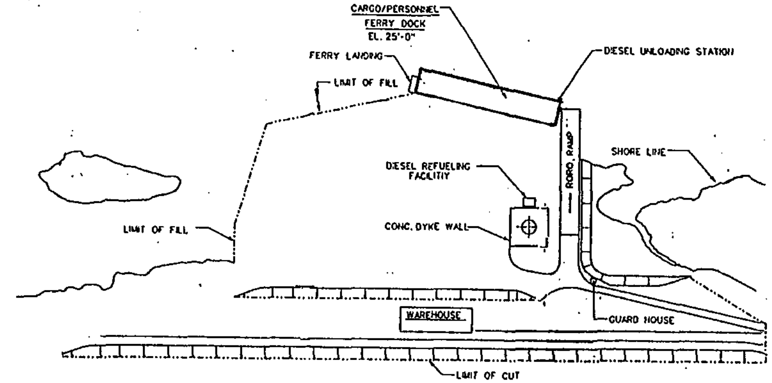
The permanent marine facilities would consist of an LNG loading system, two LNG tanker berths, a cargo vessel docking area with a ferry landing for site access, and berths for tugs and work boats. Figure 2.1.2-1 illustrates the major components of the permanent marine facilities.

LNG Loading System

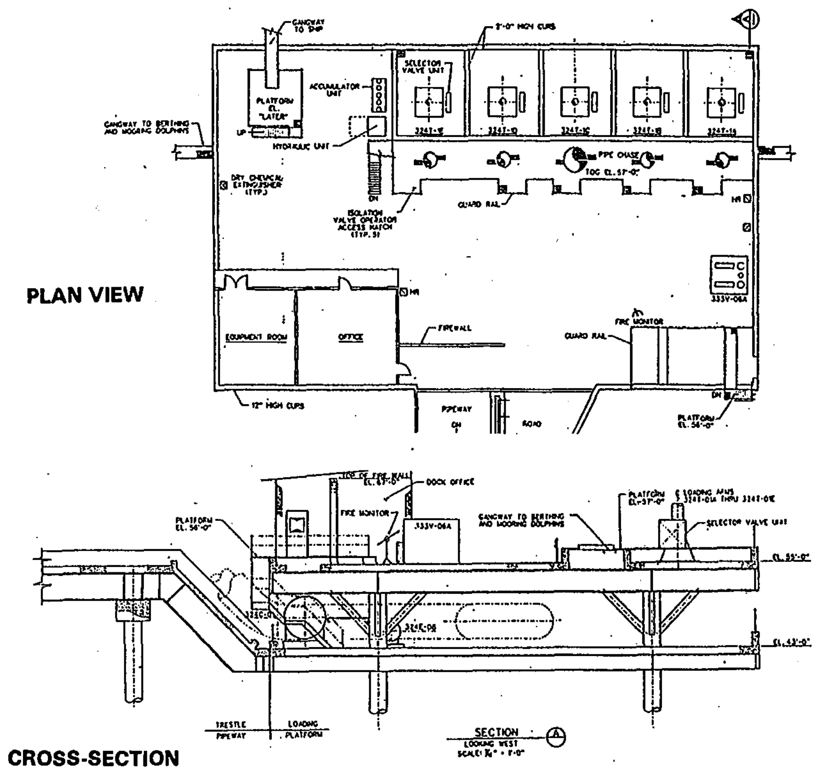
The LNG loading system would use the internal LNG pumps to transfer LNG from the storage tanks to LNG tankers berthed at the marine terminal. Transfer piping would be sized to load an LNG tanker in a 12-hour period (approximately 44,000 gpm). LNG would be transferred to each dock using two parallel 24-inch cryogenic insulated pipelines supported by trestles. During non-loading periods, LNG would be circulated through one line and returned to storage through the other line to maintain the piping at cryogenic temperatures. The loading operation at each berth would use four 16-inch articulated marine loading arms for loading LNG onto the tankers and one 16-inch vapor-return arm which would take LNG vapors back to either the plant's fuel gas system or the feed gas system for reliquefaction. Shutoff valves would be located in the 24-inch loading lines both onshore and at the docks. Additionally, each articulated arm would contain a



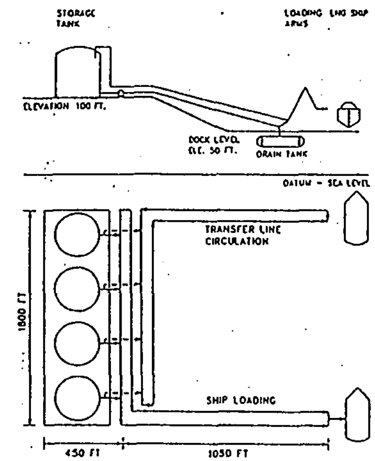
LNG DOCK



CARGO DOCK



LNG LOADING PLATFORM



LNG LOADING ARRANGEMENT

FIGURE 2.1.2-1

TYPICAL MARINE TERMINAL FACILITIES

NOT TO SCALE

hydraulically operated Powered Emergency Release Coupler (PERC) consisting of double ball shutoff valves and an emergency release coupler. The PERC would be used only for emergency situations and not for routine connections. During normal operations, the loading arm connection would either use bolted flanges or a hydraulically operated quick connect/disconnect coupler.

Each LNG loading platform would be constructed in two levels. The upper deck would be 120 feet long and 72 feet wide at an elevation of 55 feet above Mean Lower Low Water (MLLW). The product and utility piping would be located on a lower deck at an elevation of approximately 43 feet above MLLW, with risers to the upper deck at appropriate locations. A hydraulically operated gangway would provide shore-to-ship access. The platforms would be connected to shore by a causeway, built on piles, carrying roadway and piping (see figure 2.1.2-1).

LNG Tanker Berths

The two LNG tanker berths would be approximately parallel to shore in 55 feet of water. The tanker berths would be designed to handle tankers in the 125,000 to 135,000 cubic meter size range and suitable for the next generation of up to 165,000 cubic meter capacity. The LNG berths have been designed to provide safe mooring for the LNG tankers and would be designed to withstand severe environmental conditions (110 mile per hour winds and maximum waves and currents). Each berthing facility would consist of four breasting dolphins, a transfer platform for the four marine loading arms and one vapor return arm, and four mooring dolphins located outboard to the vessel. Both the mooring and breasting dolphins would be accessible by catwalks. The outer mooring dolphins of each LNG berth would be equipped with small boat landings (see figure 2.1.2-1).

Cargo/Personnel Ferry Vessel Docking Area

There are no construction or operational access roads proposed for the LNG plant and associated marine facilities. Consequently, all transportation of personnel, supplies, and materials for construction, plant operation, or emergency access or egress would be by air and/or waterborne traffic. A cargo/personnel ferry dock would be located on the west end of the site to accommodate all marine transports (see figure 2.1-4). A temporary dock would be built for initial beachhead activities associated with the landing of construction equipment, materials, and supplies. The permanent dock at the same site would support plant operations, including the receipt of diesel oil, consumables, potable water, and other supplies for plant operation and maintenance. The cargo dock would have a fuel station for supplying small craft and floating equipment. The unloading of bulk liquids would occur between supply vessels and a permanent manifold near the face of the dock. Since both areas are potential spill areas, they would be curbed and drained to the oil/water separator sump.

The cargo/personnel ferry dock would be used by ferries, freighters, and bulk carriers with drafts up to 20 feet. There would be a 600-foot-long wharf and 100-foot-wide roll-on/roll-off ramp. The cargo dock would have a 100-foot-wide apron consisting of a heavy duty compacted crushed stone pavement during construction, which would be paved prior to operation. Elevations of the wharf, ramp, and ferry dock are 30 feet, 15 feet, and 15 feet above MLLW, respectively.

The cargo/personnel ferry dock would provide permanent moorings for the service vessels and small craft employed by the plant. Also third-party owned tugs and launches could be temporarily moored at the cargo dock as required for plant operation. The ferry docking area would also have a passenger terminal building with waiting rooms for passengers leaving and entering the plant, check-in facilities, luggage handling facilities, and security and control functions. The cargo/personnel ferry dock would be located on a 23-acre site consisting primarily of fill over an intertidal marine area located near the midpoint of the Anderson Bay shoreline. The level site would be used during both construction and operation for a variety of uses, including staging, equipment, and supply storage.

2.1.3 LNG Tankers

At the design terminal throughput of 14 million metric tons of LNG per year (29.3 million cubic meters), a fleet of 15 tankers of 125,000 cubic meters capacity would make about 275 loaded voyages per year to receiving terminals in the Pacific Rim once LNG production was at full capacity. LNG tankers returning from Pacific Rim countries in ballast would enter Prince William Sound through Hinchinbrook Entrance. Yukon Pacific would require all LNG tankers to change all ballast water during the 36-hour period prior to entering Prince William Sound. Tankers would proceed north through the sound into Valdez Arm, then pass through Valdez Narrows to the marine terminal at Anderson Bay. LNG tankers entering the Prince William Sound Vessel Traffic Service Area (VTS Area) would follow the Coast Guard regulations in 33 CFR 161.301 through 161.387. Major requirements of the VTS Area include:

- a Traffic Separation Scheme (TSS) having one-way traffic lanes with a separation zone;
- a vessel movement reporting system;
- a one-way traffic area in Valdez Narrows; and
- radar surveillance in Valdez Arm, Valdez Narrows, and Port Valdez.

Further, tank vessels greater than 20,000 DWT operating in the VTS Area must have:

- two separate marine radar systems for surface navigation;
- an operating LORAN-C receiver;
- an operating rate of turn indicator; and
- two operating radiotelephones, one battery powered, capable of operating at the designated VTS Area frequency.

No later than August 1, 1993, tank vessels greater than 20,000 DWT must also have an operating Automated Dependent Surveillance Shipborne Equipment (ADSSE) that meets the requirements of 33 CFR 161.376(a)(5). The ADSSE will automatically provide the Vessel Traffic Center (VTC) in Valdez with position information on tank vessels at greater distances than now available, allowing for more timely and reliable traffic decisions.

In addition, the Coast Guard issued notices of proposed rule-making concerning escort vessels for single hull tankers on July 7, 1992, and concerning pilotage requirements in Prince William Sound on October 26, 1992, and March 26, 1993.

The Coast Guard has stated that it does not anticipate VTS problems with the increased LNG tanker traffic, but has recommended additional restrictions governing LNG tankers in the VTS Area and is likely to develop a Captain of the Port Plan specific to LNG tanker operations. Section 4.15.4, Marine Safety, presents a more detailed discussion of the VTS Area and Coast Guard requirements.

As the LNG tanker approaches Anderson Bay, the vessel and accompanying tugs would make a 180° turn to starboard prior to berthing at the marine terminal. This would enable the LNG tanker to berth on its port side with its bow toward the sea. After securing the tanker with berthing and mooring lines, the loading and vapor return arms would be connected to the tanker cargo manifold and cargo transfer would commence. Typically, cargo loading would require 12 hours, with a tanker turnaround time of about 18 hours.

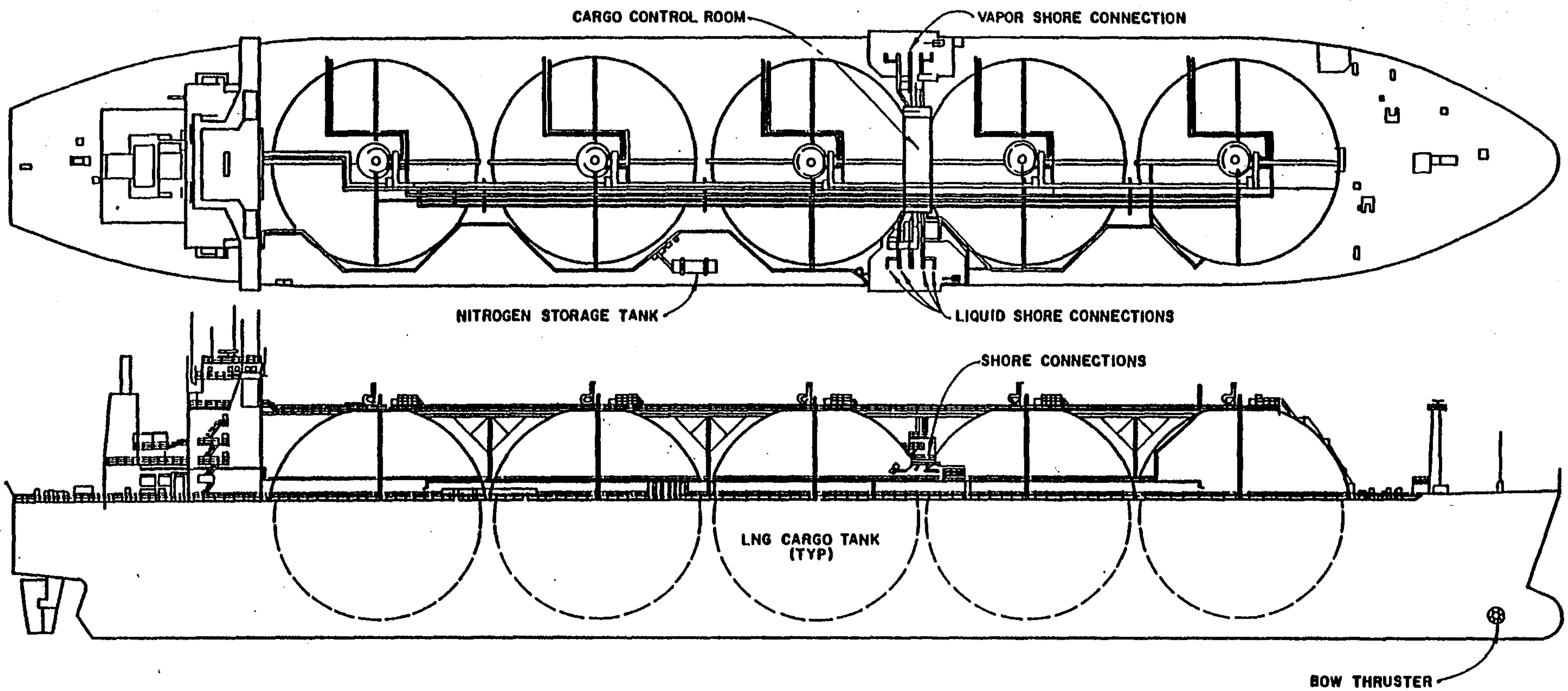
While the project design is based on a fleet of 15 LNG tankers with a nominal cargo capacity of 125,000 cubic meters, Yukon Pacific would design the marine facilities to accommodate the next generation of LNG tankers with capacities of 165,000 cubic meters. Use of larger capacity LNG tankers could correspondingly reduce the size of the fleet and annual number of tanker transits. While Yukon Pacific has neither identified shipyard(s) that would construct the LNG tankers nor determined the type of LNG cargo containment, the nominal 125,000 cubic meter tanker is fairly representative of the majority of the present LNG carrier fleet in service—between 120,000 and 137,000 cubic meters.

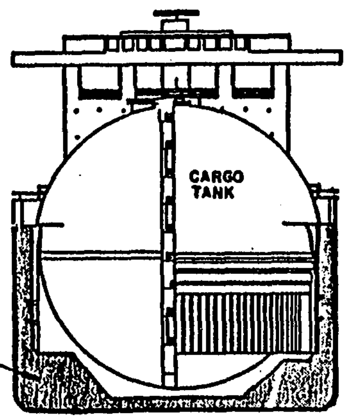
Three basic tank designs have been developed for LNG cargo containment—spherical, prismatic free-standing, and membrane. The earliest form of LNG containment is the prismatic free-standing tank. It consists of an aluminum alloy or 9 percent nickel steel, self-supporting tank that is supported and restrained by the hull structure. Insulation consists of reinforced polyurethane foam on the bottom and the sides, with fiberglass on the top. The spherical tank design uses an unstiffered, spherical, aluminum alloy tank that is supported at its equator by a vertical cylindrical skirt, with the bottom of the skirt integrally welded to the ship's structure. This free-standing tank is insulated with multi-layer close-cell polyurethane panels.

In the membrane containment system, the ship's hull constitutes the outer tank wall, with an inner tank membrane separated by insulation. Two forms of membrane are commonly used—the Technigaz membrane using stainless steel, and the Gaz-Transport membrane using Invar. (Greater detail on cargo tank containment systems is provided in Yukon Pacific's July 26, 1991 data response, Volume IX, FERC question 17, available at the Commission's offices in Washington, DC and the Joint Pipeline Office (JPO) in Anchorage, Alaska.)

Regardless of the containment system used, LNG tankers are of the double-hulled design. A double bottom and double sides are provided for the full length of the cargo area and arranged as ballast tanks, independent of the cargo tanks. The double-hulled design provides greatly increased reliability of cargo containment in the event of grounding and collisions. Further, the segregated ballast tanks prevent ballast water from mixing with any residue in the cargo tanks.

Typical characteristics of an LNG tanker for a 125,000 cubic meter tanker (a General Dynamic's spherical design) and a 165,000 cubic meter tanker are presented in figures 2.1.3-1 and 2.1.3-2 and table 2.1.3-1.





NOTE
TANKER CHARACTERISTICS WILL VARY WITH SPECIFIC MANUFACTURERS AND TANKER TYPES.

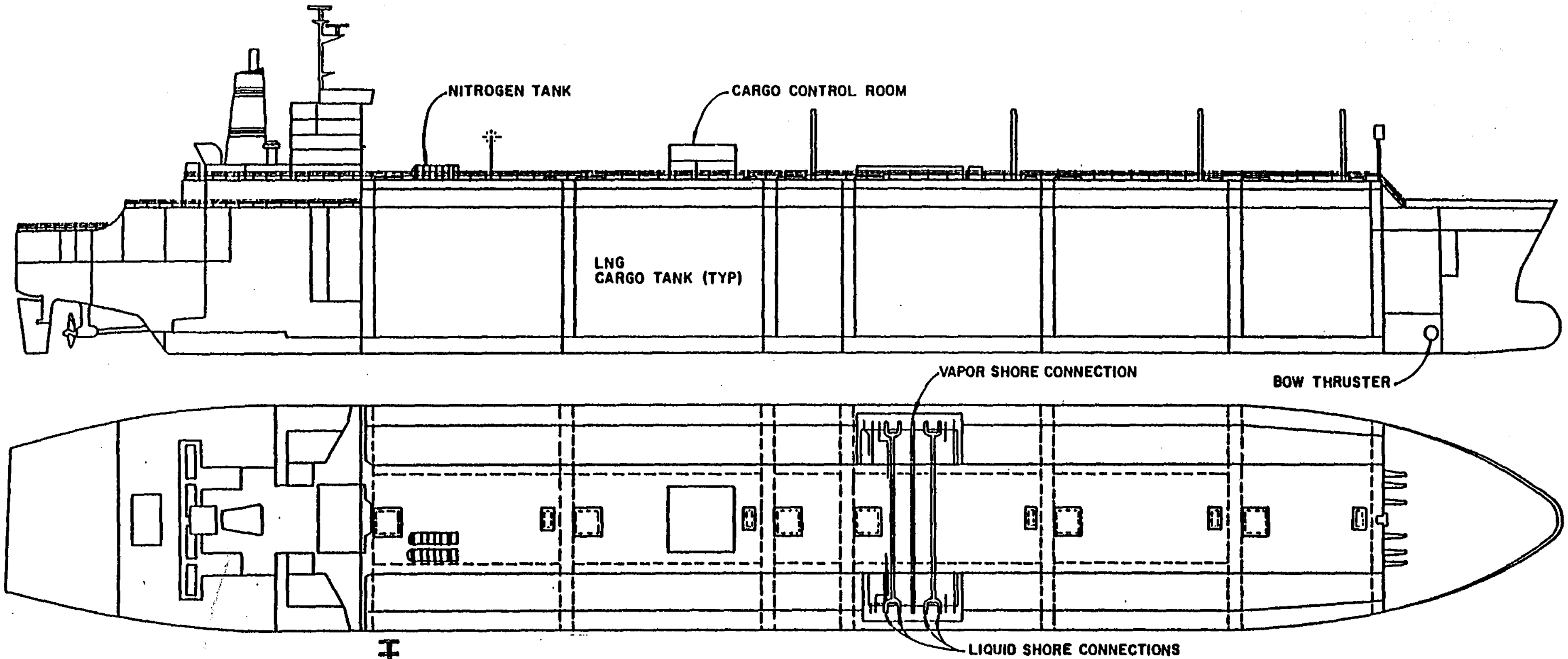
TANKER CHARACTERISTICS

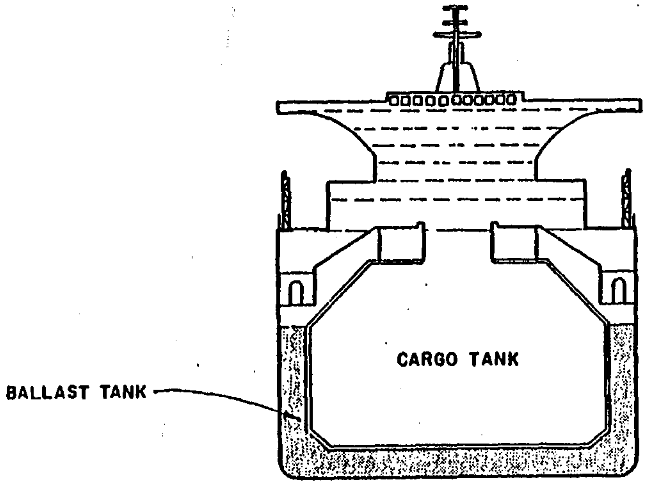
LNG CAPACITY	125,000 m^3	165,000 m^3
LENGTH OVERALL	950 FT.	1,000 FT.
BEAM	145 FT.	150 FT.
HULL DEPTH	82 FT.	100 FT.
DRAFT, LOADED	38 FT.	40 FT.
DISPLACEMENT, LOADED	95,000 LONG TONS	122,000 LONG TONS

FIGURE 2.1.3-1

TYPICAL SPHERICAL DESIGN FOR AN LNG TANKER

NOT TO SCALE





TANKER CHARACTERISTICS

LNG CAPACITY	125,000 m³	165,000 m³
LENGTH OVERALL	950 FT.	1,000 FT.
BEAM	145 FT.	150 FT.
HULL DEPTH	82 FT.	100 FT.
DRAFT, LOADED	38 FT.	40 FT.
DISPLACEMENT, LOADED	95,000 LONG TONS	122,000 LONG TONS

NOTE

TANKER CHARACTERISTICS WILL VARY WITH SPECIFIC MANUFACTURERS AND TANKER TYPES.

FIGURE 2.1.3-2

TYPICAL MEMBRANE DESIGN FOR AN LNG TANKER

NOT TO SCALE

TABLE 2.1.3-1

Typical LNG Tanker Characteristics

	Unit	125,000 m^3	165,000 m^3
Length overall	ft	950	1,002
Breadth	ft	143	150
Depth	ft	82	100
Design draft	ft	38	40
Full load displacement	long tons	95,000	122,000
Shaft horsepower	hp	43,000	55,000
Number of propellers		1	2
Service speed	knots	20.4	18.5
Fuel oil	long tons	6,650	8,200
Bow thruster	hp	2,200	2,500

Typically, the LNG tankers would be powered by steam turbines, using either a single or a twin screw. The boilers would have dual fuel capability, burning both cargo boiloff gas and bunker fuel oil. Cargo boiloff gas would not be vented to the atmosphere under normal conditions.

The LNG tankers would have a redundant, independent steering control system to maintain rudder movement in the event of a steering system failure. To improve maneuverability at low speeds such as during docking maneuvers, the tankers would have a bow thruster, consisting of a controllable pitch propeller driven by electric motors.

Navigation systems would include 3 centimeter and 10 centimeter radars, an automatic radar plotting aid, radio direction finder, LORAN-C position locating system, gyro compass system, echo depth sounder systems, doppler log system, collision avoidance/satellite navigation system, and an ADSSE.

Typically, LNG tankers use three independent fire fighting systems. A fire water system using seawater via dual centrifugal pumps is intended to extinguish Type A fires. This system supplies water to multiple fire monitors on the deck and stations throughout the ship. A carbon dioxide system would protect the machinery space, ballast pump room, emergency diesel generator, point room, and forward pump room. A dry power system would be used to extinguish LNG fires.

The LNG tankers would be constructed and operated in accordance with national and international regulatory requirements. The regulations include the International Maritime Organization's Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, the 1974 International Convention for the Safety of Life at Sea, and 46 CFR Part 154, which contain the U.S. regulations for implementing the International Gas Code. Foreign flag LNG tankers would be required to possess a valid International Maritime Organization Certificate of Fitness and a Coast Guard Certificate of Compliance.

2.1.4 Construction Plan and Schedule

Detailed design and construction of the LNG plant and marine terminal at Anderson Bay would be completed over an 8-year period using a phased construction strategy, with incremental construction, startup, and production over a period of several years. Yukon Pacific's current scenario would complete one liquefaction train per year over 4 years, with the first train startup in the fifth year of construction. Other major components—LNG tanks, docks, etc.—would also occur in sequence. A general schedule outlining the overall construction program is provided on figure 2.1.4-1. The critical path schedule consists of site preparation, LNG tank foundation installation, and tank construction.

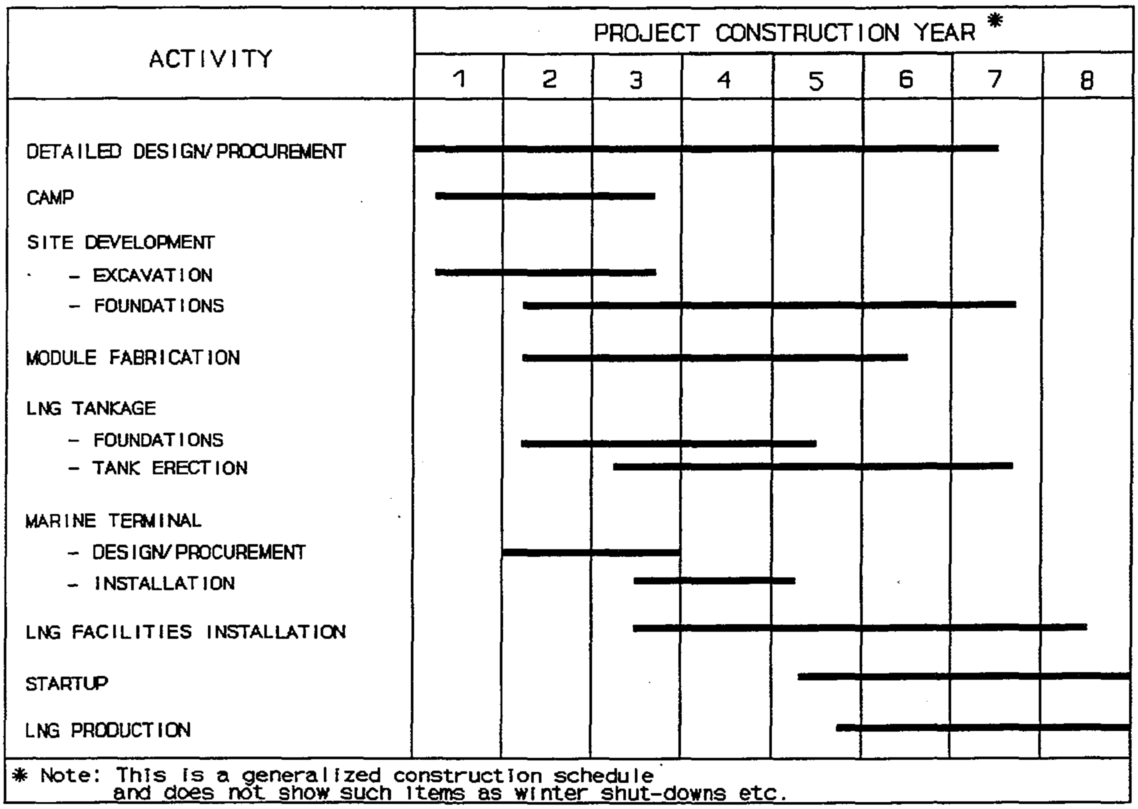


FIGURE 2.1.4-1 **LNG Plant and Marine Terminal Construction Schedule**

2.1.4.1 Construction Workforce and Related Support Facilities

Personnel for initial project mobilization would be housed in the camp facilities in Valdez which are situated near the airport (see figure 2.1.4-2). The Valdez facilities would be used during the whole project by a small number ranging between 150 to 250 personnel. These would include intransit personnel, permanent employees for procurement and personnel processing, busing, and ferrying. Some senior management people may live in the City of Valdez with their families, but this number should not exceed 30 to 40 families.

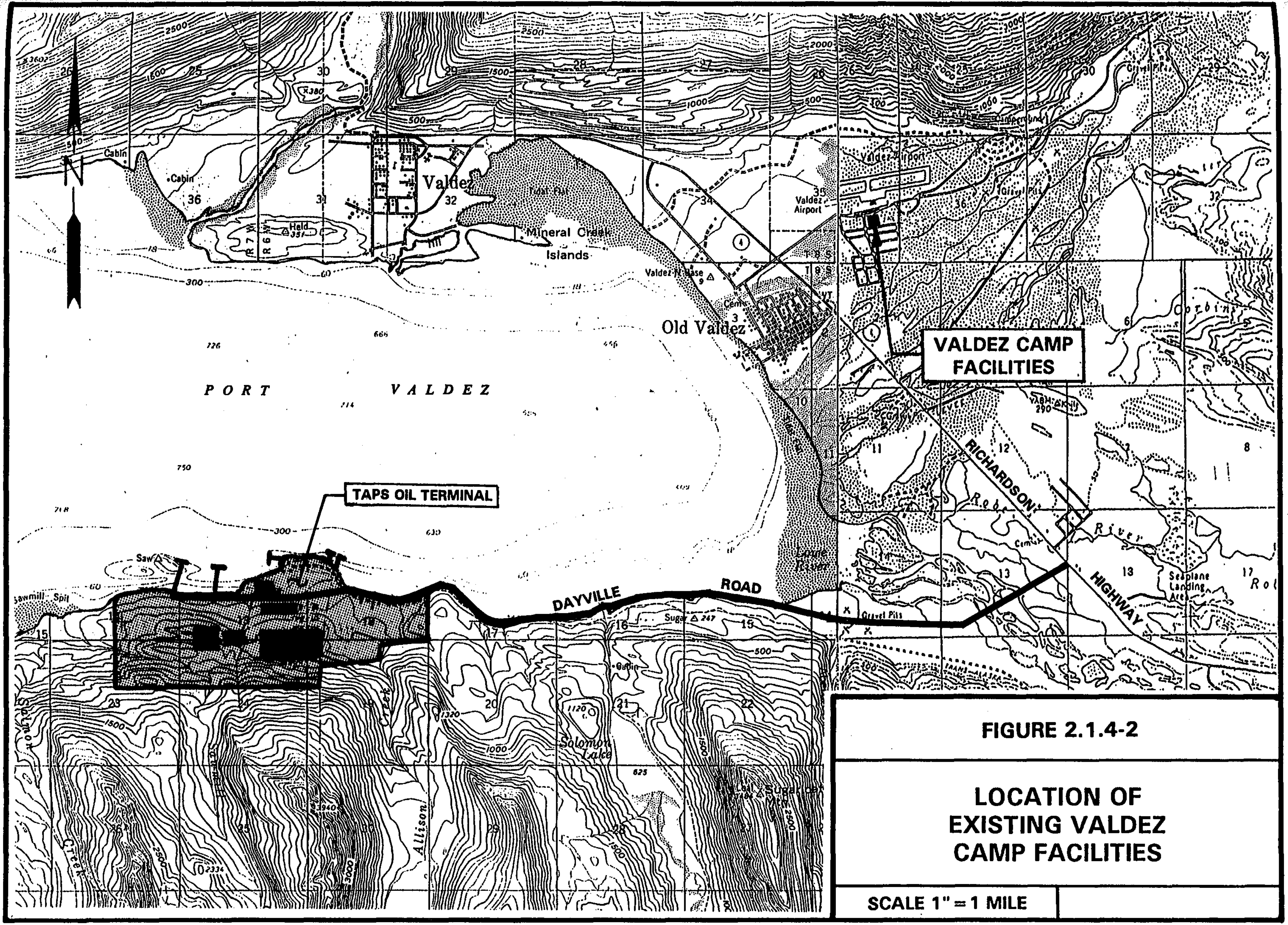


FIGURE 2.1.4-2

LOCATION OF EXISTING VALDEZ CAMP FACILITIES

SCALE 1" = 1 MILE

Floating camps would be established at the Anderson Bay job site during initial site preparation and excavation. The construction camp would be established on the banks of Seven Mile Creek (figure 2.1.4-3) and would be sized to accommodate a maximum workforce of 4,000 individuals. It would be developed in three modules, each with the capacity to house 1,300 people. Each complex would consist of a kitchen, mess hall, recreation complex, and thirteen 2-story, 100-person dormitories. These would be put in place over three consecutive summers in response to increasing manpower requirements. The Alaska Department of Labor (ADOL) enforces regulations on worker safety and health and on integrity of such things as plumbing, electrical, and boiler pressure systems. The camp site facilities would be designed to appropriate code for the protection of resident workers.

Each complex would require a cleared and leveled area of 620 feet by 500 feet (approximately 7 acres) for a total of 21 acres for the buildings alone. The total land requirement is approximately 30 acres. Liquid propane gas would be used for heating and cooking (2,200 gallons per day [gpd] per complex). Electricity usage is estimated at 10,000 kW/day per complex. The water supply would come from Seven Mile Creek as described in section 2.1.1.5 and would be processed through a packaged water treatment plant before delivery to an 800,000-gallon potable water holding tank. Sewage and liquid wastes would be collected from the camp for delivery to the waste treatment plant described in section 2.1.1.5. Solid waste (garbage) generated at the camp would be incinerated onsite in the waste incinerator described in section 2.1.1.5.

The project field administration office would be located on a bench overlooking the cargo/personnel ferry dock area at elevation 75 feet MLLW. Additional construction offices would be located on specific jobsites to place management in proximity to the work. These complexes would contain parking areas, laydown areas, tool cribs, warehouses, and lunch rooms. The construction offices would be located at the LNG train, power generation plant, marine terminal, LNG storage tanks, and offsite. Potable water would be supplied to the field offices in bottles.

2.1.4.2 Temporary Marine Facilities and Traffic

The cargo dock would be a permanent structure that initially would serve construction and later would be used for operation. During construction, the cargo dock would receive shipments of construction materials brought in by barges, module carriers, small freighters, and bulk carriers. It would have a roll-on/roll-off ramp for unloading large prefabricated modules and a ferry landing.

Some temporary dock facilities would also be built to support construction of the LNG facility. These would include a personnel and small boat dock in the construction camp area and temporary moorings for fuel and water barges. The personnel and small boat dock would consist of a 100 foot by 50 foot steel or concrete pontoon 10 to 15 feet deep with fender strips and mooring hardware with an access bridge to shore. The floating dock as currently proposed would be temporary, and would be removed upon completion of construction.

The use of large prefabricated modules is an option to reduce the total number of loads into Anderson Bay. This would result in a single shipment of 10 to 15 ocean-going barges which would all arrive at about the same time. In addition, one to two ocean-going barges per month during the construction season would be required for the first several years. Materials movement to the site from Valdez would average two trips per day, hauling six tractor trailer units or equivalent. Peak requirements could be six trips per day.

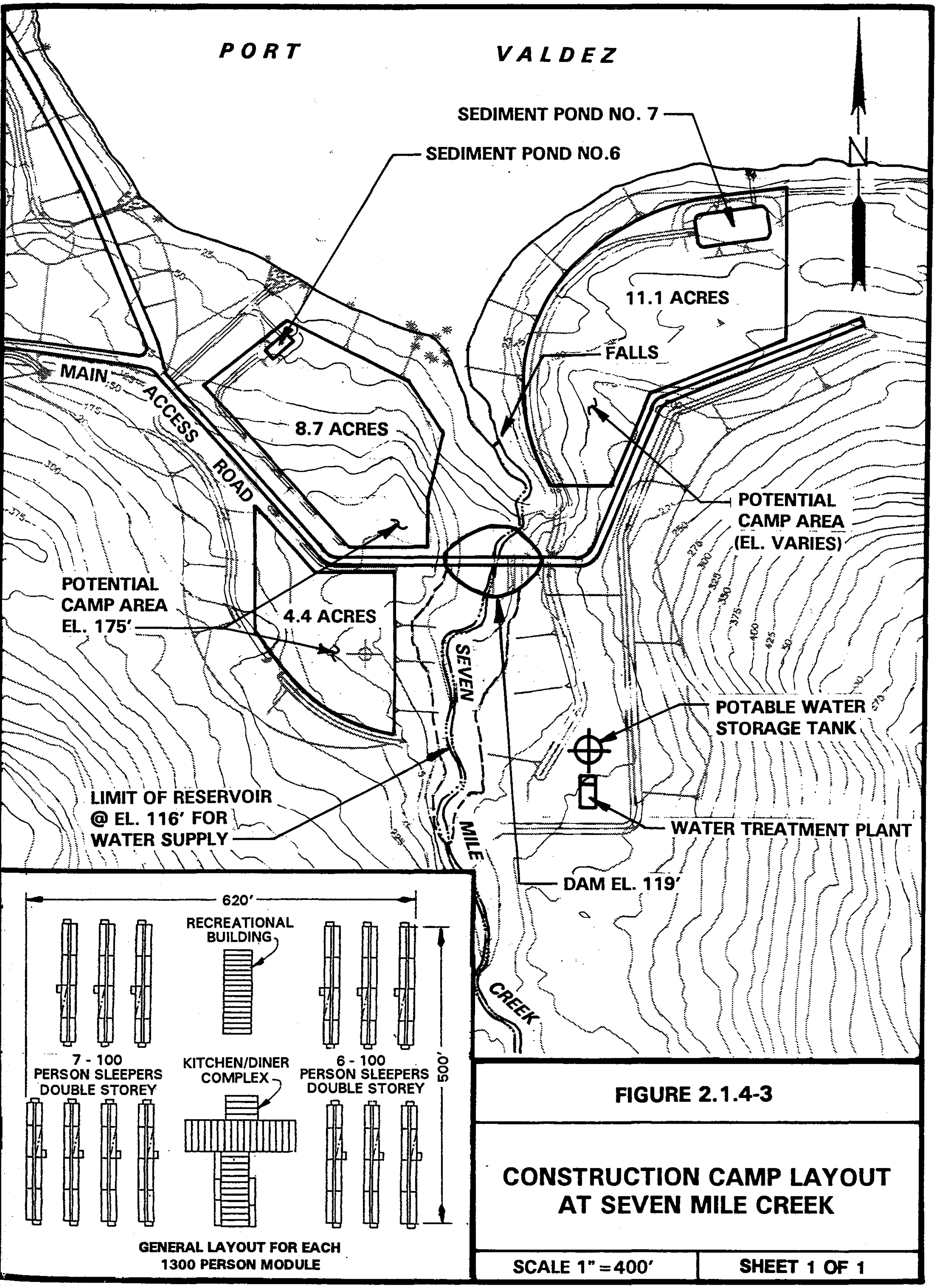


FIGURE 2.1.4-3

CONSTRUCTION CAMP LAYOUT AT SEVEN MILE CREEK

SCALE 1" = 400'

SHEET 1 OF 1

2.1.4.3 Permanent Plant and Marine Site Development

Site development activities would begin as early as possible in the first construction year and be carried out in three consecutive summer seasons. Site excavation would involve: removal of overburden soils down to bedrock and placement of these soils in planned fill and disposal areas; the removal of rock down to design grade elevations; and the placement of compacted rock fill in low areas up to design grade elevations (figure 2.1-4). Overburden removal would be done using bulldozers, backhoes, loaders, and haul trucks. Rock excavation would be done using conventional drilling and blasting techniques. Rock would be moved and placed by bulldozers, loaders, haul trucks, and compactors. Blasting of rock would commence upon project mobilization and would be planned initially twice a day—once at lunch period, and sometime between the first and second shifts, weather permitting.

The amount of underwater blasting would be limited to what is necessary at the cargo/personnel ferry dock and the LNG tanker berthing docks, and cannot be determined exactly until detailed bathymetry of the areas is completed. In any event, blasting would be designed to meet Federal Regulations Part 1926, Safety and Health Regulations for Construction Sub Part "U". The proposed schedule restricts underwater blasting to the period October 1 through April 15 or in accordance with ADFG guidelines to avoid impacts on marine resources. The TAGS Right-of-Way Lease Stipulation Number 2.11 requires the preparation of a blasting plan and approval by the Alaska Department of Natural Resources (ADNR) for blasting in streams, rivers, or lakes.

The layout of the site shown on figure 2.1-4 reflects a need to locate all critical facilities on bedrock while at the same time optimizing cut/fill requirements to minimize spoil quantities. Site excavation quantities would be approximately 9.7 million cubic yards. Approximately 5.9 million cubic yards of this would be used for onsite fill, including earthwork for the construction wharf and off-loading area in Anderson Bay. Approximately 3.8 million cubic yards of excavated material, about 19 percent rock, would not be needed and would require disposal. This is discussed further in section 2.3.2. The site development concept uses terracing (benching) to maximize the functional area of a site which is relatively steep.

The highest bench would be occupied by the LNG process trains at an approximate elevation of 175 feet MLLW. Another major bench would be located to the west where the LNG storage tanks would be placed at a base elevation of approximately 75 feet MLLW. Secondary benches would be graded for other facilities such as the:

- power plant and operations support area and utility storage area (100 feet MLLW);
- harbormaster, helipad, and wastewater retention area (50 feet MLLW); and
- construction wharf and off-loading area (31 feet MLLW).

Once site development for the LNG tank area is well underway, the LNG tanks subcontractor would mobilize to begin construction of the ring foundations for the first LNG tank. This would be as early as possible in the second construction season; with tank installation the following year. Using a phased construction strategy it is Yukon Pacific's intention to complete one train per year for 4 years with the first train startup occurring in the fifth year. At the end of the eighth year of construction, all four trains would be completed and producing.

LNG process trains, completed in modules offsite, would be shipped via barge to Alaska, unloaded at the construction dock facility in Anderson Bay, and moved into place by way of the onsite access roadway. These would be delivered and installed in sequence and the remaining yard pipe would be installed and tested. All systems would go through a transfer of custody and control procedure prior to final commissioning and operations. The installation of the remaining LNG shoreside facilities would be handled by a subcontractor, who would mobilize to the site in the third quarter of the third construction year.

The design and construction of all marine terminal facilities would be handled by a specialty subcontractor, who would begin construction of the two LNG mooring and loading berths late in the third construction year, continuing until completion in the midsummer of the fifth construction year.

The cargo dock would be constructed of precast concrete caissons filled with granular material, that can be floated into place and sunk in position. The final design of the dock would depend on the construction equipment available and the preference of the installation contractor.

2.1.4.4 Concrete Batch Plant

The proposed location for the concrete batch plant is at the construction dock because of the proximity to the unloading area. Water run-off from the batch plant would be contained in the sediment ponds, then either pumped back to the water tank or allowed to drain to a permitted outfall. Waste concrete would be used as miscellaneous fill in the construction operations or removed from the site in dumpsters to an approved landfill area.

The batch plant would require a 400,000-gallon water storage tank which would be supplied from a barge which would be loaded from the Seven Mile Creek reservoir by submersible pump. At peak, the plant would use 80,000 gpd with an average use of 10,000 gpd. During the summer months, the storage tank would supply 40 days at the average rate and 5 days at the maximum batch plant production. The tank might require occasional topping off from the sandbag catchments from Nancy or Short Creek. Water barges would be used to supplement the water supply during periods of limited stream flows. The use of a small skid-mounted desalination system is also being reviewed.

There are insufficient quantities of high quality aggregates to meet construction needs at the Anderson Bay site. Therefore, concrete aggregates would be barged to the construction dock, then transported directly to the batch plant or placed in the aggregate stockpile area at the dock. Aggregate supply would come from local sources; the deposits would be excavated using backhoes and front end loaders. Trucks would transport the material to barges which would ship the aggregate loose on the barge, or trucks would drive onto transport vessels and drive off at the cargo dock.

Estimates of required aggregate types indicate that up to 250,000 cubic yards of concrete aggregate and 700,000 cubic yards of special aggregates would be required from offsite sources. These would be purchased from private suppliers in the Valdez area and barged to Anderson Bay where they would be stockpiled. Space limitations would limit the stockpiles to less than 25,000 cubic yards.

2.1.4.5 Fuels

Power for the temporary construction facilities would be supplied by diesel generators at various locations throughout the jobsite. Fuel would be provided from small above-grade storage tanks and each location would be contained with berms. Fuel would be dispensed from the permanent diesel storage facility adjacent to the cargo/personnel ferry dock and transported in fuel tankers around the site to refuel each piece of equipment and each generator.

Fuel barges would be unloaded at the cargo dock using flexible hoses between the supply vessel and a permanent manifold near the face of the dock. During transfers, the offloading vessel would be surrounded by a floating oil boom to contain any accidental spillage.

Gasoline would be transported to the site by tanker truck on the roll-on/roll-off ramp. The use of gasoline would be limited to that required for small power tools and some vehicles. The gasoline tank farm would be located near the diesel tank in elevated tanks surrounded by a berm.

2.1.5 Safety Controls

The proposed facilities would be designed, constructed, operated, and maintained in accordance with DOT Federal Safety Standards for Liquefied Natural Gas Facilities, 49 CFR Part 193. The facilities would also meet the National Fire Protection Association 59A LNG Standards (NFPA 59A). The marine cargo transfer system and any other appurtenances located between the LNG tanker and the last valve immediately before an LNG storage tank would comply with the Coast Guard regulations for Liquefied Natural Gas Waterfront Facilities, 33 CFR Part 127 and Executive Order 10173. Table 2.1.5-1 summarizes the Siting Requirements found in Subpart B of Part 193, and Yukon Pacific's action to comply.

In recognition of the importance of design and operational safety for a major LNG export facility, the Commission staff had two studies undertaken on key safety aspects of the facility: 1) a seismic design review, and 2) a cryogenic design and technical review. To accomplish the first task, the Commission entered into an Interagency Agreement with the National Institute of Standards and Technology (NIST) in January 1992. The NIST and its predecessor, the National Bureau of Standards, had previously conducted similar reviews for the Commission on LNG terminals in high seismic areas. For the present review, the NIST conducted a technical conference in Anchorage on May 20, 1992 and conducted site inspections on May 21 and 22. The results of the seismic investigation appear in the report in appendix A and are summarized in section 4.2, Seismicity.

For the second task, the Commission staff worked jointly with its consultant, Cryogenic Engineering, to commence a cryogenic design and technical review. A cryogenic design data request was sent to Yukon Pacific on February 1, 1990 and partial responses received on July 26, 1991, and March 31, 1992. A technical conference was convened in May 1992 in Valdez, followed by a site visit. Section 4.15, Analysis of Public Safety, summarizes the study and presents the conclusions and recommendations. The preliminary cryogenic report is in appendix B.

Spill Containment

The LNG impoundment systems would be designed to comply with the DOT regulations in 49 CFR 193.2149 through .2185 which require that each LNG container and each LNG transfer

TABLE 2.1.5-1

Actions Taken to Comply with 49 CFR Part 193 Siting Criteria

Criteria	Action
193.2057 Thermal radiation protection: This criterion is designed to ensure that certain public land uses and structures outside the LNG facility boundaries are protected in the event of an LNG fire.	The calculated "thermal exclusion zones" for each container and transfer system do not impinge on any of the excluded land uses.
193.2059 Flammable Vapor-gas dispersion protection: Similar to the thermal radiation protection requirements described above, this criterion aims to protect from a flammable gas cloud resulting from an LNG spill.	No excluded uses occur within the calculated "dispersion exclusion zones."
193.2061 Seismic investigation and design forces.	Seismic design criteria, developed by both deterministic and probabilistic methods to meet or exceed the codes in 49 CFR 193, under review.
193.2063 Flooding: This criterion addresses risks from flooding on an LNG site based upon the worst occurrence in a 100-year period, taking into account the volume and velocity of the floodwater, tsunamis (tidal waves), potential failure of dams, predictable land developments which would affect runoff accumulations of water, and tidal action.	Seawall and energy dissipation devices recommended to control wave runup. Site design places benches at elevations $\geq$ 75 feet for critical features.
193.2065 Soil Characteristics: This criterion addresses the load bearing capacity of the site (static loading caused by the facility and its contents, and dynamic loading caused by the movement of contents during operation).	Through the use of bedrock and engineered rock fill, the site preparation design criteria assure compliance with this paragraph's requirements.
193.2067 Wind Forces: This criterion requires that all facilities be designed to withstand a 200 mile per hour wind force without the loss of structural integrity.	Ongoing review in conjunction with seismic study.
193.2069 Other Severe Weather and Natural Conditions: The intention of this criterion is to determine the worst effect of other weather and natural conditions which may predictably occur at the site and to ensure that the design is appropriate to withstand those conditions.	Snow and avalanche were identified and accommodated in the plant design. Ongoing review in conjunction with seismic study.
193.2071 Adjacent Activities: This criterion states that an LNG facility must not be located where present or projected offsite activities would be reasonably expected to adversely affect the operation of any of the facility's safety control systems or cause the failure of the facility.	The LNG site is surrounded by either the Chugach National Forest or by state land reserved for the plant as buffer zone.
193.2073 Separation of Activities: This criterion specifies separation distances between individual facilities and between facilities and the site boundary to permit movement of personnel, maintenance equipment, and emergency equipment.	These have been incorporated into the site layout.

system have an impoundment capable of containing the quantity of LNG that could be released by a credible accident. Each impounding system would be sized to contain the volume of LNG that could be released in 10 minutes from the single pipe rupture that would produce the highest release rate, plus the volume of LNG that could drain from the pipe (and associated containers) following an emergency shutdown.

At the present stage of design, spill containment systems for the proposed facility are conceptual with final configurations to be developed as the design progresses. Containers in the proposed facility requiring such impoundment include: liquefaction system main cryogenic heat exchangers, LNG flash drums, LNG storage tanks, and loading arm drain tanks on each loading dock. LNG transfer systems necessitating impoundment include: lines from the liquefaction trains to the LNG storage tanks, LNG loading lines from the storage tanks to the docks, and LNG ship loading arms. Details on impoundment dimensions and sizing criteria are discussed in section 4.15, Analysis of Public Safety. (Also see figure 4.15.3-1.)

The Type T-2 LNG storage tank configuration would use a high dike wall constructed of 2-foot-thick reinforced concrete. The impoundment would form a 15-foot annular space between the outer tank wall and provide a containment volume of 137 percent of the tank contents. The high wall design is considered a Class 2 impoundment. Type T-4 and T-6 configurations would be constructed with an integral concrete outer wall which would serve as a Class 1 impoundment capable of holding 110 percent of the tank contents.

Hazard Detection System

The hazard detection system would consist of combustible gas, ultraviolet/infrared (UV/IR), smoke (ionization), high temperature, and low temperature units. Precise numbers and locations would be determined in the final design. Hazard detectors would be installed to provide operating personnel with early indication of releases of flammable fluids and fires; to indicate the general location of the release or fire; to initiate automatic shutdown of equipment in the affected portion of the facility; and to initiate automatic discharge of selected fire control systems. Each hazard detector would actuate visible and audible alarms in the main control room and in the fire station. In most cases, automatic shutdown and/or automatic discharge of fire control systems would occur only if two or more hazard detectors in a given area are in alarm mode simultaneously.

Combustible gas detector installation would include the following locations:

- air inlets to all pressurized buildings;
- inside all enclosed buildings;
- air inlets to all fired heaters and gas turbines;
- each flammable liquid pump;
- each flammable gas compressor;
- inside each gas turbine enclosure;
- refrigerant storage area;
- near LNG ship loading arms;

- liquefaction trains;
- fin-fan coolers/condensers; and
- fractionation area.

Low temperature detectors would be a minimum of two point-type detectors or one continuous strip-type detector. Low temperature detectors would have a factory set point of -40°F with a field adjustment to -50°F, and be located in each of the following areas:

- each LNG impounding area and spill drainage trench;
- LNG flash drum, product pumps, and main liquefaction heat exchanger for each train; and
- below LNG loading arms on both docks.

Smoke detectors (ionization) would be installed inside all buildings within the plant complex.

UV/IR fire detectors would be installed in pairs in the following areas:

- each LNG storage tank;
- LNG loading arms on each dock;
- refrigerant storage area;
- liquefaction trains;
- LNG impounding areas;
- fractionation area;
- diesel firewater pumps;
- diesel fuel storage tanks;
- natural gas and refrigerant compressors/turbines;
- fin-fan coolers/condensers; and
- compressor lube oil skids.

High temperature detectors would have a set point of +248°F.

Hazard Control Systems

Several different types of chemical agents would be available for fighting fires within the facility. The type of agent that would be used in a specific situation would depend on the characteristics of a particular event and on the relative effectiveness of the various agents on that particular type of fires.

Low-expansion foam is effective for extinguishing fires of ordinary liquid hydrocarbons. Semi-fixed low-expansion foam systems would be installed on all diesel storage tanks with capacities greater than 200 barrels. Portable devices for producing and dispersing low-expansion foam also would be available.

High-expansion foam would be applied to unignited pools of LNG to reduce downwind travel of the flammable vapor cloud. When applied to a pool of burning LNG, high-expansion foam would be used to decrease the size of the flame and thus reduce the amount of radiated heat. Installation of fixed location foam generators would include the following areas:

- beneath the LNG loading arms on both LNG loading docks;
- curbed area around the main cryogenic heat exchanger and the LNG flash drum in each train;
- LNG drainage trench beneath each LNG storage tank piping run to main transfer line impoundment; and
- two LNG impounding areas (onshore) for holding dock spills.

The number of generators to be installed in each location would be determined during detailed design. The overall design intent is to provide sufficient generators to produce a 6-foot-thick blanket of foam over the protected area within 2 minutes. Portable high-expansion foam generators would be available to apply foam to other impounding areas. The foam concentrate would be suitable for use with both fresh water and seawater. The nominal expansion rate of the foam would be from 400:1 to 600:1.

Gaseous extinguishing/inerting agents would be used for extinguishing fires in enclosed spaces to limit the access of oxygen to the fuel and to inhibit the combustion process. Approved gaseous extinguishing systems would be installed in all gas turbine enclosures, in certain control room areas, and in other enclosures housing critical electrical/electronic equipment.

Dry chemical powders would be used for extinguishing LNG fires and fires of other hydrocarbons. Potassium bicarbonate dry chemical agent would be used on hydrocarbon fires. Monoammonium phosphate would be used in dry chemical extinguishers intended for fighting Class A fires (wood, paper, cloth). Skid-mounted, fixed dry chemical extinguishers would be installed on both LNG docks. These fixed systems would supply dry chemical to close-coupled and remote hose reels. All other plant areas would be protected by portable or mobile dry chemical extinguishers.

Portable hand-held dry chemical extinguishers of 20 or 30 pound capacity would be distributed throughout the process and storage areas, on both docks, and in all other locations where flammable gases or liquids are stored or processed. Wheeled dry chemical units of 150 or 350 pound capacity would be located beneath the east-west pipe racks in each liquefaction train (five per train), in the fractionation area (two), and in all buildings that house gas turbines and/or flammable gas compressors (one wheeled unit per two turbines or turbine/compressor sets).

Hand-held portable fire extinguishers containing an approved gaseous extinguishing/inerting agent would be installed in all buildings or rooms that house electrical or electronic equipment.

Mobile and portable fire fighting equipment would include the following:

- two fire trucks (water only);
- one fire truck (high-expansion foam);
- one fire truck (water and low-expansion foam);
- six portable high-expansion foam generators; and
- one 3,000 pound, skid-mounted, dry power unit on wheels with hose reels and one monitor.

These equipment units would be located at the Fire Station. Portable and mobile foam producing equipment and the water fire trucks would be capable of being connected to hydrants on the fire distribution system.

Firewater System

Firewater supply and distribution systems would be provided for extinguishing Class A fires; cooling tanks, structures, and equipment exposed to excessive heat radiation from fires; producing low- and high-expansion foam; and dispersing flammable vapors. The design of the firewater supply and distribution system would provide for simultaneous supply of all fixed fire protection systems, including monitor nozzles, at their design flow and pressure involved in the maximum single incident expected in the plant, plus an allowance of 1,000 gpm for hand hose streams for a period of not less than 2 hours. Jockey pumps are to maintain 150 psig system pressure.

Firewater would be supplied from two independent pumping sources. A 570,000-gallon Fire/Utility Water Tank would be provided to supply fresh (desalinated) water through the fresh firewater pumping station primarily for pressurizing the firewater system and for initial fire fighting capability. A seawater pumping station would be designed to supply the entire plant distribution loop with seawater if demand exceeds the capacity of the fresh water system. Seawater would be pumped from the Firewater Intake Structure into the distribution loop by two electric motor-driven submerged seawater fire pumps (11,500 gpm each) with two additional diesel engine-driven spare pumps.

The firewater distribution network would be a wet underground main with hydrants and monitors strategically located throughout the facility. Sectional isolating valves of the post-indicating type would be incorporated into the firewater mains to ensure system integrity and to permit isolating the system in the event of a break or for making repairs or modifications.

Automatically operated fixed water spray systems would be installed for the protection of selected tanks, pumps, vessels, columns, heat exchangers, and piping. All process vessels that would contain significant amounts of liquefied gas would be water sprayed. All fin-fan coolers/condensers that contain flammable fluids or are located above pipe racks carrying flammable fluids would be water sprayed. Lubrication oil skids located below compressors would have a combination water spray/low-expansion foam system. All pumps that handle combustible liquids that are above their flash points would be protected by fixed water spray systems.

The firewater loop in the LNG storage tank area would supply water for fixed water spray systems on the storage tanks, for monitors and hydrants, and for producing high-expansion foam. Each LNG storage tank would be protected by a fixed water spray system on exposed portions of the tank. (The concrete walls would shield much of each storage tank from heat radiation emitted by fires in adjacent tanks.)

The refrigerant storage area would be equipped with an automatically operated water spray system designed to absorb heat developed by fires and to suppress flames in order to protect piping, refrigerant storage tanks, and surrounding equipment.

The firewater systems at each of the two docks would include a firewater distribution system (normally dry); three hydrants (with hose racks) at strategic locations at the loading platforms; two firewater monitors at the inner breasting dolphins; one firewater monitor at the intersection of the loading platform and trestle; and two elevated, pre-aimed, remote on-off firewater monitors to protect the loading arms. Additionally, a fixed water spray system would be provided on the gangway, LNG Drain Drum, LNG piping, and critical valves. A fixed water spray system also would be provided on the outside of the Dock Operations Building.

Fail Safe Shutdown

There are multiple automatic and manual shutdown systems for all components of the LNG and marine operations. The emergency shutdown system (per train basis) is activated by any of the following: main heat exchanger trip, master trip, any compressor trip, loss of power or air, and a variety of other mechanical triggers.

The loading pumps for each tank are stopped automatically in the event of: emergency shutdown activation, motor overload, low tank pressure or level, dock emergency shutdown activation, and other actions.

The emergency shutdown system (per dock basis) is activated manually from either the main control room or from local hand switches, as well as power failure, instrument air failure, or the PERC activation on the loading arms. In a dock shutdown, all loading pumps stop, loading valves close, the loading arm drains and purges, and the vapor recovery arm valve closes. If the PERC is activated first, it will cause both the dock emergency shutdown and the storage tank emergency shutdown to be activated, as well as full alarms to allow personnel warning.

There are no applicant-prepared plans to develop overland access for the regular movement of personnel, equipment, or materials into or out of the Anderson Bay site; however, the pipeline right-of-way would be available as a "summer emergency only" egress route from the terminal if an event were to occur that would require evacuation of personnel from the southern area of the LNG facility and access to waterborne transportation were restricted by that event. The emergency egress route would be maintained as an unimproved private trail, graded, and kept free of brush. Although Yukon Pacific does not propose a year-round permanent access/egress road, the staff will recommend that such a road be constructed and maintained (see sections 4.15 and 4.16 of this FEIS).

2.1.6 Future Plans and Abandonment

The project has an expected life of 25 years based on the availability of natural gas. If additional supplies become available, the life of the facility could be extended. The termination procedures to be implemented would be subject to appropriate existing Federal, state, and local regulations in effect at that time.

2.1.7 Permits, Approvals, and Regulatory Requirements

As lead Federal agency for the Yukon Pacific LNG Project, the Commission is required under NEPA to ensure compliance with Section 7 of the Endangered Species Act (ESA) which, as amended, states that any project authorized, funded, or conducted by any Federal agency (e.g., the Commission) should not "...jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined...to be critical..."[16 USC § 1536(a)(2)(1988)]. The Commission is required to consult with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) to determine whether any federally listed or proposed endangered or threatened species or their designated critical habitat occur in the vicinity of the proposed project. If, upon review of existing data, the Commission determines that these species or habitats may be affected by the proposed project, the Commission is required to prepare a Biological Assessment (see appendix C) to identify the nature and extent of adverse impact, and to recommend mitigation measures that would avoid the habitat and/or species or that would reduce potential impact to acceptable levels.

Section 106 of the National Historic Preservation Act (NHPA) requires the FERC to take into account the effects of its undertakings on any prehistoric or historic sites, districts, or objects listed on or eligible for listing on the National Register of Historic Places (NRHP), and to afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the undertakings. The Commission has requested the applicant, as a non-Federal party, to assist it in meeting obligations under Section 106 by preparing the necessary information and analyses as implemented by the ACHP procedures in 36 CFR Part 800. In accordance with the ACHP procedures, the FERC, as the lead agency, is required to consult with the appropriate State Historic Preservation Officer (SHPO) regarding the NRHP eligibility of cultural resources and the potential effects of the proposed undertaking on those NRHP-listed or -eligible cultural resources.

In addition to the FERC's requirement for authorization for a place of export and the construction and operation of facilities at this place of export under Section 3 of the NGA, other Federal and state government agencies have permit or approval authority, and responsibility for determining compliance with their requirements over portions of the proposed project (see table 2.1.7-1). At the Federal level, required permits and approval authority outside of the FERC's jurisdiction include compliance with regulations of the Clean Water Act (CWA), the Rivers and Harbors Act, the Clean Air Act (CAA), the Mineral Leasing Act (MLA), the Archeological Resources Protection Act (ARPA), and the Native American Graves Protection and Repatriation Act (NAGPRA). While each of these statutes has been taken into account in the preparation of this document, actual permitting will not occur until a later phase of project development when detailed design and equipment selection has occurred.

Federal requirements of the CWA include compliance under Sections 401, 402, and 404. The U.S. Environmental Protection Agency (EPA) will require that a National Pollutant Discharge Elimination System (NPDES) permit application be filed for the construction and operation of the

TABLE 2.1.7-1

Permits and Approvals

Agency	Permit	Remark
FEDERAL		
Advisory Council on Historic Preservation	Section 106, National Historic Preservation Act (NHPA)	Provide comments for all project features that affect cultural resources that are either listed or eligible for listing on the National Register of Historic Places (NRHP).
U.S. Environmental Protection Agency (EPA)	Clean Water Act (CWA) Section 401 Water Quality Certification	Consider issuance of certification to the COE regulating construction activities affecting waters of the state including wetlands.
	CWA, Section 402 National Pollutant Discharge Elimination System (NPDES) Permit	During construction and operations, NPDES permit required for point source discharge of waste waters (e.g., from sewage treatment system) into waters of the United States.
	CWA, Section 402 Stormwater Permit for Construction	For construction sites larger than 5 acres, a permit is required for discharge of collected runoff from the site.
	CWA, Section 402 Stormwater Permit for Industrial Facilities	During operations, industrial facilities require permit for discharge of collected runoff from the site.
	Waste Generator Identification Number	Notification must be given to the EPA as to what RCRA wastes will be generated in order to be entered into Manifest System. This allows generator (Yukon Pacific) to generate, store for ≤ 90 days and ship offsite, RCRA classified wastes.
	Oil Spill Prevention, Containment and Countermeasure Plans Federal Water Pollution Control Act (Section 311; 40 CFR Part 112.7)	SPCC Plan must be prepared within 6 months of initiation of operation and must be fully implemented within 1 year of operation.
	Permit to Handle Hazardous Waste (RCRA) 40 CFR Parts 260-265	
	Hazardous Waste Regulations 40 CFR Parts 260-270	Regulations; no permit.
Federal Communications Commission (FCC)	Radio and Wire Communications and Construction Permit (47 U.S.C. 154-303)	To construct and operate communication system.
Federal Energy Regulatory Commission (FERC)	Authorization of Place of Export under Natural Gas Act Section 3; 18 CFR Part 153.6	Approval of Anderson Bay site as place from which U.S. natural gas may be exported to destinations out of the U.S.
National Marine Fisheries Service	Section 7, Endangered Species Act	Provide biological opinion on species of marine wildlife that are federally listed.

TABLE 2.1.7-1 (cont'd)

Agency	Permit	Remark
FEDERAL (cont'd)		
U.S. Department of the Army Corps of Engineers (COE)	Section 404 (CWA)	Permit for placement of dredged or fill material or mechanical land clearing and excavation in waters of the United States.
	Section 10 (Rivers and Harbors Act)	Permit for placement of structures or work in, or affecting, navigable waters of the United States, including those that are tidally influenced [33 CFR 322].
U.S. Coast Guard	33 CFR Part 127 requires Yukon Pacific to file a letter of intent	Captain of the Port issues letter of recommendation to operator and develops OPLAN.
	Permission to establish Aids to Navigation required under 33 CFR Part 66	If Yukon Pacific wishes to establish any navigational aids associated with either the tanker terminal or the cargo cock, Coast Guard must be notified and give permission.
U.S. Fish and Wildlife Service (FWS)	Section 7, Endangered Species Act	Provide, in conjunction with NMFS, biological opinion on species of wildlife and plants that are federally listed.
U.S. Department of Transportation (DOT)	LNG Facilities: Federal Safety Standards 49 CFR Part 193	Must comply with LNG siting criteria.
STATE a/		
Alaska Department of Fish and Game (ADFG)	Fish Habitat Permit AS 16.05.870	Permit is required to construct a hydraulic project; use, divert, obstruct, pollute, change the natural flow or bed; or to use wheeled, tracked, excavating, or log dragging equipment in the bed.
	Fish Habitat Permit AS 16.05.840	Permit required if efficient upstream or downstream passage of fish species is affected.
Alaska Department of Natural Resources (ADNR)	Right-of-Way Lease (AS 38.35) and Notice to Proceed	Yukon Pacific has a conditional lease which will be made unconditional only after all studies, reports etc. are submitted.
	Water Rights Permit and Certificate of Water Appropriation (AS 46.15)	For withdrawal of waters from site streams.
	Purchase of Materials (AS 38.05)	If materials (e.g., gravel or clay) are required from an area outside of the lease, a material sale permit is required.
	Burning Permit (AS 41.15)	To dispose of slash or stumps from clearing by open burning requires a state permit.

TABLE 2.1.7-1 (cont'd)

Agency	Permit	Remark
STATE (cont'd) a/		
Alaska Department of Natural Resources (ADNR) (cont'd)	Salvage Timber Sale Permit	With the clearance of timber from the site, a permit must be obtained to offer it for sale as salvage timber.
	Tidelands Lease (AS 38.05)	For use of shoreline in grading and erection of structures.
Division of Parks and Outdoor Recreation, Office of History and Archeology	Consultation under Section 106 NHPA	Consult with the FERC regarding NRHP eligibility of cultural resources, and the project effect and mitigation of those effects on historic properties.
Alaska Department of Environmental Conservation (ADEC)	CWA Section 401 Water Quality Certification	Consider issuance to the EPA of certification of the NPDES under section 401(a)(1) of the CWA.
	Prevention of Significant Deterioration (PSD) Permit AS 46.03, 140 & 150; 18 AAC 50.300	Permit required for exhaust of any incineration or fossil fuel burning equipment both during construction and operations.
	Food Service Permit AS 03.05.0.11 & 020; AS 44.46.020	Plan review required. Form 18-0310 or 18-0309.
	Wastewater Permit AS 46.03.100, .090, .110, .120; 18 AAC 15, 70, 72	
	Water and Sewerage Plan Approvals AS 08.48.221; 18 AAC 72.060	
	Open Burning Permit 18 AAC 15.020 -.100	During site clearing/preparation, the burning of slash by open fire requires a permit from the state.
	Oil Discharge Contingency Plan AS 46.03.020; 46.04.030, & .070 18 AAC 75.305	Plan for dealing with spills greater than 10,000 barrels.
	Solid Waste Disposal Permit AS 46.06.080; 46.03.020, 46.03.100 18 AAC 15 18 AAC 60	Prior to creation of onsite landfill, must have permit from ADEC classifying landfill type and stipulating limitation. b/
Alaska Department of Labor (ADOL)	Confirmation of compliance with state worker protection laws	Prior to project commencement, consultation with ADOL to ensure construction and subsequent operations are consistent with worker protection requirements
	Fired/Unfired Pressure Vessels AS 18.60.180; 8 AAC 80 Worker Safety, Petroleum, Construction, Explosives, Occupational Health and Environmental Control, Toxic and Hazardous Waste Codes, etc. AS 18.60.010 et seq; AAC Title 8	

TABLE 2.1.7-1 (cont'd)

Agency	Permit	Remark
STATE (cont'd) a/		
Alaska Division of Governmental Coordination	Coastal Zone Management Act Consistency Determination AS 46.40 and AS 44.19 and 6 AAC 50 and 6 AAC 80 of Alaska Coastal Management Program	Determination as to consistency with state coastal policies regarding development.
Alaska Department of Public Safety	Life and Fire Safety Check and Approval AS 18.70.080; 13 AAC 50	
	Commercial Motor Vehicles - Proof of Insurance AS 28.32.900; AS 28.33.010	Form 12-890.
Alaska State Fire Marshall	State Building Permit (AS 18.70.080)	All plans for construction of buildings, tanks, dock, construction camp, etc. must be reviewed and approved prior to construction.
Department of Public Safety	Building Permit	
LOCAL		
City of Valdez	Chapter 30 Zoning Permit	Site to be rezoned from "Unclassified" to "Heavy Industrial" and Conditional Use Permit required.
	Building Permit	For construction of all land facilities, authorizing inspection to ensure Building Codes are observed.

a/ The State of Alaska uses a multiple agency coordinated system for reviewing and processing all resource-related permits, leases, and other authorizations which are required for coastal projects through the office of the Governor.

b/ New draft regulations (18 AAC 60) were released for public comment on July 7, 1993. Revised regulations are to ensure compliance with Federal EPA requirements per 40 CFR 258 (RCRA Subtitle D) minimum standards.

LNG plant and terminal. A discharge permit must be obtained by anyone who discharges or proposes to discharge pollutants into the waters of the United States including, but not limited to: sanitary wastes; domestic wastes; non-contact cooling water; LNG storage tank cleaner and hydrotest discharge; oily wastewater; surface runoff (during construction and operation) and bilge water. The EPA may not issue an NPDES permit until a certification is granted or waived by the state in which the discharge will occur. There is also a general NPDES permit for stormwater related to construction activities larger than 5 acres.

The Section 404 permitting process is administered by the COE for all discharge of fill or dredged material or mechanical land clearing and excavation in waters of the United States, including wetlands, streams, and navigable waters. Section 10 of the Rivers and Harbors Act is also administered by the COE; individual Section 10 permits would be required for all construction activities that occur in navigable waterways, including those that are tidally influenced (COE, 1992, 1995). The COE has responsibility for determining compliance with all regulatory requirements associated with Section 10 and Section 404 of the CWA.

Ambient air quality is protected by Federal regulations under the CAA. These regulations include compliance under the New Source Performance Standards (NSPS) and the new requirements for the Prevention of Significant Deterioration (PSD). The Federal permitting process for the CAA has been delegated to individual state agencies. Although applications are reviewed by both the states and the EPA, the State of Alaska would determine the need for NSPS or a PSD permit.

Some individual state or local permits would be required to construct the proposed project; however, any such permits must be consistent with the conditions of the authorization for a place of export and the construction and operation of facilities at this place of export. The Commission encourages cooperation between authorization holders and local authorities. However, this does not mean that state and local agencies, through application of state or local laws, may prohibit or unreasonably delay the construction of facilities approved by the Commission.1/

At the local level, the proposed location for the LNG plant is currently zoned "Unclassified" by the City of Valdez. In order for the project to proceed, the property needs to be rezoned to "Heavy Industrial" and a Conditional Use Permit would have to be obtained from the Valdez Planning and Zoning Commission, following the submission of a formal project plan. Under the Valdez Coastal Management Program, Yukon Pacific should file the project plan 6 months before filing the permit application with the Zoning Commission.

2.2 ALTERNATIVE SITE LOCATIONS

In Order 350, the DOE concluded that the Valdez export site (Anderson Bay) is preferable to all other export sites that were considered in the TAGS FEIS issued in June 1988 and disapproved all sites other than the Anderson Bay site (DOE, 1989). Accordingly, as discussed in section 1.5, the Commission is not considering any other site. During scoping, however, several commenters asked that the process leading to selection of the Anderson Bay site be clarified in the EIS.

1/ See, e.g., Schneidewind v. ANR Pipeline Co., 485 U.S. 293 (1988); National Fuel Gas Supply v. Public Service Commission, 894 F.2d 571 (2d Cir. 1989); and Iroquois Gas Transmission System, L.P., et al., 52 FERC ¶ 61,091 (1990) and 59 FERC ¶ 561,094 (1992).

The selection of Anderson Bay as the preferred terminal location was the culmination of a series of studies spanning a period of more than 15 years. In 1976, the FPC issued a FEIS in FPC Docket CP75-96 on the then-proposed El Paso Alaska System (FPC, 1976). This project was to carry natural gas from Prudhoe Bay to a site at Gravina Point in Prince William Sound where it would be converted to LNG and transported from Alaska by ship to Point Conception, California. As part of studies leading up to issuance of a FEIS in 1976, 11 potential LNG sites in Prince William Sound, including Anderson Bay, were evaluated against the following 10 criteria:

- topographic conditions
- foundation suitability
- seismic considerations
- atmospheric conditions
- oceanographic conditions
- distance to deep water
- navigational suitability
- anchorage suitability
- ice formation
- land conflicts

In the El Paso Alaska System FEIS, the Anderson Bay site was then rejected as an alternative site based on more favorable topographic, seismic, and anchorage conditions at the Gravina Point site. Although not specifically discussed in the El Paso FEIS, the Coast Guard was, at the time, also concerned with the passage of LNG ships (with their relative high "sail" area) through the Valdez Narrows under high wind conditions.

The Anderson Bay site was re-examined in studies leading to the TAGS FEIS in 1988.2/ The TAGS LNG site selection process involved a variety of steps and considerations. Using general guidelines, the coastal regions of Alaska were screened for sites that would allow for development of a pipeline system and LNG and marine facilities capable of transporting natural gas from Prudhoe Bay for year-round export to Asian Pacific Rim markets. This screening involved review of alternatives considered in previous studies of a similar nature such as TAPS and the El Paso Alaska System. Combinations of routes and terminal sites in Norton Sound, Bristol Bay, Cook Inlet, Prince William Sound, Yakutat Bay, and Lynn Canal/Chatham Strait were examined. Following initial screening, one major regional pipeline route alternative and six alternative LNG plant and marine terminal locations were considered in detail along with the now proposed site at Anderson Bay.

Eleven pipeline criteria, 10 LNG plant site criteria, and 6 criteria related to the marine terminal were used to determine the degree of favorability for each of the alternative sites. Results of this analysis are summarized on figure 2.2-1. LNG siting criteria for the Anderson Bay site were all favorable or moderately favorable. No site was determined to have an overriding advantage over the Anderson Bay site. Unfavorable characteristics identified in the El Paso Alaska System FEIS were not found to be significant problems in the TAGS study. Table 2.2-1 compares the evaluation ratings presented in the 1988 TAGS FEIS with similar criteria unfavorably rated in the 1976 El Paso Alaska System FEIS.

Between the time of the studies presented in the El Paso Alaska System 1976 FEIS and the TAGS 1988 FEIS, two major changes occurred which influenced selection of the Anderson Bay

2/ The criteria and evaluations conducted by the BLM and the COE are described in detail in appendix C of the TAGS FEIS and incorporated herein by reference.

FIGURE 2.2-1 Criteria Evaluation Matrix for Proposed TAGS Project and Alternative Locations

	Prince William Sound				Cook Inlet		
	Proposed Project to:	Alternatives			Alternatives		
	Anderson Bay	Gravina	Gold Creek	Robe Lake	Boulder Point	Cape Starichkof	Harriet Point
Pipeline Criteria							
- Minimize length of pipeline	☐		☐	☐	☐		
- Maximize use of existing infrastructure	☐		☐	☐			
- Maximize use of proven construction techniques	☐			☐			
- Maximize opportunity for parallel construction techniques	☐		☐	☐			
- Avoid areas of potential geohazards							
- Minimize potential conflicts with sensitive environments	☐		☐	☐			
- Maximize compatibility with current and planned land use	☐		☐	☐			
- Minimize the number of water crossings	☐		☐	☐	☐	☐	
- Avoid permitting delays	☐		☐	☐			
- Minimize potential threat to national security	☐		☐	☐			
- Maximize availability of gas to Alaska consumers					☐	☐	☐
LNG Plant Criteria							
- Adequacy of available land	☐	☐	☐				☐
- Avoid areas with poor foundation characteristics	☐	☐	☐	☐			
- Avoid areas with faults							
- Avoid sites potentially exposed to seismic sea waves	☐	☐	☐	☐	☐	☐	☐
- Minimize length of pipeline to marine terminal	☐	☐	☐				
- Maximize use of existing community infrastructure					☐	☐	
- Avoid sensitive environmental habitat							
- Public safety considerations	☐	☐					☐
- Maximize value added industrial opportunities					☐	☐	
- Minimize site preparation requirements					☐	☐	☐
Marine Terminal Criteria							
- Minimize exposure to extreme oceanographic conditions	☐	☐	☐	☐			
- Minimize distance from shore to 60' MLLW depth	☐	☐	☐				
- Maximize suitability of tanker maneuvering and anchorage area	☐	☐	☐				
- Minimize potential hazards to navigation	☐		☐				
- Minimize potential problems related to soils and geohazards	☐	☐			☐	☐	☐
- Minimize threat to national security							

☐ - Favorable   - Moderately Favorable   - Unfavorable   - Highly Unfavorable

SOURCE: TAGS FEIS page 1-15.

TABLE 2.2-1

Comparison of Suitability Criteria Ratings for Anderson Bay Between El Paso Alaska System and TAGS Projects

El Paso Alaska System a/ FEIS Evaluation	TAGS b/ FEIS Evaluation
Seismic Considerations: Unfavorable due to possibility of seismic damage resulting from slide-induced waves.	Seismic Sea Waves: Favorable because the LNG plant would be located at an elevation higher than the highest recorded tsunami run up wave and no major impacts on onshore structures would be anticipated. Minimize Potential Problems Related to Soils and Geohazards: Favorable because there is minimal probability of a major submarine slide in the area of the marine terminal. The situation is similar in most respects to the Alyeska Marine Terminal site.
Topographic Conditions: Unfavorable due to the rugged topographic conditions at the site would require extensive site preparation and disposal of large quantities of spoil material.	Minimize Site Preparation: Moderately favorable because approximately 10 million yards of excavated quantities (after bulking) would be utilized and 5 million yards would require disposal. The site would require a substantial amount of earthwork before construction. Soils are of good quality overlying bedrock, and site preparation would not pose major difficulties. Excess material could be used to develop the construction wharf, off-loading area, construction support, and laydown area.
Anchorage Suitability: Unfavorable due to absence of adequate anchorage.	Maximum Suitability ... of Anchoring Areas: Favorable because a new deep water anchorage has now been established within Prince William Sound for oil and LNG tankers.

a/ El Paso Alaska System FEIS page II and figure 79, page 505.

b/ TAGS FEIS, pages C-30 - C34.

site. First, during the preparation of the El Paso FEIS and prior to 1980, there were no rigorous Federal siting requirements similar to Part 193 of the DOT's LNG Federal Safety Standards (49 CFR Part 193). These DOT standards, established on February 11, 1980, prescribe siting requirements for thermal radiation protection, flammable vapor-gas dispersion protection, seismic investigation and design forces, flooding (including tsunamis), wind and other severe weather and natural conditions, and adjacent site activities. Yukon Pacific contends that it can meet the requirements of Part 193, as well as meet the industry's consensus standards embodied in the NFPA 59A. Thus, these new standards address and supersede some of the earlier concerns with a site at Anderson Bay.

Secondly, since 1977, the construction and operation of the Alyeska oil terminal and tanker operations have given us a great deal of knowledge and experience which simply did not exist prior to and during the preparation of the El Paso FEIS. Design and construction of the Alyeska facility required extensive site preparation similar to what would be expected at the Anderson Bay site. The location of Alyeska facilities on cut and fill terraces has demonstrated the feasibility of that design/construction concept, although the disposal of the rock and other material remains an issue (see section 2.3.2). Operation of the oil tankers to and from the Alyeska Marine Terminal, along with the use of a VTS, has reduced some of the previous navigational concerns. The Coast Guard does not anticipate VTS problems with the increased LNG tanker traffic (see section 4.15.4).3/ A deep water anchorage is also now available for both oil and LNG tankers in Prince William Sound; such an anchorage area was not available in 1976.

In addition to the above improvements in terms of site acceptability, a number of governmental actions have occurred which limit the scope of the FERC's review of the Anderson Bay site and issues associated with alternative sites other than Anderson Bay. These actions are discussed in section 1.1 of this FEIS. Of importance here is the fact that DOE/FE Order 350 granting Yukon Pacific authorization of the export also concluded that "With respect to the place of exportation for the LNG..., all locations other than Port Valdez, Alaska are rejected." This decision was made after evaluation of alternative sites during preparation of the TAGS EIS, taking into account the Port Valdez site and others evaluated in both the TAGS EIS and the El Paso FEIS. Accordingly, further consideration of alternatives sites is outside the scope of this FEIS.

2.3 ALTERNATIVE CONSTRUCTION CAMP AND DISPOSAL PLANS

2.3.1 Alternative Construction Camp Sites

As described earlier in section 2.1.4, the construction period for the Yukon Pacific LNG Project spans 8 years reaching a peak construction workforce of 4,000 people during the fifth and sixth summers. Yukon Pacific proposes to house the majority of this workforce in a camp adjacent to the construction site (figure 2.1.4-3). Using land on both banks of Seven Mile Creek at approximately 100 to 175 feet elevation, 47 acres of forest would be cleared to establish the 30 acres of finished area required to erect the housing modules and ancillary facilities. Contouring the site would require the excavation of 0.175 million cubic yards of material; however, since rock would be imported to the camp location to supply structural fill requirements, the net impact of camp construction would be inconsequential regarding overall material disposal. This site is located far enough distant from the actual construction to afford undisturbed sleeping for offshift workers. To supply the 288,000 gpd of potable water required to support the peak workforce, a 40-foot-high dam is proposed to be constructed on Seven Mile Creek just above the waterfall, creating a 3.5-acre reservoir. With package water treatment and use of a large storage tank, all of the onsite potable water supply needs could be met from this source. The site could be developed without interfering with other construction activities, making the camp available for occupation early in the construction schedule. Our analyses described in section 4.0 determined that development of the work camp at this site would result in environmental impact.

In an effort to minimize environmental disturbance at the Anderson Bay site, four site and three access alternatives were screened to identify reasonable alternatives. These included locations other than Seven Mile Creek but still within the Anderson Bay area (onsite options) as well as one offsite location in Valdez. Factors considered in the initial screening were: the amount of land

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3/ Coast Guard Marine Safety Office letter dated May 25, 1990 to Coast Guard Commandant.

area disturbed to accommodate the camp; the degree of physical disturbance required to prepare the site (excavation/disposal); the availability of water supply; the worker support (quietness, ease of access); and compatibility with construction needs with respect to scheduling, cost, and logistics.

2.3.1.1 Alternatives Eliminated from Further Consideration

The three alternative camp site locations within the Anderson Bay area are shown on figure 2.3.1-1 and characteristics are described below and summarized in table 2.3.1-1. Based on preliminary information and analysis, these alternatives were eliminated from further detailed analysis; however, additional public comment was sought during the DEIS issuance. Public comment did not alter the conclusion that these options were inappropriate as sites for the construction camp. Although site-specific wetland information was not available for the alternatives that were eliminated, site-specific resource information was available and considered in the evaluation presented in section 4.16.

West Side Anderson Bay

This site is located along the bay 0.5 mile west of the cargo dock area. Due to the terrain, and the spatial requirements of the facilities, the site would be situated at an elevation of 250 to 275 feet MLLW, as compared with the Seven Mile Creek site elevation of 100 to 175 feet MLLW, making it highly visible from the bay. The total area which would have to be disturbed to prepare the site would be 60 acres, most of which is forested and would require clearing. To establish sufficient acreage on the steep terrain would require the excavation of 1.5 million cubic yards of material which would be graded to produce a comparatively flat area for erection of the required buildings. There are no nearby surface waterways with sufficient flow to provide a source for potable water. It would therefore be necessary to barge water to the site from Valdez or from the dam at Seven Mile Creek and/or rely on desalination. Blasting and excavation makes pipe delivery from Seven Mile Creek impractical during the first 3 years of site development. The site is remote from the scene of construction, making it suitably quiet for off-duty workers; however, the transport of workers to the site would require the construction of about 0.5 mile of road which would have to cross Jug, Aquaculture, and Henderson Creeks and would disturb an additional 3 to 4 acres of land. It is estimated that the site preparation costs would be approximately $25-30 million more than the proposed Seven Mile Creek site. Generally, this site offers no environmental benefits over the proposed Seven Mile Creek site while impacting more acreage for site and access development. As a result, we have eliminated this site from further consideration.

South Side of Anderson Bay

The South Side site is situated behind the cargo dock and extends west as far as Henderson Creek. It is far enough away from the construction activity to allow undisturbed sleeping for offshift workers; however, the very steep terrain would necessitate the excavation of 2.5 million cubic yards of material and the disturbance of 70 acres of predominantly forested land to create a suitable area (30 acres). Some natural water is available but the majority of the required potable water supply would have to be barged in from Valdez or from the proposed dam on Seven Mile Creek or provided by desalination. This site is at an elevation of 200 to 250 feet MLLW, well above the height of the cargo dock and Seven Mile Creek site and therefore more visible. Schedule-wise, it could be developed immediately upon the commencement of construction to be available early in the construction sequence. It is estimated that the site preparation costs would be approximately $30-35 million more than the proposed Seven Mile Creek site. For the same reasons that the West Side site was eliminated this site was also eliminated from further consideration.

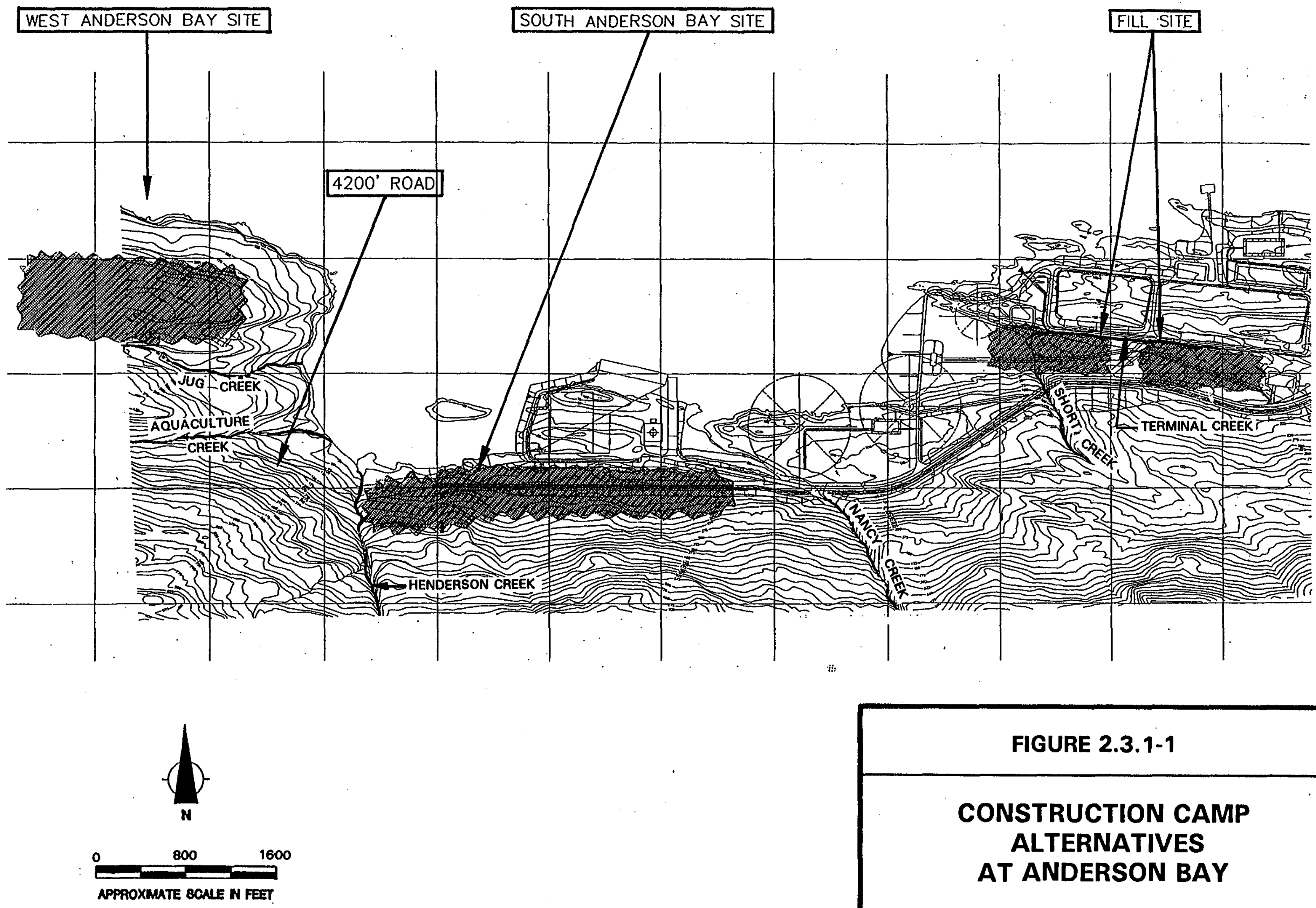


FIGURE 2.3.1-1

CONSTRUCTION CAMP ALTERNATIVES AT ANDERSON BAY

SCALE: AS SHOWN

Characteristics of Construction Camp Site Access Alternatives for Yukon Pacific LNG Project

Alternative	Site Preparation	Habitat	Worker Satisfaction	Schedule	Water Supply	Engineering	Other
ONSITE OPTIONS							
West Side Anderson Bay	• 60 acres cleared • elevation 250-275 ft, therefore, highly visible away from and higher than plant. • 1.5 million yd³ n* + $25 - 30 million a/	• No direct effect on streams but access road would have to be extended ≥ 2,000 ft and cross Jug, Aquaculture, and Henderson Creeks • 3.5 acres extra clearing for road	• Site quiet (removed from construction) • Site isolated (from community)	Compatible	Local creeks probably insufficient, therefore, barge from Valdez or from Seven Mile Creek and/or desalination needed ($13 million) b/.		
South Side Anderson Bay	• 70 acres cleared • elevation 200 - 250 ft, therefore, visible behind cargo wharf. • 2.5 million yd³ n* + $30 - 35 million a/	No additional stream crossings	• Site far enough removed from construction to be quiet • Site isolated (from community)	Compatible	Some from Nancy Creek but not enough, therefore, barge from Valdez or Seven Mile Creek and/or desalination supplement needed ($13 million) b/.		
Fill Site	• No additional excavation or clearing. • Visually hidden.	No additional impact.	• Noisy location so close to primary construction. • Site isolated	Not compatible with current schedule. Could not be made available for 3 years.	Some available from Nancy Creek but barge from Valdez or from Seven Mile Creek and/or desalination needed ($11 million) b/.	Not feasible due to scheduling	
Seven Mile Creek	• 47 acres cleared • elevation 75 - 200 ft, therefore, would not be particularly distinguishable from the plant.	Seven Mile Creek major impact from need to build dam to supply water. (Reservoir 3.5 acres.)	• Quiet location • Site isolated	Compatible	Available through impoundment of Seven Mile Creek to create storage reservoir ($2 million).	Feasible	

a/ * n = Base cost of preparing Seven Mile Creek site. Yukon Pacific provided other site preparation costs relative to this.
b/ The cost of desalination was calculated by Yukon Pacific to be comparable to barging from Valdez. Barging from Seven Mile Creek would be somewhat less costly. Blasting and excavation makes piping from Seven Mile Creek impractical during first 3 years of site preparation.

TABLE 2.3.1-1 (cont'd)

Alternative	Site Preparation	Habitat	Worker Satisfaction	Schedule	Water Supply	Engineering	Other
OFFSITE OPTIONS							
Valdez Camp with road access within pipeline right-of-way on south side of Alyeska facility	Camp site already available near airport. Expansion possible within existing property.	• No direct effect from camp • New road would consist of 0.4 mile new road joining existing Dayville Road to right-of-way east of Alyeska site (4 acres). • Remaining road would be within proposed right-of-way. Therefore no additional clearing required. • 5 stream crossings (Allison, Unnamed, Sawmill, Salmon, Seven Mile Creeks)	• Time of travel would be about 40 minutes. • Valdez less isolated base. • Max. 40-bus convoy x 3 trips in and 3 trips out/day for 2 shifts. • Risk of landslide/rockfall high (safety issue).	Would require minor adjustment in pipeline construction schedule to prepare the western 5.4 miles of the 796-mile-long pipeline right-of-way in advance.	City of Valdez can supply with development of new well.	New road south of Alyeska would climb and descend 700 feet in 2 miles, necessitating a > 13 percent average slope. Compliance with AASHTO design criteria not practically achievable.	• Major social impact on City of Valdez.
Valdez Camp with road access using existing road then to its end in Alyeska property, extended 1 mile to join the proposed pipeline alignment at Sawmill Spit and from there, remain within the right-of-way to Anderson Bay.	Camp site already available near airport.	• No direct effect from camp • 1 mile of off-right-of-way road would require ≤ 9 acres of forest clearing • 3 stream crossings (Sawmill, Salmon, Seven Mile)	• Commuting time 45 minutes. • Valdez less isolated base. • Max. 40-bus convoy x 3 trips in and 3 trips out/day.	Would require minor adjustment in pipeline construction schedule to prepare the western 2.0 miles of the 796-mile-long pipeline right-of-way in advance.	City of Valdez can supply with development of new well.	West of Sawmill Spit the proposed right-of-way is within 75-150 feet elevation with inclines acceptable to bus traffic achievable.	• Major disruption to Alyeska operations during Yukon Pacific shift changes. • Disruption to City of Valdez. • Traffic interference with Allison Point Recreation Area. • Buses $2.5 million.

Alternative	Site Preparation	Habitat	Worker Satisfaction	Schedule	Water Supply	Engineering	Other
Valdez Camp with boat access	Camp site already available.	No direct effect from camp	• Minimum 90 minute commuting time each way using 4 dedicated ferries, each making 2 trips per shift change. • Longer shifts and more workers required	Compatible with current schedule.	City of Valdez can supply with development of new well.	• Logistical problems with staggered shifts. • 20 percent larger workforce required.	• Major social impact on City of Valdez • Yukon Pacific projected $400 million extra labor costs. • Ferries $50 million; buses $2.5 million.

a/ * n = Base cost of preparing Seven Mile Creek site. Yukon Pacific provided other site preparation costs relative to this.

b/ The cost of desalination was calculated by Yukon Pacific to be comparable to barging from Valdez. Barging from Seven Mile Creek would be somewhat less costly. Blasting and excavation makes piping from Seven Mile Creek impractical during first 3 years of site preparation.

Fill Site

A third alternative location for a work camp is on the fill area created by the disposal of excess excavated rock. There are three significant disadvantages of this site. First, the fill required to create the site would be generated as a result of excavation to establish the bedrock benches on which the plant structures would be erected. The filling process would not be complete, and the site therefore not ready for camp installation, until the summer of the third construction year. This would then necessitate housing workers at another location as an interim measure. Second, once the camp was established, offshift workers would be exposed to construction noise associated with the erection and installation of nearby storage tanks and LNG process trains. Third, part of the 28-acre site area would be devoted to storage and laydown space during the later 5 years of project construction. Also, there would be no natural water source at this onsite location, and all water would be barged from Valdez or from the proposed dam on Seven Mile Creek or provided through desalination. As the site is manmade fill, however, there would be no requirement for additional excavation or vegetation removal. This site is at a low elevation (75 to 100 feet MLLW but high enough to be above the design wave (100-year tsunami-runup 75 feet).

In examining these onsite options, it was clear that the Fill Site was impractical from a scheduling point of view and was not sensitive to worker needs. The remaining two options (South and West Anderson Bay) were found to be feasible but environmentally more disturbing (extensive amounts of excavation/disposal and clearing necessitated by the topographic configuration). All three of these onsite options were eliminated from further consideration as they offered no environmental advantages over the proposed Seven Mile Creek site.

Valdez Camp Site with Boat Access

The option of housing workers at the Valdez camp site and transporting them to Anderson Bay by water was considered. In this scenario workers would be bused from the camp to the dock in the City of Valdez where they would load onto 1 of 4 dedicated passenger vessels, each capable of carrying 250 persons. During the peak of construction this would necessitate each vessel making two trips per shift. Yukon Pacific estimates the "door to door" travel time to be 90 to 135 minutes each way. This would necessitate longer work days for the workers, and a 20 percent larger workforce to maintain schedule. Yukon Pacific estimated that labor costs would increase by $400 million (4 hours/day x total job work days x $55 per hour time and one-half labor rate). However, this additional cost would be partially offset by avoiding the cost of constructing a totally new camp site at Seven Mile Creek.

The staff, however, was more concerned with the practicality of this alternative and the logistics involved with transporting workers using both boats and buses versus a camp site (Seven Mile Creek) which is physically located onsite. Public comment was specifically sought on this camp site issue, along with specific documentation as to the appropriateness and feasibility of this camp site, and any other environmental or engineering factors, versus the proposed Seven Mile Creek site. The staff received no information during the comment period to support boat access as a realistic alternative.

Valdez Camp Site with Road Access South of Alyeska Terminal

An all-road option for transporting workers from the Valdez Camp Site, while avoiding the operational area of the Alyeska Marine Terminal is the South Access Road. This alternative would follow the existing public access road (Dayville Road) from Valdez to a point 0.5 mile east of the Alyeska eastern property line and connect with the proposed TAGS pipeline right-of-way to the south (see figure 2.3.1-2). This new connector road would be about 0.4 mile in length. The south access road alternative in concept would then follow the right-of-way of the proposed TAGS pipeline for 5.4 miles to the Anderson Bay site.

The elevation at the east terminus is about 200 feet. Proceeding west, the topography becomes very steep with the pipeline right-of-way rising about 700 feet over the next mile. This represents an average grade of more than 13 percent. Subsequently, it drops back to 300 feet elevation in a distance of 5,000 feet (12 percent slope) and continues to drop to less than 100 feet by the time it reaches Sawmill Spit. From this point west to where it crosses Seven Mile Creek (west terminus), the pipeline right-of-way generally follows the shoreline and remains comparatively level. The right-of-way crosses Allison Creek, an unnamed creek aligned with the approximate center of the Alyeska site, Sawmill Creek (a mile upstream from the mouth), Salmon Creek (500 feet upstream from its exit into Sawmill Spit), and Seven Mile Creek.

The construction of pipelines in severe/steep terrain differs significantly from highway construction in the same area. Pipelines are commonly routed across the contour line to minimize side cut requirements and reduce environmental disturbance. Slopes of more than 40 percent grade have been constructed in this manner. Further, a right-of-way is only prepared as necessary to accommodate side booms and provide transit of slow-moving wheeled and tracked equipment. Based on discussions with the Alaska Department of Transportation (DOT) and Alyeska, the use of the TAGS right-of-way as a road alignment, because of the extreme terrain, appears to be highly questionable from a technical point of view (Tooley, 1993; Jenson, 1993).

The Alaska DOT uses the American Association of State Highway and Transportation Officials (AASHTO) 1990 Design "Green Book" entitled Geometric Design for Streets, with supplement by the State of Alaska Preconstruction Manual. These design manuals specify recommended design geometry based on road purpose and Average Daily Traffic, although local government design standards may apply as well. Among other design parameters, the Alaska DOT tries to ensure road grades of less than 7 percent. Yukon Pacific, if it were to construct a road for private use, is not legally bound by this design specification, but would probably not deviate from it for reasons of liability, particularly since the road would be used primarily for worker movements. To achieve grades of this order in the topography south of the Alyeska Marine Terminal would necessitate major switchbacking and sidecutting into the slopes. Conversely, it is preferable to make a direct traverse of steep slopes while avoiding side slopes in routing and constructing a pipeline. The eventual road length would be considerably longer than the direct pipeline route distance of 5.5 miles and the cuts would be highly visible at the elevations required.

Of equal practical concern is maintenance. Precipitation in the Valdez area is quite high but rates are significantly higher with even small increases in elevation. Alyeska never designs steep roads in its terminal area because of the problems it has experienced with heavy rain erosion, snow removal, and excessive icing. This road alignment option, because of its elevation, would be susceptible to very high precipitation necessitating grades even less than the 7 percent design. It is also likely that load design would be double what Alyeska already uses and perhaps four times the Alaska DOT standard of 100 pounds per square foot. This has major excavation, filling, and slope reinforcement implications.

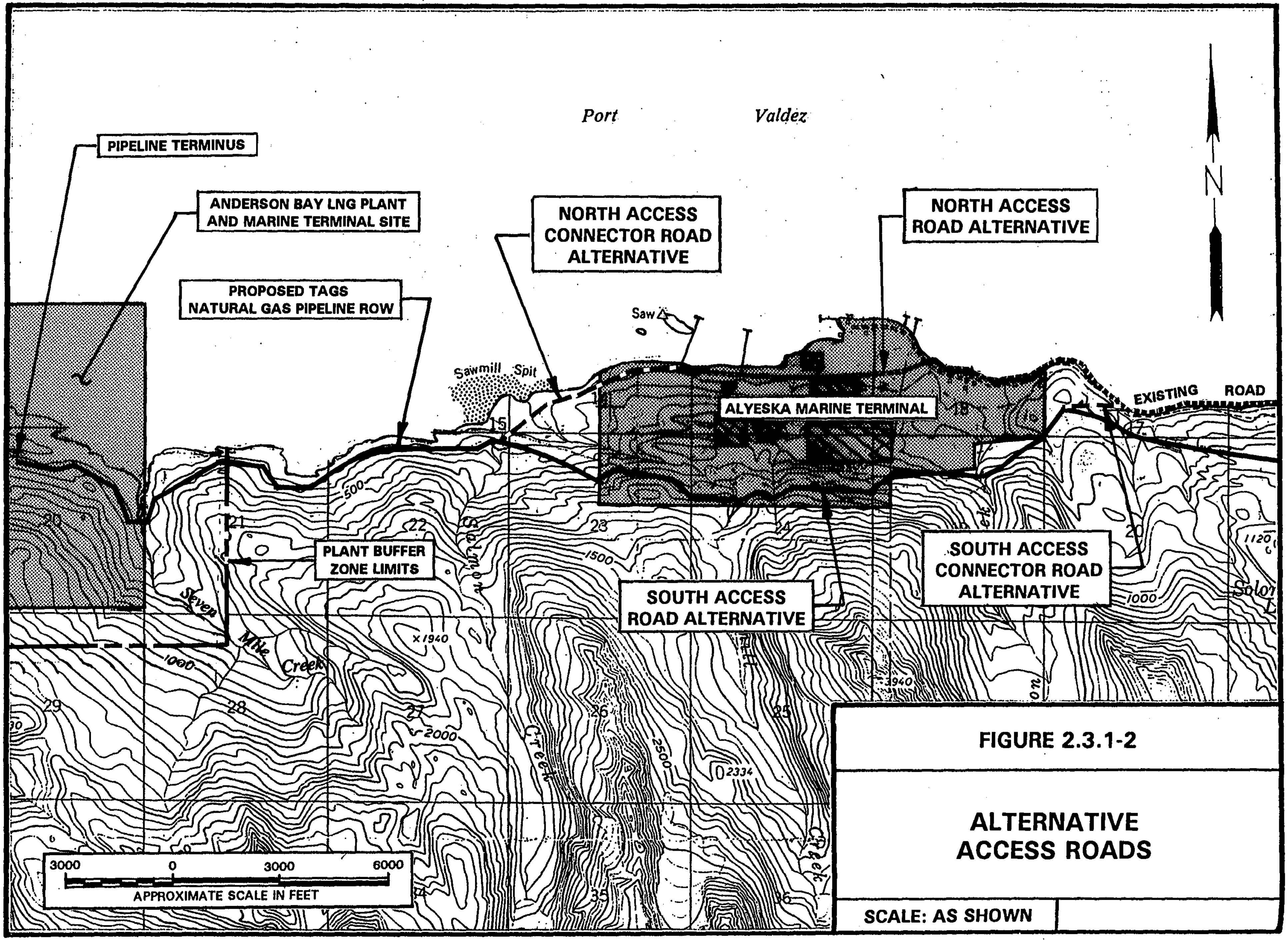


FIGURE 2.3.1-2

ALTERNATIVE ACCESS ROADS

SCALE: AS SHOWN

These factors, combined with the high risk of rock slide and avalanche, with associated safety risks for workers, eliminated this alternative from further consideration.

2.3.1.2 Alternatives Retained

Valdez Camp Site with Road Access Through the Alyeska Terminal

Based on our screening analysis, the only alternative considered to be reasonable for further study was that of using the commercial camp in Valdez and accessing the Anderson Bay site via a road through the Alyeska Marine Terminal property. The existing camp facility at Valdez is located near the airport (figure 2.1.4-2), is privately owned, and is partially established. It was developed to its current size to serve the workforce associated with cleanup of the Exxon Valdez oil spill and continues to be used for projects in the Valdez area. The camp facility has 700 beds and is expandable to 4,000 beds by developing some adjacent property. The camp uses City of Valdez utilities for water and sewer. Although the sewer system has sufficient capacity to handle the added burden, a new water well would have to be drilled to provide the additional water supply.

Transportation of workers from the Valdez camp to the Anderson Bay site could be accomplished over land by passing through the Alyeska property. This access road alternative would involve the use of the existing Dayville Road from Valdez to where it ends at the Alyeska security gates. The access road would then follow the existing main road through the marine terminal to a point approximately 0.4 mile east of the western property line. From that point, it would continue west 0.6 mile to connect with the proposed pipeline right-of-way near Sawmill Spit (figure 2.1.4-2). The additional new road requirement to reach the pipeline right-of-way would be about 1 mile. Assuming that a 75-foot-width would be disturbed in establishing the 40-foot road bed, the total land disturbance would be approximately 9 acres. An additional 2.0 miles of road would have to be constructed within the proposed pipeline right-of-way. Unlike the south access road alternative, the new 1-mile road to connect with the pipeline right-of-way is in relatively level terrain which could be developed to accommodate vehicular traffic. The pipeline construction right-of-way would be wide enough to accommodate the access road without additional clearing. The total 3.0-mile-long new access road would cross Sawmill, Salmon, and Seven Mile Creeks to reach the construction site. It would require an adjustment to the currently proposed construction schedule to allow the southern 2.5 miles of the TAGS pipeline right-of-way to be constructed in advance.

The largest obstacles to this alternative would be the potential disruption to the City of Valdez and to Alyeska's operations during Yukon Pacific's shift changes and the potential impact on security within Alyeska proper, a matter which Alyeska takes very seriously. There are also legal and other institutional questions which would have to be resolved with respect to requiring Alyeska to grant access through its property and compensation.

Compounding the analysis is the recommendation to provide a permanent all-weather vehicular access road during the operational phase (see section 4.15.2). The road would provide an alternative access point and mode to the proposed use of waterborne transportation only for emergency evacuation of personnel and for access of medical and emergency personnel and equipment. Another advantage of an all-weather vehicular access road connecting the Alyeska and Yukon Pacific Terminals is that it would enable both facilities to "pool" their mobile fire fighting equipment and provide mutual aid in the event of a serious incident at either facility.

The staff noted that the necessity for an all-weather access road through the Alyeska Marine Terminal during the operational phase of the Yukon Pacific Terminal does not necessarily justify its use as a commuter road during the construction phase for the Yukon Pacific pipeline and LNG terminal, i.e., the later need for an all-weather vehicular road for operational emergencies does not alone justify the Valdez Camp Site alternative with a road through Alyeska. Access/egress of emergency equipment through Alyeska, perhaps once or twice a year, is far less intrusive than 8 years of up to six daily transits of bus convoys during construction. However, with the potential dual purpose for both construction and operational usage for a road, the option of the Valdez Camp Site/Alyeska Road alternative was carried forward for public comment. See section 4.16 for discussion.

2.3.2 Alternative Disposal Sites

Developing the Anderson Bay site to accommodate the LNG plant and marine terminal would involve major rock excavation and disposal activities. The excavation and disposal volumes are presented in table 2.3.2-1. Based on rough grading estimates, Yukon Pacific has calculated that approximately 3,018,000 cubic yards of overburden and 6,655,000 cubic yards of rock would require excavation in order to be able to site all critical facilities on bedrock. Of these volumes, 5,920,000 cubic yards of rock would be used for structural fill onsite and 735,000 cubic yards of rock and 3,018,000 cubic yards of overburden would require disposal.

TABLE 2.3.2-1

Summary of LNG Plant Site Excavation and Disposal Volumes

	Excavation Material Generated (cubic yards)		Structural Rock Fill Required (cubic yards)
	Overburden	Rock	
Plant Site	2,520,000	5,720,000	4,300,000
Cargo Dock	396,000	803,000	1,400,000
Construction Facilities	102,000	132,000	220,000
	3,018,000	6,655,000	5,920,000
Material Requiring Disposal	Rock	735,000	
	Overburden	3,018,000 a/	

a/ Approximately 396,000 cubic yards of this overburden material would be disposed of in the cargo dock area, where it would be excavated.

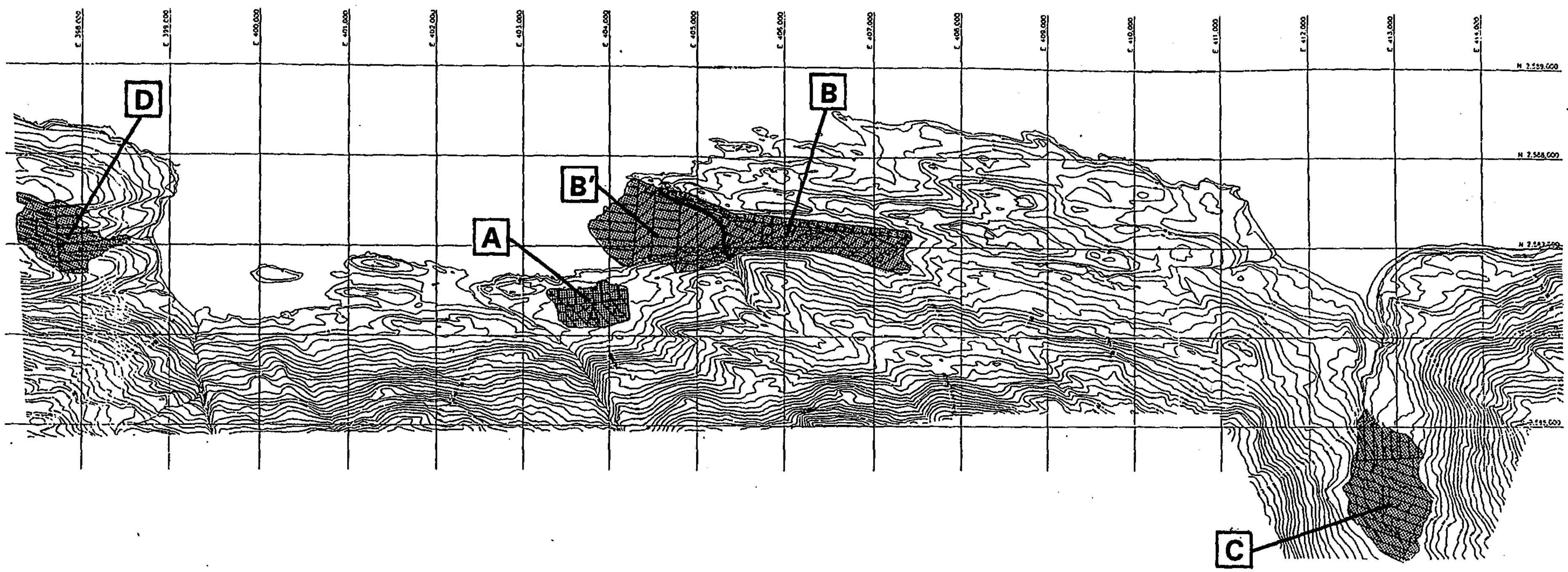
Approximately 396,000 cubic yards of this overburden material would be disposed of in the cargo dock area, since it is estimated that the overburden generated from the excavation of the cargo dock area is expected to be composed primarily of weathered rock with a minimal organic component. The remaining 2,622,000 cubic yards of overburden material and 735,000 cubic yards of rock would require disposal in a separate disposal area.

The overburden material, the natural materials that overlay sound bedrock, includes organic soils, stumps, roots, till, and broken or weathered rock. The percentage of organic material that makes up the overburden will vary considerably at the site since parts of the site consist of steep rocky ridges with little or no organic component, while other parts of the site consist of glacial troughs, which geotechnical bore holes have indicated contain sediments as thick as 20 feet. These sediments consist of organic soils, unconsolidated sediments, and glacial tills. Based on air photo analyses, geologic mapping, and drilling, the overburden material from the site has been estimated to consist of up to approximately 50 percent organic materials. Since the organic soils at the site are generally very thin, tree roots often extend into the upper, weathered and broken rock layers. Stripping of the organics would therefore include most if not all of the broken and loose bedrock.

Yukon Pacific identified six potential locations for disposal of waste excavation materials (see figure 2.3.2-1). The storage volumes of these areas were calculated using areal and contour data, assuming that the area would be filled to a level equal to the surrounding elevations (Eliason, 1993b). Height was limited to conform with adjacent benches. Four of these sites are located on land and either within or relatively near the site boundaries. A fifth site (the proposed disposal site) uses area both on land and in the east end of Anderson Bay. The sixth disposal alternative evaluated utilized an open-water disposal location situated between 0.5 and 1.0 mile out into Port Valdez. Since four of these alternative disposal sites are too limited in storage capacity to contain the entire volume of waste material requiring disposal, we also evaluated the potential for using a combination of several sites, including an open-water disposal of clean rock combined with the use of two onshore sites for disposal of the overburden. Finally we evaluated, as a disposal alternative, using the completed disposal Site B′ for the construction of the proposed cargo dock facilities to reduce the overall impact on the shoreline area of Anderson Bay.

The primary criteria used by Yukon Pacific to evaluate the alternative disposal sites included the following considerations:

- Maximize the accessibility to the disposal site from the main areas where excavated materials would be produced;
- Minimize the spoil haul distance;
- Provide adequate capacity to handle the volume of spoil material produced;
- Minimize the use of shoreline and tidal areas;
- Maximize the efficiency of disposal (disposal rate) by minimizing the total footprint of the disposal sites;
- Minimize the cost of spoil disposal;
- Try to avoid the development of new areas located offsite and the potential for construction of additional haul roads;
- Avoid impacts on existing surface waters; and
- Minimize the potential interference between spoil disposal activities and site location and the temporary and permanent facilities.



- KEY -

AREA	VOLUME (cuyds x 10⁶)
A	0.25
B	0.47
B' (Includes Site B)	3.88
C	1.62
D	1.01

N

0 1000 2000 3000

APPROXIMATE SCALE IN FEET

FIGURE 2.3.2-1

ALTERNATIVE SPOIL DISPOSAL SITES

SCALE: AS SHOWN

Other less critical criteria included:

- Minimize the hauling of spoil material up hill; and
- Maximize the use of the disposal area for temporary staging and material laydown storage.

The site characteristics and advantages and disadvantages of each of the alternative disposal sites are presented in table 2.3.2-2. These alternatives received extensive comment from Federal and state agencies during the review of the DEIS with primary concerns relating to the preservation of intertidal wetlands and subtidal habitats. We subsequently reevaluated each of the options and option combinations, supported by supplemental studies undertaken by Yukon Pacific, before making our recommendation. Each option is discussed below.

Site A

Site A is relatively small, with an overall storage capacity of only 250,000 cubic yards. It is located within the site boundaries on a hillside in an upland area between Nancy Creek and Short Creek. This site has a number of advantages, including its potential low cost of disposal, its onsite location, its proximity to the construction area, and potential use for staging or laydown during construction. The volume of overburden requiring disposal, however, greatly exceeds the storage capacity of Site A, which would have to be increased by a factor of 11 to accommodate all of the fill proposed for disposal in Site B′. To increase the fill capacity of Site A, the option of using retaining walls was examined in some detail. There are generally two preferred systems used to retain soils with low stability. The first, and most common system, is an embankment engineered from competent soils. The second is a near vertical retaining wall system which uses a massive structure (either reinforced concrete or engineered fill) to form the external wall of the fill, with the bulk of the wall retaining the spoil. The seismic design criteria for the site governs the height of the structure.

The use of an embankment-type retaining structure would be ineffective at Site A. The exterior rock embankment would follow the contours of the site and consume large quantities of rock, most of which would overlay the slope extending down from the site. The base of the embankment would encroach on Nancy Creek and/or the shore of Anderson Bay and/or the haul road while providing minimal increase in depth of fill.

The second type of retaining structure would utilize part of the disposal area volume of Site A and would be limited in height. As the height of the spoil material is increased, progressively more of the disposal area volume would be taken up by the retaining structure. Consequently, the height of the retaining wall becomes indirectly proportionate to the disposal area volume. Based on the above, the topography of Site A would not be capable of handling disposal of the volumes of materials required.

Site B

Site B is located entirely on land and is situated to the east of Anderson Bay, in a glacial trough between two rock ridges. Because it is also located directly south of the LNG storage tank platform, it would also be in close proximity to the excavation areas, providing easy access with short haul distances. The close proximity would also result in the lowest cost per cubic yard of disposal material and a potential for use as additional staging or storage area during construction.

TABLE 2.3.2-2

Alternative Disposal Site Characteristics

Alternative Disposal Sites	Spoil Capacity (yd^3)	Surface Area (acres)	Haul Distance (feet)	Cost/yd^3 Fill (dollars)	Disposal Rate a/ (yd^3/acre footprint)	Advantages	Disadvantages
Site A	250,000	8.6	4,800	7.80	29,070	• located entirely on land • located entirely within site boundaries • can be used for staging and material storage area • low cost/cubic yard	• insufficient storage capacity • low disposal rate per acre footprint • could interfere with concrete batch plant operation at Site A • loss of about 1.1 acres of palustrine wetland
Site B	470,000	18.2	2,300	7.45	25,824	• located entirely on land • located entirely within site boundaries • easy access to site • can be used for staging and material storage area • low cost/cubic yard	• insufficient storage capacity • low disposal rate per acre footprint • loss of about 1.3 acres of palustrine wetland
Site B′	3,880,000	42.1	4,000	7.70	92,162	• sufficient capacity to hold all spoil • easy access to site • can be used for additional staging and material storage area • high disposal rate per acre footprint	• partially located in water • requires filling of 16.9 acres of east end of Anderson Bay • loss of 1.3 acres of palustrine wetland and 6.3 acres of intertidal wetland • loss of 10.6 acres of subtidal habitat
Site C	1,620,000	24.6	5,800	9.35	65,854	• located entirely on land • high disposal rate per acre footprint	• insufficient storage capacity • long haul distance • would require construction of additional access road • requires uphill hauling • impact on Seven Mile Creek • high cost/cubic yard • impact on water impoundment on Seven Mile Creek (siltation/turbidity) • loss of about 0.5 acre of palustrine wetland

TABLE 2.3.2-2 (cont'd)

Alternative Disposal Sites	Spoil Capacity (yd^3)	Surface Area (acres)	Haul Distance (feet)	Cost/yd^3 Fill (dollars)	Disposal Rate a/ (yd^3/acre footprint)	Advantages	Disadvantages
Site D	1,010,000	13.8	11,600	16.85	73,188	• located entirely on land • high disposal rate per acre footprint	• insufficient storage capacity • located off-site • difficult access, requires construction of off-site road over difficult terrain • requires uphill hauling • impact on Aquaculture Creek • high cost/cubic yard • requires additional clearing and development of 13.8 acres outside site boundaries • impact on wetlands is unknown
Open-water Disposal Alternatives c/ • Port Valdez • Prince William Sound • Hinchin-brook • Continental Shelf	Unlimited	N/A	4,000/ 0.5 mile b/	11.90	N/A	• sufficient storage capacity • does not require fill placement near shore • short haul distance to barge	• requires construction of barge loading facility • has high potential for disruption and delay of earthwork activities due to bottleneck at barge loading facility, especially during bad weather • water quality problems during disposal of organic component of overburden • floating organic materials would litter surface of Port Valdez • high cost/cubic yard
Combination Sites A, B, and Open-water Disposal c/	720,000 overburden, unlimited for rock	26.8 land surface	4,800	7.45 - 11.90	26,865	• located partially on land • can be used for staging and material storage • unlimited rock disposal • would not fill intertidal or shoreline areas • easy access to site for land portion	• insufficient storage capacity for organic overburden component • low disposal rate per acre footprint for overburden component • could interfere with concrete batch plant operation at Site A • requires construction of BLF • loss of about 2.4 acres of palustrine wetland

TABLE 2.3.2-2 (cont'd)

Alternative Disposal Sites	Spoil Capacity (yd^3)	Surface Area (acres)	Haul Distance (feet)	Cost/yd^3 Fill (dollars)	Disposal Rate a/ (yd^3/acre footprint)	Advantages	Disadvantages
Cargo Dock Located at Site B′	3,880,000(+)	42.1(+)	4,000		92,162(+)	• would avoid construction of the proposed cargo dock area and associated 9.9 acres of intertidal wetland and 2.5 acres of subtidal habitat • would reduce overall size of the LNG plant site	• insufficient room at Site B′ for entire cargo dock and area components without substantial additional filling and grading • would require additional construction quality rock be excavated to add to overburden component to make suitable for dock area • excavation schedule (3 years) would prohibit Site B′ and therefore cargo dock from being filled and completed, respectively. Therefore a substantial delay in use of the cargo dock.

a/ Indicates disposal efficiency per site. The higher the number of cubic yards per acre footprint, the more efficient the site is for spoil disposal.
b/ 4,000 feet to barge area, up to 0.5 mile barge distance into Port Valdez.
c/ Open-water disposal would include clean rock only.

Similar to Site A, however, its major disadvantage is its limited capacity. The possibility of using retaining walls to raise the fill elevation and thereby increase the storage capacity was also examined at this site. The proposed site grading plan shows fill in Site B to an elevation of 125 feet which is 50 feet above the base elevation of the adjacent LNG storage tanks. Filling to a higher elevation would increase the risk of dynamic slope instability that could result in spoil movement into the LNG storage tank area.

Because of their small size, Sites A and B, even if combined, would not offer the capacity required to store the amount of fill material generated by the proposed grading activities (see table 2.3.2-2).

Site B′

Site B′ is an extension of Site B and is the site proposed for use by Yukon Pacific. It utilizes Site B in its entirety but extends further to the west into the east end of Anderson Bay. This site would be built in two stages, B first and then B′ extension, and would utilize a combination of two rock dikes: a small dike built across the west end of Site B along the existing shore of Anderson Bay, and the second, larger one built also across the eastern portion of Anderson Bay (see figure 2.3.2-1). The second dike could not be constructed until after some of the overburden is stripped from the site and excess blast rock becomes available. The dikes would function to retain the spoil material and prevent it from mixing with the waters of Anderson Bay. The primary advantage of using this site is its large capacity (3.88 millon cubic yards) which exceeds the estimated spoil volumes. Site B′ is close to the excavation areas, and would provide easy access for spoil disposal, and like Site B, would provide a relatively large, flat surface that would be used during the last 5 years of construction for staging and laydown space. Because it has a large capacity relative to its surface area (42.1 acres), it has a very high disposal rate and therefore would be very efficient to use.

Its major disadvantage is that it would require the filling of 16.9 acres of Anderson Bay. Although most of this area is relatively deep water, it has been determined to consist of about 6.3 acres of intertidal wetlands along the shoreline, with the majority of the remaining affected area in Anderson Bay consisting of subtidal habitat (see figure 3.4.2-1, polygons 3, 49, and 50). Use of this site would also result in the loss of the associated shoreline habitat currently surrounding the east end of Anderson Bay. Refer to section 3.4.3 for a more detailed discussion of these wetland and habitat components.

Site C

Site C would be located in the lower drainage basin of Seven Mile Creek approximately 1,000 feet upstream from where the creek enters Port Valdez. Because the Seven Mile Creek valley has fairly steep sides, a large amount of spoil (1.62 million cubic yards) could be disposed of in a fairly small area (24.6 acres). Although this results in a comparatively high disposal rate per acre footprint, this site would have several significant disadvantages. Seven Mile Creek would have to be rerouted during construction and filling of the area and then reestablished across the surface of the spoil fill after construction is completed. This is likely to cause unstable conditions and high levels of erosion, resulting in increased levels of sedimentation downstream of the fill site and, most significantly, in the intertidal confluence area of the stream and Anderson Bay where pink salmon are known to spawn. Although Yukon Pacific has also proposed to construct a water supply impoundment on Seven Mile Creek downstream of this site, which could result in sedimentation and increased turbidity levels, we have recommended protection procedures during the construction and operation of these facilities that would mitigate impacts related to both water quality and reduced flows. We do not believe that the impacts on Seven Mile Creek that would result from the use of this area for spoil storage could be mitigated.

Other disadvantages to using this site relate to its location away from the main area of construction. To use this area for disposal, a fairly long, new construction haul road would have to be built to provide access. This would traverse steep grades that could make transportation of spoil both difficult and time consuming, especially during bad weather conditions. Finally, the site's 1.62 million cubic yard capacity is insufficient to contain all of the spoil generated during construction. Its small capacity and the potential to severely impact Seven Mile Creek caused this site to be eliminated from further consideration as an alternative disposal area, either alone or in combination with any other site(s).

Site D

Site D is located approximately 400 feet to the west of Anderson Bay in the valley formed by Aquaculture Creek. It is completely outside the boundaries of the proposed LNG plant site. Although Site D offers storage efficiency (1.01 million cubic yards in 13.8 acres), it still has insufficient capacity to store all the materials produced during excavation. Other disadvantages of using this site include the need to construct a new access road over approximately 1 mile of rough and steep terrain that would be located outside of the affected area of the plant site. In addition to increasing the cost of disposal beyond an acceptable limit, the disposal site and the road construction would require the additional clearing and development of approximately 17.3 acres (disposal site plus road) outside the site boundaries.

Development of Site D would also impact Aquaculture Creek. The streambed would have to be relocated during construction and reestablished after construction on top of the spoil fill, potentially resulting in increased erosion and water quality problems in Anderson Bay. For these reasons, this site was also eliminated from further consideration as a potential disposal site.

Open-water Disposal

The DEIS evaluated the option for disposal of spoil materials in the deep waters of Port Valdez, following the construction of a barge loading facility along the shore. Material would be hauled to the barging area, loaded onto barges, and taken from between 0.5 and 1.0 mile off shore. It would then be dumped into the port for disposal in waters between 600 and 700 feet deep. The advantages of this option is that there is an unlimited deep water storage capacity and it would represent a relatively short haul distance from the excavation area to the barge loading platform.

As a result of comments on the DEIS, we have expanded the analysis to include three additional open-water disposal sites: Prince William Sound, the Gulf of Alaska off Hinchinbrook, and the Gulf of Alaska off the continental shelf. The expanded analysis also examines potential sites for loading barges, the daily number of barge loads, and stockpiling alternatives, based on the supplemental data provided in Yukon Pacific's July 29, 1994 Issues Resolution Document.

During the analysis of open-water disposal alternatives, we also considered reducing the 2,622,000 cubic yards of overburden and 735,000 cubic yards of rock requiring disposal by using the combined 720,000 cubic yard capacity in Sites A and B. The purpose of this was to try to avoid disposal of organic materials into open water.

Barge loading sites - Open-water disposal would require the construction of a barge loading facility near sea level that is:

- close to the excavation;
- accessible to haul trucks;
- sufficiently large to dump material and similarly load two barges; and
- would not interfere with other activities on the terminal or at the construction dock.

Yukon Pacific identified three potential barge loading sites: east of the construction dock in Anderson Bay, the Met Cove, and west of Seven Mile Beach. Figure 2.3.2-2 identifies the three potential sites for a barge loading facility and a conceptual layout. The barge loading area requires approximately 5 acres for spoil delivery, storage, and loading. Table 2.3.2-3 below compares some principal characteristics of the three potential sites with Site B′.

TABLE 2.3.2-3

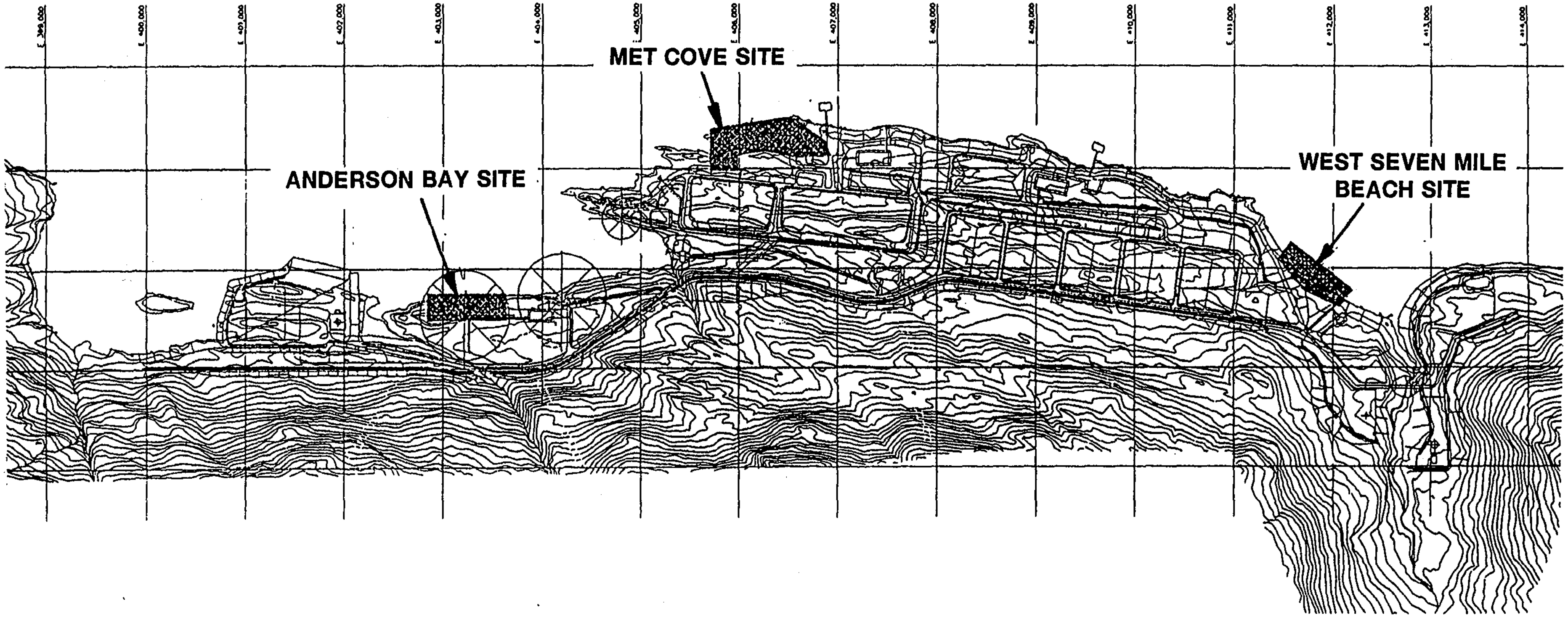
Characteristics of Barge Loading Sites

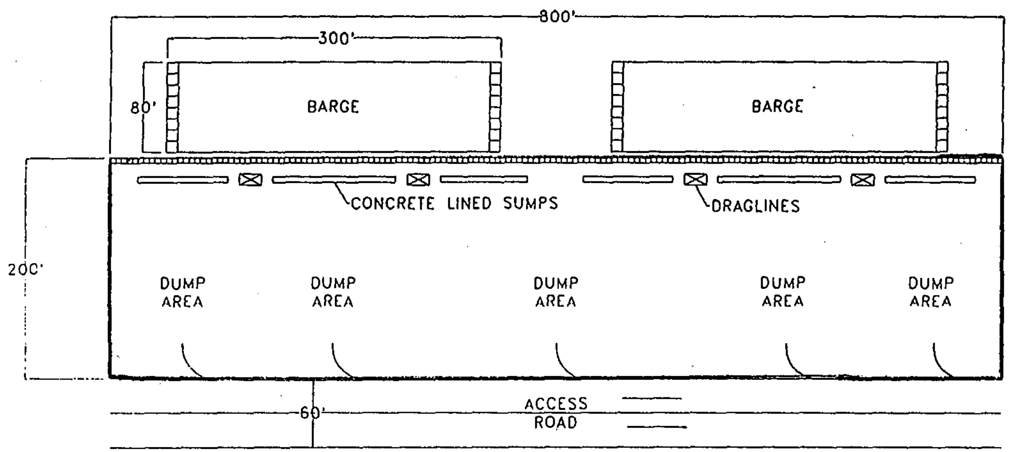
	Anderson Bay Site	Met Cove Site	West Seven Mile Beach Site	Disposal Site B′
Shoreline impact (miles)	0.2	0.6	0.2	0.5
Additional excavation required (cubic yards)	43,000	0	0	NA
Additional fill required (cubic yards)	0	350,000	155,000	NA
Intertidal fill (acres)	1.7	7.1	3.5	16.9
Open-water disposal (cubic yards)	2,680,000	2,290,000	2,480,000	0

Each barge site would require some intertidal fill which would partially offset benefits of avoiding Site B′. The 16.9 acres of intertidal fill at Site B′ is comprised of 6.3 acres of intertidal wetland and 10.6 acres of subtidal habitat. Each potential barge site would eliminate the 6.3 acres of fill in the intertidal wetland, and provide a net reduction of fill in subtidal habitat of 3.5 to 8.9 acres. When compared to the 48.8 acres of wetlands and subtidal habitats that would be filled to prepare the entire site, open-water disposal would reduce fill in wetlands from 35.7 acres to 29.4 acres, and subtidal fill from 13.1 acres to between 4.2 and 9.6 acres.

While it is possible to develop and analyze other potential barge loading sites, the three sites analyzed represent the features of the three distinct areas of the plant site.

Barge loading operations - The barge loading analysis assumes that simultaneous loading of two very large barges, each with a capacity of 10,000 DWT, would be available. Simultaneous loading would require four draglines with eight bulldozers operating 21 hours per day. Under this





TYPICAL BLF LAYOUT

FIGURE 2.3.2-2

POTENTIAL BARGE LOADING FACILITIES FOR SPOIL DISPOSAL

NOT TO SCALE

scenario, the peak number of monthly barge loads is estimated at 67, or a daily average of 2.16. The use of smaller capacity barges would correspondingly increase the frequency of barge transits.

Stockpiling - The barge loading facility would be constructed during the first year of excavation. The capacity of onsite disposal areas—the cargo dock and Sites A and B—would be adequate to handle the estimated 966,000 cubic yards of spoil excavated during the first year.

Approximately 2,100,000 cubic yards of spoil would be generated during the second year. Open-water disposal could commence in the second year with the availability of the barge loading facility, except when prevented by weather. During summer months, adverse weather prevents barging in the Gulf of Alaska an estimated 15 to 20 percent of the time. Approximately 315,000 to 420,000 cubic yards could not be disposed offshore during these periods, and would require onsite stockpiling. Weather-induced barging delays are much less likely within the protected waters of Port Valdez, and correspondingly reduce the downtime or stockpiling requirements for the Port Valdez disposal site. However, this advantage is rendered moot, since disposal within both Port Valdez and Prince William Sound is not a feasible alternative (see next section).

By the middle of the second year, the capacity for onsite fill in Sites A and B, the construction dock, and at the barge loading dock will have been consumed. At that time, weather-induced delays in barging would shut down excavation. For the 12 months of excavation during years 2 and 3, a cumulative delay of 1 to 2 months could occur, causing delays in constructing foundations, buildings, and utilities.

In order to stockpile materials on the site to accommodate weather-induced barging delays, it would be necessary to develop an additional spoil storage area. Given the rugged topography of the site, any stockpile storage area would require excavation and fill, creating additional impact beyond the present site configuration.

Open-water disposal alternatives - Overburden would be the primary component of the 2,290,000 to 2,680,000 cubic yards of spoil requiring open-water disposal, since the rock component would be required for dikes to retain overburden disposed on site and to stabilize the disposal site surfaces. The overburden would contain varying compositions of organic materials, soils, and entrained rocks. When disposed offshore, the buoyant and neutrally buoyant materials would be unconfined and drift with the currents. Coarse to fine-grained materials would eventually settle on the ocean floor.

The open-water disposal sites range from 0.5 to 1 mile offshore for Port Valdez to more than 125 miles for the continental shelf. As shown in table 2.3.2-4, the distance to the disposal sites affects the required number of vessels and the disposal costs.

The DEIS identified several key disadvantages to disposal in Port Valdez. Discussions with the NMFS (Hanson, 1993) have indicated that the dumping of large volumes of organic materials (e.g., tree stumps, roots, mosses, slash) into Port Valdez may not be acceptable since it would be in an uncontained site and would probably result in increased turbidity, sedimentation, and floating materials on the surface of the waters of Port Valdez. This could affect fisheries, benthos, and plankton communities throughout the water column. Second, disposal of material into the port would be regulated under the jurisdiction of the COE (Section 404 and Section 10), under the State of Alaska (Section 401), and under EPA's Ocean Disposal Discharge and Site Selection Criteria (40 CFR, Parts 227 and 228). The EPA indicated (EPA, 1993b) that the disposal of the organic portion of the waste materials into Port Valdez would not be acceptable and that disposal of any

TABLE 2.3.2-4

Alternative Open-water Disposal Sites

	Port Valdez	Prince William Sound	Hinchinbrook	Continental Shelf	Site B'
Nautical miles	1	50	75	125	NA
Barges	2	4	4	5	NA
Small tugs	2	2	2	2	NA
Large tugs	0	2	2	3	NA
Cost					
$million	47	81	81	99	5.5
$per cubic yards of fill	18.8	32.4	32.4	39.6	2.2

other materials (i.e., waste rock) within 3 miles of the shoreline would have to meet the Ocean Disposal Criteria (Comerci, 1993; Barton, 1993). The DEIS concluded that offshore disposal in Port Valdez for all excavated spoils was not a reasonable alternative.

The same constraints for disposal in Port Valdez apply to the waters of Prince William Sound. In its June 28, 1994 letter, the EPA agreed with Yukon Pacific that open-water disposal would create significant environmental and liability concerns. The EPA concurred that project logistics and increased costs render open-water disposal, and that these same factors, plus the inability to acquire all regulatory authorizations in a timely manner (due to the State's concerns) render disposal into Prince William Sound infeasible.

Open-water disposal of rock only - In order to avoid disposing organic materials into Port Valdez, the DEIS evaluated the potential for separating the organic component from the overburden material and disposing of it in Sites A and B. Both these sites are located entirely on shore and would not affect any previously unaffected surface waters. The mineral and rock component would then be barged for open-water disposal.

This alternative is not feasible for several reasons. First, Sites A and B have a combined capacity for only 27 percent of the total overburden material, even if no rock would be used for dikes to retain overburden disposed and to stabilize the disposal site surfaces. Second, assuming that it would be possible to segregate the organic component from the rock component of the overburden during grading activities, and that only 50 percent of the overburden consisted of organic materials, 591,000 cubic yards of organic material would still require open-water disposal once the combined storage capacity of Sites A and B had been used. This would result in the same type of water quality impacts discussed above, but to a slightly lesser extent due to the lower volume of organic material.

Conclusion - For the following reasons, open-water disposal has been eliminated from further consideration as an alternative to onsite disposal:

- While open-water disposal would eliminate the need to fill 16.9 acres at Site B′, it would have only a small effect on the total 48.8 acres of wetland and subtidal habitat to be filled on the site—a 20 to 30 percent reduction, depending on the amount of fill required at the barge loading site.

- Open-water disposal is between 8 to 18 times more costly than disposal at Site B′, and may cause additional costs through scheduling delays—the minor project-wide reduction in wetland fill does not justify these additional expenses.

- Concerns by the permitting agencies and likely regulatory obstacles render disposal in Port Valdez and Prince William Sound infeasible.

- Project logistics and increased costs render open-water disposal in the Gulf of Alaska infeasible. Discharging buoyant material into ocean currents raises additional environmental concerns.

Disposal at Other Project Sites

In a letter dated January 20, 1995, the FWS commented that the FEIS should analyze the possibility of providing excess fill material for upland disposal at other project sites, rather than in-water disposal, citing a permit application with the COE to mine gravel for sale to eastern Asia. First, there is little economic value to the 2,622,000 cubic yards of overburden containing varying compositions of organic materials, soils, and entrained rocks, when compared to the value of mined gravel. In fact, the proposed concrete batch plant would require the <u>importation</u> of up to 950,000 cubic yards of various aggregates from offsite sources in the Valdez area to the site. Second, this alternative would share the first two negative features of the open-water disposal alternative—it would have only a 20 to 30 percent reduction in the total 48.8 acres of wetland and subtidal habitat to be filled on the site, and it is between 8 to 18 times more costly than disposal at Site B′. And third, there would be additional impacts associated with a barge unloading facility, upland disposal area, and related haul roads.

Cargo Dock Located at Site B′

The last alternative we evaluated was that of locating the proposed cargo dock facilities at the disposal Site B′, thus eliminating the need to fill 9.9 acres of intertidal wetland and 2.5 acres of subtidal habitat in the area adjacent to the outlet of Nancy Creek. The location of the construction dock at Nancy Creek was questioned by several agencies primarily due to the need to fill identified wetlands. In response to a data request, Yukon Pacific reevaluated the question of location and identified six possible alternatives to the proposed cargo dock site. Five of the six locations were eliminated due to a combination of factors including exposure to the weather forces of Port Valdez, requirement for major relocation of process facilities, operational incompatibility with the construction camp, and environmental impacts on offsite locations.

The remaining location, Site B′, was favored by the COE for further consideration with the understanding that if Site B′ proved to be the best excess materials disposal option, it could be put to secondary use as the construction dock. Although the construction of the cargo dock area would result in the generation of 1,199,000 cubic yards of rock and overburden material, all of this would be used in the construction of the cargo dock facility and would consequently not affect the overall net quantities of material requiring disposal from the LNG plant site. Site B′ was considered for several other reasons. Yukon Pacific has indicated that Site B′, once filled and completed, would be used only during construction as staging and material storage areas. The 42.1 acres of filled area, including 16.9 acres of Anderson Bay, has little functional value to the operation of the LNG facility. The most obvious reason for considering this alternative was to avoid the construction of a separate cargo dock area with its associated impacts on the shoreline of Anderson Bay, while reducing the overall size of the LNG plant site.

The principal disadvantage of using Site B′ for the construction dock is the scheduling conflict with site preparation activities during the first 3 years of construction:

Bootstrap stage - This stage includes the site preparation activities necessary to support the mobilization of equipment for excavation—timber removal and stump grubbing, rough cut haul road, and a dam at Seven Mile Creek. Yukon Pacific would excavate 390,000 cubic yards of overburden and rock to prepare a bench south of the construction dock, and use it for fill at the construction dock.

Year 1 - Yukon Pacific would use excavated rock to complete the fill at the construction dock and to form a dike berm at the western edge of disposal Site B. Office and warehouse facilities would be erected on the bench south of the construction dock. Excavation activities would concentrate on the LNG storage tank area, with overburden disposed in Site B and excess rock starting to fill the berm for Site B′.

Year 2 - Concrete batch plant would be started up at the construction dock to support LNG storage tank foundations. Excavation would shift to the LNG trains and utility areas. Excavated rock would complete the berm at Site B′.

Year 3 - Site preparation would be completed. Yukon Pacific would dispose remaining overburden in Site B′ and use rock to stabilize the surface of Site B′ for later use as a laydown area.

Since Site B′ would not be completely filled until year 3, it would not be available to receive materials and equipment for clearing, grading, and foundation work that are required during year 1.

Another disadvantage associated with using Site B′ as a cargo dock site is that there would be insufficient area at Site B′ as it is presently designed to contain the facilities proposed to be located within the 23-acre cargo dock area (see section 2.1.2.2). These include the 600-foot-long wharf with 100-foot-wide roll-on/roll-off ramp, ferry docking facilities, passenger terminal building, construction offices, diesel refueling, concrete batch plant, and laydown and storage areas for bulk materials (e.g., aggregate) and supplies. Site B′ would also require substantial additional filling and grading, particularly along the new shoreline to Anderson Bay, where the dock would be located. The orientation of the dock structure, instead of being parallel to the shoreline, would at this location be perpendicular to the shoreline. This would make the approach and departure to the docks by the numerous cargo ships more difficult, time consuming, and possibly less safe navigationally.

In order to be used as a cargo dock with all of the associated facilities constructed on top of it, the percentage of rock used in the fill at this location would have to be high enough to ensure the necessary compaction and stabilization of the soils. This could require adding additional amounts of rock to the fill material, depending on the final composition of the fill material used at this site. Finally, the flat space provided by the fill at Site B′ would be used as storage and laydown space during the latter 5 years of project construction.

A question was raised during discussions with the EPA (EPA, 1993b) regarding the feasibility of utilizing a construction access road to the site for transport of construction equipment, prior to site excavation, thus potentially eliminating the need for a cargo dock. Although construction equipment could potentially be driven to the site via an access road, a cargo dock would still be required to be constructed for transport of the many oversized LNG plant process components, and skid-mounted equipment modules, which would be delivered by barge and would be too large for overland transport.

Summary of Alternative Disposal Sites

Comments on the disposal options that were presented and reviewed in the DEIS led us to reconsider all aspects of the disposal question and consider additional options. The COE, after visiting the site, considered Site B′ to be a supportable disposal option, but deferred to the NMFS with respect to the value of the underwater habitat. The NMFS placed considerable value on the Site B′ habitat and suggested pursuit of all other options before considering disposal at this location. The COE promoted the consideration of Site B′ as a dock site in order to salvage the intertidal wetlands and subtidal habitats at Nancy Creek. The EPA initially did not agree with the COE that Site B′ is the preferred alternative, and suggested further evaluation of offshore and upland disposal options. The SPCO similarly expressed concern for the Nancy Creek area and also suggested we further evaluate open-water disposal (of rock only) and combinations of reconfigured upland disposal of overburden. This view was shared by the NMFS as well. In response to these comments, we reevaluated all disposal options, as discussed in the above sections.

Consequently, we have concluded that the most efficient way to develop the Anderson Bay site and to dispose of excess materials is as originally proposed by Yukon Pacific, since:

- open-water disposal was not acceptable to Federal or state agencies for materials other than "clean" rock (i.e., no organics);
- the possibility of successfully segregating the organic materials from the overburden is considered very low;
- even if rock segregation were feasible, the quantity of remaining organic material would exceed the capacity of the Sites A and B upland disposal areas;
- retaining walls to increase the capacity of upland disposal areas were not adequate to accommodate the total overburden; and
- the cargo dock is required 2 to 3 years before B′ would be available, and potential locations other than the one proposed are not suitable.

All of the issues just discussed regarding filling of wetlands and subtidal habitat, excess materials disposal, location of the construction dock, and open-water disposal were reexamined by Yukon Pacific and following discussions and site visits with the EPA and ADEC, Yukon Pacific prepared a DEIS Issues Resolution Document. The EPA's comments of June 28, 1994, state that offshore disposal of excavated material can be eliminated from further consideration as a disposal option; consequently, the excess material must be disposed of at the plant site and the narrative in the Issues Resolution Document is valid, as reflected in this document. In its comments of July 29, 1994, the EPA states that the conceptual site configuration, location of the construction dock, overburden/rock disposal method and sites have been adequately addressed and concludes that the analysis for the location and placement of fill for the Anderson Bay facility has been adequately addressed (EPA, 1994b). We concur with this assessment.

The final conclusion is that the site configuration as originally proposed by Yukon Pacific with the construction dock located at Nancy Creek, Site B′ as the principal disposal area, and the construction work camp at Seven Mile Creek, are the most environmentally acceptable of the available options for this very constrained site.

2.4 NO-ACTION OR POSTPONED ACTION

The Commission has basically three options available to it in processing an authorization for a place of export and the construction and operation of facilities at this place of export. It can: 1) grant the authorization with or without conditions; 2) deny the authorization; or 3) postpone action pending further study.

The place of export and the proposed facilities are the final link of the TAGS Project to export North Slope gas to markets in Pacific Rim countries. If the Commission were to deny the Yukon Pacific LNG project application for place of export, the entire TAGS Project, including the pipeline, could not be built.

If the proposed action does not proceed, the impacts on the environment resulting from construction and operation of the liquefaction and transport facilities and tanker movement described in subsequent chapters would not occur.

3.0 AFFECTED ENVIRONMENT

3.1 GEOLOGY AND SOILS

Port Valdez is an east-west trending fjord approximately 14 miles long and 3 miles wide surrounded by the glaciated Chugach Mountains. Local peaks attain heights greater than 2,600 feet. Bedrock along the fjord is metamorphosed sedimentary and volcanic rocks of the Valdez Group (Nelson et al., 1985). The sedimentary rocks are predominantly interbedded sandstone and siltstone. Metamorphism has produced additional foliation approximately parallel to the bedding planes. These bedding planes and foliation form horizons of weakness along which the rock layers can separate. The bedding and foliation planes run east-west and dip fairly steeply to the north.

Surficial deposits in Port Valdez are predominantly related to Pleistocene deglaciation as well as subsequent erosion and sedimentation. Glacial deposits in the vicinity of Anderson Bay are predominantly till. These deposits have been reworked since deglaciation by minor slope processes and small streams. Glacial retreat within the fjord waters also deposited a variety of till and fine-grained sediment which blankets the submarine portions of the port, including the steep sideslopes.

Anderson Bay is relatively shallow and underlain by bedrock so that its slopes are fairly stable. At Shoup Bay, across Port Valdez to the north-northwest of Anderson Bay, the Shoup Glacier stabilized forming a large moraine that partially blocks the mouth of the bay. Shoup Bay is much shallower than Port Valdez; consequently, the slope from the moraine to the bottom of the port is quite steep. The loose morainal debris and other deposits on the steep slopes of Port Valdez have the potential to slump, producing underwater landslides. In Port Valdez, such slumping has been caused by earthquakes. This is discussed in section 3.2 in more detail.

Anderson Bay is located on the south shore of Port Valdez. The shoreline at the plant site consists of steep rocky cliffs, 30 to 50 feet in height, that are occasionally broken by shallow beaches at the outfalls of streams. The upland site is crossed by a series of heavily timbered east-west trending bedrock ridges. The soils reflect the short growing season with cool temperatures and abundant rain. Soils in the Anderson Bay area have developed on either bedrock or glacial till and fall into two major soil groups, organic and mineral. The organic soils are associated with poorly drained sites where plant matter decays very slowly. At Anderson Bay, these poorly drained sites are associated with shallow troughs that form in more easily erodible bedrock layers and parallel the east-west bedrock trend. These sites are muskeg and the partially decayed organic matter may be very shallow to many feet in thickness.

The soils that develop in better drained sites are mineral soils that are leached, nutrient poor, and acidic. The compact till parent material of these soils has been loosened by soil formation. However, the soil is still relatively erosion resistant because of a thick, dry, organic layer which protects it. When the dry, organic layer is disturbed, the underlying soil and till parent material is highly erodible. Since the Anderson Bay area is located outside of the permafrost zone, and because of the mild winter temperatures and a heavy snow cover, the soils are seldom frozen. Largely due to the steep slopes at the proposed project site, most of the soils have severe limitations for structures and other engineering uses.

The revegetation potential of the soils on the proposed LNG facility site is moderate to high. Relatively undisturbed soils would revegetate quickly with alder and other native species already present on the site. More disturbed soils could be somewhat slower to revegetate, although the revegetation period of these heavily disturbed soils could be shortened by application of soil the revegetation period of these heavily disturbed soils could be shortened by application of soil amendments and seedmixes adapted to the site.

The site of the proposed facility is located in Alaska's southcentral snow avalanche region (Hackett, 1980). The snowpack in this area is highly dynamic and generally unstable. Snow avalanches release both loose snow and snow slabs. Early winter snow avalanches are common in November and December. Hackett (1980) rated the area near Valdez as having a "high potential" for snow avalanches. More recent information indicates that the area does not have a high snow avalanche potential (Reger, 1993). Fesler and Fredston (1991) provide details on snow avalanche potential along the south shore of Port Valdez. They identified five snow avalanche paths near the proposed facility.

3.2 SEISMICITY

This section briefly discusses the results of Yukon Pacific's analysis of the earthquake hazards that the LNG facility would be exposed to, and its proposed design measures to address the risk of earthquake-induced damage to the facility. No attempt is made here to present in detail the various and extensive geoseismic studies and reports prepared by Yukon Pacific. Those studies and reports contain the baseline data, assumptions, and rationale behind the proposed earthquake engineering design measures. More information is in the applicant's FERC filings; in particular, the July 26, 1991 data response, Volumes VI and VII, available for review at the Commission's offices in Washington, DC, and at the SPCO in Anchorage.

Section 4.2 of this EIS discusses the results of the our review of Yukon Pacific's seismic risk studies and its proposed earthquake design measures. Our conclusions and recommended conditions dealing with seismicity are also contained in section 4.2.

Yukon Pacific has done extensive studies to assess and document the local and regional seismicity and geology surrounding the Anderson Bay site. The purpose of these studies was to:

- demonstrate compliance with the seismic design requirements and the site exclusion criteria of the DOT regulations;
- collect baseline data for estimating potential earthquake-related effects at the site for developing seismic design criteria; and
- inspect, in detail, the site and surrounding area to determine the potential for onsite and nearby faulting.

DOT Requirements

The proposed facility must meet the minimum siting and design requirements of the DOT regulations in 49 CFR 193.2061: Seismic Investigation and Design Forces. A comprehensive study of the historical seismicity and evaluation of the site and surrounding regions is required to quantify the potential effects on the LNG facility from earthquakes and earthquake-related phenomena.

Section 193.2061(f) of the DOT regulations lists the following geologic conditions that, if present or likely to occur, render the site of a proposed LNG facility unsuitable unless the Administrator of the DOT grants a specific approval. An LNG storage tank or its impounding system may not be located at a site where [paraphrasing]:

- the estimated design level for ground shaking exceeds a ground acceleration value of 0.8g (g = the acceleration due to gravity, or approximately 980 cm/s^2) at the tank or dike foundation;
- there is a potential for active surface fault displacement beneath the tank and dike area of more than 30 inches;
- there is more than 60 inches of displacement on a Quaternary fault within 1 mile of the tank foundation, if the potential for displacement beneath the tank and dike area cannot be determined.

Yukon Pacific's geoseismic studies conclude that none of the criteria render the Anderson Bay site unsuitable. Also, studies done of faults on the site and nearby indicate that surface faults in the site area have not been active for at least 16,000 years.

NFPA 59A Requirements

The National Fire Protection Association (NFPA) has established Standards for the Production, Storage, and Handling of LNG: NFPA 59A, which would apply to the proposed facility. Section 4-1.3 of NFPA 59A addresses the seismic design requirements. In general, as with the DOT regulations, a detailed geological study of the site and surrounding regions is required to quantify the potential effects on the LNG facility from earthquakes. However, NFPA 59A is somewhat less detailed than the DOT regulations, and does not contain any seismic site exclusion criteria.

Geoseismic Investigation

The primary objective of Yukon Pacific's geoseismic study was to evaluate potential seismic sources in the region and their relative contributions to the earthquake hazard exposure at the proposed LNG plant site. The historical seismicity of the region was also studied to gain a greater understanding of the temporal and regional variations of seismic activity, and to develop earthquake recurrence estimates for the area.

The great earthquake of March 27, 1964 dominates the historic seismicity of the region. The event had an estimated magnitude of M_w 9.2 (moment magnitude). It had a focus (point of origin) at the north end of Prince William Sound, approximately 40 miles west of Anderson Bay, and 12 to 30 miles below the surface. The earthquake caused intense ground shaking over a large area; extensive landsliding, soil liquefaction, and other ground failures, both on land and in subsea locations; and damaging waves. The duration of strong ground shaking was reported in most areas to be between 3 and 4 minutes.

Geologically, the rupture that initiated the event was on the northward dipping fault that separates the oceanic crust from the overlying continental crust. Such geologic terrains, or "seismotectonic provinces", are referred to as "subduction zones" and the fault separating the two is referred to as a "megathrust"—in this case, the Aleutian megathrust. This fault passes under the Anderson Bay site at a depth of approximately 12 miles. A great earthquake can therefore occur on this fault immediately below the site.

The 1964 earthquake is of obvious importance to the seismic risk at the site. The relative contribution to ground shaking hazard from shallow crustal faults (which are physically smaller) is low compared to the seismic exposure associated with a great subduction zone earthquake. However, faults nearer to the site than the megathrust may be capable of causing significant ground shaking. Therefore, emphasis was placed on identifying active surface faults within 12 miles of the site (i.e., those closer than the megathrust). No evidence for active faults was identified within this area.

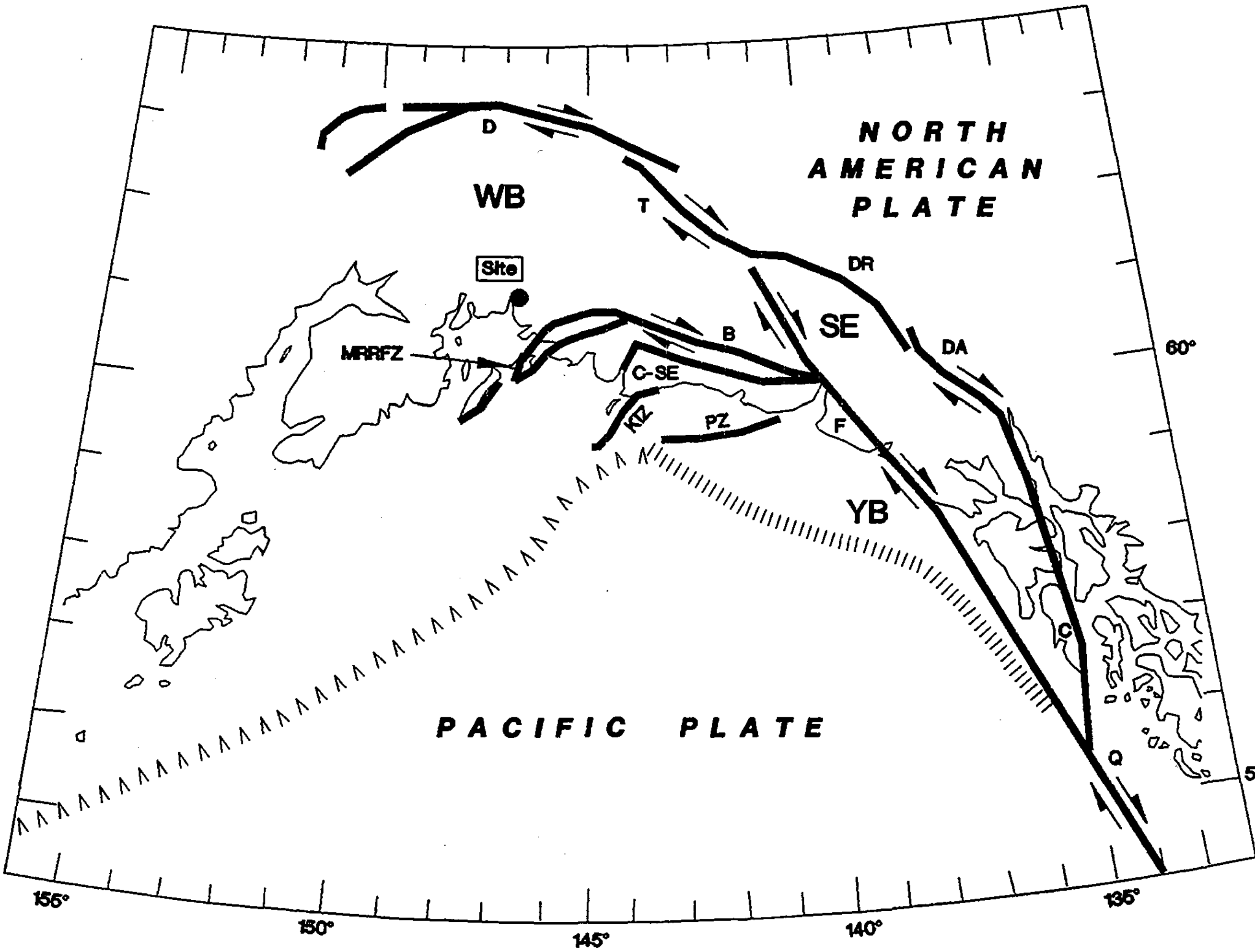
Yukon Pacific also conducted regional studies in Southcentral Alaska to evaluate the historic and geological evidence of earthquakes on the Aleutian megathrust and other active faults. Information obtained during the regional geoseismic investigation and study of the historical seismicity was used to identify and characterize potential seismic sources for use in estimating strong ground motion at the site. Principal regional faults in southern Alaska are shown on figure 3.2-1. Table 3.2-1 lists all the major faults that might generate earthquakes affecting the site, their distances from the site, and Yukon Pacific's estimate of the maximum likely earthquake magnitude ("limiting magnitude") for each. The nearest known surface fault with apparent recent displacement is part of the Montague-Rude River Fault Zone, located about 30 miles south of the Anderson Bay site.

TABLE 3.2-1

Major Faults Potentially Affecting the Proposed LNG Plant Site

Seismic Source	Proposed Limiting Magnitude (M_w)	Distance from Site (mi)
Aleutian Megathrust Intracycle Event	7.75	12 (directly below)
Yakataga Subduction Zone Gap-Filling Event	8.75	60
Yakataga Subduction Zone Intracycle Event	7.5	45
Montague-Rude River Fault Zone	7.5-7.75	30
Castle Mountain Fault Zone	7.5	60
Johnstone Bay Fault	7.0	73
Bagley Fault	7.5	55
Chugach-St. Elias Fault	8	74
Kayak Island Fault Zone	7.5	99
Ragged Mountain Fault	6.75	74

Field investigations conducted by Yukon Pacific to extend current knowledge of the prehistoric activity on the megathrust revealed evidence of at least six, and perhaps as many as eight, earthquakes believed comparable in magnitude to the 1964 event. Based on the geologic evidence, repeat times for such events are estimated to range between 600 and 950 years and average about 700 years. Given these findings, Yukon Pacific believes that the potential for a repeat of a 1964-type earthquake in the Prince William Sound area during the life of the facility is extremely remote and therefore can be neglected for facility design purposes. A lower



KEY :

(solid heavy line)	TRANSFORM FAULTS
∧ ∧ ∧ ∧	ALEUTIAN MEGATHRUST PLATE BOUNDARY
IIIIIIIIII	TRANSITION ZONE
YB —	YAKUTAT BLOCK
WB —	WRANGELL BLOCK
SE —	ST. ELIAS BLOCK
(arrows) —	HORIZONTAL SLIP ACROSS INDICATED ZONE (CM/YR)
Q —	QUEEN CHARLOTTE ISLANDS FAULT
T —	TOTSCHUNDA
F —	FAIRWEATHER FAULT
B —	BAGLEY FAULT
C-SE —	CHUGACH - ST. ELIAS FAULT
KIZ —	KAYAK ISLAND ZONE
PZ —	PAMPLONA ZONE
MRRFZ —	MONTAGUE ISLAND - RUDE RIVER FAULT ZONE
D —	DENALI FAULT
DA —	DALTON FAULT
DR —	DUKE RIVER FAULT
C —	CHATHAM STRAIT FAULT

N

0 200
SCALE IN KILOMETERS

Source: modified after Lahr and Plafker, 1980.
Plate motions from NOVEL 1 plate model (DeMets and others, 1990; DeMets, personal communication, 1991)

FIGURE 3.2-1

PRINCIPAL REGIONAL FAULTS IN SOUTHERN ALASKA

SCALE: AS SHOWN

DWG:FERC226

magnitude earthquake—the so-called "Intracycle Event"—on the megathrust beneath the site, is considered by Yukon Pacific to be a more credible event. Yukon Pacific estimates the magnitude of the Intracycle Event as M_w 7.75.

The area to the southeast of the 1964 fault rupture and aftershock zone has been termed the "Yakataga seismic gap" because of its relatively low level of recent earthquake activity. Strain energy within this zone was not relieved during the 1964 event, nor does the scientific community believe that the strain was fully relieved during two historical M_w 8.1 earthquakes that occurred in that area in 1899. Yukon Pacific concludes that the Yakataga seismic gap poses the greatest potential to generate a great earthquake in the site region during the life of the facility. The estimated magnitude of such an event is given as M_w 8.75. The postulated distance between the site and the focus of the design earthquake is approximately 60 miles.

Seismic Design Criteria

The DOT regulations specify that the proposed facility must be designed and built to withstand, without loss of structural or functional integrity, the most critical ground motion with a yearly probability of exceedance of 10^{-4} (an average repeat time between events of 10,000 years). The most critical ground motion may be calculated "probabilistically," when the available earthquake data are sufficient to perform the statistical analysis, or "deterministically," where available earthquake data are insufficient for statistical analysis.

For comparative purposes, Yukon Pacific used both probabilistic and the deterministic analyses to derive its estimates of the most critical ground motion for the site. Based on these analyses, Yukon Pacific estimates a "zero period acceleration" (ZPA) of 0.39g (deterministically), and 0.54g (probabilistically) for the most critical ground motion with a yearly probability of exceedance of 10^{-4}. Both estimates were made using the results and assumptions regarding seismic sources and estimated limiting magnitudes discussed above; in particular, the assumption that a repeat of an earthquake similar to the 1964 event will not occur during the life of the project.

Yukon Pacific has prepared preliminary seismic design criteria for the proposed facility. It proposes to apply a dual level earthquake philosophy; a lower level event—Operating Basis Earthquake (OBE)—(ZPA=0.4g), and a higher level event—Maximum Design Earthquake (MDE)—(ZPA=0.55g). The MDE value of acceleration is based on the cumulative probability contribution of the earthquake activity from the various seismic sources described above. The OBE value of acceleration, although somewhat arbitrary, is derived as ⅔ the MDE rounded up to 0.4g, based on engineering judgement.

The OBE represents the level of ground shaking through which the facility should be able to operate and continue operating after its occurrence, with perhaps only a brief shutdown for a safety inspection to confirm that no damage occurred. The larger MDE represents the level of ground shaking that should not damage the vital, safety-related components of the facility in such a way that they could not perform their function. Nevertheless, significant repairs may be needed after a MDE occurrence. Generally, the following components would be designed to withstand a MDE without loss of functional integrity:

- LNG Storage Tanks and Foundations
- LNG Tank Containment Dikes

- Fire and Leak Protection Systems
- Fire Station and Special Warehouses
- Control Building and Critical Control Panel Components
- Diesel-driven Power Generators and Fuel Systems
- Emergency Lighting
- Radio and Microwave Communications Systems
- Shutdown System
- Vent and Pressure Relief System

NFPA 59A specifies a two level seismic design approach. The geological investigation must determine the potential vibratory effects at the site from a "Safe Shutdown Earthquake" (SSE) and an "Operating Basis Earthquake" (OBE). While Yukon Pacific has adopted this dual level earthquake philosophy for facility design purposes, the proposed design levels would go well beyond the minimum requirements of NFPA 59A.

Briefly, the SSE is equivalent to the MDE discussed above (i.e., potential vibratory ground motion with a mean recurrence interval of 10,000 years). However, the NFPA 59A OBE is specified as having a mean recurrence interval of only 475 years. Based on Yukon Pacific's probabilistic ground motion study, the OBE under the NFPA standards would be about 0.2g; significantly lower than the proposed design level. Furthermore, NFPA states that "[a]n LNG container shall be designed for the OBE and a stress limit check made for the SSE". Yukon Pacific's own seismic design consultant has stated that this value is too low for the basic design of the LNG tanks under the circumstances.

Seismic Soil Liquefaction

All critical components of the LNG plant would be founded either on bedrock or engineered fill. This would preclude the potential for significant damage or hazard to these facilities due to seismic soil liquefaction.

Tsunami/Seiche/Subsea Slide-Induced Wave

The proposed LNG plant could be affected to various degrees by earthquake-induced water waves. Onshore runup—the elevation to which a breaking wave would reach—with consequent inundation and pounding effects of the water mass on plant structures is the primary concern. Damaging waves can be produced both outside as well as inside the Port Valdez basin. Out-of-basin tsunamis, caused by direct fault movement, volcanic activity, or massive landslides, are a limited hazard to the plant site because of the dampening effect of the wave energy at the port inlet and by shoaling in Prince William Sound. Estimated tsunami wave runup at Anderson Bay ranges from 13.1 to 32.2 feet. Storm surges and seiche effects from out-of-basin sources are relatively small for onland facilities. However, forces on ships and docks by resulting vertical and horizontal movements could be significant and should be considered in the design and operational procedures for the plant.

Direct in-basin generated tsunami risk to the proposed LNG plant is considered low because of the absence of significant active faulting in Port Valdez. However, the hazard due to in-basin generated waves caused by subsea slope failures is high and constitutes the most significant potential wave effects for the proposed facility. Subsea slides associated with regional earthquakes over the past 100 years have resulted in significant wave runup at the plant site and surrounding area. It is likely that most areas of potential subsea slides in Port Valdez were activated by the 1964 earthquake. The destruction of the docks at old Valdez and subsequent damaging waves were the result of a massive subsea slide. Critical areas for subsea slides that could cause significant wave runup at Anderson Bay include:

- Anderson Bay area
- Cliff Mine area
- Shoup Bay area
- Lowe River/old Valdez dock area
- Mineral Creek

Other areas within Port Valdez may have also been active in the past but are considered to represent less direct risk because of their size, location, or orientation with respect to the plant site.

The runup-prone areas at the site are at the end of bays or inlets within or adjacent to Anderson Bay. The geometry of the shoreline in these areas causes the wave energy to converge with resulting peak wave heights. A likely severe case scenario would involve a wave generated from subsea sliding on the Shoup Bay delta during high tide. Such a wave could result in peak runup on the order of 93 feet in the runup-prone areas of the plant site. Properly constructed energy dissipation devices could reduce the peak runup to approximately 67 feet.

To ensure that the LNG plant facilities and other important structures on the site would not be subject to such wave damage, Yukon Pacific proposes to:

- Use a combination of seawalls and other energy dissipation devices.
- Locate all important plant components above the 75-foot elevation.
- Reduce peak runup potential at the plant site by placing large amounts of fill in the runup-prone areas.

3.3 FRESHWATER ECOLOGY

3.3.1 Water Resources

Freshwater resources within the Anderson Bay project area include Jug Creek, Aquaculture Creek, Henderson Creek, Nancy Creek, Short Creek, Terminal Creek, Strike Creek, and Seven Mile Creek, as well as groundwater resources. There are no lakes and only one pond within the project area.

3.3.1.1 Surface Water Hydrology

The Anderson Bay project area is adjacent to a steep slope which contains short, high gradient streams with rocky channels (figure 3.3.1-1). Flow within these nonglacial streams is primarily derived from precipitation and snowmelt and tends to be highly seasonal. Flow from groundwater may also contribute to the surface water flow. Terminal Creek originates from a small pond approximately 1 acre in size. Proposed potential water sources for the project include Nancy, Short, and Seven Mile Creeks. Accordingly, the hydrology of these streams has received greater attention than that of the other five area streams. Hydrologic parameters of Nancy Creek, Short Creek, and Seven Mile Creek are presented in table 3.3.1-1. Seven Mile Creek is the largest of the three streams with a drainage area of 4.40 square miles. Stream flow is highest in the spring period during snow melt and generally reaches low levels of flow in the winter season (table 3.3.1-1). All of the streams discharge directly into Port Valdez, with varying degrees of tidal exchange. Those with significant tidal exchange, such as Seven Mile and Nancy Creeks, provide habitat for fish populations and salmon spawning (see section 3.3.2).

TABLE 3.3.1-1

Hydrologic Parameters of Nancy Creek, Short Creek, and Seven Mile Creek

Creek	Drainage Area (sq mi)	Maximum Elevation (ft)	Treeless Area (%)	Slope (ft/1,000)	Distance (mi)
Nancy	1.67	2,815	70	218	50
Short	0.17	850	1	221	50
Seven Mile	4.40	3,727	60	193	50

Source: HYDMET, Inc. (1992).

Weather conditions in Port Valdez are generally cool with abundant precipitation. Temperatures in the Anderson Bay area average 22°F during December and January and 55°F during July. Total precipitation (combined rain and snow equivalent) averages 61 inches per year. Precipitation is most abundant during September and October, which generally contribute approximately 8 inches per month. April, May, and June, typically the driest months, only contribute an average of 2.7 inches per month. Snowfall is also abundant, and averages about 294 inches per year, with an average of 39 inches per month from December through March.

Currently, no site-specific stream flow data are available for these streams. Data will soon be available for Seven Mile, Nancy, and Terminal Creeks since stream gages were installed mid-July 1992. In the meantime, Nancy, Short, and Seven Mile Creeks flow was estimated using a regression equation calibrated with comparable stream gage records. West Fork Olsen Bay Creek near Cordova (4.8 square miles, 17 years of records) was used by HYDMET, Inc. (1992) as a comparable stream since it has basin characteristics similar to those of Nancy and Seven Mile Creeks. Results of this analysis are presented in table 3.3.1-2. Average flows for Nancy, Short, and Seven Mile Creeks were estimated at 8.3, 0.8, and 23.5 cubic feet per second (cfs), respectively. Flows range from 0.1 to 22.6 cfs in Nancy Creek, 0.01 to 1.5 cfs in Short Creek,

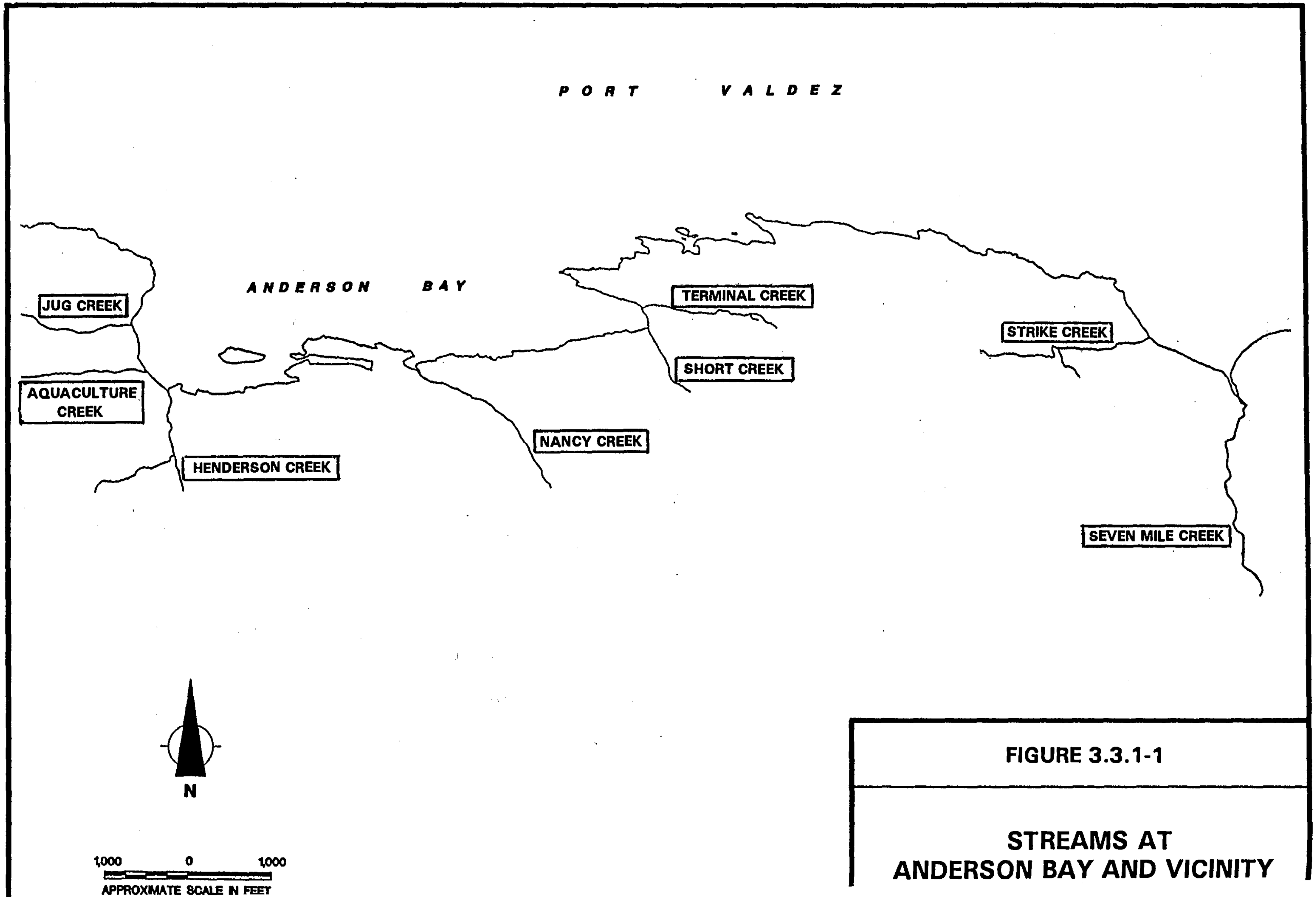


FIGURE 3.3.1-1

STREAMS AT
ANDERSON BAY AND VICINITY

and from 0.2 to 65.6 cfs in Seven Mile Creek. Flow is highest from May through October, with maximum flows in June. Seven-day, 10-year recurrence low flow (7Q10) estimates are also presented in table 3.3.1-2. The magnitude of 7Q10 flows relative to the amount of water to be withdrawn is an important consideration. Even during periods of low flow, a sufficient amount of water must remain following water withdrawal to satisfy state flow requirements for resident fish populations. Minimum flow requirements for these streams will be established following approximately 2 to 5 years of in-stream flow measurements. An alternative option would be for ADFG, ADNR, ADEC, and Yukon Pacific to agree on the use of synthesized data and the Tenant Method to establish minimum flow requirements.

TABLE 3.3.1-2

Estimated Average and Low Flows for Nancy Creek, Short Creek, and Seven Mile Creek

	Nancy Creek		Short Creek		Seven Mile	
Month	Average (cfs)	7Q10	Average (cfs)	7Q10	Average (cfs)	7Q10
January	1.5	0.1	0.3	0.02	4.4	0.2
February	1.6	0.1	0.4	0.02	4.5	0.3
March	1.0	0.1	0.2	0.01	3.0	0.2
April	2.8	0.2	0.5	0.04	7.4	0.6
May	11.9	2.4	1.5	0.30	30.8	6.2
June	22.6	9.3	1.3	0.53	65.5	26.9
July	20.6	4.9	0.8	0.19	61.7	14.8
August	15.7	2.0	0.8	0.10	45.9	6.0
September	14.3	1.4	1.2	0.12	41.5	4.2
October	7.6	0.6	0.8	0.07	22.6	1.9
November	4.5	0.3	0.6	0.05	4.8	0.9
December	1.6	0.1	0.2	0.01	4.8	0.3
Annual Average	8.3	0.1	0.8	0.01	23.5	0.2

7Q10 = 7-day, 10-year recurrence low flows

Source: HYDMET, Inc. (1992).

3.3.1.2 Groundwater Depth and Flow

Based upon several boreholes drilled during the summer of 1990 in the Anderson Bay project area, groundwater conditions at the site appear to consist of pressurized, partially confined surficial groundwater, as well as deeper groundwater connected through multiple fracture systems. Numerous small springs, seeps, and boggy areas throughout the project area are indicative of the presence of surficial groundwater. The fracture systems appear to be variable. In some cases, they appear to be well defined with water flowing through a several foot thick zone of fractured rock. In other cases, the water producing zone appears to be more expansive with a broad, moderately fractured zone extending over tens of feet. Artesian water pressures have been encountered at depth. When first penetrated, head within the artesian water producing zones was only sufficient to create flow at the ground surface with artesian flow rates of approximately 1 to 2 gpm. One drillhole, however, yielded approximately 14 gpm with higher pressures.

The overall direction of flow appears to be in a north to northeast direction. The velocity, volume, and identity of groundwater, however, are unknown. Saltwater intrusion, which is common in many of the coastal areas in Alaska (U.S. Geological Survey [USGS], 1986), may also occur in the project area due to the large tidal flux in Port Valdez.

3.3.2 Water Quality

3.3.2.1 Surface Water Quality

Nancy, Short, and Seven Mile Creeks are nonglacial streams with small drainage areas and relatively low flows. In general, nonglacial streams of this type transport less than 100 milligrams per liter (mg/l) suspended sediment during the spring melt or during periods of heavy rainfall (USGS, 1986). Between January and April, before the spring melt, the suspended sediment concentration is generally less than 20 mg/l for all Alaskan streams. Less than 50 percent of nonglacial sediment is material finer than 0.062 millimeter (mm) (silt-clay fraction).

No site-specific water quality data are available for the streams within the Anderson Bay project area. Instead, water quality has been inferred from stream studies with similar basin, flow, and climatic conditions such as West Fork Olsen Bay Creek near Cordova. Selected water quality parameters for West Fork Olsen Bay Creek are presented in table 3.3.2-1. In general, these streams are of the calcium bicarbonate type with relatively low dissolved solids, low productivity, low turbidity, high dissolved oxygen, and slightly acidic conditions. Water temperatures at West Fork Olsen Bay Creek ranged from 32°F to 49°F during water years 1965 to 1979. A spot sample was also obtained from Allison Creek, located 5 miles east of the Anderson Bay area. Cadmium, chromium, lead, mercury, and selenium concentrations (mg/l) were below unspecified detection limits. The concentration of arsenic was reported to be 0.002 mg/l. No information is available on stream sediment quality, but it is assumed that the streams are in their pristine state. See section 3.1 for soils and geology information.

Fresh waterbodies in Alaska are classified according to their designated use. The streams in the project area have not been classified by the State of Alaska, thus these streams are protected for Classes 1A, B, and C for all uses including drinking, culinary, food processing, agriculture, aquaculture, industrial, recreation, growth and propagation of fish, shellfish, other aquatic life and wildlife, and harvest for consumption of raw mollusks or other raw aquatic life. Alaska water quality standards for fresh water Class 1A as revised by the ADEC in January 1995 are presented in table 3.3.2-2, since they are the strictest use designation.

3.3.2.2 Groundwater Quality

No data are available on the groundwater quality in the Anderson Bay project area. Most groundwater in unconsolidated aquifers, similar to those near the surface at the proposed facility, contain less than the state's recommended limit of 500 mg/l dissolved solids (USGS, 1986). Calcium, magnesium, and bicarbonate are the major dissolved ions, although iron concentrations greater than 1.0 mg/l are also common. Water is generally of the sodium bicarbonate type, although saltwater intrusion near the coast can result in significant sodium chloride as well. Very little is known about bedrock water quality. In general, it is quite variable and contains higher dissolved solids concentrations than surface unconfined groundwater (USGS, 1986).

TABLE 3.3.2-1

Water Quality Parameters of West Fork Olsen Bay Creek for Use as Representative Water Quality Parameters for Nancy, Short, and Seven Mile Creeks

Date	Streamflow (cfs)	Specific Conductance (μmhos)	pH (units)	Turbidity (NTU), and Suspended Sediment (SS)(mg/l)	Dissolved Oxygen (mg/l)	Dissolved CA, Mg, HCO_3 (mg/l)	Total Dissolved N,P, (mg/l as N,P)
10/12/78	30	22	6.8	turb: – SS: 2	13.1	Ca: 2.9 Mg: 0.3 HCO_3: 10	N: 0.32 P: 0.00
12/14/78	10	25	6.0	turb: 0.0 SS: 1	13.6	Ca: 3.0 Mg: 0.3 HCO_3: 6	N: – P: –
5/1/79	53	22	5.8	turb: < 1.0 SS: 1	13.4	Ca: 2.9 Mg: 0.5 HCO_3: 6	N: 0.48 P: 0.02
6/5/79	46	18	6.4	turb: < 1.0 SS: 0	12.2	Ca: 2.5 Mg: 0.2 HCO_3: 6	N: 0.32 P: 0.01
7/25/79	60	14	5.8	turb: < 1.0 SS: 3	10.0	Ca: 2.3 Mg: 0.2 HCO_3: 6	N: 0.41 P: 0.03
8/15/79	71	22	6.2	turb: 2.0 SS: 5	10.9	Ca: 3.0 Mg: 0.4 HCO_3: 6	N: 0.27 P: 0.00
9/26/79	37	20	5.7	turb: 1.0 SS: 1	11.4	Ca: 2.5 Mg: 0.3 HCO_3: 8	N: 0.32 P: 0.00

– = lack of data.

Source: USGS (1979).

TABLE 3.3.2-2

Alaska Water Quality Standards for Fresh Water

Water Quality Parameter	Fresh Water Criteria for (A) Water Supply (i) drinking, culinary, and food processing
Fecal Coliform Bacteria (FC)	Based on a minimum of 5 samples taken in a 30-day period, the mean may not exceed 20 FC/100 ml, and not more than 10% of the samples may exceed 40 FC/100 ml. For groundwater, the FC concentration must be less than 1 FC/100 ml, using the fecal coliform Membrane Filter Technique, or less than 3 FC/100 ml, using the fecal coliform most probable number (MPN) technique.
Dissolved Gas	Dissolved oxygen (D.O.) must be greater than or equal to 4 mg/l (this does not apply to lakes or reservoirs in which supplies are taken from below the thermocline, or to groundwater).
pH (Variation of pH for waters naturally outside the specified range must be toward the range)	May not be less than 6.0 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions.
Turbidity (not applicable to groundwater)	May not exceed 5 nephelometric turbidity units (NTU) above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU.
Temperature	May not exceed 15°C.
Dissolved Inorganic Substances	Total Dissolved Solids (TDS) from all sources may not exceed 500 mg/l. Neither chlorides nor sulfates may exceed 200 mg/l.
Sediment (not applicable to groundwater)	No measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method.
Toxic and Other Deleterious Organic and Inorganic Substances	Substances may not exceed Alaska Drinking Water Standards (18 AAC 80) or, where those standards do not exist, EPA *Quality Criteria for Water*.
Color	May not exceed 15 color units or the natural condition, whichever is greater.
Petroleum Hydrocarbons, Oils and Grease	May not cause a visible sheen upon the surface of the water. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
Radioactivity	May not exceed the concentrations specified in the Alaska Drinking Water Standards (18 AAC 80) and may not exceed limits specified in 10 C.F.R. 20 and National Bureau of Standards, Handbook 69.
Total Residual Chlorine	Not applicable.

Source: Alaska Water Quality Standards 18 AAC 70. Alaska Department of Environmental Conservation. January 4, 1995.

3.3.3 Fisheries

The eight streams located on and near the proposed construction site all have steep gradients, small drainage basins, and seasonal flows which limit the distribution of resident fishes. Nancy Creek, Seven Mile Creek, and Terminal Creek are the only streams located onsite which have suitable resident fish habitat. However, electrofishing surveys conducted in 1992 in these streams found no resident fish in Seven Mile or Terminal Creeks. The surveys found three-spined sticklebacks and slimy sculpins in intertidal pools near the mouth of Nancy Creek behind the island. Several year classes of dolly varden were found in Nancy Creek (ADFG, 1992) but it is not certain if they are resident or anadromous. Dolly varden are typically the only resident fish found in similar high gradient Prince William Sound streams (Thompson, 1992).

3.4 TERRESTRIAL ECOLOGY

3.4.1 Wildlife

More than 200 species of birds (Isleib and Kessel, 1973) and 24 species of terrestrial mammals (Morsell, 1979) occur in the Prince William Sound region. Intertidal wetlands, coastal forests, and protected shoreline areas within this region provide important habitat for a variety of birds and mammals, including shorebirds, waterfowl, raptors, and large and small mammals. The distribution and abundance of these species are related primarily to seasonal availability of food resources within the Prince William Sound area. Peak use of terrestrial habitats by wildlife in this region occurs during the summer breeding season (May to August), and when a number of species (e.g., waterfowl, shorebirds) seasonally concentrate in the area during the spring (March to May) and fall (August to October) migration periods. Notably, major migratory routes of waterfowl in this region occur directly across Prince William Sound or up the Copper River Valley rather than across the heads of fjords like Port Valdez (Hemming and Erikson, 1979). In addition, the major staging ground for millions of waterfowl and shorebirds on the Pacific Flyway occurs approximately 80 miles southeast of Port Valdez on the Copper River Delta (Isleib and Kessel, 1973).

3.4.1.1 Raptors

The bald eagle is considered a common nesting raptor in the Prince William Sound region (Hemming and Erikson, 1979). Although the bald eagle is not a federally listed species in Alaska, individual birds and their nest sites are federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. § 668 (1988)). This act prohibits disturbance of bald eagles and removal of their nest sites. A total of 39 eagle nest sites, 0.48 nests per kilometer of shoreline, have been identified within the Port Valdez area (Hogan and Irons, 1988). Six of these nests were active in 1988 and four of these were near salmon streams. Bald eagle nesting densities in this area are comparable to nesting densities reported for shoreline areas in southeast Alaska (i.e., 0.38 nests per kilometer of shoreline, [Hanson and Hodges, 1985]).

Two bald eagle nest sites were reported within the LNG project area along the shoreline of Anderson Bay during nest surveys performed by Yukon Pacific in 1986; one of these nest sites was at Nancy Creek in the middle of the project area and the other was at the pipeline terminus (Yukon Pacific, 1991). The nest site at Nancy Creek blew down in 1989 (Stackhouse, 1992a). A third eagle nest site was reported by Yukon Pacific along the shoreline approximately 400 feet northwest of the project area boundary and at the northwestern most point of Anderson Bay. However, the FWS and the ADFG were unable to confirm any nests or breeding pairs within the vicinity of the reported nest sites during helicopter surveys performed in June of 1991 and 1992 (Stackhouse, 1992a; Brna, 1992a).

Large concentrations of bald eagles were also observed at Jack Bay (approximately 100 birds) approximately 3 miles south of the project area in July 1992 (Stackhouse, 1992a; Brna, 1992a), and along the Lowe River (approximately 50 birds) at the east end of Port Valdez during the early October to mid-November salmon spawning season in 1979 (Hemming and Erikson, 1979; BLM and COE, 1988).

Additional raptors known to occur in the Port Valdez area include the goshawk, sharp-shinned hawk, and peregrine falcon (Hemming and Erikson, 1979). Peregrine falcons are discussed in further detail in section 3.6.

The deciduous and coniferous forest types in the Port Valdez area provide habitat for numerous migratory, breeding, and overwintering birds, including the common raven, rufous hummingbird, belted kingfisher, downy woodpecker, and 42 passerine species (Hemming and Erikson, 1979). However, bird densities are considered low in this area compared with other nearby areas such as the Copper River Delta (Isleib and Kessel, 1973).

3.4.1.2 Large Mammals

Three species of large ungulates occur within the Port Valdez area, including moose, mountain goat, and Sitka black-tailed deer (Roberson, 1986). Moose occur in small populations primarily along the lower 25 miles of the Lowe River Valley at the east end of Port Valdez where they feed on aquatic plants, shrubs, and small trees (Gusey, 1978). Mountain goats occur throughout the Coastal Mountains surrounding northern Prince William Sound and have been observed in the project area (Brna, 1992a), but are considered abundant only in mountains east of Valdez Arm (BLM and COE, 1988). Goats summer high in steep alpine habitat where they feed on alpine vegetation. Alpine and cliff sites at Sulphide and Abercrombie gulches, east of the project area, are goat kidding areas during late May to early June (Brna, 1992a). The ADFG observed eight goats using kidding areas in the project area during June 1991. During the winter, goats move to lower elevations and wind-blown areas where cover and food are available. Sitka black-tailed deer occur only occasionally in the Valdez area, which represents a recent range extension of this species (Morsell, 1979).

Large predatory mammals that occur in the Port Valdez area include the brown bear, black bear, lynx, wolf, coyote, and wolverine (Morsell, 1979; BLM and COE, 1988). Both brown and black bears are considered common residents of the Port Valdez area (Morsell, 1979). These bears use a variety of habitats, concentrating in lowlands and tidal flats in the early spring, in mountain slopes following spring green-up, and in berry patches and along salmon spawning streams in late summer (Stackhouse, 1992a). Large concentrations of brown bears have been reported along an unnamed stream draining into Jack Bay, 3 miles south of the project area (Yukon Pacific, 1991). However, lesser concentrations of brown bears have also been frequently observed feeding on salmon along Seven Mile and Nancy Creeks (Brna, 1992a; U.S. Department of the Interior, Office of Environmental Affairs (DOI/EA), 1993; SPCO, 1993), although no bear den sites are known to occur in the project area. The FWS observed several brown bears and one black bear in the project area in June 1991 (Stackhouse, 1992a) and a helicopter pilot reported that he observed 14 separate black bears in the nearby Salmon Creek drainage (SPCO, 1993). In addition, a skinned carcass of a brown bear was found in Seven Mile Creek during the June 1991 survey. The FWS' observations of bear trails in the project area indicate that the bears access the lower portions of

Seven Mile Creek from spring alpine and early summer use areas (DOI/EA, 1993).

3.4.1.3 Small Mammals and Furbearers

Diversity of small mammal species is considered low in the Sitka spruce-western hemlock association and in the deciduous forest types in the Port Valdez area (Morsell, 1979). Three of the most common small mammals occurring in this area include the red-backed vole, tundra vole, and masked shrew. The red-backed vole is the most widespread and abundant small mammal that occurs in deciduous and conifer forest types, and commonly occurs in deciduous forest types in this area (Morsell, 1979). Both tundra vole and masked shrew occur primarily in moist ecotones between green alder shrub and deciduous forest types (Morsell, 1979). Additional small mammals occurring in the Port Valdez area include pika, hoary marmot, Arctic ground squirrel, and red squirrel (Morsell, 1979).

Other mammals occurring in the deciduous and coastal spruce-hemlock association of the Port Valdez area include the little brown bat, porcupine, snowshoe hare, red fox, pine marten, and ermine (Morsell, 1979; Brna, 1992a). Mink and river otters inhabit the river and lake systems of Port Valdez. Mink also forage along the marine shorelines.

3.4.2 Vegetation

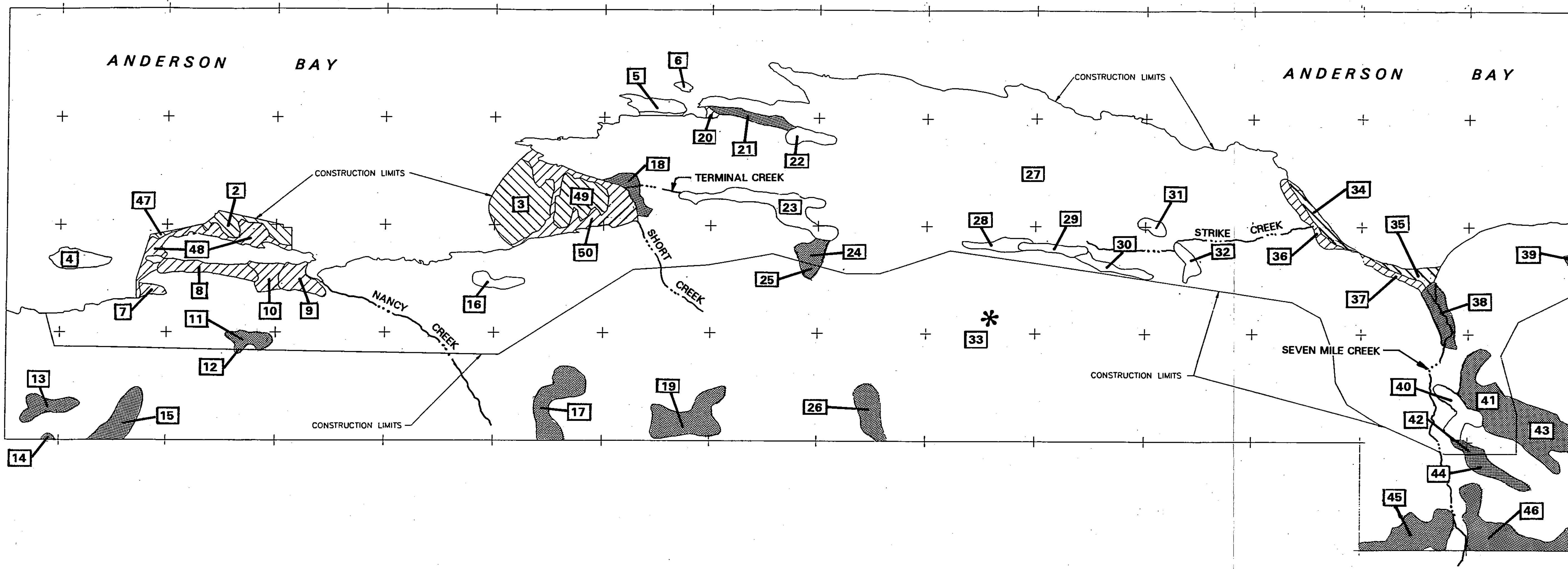
The majority of the proposed LNG plant site is covered by mature coastal spruce and hemlock forest (figure 3.4.2-1). Shrub types occur in small, isolated clusters throughout the site near stream valleys and seeps. Scattered wetlands also occur on the site. These consist primarily of estuarine intertidal wetlands along the shoreline and isolated inland palustrine shrub bogs and marshes (see section 3.4.3 for more detailed discussion of wetland vegetation).

Mature coastal spruce and hemlock forest dominated by Sitka spruce at the lower elevations along the coast and western hemlock at the higher elevations cover approximately 85 percent or 364.1 acres of the area within the proposed construction limits of the LNG site. The size of trees on the site vary according to the species, age, and microclimatic conditions. Many of the larger trees on the site are 36 inches in diameter at breast height (Stackhouse, 1992b). Common species in the forest understory include young Sitka spruce and western hemlock, Devil's Club, salmon berry, blueberry, lichens, ferns, and mosses.

The upland shrub community occupies approximately 3 percent or 13.4 acres of the area within the proposed construction limits of the site. The dominant shrub is alder. The shrub understory includes grasses, lichens, mosses, and liverworts.

3.4.3 Wetlands

Wetlands perform a number of important functions, including water quality improvement, flood and stormwater control, and erosion control. They can also provide recreational opportunities, and habitat for fish and wildlife. Wetlands help to maintain water quality through the removal and retention of nutrients and the reduction of sediment loads. In their natural undisturbed condition, inland wetlands can act as a temporary storage area for flood waters, protecting downstream areas from damage. Wetlands are also important sources of groundwater recharge and primary production (detritus) for streams. The abundant and diverse vegetation associated with both inland and intertidal wetlands acts as the primary erosion deterrent, as root systems bind sediments and reduce wave action and current velocity.



LEGEND:

50 POLYGON #	WETLANDS AND MAJOR VEGETATION TYPES WITHIN CONSTRUCTION LIMITS
	SHRUB VEGETATION
	INTERTIDAL AND SUBTIDAL VEGETATION
*	REMAINING UNDELINEATED POLYGON CONSISTS OF COASTAL SPRUCE/HEMLOCK FOREST

NOTE:
SEE TABLE 3.4.3-1 FOR NWI CODES AND ACREAGE DATA FOR ABOVE WETLANDS AND VEGETATION DELINEATIONS.

N

0 400 800 1200 1600 2000

APPROXIMATE SCALE IN FEET

FIGURE 3.4.2-1

VEGETATION AND WETLANDS WITHIN THE LNG AND MARINE TERMINAL CONSTRUCTION ZONE

SCALE: AS SHOWN

A variety of recreational activities are associated with wetlands, including hunting and fishing, hiking, canoeing, bird watching, and photography. In the Port Valdez area, however, wetlands primarily provide important breeding, migratory, and forage habitats for a number of birds, mammals, and fish.

The wetlands potentially affected by the proposed Yukon Pacific LNG Project facilities consist of both estuarine and inland freshwater wetlands. A wetland is defined as follows:

> Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (33 CFR § 328.3 (1992) and 40 CFR § 230.3 (1992)).

The FWS expands this definition to include both vegetated and non-vegetated wetlands, recognizing that some types of wetlands lack vegetation (e.g., mud flats, rocky shores, gravel beaches) (Cowardin et al., 1979).

Wetlands on the proposed LNG site were identified using the FWS National Wetlands Inventory (NWI) methodology. This delineation method relies primarily on aerial photographs, but includes some selected site visits to confirm the location, shape, and size of wetlands. Yukon Pacific determined that a total of approximately 48.8 acres of estuarine and freshwater wetlands are within the proposed construction limits of the LNG site. Subsequent field inspections by the COE and FERC staff determined that the areas identified by Yukon Pacific as E1UBL (Estuarine, subtidal unconsolidated bottom wetlands) are tidal waters greater than 6 feet deep. The 13.1 acres of area classified as E1UBL are technically not wetlands and are referred to throughout the FEIS as subtidal marine habitats or waters of the United States. Table 3.4.3-1 lists the NWI classification type, dominant vegetation, and total acreage of each of the wetlands and subtidal marine habitats within the construction limits of the proposed LNG facility site.

Approximately 70 percent or 34.3 acres of the wetlands and subtidal marine habitats within the proposed construction limits of the site are estuarine types. These include 13.1 acres of algae covered, unconsolidated bottom, non-wetland, subtidal marine habitats; 17.3 acres of intertidal, algae covered, regularly flooded, unconsolidated shores and bottoms; 2.0 acres of intertidal, unvegetated, irregularly flooded, unconsolidated shores; and 1.9 acres of intertidal, grass and sedge covered, irregularly flooded, emergent wetlands. Most of these estuarine wetlands and subtidal marine habitats are located near the mouths of Terminal Creek, Short Creek, and Nancy Creek, along the shores near the mouth of Seven Mile Creek, and in the shallow bottoms and shores surrounding Terminal Island.

The remaining 14.5 acres (30 percent) of wetlands within the construction limits of the proposed site are unforested freshwater types. These include 12.2 acres of widely dispersed sedge and grass covered emergent wetlands, a single 1.2-acre tract of scrub-shrub wetland, and one elongated 1.1-acre tract of permanently flooded, unconsolidated bottom wetland.

TABLE 3.4.3-1

Wetland Areas Affected by the Proposed Yukon Pacific LNG Plant Site

NWI Classification a/	Polygons Represented	Dominant Plant Species	Acres Within Proposed Construction Limits	Functional Value Score per Acre b/
E1UBL	2, 3, 47, 49	Algae	13.1 c/	–
E2USN	8, 34, 35, 36, 37	Algae	7.2	100-140
E2UBN	48, 50	Algae	10.1	100-120
E2USP	9, 20	Unvegetated	2.0	100
E2EM1P	7, 10	Lyngbye's sedge, seaside arrow grass, alkali grass, sea lyme grass	1.9	160
PEM1B	16, 23, 28 30, 31, 32, 40	Few-flower sedge, black alpine sedge, deer cabbage, sphagnum moss	12.2	80
PSS1B	22	Green alder, willow, bog blueberry, mountain cranberry	1.2	60
PUBH	29	Pondweed, water milfoil	1.1	120
TOTAL			48.8	

a/ NWI Wetland Types
E1UBL = Estuarine, Subtidal, Unconsolidated Bottom, Subtidal
E2USN = Estuarine, Unconsolidated Shore, Regularly Flooded
E2UBN = Estuarine, Unconsolidated Bottom, Regularly Flooded
E2USP = Estuarine, Unconsolidated Shore, Irregularly Flooded
E2EM1P = Estuarine, Intertidal, Emergent, Persistent, Irregularly Flooded
PEM1B = Palustrine, Emergent, Persistent, Saturated
PSS1B = Palustrine, Scrub-shrub, Saturated
PUBH = Palustrine, Unconsolidated Bottom, Permanently Flooded

b/ Relative functional values of wetlands on the proposed LNG facility site were determined using the wetland evaluation technique developed by the Wetland Evaluation Working Group. No functional value was given by Yukon Pacific for E1UBL wetlands.

c/ These areas are marine waters greater than 6 feet deep and therefore are technically not wetlands but rather waters of the United States.

3.5 MARINE ECOLOGY

3.5.1 Bathymetry and Circulation

3.5.1.1 Anderson Bay and Port Valdez

Port Valdez is an east-west trending fjord approximately 3 miles wide and 11 miles long. The bathymetry of Port Valdez consists of four main physiographic regions: a narrow shoreline shelf; a ridge-and-trough area, a steep slope; and a flat, relatively featureless basin at approximately 750 feet (125 fathoms) deep (see figure 3.5.1-1). The shoreline consists of extensive mudflats and glacial streams in the eastern half of Port Valdez, and of steep, rocky shores with boulder-cobble beaches in the western half. The Chugach Mountains surround Port Valdez.

On the western end of Port Valdez, the Valdez Narrows, a narrow, double-silled entrance, serves as the tidal connection between Port Valdez and Prince William Sound. Flow conditions through the narrows are driven by the relative magnitudes of tidal currents and freshwater streamflow from streams within Port Valdez (Muench and Nebert, 1973). In March, significant net transport of deep water into Port Valdez occurs in response to surface outflow associated with freshwater input from snow melt and precipitation. In December, flow into Port Valdez occurs at approximately mid-depth with outflow in surface and deep waters. Current speeds through the narrows up to 3 cm/s have been observed (Cooney and Coyle, 1988).

Circulation within Port Valdez is dictated by the interaction of tidal currents, wind-driven currents, and freshwater input from surrounding streams. Semi-diurnal tides, with daily tidal ranges of 9 to 12 feet, dominate the circulation. Current direction varies with depth, but generally runs in an east-west orientation, along the major axis of the fjord (Muench and Nebert, 1973; Dames and Moore 1990b). Current velocities range from 5.1 cm/s to 15.4 to 20.6 cm/s in the upper portions of the water column, and are about 5.1 cm/s at approximately 100 foot depth (Dames and Moore, 1990b).

Port Valdez circulation is typical of estuarine fjords (Cooney and Coyle, 1988). During early spring, the water column is well mixed with salinities from 32 to 33 parts per thousand (ppt) and temperatures around 38°F (see figure 3.5.1-2). Stratification of the water column begins in late April and May as a result of seasonal warming and freshwater input from snowmelt. During this period, surface salinity drops below 30 ppt and temperatures exceed 42°F. By July and August, the water column is fully stratified and surface salinities below 1 ppt and water temperatures about 52°F are commonly observed (Cooney and Coyle, 1988). Stratified conditions persist through October but by December, due to high winds and decreasing temperature, the water column is again well mixed. Assuming well-mixed conditions, the flushing time of Port Valdez is approximately 4 weeks (Colonell et al., 1988). While the stratified conditions during the warmer months may tend to limit tidal mixing, and thus extend the flushing time, stratification is not expected to significantly alter the residence time of contaminants in Port Valdez.

3.5.1.2 Prince William Sound

Prince William Sound, which is located off the northern Gulf of Alaska, serves as a fjord-type estuarine system linking several peripheral fjords (Orca Bay, Port Wells, and Port Valdez) and the Gulf of Alaska (see figure 3.5.1-3). Water exchange with the Gulf of Alaska primarily occurs through two openings, the Montague Strait and Hinchinbrook Entrance, since the remaining

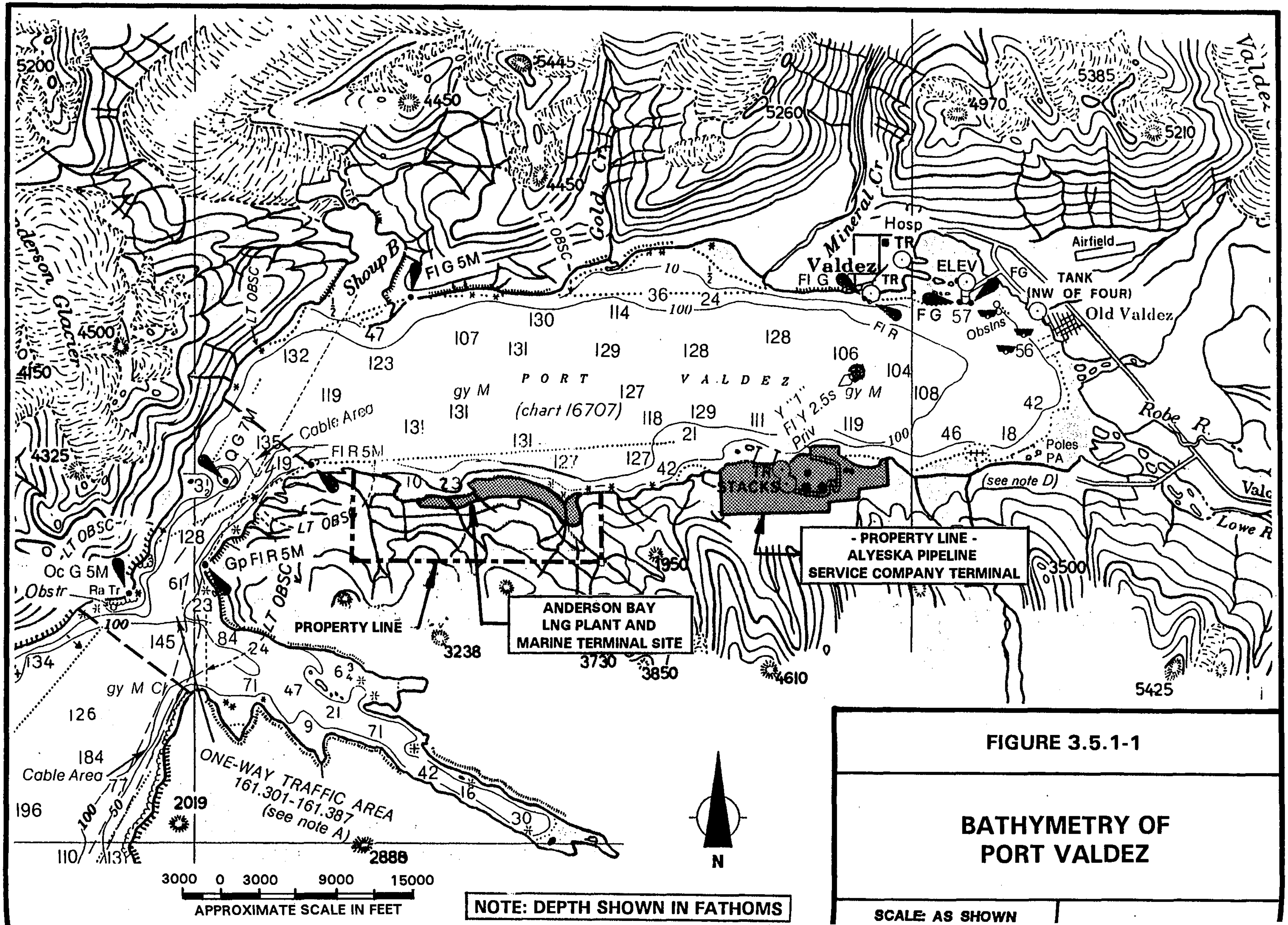
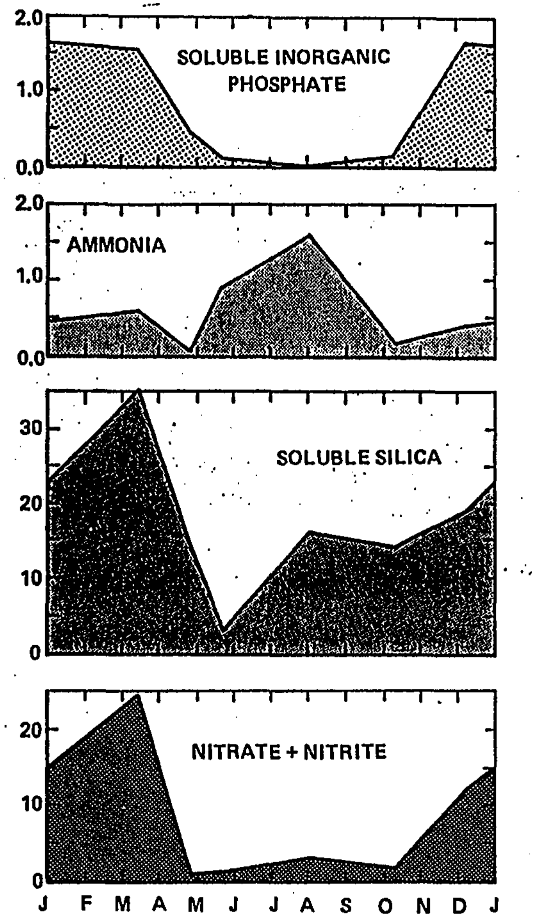
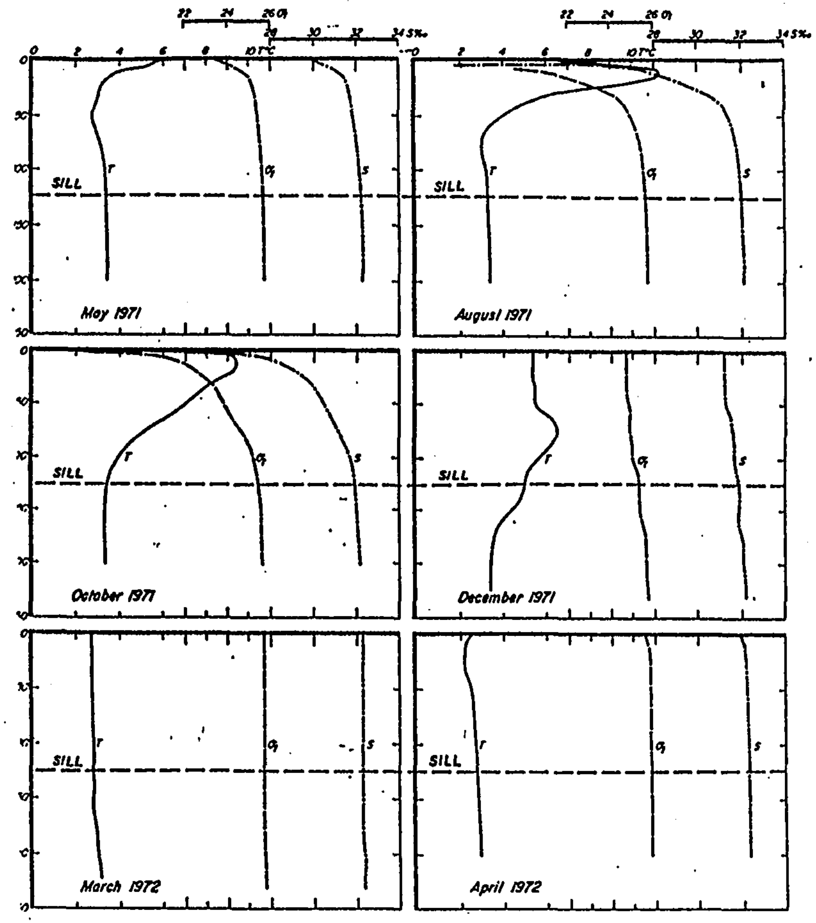


FIGURE 3.5.1-1

BATHYMETRY OF PORT VALDEZ



Concentration of nutrients in ppm at the 50% light level (Goering et al. 1973a).



Vertical distribution of temperature, salinity and density (Muench and Nebert, 1973)

Key:

———— Temperature (°C)

– – – – Density

–·–·–· Salinity (°/oo)

FIGURE 3.5.1-2

PORT VALDEZ WATER QUALITY

PRINCE WILLIAM SOUND
REGION

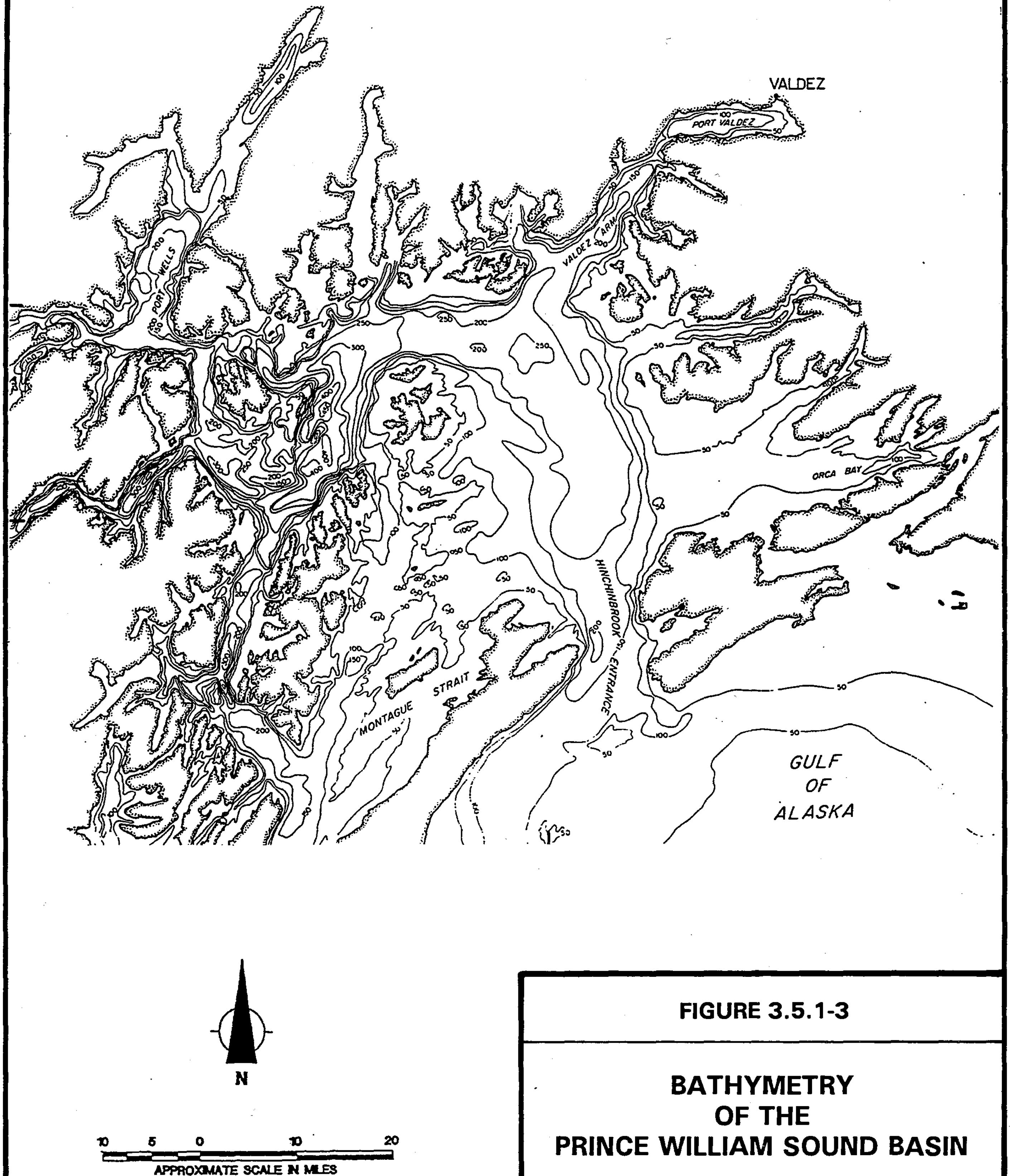


FIGURE 3.5.1-3

BATHYMETRY OF THE PRINCE WILLIAM SOUND BASIN

SCALE: AS SHOWN

smaller channels are tortuous and shallow (Muench and Schmidt, 1974). Exchange through the Hinchinbrook Entrance dominates deep water renewal.

The bathymetry of Prince William Sound is complex. In general, a series of trenches extending down to nearly 2,600 feet exists in the western portion of the Sound, and a broad north-south trending basin approximately 980 to 1,640 feet deep is located in the eastern portion. Montague Strait and Hinchinbrook Entrance sill depths are approximately 320 and 590 feet, respectively.

Circulation within Prince William Sound is driven by freshwater runoff, surface winds, tides, deep water renewal, and seasonal temperature variations. Both vertical diffusion and thermohaline convection are important (Muench and Schmidt, 1974). Consistent with classical estuarine circulation, the water column generally stratifies during the warmer summer months with high freshwater input, but is increasingly well mixed during the colder winter months with low freshwater input and higher wind speeds. Vertical mixing generally extends 98 to 164 feet deep in the central portion of the Sound (Muench and Schmidt, 1974). Appreciable horizontal circulation is expected due to the large horizontal extent of Prince William Sound and due to high regional wind speeds.

Mean seasonal air temperatures at Cape Hinchinbrook range from 55° to 57°F in July and August to 23°F in January. The mean annual precipitation is variable, and ranges from 180 inches at Latouche to about 61 inches at Valdez. Most of the summer runoff occurs in July and August. Tidal ranges in Prince William Sound are generally on the order of 10 to 12 feet. Although considerable directional variability exists, the winds are normally northeasterly, more northerly in the winter and more easterly in the summer (Muench and Schmidt, 1974).

The vertical temperature structure exhibits large seasonal variations (less than 35°F to 54°F) in the upper 246 feet, while smaller variations are observed in water depths below 246 feet (37°F to 43°F) (Muench and Schmidt, 1974). Similarly, the vertical salinity structure shows large seasonal variations in the upper 246 feet (25 ppt to 32 ppt). Salinity variations in water depths greater than 820 feet are very small (32 ppt to 32.8 ppt). The density structure parallels that of the salinity structure.

3.5.2 Water Quality

3.5.2.1 Anderson Bay and Port Valdez

Water quality profiles of temperature, salinity, pH, and dissolved oxygen in Port Valdez were measured in October 1990 as a function of depth (table 3.5.2-1). pH values in the upper 100 feet of water ranged from 7.6 to 8.0, while dissolved oxygen concentrations ranged from 5.9 to 8.6 mg/l in the upper 50 feet of water. Dissolved oxygen readings below this depth were not reported, but no evidence for seasonal oxygen depletion in deep water exists (Cooney and Coyle, 1988). The temperature and salinity profiles sampled in October showed temperature variations from 42° to 47°F and salinity variations from 29.6 to 31.9 ppt. In October, remnants of summer stratification can be seen in the profile (lower surface salinity), but cooler temperatures have already begun to increase the surface water density leading to destabilization of the water column. By December, well mixed conditions should be evident (see section 3.5.1.1).

Nutrient concentrations in Port Valdez surface waters prior to spring stratification are generally high: combined nitrate and nitrite concentrations exceed 20 micromoles per liter

TABLE 3.5.2-1

Vertical Water Quality Profile of Port Valdez

Depth (m)	Depth (ft)	Temperature (°C)	ph	Dissolved Oxygen (mg/l)	Salinity ppt
1	3.3	5.8	7.9	5.9	
2	6.6	6.1	7.9	5.9	29.6
3	9.8	6.6	7.9	5.9	29.9
4	13.1	6.7	7.9	6.1	29.9
5	16.4	6.7	7.9	6.1	30.0
6	19.7	6.8	7.9	6.2	30.1
7	23.0	6.8	8.0	6.2	30.1
8	26.2	6.8	8.0	6.2	30.2
9	29.5	6.7	8.0	6.3	30.2
10	32.8	6.9	8.0	6.3	30.3
11	36.1	7.0	8.0	6.4	30.3
12	39.4	7.1	7.9	6.4	30.4
13	42.6	7.2	7.9	6.5	31.0
14	45.9	7.3	7.9	6.5	31.4
15	49.2	7.4	7.9	6.3	31.5
16	52.5	7.4	7.8	6.9	31.6
17	55.8	7.4	7.7	7.3	31.7
18	59.0	7.3	7.9	7.3	31.6
19	62.3	7.1	7.6	7.3	31.4
20	65.6	7.2	7.7	6.6	31.7
21	68.9	7.2	7.6	7.0	31.9
22	72.2	6.9	7.9	7.8	31.9
23	75.4	6.8	7.8	8.4	31.9
24	78.7	6.5	7.7	8.6	31.8
24.4	80.0	6.5	7.8	*	31.8
27.4	90.0	6.4	7.8	*	31.8
30.5	100.0	5.9	7.7	*	31.9
33.5	110.0	5.7	7.8	*	31.7

ppt = parts per thousand
mg/l = milligrams per liter
* = erratic readings observed

(μmoles/l); silicate concentrations are approximately 35 μmoles/l; and phosphate concentrations exceed 1.5 μmoles/l (Goering et al., 1973) (figure 3.5.2-1). High nutrient concentrations coupled with sufficient light result in an intense phytoplankton bloom in April and May which essentially depletes the surface waters of nutrients (Cooney and Coyle, 1988). Nutrient concentrations generally do not reach pre-bloom levels again until November or December.

Significant sediment loading into Port Valdez occurs during the spring snowmelt and during periods of high rainfall. Approximately 2.63 x 10^{12} grams (2,590 thousand tons) of fine-grain sediments are delivered to Port Valdez each year, primarily through Mineral Creek on the northern shore and the Lowe and Robe Rivers on the eastern shore (Naidu and Klein, 1988). These fine-grained sediments do not settle well and generally remain in the upper 32 to 65 feet, with maximum concentrations 16 to 33 feet below the water surface. The presence of these sediments reduces the depth of the euphorc zone often to less than 3.3 feet, and thus is one of the limiting factors in primary productivity in Port Valdez (Cooney and Coyle, 1988).

Water column sampling was conducted near Anderson Bay on October 19, 1990 to determine baseline levels of total petroleum hydrocarbons (TPH); benzene, toluene, ethylbenzene, and xylene (BTEX); and copper, iron, nickel, zinc, arsenic, cadmium, lead, and mercury. Relatively low concentrations of TPH were found, and none of the samples contained measurable concentrations of BTEX (table 3.5.2-2). Copper, iron, nickel, and zinc were present at relatively low levels in surface and bottom waters. Twelve water samples were taken at 10-foot depth intervals. Marine waters near the site are protected for all classes (2A, B, C and D). The most stringent class of Alaska marine water quality standards as revised by the ADEC in January 1995 are listed in table 3.5.2-3. No clear exceedances are present near Anderson Bay.

Under the CWA, all states are required to submit to the EPA, on a biannual basis, water quality data for the state and a 305 B List, which cites 1) impaired, 2) suspect, and 3) waters of concern. Water quality within Port Valdez near the Alyeska terminal was listed as impaired on the 1990 Alaska 305 B list, but was delisted on the 1992 Alaska 305 B list due to insufficient evidence to justify a continued listing (Hubbard, 1993). Water quality near the small boat harbor at Valdez was listed on the 1992 Alaska 305 B list.

3.5.2.2 Prince William Sound and Offshore Water Quality

Water quality within Prince William Sound was listed as impaired on the 1990 Alaska 305 B list due to the 1989 *Exxon Valdez* oil spill. The extent of impaired areas was refined for the 1992 Alaska 305 B list and the following 17 areas were identified as impaired: Bay of Isles; Cape Douglas; Foul Pass; Herring Bay Knight Island; small unnamed island northwest of Green Island; unnamed island off the mouth of Marsha Bay; north shore of Latouche Island; northeast shore of Eleanor Island; northeast shore of Seal Island; northeast shore of Knight Island; northeast shore of Evans Island; northwest bay of Disk Island; northwest bay of Eleanor Island; Rua Cove on Knight Island; southeast shore of Ingot Island; and Tonsina Bay and Windy Bay off the Kenai Peninsula. While these areas are listed as impaired, it is unlikely additional cleanup activities will occur since the evidence for continuing impacts is less apparent and additional sampling is difficult because the areas are remote (Hubbard, 1993).

3.5.3 Sediment Quality

Sediments within Port Valdez originate from several depositional environments including sediments from glacial moraine and drift deposits, fluvial and turbidite units from channel deposits,

TABLE 3.5.2-2

Hydrocarbon and Metal Concentrations in the Water Column Offshore of Anderson Bay

	PARAMETERS													
Sample No.	Total Petroleum Hydro-carbons (mg/l)	Benzene (μg/l)	Chloro-benzene (μg/l)	Ethyl-benzene (μg/l)	Toluene (μg/l)	Xylenes (μg/l)	Copper (mg/l)	Iron (mg/l)	Nickel (mg/l)	Zinc (mg/l)	Arsenic (mg/l)	Cadmium (mg/l)	Lead (mg/l)	Mercury (mg/l)
1	0.6	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u	0.043	0.068	0.017	0.041	0.001 u	0.0001 u	0.001 u	0.0003
2	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
3	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
4	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
5	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
6	0.5	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
7	0.5	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
8	0.5	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
9	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
10	2.0 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
11	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								
12	0.4 u	0.2 u	0.2 u	0.2 u	0.3 u	0.6 u	0.066	0.092	0.019	0.044	0.001 u	0.0001 u	0.001 u	0.0002 u
Travel Blank		0.2 u	0.2 u	0.2 u	0.3 u	0.6 u								

Note: u = Below Detection Limit. Detection Limit stated in results.
m/l = milligrams per liter.
μg/l micrægram per liter

Source: Yukon Pacific 1991

TABLE 3.5.2-3

Alaska Marine Water Quality Standards

Water Quality Parameter	Marine Criteria for (A) Water Supply (i) Aquaculture
Fecal Coliform Bacteria (FC)	For products normally cooked, the mean, based on a minimum of 5 samples taken in a 30-day period, may not exceed 200 FC/100 ml, and not more than 10% of the samples may exceed 400 FC/100 ml. For products not normally cooked, the mean, based on a minimum of 5 samples taken in a 30-day period may not exceed 20 FC/100 ml, and not more than 10% of the samples may exceed 40 FC/100 ml.
Dissolved Gas	Surface dissolved oxygen (D.O.) concentration in coastal water may not be less than 6.0 mg/l for a depth of one meter except when natural conditions cause this value to be depressed. D.O. may not be reduced below 4 mg/l at any point beneath the surface. D.O. concentrations in estuaries and tidal tributaries may not be less than 5.0 mg/l except where natural conditions cause this value to be depressed. In no case may D.O. levels exceed 17 mg/l. The concentration of D.O. may not exceed 110% of saturation at any point of sample collection.
pH (Variation of pH for waters naturally outside the specified range must be toward the range)	May not be less than 6.0 or greater than 8.5, and may not vary more than 0.1 pH unit from natural conditions.
Turbidity	May not exceed 25 nephelometric turbidity units (NTU).
Temperature	May not cause the weekly average temperature to increase more than 1°C. The maximum rate of change may not exceed 0.5°C per hour. Normal daily temperature cycles may not be altered in amplitude or frequency.
Dissolved Inorganic Substances	A human-induced alteration may not cause a change in the water's isohaline patterns of more than ± 10% of the natural variations.
Sediment	No imposed loads that will interfere with established water supply treatment levels.
Toxics and Other Deleterious Organic and Inorganic Substances	Individual substances may not exceed criteria in EPA, *Quality Criteria for Water* or, if those criteria do not exist, may not exceed the Primary Maximum Contaminant Levels of the Alaska Drinking Water Substances (18 AAC 80). If those criteria are absent, or if the department finds that the criteria are not appropriate for sensitive resident Alaskan species, the department will, in its discretion, establish in regulation chronic and acute criteria to protect sensitive and biologically important life stages of resident Alaskan species, using methods approved by EPA or alternate methods approved by the department. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, toxic effects on aquatic life, except as authorized by this chapter. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassay or organoleptic tests.
Color	May not exceed 50 color units or the natural condition, whichever is greater.
Petroleum Hydrocarbons, Oils and Grease	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 μg/l. Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 μg/l. There may be no concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.

TABLE 3.5.2-3 (cont'd)

Water Quality Parameter	Marine Criteria for (A) Water Supply (i) Aquaculture
Radioactivity	May not exceed the concentrations specified in the Alaska Drinking Water Standards (18 AAC 80). Concentration factors for organisms involved may not exceed maximum permissible limits for specific radioisotopes and unidentified mixtures as established in 10 C.F.R. 20 and National Bureau of Standards, Handbook 69.
Total Residual Chlorine	Concentrations may not exceed 2.0 μg/l for salmonid fish, or 10.0 μg/l for other organisms.
Residues (Floating Solids, Debris, Sludge, Deposits, Foam, Scum, or Other Residues)	May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for use. May not cause detrimental effects on established water supply treatment levels.

Source: Alaska Water Quality Standards 18 AAC 70. Alaska Department of Environmental Conservation. January 4, 1995.

and from marine sedimentation of biotic material (Dames and Moore, 1990a). Near Anderson Bay, shallow sediments consist of a bedrock/boulder/cobble mix, whereas sediments at water depths greater than 32 to 50 feet are dominated by silt/sand/clay fractions (Dames and Moore, 1990a). In the construction wharf area, a sediment core consisted of 8 to 12 inches of sandy silt overlying 12 to 16 inches of fine, silty sand over 8 to 12 inches of silty clay over a silty and sandy gravel (Dames and Moore, 1990a). This type of sediment structure is common in an outwash fjord, and probably results from seasonal circulation patterns (Feder and Jewett, 1987; Dames and Moore, 1990a).

The clay fractions present in Port Valdez sediment appear to be glacially derived clay minerals with relatively low ion-exchange (1 - 14 milliequivalents per 100 grams) and adsorptive capacities (Naidu and Klein 1988 and references therein). Studies of periglacial sediments in southcentral Alaska by Malinky and Shaw (1979) indicated only slight sorption of dissolved hydrocarbons. Average organic contents in Port Valdez sediments and in intertidal sediments are 4.7 and 1.1 milligrams per gram on a dry weight basis, respectively (Naidu and Klein, 1988).

Mean concentrations of total and leachable metals in Port Valdez sediments are presented in table 3.5.3-1. The relative percentage of the total metal concentration in the leachable fraction indicates the relative potential for metal mobilization from sediments under changing sedimentary conditions, such as decreasing pH/Eh conditions (Chester and Hughes, 1967). Similar results were obtained from tidal flat sediments in eastern Port Valdez (Naidu et al., 1978) and from suspended sediments (Gosink and Naidu, 1983). These results show that iron has the largest potential for mobilization followed by zinc, cobalt, copper, nickel, and manganese. Chromium and vanadium are the least mobile under low pH/Eh conditions.

TABLE 3.5.3-1

Mean Concentrations of Metals in the Total Sediment and Hydroxylamine Hydrochloride-Acetic Acid Extract of Sediment of Port Valdez a/

	Zn	Co	Cr	Cu	Ni	V	Mn	Fe
Total								
Mean	125	36	133	75	62	243	1,342	5.112
SD	23	19	16	17	11	44	623	1.046
Extractable								
Mean	32	10	3	29	11	7	504	3.607
SD	15	3	1	3	1	3	644	0.455

a/ All concentrations are expressed as $\mu g/g$ of dry weight sediment except for Fe concentrations, which are expressed as 10^4 $\mu g/g$ (percent). Means are based on analysis of 14 samples.

Source: Naidu and Klein, 1988.

As a result of crude oil stranding and discharge of treated ballast water by the existing TAPS oil terminal, sediments near the TAPS oil terminal have been affected. Naidu et al. (1978) demonstrated significant mobilization of iron, manganese, cobalt, copper, chromium, cadmium, nickel, and vanadium from tidal flat sediments due to decreases in pH/Eh conditions following oxidative decomposition of stranded crude oil and treated ballast water discharge. Furthermore, alkane and aromatic hydrocarbon concentrations were significantly higher at the diffuser than at other station groups (Columbia Aquatic Sciences, 1993). Minor input from petroleum and pyrolysis is evidenced primarily at near-field and mixing zone stations by the presence of a suite of polynuclear aromatic hydrocarbons (PAHs). In 1992, a sample was also taken near Anderson Bay (station 90). Sediment chemistry results from this station revealed a mean total PAH value of less than 75 ng/g, which represents essentially clean, relatively unimpacted sediments.

3.5.4 Fisheries

Five species of salmon occur in Port Valdez, and contribute to fisheries in the eastern, northern, and western portions of Prince William Sound (Merrell, 1988). Port Valdez and Valdez Arm support the largest sport fishery in Prince William Sound (Solomon Gulch Hatchery Management Plan [SGHMP], 1991). Pink salmon are the most abundant, followed by chum salmon, coho, and sockeye salmon. Chinook salmon are occasionally caught by commercial and recreational fishermen, but are not known to spawn within Port Valdez. The Solomon Gulch Hatchery, located at the east end of Port Valdez, supports a common property fishery in Port Valdez and other Prince William Sound locations by raising and releasing pink and chum salmon fry as well as coho and chinook salmon smolts. Pink and chum salmon are the only salmon species known to spawn in streams at the proposed Anderson Bay project site (Thompson, 1992).

There are 24 documented pink salmon spawning streams in Port Valdez. Spawning pink salmon have been documented in Seven Mile, Henderson, and Nancy Creeks (Thompson, 1992, 1993); adult pink salmon have occasionally been observed in Short Creek (Dames and Moore, 1991; Thompson, 1992, 1993) (see table 3.5.4-1). Based on a comparison of 1991 ADFG, commercial fisheries division aerial survey data, the runs to Seven Mile and Anderson Bay streams appear to be important contributors to the Port Valdez wild stock return (Thompson, 1992). The production from Seven Mile and Anderson Bay streams appears to be limited by spawning and rearing habitat.

TABLE 3.5.4-1

Pink and Chum Salmon Peak Spawning Counts in Anderson Bay Streams, 1991 and 1992

Stream	1991 Pink	1991 Chum	1992 Pink	1992 Chum
Seven Mile Creek	982	161	1,067	83
Nancy Creek	250	3	7	1
Short Creek	-	-	3	-
Terminal Creek	-	-	-	-
Henderson Creek	12	--	3	-
Aquaculture Creek	-	-	-	-
Jug Creek	-	-	-	-

Pink salmon have a 2-year life cycle, with larger runs historically occurring in odd years, although releases from Solomon Gulch Hatchery have diminished the differences in yearly run sizes. The adults spawn from late June to September, with the peak spawning occurring in late July. Eggs hatch in late winter and fry emerge from the streambed gravel in April or May. Fry are released from the Solomon Gulch Hatchery net pens when plankton production begins to peak in the spring. The fry immediately migrate into estuarine areas and congregate in feeding schools. The pink salmon fry released from the hatchery use Anderson Bay as a nursery area while migrating along the side of Port Valdez, apparently avoiding the turbid surface water along the northern and eastern shores (Jewett, 1990; Jewett and Sark, 1991). They migrate to the ocean by the end of summer. The Valdez area pink salmon sport fishery is the largest in the State of Alaska (SGHMP, 1990).

Chum salmon life history is similar to pink salmon except they spend two to five winters rearing in the Gulf of Alaska and there is no cyclic dominance in run size. Spawning chum salmon have been observed in Seven Mile and Nancy Creeks (Thompson, 1992). Chum salmon fry have been observed in mixed schools with pink salmon and herring in the western portion of Port Valdez (Mattson, 1977). Wild fry emerging from rivers at the eastern end of the port moved westerly along the northern shore although few samples were taken along the southern shore (Morsell and Perkins, 1979).

Pacific herring are the only other economically important fishery resource occurring in Port Valdez. Herring spawn yearly in Valdez Arm and occasionally spawning will extend into Port Valdez near Anderson Bay, but kelp, an important spawning substrate, is not abundant. There is no harvest of eggs on kelp in Port Valdez because of contamination by glacial silt rendering them unsuitable for human consumption (Merrell, 1988). There are summer feeding grounds in the west end of Port Valdez and Valdez Arm. Part of the Valdez herring stock overwinters in the City of Valdez's small boat harbor where residents catch them for personal use as bait (Merrell, 1988).

Pacific halibut, rockfish, and lingcod are occasionally taken for personal use as are Dungeness crab, tanner crab, king crab, spot shrimp, and coonstripe shrimp (Dames and Moore, 1991; Merrell, 1988; Feder and Jewett, 1988). Demersal fish and shellfish occurring in Port Valdez are not abundant and the species composition has not been thoroughly sampled. Sculpins, flathead sole, and juvenile pollock appear to be the most common bottom fishes present (Smith et al., 1969; Feder and Paul, 1977). This is similar to Prince William Sound, where extensive trawl surveys have found relatively small numbers of low value species such as walleye pollock, eulachon, skates, turbot, flathead sole, and sculpins (Parks and Zenger, 1979).

3.5.5 Benthic

The rocky intertidal benthic community is characterized by a patchy distribution and relatively low species diversity (Dames and Moore, 1991). This is due in part to the rigorous physical and chemical conditions in Port Valdez. Surface salinity can fluctuate widely and rapidly reaching almost 0 ppt during spring runoff or fall rains and nearshore ice flows and slush ice can damage intertidal organisms (O'Clair and Zimmerman, 1987). Rockweed (*Fucus sp.*) and mussels (*Mytilus edulis*) dominate the intertidal zone in rock areas, forming dense clumps in all but the highest and lowest intertidal levels (Dames and Moore, 1991; Feder and Keiser, 1980). Red algae (mostly *Odonthalia floccosa*) occurs in the mid-intertidal zone and *Ulva fenestrata* dominates the low intertidal zone. Also present but not common are barnacles (*Semibalanus balanoides*, *S. cariosus*, *Balnus glandula*), polychaete worms, and other minor taxa as well as the predatory snail (*Nucella lamellosa*) and sea stars (*Pycnopodia helianthoides*, *Evasterias troschelii* and *Dermasterias imbricata*) (Dames and Moore, 1991).

Several eel grass beds are located on the west side of the proposed cargo dock area, in the proposed fill disposal area off of the mouth of Short Creek and in one of the inlets on the north side of the proposed construction site (Dames and Moore, 1991). Kelps (*Agarum cribrosum*) and lamanarians (*Laminaria groenlandica* and *L. saccharina*) are seasonally present in dense stands with cover varying from 25 to 100 percent in shallow subtidal zones. Rocky substrate gives way to silty sand below 15 meters depth with no plant cover although there are occasional patches of the large white sea pen (*Virgularia sp.*) (Dames and Moore, 1991). Benthic plants appear to account for less than 1 percent of the total production in Port Valdez (Hood, 1973).

The subtidal benthic habitat in Port Valdez is characterized by a soft/clay silty bottom and is chronically disturbed by the annual deposition of large quantities of glacially derived sediments (Feder and Matheke, 1980). The infauna off of the proposed construction site is characteristic of areas with high levels of glacial sediment deposition, and is dominated by polychaete worms with bivalve molluscs and arthropod crustaceans of secondary importance (Feder and Jewett, 1988). Epifaunal macroinvertebrates are sparsely distributed, probably due to a lack of large polychaetes and clams for food (Feder and Jewett, 1987). Pandalid shrimp are the dominant shrimp in Port Valdez; spot shrimp and northern pink shrimp (*P. borealis*) occur near the proposed construction site (Dames and Moore, 1991; Feder and Jewett, 1987; Feder and Jewett, 1988).

Annual monitoring of the benthic fauna from 14 locations in Port Valdez was conducted over the last 3 years to evaluate possible effects of the Alyeska discharge outfall upon patterns of abundance, biomass, and species diversity (Columbia Aquatic Sciences, 1993). Station 90, near Anderson Bay, was included in the study as a far-field shallow station. Relative to the species density average of all stations combined (22.7 per grab sample), station 90 was significantly elevated in species richness (63.8 species per sample). In general, similarity of species and their relative abundances at the sampling stations in Port Valdez were strongly associated with depth.

In order to evaluate the potential impacts associated with the discharge outfall, only five shallow stations within or just outside the mixing zone were included in the two-way (site/year) analysis of variance and regression analysis (station 90 is a far-field station, and was therefore not included). This analysis evaluated the significance of spatial patterns and correlations of biological data with sediment petroleum hydrocarbons, total organic carbon, and distance from the discharge. According to the analysis, site replicate variability precluded a statistically significant difference in abundance or biomass among the five stations considered (replicate data not included). In contrast, station 82, which is outside the mixing zone, had significantly higher species densities than the other stations in 1992 and long term.

3.5.6 Wildlife

3.5.6.1 Seabirds

Hogan and Irons (1988) listed 12 species of seabirds occurring in the vicinity of Port Valdez. Gulls dominate the seabird community with glaucous-winged gulls, black-legged kittiwakes, and mew gulls being the most common. Small breeding colonies of black-legged kittiwakes, glaucous-winged gulls, and Arctic terns nest at Shoup Bay, directly across Port Valdez from the project area (Hogan and Irons, 1988), and forage in the Anderson Bay area (BLM and COE, 1988).

During winter, common murres are the most dominant seabird in the Port Valdez area along with gulls and pelagic cormorants, while marbled murrelets are the most common alcid during the summer (Hogan and Irons, 1988). However, McRoy and Stoker (1969) found marbled murrelets more concentrated in the Valdez Narrows rather than Port Valdez proper.

In general, summer densities of seabirds, especially gulls, in Valdez Arm are strongly linked to breeding opportunities and salmon runs while winter densities are marked by greater numbers of common murres moving inshore where they apparently feed on capelin (Forsell and Gould, 1981).

3.5.6.2 Waterfowl

Tidal flats and salt marshes within the Port Valdez area provide important habitat for waterfowl (Hogan and Irons, 1988). DeGange and Sanger (1986) listed 28 species of waterfowl (including loons and grebes) occurring in the Gulf of Alaska region and Hogan and Irons (1988) recorded 26 species in the Port Valdez area. Dominant waterfowl occurring in Valdez Arm include Canada geese, mallards, Harlequin ducks, scoters, and Barrow's goldeneyes (Hogan and Irons, 1988). The FWS reported that 1993 waterfowl surveys of Port Valdez indicated that mallards, gadwalls, common goldeneyes, and buffleheads were dominant during winter (FWS, 1995). Nesting habitat for waterfowl in the Port Valdez area is limited primarily to the freshwater marsh at Robe Lake on the east end of Port Valdez (Hemming and Erikson, 1979). Essentially no waterfowl nesting habitat is present in the Anderson Bay area due to the lack of islands and preponderance of seacliffs along the shoreline.

During winter, waterfowl diversity is low in the Port Valdez area (Hogan and Irons, 1988), although large concentrations of Barrow's goldeneyes and surf scoters can be found. Wintering seaducks move onto the intertidal flats during high tide to feed on abundant pink-shelled clams (Hemming and Erikson, 1979). Tidal mudflats and intertidal marshes in the Anderson Bay area provide stop-over and foraging areas for migrating sea ducks, dabbling ducks, and geese during the spring and fall (BLM and COE, 1988; Brna, 1992a).

3.5.6.3 Shorebirds

Twenty-two species of shorebirds have been listed as common at some time of the year in the Gulf of Alaska region (DeGange and Sanger, 1986). Hemming and Erikson (1979) listed 16 shorebirds (18 including sandhill crane and great blue heron) occurring in the Port Valdez area. Common summer residents include semipalmated plover, common snipe, spotted sandpiper, and northern phalarope. Island Flats, Mineral Creek delta, and Robe Lake marsh are important feeding and breeding habitats for these species. Common migrants include greater yellowlegs, least sandpipers, and short-billed dowitcher. The only shorebird common during winter in Port Valdez is the rock sandpiper (Hogan and Irons, 1988).

3.5.6.4 Marine Mammals

Sea otters and harbor seals are the most common marine mammals found in Port Valdez (Hogan and Irons, 1988). Killer whales, Dall's porpoise, and Steller sea lions occasionally occur within Valdez Arm (McRoy and Stoker, 1969; Hogan and Irons, 1988). Harbor porpoises, minke whales, fin whales, and humpback whales frequenting Prince William Sound may also occasionally enter Valdez Arm.

Officially, sea otters were first recorded in Port Valdez in 1974 when a single animal was sighted (Pitcher, 1975). By 1985 at least 76 otters were using the area (Irons et al., 1988) and 116 were recorded in 1986 (Hogan and Irons, 1988) indicating an expanding population in Port Valdez. The significance of this growing population may have increased with the loss of nearly half (3,500 to 5,500 otters) of the Prince William Sound sea otter population from the 1989 *Exxon Valdez* oil spill (*Exxon Valdez* Oil Spill Trustees, 1992). Most sea otter concentrations are found in shallow areas (Hogan and Irons, 1988) where they feed largely on clams (*Mya* spp.), mussels (*Mytilus* spp.), and horse crabs (Calkins, 1978; Estes et al., 1981).

McRoy and Stoker (1969) estimated that approximately 100 harbor seals were using Port Valdez in 1969; however, by 1985, only 30 individuals were recorded (Hogan and Irons, 1988). In general, the Gulf of Alaska stock has declined substantially since 1973 (DeGange and Sanger, 1986; Pitcher, 1990). The Prince William Sound population, estimated at 590 to 946 in 1979 (Hall, 1979), was further devastated by the loss of an estimated 200 seals from the *Exxon Valdez* oil spill (*Exxon Valdez* Oil Spill Trustees, 1992). A portion of the lost animals may have included Valdez Arm as part of their seasonal range. Port Valdez harbor seals are most often seen near salmon streams in summer and generally haul-out on rocks near Island Flat and ice floes near Shoup Glacier (Hogan and Irons, 1988).

Also of note are beluga whales. Although they have never been recorded in Valdez Arm, they do occasionally enter Prince William Sound with a high count of 200 in 1983 (DeGange and Sanger, 1986). A more detailed discussion on fin whales, humpback whales, and Steller sea lions is provided in section 3.6.

3.6 ENDANGERED AND THREATENED SPECIES

To comply with requirements of Section 7 of the ESA, the Commission has conducted informal consultation with the FWS and the NMFS regarding the presence of federally listed or proposed endangered and threatened species in the project area. Yukon Pacific, as a non-Federal party, has assisted the Commission in meeting Section 7 requirements by conducting informal consultation with the FWS.

3.6.1 Plants

The FWS indicated in a letter dated February 20, 1992 that "no listed, proposed, or candidate species [including plants] for which the U.S. Fish and Wildlife Service (FWS) has responsibility are known to occur in the project area." In an April 19, 1993 letter the FWS confirmed that the information is current for 1993.

3.6.2 Terrestrial Wildlife

No federally listed or proposed endangered or threatened terrestrial wildlife species were reported in the vicinity of the Anderson Bay project area (Stackhouse, 1992a). However, the endangered American and threatened Arctic subspecies of the peregrine falcon may occasionally occur in the area.

Peregrine Falcon

Three subspecies of peregrine falcon (*Falco peregrinus*) occur in Alaska: American (*F. p. anatum*), Arctic (*F. p. tundrius*), and Peale's (*F. p. pealei*). The American peregrine falcon, a federally endangered species and the only current federally listed subspecies of peregrine falcon in Alaska, nests in interior Alaska, primarily along the Yukon and Tanana Rivers. However, this subspecies may pass through the Prince William Sound area as it migrates between breeding sites and southern wintering grounds (Swem, 1993), although the Copper River Delta region may be more important (BLM and COE, 1988). Prince William Sound falls within the breeding range of the nonendangered Peale's peregrine falcon only (Craig, 1986), although an unconfirmed American peregrine falcon nest site has been reported near Cordova, approximately 50 miles southeast of Port Valdez (Isleib and Kessel, 1973).

3.6.3 Marine Wildlife

Three species of endangered whales and one species of sea lion presently occur in the Prince William Sound region. Additionally, two endangered whales, the northern right whale and the blue whale, historically occurred in the Gulf of Alaska.

Gray Whale

This whale passes through the Prince William Sound area twice each year on its annual migration to and from winter breeding grounds in Mexico and summer feeding grounds in the Bering and Chukchi Seas (Braham, 1984). Timing of passage is usually in the spring (March to May) and fall (November to January). Gray whales closely follow the coast around the Gulf of Alaska, frequently passing through both Hinchinbrook Entrance and Montague Strait (Hall, 1979). Although gray whales occur in Prince William Sound, they have seldom been reported in Valdez Arm and are considered a rare visitor at that locality.

Humpback Whale

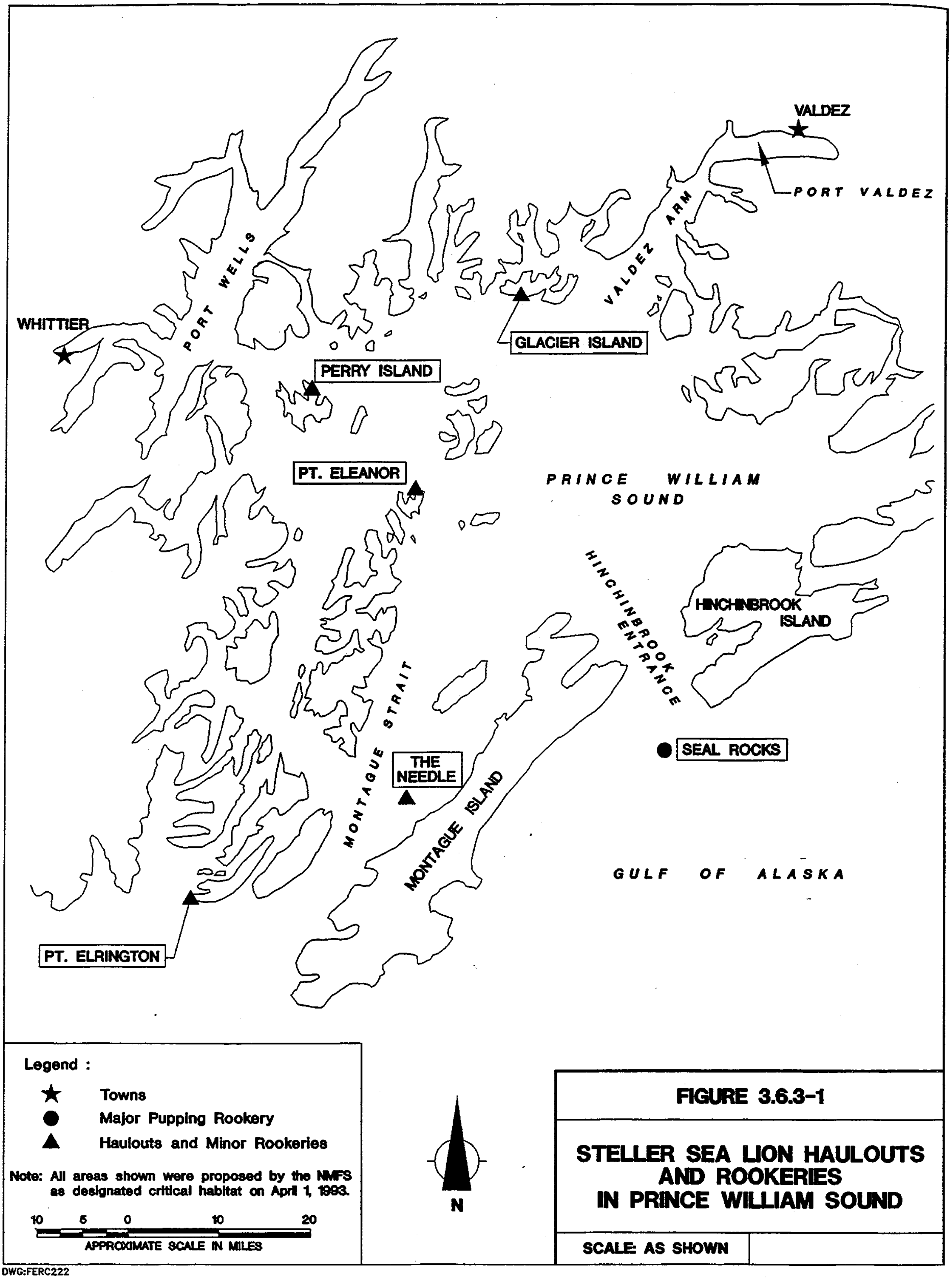
This whale occurs primarily in two distinct areas of Prince William Sound during two separate periods (Hall, 1979). During May to late June they are most frequently reported in the area between Perry, Naked, and Eleanor Islands (see figure 3.6.3-1) which is characterized by high primary and secondary productivity during the spring of the year. By early July, most move to the vicinity of Icy and Whale Bays near Chenega Island (Hall, 1979). Individuals are observed throughout Prince William Sound and occasionally are seen in Valdez Arm where they are considered a rare visitor.

Fin Whale

Fin whales occur in the Gulf of Alaska from May to November (Berzin and Rovnin, 1966) where they have generally been found feeding in deeper waters along submarine canyons and the shelf break (Consiglieri and Braham, 1982; Leatherwood et al., 1983; Brueggeman et al., 1987, 1988). Hall (1979) observed fin whales in Prince William Sound from April to June, but believed these animals were primarily transients. A few animals have been known to wander into Valdez Arm, but are considered a rare visitor there.

Northern Right Whale

This is probably the most endangered whale in the North Pacific. Recent estimates place the North Pacific population at between 100 to 200 individuals (Braham and Rice, 1984). Northern right whales have not been observed in the Prince William Sound area in recent times. However, Prince William Sound lays adjacent to the Gulf of Alaska where, historically, major concentrations occurred (Scarff, 1986). Consequently, the possibility of encountering a right whale in the Prince William Sound area does exist given their traditional use of the area. However, this possibility is


VALDEZ
PORT VALDEZ
VALDEZ ARM
PORT WELLS
WHITTIER
GLACIER ISLAND
PERRY ISLAND
PT. ELEANOR
PRINCE WILLIAM SOUND
HINCHINBROOK ENTRANCE
HINCHINBROOK ISLAND
MONTAGUE STRAIT
THE NEEDLE
SEAL ROCKS
MONTAGUE ISLAND
GULF OF ALASKA
PT. ELRINGTON
Legend :
Towns
Major Pupping Rookery
Haulouts and Minor Rookeries
Note: All areas shown were proposed by the NMFS as designated critical habitat on April 1, 1993.
10 5 0 10 20
APPROXIMATE SCALE IN MILES
N
FIGURE 3.6.3-1
STELLER SEA LION HAULOUTS AND ROOKERIES IN PRINCE WILLIAM SOUND
SCALE: AS SHOWN
DWG:FERC222

very slight given the small size of the existing population and the lack of evidence for recovery in the North Pacific (Scarff, 1986).

Blue Whale

Blue whales, although present in the North Pacific at higher numbers than right whales (1,400 to 1,900; Gambell, 1976), are rarely sighted in the Gulf of Alaska (Calkins, 1986). Historically, they summered in the western Gulf of Alaska (Berzin and Rovnin, 1966). There are no recent records of blue whales occurring in Prince William Sound.

Steller Sea Lion

This sea lion is found in Prince William Sound throughout the year. A major breeding rookery occurs at Seal Rocks at the southern end of the sound and several haulout sites occur throughout Prince William Sound (figure 3.6.3-1). Neither the rookery nor any of the major haulout sites occur near Valdez Arm (Calkins and Pitcher, 1993) and all haulout sites occur 6 to 25 miles west of the shipping lanes. The closest haulout site to Valdez Arm is Glacier Island which is used only in the winter (Calkins and Pitcher, 1993). Steller sea lion use of Valdez Arm is only occasional and sporadic. A spring influx into the arm may occur if spawning herring are present, but herring use of Valdez Arm is also occasional and sporadic. Consequently, Steller sea lions are considered occasional visitors to Valdez Arm.

The NMFS proposed to designate specific Steller sea lion rookeries and haulouts in Prince William Sound as critical habitat on April 1, 1993 (58 CFR 17181 (1993)). These areas, recommended by the Steller Sea Lion Recovery Team, include the Seal Rocks rookery, and The Needle, Wooded Island, Perry Island, Point Elrington, and Point Eleanor haulout sites (see figure 3.6.3-1). As proposed by the NMFS, the designated critical habitat at each of these locations would extend 3,000 feet landward and 20 nautical miles seaward from the area's shoreline at MLLW.

In general, gray, humpback, and fin whales can be found seasonally in Prince William Sound and may occasionally enter Valdez Arm, with humpback whales the most likely to enter. Steller sea lions are found in Prince William Sound year-round and may occur in Valdez Arm in numbers if spawning herring are present. But for the most part, major use areas of all four species are located in Prince William Sound far from Valdez Arm. Northern right and blue whales occur in such low numbers in the North Pacific that their possibility of entering Valdez Arm is extremely remote.

3.7 AIR QUALITY

Air quality can be affected by both the construction and operation of the LNG plant. Air quality pollutants from onsite construction activities can be divided into two types: 1) the generation of fugitive particulate matter dust, as a result of construction operations and 2) the emissions of gaseous criteria pollutants from construction equipment. Air quality pollutants generated during normal operation would result from natural gas-fired turbines and equipment, fuel use in LNG tankers, and operation of an incinerator and wastewater treatment systems.

The ADEC regulates air quality in the project area and would require a full review of potential air quality impacts that would result from the proposed facility. The first step in an air quality analysis is to collect data on the existing ambient air quality in the area. Two types of data are required to assess the existing air quality conditions. One is meteorological data which gives information on the local climate at the site and on the nature of dispersion of pollutants from the facility and the second is the baseline ambient concentration data of the pollutants which would be emitted from the facility. In 1989, Yukon Pacific installed and began operation of a meteorological monitoring station, the Met Cove tower, at the Anderson Bay site. Since 1989, the Alyeska Marine Terminal has been monitoring ambient concentrations of criteria pollutants at several sites around Valdez.

3.7.1 Meteorology

The transport and dispersion of air contaminants in the project vicinity is related to the meteorology of Anderson Bay. The wind speed, direction, and atmospheric stability determine how emissions from the facility would be transported through the airshed and the resulting ground level concentrations from facility emissions.

The ridgeline surrounding the bay is generally 2,000 to 4,000 feet in elevation with higher peaks and several intersecting valleys and glaciers. Near surface level winds are channeled both along the bay and along the intersecting valleys. Up and down valley flows dominate the near surface winds and result in complex wind fields, especially along the ridgeline where outflow from the intersecting valleys causes local eddies. Temperature, precipitation, atmospheric stability, and wind patterns in the project area are all influenced by this rugged terrain.

Questions regarding the accuracy and representativeness of meteorological data collected at the Met Cove tower between September 1989 and August 1990, have resulted in an agreement between Yukon Pacific, the EPA, and the ADEC on March 15, 1994, that a new meteorological tower would be installed at the site. This tower would be operated to collect data according to a protocol and monitoring plan approved by the EPA and ADEC for use in generating meteorological data for modeling analysis supporting PSD review and the air permit. A siting visit with the ADEC, EPA, ADNR, and Yukon Pacific and its meteorological consultant was held on June 6, 1994 to mutually agree on a preferred site for the 40-meter tower. The selected site is at the same location where the process trains are planned, to ensure that measured conditions will be the same as actual conditions.

During this siting visit, the meteorological monitoring program was discussed in detail. The draft meteorological monitoring plan was submitted to the EPA and ADEC on July 29, 1994 for review and approval. Data collection and debugging at the new 40-meter meteorological tower began in November 1994. All meteorological data used in the modeling analysis for the PSD review and the air permit will be approved by the ADEC and EPA.

Although complete meteorological data from the 40-meter tower will not be available for the FEIS, Yukon Pacific was able to secure improved quality data from the 10-meter tower for the period November 1, 1992 through October 31, 1993, with an overall data capture rate of 96.7 percent. Meteorological data for the same period were also secured from the 30-meter tower at Alyeska's Valdez Marine Terminal at Jackson Point, about 5 miles east of the proposed LNG plant site. Both sets of meteorological data were used in the supplemental dispersion modeling analyses.

Precipitation is abundant in all seasons of the year and is greatest in September and October. The average annual precipitation is 61 inches and yearly snowfall is 294 inches. Cloudy conditions, with greater than 80 percent cloud cover, occur 60 to 70 percent of the year.

3.7.2 Ambient Air Quality

Ambient air quality is protected by Federal and state regulations. The EPA has developed National Ambient Air Quality Standards (NAAQS) for certain criteria air pollutants. The NAAQS are the maximum allowable concentration of a pollutant in the atmosphere. Air quality standards for a state may not be less stringent that the NAAQS. For a new source, compliance with any NAAQS is based upon the total estimated air quality. This is the sum of the ambient estimates resulting from existing sources of air pollution, and the modeled ambient impact caused by the new facility's proposed emissions.

Table 3.7.2-1 lists the criteria air pollutants, the NAAQS, and ambient concentrations in the project area for those criteria air pollutants potentially affected by the proposed LNG project. The ambient concentrations presented are the highest values recorded at any station in the Valdez Air Monitoring System from October 1, 1990 through March 31, 1993. See appendix D for a more detailed presentation of ambient monitoring values and a map showing the monitoring sites. Emissions of lead and ammonia would be negligible. The proposed LNG facility would be in the South Central Alaska Intrastate Air Quality Control Region (AQCR) which is in attainment for all criteria pollutants.

Existing ambient air quality is also protected by the EPA's Prevention of Significant Deterioration (PSD) regulations. These regulations are intended to preserve the existing air quality in areas where pollutant levels are below the NAAQS. PSD regulations impose specific limits to the amount that new or modified major stationary sources may contribute to existing air quality levels. An air pollutant point source that is subject to PSD review is required to submit a review of existing air quality, use modeling analyses to demonstrate compliance with the NAAQS and applicable increments, apply best available control technology (BACT), and include an analysis of the general impact on the environment. Table 3.7.2-2 identifies the allowable Class I and II PSD increments for the criteria air pollutants.

Air quality permitting in Alaska is conducted by the ADEC. The proposed LNG plant would require a Permit to Operate in accordance with the AAC, Title 18, Section 50.300. The project's impact area is the geographical area for which the required air quality analyses for the NAAQS and PSD increments are carried out. This area includes all locations where predicted emissions of a criteria pollutant from the proposed LNG facility would potentially cause a significant impact on ambient levels.

The PSD regulations also require an analysis of the impact on nearby Class I areas. Congress established certain areas, such as wilderness areas and national parks, as mandatory Class I areas. In all Class I areas stringent limits on increments for sulfur dioxide (SO_2), particulate matter (PM_{10}), and nitrogen dioxide (NO_2) are imposed to avoid air quality degradation. The nearest Class I areas include Denali National Park, and Tuxedni and Simeonof National Wilderness Areas, which are located 158 miles, 240 miles, and 640 miles, respectively, from the proposed Anderson Bay site.

The Federal land management agency has responsibility to protect air quality related values for the area which may be adversely affected by the cumulative ambient pollutant concentrations. An analysis of impacts on visibility and other air quality related values must be provided to determine the effect on the Class I area. The Federal land management agency of the Class I area is responsible for evaluating a source's projected impact on the area and recommending that the ADEC either approve or disapprove the source's permit application based on anticipated impacts.

TABLE 3.7.2-1

Ambient Air Quality Standards and Ambient Concentrations

Pollutant	Averaging Period	National a/	State b/	Ambient Concentration c/	Attainment Status
Sulfur Dioxide (SO_2) ($\mu g/m^3$)	Annual	80 d/	80 d/	16	In
	24-hour	365 e/	365 e/	81	In
	3-hour	1,300 e/	1,300 e/	327	In
	30-minute	–	50 e/	N/A	In
Respirable Particulates (PM_{10}) ($\mu g/m^3$)	Annual	50 d/	50 d/	33.5	In
	24-hour	150 e/	150 e/	100	In
Carbon Monoxide (CO) (mg/m^3)	8-hour	10 e/	10 e/	4.5	In
	1-hour	40 e/	40 e/	7.7	In
Ozone (O_3) ($\mu g/m^3$)	1-hour	235 f/	235 e/	123.7	In
Nitrogen Dioxide (NO_2) ($\mu g/m^3$)	Annual	100 d/	100 d/	27	In
Lead (Pb) ($\mu g/m^3$)	Calendar Quarter	1.5 d/	1.5 d/	0.08	In
Ammonia (NH_4) (mg/m^3)	8-hour	–	2.1 g/	N/A	In

a/ 40 CFR Part 50

b/ 18 AAC 50

c/ Highest values recorded at any station in the Valdez Air Monitoring System from October 1, 1990 through March 31, 1993.

d/ Never to be exceeded.

e/ Not to be exceeded more than once per year.

f/ Number of days per year with maximum hourly average above 235 $\mu g/m^3$ must be equal to or less than one.

g/ Not to exceed 2.1 mg/m^3 averaged over any consecutive 8 hours more than once each year.

– = no standard exists

N/A = not available

TABLE 3.7.2-2

PSD Increments

Pollutant	Averaging Period	Class I PSD Increment ($\mu g/m^3$)	Class II PSD Increment ($\mu g/m^3$)
SO_2	Annual	2	20
	24-hour	5	91
	3-hour	25	512
NO_2	Annual	2.5	25
PM_{10}	Annual	5	19
	24-hour	10	37

3.8 NOISE

At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. This variation is caused in part by changing weather conditions and the effects of seasonal vegetative cover. Two measures commonly used by Federal agencies to relate the time-varying quality of environmental noise to its known effect on people are the 24-hour equivalent sound level (Leq(24)) and the day-night sound level (Ldn). The Leq(24) is the level of steady sound with the same total (equivalent) energy as the time-varying sound of interest, averaged over a 24-hour period. The Ldn is the Leq(24) with a 10 decibels of the A-weighted scale (dBA) weighing applied to nighttime sound levels between the hours of 10 p.m. and 7 a.m., to account for people's greater sensitivity to sound during nighttime hours.

No measurements of the background noise levels in the vicinity of the Anderson Bay site are available. In the absence of actual monitoring data, some deductions based on existing land use and the level of human occupancy may serve to define anthropogenic noise levels. At this time, no residences or businesses are known to be present on Anderson Bay. The size of the land unit to be controlled by the LNG facility precludes any residences from being constructed immediately adjacent to operating units which might be a source of noise.

Noise levels created by natural sources can be quite loud in wilderness areas with rugged terrain and ample rain or snowfall. Numerous small, rapid streams and waterfalls can create noise which elevates the background noise levels to over 40 dBA. In very quiet locations, the normal noise levels are likely to be in the low 30s dBA.

Due to noise reflection from hard rock surfaces and unattenuated propagation over water surfaces of Port Valdez, it is likely that distinctive noises of human origin, such as bells, whistles, and alarms might well be heard distinctly over considerable distances on the shoreline. Some undocumented experience may have been gained in the characteristics of an industrial noise environment due to operations of the crude oil terminal in Port Valdez.

The LNG facility is proposed to be located in an undeveloped area of southwest Port Valdez where there are few anthropogenic noise sources. Shipping traffic associated with the crude oil terminal is assumed to cause occasional noise impacts, although no measurements have been made to determine background noise levels from this source. Rugged mountains along a very narrow coastline at Anderson Bay afford little opportunity for human habitation. Noise-sensitive areas (NSAs) potentially affected by the project are discussed in section 4.8.

3.9 LAND USE AND RECREATION

3.9.1 Land Use

3.9.1.1 Regional

The Prince William Sound region is a large, primarily undeveloped area, composed of rugged coastline, timbered slopes, and high jagged mountains. Land uses tend to capitalize on the area's natural resources and coastal setting, and include recreation, wildlife habitat, mineral extraction, forestry, mariculture, energy-related industry, various types of commercial uses, small industry, and settlement (ADNR, 1988).

Principal landowners in Prince William Sound are the Federal Government, the State of Alaska, and various native corporations. Federal land, which is managed by the U.S. Forest Service (FS) as Chugach National Forest, comprises approximately 70 percent of land in the Prince William Sound region (ADNR, 1988). Land owned, selected, or proposed for selection by the State of Alaska accounts for an additional 20 percent. The largest contiguous area of land owned, selected, or proposed for selection by the state (approximately 680 square miles), occurs east of Port Valdez. In addition to uplands, the state also owns land beneath navigable lakes and streams and most tidal and submerged lands (ADNR, 1988).

Native-owned and selected lands comprise approximately 10 percent of the land in the Prince William Sound region and are scattered throughout the region. The closest Native lands to the project site are owned by the Tatitlek Corporation, and are located approximately 6 to 8 miles south of Port Valdez.

Other private or municipally owned lands make up a very small percentage of the land in the Prince William Sound region. Privately owned lands are located in small tracts throughout the Sound, primarily near developed communities.

3.9.1.2 City of Valdez

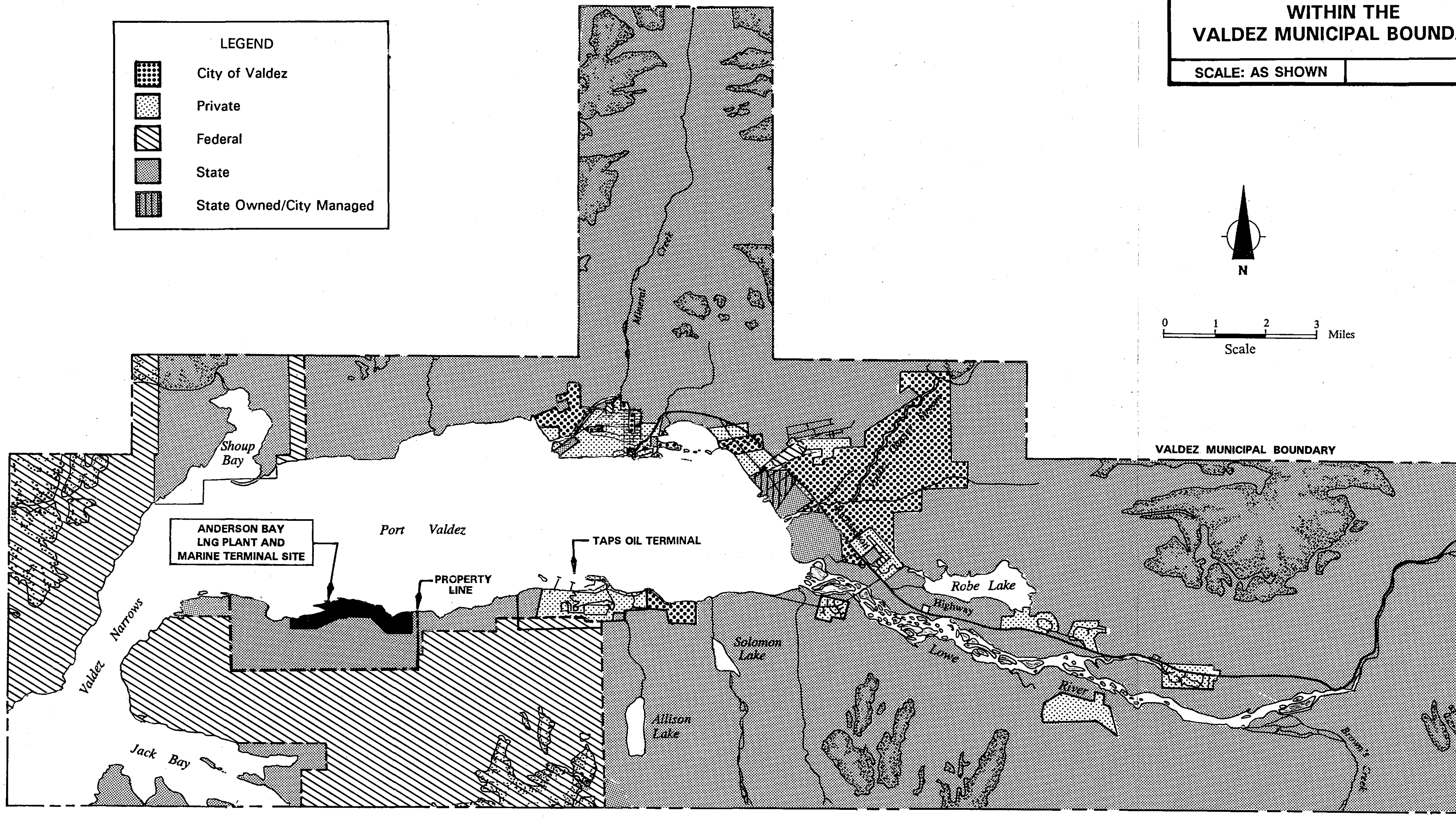
The Valdez municipal area consists of 274 square miles of land and water, and includes much of the area known as Port Valdez. The western edge of the municipal boundary is the west end of Valdez Narrows. The municipal area extends 36 miles east from the Narrows to Keystone Canyon. The northernmost section of the municipal area includes the headwaters of Mineral Creek. The southern boundary is located approximately 25 miles south of the northern edge (see figure 3.9.1-1). Most of the land within the municipal area is mountainous, undeveloped, remote, and not easily accessible.

Land uses and land use designations within the municipal area include: recreation, wildlife habitat, forestry, energy-related industry, settlement, and transportation (ADNR, 1988). Much of the state land in Valdez is available for mineral leasing. At this time, however, the only mineral

FIGURE 3.9.1-1

LAND OWNERSHIP WITHIN THE VALDEZ MUNICIPAL BOUNDARY

SCALE: AS SHOWN



Source: Information was derived from the State of Alaska's Valdez Coastal Management Program Map.

extraction occurring in the Port Valdez area is gravel extraction from the Valdez Glacier stream floodplain that is used for local construction projects and highway improvements (City of Valdez, 1986; Dengel, 1992).

Chugach National Forest lands within the western part of the municipal boundaries are classified as "timber production" (FS, 1984). As such, the lands are eligible to be used for timber production. However, there has been no significant harvest on Forest land to date and the FS plans no timber sales on land within the city boundaries within the near future (Behrends, 1992). As with state lands, most National Forest lands are open to mineral exploration and extraction. However, there are no active mining claims on the National Forest land within the municipal boundary. The only special use permit issued on National Forest land located within the municipal boundaries is a permit issued to a commercial hunting guide for an area that includes lands near the project area.

The greatest concentration of development in the Valdez municipal area occurs in "central Valdez" which includes residential neighborhoods, the central business district, schools, parks, the city dock, the Alaska Marine Highway ferry terminal, the boat harbor, and other public facilities. Future planned uses include continued expansion of the commercial and residential districts, and expansion of the Valdez Boat Harbor (City of Valdez, 1986).

Dayville Road provides the only vehicular access to developments located on the south side of Port Valdez. This area contains several major developments: the Alyeska Marine Terminal, the Solomon Gulch Hydroelectric Project, Fort Liscum, and the Valdez Fisheries Development Association fish hatchery. The Alyeska Marine Terminal complex is the largest facility, and most intensive land use in Port Valdez, and is located approximately 3.5 miles east of the project site. Major facilities at the complex include 18 crude oil holding tanks, 4 tanker loading berths, a ballast water treatment facility, and biological treatment ponds.

Federal land accounts for approximately 33 percent (48,000 acres) of the land within the Valdez municipal boundary. All Federal land is part of the Chugach National Forest.

Of the 222 square miles of land within the municipal boundary, approximately 61 percent (186,700 acres) is state owned. The City of Valdez will eventually receive title to approximately 6 percent (4,800 acres) of the state-owned lands under the Municipal Entitlement Act (City of Valdez, 1986). The ADNR, through the Public Interest Land Identification project, has identified lands within municipalities that will either be retained and managed by the state, or sold to private interests. State public interest lands in the Port Valdez area that will be retained and managed by the state will serve various functions such as: public recreation, fish and wildlife habitat, watersheds, forests, materials, and public facilities (City of Valdez, 1986). None of the state public interest lands identified in the Valdez District Coastal Management Program (VDCMP) are within 3.5 miles of the project site.

Municipally and privately owned land comprises less than 1 percent of land within the municipal boundary. Municipal and private lands are generally located near the city center. Private land is primarily residential, commercial, and industrial.

3.9.1.3 Project Site

The LNG plant and marine terminal facility would be located adjacent to and in, Anderson Bay. Approximately 426 acres of land are within the construction limits. The total project area including the buffer zone would encompass 2,630 acres. With the exception of recreation and subsistence gathering (see section 3.9.3.2 and 3.13), there is no active land use presently occurring at the site or on adjacent lands. There are also no improvements on the site, or on adjacent lands. The uplands of the site are covered in forest, and are difficult to reach due to the rugged coastline and steep terrain. FS land adjacent to the site has been classified as timber production, but is primarily managed for recreation (FS, 1984). In addition, Anderson Bay is used by boaters for safe moorage during dangerous weather.

The developed plant site would be located on land selected by the State of Alaska and currently managed by the ADNR. Project area lands have been designated by the ADNR as "reserved use" and are being held by the state specifically for the proposed project. To that end, these lands are closed to mineral entry and settlement. Yukon Pacific applied to the ADNR and received on December 10, 1988 a conditional lease for the TAGS Project, including the LNG plant and marine terminal area. The buffer zone would encompass both state and Federal lands.

3.9.2 Comprehensive Plans

3.9.2.1 Prince William Sound Area Plan

The Prince William Sound Area Plan (PWSAP) describes how state-owned uplands, tidal, and submerged lands in Prince William Sound will be managed. The plan determines land-use classifications, land disposal locations, administrative designations, land selections, and relinquishments and guidelines for leases and permits on state lands. The PWSAP only pertains to state land, and requires that all activities on tidelands, submerged lands, and uplands within the coastal zone be consistent with the Alaska Coastal Management Program.

The PWSAP has created 29 management units that are generally homogeneous in terms of resources, topography, and land ownership. Each unit has "primary and secondary surface land uses" which indicate general uses that will be allowed in a unit. Each management unit is further broken down into subunits which is the level at which land uses are designated. All state land (including the project site and buffer) on the south side of Port Valdez, west of the Alyeska Marine Terminal is within subunit 21T (Anderson Bay-TAGS Terminal) of Management Unit 21. The land use designation in subunit 21T is transportation. All of subunit 21T has been reserved for construction of the TAGS pipeline and terminal unless a different terminal site is developed.

3.9.2.2 Valdez District Coastal Management Program

The Alaska Coastal Management Program was initiated in 1977 with the adoption of the Alaska Coastal Management Act. The Alaska Coastal Management Program is overseen by the Alaska Coastal Policy Council, which sets policy and reviews coastal district programs for approval. The Coastal Policy Council has adopted general policies or standards to guide coastal development.

The Coastal Management Program has established 31 coastal districts (as of February 1991) which have developed approved coastal management programs. All the programs are based on state standards. The VDCMP includes all areas within the Valdez municipal boundaries up to 1,500 feet in elevation, and all marine waters within the city limits.

The VDCMP has established a series of policies regarding coastal development. The stated policies are used as a basis for "consistency determinations" by Federal and state agencies and the

Coastal Coordinator. The plan's policies apply to all lands and subject uses and activities in the Valdez District. Under the provisions of 6 AAC 50, the State of Alaska is required to make a determination of consistency for certain permits and other activities requiring approval with the Alaska Coastal Management Program. The list of permits that are subject to coastal consistency determination has been divided into three groups: Categorical Approval, General Concurrence, and Individual Project Review. The proposed TAGS Project falls into the Individual Project Review category and as such, is subject to state and local review. It would also be considered to be a "major" project.

3.9.2.3 Valdez Comprehensive Development Plan

In 1991, the City of Valdez completed a draft update to the existing 1971 Valdez Comprehensive Development Plan. The update has not been approved by the City Council as of this date, so the 1971 plan is still valid. As part of the update, a survey of approximately 10 percent of the city's population was conducted in 1990 to, among other things, help determine development goals for the City of Valdez.

Based on the survey, several goals and objectives were included in the plan that could relate to the proposed project. The second stated goal in the plan concerns economic development, and encourages the development of a broadbased economy. Objectives of the economic development goal include: encouraging placement of a gas pipeline terminus in Valdez; development of an associated petrochemical industry; marketing the Port of Valdez as a commodities port facility for gas and oil pipelines; and striving to create an atmosphere in the community conducive to commercial and industrial development.

Other goals and objectives in the plan that could have an impact on the project include: the separation of incompatible land use; the prohibition of locating structures in environmentally sensitive areas; providing buffers between industrial and other land uses; controlling undesirable air and water emissions from industrial land use; providing adequate access to shorelines and public lands and water; and establishing development standards for lands that contain special physical or environmentally sensitive areas.

In addition to the stated goals and objectives, the plan has a number of planning recommendations that could pertain to the TAGS Project. They include avoiding potentially adverse impacts on fish and wildlife and their habitats, and on water quality and vegetation. Where industrial activities would cause significant adverse visual or noise impacts, the developer would be required to provide adequate screening or buffers. Where feasible, a 100-foot buffer of natural vegetation would be maintained.

3.9.2.4 Chugach National Forest Land and Resource Management Plan

The current Land and Resource Management Plan for the Chugach National Forest was adopted in 1984 and was designed to guide management for a 10-year period. The plan will next be revised in 1995 or 1996 (Behrends, 1992). The forest is managed under the multiple use concept and has developed nine Management Areas which are composed of various Analysis Areas. The Analysis Areas have specific management goals, practices, standards, and guidelines for their identified resources.

The project buffer abuts Management Area 7 (Gravina). The Chugach National Forest land adjacent to the LNG plant site is designated as a "timber production" analysis area, and as such has three primary management goals. The goals are to: 1) improve marine-oriented recreation opportunities, 2) maintain wildlife habitat, and 3) improve fish habitat. Four identified resources in the timbered sideslopes analysis area are recreation, wildlife and fish, timber, and minerals and geology.

3.9.2.5 Alaska Statewide Comprehensive Outdoor Recreation Plan

The ADNR is responsible for outdoor recreation planning by virtue of Alaska Statute 41.20.020. The ADNR prepares an updated recreation resource assessment and policy plan every 5 years that sets forth goals, assesses recreation needs, and analyzes issues, policies, and land use affecting recreation opportunities.

The project site is located in southcentral Alaska, where 62 percent of the state's population lives. Many existing recreation sites in southcentral Alaska are overcrowded. The 16 proposed additions to the state park system that are located in the region contain 84 percent of all the acreage in the entire state recommended for addition to the state park system. Proposed marine parks in Prince William Sound total 3,000 acres.

3.9.3 Recreational Resources

The proposed project is located in the northeast corner of Prince William Sound, which is a major state recreational resource due to its outstanding scenic and natural resources, and accessibility to more than half the state's population. Prince William Sound has over 2,700 miles of coastline, 4.4 million acres of National Forest, three major ice fields, islands, mountains, streams, and rivers (Prince William Sound Tourism Coalition, undated). Recreational activities available in the Prince William Sound area tend to focus on natural features and include sightseeing, fishing, hunting, camping, backpacking, boating, kayaking, and photography.

3.9.3.1 City of Valdez

Federal, state, and municipal lands are available throughout the Valdez area for various types of recreation. Figure 3.9.3-1 depicts the location of existing and proposed recreational facilities throughout the City of Valdez. The following subsections discuss developed facilities and services available in the City of Valdez area as well as dispersed recreation.

Developed Facilities and Services

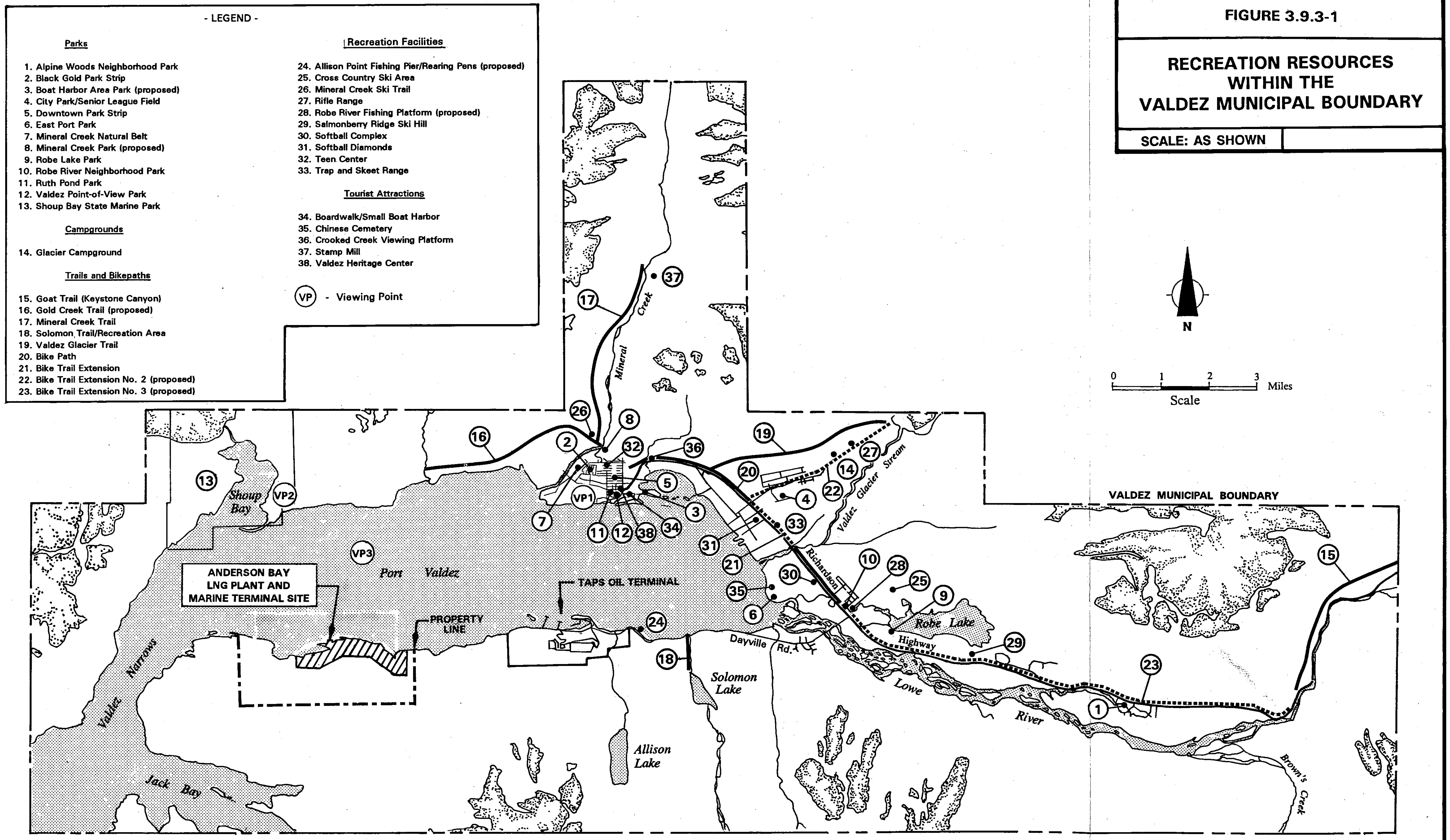
Chugach National Forest lands within the municipal boundary are classified by the FS as "timber production," but are being currently managed to maintain scenic value and recreational use (City of Valdez, 1986). There are no developed FS facilities within the project area or city. The closest developed FS facility is a recreation cabin at Jack Bay, southwest of Anderson Bay (Behrends, 1992).

The only state land within the municipal boundary of Valdez specifically designated for recreation is Shoup Bay State Marine Park. It is located on the north side of Port Valdez, approximately 3 miles to the northwest of the proposed site. There has been no development of facilities at the park, and there are no immediate plans to develop it. The ADNR, Division of Parks and Outdoor Recreation will devise a facility and development plan when there is funding (Bingham, 1992). The Jack Bay State Marine Park is located in the City of Valdez south of Valdez Narrows. As with Shoup Bay, it has not been developed to date.

FIGURE 3.9.3-1

RECREATION RESOURCES WITHIN THE VALDEZ MUNICIPAL BOUNDARY

SCALE: AS SHOWN



Source: Information was derived from the State of Alaska's Valdez Coastal Management Program Map.

The Valdez City Parks and Recreation Department is responsible for municipal recreation facilities and activities in Valdez. The city manages a number of parks, several trails and bike paths, a campground, a softball complex, a trap and skeet range, a boat harbor, and other facilities (see figure 3.9.3-1). Three gymnasiums and an indoor swimming pool located at Valdez schools are used by the Parks Department for community recreation (Robb, 1993). The campground (which is leased to the City of Valdez from the state) has 102 camp spaces, and is the only developed public camping facility in the Port Valdez area. The city also operates the Valdez Boat Harbor, which has 513 slips.

A number of commercial recreation and tourism oriented businesses operate in the Valdez area. They include commercial bus tour operators from Anchorage, three luxury cruise lines that stop in Valdez, two large tour boat operators based in Valdez, 1-day cruise boats, and private guides and rental boats. Popular destinations for tour operators include Columbia Glacier, Shoup Glacier, and the Alyeska Marine Terminal. There are 3 private RV parks and 27 charter boat operators listed in the 1991-92 Facilities and Services Directory (Valdez Convention and Visitors Bureau 1991-92, undated).

Recreational activities in the Port Valdez area, as in the rest of Alaska, tend to be outdoor oriented. Fishing, tent camping, hunting, motorboating, and hiking are the five favorite outdoor recreation activities for residents of southcentral Alaska according to the ADNR (ADNR, undated). Visitors have similar interests, but also include sightseeing as one of their favorite activities.

Fishing is a popular activity in the Port Valdez area. The most current ADFG estimate is that in 1991, 31,088 boat and shoreline anglers made 38,194 trips and spent 67,891 angler days fishing in Port Valdez (SPCO, 1993). Of the various types of offshore fishing available, salmon fishing is the most popular. Offshore areas near Anderson Bay and Seven Mile Beach are popular with anglers (Valdez Fishing Facts, undated). Other fishing activities in Port Valdez include crabbing, shrimping, and fishing for rock fish. Streams in the Port Valdez area are closed to salmon fishing, so stream fishing efforts are directed primarily to fishing for Dolly Varden char (City of Valdez, 1986).

Big game hunting in the Valdez area is not well documented. Hunting activities have concentrated on mountain goat, black bear, brown bear, and moose. Waterfowl and upland game bird hunting also occurs in the area, but is undocumented (City of Valdez, 1986).

3.9.3.2 Project Site

Anderson Bay was evaluated by the ADNR for inclusion in the Alaska Marine State Park system. Although it was not included in the system, it was considered to have high recreational potential (City of Valdez, 1986).

There are no developed facilities near the proposed site although western Port Valdez is a "major recreation resource of Valdez" (City of Valdez, 1986). A lack of road access, facilities, and steep, rugged terrain, limit upland use of western Port Valdez. Beaches near the project site do receive some usage such as occasional boat landings and camping (City of Valdez, 1986). Seven Mile Beach is used for landbased activities such as picnics and weddings (Janka, 1992).

Most recreational activities occurring near the site take advantage of the gentle slopes and the cobble and pebble beaches in Anderson Bay and the mouth of Seven Mile Creek, as well as the immediate offshore waters. Between these two areas, the shoreline is steep and rugged and not easily accessible to recreationists. Boating and fishing for halibut and silver salmon is popular near the site, particularly during the summer. Anderson Bay is protected from southeast winds and is used by boaters (particularly fishing) seeking shelter from the wind. Although Anderson Bay may be used occasionally as a harbor of refuge for recreational boats, due to its close proximity to the Valdez Boat Harbor, this is infrequent (Bratton, 1993; Bodine, 1993). The area around Anderson Bay is also used for cost recovery fishing by the Valdez Fishery Development Association for its hatchery, and some commercial salmon fishing occurs there as well.

3.10 VISUAL RESOURCES

Visual Characteristics

Port Valdez is the northeastern-most section of the Valdez Arm of Prince William Sound. The narrow, deep fjord extends approximately 14 miles from the Valdez Narrows on the west to the Lowe River Delta on the east. Port Valdez is approximately 3 miles wide, and is surrounded on the north and south sides by steep rocky slopes, which rise to elevations of 4,500 feet above mean sea level. The mountainous terrain surrounding Port Valdez has been heavily glaciated, and consists of horns, aretes, cirques, U-shaped valleys, and rock basin lakes. Diversity in this rugged landscape is created by relatively level delta outwashes formed from the Lowe and Robe Rivers, Mineral Creek, Shoup Bay, and the Valdez Glacier (ADNR, 1988).

Anderson Bay is a shallow, well-defined bay, approximately 1 mile wide near the western entrance to Port Valdez. The steep rocky shoreline of the proposed site is composed of cliffs that rise from 30 to 40 feet in height above the shoreline. From benches adjacent to the cliffs, the terrain rises steeply to the southern boundary of the project area and reaches an elevation of approximately 300 feet above sea level. Beyond the southern boundary are the Chugach Mountains, which form a backdrop to the site with elevations up to 4,600 feet. Below the rocky cliffs surrounding Anderson Bay are several narrow beaches at the outlets of Seven Mile, Nancy, and Short Creeks, a small rocky island, and well-defined tidal wetland areas that appear as "meadows" depending upon tidal conditions.

Dense virgin coastal spruce and hemlock forests are found along much of the south side of Port Valdez and the project area. Hemlock and spruce on lower slopes give way to shrubby alpine vegetation at higher elevations. Understory vegetation is thick and consists of various species of alder and willow, salmonberry, devils club, blueberry, and other woody shrubs. The dense forest is virtually unbroken as it follows the shoreline from west of the Alyeska Marine Terminal, to the western end of Port Valdez.

Anderson Bay and the project site can be seen from the City of Valdez, from Shoup Bay State Marine Park, and from boat and plane traffic passing the site. Visibility of the site depends upon a number of factors such as weather, sun angle, and light. Low clouds and fog often cover vast sections of Valdez Arm, and obscure views of the project site from many areas of Port Valdez.

Forest Service Visual Management System

Although the project area is not located on FS lands and is not subject to National Forest visual standards, it is surrounded on the three land sides by Chugach National Forest. The FS has established a Visual Management System (VMS) that is used in multiple use resource planning and decision making processes. The VMS has established measurable standards for the visual resources of National Forest lands. A set of premises relating to landscape character, view expectations, number of viewers, viewer duration, and management objectives underlie the VMS (FS, 1974).

Because the project site is located on state lands, rather than on FS-administered lands, the project site was not inventoried as part of the VMS. FS land adjacent to the site, however, was inventoried and classified. The lands adjacent to the project site were assigned a landscape variety class rating of B ("common") rather than a rating of A ("distinctive") or C ("minimal").

Viewers

Port Valdez receives considerable use by water craft passing through the area on the way to or from Valdez. Many of the vessels are used by tourists and other recreationists to view attractions in the Port Valdez area and to access recreation areas. Destinations in the Port Valdez area that are popular with residents and tourists alike and require passing by the project site from Valdez include: Shoup Bay (which is directly across Port Valdez from the project site), Sawmill Bay, and Jack Bay. In addition, summer boat tours and cruises from Valdez go past the project site on their way to and from the popular Columbia glacier. Approximately 72,000 charter, sightseeing, and Alaska Marine Highway passengers would be expected to pass by Anderson Bay in a year. In 1993, there were approximately 44,000 charter and sightseeing boat passengers that were transported past Anderson Bay (Stephens, 1993; Valentine, 1993). In addition, approximately 28,000 passengers embarked or disembarked from Valdez on Alaska Marine Highway ferries in 1992 (Ashmore, 1993).

3.11 SOCIOECONOMICS

The Socioeconomic study area is the City of Valdez (270 square miles), located at the southern terminus of the Richardson Highway at the head of the east/west oriented Port Valdez in Prince William Sound. It is 305 road miles from Anchorage, and 45 air miles northwest of Cordova (Darbyshire & Associates, 1991). The City of Valdez is a scenic, tourist port town with short, mild summers and long winters.

3.11.1 Population

The population of the City of Valdez in 1990 was 4,068 persons (table 3.11.1-1) (U.S. Bureau of the Census, 1990). This represents a 32 percent increase over the 1980 population of 3,079 persons and a 20 percent increase over the 1988 pre-*Exxon Valdez* oil spill population of 3,686 persons (Department of Finance, 1992). Beginning in March 1989, Valdez became the center for oil spill cleanup operations, precipitating a huge influx of people to the city. Although cleanup operations have ended, the city's population remains above pre-spill levels. In the period from 1970 to 1980, the TAPS pipeline and marine terminal construction led to a 206 percent population increase.

During the summer months of 1990, population was estimated at 4,653 persons. Additional employment in fish processing and new construction during the summer is responsible for the temporary increase in population (Department of Finance, 1992).

Population increases for the State of Alaska were 34 percent and 37 percent from 1970 to 1980 and 1980 to 1990, respectively (table 3.11.1-1). Population increase for the United States was 9.89 percent from 1980 to 1990, significantly lower than the growth rate of Valdez and Alaska.

TABLE 3.11.1-1

Population and Selected Demographic Census Numbers

	Total Population	% Change Population	No. of Households	Per Capita Income
1990		1980 to 1990		
City of Valdez	4,068	32%	1,277	26,968
Alaska	550,043	37%	188,915	17,610
1980		1970 to 1980		
City of Valdez	3,079	206%	957	13,371
Alaska	401,851	34%	131,463	10,193
1970				
City of Valdez	1,005	NA	281	NA
Alaska	300,382	NA		NA

NA=Not available
Source: U.S. Bureau of the Census, 1970, 1980, 1990.

3.11.2 Economy, Employment, and Income

Total employment for the City of Valdez was 2,200 persons in 1990 (table 3.11.2-1) (Alaska Department of Labor, 1992). The Valdez economy is heavily dependent on the Alyeska oil operations, tourism, Prince William Sound commercial fishing, and Federal and state government expenditures. In 1990, public administration (34.0 percent) and transportation, communication, and utilities (TCU) (25.6 percent) were the major employment sectors. The primary employer in the transportation sector is Alyeska, which is responsible for the transport of crude oil through the TAPS pipeline system to Valdez and then by tanker to customers. Alyeska accounted for 40 percent of the Valdez TCU industry employment in 1990. An airline service, boat charters, shipping agents, stevedoring (i.e., loading and unloading ships), car rentals, and a bus and taxi service make up the remainder of the sector's employment. The 1989 *Exxon Valdez* oil spill created approximately 125 permanent transportation positions in Valdez, primarily through the establishment of the Ship Escort Response Vehicle System (SERVS), which is a subsidiary of Alyeska (Department of Finance, 1992).

The City of Valdez has experienced two spurts in employment growth in the past two decades. The first came with the construction of the Alyeska TAPS pipeline and oil terminal in the mid 1970s. This construction led to the tripling of employment levels in the city. When the pipeline and oil terminal were completed in 1977, employment fell by more than 50 percent in Valdez. Employment levels did not fall below pre-construction levels because Alyeska became a major employer in the city.

In the period from 1980 to 1985, employment grew by just under 6 percent, but the Valdez economy was moving towards greater diversification. Pipeline revenues contributed to the construction of air and cargo port facilities as well as a civic center. Valdez became a major

TABLE 3.11.2-1

Employment by Major Industrial Sector in the City of Valdez

	1980	1985	1988	1989	1990	1991
Construction	226	112	38	23	26	34
Manufacturing	9	171	206	261	247	288
TCU	449	416	388	1,129	563	655
Trade	105	155	175	237	265	228
FIRE	36	20	15	24	30	32
Services	242	251	294	462	346	306
Government	680	725	673	751	749	604
Total	1,746	1,850	1,789	2,887	2,200	2,146

TCU = Transportation, Communication, and Utilities
FIRE = Finance, Insurance, and Real Estate
Source: Alaska Department of Labor, 1991.

tourist attraction catering to cruise ships and visitors seeking hunting, fishing, and sightseeing opportunities. The fish processing business increased its presence in the local economy. Valdez offered road and air access, labor availability, and a dramatic increase in the sound's salmon fishery.

The *Exxon Valdez* oil spill of 1989 dramatically increased employment levels in Valdez. The workforce nearly doubled within 2 weeks of the spill. Total employment reached 2,887 in 1989, with enormous gains in the transportation sector. Again, despite a fall-off in these jobs after spill cleanup, employment remains above pre-spill levels.

Manufacturing has consistently increased in importance in the Valdez economy, representing 11.2 percent of employment in 1990 compared to less than 1 percent in 1980. Increases in transportation and manufacturing are partly attributable to the increase in commercial fishing that has occurred in Valdez. On the other hand, construction employment has declined from 1980 levels of 226 persons to the 1990 level of 26 persons, an 88 percent decrease. Construction employment increased in 1992 when the Petro Star Refinery was built. In January 1993, the Petro Star Refinery construction was completed and the refinery now employees 25 persons with potential for future expansion (Griffin, 1993).

In 1990, per capita income in the City of Valdez was $26,968 compared to the state average of $17,610. This is due in part to the relatively high average wage earned by the Alyeska Terminal employees.

3.11.3 Housing

The 1990 U.S. Census indicated a total of 1,499 housing units in the City of Valdez with a 14.8 percent vacancy rate. There are approximately 583 single-family homes, 617 mobile homes, and 225 multi-family homes, and a total of 63 hotels, motels, and bed and breakfasts (Darbyshire & Associates, 1991). Nearly 45 percent of all vacant units in 1990 were mobile homes. Many of these mobile homes are considered poor quality housing (Smith, 1992). The vacancy rate for single-family units was 6.9 percent. In the past, the housing market has been tight. Construction of new homes is expensive, especially during the winter months because of the high cost and frequency of snow removal.

The vacancy rate for multi-family units was 22.9 percent in 1990. A number of bed and breakfasts rent rooms to offset the decline in tourism during the winter months. The rental market becomes tight during the summer with increased demand.

The average cost for a moderate house is $130,000 and average fair market rent for a two-bedroom apartment is $853 per month.

In 1992, the Cottonwood, Mineral Creek, and Winterpark subdivisions stimulated housing development. Cottonwood, located west of town off of Egan Drive across the Mineral Creek Bridge, currently has about 34 lots on 300 acres of land. Also located west of town, between West Egan and Pioneer near the elementary school, is Winterpark which has approximately 30 lots with an additional 50 or 60 acres available for development. Mineral Creek Heights is located on North Mineral Creek Drive, north of town. Additional areas for development include the Robe River subdivision, located 5.5 miles east of town and Alpine Wood, located 10 miles outside of town. These subdivisions use city water and either city or onsite sewer. There is adequate land to meet foreseen demand; however, sewer and water services may need to be expanded in certain areas (Dengel, 1993). Foreseen demand does not include construction and operation of the Yukon Pacific LNG facility.

3.11.4 Public Facilities and Services

The City of Valdez school programs and curricula have an excellent reputation statewide (Darbyshire & Associates, 1991). The school systems serve students in grades K-12. There is an elementary school with 583 students. The elementary school has a 650 person capacity. The junior high school has 154 students with a facility capacity of 125 students. Four new modules were constructed in 1991 to support the additional students. The high school has 232 students, with a facility capacity of 400 students. There are no immediate plans for expansion.

The pupil to teacher ratio is 15 to 1, and there is little teacher turn-over. The teacher pay schedule ranks in the top 3 of the 54 school systems in the State of Alaska. Facilities include libraries and gymnasiums, which are used for community events as well. Books and supplies are currently adequate (Tongen, 1992).

The Valdez Community Hospital is a 15-bed acute care facility managed by Lutheran Home Services Management Company. There are four doctors who practice out of the Valdez Medical Clinic located next to the hospital. The hospital has 34 employees, including 12 nurses, 6 nurses' aids, and 1 licensed practical nurse. The hospital is fully equipped and includes emergency room, surgical, and radiological facilities as well as a laboratory. In 1989 during the *Exxon Valdez* oil spill cleanup, additional doctors were brought into the hospital. Despite increased staffing, hospital services were overwhelmed by the number of persons seeking care at the hospital (Jacobs, 1993).

The police department has approximately 24 full-time employees, including the Chief of Police, 14 certified officers, 4 jail officers, and 5 dispatchers. Officers work 12-hour shifts with

7 days on and 7 days off. All police on the force must complete Alaska State Troopers Police Training. The department owns seven cars (Crystal, 1992). The jail can house 16 offenders. In 1991, the department assumed civil defense responsibilities in order to ensure the health and safety of the public during and after a civil or natural disaster (Darbyshire & Associates, 1991).

The Valdez fire department has 12 full-time employees including the Fire Chief, 3 captains, 3 lieutenants, 3 engineers, and 1 secretary. The department also has approximately 25 volunteer fire fighters from the community. Fire fighters work in 24-hour shifts, averaging 150 hours a month. In addition, the Alyeska Fire Brigade is available to assist during large-scale fires, including emergencies at the terminal. Alyeska's helicopter is routinely used by the fire department for search and rescue missions (Lundfelt, 1993).

The fire department trains fire fighters in fire fighting and emergency services. The department provides public safety programs in the area of fire protection, rescue, and emergency medical services (EMS). The fire protection program includes marine fire protection response and investigations, in addition to structural fire protection and training. The rescue program is designed to handle any reasonable contingency, including high angle mountain rescue, avalanche rescue, and swiftwater rescue (Darbyshire and Associates, 1991).

Equipment owned by the fire department includes five engines and two heavy tankers (McCollum, 1992). EMS personnel operate three fully equipped ambulances and a rescue truck, in addition to contracting for local aviation service when required. The fire department headquarters and main station are housed in the east north wing of City Hall. There are additional stations at the airport, the Robe River subdivision, and Alpine subdivision (Darbyshire & Associates, 1991).

Police and fire departments experienced unusually high demands during the *Exxon Valdez* oil spill cleanup. For the most part, existing staff met demands successfully, but both departments were strained and overworked. Currently, staffing and facilities adequately serve the community's needs.

The main public water system, Valdez Downtown, services the majority of the city. It consists of four wells with total usage of 1.5 million gpd. Total pumping capacity is 4.3 million gpd (3,000 gpm). There are two wells within the South Central Division System serving a small rural area. The Robe River Subdivision and Loop Road system each have one well (Schlitz, 1992). The Valdez Comprehensive Development Plan notes that any additional development, such as the Mineral Creek Subdivision, will require more wells (Darbyshire & Assoc., 1991). The Valdez Sewage Treatment Plant operates at 60 to 70 percent capacity, taking in 1.75 million gpd (Schlitz, 1992).

3.11.5 Fiscal

The City of Valdez 1991 revenues were approximately $37 million, down 4 percent from the 1990 level of $39 million (table 3.11.5-1). Revenues for 1991 include approximately $18.8 million in taxes, $12.9 million in intergovernmental transfers, and $3.2 million in revenues from investments and property. Taxes received based on the assessed value of oil-related facilities are the major revenue source, accounting for 90 percent of the local government's tax base. The assessed value of these facilities is decreasing at a rate of approximately 7.5 percent per year (Darbyshire & Associates, 1991).

TABLE 3.11.5-1

Fiscal Data for City of Valdez

Combined Statement of Revenues, Expenditures, and Changes in Fund Balances
All Governmental Fund Types and Expendable Trust Fund

Year Ended December 31, 1991
With Comparative Totals for Year Ended December 31, 1990

	Governmental Fund Types			Fiduciary Fund Type	Totals (Memorandum Only)	
	General	Special Revenue	Capital Project	Expendable Trust	1991	1990
Revenues:						
Taxes	$18,798,480	–	–	–	18,798,480	19,332,389
Licenses and permits	94,973	–	–	–	94,973	61,464
Fines and forfeitures	30,370	–	–	–	30,370	36,373
Intergovernmental	6,034,005	6,871,487	648,083	–	13,553,575	12,991,224
Revenues for use of money and property	1,026,169	2,197,064	–	2,247	3,225,480	4,050,350
Charges for services	473,137	836,365	–	–	1,309,502	1,646,470
Other	–	208,278	34,375	–	242,653	799,791
Total revenues	26,457,134	10,113,194	682,458	2,247	37,255,033	38,918,061
Expenditures:						
Current:						
General government	2,970,348	–	–	–	2,970,348	2,943,707
Public safety	2,682,124	–	–	–	2,682,124	2,550,358
Public works	2,097,280	688,076	–	–	2,785,356	2,852,930
Public service	2,611,242	810,609	–	–	3,421,851	3,278,469
Other services	–	45,450	–	3,000	48,450	28,088,433
Education	–	8,346,372	–	–	8,346,372	7,915,064
Debt service:						
Principal retirement	5,030,000	–	–	–	5,030,000	4,710,000
Interest and fiscal charges	4,908,074	–	–	–	4,908,074	4,955,489
Capital projects	–	–	3,517,819	–	3,517,819	2,775,812
Total expenditures	20,299,068	9,890,507	3,517,819	3,000	33,710,394	59,990,262
Excess of revenues over (under) expenditures	6,158,066	222,687	(2,835,361)	(753)	3,544,639	(21,072,201)
Other financing sources (uses):						
Operating transfers in		3,791,258	1,871,523	–	5,662,781	6,255,385
Operating transfers out	(5,548,040)	(2,671,443	–	(36,608)	(9,256,091)	(9,642,825
Net other financing sources (uses)	(6,548,040)	1,119,815	1,871,523	(36,608)	(3,593,310)	(3,387,440)
Excess of revenues and other financing sources over (under) expenditures and other uses	(389,974)	1,342,502	(963,838)	(37,361)	(48,671)	(24,459,641)
Fund balances, January 1	5,652,271	22,104,184	2,255,947	37,361	30,049,763	54,509,404
Fund balances, December 31	$5,262,297	23,446,686	1,292,109		30,001,092	30,049,763

Source: Comprehensive Annual Financial Report of the City of Valdez, Alaska, 1992.

The city expended $3.5 million on capital improvement projects during 1991. Debt levels are not excessive at $50 million, down $7 million from the 1990 level. There is no income or sales tax in the City of Valdez. The property tax rate was $19 per $1,000 of assessed value in 1992. A bed tax of 6 percent is charged by hotels, motels, and bed and breakfasts.

3.12 TRANSPORTATION

Roads and highways are administered by both the state Department of Transportation and the City Engineering Department. Other transportation facilities, including the port, harbor, and airport, are administered by the Municipal Dock/ Boat Harbor Department.

3.12.1 Highways

The Alaska Department of Transportation manages 34 miles of roads located within the city limits, including Richardson Highway connecting Valdez with Fairbanks, Anchorage and the lower-48 states. This is a two-lane highway with 6-foot shoulders that is in good condition. Other roads under state management include Mineral Creek Loop Road, Egan Drive, and Dayville Road, two-lane paved highways with no shoulders. Given current traffic patterns, Mineral Creek Road and Egan Drive, two heavily used roads, will need upgrading within the next 10 years.

The City of Valdez maintains 22.29 miles of roads. The ages of the roads range from 6 months to 27 years, and most are less than 15 years old (City of Valdez, 1992). Normally, roads within Valdez would have a 30-year life with proper maintenance and normal traffic.

In general, the city's infrastructure is well maintained and quite able to handle a population of twice its present size (Department of Finance, 1992). Heavy traffic is a problem on most roads during the summer months.

3.12.2 Marine

Valdez has a bustling port with two separate deep water docks, a city dock with a 2-acre staging area, and a container terminal with a 21-acre staging area (Darbyshire & Associates, 1991). In terms of activity level, the port is not overcrowded. Usual marine traffic consists of a number of oil tankers, cruise ships (averaging about 35 landings a summer), approximately 200 fishing boats, a general cargo barge, and several foreign freezer ships. Operational procedures that govern marine traffic in and out of Port Valdez are discussed in section 2.1.3.

The Alaska State Ferry System provides ferry transportation to Valdez from Cordova during the winter and from Whittier during the summer. The winter schedule includes stops in Valdez about every 2 days, while the summer schedule, beginning May 1, has scheduled stops 4 days a week.

The City of Valdez boat harbor provides boat moorage, amenities (such as showers, rest rooms, fresh water), and haul out services. There are 513 slips and a waiting list of 2 to 3 years for available space. During 1990, the harbor operations had revenues of over $350,000 and expenses of $315,000 (Darbyshire & Associates, 1991). There is a boat harbor expansion plan which is in the initial phases of development. It would increase the current number of slips to a maximum of 600.

3.12.3 Airport

The Valdez Airport, located east of the Valdez city center, is a relatively large and adequate airport for a city the size of Valdez (see figure 2.1.4-2). The runway is 6,700 feet long and well lit for nighttime flights. The airport normally handles 24 private planes and 7 commercial flights in and out per day (this increases to 8 or 9 flights during the summer months). Mark Air and ERA are the two major carriers. There are also two helicopter companies and a few cargo and charter planes. In 1989 during the *Exxon Valdez* oil spill cleanup, airport operations averaged approximately 400 to 500 flights per day. There is a waiting list for airplane hangars. Room is available to construct additional hangars, although none are currently planned (McAllister, 1992).

3.13 SUBSISTENCE

Projects proposed for the State of Alaska, which require Federal permits prior to construction and which are determined to potentially have significant effects on the human environment, are required to evaluate the effects of those projects on subsistence uses and needs under Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA). ANILCA requires the preparation of an evaluation of effects of a project on subsistence use and needs, a finding of whether subsistence uses will be significantly affected, a public hearing with prior notification in the area, and a Section 810 determination.

The subsistence use of resources has been traditionally and still is pursued as a way of life in much of Alaska. It is an integral part of the social structure, cultural traditions, and identity, as well as a source of nutrition for Alaska Natives. The foundation of their social and cultural systems is the utilization of the natural environment and its resources. Subsistence foods typically comprise a significant portion of their diet, particularly in smaller villages where imported foods are not readily available or are expensive to transport to the area. Much of Native Alaskan culture is centered around teaching subsistence methods to the young, activities to obtain subsistence foods, sharing and exchanging resources with others, and the religious and cultural gatherings in which the food is shared or eaten.

3.13.1 Overview of Resource Harvesting

Subsistence harvesting patterns are determined by the types of resources available, the proximity of those resources, the season, ease of travel and access, and historical uses of resources. Each community relies upon specific subsistence resources to varying degrees based upon these factors. Major subsistence resources include fish, invertebrates, marine mammals, deer, waterfowl, bird eggs, firewood, and house logs. Deer are generally the most commonly harvested resource. Goat hunting takes place above mountain timberlines, particularly in the eastern part of Prince William Sound.

Major subsistence harvesting activities occur year-round but harvesting of specific resources is highly seasonal. Salmon are primarily harvested from May through October; crab, shrimp, and halibut from April through October when boating is easier and the species are not in deep waters; shellfish from September through April; and deer are hunted after October when the cold weather drives them to lower elevations. Hunters usually do not harvest seal and sea lion during the pupping season.

Under current regulations, only Alaska Natives can legally hunt sea mammals. Seals are hunted throughout Prince William Sound, but most often in the western part of the sound.

3.13.2 Community Harvesting

Two communities exist in the project area, Valdez and Tatitlek, from which subsistence/personal uses are most likely to occur and that could potentially be affected by increased tanker and other vessel traffic and potential accidents. Subsistence/personal harvests are described below for each community. The primary sources of information concerning subsistence and personal use of resources are the ADFG (1988) and Rural Alaska Community Action Program (1981).

Valdez

Valdez primarily has a wage employment and cash economy. As a result, Valdez residents' hunting and fishing levels are considered low when compared to residents from elsewhere in the Prince William Sound/Copper River Basin region. In 1987, the Alaska Joint Boards of Fisheries and Game classified Valdez as a nonrural area and, as such, it would not receive priority hunting and fishing rights if subsistence resources were determined to be significantly limited. Thus, harvests by Valdez residents since 1987 have been classified as personal use or recreational, and are not considered to be subsistence.

Tatitlek

Tatitlek is the oldest remaining Native community on Prince William Sound. Tatitlek is a Chugach Eskimo community of 119 people (in the Tatitlek census designated place [CDP] for 1990; U.S. Bureau of Census, 1992) located on Prince William Sound, 16 miles south of Anderson Bay, and outside of Port Valdez. It is on a point surrounded by the Tatitlek Narrows and Boulder Bay, and across from Bligh Island. Access is primarily by boat and plane.

The village economy is primarily based upon commercial fishing and subsistence harvesting activities. Approximately 83 percent of the households rely upon fishing-related employment on at least a seasonal basis. In 1979, 43.8 percent of the Native households had a net annual income of less than $10,000, and over 60 percent were under $15,000. The majority of the cash appeared to be expended on fuel, groceries, and fishing equipment. Overall, income levels and the amount spent on food, expensively boated or air freighted in from Cordova and Valdez, indicated that residents rely heavily upon subsistence harvesting activities to meet their dietary needs (Rural Alaska Community Action Program, 1981).

Tatitlek residents focus summer (May through August) subsistence harvesting activities on salmon, berries and plants, and intertidal resources (i.e., clams, cockles, octopus, shrimp, sea cucumbers, and herring roe). Year-round subsistence harvesting occurs for halibut, seal, crab, ducks, octopus, cockles, clams, and chiton (gumboot). Harvest activities of residents tend to be oriented to use of the relatively close marine and coastal areas (Rural Alaska Community Action Program, 1981).

In 1979, at least 25 percent of Tatitlek residents harvested 39 of 113 subsistence resources available, 13 of these were fish. Three-fourths or more of the households harvested silver salmon, red salmon, and pink salmon. Fifty to 74 percent of the households harvested king salmon, chum salmon, and halibut. Twenty-five to 49 percent of households also harvested herring and red snapper. Salmon harvests annually averaged 113 pinks/household, 50 chum, 43 red, 38 silver, and 10 king salmon. Salmon were primarily harvested by use of gillnets in saltwater (Rural Alaska Community Action Program, 1981).

Game subsistence harvesting was slightly less pervasive than fish harvesting. Twenty-five percent or more of the households harvested 12 big game and bird resources. Fifty to 74 percent of the households harvested deer while 25 to 49 percent harvested black bear and goat. Fifty percent or more of the households harvested goldeneye, Canada goose, and bird eggs; and 25 to 49 percent harvested buffalohead, loon, mallard, common merganser, scaup, black scoter, and surf scoter (Rural Alaska Community Action Program, 1981).

Fifty to 75 percent of Tatitlek households harvested tanner crab, octopus, cockles, chiton (gumboot), and seaweed with herring roe. In addition, one-fourth to one-half of the households also harvested dungeness crab, king crab, butter clams, razor clams, and shrimp (Rural Alaska Community Action Program, 1981).

Three-fourths or more of the households harvested harbor seal and 50 to 74 percent harvested sea lion.

Over one-fourth of households harvested seven types of berries and plants. Three-fourths or more of Tatitlek households harvested salmonberry and highbush blueberrys; 50 to 74 percent harvested wild celery; and 25 to 49 percent cloudberry, highbush cranberry, and nagoonberry (Rural Alaska Community Action Program, 1981).

3.14 CULTURAL RESOURCES

Prehistoric/aboriginal site density in the Prince William Sound area is quite low in comparison with other Alaska coastlines, and only a few major site excavations have been carried out. No intact sites predating about 3800 BP have been found in the area, possibly because of tectonically induced shoreline changes. As a result, the culture history for the area is based mainly on extensive surveys and excavations at the Palugvik site in the early 1930s by de Laguna (1956). This site is located approximately 56 miles southeast of Anderson Bay on Hawkins Island in southern Prince William Sound. She defined four cultural stages for the area. These stages are based on diagnostic artifacts, presence or absence of European trade goods or skeletal evidence of European diseases, degree of shell and bone decomposition in middens, and the nature of trees growing on abandoned sites. The attributes of these stages (Hassen 1978 and Workman 1978, cited in Mobley et al., 1990) may be summarized as follows:

Older Prehistoric Period (before 1750 BP). Sites and components assigned to this period exhibit decomposed shell in midden; incised stone plaques; a relative abundance of planing adzes and smaller woodworking tools; a predominance of simple stemmed slate blades and slender, awl-like slate projectile points, over barbed slate blades; chipped ulu-shaped scrapers; socket pieces with bifurcated bases; a greater abundance of bone or shell beads; a scarcity of fire-cracked rock; and the absence of native copper.

Younger Prehistoric Period (undated). Sites and components assigned to this period exhibit less shell decomposition. In contrast to the Older Prehistoric Period, fire-cracked rock (interpreted as sweatbath refuse) is abundant, and native copper is present. Other attributes associated with this period are grooved splitting adzes, stone picks, very small adze blades or scrapers, small ground chisels, barbed slate points, socket pieces with plain bases, and war clubs.

Protohistoric Period (undated). Attributes of sites and components of this period are similar to those of the earlier Younger Prehistoric Period, with large blue "Cook type" beads (and presumably some iron).

Historic Period (after 1783). The start of this period is marked by the appearance of "Glacier Island" trade beads and other European goods associated with the beginning of Russian expansion into the region. Human bones from this period show evidence of introduced disease; Christian burial practices are used by the aboriginal population.

More recent archeological work in the Valdez area commenced in 1969 and 1970 in connection with the construction of the TAPS Project (Workman, 1970). No sites were found at that time. Subsequent work has consisted almost exclusively of surveys and inventories and the area sequence outlined above remains unchanged.

The most common types of sites found in the Prince William Sound area are rockshelters and villages. The latter are generally located close to shore in proximity to resource loci, primarily salmon streams and on protected waters with a beach suitable for landing water craft. A preference for locations near caves suitable for interment of the dead is also indicated. Yukon Pacific sponsored a cultural resources survey of the LNG Project area concentrating on locales possessing one or more of these characteristics (Hall, 1990). No cultural resource sites were located.

A check of the Alaska Heritage Resource Survey (AHRS) files identified eight non-aboriginal historic period sites around Port Valdez in the area stretching from Old Valdez in the east to Entrance Island in the west. Two additional sites were noted on the AHRS map in the same area. None of these 10 sites is located within the project area.

The Alaska SHPO has reviewed the report of the Yukon Pacific-sponsored cultural resources survey of the project area and concluded that no properties on or eligible for the NRHP are located in the project area.

One commenter noted that a burial site was located on the property. Staff investigated this on June 11, 1993, and located a monument which identified the grave site of Harry Alden Henderson, born July 12, 1915, and died March 27, 1964 (the date of the great earthquake at Valdez). The monument is located on an island at the mouth of Henderson Creek within Anderson Bay, but it is not located within the construction limits of the project.

3.15 ALTERNATIVE CONSTRUCTION CAMP SITE AND ACCESS ROAD

After examining several potential sites for the location of the construction camp site, one alternative offered sufficient merit to be carried forward for further assessment and public comment. This alternative, as described in section 2.3.1, would have the construction workforce housed in Valdez at the existing, but upgraded, camp site adjacent to the airport. This camp site is owned by Arctic Camps Limited, a commercial operation which operates a 700-person camp on its 7.5-acre property. About half the site is occupied by its buildings which include 7 two-story dormitories and a cafeteria/dining room that can seat 250. The remainder of the site, which is located on the gravel outwash downstream from the Valdez Glacier, supports grass and shrub vegetation and there are no waterbodies or flowages. Arctic Camps just recently leased an adjacent 10-acre parcel of land which has a 100-foot by 130-foot steel warehouse building which the company intends to rent to outside agents. It also intends to construct a new camp.

Arctic Camps has temporary camps at other locations for construction and other purposes. Its current inventory of modular structures is sufficient to expand its Valdez facilities to accommodate the projected peak Yukon Pacific workforce of 4,000 (Purcell, 1993). From a scheduling point of view, the camp upgrades could be put in place well in advance of the main construction, making a camp at Seven Mile Creek unnecessary.

With this camp site alternative, it would be necessary to construct road access to the Anderson Bay site. This would require a total of 1 mile of new, off-right-of-way road extending from the end of the existing Alyeska site road (figure 2.3.1-2) west to the pipeline right-of-way at Salmon Creek. From there, 2.5 miles westward to the Anderson Bay site, the road would follow the pipeline alignment which generally follows the shoreline at the 100 foot contour. The road would require the clearing of an estimated 9 acres of forest over and above the clearing requirements of the pipeline right-of-way. This forest type is spruce-hemlock, interspersed with alder and is typical of the region and is similar to what currently exists at the LNG plant site.

Although no wetlands have been identified from the available aerial photographs, some small ones can be expected to occur along the 3.0-mile alignment. These would have to be filled to prepare the road bed.

This access road would also cross Sawmill, Salmon, and Seven Mile Creeks. The latter two crossings could be paired with that of the pipeline. Each of these streams is known to support pink and chum spawning. Bears have been observed feeding at Sawmill Creek as well.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 GEOLOGY AND SOILS

During construction of the LNG facility, 3,018,000 cubic yards of overburden and 6,655,000 cubic yards of rock would be excavated. This process would involve grading, ripping, excavating, and movement of material by heavy equipment in addition to drilling and blasting. Approximately 70 percent of the generated material would be used for structural fill onsite. The remaining 30 percent of debris would be disposed of as discussed in previous sections. The excavated areas would consist of steep rockcut slopes and level benches which would be the primary sites for the facility.

4.1.1 Bedrock and Slope Stability

The stability of the surficial deposits and shallow bedrock would depend on the angle or slope of the cut, the nature and orientation of bedrock jointing, groundwater conditions, and the strength and weathering characteristics of the material. During site construction, major cuts would be made at the south edge of the site and along the access roads. The proposed angle of the slope is 50° and would be oriented approximately east-west. Slope cuts with angles 50° or greater would oversteepen the slopes and increase the potential for rock slides. The proposed 50° slope cuts would not oversteepen the bedrock slopes. The new cuts would, however, weaken the rock along existing foliation, bedding planes, and joints making downslope movement of rock and soil more likely. Yukon Pacific proposes to minimize this risk by using rock bolts to stabilize the cut slopes. These bolts would be at least 30 feet long and placed on 10 foot by 10 foot centers across slopes where unstable conditions are encountered. The bolts would substantially reduce the risk of bedrock slope failures. Instability of cut rock faces was encountered during the construction and operation of the Alyeska facilities. Stabilization of these walls using a combination of rock bolts and drains, and frequent monitoring was apparently successful. The planned maximum rock cut-slope height for the LNG plant site is 100 feet. If this height is exceeded during construction, then the slope would be benched. These height limits would minimize the potential for bedrock slope instability.

The presence of water on rock slopes also increases the pore pressure which facilitates ground movement. Yukon Pacific plans to dewater the rock slopes with the use of weepholes and toe drains. The proposed dewatering would greatly add to the slope stability. Draining this water would also reduce the effects of ice wedging during the winter months. Ice wedging results in the fracturing of rocks caused by the expansion of water upon freezing. The water collected would be channeled into the planned drainage and stormwater system.

For added safety, Yukon Pacific proposes to construct a permanent catchment area at the base of each slope. The catchment would have a minimum width of one-half of the slope height. This would be sufficient to catch all debris from minor rock falls that can occur during construction.

Thin deposits of glacial overburden are widespread throughout the site. The overburden is 0 to 15 feet thick and composed of silt, fine- to medium-grained sand, and gravel. Construction and movement of these materials by heavy equipment may result in localized slumping. During daily construction activities the available heavy equipment would be sufficient to remove these unstable deposits. Any unstable areas would be maintained on a daily basis so that slumping does not occur during nonconstruction periods. Maintenance of unstable areas would include grading the sites to a lower angle and installation of erosion control measures, if necessary.

4.1.2 Surface Erosion

The primary project-related impact on soils would occur during site excavation. This would include the removal of overburden soils down to bedrock and the placement of these soils in planned fill and disposal areas. The soils would be removed because their long-term stability beneath the permanent facilities cannot be ensured. Under the current construction schedule, excavation of the site would take place over three consecutive summers.

The total construction area subject to vegetative clearing and excavation would be 392 acres. This includes approximately 377 acres of forest and shrub and 15 acres of palustrine wetlands. Possibly not all of this area would be denuded and graded; however, this analysis assumes the project would impact the entire acreage. The soil overburden profile ranges from very thin on the ridges to as thick as 20 feet in the glacial troughs. Because the bedrock is so shallow on the ridges and is often covered with a layer of weathered and broken rock, the overburden material is expected to consist of organic soils, stumps, roots, glacial till, and rock. Approximately 3,018,000 cubic yards of overburden material would be generated during the excavation activities. It is estimated that up to 50 percent of this material would be organic soils.

The average annual precipitation at the site is about 61 inches which includes the water equivalent of 294 inches of snow. Under the current site conditions, the steep slopes and shallow soils result in an exceptionally high runoff rate (approximately 12 cubic feet per second per square mile). The drainages in the area are steep ravines that discharge into streams that flow directly into Anderson Bay. During the 3-year excavation period, portions of the construction site would be disturbed and exposed to potential water-related impacts before the soils would be relocated to the designated fill areas and the potential for soil loss and sedimentation due to rain runoff and snow melt would be high.

To reduce surface water related impact on soils, Yukon Pacific filed an Erosion Control Best Management Practices Manual (BMPM). The BMPM is not a detailed site-specific plan rather it describes general guidelines and erosion control techniques that are applicable to the non-permafrost conditions characteristic of the Valdez area. Yukon Pacific has indicated that a detailed site-specific erosion and sediment control plan that conforms to the BMPM guidelines would be developed prior to initiation of construction. This site-specific plan is required by the state (SPCO, 1993) and would be submitted to the ADNR for review and approval as part of the state's conditional right-of-way lease. The ADNR, acting as the lead state agency, would coordinate its review with any other state agencies opting to participate in the review.

The objective of Yukon Pacific's BMPM is threefold. First, it provides guidelines for stabilizing soils and controlling hydraulic erosion processes to minimize erosion-related damage to natural terrain and earth structures. Second, it recommends methods to decrease the potential for siltation of streams and other bodies of water that receive runoff from the proposed site. Finally, it emphasizes the importance of maintenance of the installed erosion control structures during and following construction.

Five major topics are addressed in the BMPM: site preparation; slope stabilization measures; channel control structures; sediment retention structures; and revegetation measures. For each of these five topics the BMPM provides several best management guidelines that either could or would be implemented to minimize disturbance to the local environment. A brief summary and analysis of effectiveness of the best management practices for each of the five topics are discussed below.

Site Preparation

Clearing activities would be restricted to areas marked on the ground prior to initiation of construction. Trees would be felled within the permitted clearing boundaries. Any felled trees or other debris which accidentally enters a stream would be removed from the water within 48 hours. The BMPM specifies that any borrow sites which would be used should be worked in phases to minimize the amount of exposed surface area at any one time. It also suggests that these borrow sites would be located away from groundwater seepage zones and floodplains to the extent possible. The BMPM indicates that surface runoff upslope of the borrow areas should be diverted away from the borrow areas by diversion ditches, while surface runoff from the borrow areas should be collected in settling ponds.

Temporary erosion and sediment controls would be installed on the downhill side of construction work areas prior to any earthwork. Temporary drainage ditches would be constructed prior to major ground disturbance work to facilitate offsite drainage through the work area until permanent drainage structures could be installed. Temporary control structures would be designed for a 10-year storm and permanent control structures would be designed for a 50-year storm. Cut and fill slope angles would vary based on the composition and erodibility of the fill material. Steeper slope angle would be allowed for coarse-grained, less erodible material than for fine-grained or high moisture soils.

Slope Stabilization

Slopes would be stabilized by constructing structures to direct surface runoff away from erodible slopes and by revegetating disturbed areas. Diversion terraces and interceptor dikes would be installed or cut into slopes to channel runoff laterally away from erosion-sensitive areas to stable erosion-resistant channels. Diversion levees may also be installed along the top of slopes to prevent runoff from crossing erosion-sensitive slopes. These diversion structures would be cleaned periodically to prevent the buildup of sediment and debris. Benches or flat terraces may be built to stabilize steep cut and fill slopes. These benches would be constructed across the slope and would be engineered to convey water along the bench to stable drainage outlets. Slope drains would be installed where necessary to carry runoff from diversion ditches and levees. The BMPM recommends that slope drains should be lined with rock or some other erosion-resistant material. In some cases these slope drains may outlet into rock aprons or stilling basins to dissipate energy.

Channel Control

Runoff through the facility site would be controlled by culverts, drainage ditches, and/or channel liners. Culverts would be installed to provide stream crossings of roads and other work areas. The BMPM specifies that culverts should be aligned to maintain the stream's natural gradient. Where flow from the outlet of the culvert is excessive, construction of stilling basins or other energy dissipation structures may be required. Other culvert features also may be required including debris deflectors upstream of the culverts to prevent obstruction of flow, thaw cables to prevent culverts from freezing, and markers to identify the inlet and outlet of the culverts during periods of deep snow cover.

Drainage ditches may be used to control runoff. Where necessary temporary ditch checks or check dams would be installed in ditches to reduce flow velocity and erosion until the ditches could be lined with an erosion resistant material such as rock riprap, erosion control fabric, gabions, timbers, or concrete blocks.

Sediment Retention

Sediment retention would ultimately be accomplished through revegetation of disturbed areas. Prior to reestablishment of a vegetative cover, sediment would be controlled using a variety of structures. Silt fence would be installed in upland areas along the toe of slopes and along streams to prevent sediment from reaching waterways. Periodic inspections would be required to check silt fences for tears and accumulation of sediment. Excess sediment would be removed as necessary. Sediment basins may be installed in drainages to help remove sediments from runoff. The BMPM specifies that several factors should be considered in sediment basin design including the rate of flow, desired retention time, and particle size of the suspended sediment. Sediment traps constructed of stone, brush, or hay bales may be used to retain sediments in small channels.

Revegetation

Disturbed areas that are prone to erosion would be revegetated as soon as practical after final grading is completed. In the event that final grading is delayed for a prolonged period of time, temporary seeding may be required. The BMPM recommends revegetating with native plants and grasses. The optimum period for seeding would be between May 15 and June 20. Fertilizer and mulch may be applied in some areas to control erosion and promote seedling growth. In areas of high soil moisture erosion control fabric may be installed instead of mulch.

Stormwater Control

In addition to developing the detailed site-specific erosion and sediment control plan referenced above, Yukon Pacific would develop a stormwater discharge plan as required under the EPA's application requirement for stormwater discharges associated with industrial activity (40 CFR Part 122.26). This plan, which would be reviewed by the ADEC to confirm consistency with state water quality standards, would incorporate many of the sediment control measures specified in the BMPM and would also include measures to control pollutants in stormwater discharges during and after construction. The plan would include an estimate of the runoff coefficient from the site (fraction of total rainfall that will appear as runoff) and the increase in impervious area after construction is completed.

Yukon Pacific's BMPM describes general guidelines and measures that could or would be utilized during construction, but it does not provide detailed information regarding where a particular mitigation measure would be employed or who would be responsible for its implementation. Furthermore, although a variety of erosion and sediment control structures are discussed, the BMPM does not specify the number, size, or, most importantly, the placement of these structures. However, we believe the BMPM does provide a foundation for the development of a detailed site-specific erosion and sediment control plan that would be capable of reducing erosion and sedimentation to acceptable levels. To ensure adequate permanent and temporary erosion control at the project site, we **recommend Yukon Pacific prepare a site-specific erosion control and sedimentation plan that:**

1) **provides detailed procedures for controlling sediment from access road construction including the roadbed, cut and fill materials, culvert installation, and bridge installation;**

2) **provides detailed drawings that show the number, size, and placement of erosion and sediment control structures on the site;**

3) **provides detailed drawings which show the areas that would be revegetated and include a description of the seedmix, seeding methods, soil amendments, and mulching methods that would be used; and**

4) **should be filed, together with comments of the ADNR, if any, with the Secretary of the Commission (Secretary) for review and approval by the Director of the Office of Pipeline Regulation (OPR) prior to initiation of construction.**

The FERC staff's review of the site-specific erosion control and sedimentation plan will concentrate on ensuring that the FERC's erosion control requirements relative to natural gas facilities have been met. Review to ensure other Federal water quality standards for stormwater control runoff will be the responsibility of the EPA, while determination to ensure adequacy relative to the state water quality standards will be made during review by the ADEC. Our recommendation for Yukon Pacific to secure input from the ADNR is an attempt to avoid duplicate approvals from other agencies. The goal of this process is to produce a **single** erosion and sedimentation plan that satisfies the various regulatory agencies involved.

4.1.3 Snow Avalanche Impacts

A preliminary snow avalanche hazard evaluation prepared for Yukon Pacific (Fesler and Fredston, 1991) identified five potential avalanche paths, primarily at the west end of the site. No portion of the main LNG processing or storage facilities, nor the plant or terminal facilities, would be exposed to potential snow avalanche hazard. However, the haul road connecting the facilities could be affected by snow avalanches at two locations, paths No. 4 and No. 5. In both cases, the snow avalanche potential is small and the likelihood of an event infrequent; consequently, normal road clearing operations would suffice to maintain winter use of the access road.

Only facilities located at the south edge of the construction dock area, which will become the cargo/ferry personnel dock, would be within the range of snow avalanche path No. 3 and could be potentially affected. A major avalanche (i.e., approximately a 200-year event) along this path could reach the compound and bury vehicles, break windows, and possibly cause structural damage to buildings. To avoid the potential for damage to facilities located in this area, **we recommend that further field evaluation of avalanches on path No. 3 be undertaken prior to the development of final design in order to determine the need for mitigation.** Simple mitigation measures such as enhanced building strength, the absence of windows on the south side of buildings, or a barrier at the south end of the compound at the base of the avalanche path should minimize danger from snow avalanches.

4.2 SEISMICITY

This section briefly discusses the results of the FERC staff's review of Yukon Pacific's analysis of the earthquake hazards and its proposed design measures to mitigate earthquake-induced damage to the facility. In conducting its review, the FERC staff was assisted by staff of the NIST and the USGS, collectively referred to as FERC staff. The December 23, 1992 report of the NIST/USGS review is entitled "Review Comments on the Design Criteria for the Anderson Bay Terminal of the Trans-Alaska Gas System" (see appendix A).

It is important to note that the intensity of earthquake shaking is only one of many matters of great significance in the seismic design of the proposed facility. The structural and geotechnical parameters governing the response of the plant structures and equipment to ground shaking are of equal or greater importance. The quality and type of materials and equipment selected and delivered, and the quality of the workmanship in the actual construction of the facility are of critical importance. The quality of the constructed facility will depend largely on implementing a sound program of equipment qualification.

It is also important to note that the design of the proposed facility is still in a preliminary phase. The seismic design criteria have been proposed, as required by Federal regulation, but there are many details and significant decisions involving professional engineering judgements yet to be made. Consequently, it is not appropriate for us to recommend specific conditions at this time to address certain issues such as design spectra, damping, and ductility. The recommendations presented in this section of the FEIS form the basis for the staff's conclusions on the proposed design criteria, the acceptable level of risk for the LNG plant, and the fundamental assumptions regarding the seismicity of the site area. Subsequent reviews and approvals of seismic design plans would be done through the Director of OPR's clearance letter process. Since many of these decisions will not be made until the FERC authorization for a place of export and the construction and operation of facilities at this place of export is issued and final design plans are prepared, **we recommend that all final seismic design plans and specifications be filed with the Secretary for review and approval by the Director of OPR. The seismic design measures should take into account the specific recommendations and results of studies specified below.**

Compliance with DOT Requirements/NFPA Standards

The DOT regulations require the project sponsor to determine the most critical ground motion with a yearly probability of exceedance of 10^{-4} or less. The input values are determined on the basis of the seismic source characterization discussed below and in section 3.2 of this FEIS.

The FERC staff believes that the scope of the geoseismic information presented by Yukon Pacific satisfies the seismic investigation requirements of the DOT regulations and the NFPA Standards. Also, sufficient evidence has been provided to demonstrate that the site is suitable for construction of LNG storage tanks and their impounding systems under the criteria of § 193.2061(f). The data do, however, allow for alternative interpretations on the parameters for detailed design as discussed below.

Seismic Source Characterization

One of the important conclusions of the Yukon Pacific seismic hazard studies is that during the service life of the facility as projected by Yukon Pacific (approximately 30 years), the chance for a repeat of a great subduction zone earthquake in the Prince William Sound area comparable to the 1964 event (M_w 9.2) is extremely remote and thus can be discounted with respect to the seismic design of the LNG plant. A great subduction zone earthquake is judged possible in the Yakataga region (the "Yakataga Gap"), approximately 60 miles to the east of the Anderson Bay site. A lower-magnitude earthquake—the so-called "intracycle event"—on the Aleutian megathrust beneath the site, is considered by Yukon Pacific to be a more credible event than a repeat of the 1964 earthquake. Yukon Pacific estimates the magnitude of the intracycle event as M_w 7.75.

Based upon its geologic studies, and a new proposed explanation of how tectonic strain is partitioned between the megathrust and other faults in the region, Yukon Pacific's estimate of the earthquake exposure at the LNG plant site includes the assumption that the strain accumulated on the megathrust prior to 1964 was completely released in the 1964 event. This assumption is significant with respect to earthquake recurrence on the megathrust and the maximum magnitude of the intracycle event.

Yukon Pacific used a number of approaches to evaluate the repeat time for 1964-type earthquakes in the Prince William Sound area. These approaches were based on recent and historic seismicity, plate tectonic data, and geologic (paleoseismic) evidence. However, there is a large discrepancy between estimates of return period (RP) for 1964-type earthquakes derived from paleoseismic studies (RP 600 to 950 years) and from plate tectonic studies (RP 175 to 333 years). This discrepancy is a long-standing issue of discussion in the research community, and the lack of definitive data assures that the issue will not be resolved quickly.

The paleoseismic studies are subject to several difficulties, including: obtaining sufficient samples over a broad region, constraining ages of events, correlating events between samples over large distances, and knowing that all events have been sampled. Given these difficulties, it is not a simple matter to draw reliable conclusions about the repeatability of 1964-type events. While available data may be consistent with the conclusion that such events have repeat times of 600 to 950 years, alternative interpretations are also possible. The possibility of shorter repeat times cannot be ruled out.

While Yukon Pacific presented evidence to support its conclusion that the possibility of a great subduction zone earthquake in Prince William Sound can be disregarded, we believe the Yukon Pacific scenario is not the only credible one that can be deduced from the available data.

Yukon Pacific's analysis of the maximum intracycle earthquake is based on comparisons of the 1964 source zone to other subduction zones that have generated $M_w \geq 9.0$ earthquakes. That comparison may not be appropriate because the tectonic setting of the 1964 zone is much more complex than that of the southern Chile and Kamchatka zones with which it is compared.

That issue notwithstanding, we note that in the western Aleutian zone, which may be equally analogous to the Prince William Sound area, a M_w 8.0 earthquake in 1986 occurred in the rupture zone of the 1957 M_w 8.6 earthquake; only 29 years after that great earthquake. Unless this type of rapid reoccurrence can be ruled out in the Prince William Sound area, the occurrence of an earthquake of $M_w \geq 8.0$ on the megathrust zone below the site during the projected life of the facility must be seriously considered.

We also note that at the projected rate of gas production, the service life of the facility could be much longer than 30 years. Since, with each passing year of low seismic activity, the probability of a major earthquake increases, the maximum likely magnitude for the intracycle event goes from M_w 7.6 in 1995, to M_w 8.2 in 2025. **Therefore, we recommend that the intracycle earthquake specified for facility design purposes be set at M_w 8.2.**

Seismic Design Motions/Criteria

Design Accelerations - Yukon Pacific proposes to apply a dual-level earthquake concept to the seismic design considerations for the LNG plant. We concur with this general approach.

Input values for effective acceleration are proposed to be 0.4g for the OBE, and 0.55g for the MDE. These values would be applied as input parameters to design response spectra. However, Yukon Pacific's supporting documentation for the ground acceleration analysis indicates that the MDE value of 0.55g corresponds to a "reasonable estimate". The same analysis cites 0.62g as a "conservative estimate" and 0.72g as an "upper bound estimate" for zero period accelerations. In that regard, and in consideration of our previous recommendation that the intracycle earthquake be set at M_w 8.2, **we recommend that the MDE value for the effective acceleration be at least 0.6g.**

Design Spectra and Hydrodynamic Effects/LNG Sloshing - DOT regulations also require that the most critical ground motion with a yearly probability of 10^{-4} or less be specified in terms of both horizontal and vertical design response spectra determined from the mean plus one standard deviation of a free-field horizontal elastic response spectrum. In practice, there are a number of different ways to specify design spectra, all involving considerable engineering judgement. The spectra proposed by Yukon Pacific were derived using fixed ratios between controlling values of effective acceleration, velocity, and displacement as proposed by Newmark and Hall in 1982. In the case of the Anderson Bay site a great earthquake in the Yakataga Gap region, 60 miles from the project site, must be considered in the design of the facility. The low frequency components of such an earthquake would not be significantly attenuated and therefore must be considered in the long period range of the design spectrum.

The effect of long period vibrations is a significant consideration in analysis of the tank wall stresses, and the hydrodynamic response (i.e., liquid sloshing) of the LNG in the tanks and the required amount of tank freeboard—the space between the liquid level and the top of the tank. **We therefore recommend that Yukon Pacific evaluate the adequacy of the long period levels of the proposed design response spectra using seismological modelling analyses to estimate directly the long period ground motion from postulated critical design earthquakes on the Aleutian megathrust and in the Yakataga Gap. A report on the methods, assumptions, and results should be filed with the Secretary. The results of that analysis would be incorporated into the seismic design, as appropriate.**

Vertical Acceleration - The level of vertical acceleration proposed by Yukon Pacific is two-thirds of the horizontal acceleration. The DOT regulations state that for source distances less than 10 miles, horizontal and vertical acceleration should be assumed equal. While it is true that the postulated distance of the design earthquake on the megathrust is 12 miles, as opposed to 10 miles, the focus of the design event would potentially be directly below the site.

The DOT regulations are not clear on whether the "source" distance should be measured from the hypocenter—the actual location of the earthquake with a depth below the surface component—or, from the epicenter—the vertical projection of the hypocenter on the earth's surface. Vertical acceleration is likely to be at its maximum in the epicentral area, especially for thrust-type faulting. **On that basis we recommend that the vertical acceleration be set as equal to the horizontal acceleration for design purposes.**

Subsurface Conditions - We also note that Yukon Pacific's proposed design spectra are for structures founded directly on bedrock. Since even relatively small depths of fill or soil deposits can result in significant ground motion amplification, **we recommend that, for all structures not directly supported by rock, design spectra for "competent soil conditions" as recommended by Newmark and Hall (1982) should be used. Under no circumstances shall the agreed upon criteria be less than proposed in the application.**

Duration - An important consideration in the damage potential of an earthquake is the duration of strong ground shaking. This factor is particularly important for major earthquakes of the size that occur along the southern coast of Alaska. Yukon Pacific has presented no explicit discussion or estimate of the duration of shaking to be considered in the seismic design of the facility. In its response to a data request on this issue Yukon Pacific stated that the proposed broad-band design spectrum adequately accounts for duration effects. That may or may not be true for this particular situation. **We recommend that Yukon Pacific conduct a specific analysis of the duration of strong ground shaking likely to be experienced at the site as a result of the design earthquake, and document that the structures are designed to accommodate the ductility demand associated with the duration of the shaking. A report on the methods, assumptions, and results should be filed with the Secretary. The results of that analysis would be incorporated into the seismic design, as appropriate.**

Damping and Ductility - As previously noted, the FERC staff recommends that the occurrence of a M_w 8.2 near-source earthquake during the service life of the facility be considered in the plant design. In a great earthquake the duration of shaking would be longer, and the cyclic strength degradation and ductility demand would be more severe than in the proposed M_w 7.75 magnitude design earthquake. The proposed MDE design spectrum assumes a damping value of 7 percent of critical. According to Yukon Pacific, this represents the lower bound of recommended values for prestressed concrete with no prestress remaining. While this damping value seems reasonable for the stated condition of the structure, we question the ability of a prestressed concrete tank to contain LNG without a major spill if this condition were allowed to develop, particularly in the case of a great earthquake where the duration of shaking would be relatively long.

Yukon Pacific's proposed use of a ductility ratio of 1.2 should also be examined for the case of the longer duration earthquake. The selection of a ductility ratio carries with it the need to ensure that it actually is achieved reliably through proper selection of materials, proper structural detailing, and reliable quality assurance procedures, and that the deformations associated with this ductility ratio do not cause failure. Allowable deformations of LNG tanks in the MDE must be predicated on the premise that an LNG spill would lead to failure, even if it is not triggered by total structural collapse.

Combined Loads/Structural Details - While the load criteria and structural details are incomplete and/or uncertain at this time, deficiencies and inconsistencies must be identified so that they are taken into account in the final design criteria. We have identified areas where we have design concerns that are in addition to those Yukon Pacific has recognized need more work. **Consequently, we recommend that Yukon Pacific file with the Secretary a discussion of each of the following issues, as the design of the facility progresses:**

- **Unless there is clear and convincing justification for lesser values, the load combination factors specified in ASCE 7-88 (1990) should be used.**

- **Use of the calculated flat-roof snow load of 169 pounds per square foot in conjunction with earthquake loads appears to be conservative. This snow load corresponds to a mean recurrence interval of approximately 100 years and does not account for any load reduction due to snow slide-off on the steeper roof slopes. If the ASCE 7-88 (1990) load combination factors are used, then the design snow load with a 50-year recurrence interval could be used in conjunction with earthquake loads.**

- **The design load criteria should account for the possibility of combined seismic and impounded fluid loading for the outer tank. This load combination could be critical for the so-called "double integrity" tank designs.**

- **Since snow load is one of the controlling design factors, the design basis for snow load should be consistent with that for earthquakes. Therefore the design for maximum snow load should use an annual failure probability of 10^{-4}.**

- **For the double integrity tanks, the secondary containment is not isolated from the primary containment, thus creating the potential for collapse of the outer tank as the inner tank fails. There does not appear to be a structurally independent impounding system.**

- **The detail for the joint between the floor of the double concrete wall tank needs additional development to assure proper function under strong ground shaking and possible differential movements and settlement of the tank footing.**

- **The behavior of the circumferential prestressing for the double concrete wall tank is unclear in the event of a wire failure due to corrosion or wind borne missile impact.**

- **Weathering effects on the bedrock formation could affect the rock anchors for the tank foundation and rock slopes in the project area.**

Earthquake-Related Phenomena

As discussed in section 3.2 of this FEIS, the most significant earthquake-related hazard to the LNG plant, other than ground shaking, is the potential effect of damaging waves resulting from seismically induced subsea landslides in Port Valdez. Such waves can occur due to moderate-sized earthquakes as well as great earthquakes and are therefore quite likely to occur during the life of the project. Potential sources of subsea generated waves are shown on figure 4.2-1 while potential locations of wave runup at the Anderson Bay site are shown on figure 4.2-2.

The postulated severe case scenario would involve a wave generated from a large subsea slide on the Shoup Bay delta during high tide. Yukon Pacific estimates that such a wave could attain a height of 13 to 26 feet and result in peak runup on the site of approximately 93 feet. Properly constructed energy dissipation devices could reduce the peak runup to approximately 67 feet. Yukon Pacific proposes the following mitigation measures:

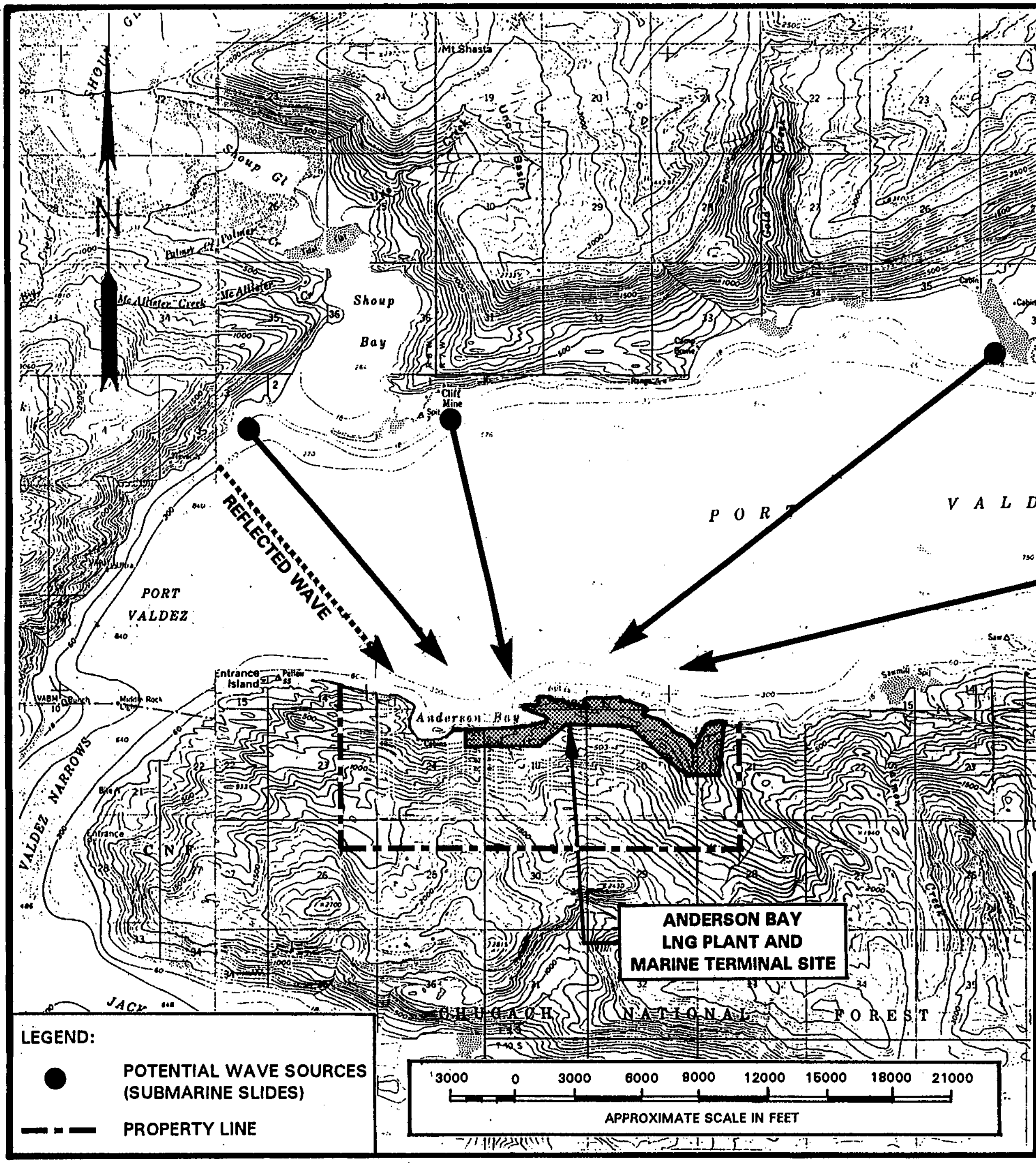


FIGURE 4.2-1

SOURCES OF SUBSEA SLIDE GENERATED WAVES

SCALE: AS SHOWN

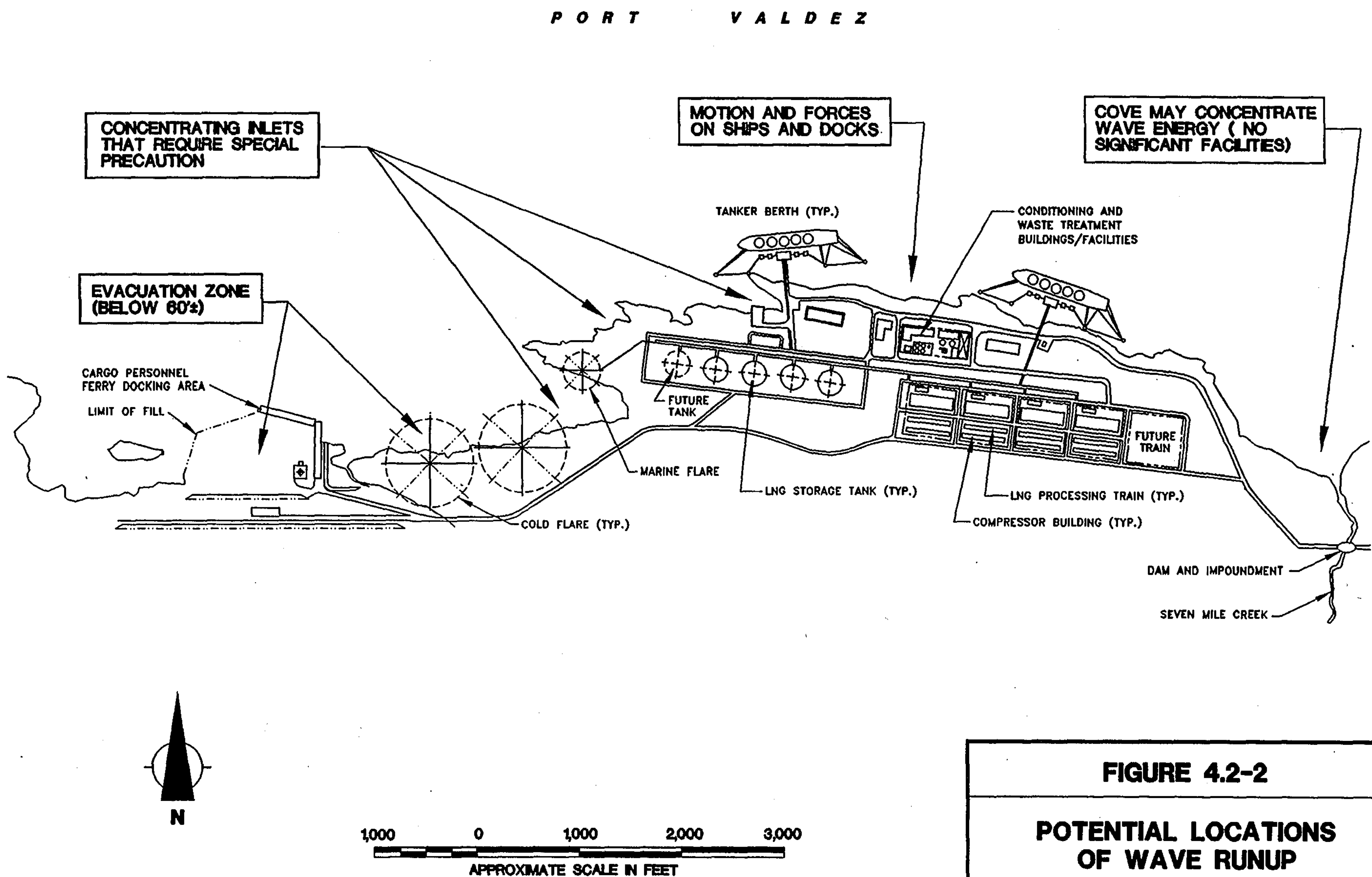


FIGURE 4.2-2

POTENTIAL LOCATIONS OF WAVE RUNUP AT THE ANDERSON BAY SITE

SCALE: AS SHOWN

DWG:FERC223

- Use a combination of seawalls and other energy dissipation devices.

- Locate all important plant components above the 75-foot elevation.

- Reduce peak runup potential at the plant site by placing large amounts of fill in the runup-prone areas.

The FERC staff believes that for the shore-side facilities these measures are appropriate and reasonable. With respect to the marine facilities, Yukon Pacific's analysis of slide-induced waves predicts that the trough of the 26-foot maximum wave would be at least 6 feet below the mean water level and its peak only 20 feet above that level. Adding the 20-foot wave height to the maximum high tide results in a 35-foot maximum height. Since the lower level of the LNG loading docks would be 40 feet above MLLW, the maximum slide-induced waves would pass under the docks.

If an LNG tanker were at berth, the energy applied by a slide-induced wave would be primarily in the vertical direction. The breasting and mooring dolphins would be at an elevation so that a slide-induced wave could not lift an LNG tanker on top of them. Horizontal forces applied on the LNG tanker could damage the outer hull. However, the double-hull construction of an LNG tanker, with the inner and outer hull separated by more than 10 feet, provides additional protection to the cargo tanks. Plant personnel would have less than a 1-minute warning from the time the wave is generated to the time it hits the marine terminal.

The potentially serious effects of a slide-induced wave must be incorporated into the final design for the marine terminal and the operational plans. **We recommend that Yukon Pacific develop plans to mitigate the effects of damaging waves (especially those resulting from subsea landslides) on the marine terminal facilities and on tankers at berth.**

The steep terrain on the plant site, the heavy annual snow accumulations, and the major excavations and earth-moving that would take place when the facility is built, could have a significant effect on rock slope stability and avalanche potential. This hazard needs to be more fully evaluated as the design and construction progresses. **We recommend that Yukon Pacific conduct an analysis of rock slope stability and potential effects of snow avalanches on the plant, especially under seismic conditions, and incorporate appropriate mitigative measures into the plant design and operation plans.**

4.3 FRESHWATER ECOLOGY

4.3.1 Water Resources

Water would be required during construction and operation of the LNG facility. During construction, water would be obtained from Seven Mile Creek and Nancy or Short Creeks for one concrete batch plant, the construction camp, and various industrial uses including dust control. It is anticipated that one concrete batch plant would be required; however, a second small backup plant may also be used. Water usage estimates during construction are 13,917 gallons per hour (gph) average (4,200 gph average from December through April), and 25,833 gph maximum year round assuming that maximum flows for the concrete batch plant and the construction camp coincide. While Seven Mile Creek is anticipated to supply most of this water, Nancy or Short Creek may be utilized to supply water for the batch plant, which would require an average of 125 gph from December through April and an average of 417 gph from May through November. Maximum withdrawal for the batch plant has been estimated at 3,333 gph year round.

During operations, the primary water source would be Seven Mile Creek with backup provided by the desalination plant and barge water from Valdez. Water for operations is not anticipated to be provided by Nancy and Short Creeks. Year round withdrawals from Seven Mile Creek are expected to be 4,500 gph (average) to 12,000 gph (maximum) during operations. Approximately 48,200 gph (average) to 150,600 gph (maximum) would be withdrawn from Port Valdez for the desalination plant; however, about 90 percent would be returned to Port Valdez. The maximum withdrawal rate for operations is the design rate required to supply the sum of the individual peak demand rates.

A comparison of estimated water supply and water requirements was conducted by Yukon Pacific (R&M Consultants) to determine if sufficient water is available onsite to satisfy both short- and long-term project needs. R&M Consultants estimated water requirements of 13,320 gph from May through November and 4,560 gph from December through April during construction and 4,560 gph during operations year round. These water requirements from the creeks are similar to the average requirements given above. To these water requirements, total water requirements were estimated by the addition of 5,400 gph (0.20 cfs) year round for estimated minimum flow requirements, bringing the total to 18,840 gph (0.70 cfs) during construction from May through November and to 10,020 gph (0.37 cfs) during operations and for the rest of the year during construction. These average total water requirements were compared to estimated water flows from Seven Mile Creek (table 4.3.1-1). Flow estimates are being verified during a 1992/1993 monitoring project to provide site-specific flow data for Seven Mile Creek and Nancy Creek. However, the SPCO commented that minimum flow requirements are probably far greater than the assumed 0.20 cfs.

Flow comparisons are used to ensure that sufficient water would be available for facility construction and operation, while also ensuring that stream flow rates do not fall below minimum flow rates to be set by the State of Alaska. Minimum flow rates are required for both water quality and the support of salmon spawning within the streams and would be set following the collection of 2 to 5 years of flow monitoring data in Seven Mile Creek and Nancy Creek and the evaluation of minimum flow studies or the use of synthesized data and the Tenant Method. Based on the relative water requirements for the facility and the estimated water flows in Seven Mile Creek, insufficient water would be available from December through March during low flow years (table 4.3.1-1). This deficit would be even larger during peak water usage.

As a remedy to the water supply shortage, a 40-foot-high, in-stream rockfill dam with a central concrete core has been proposed to provide the required storage. Located 400 feet upstream of the waterfall on Seven Mile Creek, the dam would produce a reservoir approximately 3.5 acres in area (see figure 2.1.4-3). In addition, storage tanks would be constructed to buffer the impact of periodic low flows. A 400,000-gallon tank would provide an average of 40 days water for the concrete batch plant. An 800,000-gallon tank would provide potable water for 2.5 days during construction from May through November and for 7.3 days for construction during the rest of the year or during operations year round.

Water from Nancy Creek has also been considered to supplement water requirements for concrete batch plant usage during low flow periods. Similar to Seven Mile Creek, following the 1992/1993 flow monitoring period, minimum flow requirements will be determined for Nancy Creek as well. Short Creek has also been considered as a supplemental source. However, its use

TABLE 4.3.1-1

Water Needs During Construction Compared to Flow in Seven Mile Creek

Month	Mean Monthly a/ (cfs)	7Q10 a/ (cfs)	Needed b/ (cfs)	Surplus c/ (cfs)	Deficit d/ (cfs)
January	4.4	0.2	0.37		0.17
February	4.5	0.3	0.37		0.07
March	3.0	0.2	0.37		0.17
April	7.4	0.6	0.37	0.23	
May	30.8	6.2	0.70	5.5	
June	65.5	26.9	0.70	26.2	
July	61.7	14.8	0.70	14.1	
August	45.9	6.0	0.70	5.3	
September	41.5	4.2	0.70	3.5	
October	22.6	1.9	0.70	1.2	
November	13.3	0.9	0.70	0.2	
December	4.8	0.3	0.37		0.07

a/ Estimated by HYDMET, Inc.

b/ Assumes in-stream flow requirement of 0.20 cfs. Actual in-stream flow requirements have not yet been set.

c/ Calculated by R&M Consultants (1992).

d/ Deficit based on averages. Peak usage deficit would be greater.

is not recommended since flows within Short Creek are expected to be much less than in Nancy or Seven Mile Creek (table 3.3.1-2). The state would prefer to withdraw water from Short, Henderson, Jug, Terminal, and Aquaculture Creeks instead of Seven Mile and Nancy Creeks, since the latter are the only creeks at the project site which the ADFG believes support populations of wild salmon. However, since Short Creek, the largest of these streams, contains less than 3.4 percent of Seven Mile Creek flows and 9.6 percent of Nancy Creek flows, these streams are too small to provide the quantities of water required by the project. Supplemental sources from offsite as well as from groundwater were also reviewed by Yukon Pacific. Groundwater has not been selected as a possible water supply source, and the offsite source would be limited to potable water barged from Valdez.

There are several issues of concern relating to water supply. The basis for facility water requirements during operation has not been adequately supported by a design water balance; the basis for Yukon Pacific's estimates is lacking detail. The ADFG has expressed specific concern about the withdrawal of water from either Nancy or Seven Mile Creeks, believing them to be the only streams in the project area supporting populations of wild (non-hatchery) salmon. In addition, the constrained construction window recommended for fisheries' requirements during spawning season may increase construction supply requirements during the fall and winter months (although certain activities are severely constrained by weather conditions). Finally, given typical stream morphology and the unique setting of Seven Mile Creek, the in-stream flow requirements may exceed the original estimate of 5,400 gph. Monthly variations should also be used to approximate requirements; during spring/summer periods of higher flow, minimum stream flow requirements would be higher. Given the above concerns, we believe that water supply requirements may be understated and that a water supply shortage for the proposed project could occur. To clearly demonstrate water supply requirements for the proposed facilities, **we recommend that Yukon Pacific prepare, in consultation with the ADFG, and file with the Secretary, a detailed water balance and design supply analysis, prior to initiation of construction.**

In addition, regardless of what the actual facility water requirements may be, we **recommend that Yukon Pacific, in consultation with the ADFG, ADNR, and ADEC and in conjunction with preparation of the detailed water balance and design supply analysis, conduct an in-stream flow study to determine the minimum flow requirements to minimize impact on spawning fish (see sections 4.3.3, 4.4.3, and 4.5.4) and maintain flow through Seven Mile Creek above the minimum levels. The results of this study, based on a minimum of 2 years flow monitoring, should be reviewed with the ADFG, ADNR, and the ADEC for consideration of additional flow regulation mitigation. The results of the study incorporating comments of reviewing agencies, should be filed with the Secretary for review and approval by the Director of OPR.**

4.3.2 Water Quality

Stream water quality in the proposed project area could be adversely affected during construction and operation of the LNG facilities. During construction, activities in streams, damming of stream flow, grading of shoreline, rechanneling of streams, and release of contaminants from construction activities and road deicing could adversely affect stream water quality. During operation of the LNG facility, stream water quality could be affected through emissions, spills, road use, and outfall discharges directly into streams or into areas with significant tidal exchange. Groundwater quality could be affected by recharge from contaminated surface waters as well as by spills and by leakage from any onsite tanks or landfills.

4.3.2.1 Stream Quality

In order to provide for a stable water supply, a dam has been proposed for Seven Mile Creek (see figure 2.1.4-3). Based on the relative flow and water requirements, the dam would be required to supply water for construction and operation activities. When flowing water is dammed, the physical and chemical characteristics of the water may be altered both at the dam site and downstream. The extent of alteration is primarily a function of the residence time of water behind the dam. In small dams, the water is generally only detained for a few hours or days, the flushing rate is high, and the physical and chemical characteristics of the water are not significantly changed.

However, even with small dams, sediment, temperature, and nutrient transport within the stream can be altered. In the short term, construction of the dam would result in increased turbidity within the stream due to construction activities. Elevated turbidity levels would be expected to remain for only a short time following the construction period, and to affect a relatively small area (Dehoney and Mancini, 1984). Short-term increases in sediment may violate the Alaska Water Quality Standards for (A) Water Supply (i) drinking, culinary, and food processing, under which the area streams are classified by default. The regulations require no increase in the concentration of sediment, including settleable solids, above natural conditions. However, the state, at its discretion, may grant a short-term variance for a one-time, temporary activity associated with the placement of dredged or fill material affecting a specific waterbody. The applicant must demonstrate that the activity would be conducted in a manner to mitigate water quality impacts, using methods found by the ADEC to be most effective, and must show that the activity, once completed, will not cause a long-term, chronic, or recurring violation of the water quality standards. If the dam is approved for construction by the COE and ADFG, the JPO does not anticipate a problem with granting a short-term water quality variance for turbidity and suspended solids, although some time restrictions may be required to protect the downstream salmonid habitat (Wilson, 1993).

In the long term, however, dams may serve as sedimentation ponds, resulting in a decrease in turbidity downstream from the dam. However, based on visual observations, very little sediment is transported in Seven Mile Creek, and according to R&M Consultants (1992), most of this sediment may be carried through the dam via the outlet works. The dam may serve as a beneficial water flow regulator for low flow periods, provided sufficient water is available for operators during those periods. The effects on nutrient transport and stream temperature are expected to be insignificant in the long term due to the relatively short detention time of the dammed reservoir. As a result, the proposed dam is not expected to have a significant impact on the water quality of Seven Mile Creek, assuming minimum flows can be maintained.

Significant alterations in coastal morphology and stream discharge have been proposed to construct the LNG plant facilities (figure 2.1-4). Grading and stream rechanneling activities would significantly impact water quality within Nancy, Terminal, Strike, and Short Creeks during construction and restoration. In addition, Seven Mile Creek may be impacted, as grading is proposed below the falls near the creek. Grading and fill activities may significantly increase turbidity near the mouths of the streams, but would not affect water quality upstream beyond tidal influences. Short Creek would be rechanneled from its present course to discharge as outfall No. 6. Terminal Creek (and its pond) would be eliminated. Strike Creek would be rechanneled and would discharge from outfall No. 1. The long-term effects of rechanneling Short Creek should be minimal with respect to water quality provided Short Creek flows into a concrete channel to minimize turbidity effects from the creation and flow over a new streambed. However, short-term water quality degradation may occur through leaching of concrete. Mitigation for the destruction of Terminal Creek and its pond is discussed in section 4.4.3.

Construction and use of roads in the facilities may also increase the turbidity in the streams. In addition, chemicals, such as road deicers in the wintertime, increase the potential for contaminant entry near the mouths of Nancy and Short Creeks. Best management practices for erosion control during construction and along the roadways must be followed to minimize any adverse effects from the roads, especially since the soils in the project area are highly erodible organic soils or erodible mineral soils following alterations to the overlying duff layer (see section 4.1.2).

Outfall Nos. 5 though 8 discharge into Anderson Bay, while the remaining outfalls discharge into nearshore Port Valdez. Several of the outfalls include stream discharge as a major component (along with site runoff) and discharge at the mouth of streams (figure 2.1-4). Thus, depending on the location of other discharges and tidal influence within the stream, site runoff and other discharges could affect the water quality of the stream. Affected outfalls include Nos. 1, 6, and 7. Strike Creek would discharge from outfall No. 1, rechanneled Short Creek would discharge from outfall No. 6, and Nancy Creek would discharge from outfall No. 7. Since natural streamflow would dominate the outfalls, the water quality from these outfalls should be heavily influenced by the water quality within these streams (section 3.3.2.1). Furthermore, site runoff should not significantly alter the outfall water quality since: 1) drainage from upslope is routed around or channeled through the plant site, and 2) water from areas on sites at which contamination might occur (such as diesel fueling) is collected and sent to the wastewater treatment plant. Water from the concrete batch plant could also affect water quality within outfall Nos. 6 and 7. Water runoff from the batch plant site, potentially high in fines and colloidal material, would be either pumped back into the water tank or allowed to drain to a permitted outfall following containment in the sediment ponds.

Site runoff could affect the water quality from outfall Nos. 1, 6, 7, 9, and 10. Site runoff water quality predictions based upon limited area stream water quality are presented in table 4.3.2-1 and compared to estimated desalination source seawater water quality and stream water quality standards (drinking water standards as given in 18 AAC 80 apply). The standards may be applicable at outfall Nos. 1, 6, and 7 since site runoff and other sources appear to discharge directly into the streams near the mouth. Outfall Nos. 9 and 10 do not directly discharge into the streams, and thus the freshwater standards would probably not be applicable. Instead, marine water quality criteria would apply.

Assuming the applicability of strict freshwater standards (i.e., no mixing zones, variances), maximum concentrations of iron, arsenic, cadmium, and lead may fail state water quality standards (table 4.3.2-1). However, since none of the projected average concentrations exceed the standards, it is unlikely these constituents would violate the standards. However, actual discharge water quality should be sampled during plant operation to ensure compliance with Alaska State Water Quality Standards. If standards are not met, mitigative measures such as treatment may be necessary.

Contamination of streamwater through the introduction of oils, grease, and fuel during the construction and operation activities is possible. The residence time of these materials within the stream would be dependent upon the amount introduced, the persistence of the chemical, the flow conditions, and the mineralogical and organic matter content of the stream sediments. Accidental spills of chemical reagents and fuels may also introduce hydrocarbons and other chemicals to streamwater. **We recommend that Yukon Pacific, prior to commencing construction, develop and file with the Secretary for review and approval by the Director of OPR, a Spill Prevention, Containment, and Countermeasure Plan (SPCC Plan) that would describe the preventive and mitigative measures it would employ to minimize the impact associated with accidental spills, both in freshwater streams as well as those that may occur in nearshore marine waters. These measures should include but not be limited to: requiring all fueling and lubricating to be done in areas designated for such purposes, with such areas to be located at least 100 feet away from all waterbodies; specifying collection and disposal procedures for wastes generated during vehicle maintenance; requiring each construction crew to have on hand sufficient supplies of absorbent and barrier materials to allow the rapid recovery of any spills; and development of standing procedures regarding excavation and offsite disposal of any soil materials contaminated by spillage. In addition, we recommend that Yukon Pacific ensure that construction contractors are able to demonstrate to environmental, local, or state inspectors their ability to implement the SPCC Plan. The SPCC Plan should also identify the types and quantities of hazardous materials that would be stored or used on the construction site.**

The impact of contaminants may also occur through the application of deicers on nearby roads. These would be proportional to the quantity and frequency of material application during both construction and operation of the proposed facility. To document compliance with Federal

TABLE 4.3.2-1

Estimated Site Runoff and Seawater Water Quality

Water Quality Parameter	Unit	Site Runoff, Average	Site Runoff, Maximum	Desalination Source Seawater	Freshwater Standard (18 AAC70 & 80)
Temperature (winter)	°F	36	40	38	< 59
Temperature (summer)	°F	50	60	52	< 59
pH		7.5	8.5	8	6.5-8.5
BOD	mg/L	2	5		60 a/
COD	mg/L	3	7		
TSS	mg/L	20	200		45 a/
Ammonia (N)	mg/L	0.15	0.15		
Oil/grease	mg/L	1	5		no sheen, taste, or odor 10 a/
Fecal coliform	mg/L b/	16	200		< 1 per 100 mL (18 AAC80); 14/100 mL a/
Nitrate (N)	mg/L	1	3		10
Phosphorus	mg/L	0.01	0.02		
Copper	mg/L	0.01	0.29	0.066	1
Iron	mg/L	0.2	2.0	0.092	0.3
Nickel	mg/L	0.01	0.70	0.019	
Zinc	mg/L	0.02	5.00	0.044	5
Arsenic	mg/L	0.002	3.600	0.001	0.05
Cadmium	mg/L	0.0002	0.9000	0.0001	0.010
Lead	mg/L	0.02	0.50	0.001	0.05
Mercury	mg/L	0.0003	0.0020	0.0003	0.002
Hydrocarbons	mg/L	0.1	0.2	0.6	no sheen, taste, or odor
BTEX	g/L				1.3 (summer) - 5.0 (winter) a/
Benzene	g/L	0.1	0.1	0.2	
Chlorobenzene	g/L	0.1	0.1	0.2	
Ethylbenzene	g/L	0.1	0.1	0.2	
Toluene	g/L	0.1	0.1	0.3	
Xylenes	g/L	0.2	0.2	0.6	

a/ Maximum discharge specified on Alyeska's NPDES permit (12/14/90).

b/ Real units should be no. of colonies/100 mL.

and state stormwater discharge requirements, we **recommend Yukon Pacific develop a stormwater monitoring plan. This plan should be developed in conjunction with the new NPDES stormwater permit requirements that will be imposed under Section 402 of the CWA (40 CFR Part 122.26(c)(ii)). This plan should be prepared in conjunction with the site-specific Erosion and Sediment Control Plan and should provide a detailed description of the stormwater collection and treatment process, including best management practices to control pollutants in stormwater discharges during both construction and operation. These plans should be filed with the Secretary, and provided to the EPA as part of the documentation with the NPDES permit application.**

4.3.2.2 Groundwater

Based upon preliminary borehole results, groundwater flow within the project area has an upward gradient. Although this flow pattern results in seeps, bogs, and springs, which could complicate grading operations and drainage from the site, these flow conditions should prevent serious groundwater contamination from any spills or leakage that may occur onsite. Contaminated groundwater would be expected to surface instead of recharging and contaminating large volumes of groundwater in the area. Although groundwater has not been proposed as a possible water supply, it should be emphasized that the grading operations would impact the surficial unconsolidated aquifer which may result in decreased flow in area streams. A french drain network may be required in the project area for drainage purposes based on experience with similar sites (Lawson, 1992).

Provisions to contain and treat spills and leakage will be outlined in the SPCC Plan. Possible sources of onsite contaminants include leaching from waste rock, spills, treatment plant waste solids, and garbage dump piles. An onsite permitted landfill has been proposed to dispose of ash from the incinerator and possibly to house spent molecular sieves. Although no hazardous waste would be incinerated, ash from the incinerator must be tested for toxicity using the toxic compound leaching procedure to determine if the ash is hazardous since flyash from municipal incinerators is frequently hazardous (Tillman, 1991). If any of the incinerator ash is hazardous, the landfill must be permitted under the Resource Conservation and Recovery Act (RCRA) or that portion of the ash must be shipped offsite to a permitted hazardous waste facility.

The spent molecular sieve is not expected to be hazardous and may be landfilled directly onsite or shipped offsite for regeneration or disposal. The composition of the molecular sieve has been projected as 75 to 85 weight percent zeolite; 23 to 15 weight percent magnesium aluminosilicate; and 2 to 0 weight percent quartz. It is assumed that the spent activated carbon from the Mercury Guard Vessels will be disposed of offsite. This carbon may be considered hazardous waste according to the mercury content (up to 16 weight percent).

4.3.3 Freshwater Fisheries

Construction of the Anderson Bay LNG facility would have direct and indirect impacts on five of the eight identified streams on the facility site. The primary direct impacts include altering the channels of Terminal, Short, and Strike Creeks; the crossing of Nancy Creek approximately 1,200 feet upstream of the stream mouth by the main access road from the cargo dock area; and grading the banks and intertidal area of Seven Mile Creek. Construction of water withdrawal structures on Nancy Creek, a dam on Seven Mile Creek, and a temporary construction camp along the banks of Seven Mile Creek may directly impact the surface waters.

There were no resident fishes present in Terminal, Short, and Strike Creeks during surveys conducted by ADFG personnel. This was attributed to high gradient, poor habitat, or the presence of barriers to fish movement (ADFG, 1992; Thompson, 1992). Therefore, alteration of these creek channels would not impact resident fish resources in these streams.

Pink and chum salmon are the only anadromous fish utilizing creeks on the proposed site. The steep gradient of the area limits their distribution to the lower reaches and intertidal areas of Seven Mile, Nancy, and Henderson Creeks where spawning occurs during late summer. Fry emerge in the spring and immediately migrate out of the stream. Therefore, the ADFG has proposed an in-stream construction window of May 1 to July 15 when no salmon are present in the system (Brna and Stackhouse, 1993). In its comments on the DEIS, the NMFS cited studies showing that pink fry are still outmigrating from many Alaska streams in early May, and recommended a construction window of May 15 to July 15 (NMFS, 1993c).

Henderson Creek is on the edge of the site and would experience no direct impacts from plant construction or operation. The main access road from the cargo dock area, however, would cross Nancy Creek approximately 1,200 feet upstream from its mouth. In-stream construction of the road crossing may disturb fish habitat. Runoff from the equipment road may increase the delivery of fine sediments into the stream. To prevent potential disturbance of the limited anadromous and resident fish habitat in this stream, **we recommend the road crossing be made above a small falls which may currently be acting as a fish barrier (Brna and Stackhouse, 1993). To minimize impacts due to siltation of spawning gravels and redds from construction and from road runoff, we recommend any in-stream construction be limited to the period between May 15 and July 15 when there are no spawning fish or incubating redds present and that sediment traps be placed along the road to prevent fines from running off into the stream. To prevent loss or disruption of habitat, we further recommend there be no other in-stream construction activity or in-stream equipment crossing or fording the streambed at any time. Any temporary crossing structures should be limited to portable construction bridges or crushed, clean rock and culvert bridges.**

There were no resident fish found in the reaches of Seven Mile Creek above the falls (ADFG, 1992), but spawning pink and chum salmon utilize the area below the falls as spawning and nursery habitat. The hydrology of this area is not well understood; however, there is apparent upwelling of subsurface water through the gravels near the stream mouth which is probably critical to salmonid spawning and redd survival. In addition, the gravels and incubating redds are sensitive to siltation and disturbance. To minimize potential impacts, we **recommend no construction equipment or in-stream activity occur in the area below the falls and any in-stream construction or activity which may cause siltation (above and below the falls) be scheduled between May 15 and July 15 when there are no salmon or incubating redds present in the stream** (see section 4.1.2 for discussion of Erosion and Sediment Control Plan). As a mitigation measure, Yukon Pacific has proposed to increase spawning habitat and incubation success by maintaining higher stream flows in Seven Mile Creek during the winter low flow period. However, there are no data at the present time to indicate that spawning habitat in Seven Mile Creek is limited by flow. To determine the existing conditions in this area and to avoid impacts on spawning salmon or incubating redds due to reduced flows or an altered hydrograph caused by the proposed 40-foot dam, water withdrawal structure, and 3.5-acre reservoir, we have recommended Yukon Pacific conduct an in-stream flow study as directed by the ADFG (see section 4.3.1).

The proposed location of the construction camp is along both banks of Seven Mile Creek. Yukon Pacific has developed a construction plan that requires considerable grading (figure 2.1.4-3) which would eliminate riparian vegetation. In addition, working the banks in this steep canyon area would likely cause rockfall into the streambed and an increased runoff of fines. Grading the banks and eliminating riparian vegetation may result in increased sedimentation in the stream and loss of downstream spawning habitat. **We recommend that Yukon Pacific prepare a revised site plan that avoids grading and clearing the riparian zones within 100 feet of the streambanks along Seven Mile Creek above the proposed dam. The revised plan should also avoid grading and clearing to preserve the gorge area surrounding the water falls and the associated intertidal shoreline area located on either side of the confluence of Seven Mile Creek and Anderson Bay. The revised plan should be filed with the Secretary for review and approval by the Director of OPR.**

Fuels, lubricants, and other chemicals spilled during plant construction and operation would negatively impact water quality if allowed to run off into the streams. Leachates from disturbed soils and decaying vegetation could also negatively impact water quality and affect fish utilizing the streams. To minimize impacts caused by runoff of spills or leachate, we have recommended Yukon Pacific develop a SPCC Plan using best management practices (see section 4.3.2.1).

Overall, there would be minimal impacts on resident fish resources because of their limited distribution on the site. Anadromous fish resources spawning in Nancy Creek would not be significantly impacted if disturbance to the streambed is avoided or minimized and the runoff of fine sediments is controlled. The impacts on anadromous fish spawning in Seven Mile Creek are less clear because the flow patterns are not well understood. Once an in-stream flow study has been completed, we have recommended that Yukon Pacific coordinate with the ADFG and FERC staffs to determine a flow regime to minimize impacts on spawning fish (see section 4.3.1). Grading and clearing the banks would cause some disturbance of the streambed and increased runoff of fine sediments. If the disturbance and runoff are minimized by careful construction and adequate sediment and erosion control, the impacts would not be significant.

4.4 TERRESTRIAL ECOLOGY

4.4.1 Wildlife

4.4.1.1 Raptors

The project may adversely affect raptors by disturbance or destruction of existing nest sites. (These issues as they relate to peregrine falcons are addressed in section 4.6.) Perhaps the greatest issue concerning raptors is the number of active bald eagle nests which could potentially occur within and near the project site. The Bald and Golden Eagle Protection Act (16 U.S.C. 668 (1988)) strictly prohibits the disturbance and/or destruction of bald eagle nests. In previous years, three bald eagle nests have been recorded within the project site and an additional two nests within 1 mile of the facility boundary. A nest site at Nancy Creek is known to have blown down in 1989, and no nest sites were recorded in the vicinity of Anderson Bay by FWS and ADFG personnel during surveys in June of 1991 and 1992. Bald eagles could, however, reestablish nesting territories within the project area at any time and the existence of a bald eagle nest would have an impact upon project scheduling and/or activities. Consequently, we **recommend that Yukon Pacific conduct surveys for bald eagle nest sites during the year prior to the commencement of site activities and each year subsequently, to determine nesting activity at the site. If active**

nests are found, Yukon Pacific must consult with the FWS to ensure the project does not violate the Bald and Golden Eagle Protection Act.

4.4.1.2 Large Mammals

A variety of large ungulates and large predatory mammals occur within the Port Valdez area (Morsell, 1979; Roberson, 1986). Many of these species occur in such low numbers in the vicinity of the proposed project area, however, that adverse impacts would not be expected. The exceptions are mountain goats, brown bears, and black bears.

Mountain goats are considered abundant only in the steep mountainous terrain east of Valdez Arm (BLM and COE, 1988) with the nearest goat habitat of importance occurring at Abercrombie and Sulphide gulches, 10 to 14 miles east of Anderson Bay. The construction and operation of the project would not directly impact mountain goats. However, mountain goats could be indirectly impacted by increased human disturbance and hunting pressure from the expected additional 4,000 construction workers living at the construction site and the City of Valdez. Since many of the Valdez area goat populations are accessible to humans, including the kidding areas at Abercrombie and Sulphide gulches, regulating or limiting human access to goat areas may be necessary to minimize impacts. Since Prince William Sound goat populations presently appear to be depressed (Abbot, 1992), additional pressures on them may need to be controlled by the ADFG.

Although black bear densities are considered to be low to moderate and brown bear densities low in the Anderson Bay area (Griese, 1991), several brown bears and a black bear were observed in or near the project area in 1991 (Stackhouse, 1992a; ADFG, 1993). As is the case at nearby Jack Bay (Yukon Pacific, 1991), bears may concentrate in the Anderson Bay area during the late summer to feed on spawning pink and chum salmon in Nancy and Henderson Creeks and especially in nearby Seven Mile Creek (Thompson, 1992; ADFG, 1993).

Since personnel with the ADFG have at times observed large numbers of bears in the vicinity of the project (Brna, 1992a), the potential for bear/human conflicts is potentially great with the construction and operation of the LNG plant and terminal. The LNG Project could impact bears in four ways: 1) the clearing for the construction site and access road allowance would impact currently used bear habitat, 2) the project facilities would block travel access along the Port Valdez shoreline potentially deflecting bear movements through areas of high human activity, 3) food and garbage odors could attract bears to human high use areas and increase the likelihood of bear/human contact, and 4) location of the project facilities on or adjacent to Seven Mile Creek will be expected to cause bears to avoid foraging in this salmon-bearing stream. Bear/human contact frequently leads to killing of the bear. For example, at least 13 "problem" grizzly bears were killed during the construction of the Trans-Alaska Oil Pipeline (Herrero, 1986). Human habitations, like salmon streams, will attract several bears from great distances if the animals anticipate food. These sites are called "population sinks" (Knight et al., 1988), and when they involve man-made attractants, often result in human contact with subsequent death or injury to bears. At Yellowstone Park and its vicinity, the second major cause of grizzly bear deaths is controlled removals of "problem" bears (Knight et al., 1988). The first is illegal hunting. The anticipated peak workforce of 4,000 construction workers would most likely increase the possibility of bear/human conflicts. The ADFG, with the concurrence of the FWS, has suggested convening a panel of agency bear experts familiar with similar habitats, who, in consultation with Yukon Pacific, would develop a worst-case scenario of potential project impacts and develop realistic mitigation measures for incorporation into an overall mitigation plan. **We recommend that Yukon Pacific contact the FWS and ADFG regarding the proposed panel and develop, in consultation**

with the ADFG, FWS, and the Valdez Chief of Police, a plan to mitigate impacts on bears arising from both habitat loss and from bear/human interaction. This plan should detail procedures for avoiding human/animal conflict and shall stress implementation of an education program for workers, in addition to methods of bear-proofing the site. This plan should be filed with the Secretary for review and approval by the Director of OPR prior to initiation of construction.

4.4.1.3 Small Mammals and Furbearers

Construction of the LNG plant and marine facilities would result in the loss of habitat for several species of small mammals, especially the forest-dependent red-backed vole. However, this is probably the most abundant small mammal in the Port Valdez region (Morsell, 1979), and no small mammal species are known to occur at the project site for which significant losses in habitat or population can be expected.

The greatest impact that the construction and operation of the LNG plant would have on furbearers would result from the loss of coniferous forest habitat for pine martens and the loss of shoreline habitat for mink. The significance and extent of these impacts are insignificant from a regional population scale.

4.4.2 Vegetation

Construction of the proposed LNG facility would require the clearing of approximately 365 acres of mature coastal spruce and hemlock forest and 13 acres of alder shrub. Overall, this clearing represents a relatively minor impact since both forest and shrub vegetation types are common and well represented in the areas of Anderson Bay surrounding the proposed LNG site. All vegetation clearing would be conducted in accordance with a state-approved site-specific erosion and sedimentation control plan (Braden, 1993) (see section 4.1.2). This plan would be developed by Yukon Pacific prior to construction and would include specifications that define the physical limits of clearing activities; detail timber salvage and brush disposal operations; and outline acceptable methods for blasting, erosion control, and revegetation of areas that would not be used for siting of permanent aboveground facilities (Braden, 1993).

The proposed clearing activities could result in several secondary effects, including increased soil erosion potential (see section 4.1.3), elevated soil temperatures, and permanent loss and alteration of wildlife habitat (see section 4.4.1). The clearing of forest could also affect uncleared forest vegetation growing along the edges of the cleared areas. Some edge trees would be exposed to elevated levels of sunlight and wind, which could increase evaporation rates and the probability of wind throws. The proposed clearing also could temporarily reduce local competition for available soil moisture and light and may allow some early successional species to become established and persist on the edge of the uncleared areas adjacent to the site. In general, however, all of these secondary impacts, with the possible exception of loss of wildlife habitat, would be minor and would not require any additional mitigation that has not already been proposed or recommended by us or Yukon Pacific.

Yukon Pacific's BMPM indicates that buffer strips of uncleared, native vegetation may be left between construction areas and natural waterbodies to minimize erosion and sedimentation. However, no such buffer strips are shown on Yukon Pacific's rough grading overall site plan. Instead, these plans indicate that the entire site would be cleared and graded to the waterline of the of the bay and streams. We believe that the maintenance of such buffer strips would minimize the risk of sedimentation. Therefore, **we recommend that where feasible Yukon Pacific should maintain a natural, uncleared vegetative buffer strip at least 50 feet wide between construction areas and waterbodies. Yukon Pacific should indicate the location and size of these buffer strips on its final site plans that would be filed with the Secretary prior to construction. Where Yukon Pacific believes maintenance of a 50-foot-wide buffer strip would be infeasible, Yukon Pacific should file with the Secretary for review and approval by the Director of OPR prior to construction a detailed explanation of why the required buffer strips cannot be maintained, and should include with this explanation a description of alternative sediment control measures that would be employed on a site-specific basis instead of maintaining the vegetative buffer strip.**

4.4.3 Wetlands

Approximately 35.7 acres of estuarine and palustrine wetlands and 13.1 acres of non-wetland subtidal marine habitats are located within the construction limits of the proposed site. For this analysis we have assumed that all of this wetland and subtidal habitat area would be affected by site development. Yukon Pacific has proposed a wetland mitigation plan, in accordance with the President's Council on Environmental Quality Guidelines, to compensate for wetland losses and adverse wetland effects associated with the proposed construction. Yukon Pacific's wetland mitigation plan is based on a numerical accounting of the physical and geomorphic characteristics and functional values of the potentially affected wetlands on the site. The characteristics evaluated included hydrologic connection of the wetland to lakes, ponds, rivers, or streams; the water regime (tidal or nontidal); extent of open water; edge complexity and interspersion; vegetation type; and scarcity. The functional value of each wetland characteristic was rated with a value score of either high (30 points) or low (10 points) based on a wetland evaluation technique that was developed by the Wetland Evaluation Working Group (WEWG) in June 1992 as a modification of the FWS National Wetlands Inventory (NWI). The WEWG is made up of staff from various state and Federal agencies, including the ADFG, FWS, COE, and EPA, and representatives from Yukon Pacific. The relative functional value scores per acre for each wetland type are listed in table 3.4.3-1. Yukon Pacific did not evaluate the functional values of non-wetland, subtidal marine habitats because it contends that adverse effects on these areas would not require mitigation. Of the wetlands that were evaluated, the highest functional values per acre were given to the estuarine intertidal emergent and unconsolidated shore wetlands between Terminal Island and the mainland. The lowest functional values were assigned to the inland palustrine scrub-shrub and emergent wetlands.

Yukon Pacific's wetland mitigation plan was designed to offset the construction-related loss of wetland functional values. The plan has three components: 1) rectification of wetland impacts through repair, rehabilitation, restoration, or enhancement of specific wetland sites; 2) reduction or elimination of wetland impacts over time through recovery and maintenance of wetlands over the life of the project; and 3) compensation for impacts through onsite and/or offsite replacement or substitution of resources and habitats. In-kind and onsite mitigation was developed for wetland types that were determined to have valuable ecological characteristics. Mitigation for other wetlands involved either creation of new, more valuable wetland types or enhancement of existing low functional value wetlands, both on and offsite. Proposed onsite mitigation includes re-meandering the surface discharges of Short and Terminal Creeks; rehabilitation and creation of intertidal and shallow subtidal salt water habitats in the rock disposal area of Anderson Bay; and flow regulation enhancement at Seven Mile Creek. Proposed offsite mitigation includes enhancement and creation of intertidal seepage-fed pond/channel complexes in the area of the Old

Valdez townsite; and creation of a freshwater pond/channel complex behind the Old Valdez townsite docks.

Onsite Marine Mitigation

Most of the impact on estuarine intertidal wetlands would be mitigated by onsite rectification and reduction of impacts, and by compensation through replacement or substitution of affected wetlands. Yukon Pacific proposes to fill an area of approximately 16.9 acres in size at the east end of Anderson Bay near the mouths of Short and Terminal Creeks (see section 2.3.2). This area, referred to as spoil fill Site B′, currently comprises mostly non-wetland, subtidal marine habitats but also includes estuarine, subtidal and intertidal, unconsolidated bottom wetlands. These existing subtidal marine habitats and wetlands would be filled during construction. Following construction, Yukon Pacific proposes to grade down the western portion of this area and return it to intertidal and shallow subtidal habitat. This mitigation would require that some excess rock and soil be pushed out into the deeper water at the east end of Anderson Bay, creating at least 10 acres of new shallow subtidal habitat to the west of the proposed disposal site. While this reconfiguration of spoil fill Site B′ is discussed in the wetland mitigation plan filed on October 13, 1992, it is not reflected on any site plans currently on file.

Onsite Freshwater Mitigation

Several emergent wetlands, one scrub-shrub wetland, and one unconsolidated freshwater wetland, would be filled or adversely affected by construction. Yukon Pacific proposes to mitigate this impact through compensation of wetlands in the vicinity of Short Creek, Terminal Creek, and Seven Mile Creek. Following construction, Yukon Pacific would re-meander Short and Terminal Creeks. In addition it would create at least 5 acres of small, irregularly shaped, open water ponds fringed by emergent and rooted aquatic vegetation along the Terminal Creek corridor, and would construct one larger 2-acre pond from the upland areas surrounding Terminal Creek. The remainder of freshwater wetland impact would be mitigated by regulating the water flow of Seven Mile Creek. Yukon Pacific contends that the low winter streamflow of Seven Mile Creek and the frequency and duration of tidal inundation of spawning redds are two factors which limit the survival and production potential of pink and chum salmon that spawn in the creek. Yukon Pacific believes that by releasing water from the proposed Seven Mile Creek reservoir and increasing downstream flow during winter it can increase the reproductive success of these salmon. However, Yukon Pacific has not presented any construction plans or a water budget analysis which indicates that this mitigation can be implemented. See sections 4.3.3 and 4.5.4 for a more detailed discussion of salmon redds in Seven Mile Creek.

Offsite Mitigation

The proposed offsite mitigation involves construction of several acres of intertidal and freshwater pond/channel complexes within the intertidal flats along the shore south of the Old Valdez Townsite and the area behind the Old Valdez Townsite docks. This area is predominantly flat, unconsolidated, and sparsely vegetated ground with little habitat or other functional value. The proposed pond/channel complex would be created by constructing several irregularly shaped shallow depressions, 1 to 4 feet deep, with interconnecting channels and slightly elevated margins. This would result in a mix of vegetated and open water wetland types.

Following publication of the DEIS, Yukon Pacific submitted to the FERC a Mitigation Policy Statement for the proposed project. This policy statement outlined Yukon Pacific's mitigation priorities and reasserted the company's commitment to environmental protection. However, it provided only general broad sweeping statements and contained no new site-specific mitigation information regarding wetlands on the proposed LNG facility site.

Plan Comments

Yukon Pacific's wetland mitigation plan has been reviewed by the Alaska offices of the COE, EPA, and NMFS. These agencies expressed several concerns regarding the plan in letters to the FERC written before publication of the DEIS. The EPA indicated that more field studies are needed to collect additional wetland information, particularly for the intertidal wetlands at the east end of Anderson Bay (EPA, 1993a). The COE, EPA, and NMFS did not agree with Yukon Pacific's presumption that no mitigation would be required for the subtidal marine areas (E1UBL) that would be affected by site development. Both the COE and NMFS indicated that mitigation may be required to offset impact on or loss of these areas (COE, 1993b; NMFS, 1993a). Another concern of the COE and EPA is that the wetland mitigation plan lacks sufficient site-specific details regarding how it would be implemented.

The COE generally agreed with the functional value scores given to specific wetlands and approved of Yukon Pacific's efforts to match the losses of particular values with appropriate mitigation. However, the COE was dissatisfied with the level of effort regarding review of alternatives that would avoid the destruction of shallow intertidal areas and also the lack of information regarding the successes and failures of other similar mitigation plans that have been implemented in the same geographic area. The COE also indicated that a precise mathematical offset of losses and gains of wetland functional values has not been required in past practice and is not of great concern to the COE (COE, 1993a).

Other concerns were identified in letters written subsequent to the publication of the DEIS. The COE and NMFS expressed concerns about the proposed mitigation plan (NMFS, 1993c; COE, 1993b). The COE indicated that additional information is necessary regarding the proposed onsite mitigation at the Site B′ disposal area and the NMFS expressed concern that the proposed mitigation at Site B′ might be unsuccessful. The COE also indicated that the proposed onsite freshwater mitigation plan should be refined after the in-stream flow study at Seven Mile Creek recommended in section 4.3.1 and the salmon fry utilization study recommended in section 4.5.1 are completed.

The EPA expressed concerns about the wetland evaluation technique that was used to evaluate wetlands and Yukon Pacific's mitigation policy statement (EPA, 1994b). The EPA indicated that the Mitigation Policy Statement is vague and the wetland technique is flawed because:

- it is based upon fish and wildlife criteria and excludes consideration of some wetland functions such as water quality maintenance and enhancement, erosion control, and flood attenuation;
- the ranking system is intentionally biased toward open water systems;
- it does not provide information necessary to comply with Section 404(b)(1) Guidelines; and

- it does not incorporate methodology from the COE HydroGeoMorphic Approach to Wetland Evaluation.

The DOI/EA (1993) indicated that a wetland complex Yukon Pacific has identified for offsite mitigation supports spawning salmon and waterfowl. The wetland area, located at the Old Valdez townsite, would require a detailed investigation prior to development of wetland mitigation to avoid disrupting spawning salmon and waterfowl using the existing ecosystem.

Other parties whose comments are summarized in a letter from the JPO (1994) were also critical of the Mitigation Policy Statement. Some of these parties were concerned about the delayed timing for the development of a detailed mitigation plan and some felt that the mitigation policy statement fails to adequately address marine impact mitigation, the issues of indirect and cumulative impacts, and mitigation monitoring. These parties were also generally critical of the wetland evaluation technique because:

- it addresses primarily fish and wildlife function of wetlands and fails to evaluate other important wetland functions (TAGS Environmental Review Committee (TERC), 1994; National Wildlife Federation (NWF), 1994; Greenpeace, 1994);

- it fails to acknowledge the importance of and the need for field research (TERC, 1994; Copper Country Alliance (CCA), 1994; NWF, 1994; Greenpeace, 1994; The Wilderness Society (WS), 1994);

- it fails to address flood regulation values of wetlands; (TERC, 1994; CCA, 1994; NWF, 1994);

- it provides inadequate rationale for the classification of wetlands (TERC, 1994; NWF, 1994; WS, 1994); and

- it fails to address issues of subsistence, recreational, social, or economic wetland uses (TERC, 1994).

The FWS (1995) indicated that there are several potential mitigation measures that Yukon Pacific should evaluate and incorporate into the detailed mitigation plan. These include: 1) using the excess rock material to create artificial underwater reefs in other deepwater locations; and 2) grading the excess material disposed of in low productivity marine waters so that the surface elevation of as much of it as possible is 1 to 2 feet below MLLW, and artificially seeding the submerged rock material with blue mussel spat to create mussel beds. Also, all eelgrass beds to be destroyed should be replaced, preferably by salvaging the eelgrass for transplanting before it is filled over. Lastly, organic materials disposed of at upland Sites A and B should be separated from other waste fill, spread on top of the waste fill, and contoured to create replacement artificial wetlands.

In general, we agree with the comments of the other agencies and individuals and share similar concerns regarding Yukon Pacific's wetland mitigation plan. The plan does not provide mitigation for any of the subtidal areas that would be affected. Further, although it proposes various rectification, reduction, and compensation for most of the affected wetland functions and values, it provides no design plans or details as to how the proposed mitigation would be implemented and monitored, or whether the mitigation is likely to be successful. In addition to the concerns raised by other agencies, we have a concern regarding Yukon Pacific's proposed onsite marine mitigation. We believe that the proposal to grade excess rock and soil further out into the deeper water of Anderson Bay following construction of the LNG facility would result in sedimentation of marine waters that could potentially harm marine organisms and possibly marine habitat. If not properly mitigated, this action would present an additional unnecessary impact on the waters and wetlands of Anderson Bay.

It is generally believed that wetland replacement can be an effective method of mitigation if properly implemented. Research suggests that soils, plants, hydrology, and elevation are key factors that influence the success or failure of wetland construction projects (COE, unpublished paper). A study of eel grass transplantation projects in the Pacific Northwest found that substrata, elevation, current or wave disturbance, light energy, scale or size of plots, salinity, and temperature were all factors influencing the success of eel grass transplants (Thom, 1990). Several of these factors as well as timing of construction have been cited as critical aspects to be considered in planning and implementing tidal marsh creation and restoration in other areas of the United States (Broome, 1990). In view of this information, we believe that additional information about Yukon Pacific's wetland mitigation plan is necessary. However, we do not believe the detailed elements of the mitigation plan need to be addressed in this FEIS. The EPA shared this view in its July 29, 1994 letter to the FERC (EPA, 1994b). Therefore, **we recommend that Yukon Pacific file with the BLM/JPO for review and with the Secretary for review and approval by the Director of OPR prior to construction a revised wetland mitigation plan based on the final site grading, excavation, and spoil disposal plans that contains the following:**

- **field delineations and results from site investigations that verify the size, vegetation, and functional values (including salmon and waterfowl habitat) of the wetlands and subtidal marine habitats that would be affected or enhanced on and off the site;**

- **identification of, and proposed mitigation for, all the subtidal marine habitats that would be affected by the site's development and a discussion of the proposed mitigation's probability of success;**

- **identification of the locations and land ownership of the proposed mitigation and enhancement areas;**

- **a detailed literature review of the other wetland and subtidal marine habitat mitigation projects that have been conducted in the Pacific Northwest, including a summary of the successes and failures of these projects;**

- **site-specific construction plans that incorporate information learned from the literature review regarding how the proposed mitigation would be implemented including detailed information regarding the key factors that are known to influence the success of wetland construction (e.g., elevation, substrate, hydrology);**

- **details regarding how the proposed wetland mitigation would be monitored and evaluated following construction to ensure its success; and**

- **written comments, if received, from the JPO, COE, NMFS, FWS, and EPA on Yukon Pacific's revised wetland mitigation plan.**

4.5 MARINE ECOLOGY

Marine impacts include those from the LNG facility upon Anderson Bay, Port Valdez, and the shipping lane through Prince William Sound. This section addresses the potential for impacts within these waterbodies.

4.5.1 Bathymetry and Circulation

Due to fill and blasting operations, the bathymetry of nearshore Anderson Bay would be significantly altered, and at least 35 acres of intertidal habitat would be destroyed. An 18- acre area would be graded to 30 feet elevation by filling the intertidal areas between the shore and the adjacent island and extending beyond the island several hundred feet into Anderson Bay, and about 17 acres near and including the intertidal lower reach of Short Creek would be filled.

Approximately 3,018,000 cubic yards of overburden soils down to bedrock and 735,000 cubic yards of rock would be removed and placed in planned fill and disposal areas. In addition to disposal of waste rock and overburden, an additional 1,400,000 cubic yards of structural rock fill would be used as fill to construct a cargo dock. Disposal of the overburden material, which includes stumps, roots, organics, till, and broken bedrock, can affect water quality and is discussed in section 4.5.2.

Circulation within Anderson Bay would be affected by rock and spoil disposal resulting in the filling of 16 acres of its east end, and circulation in nearshore Port Valdez may be affected by thermal discharge. Decreased stream flow would result from the use of Seven Mile Creek, Nancy Creek, or Short Creek to provide water supply for construction and operation of the facilities (section 4.3.1) and may alter the salinity structure within Anderson Bay and nearshore Port Valdez. Thermal discharge would primarily arise from desalination plant and HRSG blowdown discharge during operation (table 4.5.1-1). High temperature discharges can impact marine habitat and alter the circulation in the vicinity of discharge and should therefore be minimized.

HRSG blowdown effluent and desalination discharge effluent share the same discharge piping. The NPDES and state receiving water quality standards require that weekly average temperature increases be limited to no more than 1 degree Celsius at the edge of the mixing zone; maximum rate of change shall not exceed 0.5 degree Celsius per hour; and normal daily temperature cycles shall not be altered in amplitude or frequency. The desalination discharge volumes are expected to be much larger than the blowdown volumes, although the blowdown temperature may be much higher. Therefore, in sizing and evaluating the mixing zone, the relative discharge rate and temperature of both effluents must be considered.

Yukon Pacific has estimated a maximum differential temperature of 55°F to 65°F above ambient seawater for desalination plant discharge. For this temperature differential range, dilution to assure compliance with a 1°C or 1.8°F temperature increase would be 30-36 parts seawater to 1 part discharge or less than 50 to 1 dilution (55-65/1.8 = 30-36). A standard diffuser design would probably provide dilution in excess of 50:1. Dilution models may be utilized to incorporate information on water depth, local currents, salinity, temperature and volume of discharge, and seasonal stratification in order to calculate site-specific dilution for mixing zone allowances. Due to the high temperature of the discharge, we **recommend that Yukon Pacific use a dilution model to design the diffusers for the high temperature of the desalination and HRSG/Blowdown discharges, and determine the vertical extent of the mixing zone so that the surface and bottom thermal layers of Port Valdez are not subject to periodic surges of hot water.**

TABLE 4.5.1-1

Location, Volume, and Temperature of Discharge from Proposed Outfalls

Outfall	Discharge Volume (gpm) a/, b/	Temperature °F	Comments
Desalination Plant LE-1	Average: 657 Maximum: 1,503	Mean: 100 Minimum: 100 Maximum: 100 Edge of mixing zone c/: seawater + 1.8	See text
HRSG/Boiler Blowdown d/ LE-2	Average: 4 Maximum: 6	Mean: 230 Minimum: 230 Maximum: 230 Edge of mixing zone c/: seawater + 1.8	See text
Wastewater Treatment Plant LE-3	Average: 30 Maximum: 120	Mean: 48 Minimum: 35 Maximum: 60	
No. 1	Average: 667 Maximum: 7,900	Ambient	Mouth of Strike Creek
No. 2	Average: 317 Maximum: 34,400	Ambient	Combined wastewater plant discharge
No. 3	Average: 183 Maximum: 17,250	Ambient	
No. 4	Average: 167 Maximum: 1,417	Ambient	
No. 5	Average: 183 Maximum: 15,283	Ambient	
No. 6	Average: 417 Maximum: 20,683	Ambient	Mouth of rerouted Short Creek
No. 7	Average: 3,700 Maximum: 144,383	Ambient	Mouth of Nancy Creek
No. 8	Average: 117 Maximum: 12,617	Ambient	
No. 9	Average: 367 Maximum: 19,033	Ambient	Near mouth of Seven Mile Creek
No. 10	Average: 667 Maximum: 6,917	Ambient	

a/ The desalination plant volumes reported do not include strainer and pressure filter backwash volumes.

b/ The average discharge volumes from the outfalls are based upon average annual precipitation. The maximum discharge volume from the outfalls is based upon the 100-year return storm event with the duration/intensity chosen to yield the maximum instantaneous discharge volume.

c/ Assumes 50 to 1 dilution at edge of mixing zone (see text).

d/ The temperature of the wastewater treatment plant effluent is expected to be around 35°F to 45°F in the winter and around 50°F to 60°F in the summer. The temperature reported is the arithmetic average of the minimum and maximum temperatures.

The worst-case difference in temperature between blowdown and ambient water would be about 195°F (230°F blowdown temperature relative to 35°F seawater temperature). To meet criteria, and in the absence some initial cooling, slightly greater than a 100:1 dilution would be necessary within the mixing zone (195/1.8 = 108). Again, dilution models would be required to determine the mixing zone necessary to sufficiently dilute this low volume, high temperature discharge and will be conducted before discharge is permitted by state agencies.

The actual size and shape of the mixing zone must comply with Alaska water quality standards 18 AAC 70.032 which state the cumulative linear length of all mixing zones intersected on any given cross section of an estuary, inlet, cove, channel, or other marine water measured at mean lower low water may not exceed 10 percent of the total length of that cross section, nor may the total horizontal area allocated to mixing zones in these waters exceed 10 percent of the surface area measured at mean lower low water. Temperature discharge must not have an adverse impact on anadromous fish spawning or rearing or form a barrier to migratory species. Although the state has some latitude in assigning limits, mixing zones are receiving more scrutiny and more evidence is being requested by the state.

Mixing zones of 600 feet by 600 feet (183 m) have been predicted for desalination plant discharge and assumed to meet the mixing requirements for blowdown discharge. Mixing zones of this size are within the normal range (Sturdevant, 1993). Before permitting, Yukon Pacific must apply for a mixing zone with the ADEC, and run models to assess the temperature of water at the edge of the mixing zone (Kawabata, 1992). If the size of the allowable mixing zone is not sufficient to meet the water quality standards for temperature, Yukon Pacific must cool the water before discharge into Port Valdez. Cooling measures, if necessary, could include cooling periods in sedimentation ponds or the installation of a small air cooler.

The location of the desalination discharge would not be determined until detailed design, but would be chosen so that its mixing zone allowances do not overlap with adjacent allowances (i.e., for the wastewater treatment plant discharge). The location of the combined desalination and boiler discharge shown on figure 2.1.4 sheet 2 is at the Port Valdez shoreline immediately north of the source water treatment (desalination) area. The location shown for the discharge from the wastewater treatment plant is based upon the assumption that the discharge would flow into Sediment Pond No. 1, ultimately leaving the site via outfall No. 2.

4.5.2 Water Quality

Possible impacts on marine water quality in the project area include increased turbidity from construction, grading, and blasting, loss of wetlands as buffers, disposal of fill, outfall discharge, ballast water exchange, and accidental spills. This section discusses the impacts of these activities upon nearshore water quality in Anderson Bay and Port Valdez as well as the shipping lane through Prince William Sound.

4.5.2.1 Anderson Bay and Nearshore Water Quality

Increases in turbidity in Anderson Bay and nearshore Port Valdez may arise from construction activities. We have recommended that Yukon Pacific prepare and submit a detailed erosion control and sedimentation control plan (see section 4.1.3) to delineate appropriate leaching, runoff, and erosion control measures from site surface excavation and uncontrolled or diverted runoff during construction activities. This plan would include control methods such as retention basins, berms, revegetation, and straw bales as appropriate.

Underwater blasting would be required in most areas of the leveling operation. Blasting would not occur until a detailed blasting test program has been conducted to determine the limits for charge size, charges per delay, and total charge weight for Anderson Bay. The blasting plan would be covered in the ADNR state permit (TAGS Right-of-Way Lease Stipulation Number 2.11) and COE Section 10 and Section 404 permits, and it would be reviewed by the NMFS, ADFG, COE, and FWS. Blasting would be expected to increase turbidity within the water column, thus blasting during the spring season should be avoided. In addition, blasting is likely to change water quality in the vicinity of the blast location. Only short-term turbidity impacts are anticipated, assuming the bathymetry of important tidal areas is not changed significantly.

Placement of fill within Anderson Bay could adversely affect water quality in Anderson Bay through increased turbidity during placement and subsequent leaching. The fill would contain all sizes of excavated rock, organics, concrete, and glacial till. According to a study conducted by Dames and Moore (1991) and Steffen Robertson and Kirsten, Inc. (1991), however, placement of onsite rock should not result in the formation of acids which would favor the leaching of metals from the rock. This conclusion was reached following a procedure known as static acid-base accounting using a total of 92.8 percent of onsite bedrock types from over the entire Anderson Bay plant site, including those with the highest acid-generating minerals (sulfides). Paste pH tests were also run on each sample to determine if acid generation had already begun. None of the rock demonstrated any potential for acid generation, and thus the potential for metals leaching from fill disposal appears to be minimal. As a further deterrent to leaching, all disposal areas would first be isolated from Port Valdez by containment dikes composed of mineral soil or rock.

The material used to construct these initial containment dikes would be relatively free of organic soils (less than 5 percent) and would not contain stumps or large roots. Organic material, which would be present in the overburden, could adversely affect water quality through the introduction of nutrients, metals, and turbidity. The state is opposed to the marine disposal of organic material, and recommends further investigation into the upland disposal of this material. When complete, the surface of the disposal areas would be plated with clean rock to provide a trafficable surface for equipment and for the storage of construction materials. Following construction, the western portion could be graded down and returned to intertidal and shallow subtidal salt water influence according to the proposed wetland mitigation plan submitted by Yukon Pacific (see section 4.4.3). This would temporarily result in increased levels of turbidity within an uncontained area of Anderson Bay. To protect the water quality and habitat of Anderson Bay from unnecessary impacts, we have recommended that Yukon Pacific provide greater detail on its wetland mitigation plan to the Director of OPR for review and approval, along with comments, if received, from the JPO, COE, NMFS, FWS, and EPA.

Although long-term leaching is not expected to be a problem, placement of the fill in the nearshore environment is expected to result in short-term violations of state water quality standards (e.g. turbidity). However, the state, at its discretion, may grant a short-term variance for a one-time, temporary activity with the placement of dredged or fill material affecting a specific waterbody. The petitioner must demonstrate that the activity would be conducted in a manner to mitigate water quality impacts, using methods found by the Department to be most effective, and must show that the activity, once completed, would not cause a long-term, chronic, or recurring violation of the water quality standards.

As discussed in section 4.5.1, 10 outfalls and effluent from the desalination plant, HRSG/boiler blowdown, and the wastewater treatment plant would discharge into Anderson Bay and nearshore Port Valdez. The 10 outfalls would contain stream water and controlled site drainage from developed areas. There would be no uncontrolled site drainage except for drainage from the shoreside perimeter of the site. To minimize uncontrolled runoff, we have recommended that a vegetative buffer strip 50 feet wide be maintained along all shoreline areas, where possible (see section 4.4.2). Grading and restoration requirements for the shoreside perimeter areas would be reviewed during detailed design by the FERC staff prior to construction and by other state and Federal agencies as it relates to the site-specific erosion and sedimentation control plan (see section 4.1.2).

Table 4.5.2-1 presents predicted water quality from the desalination plant and HRSG/boiler blowdown. Water quality estimates for the desalination plant, HRSG/boiler blowdown, and the wastewater treatment plant were compared to state water quality regulations. Desalination discharge composition was estimated based upon a concentration factor of 10/9 seawater assuming 90 percent of water withdrawn from Port Valdez is returned to Port Valdez. No violations were evident in the predictions with the possible exception of total dissolved solids (TDS) in the desalination plant discharge. However, dilution in the mixing zone is predicted to bring TDS into compliance by the edge of the mixing zone (from 50,000 to 30,932 mg/L). The HRSG/boiler blowdown composition was estimated based on an assumed operational limit of 3,000 mg/L total dissolved solids. The composition of the blowdown would be the composition of the desalination plant effluent concentrated by the ratio of TDS in the effluent to a TDS of 3,000 mg/L plus any corrosion or scaling inhibitors. The addition of these inhibitors would have to be approved through the NPDES permit process before discharge would be allowed.

The two-step wastewater treatment system would be designed to bring the significant amounts of oil and grease, grit and other settleable solids, and organic and inorganic suspended solids into compliance with state regulations. Table 4.5.2-2 presents a typical estimate of effluent quality for the wastewater treatment plant based upon similar plant effluents (Metcalf and Eddy, 1979) and Yukon Pacific's experience with similar facilities. Predicted maximum biochemical oxygen demand (BOD) and total suspended solids in the wastewater treatment plant effluent are equal to values identified in a nearby NPDES permit (Alyeska's Treatment Plant) and are thus near the permitted limit. Fecal coliform predictions for the wastewater treatment plant effluent are in incompatible units with the standards (mg/L predicted versus #/100 mL regulated), and thus could not be directly compared. Alyeska is also required to periodically monitor nearby sediment to check for accumulation of organic contaminants within and outside of their designated mixing zone. While the wastewater effluent concentrations for Yukon Pacific are predicted to be in compliance, periodic water quality analyses for selected constituents may still be required in the NPDES permit.

All ballast water from the LNG tankers would be exchanged during the 36-hour period prior to entering Prince William Sound in order to ensure that foreign organisms do not enter the Sound. In addition to the 36-hour period, **we recommend that Yukon Pacific require ballast water discharge/exchange to occur at least 10 kilometers south of Hinchinbrook Entrance in order to protect against any waiting or slow travel scenarios.** Therefore, ballast water exchanged at the facility should be relatively clean water based on its source and its recent change. In addition, the ballast storage system in LNG tankers is designed to isolate ballast water from the cargo and thus to prevent hydrocarbon discharge with the ballast water. Therefore, we do not believe impacts from discharge of this ballast water would be significant. Bilge discharges into nearshore waters from vessels moored at the site would not be allowed.

TABLE 4.5.2-1

Liquid Effluent Compositions and Pollutant Mass Rates for Desalination Plant Effluent and HRSG/Boiler Blowdown

		Desalination Source Seawater	Desalination Discharge, Average, in the Pipe	Desalination Discharge, Daily Maximum, in the Pipe	Desalination Discharge, Daily Maximum, Edge of Mixing Zone a/	HRSG/Boiler Blowdown, Average & Daily Maximum, in the Pipe b/	HRSG/Boiler Blowdown Average & Daily Maximum, Edge of Mixing Zone a/	Desalination Discharge, Rate of Pollutants Average (lb/hour) c/	Desalination Discharge, Rate of Pollutants Maximum (lb/hour) d/	HRSG/boiler Blowdown, Rate of Pollutants Average (lb/hour) c/	HRSG/boiler Blowdown, Rate of Pollutants Maximum (lb/hour) d/
Temperature e/			100F	100F	seawater+1.8F	230F	seawater+1.8F				
Discharge flow											
Average, gph			39,420			240					
Maximum, gph			90,180			360					
Salinity	ppm	30,000	33,333	50,000	30,392						
pH		8	8	8	8	8.2	8.2				
Hydrocarbons	mg/l	0.6	0.67	1.00	0.61			0.219	0.753		
Benzene	ug/l f/	0.2	0.2	0.2	0.2			0.000	0.000		
Chlorobenzene	ug/l f/	0.2	0.2	0.2	0.2			0.000	0.000		
Ethylbenzene	ug/l f/	0.2	0.2	0.2	0.2			0.000	0.000		
Toluene	ug/l f/	0.3	0.3	0.3	0.3			0.000	0.000		
Xylenes	ug/l f/	0.6	0.6	0.6	0.6			0.000	0.000		
Copper	mg/l	0.066	0.073	0.110	0.067			0.024	0.083		
Iron	mg/l	0.092	0.102	0.153	0.093			0.034	0.115		
Nickel	mg/l	0.019	0.021	0.032	0.019			0.007	0.024		
Zinc	mg/l	0.044	0.049	0.073	0.045			0.016	0.055		
Arsenic	mg/l f/	0.001	0.001	0.001	0.001			0.000	0.001		
Cadmium	mg/l f/	0.0001	0.0001	0.0001	0.0001			0.000	0.000		
Lead	mg/l f/	0.001	0.001	0.001	0.001			0.000	0.001		
Mercury	mg/l	0.0003	0.00033	0.00050	0.0003			0.000	0.000		
Chloride	mg/l	12,000	13,333	20,000	12,157	1,648	11.,97	4,386.2	15,051.4	3.301	35.442
Sulfate	mg/l	2,700	3,000	4,500	2,735	232	2,652	986.9	3,386.6	0.465	7.966
Bicarbonate	mg/l	150	167	250	152	12	147	54.8	188.1	0.024	0.443
Bromide	mg/l	70	78	117	71	6	69	25.6	87.8	0.012	0.207
Sodium	mg/l	10,000	11,111	16,667	10,131	922	9,822	3,655.2	12,542.9	1.847	29.508
Magnesium	mg/l	1,300	1,444	2,167	1,317	111	1,277	475.2	1,630.6	0.222	3.836
Calcium	mg/l	400	444	667	405	35	393	146.2	501.7	0.070	1.180
Potassium	mg/l	390	433	650	395	33	383	142.6	489.2	0.066	1.151
Strontium	mg/l	13	14	22	13	1	13	4.8	16.3	0.002	0.038
TDS	mg/l	30,000	33,333	50,000	30,392	3,000	29,471	10,965.6	37,628.6	6.009	88.538

a/ Assumes 50 to 1 dilution at edge of mixing zone.
b/ HRSG/boiler system will be operated to maintain 3,000 TDS.
c/ Calculated as the product of average flow and average concentration (mass rate is that of the pollutants in the raw seawater feed).
d/ Calculated as the product of maximum flow and maximum concentration.
e/ Mean, minimum, and maximum temperatures are the same for desalination plant discharge and blowdown.
f/ Actual values are less than the estimated values shown.

TABLE 4.5.2-2

Liquid Effluent Compositions and Pollutant Mass Rates for Wastewater Plant Effluent / Outfall No. 2

		Wastewater Treatment Plant Average	Wastewater Treatment Plant Maximum	Site Runoff Average	Site Runoff Maximum	Combined Discharge, Outfall No. 2 Average a/	Combined Discharge, Outfall No. 2 Maximum b/	Wastewater Treatment Effluent Average (lb/hr) c/	Wastewater Treatment Effluent Maximum (lb/hr) d/
Flow e/	gph	1,800	7,200	19,000	210,000	20,800	217,200		
Temp. (winter)	F	35	45	36	40	35.9	40.2		
Temp. (summer)	F	50	60	50	60	50.0	60.0		
pH		7.5	8.5	7.5	8.5	7.5	8.5		
BOD	mg/l	30	45	2	5	4.4	6.3	0.451	2.704
COD	mg/l	45	60	3	7	6.6	8.8	0.676	3.605
TSS	mg/l	30	45	20	200	20.9	194.9	0.451	2.704
Ammonia (N)	mg/l f/	0.5	1	0.15	0.15	0.2	0.2	0.008	0.060
Oil/grease	mg/l f/	5	10	1	5	1.3	5.2	0.075	0.601
Fecal Coliform	mg/l f/	16	200	16	200	16.0	200.0	0.240	12.017
Nitrate (N)	mg/l f/	10	20	1	3	1.8	3.6	0.150	1.202
Phosphorus (P)	mg/l f/	3	6	0.01	0.02	0.3	0.2	0.045	0.361
Copper	mg/l f/	0.05	0.05	0.01	0.29	0.01	0.28	0.001	0.003
Iron	mg/l f/	0.2	1.5	0.2	2.0	0.2	2.0	0.003	0.090
Nickel	mg/l f/	0.01	0.01	0.01	0.70	0.01	0.68	0.000	0.001
Zinc	mg/l f/	0.05	0.05	0.02	5.00	0.02	4.84	0.001	0.003
Arsenic	mg/l f/	0.001	0.001	0.002	3.600	0.002	3.481	0.000	0.000
Cadmium	mg/l f/	0.0002	0.0002	0.0002	0.9000	0.0002	0.8702	0.000	0.000
Lead	mg/l f/	0.05	0.05	0.02	0.50	0.02	0.49	0.001	0.003
Mercury	mg/l f/	0.0003	0.0003	0.0003	0.0020	0.0003	0.0019	0.000	0.000
Hydrocarbons	mg/l f/	0.1	0.2	0.1	0.2	0.1	0.2	0.002	0.012
Benzene	ug/l f/	0.1	0.1	0.1	0.1	0.1	0.1	0.000	0.000
Chlorobenzene	ug/l f/	0.1	0.1	0.1	0.1	0.1	0.1	0.000	0.000
Ethylbenzene	ug/l f/	0.1	0.1	0.1	0.1	0.1	0.1	0.000	0.000
Toluene	ug/l f/	0.1	0.1	0.1	0.1	0.1	0.1	0.000	0.000
Xylenes	ug/l f/	0.2	0.2	0.2	0.2	0.2	0.2	0.000	0.000

a/ Average combined discharge characteristics reflect a mass balance of effluent and runoff at average flow rates and concentrations.
b/ "Maximum" combined discharge characteristics reflect a mass balance of effluent and runoff at maximum flow rates and concentrations.
c/ Calculated as product of average flow and average concentration.
d/ Calculated as product of maximum flow and maximum concentration.
e/ Peak runoff to the Sediment Pond is 34,400 gpm; the equalized rate for discharge was assumed to be 3,500 gpm.
f/ Actual values are less than the estimated values shown.

Other impacts that could potentially affect marine water quality in the project area include air emissions from the plant operations as well as accidental spills. Air emissions should not significantly impact marine water quality due to the high buffering potential of seawater. However, spills could result in significant effects, and thus appropriate precautions would be detailed in a SPCC Plan and followed accordingly. Such precautions include the placement of booms around tankers during loading as well as spill containment for any petroleum storage tank.

4.5.2.2 Prince William Sound and Offshore Water Quality

All ballast water from the LNG tankers would be exchanged during the 36-hour period prior to entering Prince William Sound to ensure ballast discharge (with foreign organisms) does not enter into Prince William Sound. Bilge water may be dumped in offshore waters because its discharge would not be allowed in Port Valdez. According to MARPOL regulations 73/78, bilge water must contain less than 100 ppm total petroleum hydrocarbons (TPH) if discharged over 50 miles from the coast, and must contain less than 15 ppm TPH if within 50 miles of the coast.

Bilge water from LNG tankers and support vessels will not be discharged to Port Valdez or Prince William Sound. The wastewater treatment plant proposed for the Anderson Bay facility will be designed to accommodate oily water from various sources. The oils collected will be disposed of in the onsite waste incinerator. The oil feed to the incinerator will be tested to ensure that it is non-hazardous.

It has not been determined whether support vessels will be contracted or facility owned. If contracted, the contractor may have access to other bilge water disposal facilities. Regardless of ownership, if bilge water must be removed from a vessel associated with the LNG facility while in Port Valdez, and there is no other means of handling such water, the bilge water can be processed through the proposed wastewater treatment facility. Surge storage capacity can be installed to accommodate large amounts of bilge water if this is found to be necessary.

As identified in section 4.15.4, the worst scenario for Prince William Sound would involve release of LNG cargo due to a serious grounding or collision of a tanker. If LNG were released, it would either evaporate rapidly forming a flammable cloud, or ignite and burn. In either case, a LNG spill would not affect water quality.

4.5.3 Sediment Quality

Sediments throughout Port Valdez are slightly contaminated with PAHs from past activities. However, the extent of the most highly impacted sediment, near the Alyeska terminal, does not appear to extend beyond 1-2 miles from the terminal and, therefore, does not significantly affect the sediments in the vicinity of Anderson Bay. At a station 1 to 2 miles west of Anderson Bay in the middle of Port Valdez, the most concentrated PAH, phenanthrene, has a mean concentration of 38 ppb (Shaw, 1992). Since the sediments in Port Valdez have such a low organic content, very low amounts of contamination are noticeable, even though the sediments do not have a high affinity for the organic contaminants. Cumulative impacts do not appear to be of concern at this time. However, possible sediment accumulation could arise from discharge from the outfalls, and the accumulation of small spills. The exchange of ballast water should not be of major concern.

4.5.4 Marine Fisheries

Construction of the Anderson Bay facility would impact the marine environment in several ways. Estuarine spawning areas at the mouths of Seven Mile and Nancy Creeks are used by pink and chum salmon. These areas would be highly sensitive to changes in the flow regime and alteration due to the proposed grading of the shoreline near the mouth of Seven Mile Creek. Salmon fry utilize protected, shallow intertidal areas in Anderson Bay. There is a proposed loss of approximately 35 acres of this habitat. There would be changes in the rocky intertidal and subtidal areas in the tanker berthing area and along the face of the cargo dock area. The release of heated water from the desalination plant and HRSG/Boiler blowdown may impact the marine environment. This section reviews these impacts and potential mitigation measures to minimize the negative effects on marine fish resources.

Pink salmon fry exiting Port Valdez migrate along the south side of the port and use Anderson Bay as a nursery area. Chum salmon fry have also been observed in Anderson Bay. The construction of bulkheads and docking facilities for the cargo dock and the spoil disposal area would eliminate approximately 35 acres of productive, protected, shallow water areas which provide cover and food for salmon fry. The fill disposal area in the eastern corner of Anderson Bay would cover an eel grass bed which is a highly productive marine habitat and is limited in Port Valdez. Yukon Pacific has proposed to create shallow intertidal habitat in the fill disposal area following construction when this location is no longer needed as a laydown area. We believe this mitigation plan would be inadequate (see sections 4.4.3.1 and 4.4.3.3). The salmon stocks in Port Valdez have 2- to 5-year life cycles and construction is scheduled to take place over 5 years. Eliminating critical habitat for the entire life cycle of the species of concern could negatively impact the entire stock as opposed to impacting an isolated year-class. In addition, attempts to create eel grass habitat in the northwest U.S. and Canada have generally met with poor success (Thom, 1990).

Although salmon fry have been observed in this area, its importance relative to other parts of Port Valdez and other habitat types has not been documented; therefore, it is difficult to determine if there are real negative impacts and the degree of the impacts. **We recommend that Yukon Pacific, in consultation with the ADFG, ADNR, and FERC, develop and conduct a salmon fry utilization study, designed to determine the importance of the nearshore areas affected by plant construction relative to other areas in Port Valdez. In particular, the proposed B′ disposal area must be addressed in detail. This study along with proposed mitigation should be submitted to the ADFG and ADNR and filed with the Secretary for review and approval by the Director of OPR.**

Shock waves from underwater blasting may injure or kill fish which occur in the area. To minimize impacts from blasting, **we recommend that Yukon Pacific prepare a blasting plan that considers (1) scare charges and/or bubble curtains to move resident fish away from the area prior to blasting, and (2) coordination with the ADFG and the Solomon Gulch hatchery personnel to schedule blasting activities when no adult or juvenile salmon are in the area.**

Intertidal and subtidal construction and blasting may cause changes in the algal community which in turn could cause changes in spawning patterns for herring which have been occasionally observed to spawn in Anderson Bay. Currently herring spawning in Port Valdez is sparse and does not occur on an annual basis. It is unlikely that changes in intertidal structure or the intertidal algal community would significantly impact herring spawning patterns.

The discharge of effluent water at a temperature of 100°F from the desalination plant and 230°F from the HRSG/blowdown may attract marine fish to the warm water in the mixing zone. If fish become acclimated to warm water, its removal can cause mortality due to thermal shock. Once Yukon Pacific has determined the specific discharge volume, **we recommend that Yukon Pacific consult with the EPA, ADFG, and NMFS to determine the allowable location, frequency, and duration of warm water discharges into Port Valdez.**

4.5.5 Benthic Organisms and Algae

Intertidal and subtidal construction, and blasting in the tanker docking area would cause long-term physical changes in bathymetry, and available substrate. In the short term, it is likely that intertidal and subtidal organisms and algae would be damaged, covered, or killed. Disruption of the rocky intertidal zone due to ice scour and extreme weather is common in Port Valdez. The intertidal marine community has adapted to this and tends to recover quickly. The changes in substrate profiles and substrate types may cause changes in the benthic community, but there is a low species diversity in Port Valdez and it is unlikely these changes would be significant.

Construction of the cargo dock area, and use of the nearshore fill disposal area would cover shallow gravel, cobble, and sand/silt substrates. This would reduce the amount of interstitial spaces and soft substrate available to epiphytic, benthic, and burrowing organisms. Clams and crabs do not occur in significant numbers in Port Valdez and it is unlikely loss of this habitat would impact these populations. However, harpacticoid copepods have been found congregated in and on these habitat types and are an important salmon fry food resource. In addition, there is a documented eel grass bed in the fill disposal area. Yukon Pacific has proposed to create shallow intertidal habitat in this area after construction and abandonment of this location as a laydown area to mitigate for the loss of the shallow intertidal habitats. We are not confident in the viability of this mitigation. See section 4.4.3.3 for further discussion.

Fill placed in deep water marine disposal areas would cover and kill any established benthic organisms. The deep water benthic community in Port Valdez has adapted to chronic disruption due to deposition of high levels of glacial sediments. The benthic community would probably recover once fill disposal has been completed.

Fuels, lubricants, and other chemicals spilled during plant construction and operation would negatively impact intertidal benthic organisms if allowed to run off into the marine environment or streams. In addition, fuels, lubricants, and other chemicals spilled from supply or transport vessels would negatively impact marine organisms. To minimize impacts caused by runoff of spills or leachate, we have recommended that Yukon Pacific develop a SPCC Plan using best management practices.

Finally, ballast water loaded in the LNG tankers from other geographic areas may contain exotic species of algae or organisms. Yukon Pacific would require that all ballast water be exchanged 36 hours prior to entering Prince William Sound. This would prevent the exchange of water from different global regions in the sound and would prevent exotic introductions.

4.5.6 Wildlife

4.5.6.1 Seabirds

Hogan and Irons (1988) listed 12 species of seabirds occurring in the vicinity of Port Valdez. This list is dominated by gulls and terns which nest at Shoup Bay directly across Port Valdez from Anderson Bay. These birds, along with marbled murrelets and pelagic cormorants, are the most common birds during the summer, while gulls and common murres are most common during the winter. Most of these birds will forage in the Anderson Bay area (BLM and COE, 1988). The LNG Project is expected to have little impact on seabirds mainly because most of these birds forage throughout Port Valdez and there are no nesting colonies within the immediate vicinity of the project area. However, as with waterfowl (see section 4.5.6.2), seabirds are highly susceptible to fouling by hydrocarbon discharges (Hogan and Irons, 1988). This is especially true with alcids such as murres and murrelets which spend most of their time on the water. Potential hydrocarbon discharges associated with the LNG Project include wastewater discharges. However, as mentioned previously, these potential impacts would be minimized by Yukon Pacific's proposed two-stage wastewater treatment system (see section 2.1.1.5) and our recommended SPCC Plan.

Seabirds may also be impacted by potentially lethal shock waves from the proposed submerged blasting at Anderson Bay. These impacts might be minimized by hazing seabirds from the zone of influence prior to blasting (see section 4.5.6.4 Marine Mammals below).

In general, the overall impacts on seabirds would not likely be great if all precautionary measures are fully implemented.

4.5.6.2 Waterfowl

Impacts on nesting waterfowl are expected to be minimal as a direct result of the construction and operation of the LNG plant and the marine facilities due to a general lack of waterfowl nesting habitat at the Anderson Bay site. Although few waterfowl occur in the Port Valdez area during winter (Hogan and Irons, 1988), large concentrations of overwintering Barrow's goldeneyes and surf scoters may occasionally feed in the intertidal areas of Anderson Bay. Both species would be impacted from both the loss of approximately 35 acres of intertidal and subtidal habitat due to construction of the LNG plant and marine facilities.

The LNG tankers, unlike conventional oil tankers, would have entirely segregated ballast tanks that would not be exposed to either LNG cargo or petroleum products. Furthermore, the ballast discharge procedures require changing all ballast water at sea during the 36-hour period prior to entering Prince William Sound.

Foraging waterfowl might also be impacted by potentially lethal shock waves emanating from proposed submerged blasting in Anderson Bay. Impacts on birds might be minimized by hazing waterfowl from the blast zone of influence prior to blasting (see section 4.5.6.4 Marine Mammals). In general, the overall impacts on waterfowl from construction and operation of the LNG plant and marine facilities would not be significant if all proposed precautionary measures are fully implemented.

4.5.6.3 Shorebirds

The intertidal zones of Anderson Bay provide limited foraging habitat for shorebirds compared to elsewhere in the Port Valdez region due to a lack of mudflats and other shallow water areas. What foraging habitat does occur, however, would be impacted by the infilling of intertidal zone at the east end of Anderson Bay during rock and overburden fill and disposal (see section 2.3.2). Potential operational impacts on the intertidal habitat remaining after construction by hydrocarbon contamination from marine facility washdown and small fuel spills would be minimized by onsite collection and treatment of runoff and wastes. In general, although the proposed construction dock and spoil disposal site would severely reduce the intertidal zone of Anderson Bay, the impact on Port Valdez shorebirds would not be significant.

4.5.6.4 Marine Mammals

While several species of marine mammals have been recorded in Valdez Arm, only sea otters and harbor seals occur there on more than an occasional basis. (Endangered and threatened marine mammals are discussed in section 4.6). The importance of Port Valdez to these species is presently unknown, although both species were observed in Anderson Bay during surveys conducted by the ADFG during June 1991 (Brna, 1992a).

Probably the greatest potential impact on sea otters and harbor seals (and other marine mammals in the area) from the proposed LNG Project is the proposed submerged blasting operation. Submerged blasting can cause severe damage to marine mammals in two ways: 1) produced sharp noise pulses can impair hearing systems and 2) intense shock waves can physically disrupt internal tissues (Richardson et al., 1989). While there is no direct information on the effect of pulse noises on marine mammals (Richardson et al., 1989), Bohne et al. (1985) speculated that cochlear lesions observed in Antarctic seals were caused by explosions that had occurred in the area. Submerged blasting would probably not affect resting otters and seals because their heads are out of the water during these periods.

Intense shock waves created by underwater high explosions are a more serious problem. Studies conducted in association with the Amchitka Island underground nuclear tests indicated that shock waves with peak pressures of 100 to 300 psi were lethal or damaging to sea otters and harbor seals (Rausch *in* Fuller and Kirkwood, 1977). Pressures greater than 300 psi were lethal to sea otters (Wright and Allton, 1971). Hill (1978) and Wright (1982, 1985), following Yelverton et al. (1973), described procedures for calculating safe distances from explosions for marine mammals based on a combination of physical factors. Hill (1978) calculated that an 11 pound (5 kilogram [kg]) charge detonated at a depth of 16 feet (5 meters [m]) would not physically harm a ringed seal occurring 1,180 feet (greater than 360 m) away at depths greater than 82 feet (greater than 25 m). Correspondingly, Hill calculated that a 110 pound (50 kg) charge would not cause physical damage beyond 2,526 feet (770 m). However, these calculations for marine mammals were based upon terrestrial mammal data and do not take into account physiological and anatomical differences between terrestrial and marine mammals, causing Hill to suggest that the calculations may overestimate shock wave impacts on marine mammals. Nevertheless, in the absence of better data, the Yelverton/Hill procedure does provide a conservative approach to setting zone of physical influence boundaries. Additionally, Hill (1978) and Wright (1982) have suggested that calculated safe distances should be doubled in circumstances where explosions occur at or near rocky bottoms, such as at Anderson Bay, because shock waves may attenuate less rapidly than in open water.

Consequently, while proposed submerged blasting associated with construction of the LNG Project may have the potential to impact local marine mammals, Hill (1978) has provided a mechanism to develop a zone of influence for these impacts. **We recommend that Yukon Pacific include in its blasting plan measures, such as the use of NMFS-approved spotters or lookouts, to ensure marine mammals are not present within the zone of influence prior to blasting.** If necessary, the zone of influence may be extended to take into account that marine mammal reactions to audible noises might occur at much greater distances than shock wave influences (Richardson et al., 1989).

4.6 ENDANGERED AND THREATENED SPECIES

4.6.1 Terrestrial Species

No federally listed or proposed endangered or threatened plant or wildlife species have been reported in the vicinity of the Anderson Bay project area (Stackhouse, 1992a; FWS, 1993). However, the federally endangered American subspecies (*Falco peregrinus anatum*) of the peregrine falcon may occasionally occur in the area as it migrates between its interior Alaska breeding areas to southern winter areas (Swem, 1993). This subspecies has not been confirmed to nest in the Prince William Sound area, although Prince William Sound falls within the breeding range of the nonendangered Peale's subspecies (*F. p. pealei*) (Craig, 1986). Construction and operation of the Yukon Pacific LNG Project would not affect this species.

4.6.2 Marine Species

To assess the potential effects that the Yukon Pacific LNG Project could have on populations of endangered whales or Steller sea lion, and in accordance with Section 7 of the ESA, the staff prepared a Biological Assessment (BA) (see appendix C) and submitted it for review to the NMFS. This BA addressed four federally listed species that were identified by the NMFS as well as the endangered northern right whale.

Our assessment concluded that no direct impacts on the populations of the northern right, gray, humpback, or fin whales, or Steller sea lions would occur as a result of this project. Port Valdez is not documented as being important habitat or often used by any of these species. The potential increase in shipping would have little or no effect on marine mammals as existing, high use shipping travel lanes would be used for transport of LNG to market. There is no documented evidence that normal shipping activities have had any adverse effects on whales or sea lions in Prince William Sound.

In a letter dated March 17, 1993, the NMFS (NMFS, 1993b) responded to the FERC staff by concurring that there is presently no identified critical habitat for any of the four species of the whales of concern or for the Steller sea lion, although there are currently plans to designate specific Steller sea lion rookeries and haulouts in Prince William Sound as critical habitat. None of these rookeries or haulout sites occur in Port Valdez. Consequently, the NMFS agreed with the conclusion that construction of the LNG terminal would not have direct impacts on the species discussed above and has indicated that formal consultation is not required for this project, therefore concluding Section 7 consultation between the FERC and the NMFS.

4.7 AIR QUALITY

4.7.1 General Construction and Operational Impact

Construction of the proposed Anderson Bay facility would cause temporary reduction of local ambient air quality due to fugitive dust and emissions generated by construction equipment. The extent of fugitive dust generation during the construction phase would depend on the level of activity and on the moisture content and texture of the soils that would be disturbed. If appropriate dust suppression techniques are not employed, dry and windy weather conditions could create a nuisance. Blasting could also generate large amounts of fugitive dust, but would occur only once or twice a day.

Construction Equipment Emissions

Construction phase emission sources would include exhaust from diesel- and gasoline-fired equipment and vehicles, mechanical earth-moving activities, and soil disturbances as workers and equipment are transported over exposed surfaces. Due to their temporary nature, construction impacts are not generally considered as part of the PSD permitting process. In the case of Anderson Bay, however, construction will extend over an 8-year period and will entail substantial clearing and earth-moving activities to prepare the site for installation of the LNG plant equipment and storage vessels.

Table 4.7.1-1 presents the estimated annual emissions from construction activities during the second construction year, the year with the maximum construction-related emissions. Activities during this period would include the second year of the 3-year site clearing and grading; and installation of the construction camp, water and wastewater treatment facilities, some foundations, and the cargo dock.

TABLE 4.7.1-1

Emissions During the Second Construction Year

Source	Pollutant Emissions (tpy)				
	NO_x	CO	VOC	PM_{10}	SO_2
Diesel Construction Equipment	1,042.1	640.8	103.0	71.8	74.2
Gasoline Construction Equipment	30.4	78.4	6.6	0.0	0.0
Construction Camp	7.9	2.0	0.2	0.3	0.1
Incinerator	8.42	6.42	0.0	1.15	3.17
Diesel Power Generation	628.7	136.6	35.9	53.4	57.2
Site Preparation, Fugitive Dust	0.0	0.0	0.0	123.4	0.0
Total	1,717	864	146	250	135

Emissions presented in table 4.7.1-1 were calculated using emission factors in tables in the EPA's AP-42. Emissions from heavy-duty machinery for moving earth (activity which occurs in years 1 through 3) and support construction equipment which burn diesel fuel were calculated assuming consumption of 4,773,001 gallons of oil per year with emission factors from table 3.3-1. Emissions from construction equipment burning gasoline, including pickup trucks, vans, 4x4s, school buses, and emergency equipment, were calculated assuming consumption of 4,589,201 gallons of gasoline per year with emission factors from table 3.3-1. Emissions from the consumption of 1,273,800 gallons of LPG for heating and cooking, the "Construction Camp," were calculated using emission factors from table 1.5-1. Emissions from the fluidized-bed incinerator, which would burn both solids and biological sludge, were calculated assuming the incinerator burns less than 1,000 pounds per hour with emission factors from table 2.1-1 for the solids and table 2.5-1 for the biological sludge. The diesel power generation emissions were calculated using emission factors in tables 3.3-1 and 3.4-1.

Fugitive dust emissions from site preparation and other construction activities include 8.8 tpy from the concrete plant and 114.6 tpy from site preparation. Since site preparation would be limited to May through November, and major construction activity to the summer months, fugitive emissions would be concentrated in the summer months, potentially dramatically influencing PM_{10} concentrations during the summer.

The criteria pollutants listed in table 4.7.1-1 are typical of the construction-related emissions from any major earth-moving project or standard highway construction project. Our analysis of these activities has not identified any significant non-criteria pollutants regulated under the Clean Air Act. Nor have any comments been received, either during the scoping process or during the review of the DEIS, that identified any non-criteria pollutants related to construction, or suggested that they might be present. Nevertheless, if future research uncovers a non-criteria pollutant emitted from standard construction practices, the PSD permit process provides a safeguard to evaluate such pollutants before construction can begin.

In its comments on the DEIS, the EPA stated that since construction activities would occur over 8 years, it is not clear how construction could be viewed as temporary, and that further evaluation should be performed to determine the significance of construction-related activities on air quality levels. In September 1993, Yukon Pacific submitted a detailed emission inventory of construction activities which is summarized above in table 4.7.1-1. In its December 1993 supplemental comments, the EPA stated that supplemental modeling would be necessary to determine the impacts from construction activities.

On March 15, 1994, the FERC attended a technical meeting in Seattle, Washington with the EPA, ADEC, and Yukon Pacific to resolve any remaining issues of air quality, wetlands, and excess material disposal. With respect to construction activities, the concern was the 8-year construction period and the potential for peak emissions to exceed the NAAQS. It was agreed that Yukon Pacific need only develop a plan to demonstrate compliance with the 24-hour PM_{10} ambient standard. The EPA suggested using a screening model, treating construction emissions as area sources, and modifying the fugitive dust factor to account for the high moisture content of Valdez soils. Dispersion modeling of other pollutants was not requested. As shown in table 4.7.1-1, neither SO_2 nor VOC exceed the 250 tpy threshold and therefore do not require dispersion modeling. While CO and NO_2 emissions exceed the threshold, the NAAQS for CO is very high and exceedances are normally associated with heavy traffic in urban areas. The NAAQS for NO_2 is an annual standard so that peak construction emissions which are confined to the summer months are not likely to cause an exceedance of the standard. Yukon Pacific modeled PM_{10} emissions from construction activities in its May 1994 Draft Issues Resolution Document and circulated it for comment to the parties that had attended the March 15, 1994 meeting. No party commented on the analysis. A summary of the modeling results presented in the 1994 DEIS Issues Resolution Document is presented in appendix D, attachment I.

Fugitive Dust Emissions

Conditions favoring the generation of dust from exposed soils do not typically exist at Anderson Bay. The high frequency and quantity of precipitation experienced in the area would inhibit dust generation most of the time. The Valdez area experiences about 68 inches of total precipitation per year (water equivalent) and records measurable precipitation on almost half the annual days. On average, at least 2 inches of total precipitation occur every month of the year. Snowfall averages over 300 inches per year, with some snowfall usually occurring each month from October through May. Soils in the area seldom reach a dry state, except very near the surface, and the local water table at Anderson Bay is high.

Saturation of the soil is expected to be a far greater problem than dust generation during construction at Anderson Bay. Personnel involved in the construction of the Alyeska Marine Terminal on Port Valdez recall that visible construction dust was seldom, if ever, seen during that project.

These wet conditions are not addressed in the approved dust emission factors that are available for use in modeling construction projects. For example, the often-used PM factor of 1.2 ton/acre/month from EPA Document AP-42, section 11.2.4.3 was developed from data collected during uncontrolled activity associated with construction of shopping center and residential complexes in Phoenix, Arizona during late August to late October of 1972, and is thus hardly representative of Anderson Bay conditions. Text provided in AP-42 with the construction emission factor referenced above states that it is applicable for moderate construction activity in semi-arid conditions (Thornthwaite precipitation-evaporation (PE) index of about 50) and moderate soil content (about 30 percent). In addition, the document states that heavy construction emissions should be proportional to silt content and inversely proportional to the square of the soil moisture, as represented by the Thornthwaite PE index. A map of PE index values across the lower 48 states is provided in a reference document that describes the basis for the AP-42 emission factors (i.e., Development of Emission Factors for Fugitive Dust Sources (EPA 450/3-74-037, Cowherd et al., 1974)). Although the map cited by the EPA does not show PE values for Alaska, the data that are provided for western Washington between 200 and 300 could reasonably be used to approximate the PE index at Valdez. In fact, Valdez might be expected to have an even higher index value based on its higher precipitation, lower sunlight, and colder temperatures. Assuming a PE of 250 as a representative value for Valdez, this represents a five-fold increase in PE index relative to the value of 50 that is cited for the uncorrected emission factor. Application of the inverse square relationship would yield a basic construction dust emission factor 25 times lower than 1.2 tons/acre/month, or about 0.05 ton/acre/month for uncontrolled construction activity.

Based on a preliminary schedule for overall construction of the Anderson Bay facility, the first three construction seasons (May-November) would include virtually all the major earth-moving activities associated with the project, and therefore would be the time frame with the greatest potential for generation of construction dust. Because local weather will permit earth moving only during a limited portion of the year, compliance with the 24-hour NAAQS is the primary issue regarding particulate emissions. As a first step toward determining a worst case 24-hour dust impact, we have assumed that 50 acres of the site would be cleared and grubbed during any 1 month of this period. In order to represent these emissions for screening modeling, we have also assumed that this activity would be uniformly distributed over the month.

The ISCST2 model was used for this exercise in screening mode (i.e., with the full set of hypothetical meteorological conditions incorporated by the EPA SCREEN2 model and wind directions at 5-degree intervals around the compass). Emissions for earth-moving activities were estimated on the basis of uniform activity 24 hours per day, 27 days per month, and a disturbed area of 50 acres. Other assumptions were as follows:

Total estimated uncontrolled dust emission were determined as follows:

0.05 ton/acre/month*0.5 (PM_{10} fraction) *50 acres*(month/27 days)*
(day/24 hours)*hour/3600 seconds)*(2000 lb/ton)*(454 grams/lb)
= 0.48 grams dust per second.

For screening modeling purposes, the emissions were spread over 20 square areas 100 meters by 100 meters each (see figure D-1 in appendix D). The input emission rate for each source area is 2.4×10^{-6} grams/m^2/sec. In addition, excavation of 550,000 cubic yards of earth by blasting was assumed to occur during the same month at a location south of the clearing and grubbing activity, as shown on figure D-1. Assuming that blasting occurs to a depth of 70 feet, the emissions from this activity would occur over an area of 23,571 square yards, leading to an average blasting PM_{10} emission rate of 7.2 lbs/day, or 0.038 gram per second. The emissions for each day are assumed to be spread over a square area 27 meters on a side. This source was included with the clearing/grubbing emissions in the screening model calculations.

The results of this screening exercise indicate that the highest local concentrations of PM_{10} during construction would occur with light wind, stable atmospheric conditions. Because fugitive dust emissions are produced at ground level and are non-buoyant, the nearest receptors must receive the highest concentrations; in this case, the northern (shoreline) boundary of the Yukon Pacific Anderson Bay facility. The predicted maximum is 106 $\mu g/m^3$, which is well below the 24-hour NAAQS for this pollutant (150 $\mu g/m^3$).

It has been suggested that it might be possible to scale the impacts from the PM_{10} modeling analysis to account for emissions of other construction-related pollutants. There are several disadvantages to this approach. First, the spatial and temporal distribution of the pollutants is not the same. Fugitive dust was modeled for a 50-acre parcel of the site being cleared and graded during a month, while the other construction-emission sources would be distributed throughout the entire 426-acre site. Second, fugitive dust emissions are ground level sources, while the combustion-related emissions have elevated stacks and plume rise. Finally, the parties at the March 15, 1994 technical meeting agreed that modeling 24-hour PM_{10} levels would be adequate for the purpose of the FEIS.

Equipment Operation Emissions

During operation of the Anderson Bay facility, emissions of pollutants would be generated from power generation, the liquefaction process, the onsite incinerator, and from tugboat and LNG tanker traffic. Emissions from these sources would be predominantly NO_x and CO since most equipment would use natural gas fuel. However, there would also be SO_2 and PM_{10} emissions from the bunker-fueled boilers on the LNG tankers, the diesel-fired tugboat engines, and some of the power generation equipment with oil as a backup fuel. Volatile organic compounds (VOC) would also be generated from all of these activities. A detailed discussion of emission estimates is presented in section 4.7.3.

4.7.2 New Source Review

Whenever a new source of air emissions is proposed, the process for determining if the source would operate in compliance with Federal and state regulations is called the New Source Review (NSR). For any source, compliance with the NAAQS and the Alaska standards, as listed in table 3.7.2-1, is based on the sum of impacts from the existing sources, the proposed source, and the ambient background level.

Under the Clean Air Act, permitting procedures, including NSR, are different for sources in attainment areas (areas designated as complying with the NAAQS) versus non-attainment areas (areas with concentrations exceeding the NAAQS). Attainment designations are pollutant specific. For example, an area may be designated nonattainment for ozone, and attainment for NO_x and the other criteria pollutants. Valdez and the Anderson Bay area, in the Southcentral Alaska Intrastate AQCR, are designated attainment for all criteria pollutants.

The Federal NSPS (40 CFR Part 60, Subpart GG(C)) limit NO_x emissions in the exhaust gases from stationary gas turbines with a heat input greater than 10 million British thermal units (Btus) per hour (approximately 1,000 hp) to 150 ppmv based on 15 percent oxygen in the exhaust on a dry basis, and at a turbine heat-rate of 14.4 kiloJoule/Watt-hour (kJ/W-hr). Proportional increases in the 150 ppmv are permitted with higher efficiencies. Emissions from gas-fired engines are regulated through the state permitting process.

The Federal PSD regulations (40 CFR 52.21) require that any proposed facility with the potential to emit more than 250 tpy of any pollutant in an attainment area, be classified as a major stationary source and be subject to PSD review. PSD regulations for major stationary sources and major modifications include a review of the existing air quality, the use of a modeling analysis to demonstrate compliance with the NAAQS, an analysis of the incremental increase in air pollution levels, application of BACT, and an assessment of the impact of new emissions on the environment. Ambient concentrations from any new pollutant source emitting after the baseline date must not exceed increments that have been set for specific pollutants (see table 3.7.2-1). Compliance with these requirements is verified through the state permitting process.

A top-down approach to BACT is now required where an applicant must demonstrate the use of the best available technology in controlling emissions from major stationary sources and major modifications. This approach requires that the applicant first consider the most stringent controls available and either use this technology or demonstrate why it is not feasible to do so, considering economic, energy, or environmental impacts. The process is then repeated for the second most stringent control, then the third, etc., until a feasible solution is reached.

Dispersion modeling analysis is required for PSD review and some state permits to demonstrate that the new emissions would not result in impacts with a significant increase over existing ambient air quality and that the impacts of these would comply with the NAAQS and PSD Increments. The ADEC must approve the procedures and the input for the dispersion models to be used (primarily ISCST2 and COMPLEX 1). In granting an air emission permit and an open burning permit, the ADEC would decide any restrictions on operations required to ensure that the Yukon Pacific LNG facility does not have an adverse impact on local air quality. Regulations regarding both permits are given in the Alaska Administrative Code, Title 18, Chapter 50.120.

4.7.3 Emission Sources

Emission estimates from operation of the Anderson Bay LNG facility were revised in response to comments submitted by the EPA in a letter dated December 1, 1993. Forty-four sources were included in these emission estimates, including the waste incinerator operating with the various anticipated loads and the LNG tankers. The primary emission sources would be the gas-turbines in the four liquefaction trains, the gas-turbines used for electric power generation, and the LNG tankers while at berth. Facility emissions are summarized in table 4.7.3-1.

TABLE 4.7.3-1

Annual Air Emissions Summary for LNG Plant and Marine Terminal

Source	Pollutant Emissions (tpy)a/				
	NO_x	CO	VOC	PM_{10}	SO_2
LNG Trains A, B, C, & D	2,293.88	3,890.20	454.48	194.68	19.24
Marine Flare	0.35	1.39	0.00	0.09	0.00
Wet Process Flare	0.35	1.39	0.00	0.09	0.00
LNG Tanker Berths	18.02	0.52	2.66	6.14	286.38
Boil-off Compressors	9.64	11.57	3.37	0.77	0.08
Steam Boiler	6.13	4.90	0.12	0.31	0.04
Incinerator	10.90	7.90	0.00	1.60	2.57
Power Generation (Gas turbines & HRSG)	131.50	152.71	41.81	10.14	1.04
Leakage			1.74		
Total	2,470.77	4,070.58	504.18	213.82	309.35

a/ Details of the emission sources, operating conditions, and emission rates are presented in tables D-1, D-2, and D-3 of appendix D.

Project emissions are based on vendor quotes and EPA emission factors for the equipment identified in Yukon Pacific's July 1994 DEIS Issues Resolution Document. Some of the proposed equipment has changed since the TAGS FEIS (1988) and will continue to change as the design of the facility evolves. Emissions used in modeling required for a permit application would reflect the actual equipment selected. The basis for the emission estimates is provided in tables D-1 and D-2 of appendix D.

There would be a total of sixteen 37,000-hp refrigeration compressor drivers and four 6,400-hp flash gas compressor drivers in the liquefaction trains. The combustion products from these turbine drivers would comprise the majority of the total air emissions from the facility. The refrigerant and flash gas compressor turbine drivers would be equipped with dry low NO_x combustors. The shaft seal losses would be routed into the process flare headers for ultimate disposal by incineration.

There would be three 6,400-hp boil-off gas compressors. One would be required to compress tank vapors when no LNG tankers are loading. The second boil-off gas compressor would be required only when one LNG tanker is loading which, at design rates, would be about 31 percent of the time. The third boil-off gas compressor would be required only when two LNG tankers are loading simultaneously, which should occur so rarely that this third unit can be considered as an off-line spare. Normal shaft leakage from the three boil-off compressors would be routed to the marine flare header for incineration.

Electricity for the proposed plant would be provided by seven 9,400-kW generators driven by 12,600-hp gas turbines. The operating electrical load would be approximately 62 percent of the combined capacity of all seven generators operating at 40°F. A HRSG would be provided on one of the generator sets to produce steam for plant heating and minor utility requirements. Two of the generator sets would be equipped to burn either gas or diesel fuel for black start operation. The turbine drivers would be equipped with dry low NO_x combustors.

Steam for heating the plant would be generated using a HRSG which exchanges the heat in the combustion gases from the #1 power turbine with boiler feed water. The HRSG also would have auxiliary gas and oil burners to provide additional steam generation. There would be a standby conventional package boiler for use when the HRSG or associated turbine is out of service. Maximum fuel consumption to generate steam would occur when the HRSG is off line and the package boiler is used to generate the maximum steam flow. It is, therefore, inappropriate to consider the maximum fuel to both the HRSG and the boiler simultaneously.

Each process train would be provided with a dry flare system. All moisture-free relief discharges, vents, and drains would be sent to the dry flare. The flare feed would travel through a knockout drum to disengage liquid droplets prior to flaring. The collected liquid would be revaporized into the flare feed.

One wet flare system would be shared by the four liquefaction trains. All moisture-containing discharges would be sent to the wet flare except the derime circuit outlet. The wet flare would be provided with a liquid knockout drum.

Relief discharges and vents from the LNG storage and loading facilities would be routed to the marine flare. The fractionation plant would be tied into the marine flare.

The incinerator would be of a conventional design for municipal and industrial waste disposal (non-hazardous). It would incorporate a bed of ground refractory material and/or quartz sand which is fluidized by an air stream from a dedicated blower. Feed to the incinerator would consist of biological sludge from the wastewater treatment plant, spent oils, and various solid facility wastes. Both the preheat burner and the main combustion burner could burn either fuel gas, diesel oil, or waste lubricating oil and hydraulic fluids. No substances with toxic characteristics or other hazardous characteristics would be stored in the spent waste oil tank or introduced into the incinerator. The incinerator would be equipped with a venturi-type spray scrubber to control emissions.

Emissions from 44 separate pollutant sources of the proposed Anderson Bay were included in the screening modeling analysis. Tables showing the basis for the emission estimates for each source and the parameters used for modeling are provided in tables D-1, D-2, and D-3 of appendix D, and the source locations are shown on figure D-2.

The refrigeration compressors, turbine generators, and flash gas and boil off compressors would account for the majority of the project's emissions of NO_x, CO, and particulates (PM). The estimated emission rates for these sources are based on vendor data. The quantity of fuel burned by all these units to generate a given horsepower, and therefore the corresponding pollutant emissions, are dependent on air temperature. For purposes of this analysis, maximum hourly emission rates were assumed for all modeling simulations except those for annual NO_2 impacts. These maximum emissions are defined by the properties of the compressors/turbines operating at an ambient temperature of 15°F, a temperature that is lower than all but 5 percent of the annual temperature observations in Valdez. For purposes of computing annual average NO_x concentrations, however, the emission properties of these units are calculated for the mean annual Valdez air temperature of 40°F. For either condition, full load operation is assumed in all modeling runs.

The LNG tankers would be responsible for almost all of the project's expected emissions of SO_2. The emission estimates are based on 275 LNG tanker trips per year. The estimate conservatively assumes two tankers are docked and burning bunker fuel. Actually, these operations would be intermittent, and there would be two tankers at berth very rarely. Emissions from these sources have been calculated for a tanker fuel with a sulfur content of 0.5 percent by weight.

At the March 15, 1994, technical meeting in Seattle, the EPA requested that Yukon Pacific either provide justification for modeling the annual NO_x concentration using turbine operations at the mean annual temperature, or complete a sensitivity analysis for annual NO_x emissions as a function of turbine operations at varying temperatures. The technical reasons for the selection of highest emission rates calculated at 15°F and average annual conditions calculated at 40°F, and the sensitivity analysis are discussed in appendix D (see Maximum NO_x Emission Rates Estimation section).

The calculated annual emissions are summarized in table 4.7.3-1, based on the detailed information on vendors' guaranteed emission rates, operating conditions, and anticipated hours of operation given in tables D-1, D-2, and D-3 of appendix D.

4.7.4 Ambient Impacts

Before Yukon Pacific may begin construction of its Anderson Bay LNG plant and marine terminal, it must demonstrate that the facility would be in compliance with various aspects of the Clean Air Act. The definitive vehicle to ensure such compliance is the PSD permit issued by the State of Alaska. To obtain this permit, Yukon Pacific must conduct extensive air quality modeling based on representative meteorological data from the facility. Yukon Pacific has erected a 40-meter tower at the site and is collecting new meteorological data.

Until the data from the new Anderson Bay meteorological station have been collected, the only air quality modeling analysis that can be conducted in strict conformance with EPA modeling guidelines is a screening analysis using hypothetical meteorological input data. Such approved screening methods use very conservative assumptions (i.e., assumptions designed to ensure that errors in the predicted concentrations would be in the direction of over prediction) to provide rough estimates of the maximum pollutant concentrations that may result from a proposed source's emissions. More detailed information on the screening analysis is presented in appendix F of Yukon Pacific's DEIS Issues Resolution Document regarding FERC Docket Nos. CP88-105-000 and CP88-105-001. Copies can be obtained by contacting the FERC Project Manager or Yukon Pacific directly.

For a project with receptors either above plume height or below stack heights, the EPA guidelines for screening analyses recommend the use of the SCREEN2 and COMPLEX I models, respectively. However, SCREEN2 does not allow separate representation of multiple stacks, so this option was dismissed for the Yukon Pacific screening analysis. Instead, the ISCST2 and BEESTX models (Versions 93109) were used in screening mode to accomplish the required analysis for the proposed Anderson Bay facility. BEESTX is a model which uses the simple terrain algorithms of ISCST2 with the complex terrain algorithms of COMPLEX I. For receptors with elevations below the lowest stack top elevation, the ISCST2 algorithm is used. For receptors with elevations above the final plume rise centerline elevation, the COMPLEX I algorithm is used. For "intermediate terrain" receptors with elevations above the lowest stack top but below the final plume rise elevation, the highest results from the ISCST2 and the COMPLEX I algorithms are selected for each hour of meteorology at each receptor to calculate the maximum concentrations for each averaging time. Both models were employed because of the variable terrain that characterizes the project site and its environs and the limited meteorology used with complex terrain in screening runs.

Theoretically, the BEESTX model could have been used alone in screening mode to evaluate impacts at all terrain elevations, as it combines the ISCST2 and COMPLEX I dispersion algorithms with decision tree logic to determine whether the flat terrain or complex terrain calculations should be used to represent the impact at each receptor, and to select the higher of the concentrations predicted by the two methods for receptors in "intermediate" terrain. For practical reasons, however, Yukon Pacific used a combination of ISCST2 and BEESTX runs for efficient completion of the screening analysis. The use of both models was more convenient, primarily because different meteorological conditions needed to be addressed for different groups of receptors and because of the manner in which BEESTX prints out the modeling results. The screening analysis was therefore conducted according to the following sequence.

1. First, ISCST2 was used with a coarse receptor grid (500-meter spacing) and the full set of meteorological input parameters incorporated by the EPA SCREEN2 model to compute the maximum concentrations resulting from the algorithm for flat terrain dispersion.

2. Second, BEESTX was used with the standard EPA screening assumptions for complex terrain of F stability with 2.5 m/sec wind speed to compute the highest concentrations resulting from the elevated terrain dispersion algorithm. Other wind speed-stability combinations are not required for the elevated receptors.

3. A second set of runs was made for each pollutant using a fine receptor grid (50-meter spacing) in the vicinity of the highest values predicted by the first two sets of runs. Either the ISCST2 or BEESTX model was used for the second round of simulations, depending on which model yielded the highest coarse grid concentrations for each pollutant. The highest hourly concentrations for each pollutant from the second set of runs were used with EPA-approved factors to

estimate the maximum multiple-hour average values for comparison with applicable standards and increments. The factors used to convert the model-predicted hourly maxima to estimates of the peak 3-hour, 8-hour, 24-hour, and annual average concentrations are listed as follows:

Averaging Time	Conversion Factor
3-hour	0.9
8-hour	0.7
24-hour	0.4 (ISCST2); 0.25 (BEESTX)
Annual	0.08

Based on a methodology described in *Use of Ambient Ratios to Estimate Impacts of NO_x Sources to NO_2 Concentrations* by Chu and Meyer (1991), a factor of 0.75 was used to convert modeled annual average NO_x concentrations to NO_2 concentrations.

Maximum predicted impacts from the screening analysis are shown in table 4.7.4-1. More detailed results are presented in tables D-4, D-5, and D-6 of appendix D. The screening analysis shows that the proposed Yukon Pacific LNG Project has the potential to cause significant incremental impacts on air quality in the vicinity of the Anderson Bay site. Based on this finding, the need for refined modeling analysis is indicated. The screening calculations indicate that such modeling should be performed for evaluation of compliance with the NO_2 and SO_2 PSD increments. Any increment consuming source identified in the 1992 Petro Star Valdez Refinery PSD permit application should also be included. Despite extremely conservative assumptions regarding the project's operations and emissions, as well as worst-case meteorological inputs, the results of the screening analysis indicate that compliance with PM increment can be achieved by the proposed project. Predicted carbon monoxide impacts, both total and increment consuming emissions, from the screening analysis are sufficiently low to conclude that no significant impacts on local CO concentrations will occur. In addition, the screening results indicate that all maximum pollutant concentrations are well below all NAAQS.

TABLE 4.7.4-1

Screening Modeling Results Compared with Applicable National Ambient Air Quality Standards and PSD Increments

Pollutant	Averaging Period	Existing Ambient ($\mu g/m^3$)	Predicted Maximum Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	Applicable NAAQS ($\mu g/m^3$)	Applicable Class II PSD Increment ($\mu g/m^3$)
SO_2	Annual	16	15.1	31.1	80	20
	24-hour	81	75.7	156.7	365	91
	3-hour	327	170.2	497.2	1,300	512
NO_2	Annual	27	42.06	69.06	100	25
PM_{10}	Annual	33.5	5.04	38.54	50	19
	24-hour	100	15.75	115.75	150	37
CO	8-hour	4,524	805.1	5,329.1	10,000	N/A
	1-hour	7,680	1,150.1	8,830.1	40,000	N/A

Because of the very conservative nature of the screening model analysis discussed above, it was prudent to make use of available data to support a more realistic analysis using supplemental dispersion modeling with a full year of meteorological data. Two sets of meteorological data were used, one from a 10-meter tower at Anderson Bay and one from the Valdez Air Monitoring System (VAMS). More detailed information on the supplemental modeling is presented in appendices G and H of Yukon Pacific's DEIS Issues Resolution Document regarding FERC Docket Nos. CP88-105-000 and CP88-105-001. Copies can be obtained by contacting the FERC Project Manager or Yukon Pacific directly.

The first set of meteorological data was improved quality data from the onsite 10-meter tower at Anderson Bay for the period November 1, 1992 through October 31, 1993. The EPA acknowledged that more supplemental modeling based on the best year of the Yukon Pacific meteorological data, although not definitive as refined modeling because the EPA did not consider the tower's location to be representative of the LNG trains' stacks, would provide useful information regarding the range of air quality impacts that may occur due to operation of the proposed Anderson Bay facility. The results of that supplemental modeling using the 10-meter Anderson Bay meteorological data show levels below the respective PSD increments as shown in table 4.7.4-2 and NAAQS as shown in table 4.7.4-3.

A second set of supplemental dispersion modeling results was generated using 30-meter meteorological monitoring data for the same period collected by Alyeska at its marine terminal at Jackson Point, approximately 5 miles east of the proposed LNG process trains at the site of the Yukon Pacific plant. The EPA has stated that supplemental modeling results obtained with these data are of interest because the winds 30 meters above ground level may be more representative of transport and dispersion conditions that would govern the behavior of the Anderson Bay emission plume than the 10-meter Yukon Pacific data from Anderson Bay. Like the results using Yukon Pacific's Anderson Bay meteorological data, the results from supplemental modeling using the 30-meter Alyeska meteorological data show levels below the respective PSD increments and NAAQS. The results of this supplemental modeling analyses are presented in table 4.7.4-4 for the PSD increment consumption and table 4.7.4-5 for the comparison with NAAQS.

In summary, the very conservative screening model analysis predicted compliance for all pollutants with the NAAQS, and compliance for all pollutants with PSD increments except for NO_2. Supplemental modeling for NO_2 using two sets of meteorological data collected near the proposed Anderson Bay facility depicts a range of potential impacts relative to the screening assessment. While these results cannot be relied upon to make conclusive determinations on the ability of the project to comply with applicable NAAQS and PSD increments, the supplemental modeling shows levels below the respective NAAQS and PSD increments for FEIS purposes. The meteorological data which Yukon Pacific is capturing from its 40-meter tower at Anderson Bay will be used for modeling in support of its PSD application which must demonstrate compliance with all NAAQS and PSD increment standards.

Under the Clean Air Act, the ADEC's PSD program (which has been delegated to the State of Alaska by the EPA) is intended to ensure compliance with any operating restrictions necessary to keep air impacts from Yukon Pacific's LNG facility from adversely affecting the local population and environment. The permitting process with the ADEC will ensure that the proposed project complies with all aspects of the PSD regulations, including BACT for each source of emissions.

TABLE 4.7.4-2

Predicted Maximum PSD Increment Consumption Due to the Proposed Anderson Bay Project and Other Sources in the Valdez Area (10-Meter Anderson Bay Meteorological Data)

Pollutant	Averaging Period	Yukon Pacific Contribution ($\mu g/m^3$)	Contribution of Other Sources ($\mu g/m^3$)	Total Increment Consumed ($\mu g/m^3$)	Class II Increment ($\mu g/m^3$)	% of Increment Consumed	Location of Maximum (UTM)			Mo/day/hr of Maximum
							East (m)	North (m)	Elevation (m)	
SO_2	3-hour	100.69	0.00	100.69	512	19.67	527200	6771750	0.00	05/25/15
	24-hour	36.10	0.23	36.33	91	39.92	524250	6776500	70.10	11/11/24
	Annual	5.48	0.16	5.64	20	28.20	524300	6776500	60.96	N/A
PM	24-hour	11.46	0.02	11.48	37	31.03	524050	6776750	245.36	11/11/24
	Annual	1.66	0.02	1.68	19	8.84	523950	6776700	237.74	N/A
NO_2	Annual	13.29	0.34	13.63	25	54.52	523900	6776700	243.84	N/A

TABLE 4.7.4-3

Predicted Maximum Pollutant Concentrations During Operation of the Proposed Anderson Bay Facilities (10-Meter Anderson Bay Meteorological Data)

Pollutant	Averaging Period	Yukon Pacific Contribution ($\mu g/m^3$)	Contribution of Back-ground ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Location of Maximum (UTM)			Mo/day/hr of Maximum
						East (m)	North (m)	Elevation (m)	
SO_2	3-hour	100.69	327	427.69	1,300	527200	6771750	0.00	05/25/15
	24-hour	36.33	81	117.33	365	524250	6776500	70.10	11/11/24
	Annual	5.64	16	21.64	80	524300	6776500	60.96	N/A
PM	24-hour	11.48	100	111.48	150	524050	6776750	245.36	11/11/24
	Annual	1.68	33.5	35.18	50	523950	6776700	237.74	N/A
NO_2	Annual	13.63	27	40.63	100	523900	6776700	243.84	N/A

TABLE 4.7.4-4

Predicted Maximum PSD Increment Consumption Due to the Proposed Anderson Bay Project and Other Sources in the Valdez Area (30-Meter Jackson Point Meteorological Data)

Pollutant	Averaging Period	Yukon Pacific Contribution ($\mu g/m^3$)	Contribution of Other Sources ($\mu g/m^3$)	Total Increment Consumed ($\mu g/m^3$)	Class II Increment ($\mu g/m^3$)	% of Increment Consumed	Location of Maximum (UTM) East (m)	North (m)	Elevation (m)	Mo/day/hr of Maximum
SO_2	3-hour	218.91	0.00	218.91	512	42.76	528250	6771450	91.44	04/04/24
	24-hour	54.09	3.45	57.54	91	63.23	522150	6771900	60.96	01/11/24
	Annual	10.15	0.45	10.60	20	53.00	522150	6771900	60.96	N/A
PM	24-hour	20.24	0.12	20.36	37	55.03	522200	6771000	274.32	01/11/24
	Annual	2.23	0.02	2.25	19	11.84	522150	6771000	274.32	N/A
NO_2	Annual	17.95	0.55	18.50	25	74.00	522200	6771000	274.32	N/A

TABLE 4.7.4-5

Predicted Maximum Pollutant Concentrations During Operation of Proposed Anderson Bay Facilities (30-Meter Jackson Point Meteorological Data)

Pollutant	Averaging Period	Yukon Pacific Contribution ($\mu g/m^3$)	Contribution of Back-ground ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Location of Maximum (UTM) East (m)	North (m)	Elevation (m)	Mo/day/hr of Maximum
SO_2	3-hour	218.91	327	545.91	1,300	528250	6771450	91.44	04/04/24
	24-hour	57.54	81	138.54	365	522150	6771900	60.96	01/11/24
	Annual	10.60	16	26.6	80	522150	6771900	60.96	N/A
PM	24-hour	20.36	100	120.36	150	522200	6771000	274.32	01/11/24
	Annual	2.25	33.5	35.75	50	522150	6771000	274.32	N/A
NO_2	Annual	18.50	27	45.50	100	522200	6771000	274.32	N/A

Since representative meteorological data necessary to complete an emission permit application are still being collected, we **recommend that Yukon Pacific file a copy of all air emission permit and open burning permit applications submitted to the ADEC with the Secretary. Specifically, Yukon Pacific must file its PSD permit from the ADEC prior to receiving a written notice to proceed with any construction from the Director of OPR.**

4.7.5 Ozone Impacts

Given the large amount of NO_x and VOC, both precursors of ozone, which the Alyeska Marine Terminal is permitted to emit (1,700 tpy and 57,000 tpy, respectively), the potential for more emissions of NO_x and VOC could impact ozone concentrations in the Valdez area. The proposed Anderson Bay project would be a source of both NO_x and VOC. Fugitive emissions of VOC, due to leaks from valves, flanges, pump seals, storage tanks and tanker loading operations, would be less than 2 tpy. The gas received at Anderson Bay would primarily consist of methane and ethane, which are relatively unreactive, with only small amounts of the gas consisting of reactive compounds that are involved in ozone formation; however, fugitive emissions were included in the VOC project emission calculations. This section discusses the potential effects of the Anderson Bay project's operations on ambient ozone levels in the Valdez area.

There are presently no approved mathematical models that adequately evaluate the effects of individual project emissions on ambient ozone concentrations. Furthermore, application of regional numerical grid models, such as AIRSHED, would require extensive data on the three-dimensional field of meteorological and air chemistry variables throughout the airshed--data that are not presently available for Valdez and its environs. Given these circumstances, and the fact that the highest ozone concentrations recorded in the Valdez area are well below the NAAQS, the EPA Region 10 has agreed that ozone modeling for the Yukon Pacific project is not required for the purpose of this FEIS. However, as described below, there is adequate information available to support a conclusion regarding continued maintenance of acceptable ozone air quality in the Valdez area with the addition of the proposed Anderson Bay Project.

Ozone was recorded for the period between October 1, 1990 and March 3, 1993, at the East Gate, West Terminal, and High School stations, and during the first year at the Old Valdez station. These data are presented in tables D-7 and D-8 of appendix D. During the 2.5-year monitoring program, the highest hourly average ozone concentration recorded at any station was 0.063 ppm, i.e., just over half the NAAQS. The highest hourly concentrations for most quarters were only about one-third of the NAAQS. It is interesting that the highest values at all stations occurred during the first and second calendar quarters, a result that is completely contrary to the patterns of ozone pollution observed in the areas where anthropogenic sources of precursors are responsible for ozone pollution. This may be an indication that natural sources and/or incursion of stratospheric ozone contribute to the maximum concentrations in the Valdez area. The EPA has estimated that the concentration of naturally occurring ozone at sea level in the unpolluted atmosphere of the United States is in the range of 20 to 35 parts per billion, or 0.20 to 0.035 ppm, i.e., only marginally lower than the highest hourly values recorded during most quarters monitored in Valdez.

The Anderson Bay facility would be the largest NO_x source in the airshed. The Alyeska Marine Terminal, a few miles east of Anderson Bay on the south shore of Port Valdez, has emitted substantial quantities of reactive hydrocarbons for many years, primarily during uncontrolled crude oil tanker loading operations. These emissions, however, have lessened over the last several years as the throughput of that facility has decreased because of the depletion of the Prudhoe Bay Oil

Field. The Petro Star Refinery began operation in approximately 1993 at the eastern end of Port Valdez and therefore is considered to be increment consuming. This petroleum refinery is permitted by the ADEC to emit combustion and process pollutants from a variety of sources. The sources of precursor emissions and the magnitude of those emissions are given in table 4.7.5-1.

TABLE 4.7.5-1

Major Sources of Ozone Precursor Emissions in the Valdez Air Basin

	Actual (tpy)		Potential (tpy)	
	VOC	NO_x	VOC	NO_x
Alyeska Marine Terminal	57,296	1,219	57,296	1,752
Petro Star Refinery	0	0	70	70
Other Valdez Sources	179	13	179	13
Proposed Anderson Bay Facility	0	0	374	2,528
Total	57,475	1,232	57,919	4,363

The potential emissions in table 4.7.5-1 reflect the permitted emissions for the Alyeska Marine Terminal and the Petro Star Refinery; and the estimated future emissions from the proposed Anderson Bay LNG facility. Future emissions from the Alyeska Marine Terminal are expected to decline slowly from permitted levels as oil through put is reduced and fewer tankers are loaded. The "Other Valdez Sources" were estimated by scaling area source emissions from the South Coast Air Basin on the basis of population.

In order to better correlate ozone precursor emissions with the period when elevated ozone levels were measured, we have attempted to estimate the actual emission levels during the monitoring program. Actual emissions for the Petro Star Refinery are shown as zero because the refinery began operating only 2 months before the end of the monitoring period. The NO_x emitted from the Alyeska Marine Terminal is based on actual emissions during 7 of the 10 quarters that the monitoring system was in operation, from the quarterly operating reports that Alyeska is required to file with the ADEC under its air quality control permit to operate. The NO_x emission value of 1,219 tpy is an annual average emission rate based on the seven reported quarters. Similar data are not available for the actual VOC emissions; however, they are expected to approximate permitted levels during this period.

The Valdez area is notably lacking in some of the most important meteorological conditions that have been related to high ozone levels in urban and rural areas in the lower 48 states. In terms of temperature, the annual average mean value at the Valdez NWS station is only 38°F. The average daily maximum temperature at Valdez over the full year is 43.5°F, and the warmest month (July) has an average daily maximum temperature of only about 61°F. A definite link between temperature and maximum ozone concentrations in both urban and rural areas has been established by a number of researchers, with higher values occurring in conjunction with higher temperatures.

Solar radiation is another important meteorological factor in ozone formation, and incoming radiation is severely limited in Valdez. Cloud cover during daylight hours averages 77 percent and the climatological summary prepared for Valdez by the National Oceanic and Atmospheric Administration classifies 259 days per year as cloudy, 40 days as partly cloudy, and only 66 days as clear. At least 0.01 inch of precipitation falls in Valdez on more than half of the days during an average year, and the annual total precipitation (water equivalent) averages almost 68 inches. At least 2 inches of this total occurs in every month of the year.

Given the low temperatures and cloudy conditions, it is not surprising that Valdez experiences some of the lowest ozone concentrations recorded in the United States, despite fairly substantial local anthropogenic and natural precursor emission sources. Regulatory agencies have expressed concern that the light winds and surrounding high terrain may constrict airflow in the area and promote stagnation conditions that could lead to elevated ozone levels. However, while light winds are definitely a characteristic of the area, the lack of any measured concentrations more than half the ozone NAAQS demonstrates that conditions in Valdez do not favor ozone formation. The general coolness of the area and the severely limited supply of sunlight are the most likely factors suppressing production of this pollutant.

4.7.6 Visibility Impacts

Valdez is approximately 156 miles from the nearest Class I PSD area (Denali National Park). In addition, Valdez is surrounded by the Chugach Mountains, which prevent any systematic transport of pollutant emissions toward the park. Thus, the effects of the Anderson Bay facility's emissions on visibility in Class I areas are expected to be negligible. For completeness, a level-1 screening visibility analysis was conducted using the EPA VISCREEN model to estimate the impacts of project emissions on visibility in Denali National Park. The VISCREEN model calculates plume perceptibility using two parameters: delta E, a color difference parameter between the plume and the viewing background; and the contrast, at the 0.55 μm wavelength (the center of the visible spectrum) between two colored objects. A plume is considered to be perceptible if the delta E exceeds 2.0 or the contrast exceeds 0.05, and further analysis is required. The maximum predicted values inside the Class I area for the Anderson Bay-Denali simulations were a delta E of 0.378 and a contrast of 0.004. The highest values calculated outside the park were a delta E of 0.407 and a contrast of 0.005. Based on these results, impacts of the proposed facility on visibility in or near Denali National Park would be clearly insignificant, and no additional modeling is required.

The combustion of natural gas at the facility has the potential for visibility impacts within the Valdez airshed. Emissions of NO_x would occur primarily as NO, an invisible gas, but would convert to NO_2 in the presence of sunlight. NO_2 is visible, however, and a reddish-brown haze near the inversion level can develop in polluted areas. This could occur to some degree near Anderson Bay when winds are light, especially in relatively limited occurrences of clear weather.

Water vapor is a major by-product of natural gas combustion and could create visible steam plumes given the generally cold and moist environment of the Valdez area. This is unlikely to occur on a frequent basis, because the makeup of combustion exhaust is more than 90 percent air, and the plumes from the larger compressors and power generation turbines would be released with very high vertical velocities and very hot temperatures. Water condensation within the plume from the Anderson Bay facility could occur under very cold or high humidity conditions. However, such plumes would be well above the surface of Port Valdez and would present no impediment to navigation.

4.7.7 Micrometeorological Changes

Fog problems in and around Anderson Bay as a result of thermal release during operations are not anticipated. As discussed in section 4.5.1, the release of heated effluent is highly regulated to ensure that dramatic temperature differentials do not occur at the surface. Even if one were to assume that the temperature differential within the mixing zone resulted in local fog generation, the size of the zone would be in the order of 0.5 acre. The location of the thermal outfall (see figure 2.1-4, sheet 2), approximately midway between the tanker berths, places it 1,200 to 1,500 feet from tanker maneuvering (the activity presumably most at risk from foggy conditions).

There are no other onsite contributors to fog formation as all cooling systems relating to the liquefaction trains are air-cooled, exhausting only dry, warm air to the exterior.

4.8 NOISE

Construction of the proposed facilities would increase noise levels in the vicinity of the project area. Construction equipment would be operated on an as-needed basis during the 8-year construction period. Diesel generators would be used to supply power for the temporary construction facilities at various locations throughout the jobsite. Operation of construction equipment, the diesel generators, and transporting materials to the jobsite would increase noise levels in the Anderson Bay area by large amounts; however, the remote location would minimize any impact on the general population's activities. Typical noise levels (in dBA at 50 feet) of the noisiest construction equipment are: front-end loaders, 72 to 85 dBA; backhoes, 72 to 94 dBA; tractors, 72 to 95 dBA; scrapers and graders, 76 to 94 dBA; trucks, 68 to 96 dBA; and the pile driver used in offshore construction, 92 dBA. Of all the construction activities, rock blasting would produce the greatest noise impact, although the duration of the noise impact would be the shortest, occurring at most twice per day, once at the noon hour and, if necessary and weather permitting, another later in the evening. At the nearest noise-sensitive area (NSA), a distance of 3.7 miles from the proposed main utility building, a sound level of 95 dBA would be attenuated by the air to a sound level of 43 dBA, which would not be disturbing.

Increases in noise during the operational phase of the project would include noise generated by power generation, the liquefaction and fractionation of natural gas, compressed air and nitrogen plants, LNG transfer facilities to pump the LNG into storage tanks and out of storage tanks and to the LNG tankers, wastewater treatment facilities, an onsite waste incinerator, and LNG tanker and associated tugboat movements. Principal noise sources in these operations would include gas turbine-driven compressors, gas turbine generators, pumps, gas driers, heat exchangers, flares, incinerator, motors to drive hydraulic machinery, and engines powering the LNG tankers, tugs, and ferries. Noise from the relief valves, blowdown stacks, and emergency electrical generation equipment would be infrequent. The amount of silencing required for the equipment and piping depends on the facility's location, size, and proximity to NSAs.

Regulatory Requirements

In 1974, the EPA published "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an Ldn of 55 dBA. The

Ldn is defined as the 24-hour equivalent sound level [Leq(24)] with a 10 dBA weighting applied to nighttime sound levels (10:00 p.m. to 7:00 a.m.) to prevent sleep interference. Further, an Leq(24) of 55 dBA has been identified as protecting outdoor activity interference where people spend limited amounts of time such as playgrounds and schoolyards. These criteria have been used by the FERC to evaluate the noise impact from pipeline operation and compressor station operation. Additionally, the EPA requested that the DEIS evaluate the number of residences/businesses where noise levels would increase by more than 10 dBA over existing noise levels.

Noise-Sensitive Areas

The Anderson Bay site is remote, with the closest permanent buildings being part of the Alyeska Marine Terminal. The closest area which could be considered a NSA is the Shoup Bay State Marine Park, a tidewater glacier that is a primary attraction for tour boats. As such, it is an outdoor area where people spend limited amounts of time. The mouth of Shoup Bay is approximately 3.7 miles northwest of the main utility building.

Another NSA is the Allison Point Recreation Area north of Dayville Road just outside the eastern gate of the Alyeska Marine Terminal, near the Valdez Fisheries Development Association Hatchery. This area is used for public camping, primarily by recreational vehicles and truck campers during the salmon fishing season, and is owned by the City of Valdez. Due to this area's proximity to the Alyeska Marine Terminal, the Valdez Fisheries Development Association Hatchery, and the Solomon Gulch Hydroelectric Project, it is currently a noisy area, which does not prohibit its use by those who choose to camp there. This area is approximately 5.9 miles east of the main utility building.

The nearest residences in Valdez are three houses at the mouth of Mineral Creek, approximately 5.0 miles northeast of the main utility building.

Construction and operation of the Anderson Bay LNG facility would generate noise which would impact local marine and terrestrial wildlife. However, given the site's proximity to the Alyeska Marine Terminal and the noise generated by its operation, local marine and terrestrial wildlife are already exposed to industrial noise levels, which should not greatly increase.

Predicted Noise Impact

The Yukon Pacific LNG Project as proposed is a large, industrial facility with equipment capable of generating noise. Fortunately, much of this equipment would be housed in buildings or enclosures, which provide noise reduction. Exact specifications on each building or enclosure involved have not yet been selected, and the amount of noise reduction would vary greatly depending on what types of insulation, building windows, building doors, and building ventilation are used. The major sources of noise are associated with the gas liquefaction process, power generation, LNG transfer facilities, the onsite waste incinerator, wastewater treatment facilities, and the LNG tanker plus associated tugboat traffic.

Power generation for the facility would be created by seven 9,400-kW gas turbine generators which would be housed in the 700 feet by 400 feet main utility building. The main utility building would also contain the compressed air and nitrogen plants. Specific equipment for the generators and compressors has not yet been selected.

The gas liquefaction process would be accomplished in four parallel LNG process trains. Each train would contain pretreatment and gas liquefaction equipment. Additionally, one refrigerant fractionation system would operate feeding gas from any of the four LNG process trains. In the main cryogenic heat exchanger, the refrigerant would be driven by three 37,000-hp gas turbine-driven centrifugal compressors, such as GE Frame 5 gas turbines. Additionally, there would be a 37,000-hp propane compressor and a 6,700-hp flash gas compressor in each LNG process train. Most of the specific equipment has not yet been selected nor has information regarding buildings housing this equipment. The LNG process trains would be located south and southeast of the main utility building.

The gas fractionation system for the plant would be located adjacent to the east wall of the main utility building. Equipment involved in this process include: a feed gas expander suction drum, a fractionation feed gas expander, a scrub column, a deethanizer column, a depropanizer column, and the refrigerant storage tanks. Specific equipment has not yet been selected.

Four 800,000-barrel storage tanks are planned, located south and west of the main utility building. Each storage tank would contain four 7,500-gpm submerged centrifugal LNG loading pumps and a 500-gpm circulating pump—all located in the tanks. Specific equipment has not yet been selected.

An onsite incinerator would be used to handle solid and liquid waste generated by construction and operation of the facility. The incinerator would operate with a feed rate below 1,000 lb/hr and would be enclosed. Wastewater treatment would be located in the main utility building and would treat oily wastewater from washdown and marine facilities and sanitary wastewater from personnel facilities. The treatment would involve an oil/water separator and a biological secondary treatment, with a mixed aeration tank followed by a settling tank. Primary noise sources from the pumps would be enclosed in the main utility building.

LNG tanker and tugboats would generate noise during the transit through Port Valdez and while loading cargo. No estimates of the amount of noise generated by these ships and boats is provided. However, because no other ships or boats would be moving at the time the LNG tanker and its associated tugboats are moving in Port Valdez, the noise generated would probably not exceed the noise generated currently by other marine traffic.

Noise control for plant equipment would be determined by each manufacturer at the time of equipment selection to meet the requirements of Yukon Pacific's Specification A-09, Specification for Noise Control. Specific sources of noise and noise control measures designed to reduce that noise are listed in table 4.8-1. Specification A-09 limits the maximum sound levels at 1 meter from the major abounding surface for furnaces, air fin coolers, gas valves, compressors, and piping systems to 89 dBA; for electric motors, to 90 dBA; and for liquid valves, pumps, and turbines to 92 dBA.

Since the project is in the preliminary design phase, Yukon Pacific has not selected the actual equipment it would use for its Anderson Bay LNG plant. As a result, actual manufacturer's noise-level data is not available. Instead, Yukon Pacific's July 1992 "Noise Level Prediction at Plant Boundary Limit," is based on the assumption that exhaust stack noise levels would not exceed 85 dBA at 10 feet and no other plant equipment would exceed a noise level of 85 dBA at 3 feet. We note that these assumptions do not agree with Noise Control Specification A-09. Yukon Pacific's noise analysis predicted an Leq(24) of 46 dBA at the site's eastern property line, approximately 0.9 mile from the assumed acoustic center. Predicted noise levels at the other NSAs

TABLE 4.8-1

Desirable Design Features for Noise Reduction

Equipment	Source of Noise	Design Features
Heaters	Combustion at burners	Acoustical air intake plenum
	Inspiriting of air at burners	Inspiriting air intake silencer Acoustical air intake plenum
	Draft fans	Air intake silencer or acoustical plenum
	Ducts	Lagging
Motors	TEFC cooling air fan	Acoustical fan shroud, unidirectional fan and/or intake silencer
	WP 11 cooling air openings	Absorbent-liner ducts
	Mechanical and electrical	Enclosure
Air Fin Coolers	Fan	Lower rpm (increased pitch) Tip and hub seals Increased number of blades Decreased static pressure drop More fin tubes
	Speed changer	Belts in place of gears
	Fan shroud	Streamlined air flow Stiffening and damping
Centrifugal Compressors	Discharge piping and expansion joints	Inline silencer and/or lagging
	Anti-surge bypass system	Quiet valves, reduced velocity and streamlining Lagged valves and piping inline silencers
	Intake piping suction drum Air intake/air discharge	Lagging Silencer
Screw Compressors (Axial)	Intake and discharge piping	Silencers and lagging
	Compressor and gear casings	Enclosure, constrained damping or lagging
Speed Changers	Gear meshing	Enclosures, constrained damping on case or lagging
Engines	Exhaust	Silencer
	Air intake	Silencer
	Cooling fan	Enclosed intake and/or discharge quieter fan
Condensing Turbine	Expansion joint on stream discharge line	Lagging
Atmospheric Exhausts and Intakes	Discharge jet	Discharge silencer
	Upstream valves	Quiet valve or silencer
Piping	Eductors	Lagging
	Excess velocities	Limited velocities Smooth gradual changes in size and direction Lagging
	Valves	Limited velocities Constant velocity or other quiet valve Divided pressure drop
Pumps	Cavitation of fluid	Enclosure
Flares	Steam jets	Multiport nozzles on air injectors

are listed in table 4.8-2. Noise levels at both the plant property line and the mouth of Shoup Bay are below an Leq(24) of 55 dBA, and the camp and nearest residence in Valdez are below an Ldn of 55 dBA. Further, the predicted noise levels at all NSAs are unlikely to significantly exceed current background levels.

TABLE 4.8-2

Noise-Sensitive Areas Potentially Affected by Plant Operation

NSA	Distance and Direction from Proposed Main Utility Building (miles)	Predicted Leq(24) (dBA)	Predicted Ldn (dBA)
Southeast property line	0.9 E	46	-
Mouth of Shoup Bay	3.7 NW	34	-
Allison Point Recreation Area	5.9 E	-	36
Valdez - residences at Mineral Creek	5.0 NE	-	38

Since Yukon Pacific's noise analysis is based on assumed equipment noise levels rather than actual manufacturer's data, and on noise levels which do not reflect its own Specifications for Noise Control, we **recommend that Yukon Pacific file with the Secretary a revised acoustical analysis of the Anderson Bay LNG site reflecting far-field sound data of equipment finally selected (from either the manufacturer or a similar unit in service elsewhere), manufacturer's specifications and attenuation data for the intake and exhaust silencers finally selected, and the actual noise control equipment, for review and written approval by the Director of OPR before commencing construction of the compressor facilities.**

Due to the considerable amount of proposed horsepower and its ability to produce a substantial impact on the existing noise quality at the Anderson Bay site, we **recommend that Yukon Pacific file with the Secretary a noise survey of the Anderson Bay LNG Terminal no later than 60 days after placing the terminal in service. If the noise attributable to the operation of the facility exceeds an Ldn of 55 dBA at nearby NSAs, additional noise controls shall be added to meet that level within 1 year.**

4.9 LAND USE AND RECREATION

4.9.1 Land Use

Development of the LNG facility at the Anderson Bay site would have direct and indirect effects on land use in the project area. The primary effect would be the conversion of approximately 377 acres of forest and shrub and 49 acres of wetlands (within the 426-acre construction limits) to an industrial use. Indirect effects would be use restrictions on a larger area resulting from Yukon Pacific's proposed buffer zone and an overlapping dispersion exclusion zone required by DOT regulations (see section 4.15.3).

Yukon Pacific's proposed buffer zone would involve transfer of approximately 2,630 acres of land owned by the State of Alaska and accessible to the public, to Yukon Pacific for a use that would restrict public access. No Chugach National Forest lands would be used for construction. The 2,630-acre buffer zone would limit the public from accessing the project area by land (see figure 2.1-1 and 3.9.1-1). Because of the remoteness of the area, the buffer zone would not be fenced, but would be posted around its perimeter. Although access to the Chugach National Forest lands surrounding the project site would still be possible, access via the 3.5 miles of coastline in the buffer zone would be restricted. Due to the site's remote location and rugged terrain, the number of people who presently use the uplands above the project area for recreational or subsistence uses is very low. The impact of restricting access to the upland areas adjacent to the site is therefore not expected to be great.

The Coast Guard, however, intends to enforce a 200-yard safety exclusion zone around the waters of the entire site which could affect virtually the whole of Anderson Bay as the site is currently configured. This would exclude all non project-related activity, both water and land based, and would have an impact on the use of some parts of Anderson Bay for fishing and recreation but not for emergency safe anchorage.

The project would not conflict with any local comprehensive plans. Two of the plans specifically mention the project and identify its location. The Prince William Sound Area Plan states that the proposed Anderson Bay site is reserved for the TAGS LNG terminal, unless another terminal site is developed. The Valdez Comprehensive Development Plan also supports the project, numbering among its economic goals, the encouragement of a gas pipeline terminus facility in Port Valdez.

4.9.2 Recreation

The proposed project would not have significant short- or long-term negative effects on recreation in the Port Valdez area. Although the reported number of recreationists using the project area (particularly the uplands) is minimal, virtually all recreational activity that currently occurs within, or near the project site, would be impacted to varying degrees.

The noise, dust, and activity generated by construction of the project would discourage marine and land-based recreation in and near Anderson Bay for the duration of construction activity, particularly during the summer seasons. As a result, the numbers of recreationists who would normally be expected to use the site (primarily to fish) would be substantially reduced. Part of the 390 land acres that would be converted to industrial use would be approximately 30 acres surrounding Seven Mile Creek above the waterfall, which has been proposed to serve as the site for worker housing. The Seven Mile Creek area, particularly the waterfall and beach area, is popular for activities such as picnics, weddings, and fishing.

Most of the recreational uses of the site area take advantage of the gentle slopes and cobble and pebble beaches in Anderson Bay and at the mouth of Seven Mile Creek. Between these two points the shoreline is steep and rugged and not easily accessible to recreationists. The project would affect the recreational uses in several ways: 1) Yukon Pacific proposes to regrade and contour approximately 2.5 miles of shoreline beginning east of the mouth of Seven Mile Creek and ending just east of Henderson Creek in Anderson Bay (see figure 2.1-4); 2) approximately 390 acres of upland would become industrial; and 3) the Coast Guard intends to establish a 200-yard exclusion zone in the waters around the entire facility, eliminating recreational uses from most of Anderson Bay and the western shore of Seven Mile Creek. To partially mitigate the impact on recreational uses, we have recommended that Yukon Pacific preserve the gorge and intertidal shore at Seven Mile Creek, so that the area outside the Coast Guard exclusion zone could still remain available for recreational boating and fishing.

Most of the approximately 4,000 construction personnel working on the project at its peak would be housed at a construction camp that would be built on the project site (see sections 2.3.1 and 4.16). Recreational facilities and activities would be available to construction workers at the construction camp. Despite onsite activities and facilities, some workers would no doubt recreate by fishing in the project and Port Valdez areas. No hunting would be permitted by anyone transported to the site by Yukon Pacific.

Temporary increased demand on recreational facilities in the City of Valdez from construction personnel would occur, but would not be great. Impacts on outdoor facilities such as skiing and hiking trails would be minimal (Robb, 1993). The greatest potential impact on city facilities would be to indoor facilities such as the three school gyms and one pool operated by the City of Valdez Parks and Recreation Department for public recreation. Since most workers would be housed at the project site, and the number of workers would be reduced during the winter by 70 percent when indoor recreational activity would be greatest, the impact from workers on indoor city facilities would not be significant.

4.10 VISUAL RESOURCES

The degree of visual impact has been evaluated considering the visually prominent features of the proposed facility, site visibility from sensitive viewing points, and number of potential viewers. In this case, the low number of possible viewing points and limited site visibility due to distance reduce the visual impact to less than significant in spite of severe landscape alteration. Figure 2.1-2 is an artist's rendering of the proposed plant from Port Valdez.

One of the most prominent visual features of the project involves site development down to the water's edge. The proposed project would permanently change the visual character of a 2-mile stretch of southern Port Valdez shoreline. The pristine rocky coastline of the project site would be replaced with a large, industrial facility, resulting in contrasting form, color, and texture with the adjacent natural, heavily forested landscape. Site development activities would change the existing topography of the site by creating a series of benches ranging from an elevation of 31 feet MLLW for the construction wharf, to an elevation of 175 feet MLLW for the LNG process trains. In establishing the series of benches, Yukon Pacific proposes to grade down to the water's edge for the majority of the 2 miles of shoreline within the construction site. In these locations the existing vegetation, road outcrops, and irregular shoreline would be replaced with a uniform riprap or waterside facilities such as the cargo docking area and tanker berths. While this plan probably represents an engineering and cost solution, it has a drastic visual effect on the quality of the existing landscape.

The other most prominent visual features are the four LNG storage tanks and the four liquefaction trains. The storage tanks would be located on a cut bench at an elevation of 75 feet MLLW immediately east of Anderson Bay. The outer tank walls would measure from 91 to 111 feet high, depending upon the type of tank selected, and would thus be at elevation 166 to 186 feet MLLW. The domed roof would be somewhat higher, but less visible than the walls. The four LNG process trains would be located on a cut bench at elevation 175 feet MLLW near the east end of the site. Each would occupy an area 600 feet by 550 feet.

LNG tankers would also be visually prominent when traversing Port Valdez, and while at the marine berths during the approximately 18 hours required for turnaround. The typical tanker would be approximately 950 feet long and more than 140 feet wide. However, they would be a minor addition to the current tanker traffic in Port Valdez.

Viewers throughout Port Valdez would be able to see the major project facilities and some operational activities to varying degrees depending upon viewer distance and atmospheric conditions. The following describes the visual impact of the proposed project from representative viewing points (VPs) in Port Valdez which were considered visually sensitive points or where concentrations of viewers occur. The locations of VPs are shown on figure 3.9.3-1.

Valdez City Harbor (VP1)

The Valdez City Harbor would be a focal point for residents, tourists, and commercial marine operators. Because the project is 5.5 miles away from VP1, certain atmospheric and light conditions would be necessary for the project to be readily visible. While project features could be detected, distance would significantly mitigate the visual effect of storage tanks, ships, and nighttime lights. The project site constitutes a very small component of the viewed landscape. The site is further diminished in visual prominence by the magnitude of the surrounding mountains and expanse of water between the site and city harbor. The presence of the existing Alyeska Marine Terminal also acts to decrease the visual impact. We estimate the project would result in a low visual impact from this viewing point.

Shoup Bay (VP2)

The potential viewers at Shoup Bay would be recreationists on boats visiting the Shoup Bay State Marine Park. The primary attraction to park visitors is the large and impressive tidewater glacier at the north end of the bay. The mouth to Shoup Bay is located across Port Valdez about 3 miles from the plant site. The possibility of viewing the plant would diminish after passing inside the bay's entrance. Because the LNG plant would only temporarily be visible to those traveling to or from Shoup Bay and, at such a great distance would not be noticeable from the marine park, the project is expected to have a low visual impact on this viewing point.

Alaska Marine Route (VP3)

Existing and potential viewers from VP3 would include: ferry, cruise ship, and sightseeing passengers; recreational boaters; and commercial and recreational fishermen. Viewers on vessels passing the site would view the facility from a number of angles, and would have direct views for as long as it would take the vessel to pass the site. One mitigating factor is the visual presence of the Alyeska Marine Terminal which tends to become a larger detraction to the natural landscape at locations closer to the LNG plant. A moderate degree of visual impact could occur from some viewing points along this route.

In summary, the anticipated visual impact from the points evaluated is representative of the range of impacts we would expect to find. The few number of visually sensitive areas, relatively few numbers of viewers, and distance at which the proposed facility would be seen most of the time to a large extent offsets the visual effect of the proposed project on the generally distinctive landscape quality of the area surrounding the site. To reduce visual impact, we **recommend that Yukon Pacific file with the Secretary for review and approval by the Director of OPR prior to construction a visual mitigation plan that includes:**

- **shoreline protection measures that provide a more natural appearance by preserving existing landform and mature vegetation at prominent features along the shoreline, developed in conjunction with the recommended 50-foot-wide vegetation buffer strips; and**

- **landscape and architectural treatments that reduce the contrast of the aboveground structures with the natural landscape.**

4.11 SOCIOECONOMICS

Socioeconomic impacts associated with the Yukon Pacific LNG Project would be related to the jobs it would bring to Valdez, the economic and population growth it would stimulate, and the increased demands on public and private services and facilities it would create.

4.11.1 Employment

Construction of the LNG plant would create construction jobs and supervisory and operational jobs on the site. These newly created jobs would impact employment levels for the City of Valdez. Direct employment would consist of those workers hired for construction and operation of the plant. An influx of persons employed at the site would increase the demand for goods and services in Valdez. Businesses in the City of Valdez would have to hire additional staff to meet demand. These jobs would constitute indirect employment resulting from construction of the LNG plant.

According to Yukon Pacific, LNG Project construction phase employment at Valdez would build up gradually during the first two project years. Project employment would reach an average of 1,300 persons in Year 3 and would reach an average of 2,000 persons and a peak of 4,000 persons in Year 5 (see table 4.11.1-1). Total construction would be completed by Year 9.

Yukon Pacific proposes to house most construction employees in camp facilities located along the banks of Seven Mile Creek. These facilities would have a 4,000-person capacity with kitchens, dining facilities, and recreation complexes. According to Yukon Pacific, operations employment would begin in Year 5 with 200 persons. It would continue at this level for the duration of the plant operation.

Indirect employment would begin in Year 1 with 125 persons. Indirect employment would continue to increase until Year 5, and then would decrease as the number of construction workers on the site decreased. In Year 9 and throughout the life of the plant, indirect employment would be approximately 100 persons.

Total average employment would peak at 2,460 in Year 5, including an average 1,800 workers directly involved in project construction, 200 persons involved in operation of the plant, and an average 460 additional people employed in other economic sectors. During the summer months of Year 5, construction employment could reach a peak of 4,000 persons.

Construction workers would likely work an 8 weeks on, 2 weeks off schedule. This would offer workers the opportunity to leave Valdez for their 2 weeks off. During the 8 weeks on, workers would probably remain in the camp or in Valdez on their days off.

TABLE 4.11.1-1

Yukon Pacific LNG Project Annual Average Employment and Population by Project Year for the City of Valdez

	Direct Employment		Indirect Employment				
Project Year	Construction Workers a/	Operations Workers a/	Construction Related b/	Operations Related c/	Total Employment	Additional Family Members d/	Total Population e/
Year 1	625	0	125	0	750	31	781
Year 2	875	0	175	0	1,050	43	1,093
Year 3	1,300	0	260	0	1,560	65	1,625
Year 4	1,750	0	375	0	2,125	93	2,218
Year 5	1,800	200	360	100	2,460	390	2,850
Year 6	1,100	200	220	100	1,620	355	1,975
Year 7	400	200	80	100	780	320	1,100
Year 8	575	200	15	100	890	304	1,194
Year 9	0	200	0	100	300	300	600

a/ Includes construction and operations personnel employed by Yukon Pacific.

b/ Construction-related indirect employment = 0.2 direct construction employment.

c/ Operations-related indirect employment = 0.5 direct operations employment.

d/ Construction workers are assumed to maintain family residence elsewhere. Additional family members accompanying permanent operations workers are estimated to be equal to the number of jobs. Additional family members accompanying indirect employees are estimated at equal the number of indirect jobs resulting from project operations and 0.25 times the number of indirect jobs resulting from project construction.

e/ Includes direct and indirect workers plus family members that would move to the area with new direct and indirect workers.

4.11.2 Population

Population projections for the State of Alaska forecast an increase in population of 2.9 percent from 1990 to 1995 and 2.3 percent from 1995 to 2000 (Spatz, 1993). Valdez has probably experienced an increase in population of at least 50 persons (a 1.2 percent increase) since the 1990 census because of new employees (and their families) at the Petro Star Refinery, which began operation in 1993. However, possible future cutbacks at the Alyeska Terminal could limit growth or cause a net loss of population for the city. Given the uncertainty of employment at Alyeska and the relatively slow growth scenario for the state, a no growth forecast is assumed for the City of Valdez through the year 2000 in the absence of the proposed LNG project. The following impact descriptions assume the total workforce would increase the population of Valdez when, in effect, the majority of the workers would be living at the proposed construction camp.

Average population increases associated with construction of the LNG facility would peak at about 2,850 persons in Year 5 (table 4.11.1-1). This would include 1,800 construction workers, 200 operations workers, 460 workers in other sectors, and 390 family members which we estimate would accompany new workers to the area, including new direct and indirect workers. Maximum seasonal population could exceed this level, since potential peak construction employment would equal 4,000 persons. The greatest population increases on an average yearly basis would occur in Year 1 (+781 persons) and Year 4 (+593 persons from the previous year) and would begin to decline in Year 6 (-875 persons from the previous year) until Year 9 when the plant would no longer be in its construction phase.

An addition of 2,850 persons to the Valdez population of 4,068 persons (1990 population) represents a total population of 6,918, a 70 percent increase over the 1990 population by Year 5 of construction. This would be a significant increase in population. Additional workers associated with construction of the TAGS pipeline would be expected to be in the Valdez area during some portion of the plant construction period. These workers tend to be transitory, following along with pipeline construction with a relatively short duration in any one location.

Construction of the Alyeska terminal and pipeline and later *Exxon Valdez* oil spill cleanup also created a large influx of population in a short time period. During construction of the Alyeska terminal and pipeline, Valdez population peaked at 8,253 persons in 1976 (Darbyshire and Associates, 1991). During the Valdez oil spill cleanup operations in 1989, the July population estimate was 7,300 persons (Dengel, 1993). Some estimates are closer to 10,000 persons at one time. The city successfully handled the large population influxes. Proper planning and cooperation between Yukon Pacific and city officials would avoid some of the difficulties that have been experienced in the past.

During operation, the permanent population would increase by approximately 600 persons, including direct and indirect employment and the families of employees that would move to Valdez. The operational increase of 600 persons would produce a total population of 4,668, a 15 percent increase over the 1990 population. Some additional people moving to Valdez to seek work at the LNG plant would create additional upward pressure on total population. Population increases of this magnitude would stress city operations beyond capacity.

4.11.3 Economy and Income

Construction of the LNG Plant would boost economic activity in the City of Valdez. Some of Yukon Pacific's employment needs could be filled by local residents. Some construction materials and supplies could be purchased from Valdez businesses. The increase in population would increase the amount of goods and services purchased in the city. The city's tax base would rise, increasing property and revenue tax receipts. These revenues could be used to improve city facilities and infrastructure, promoting further growth and economic diversity.

Local businesses in Valdez, primarily construction, retail, and service businesses, would experience increased activity as a result of the LNG facility construction. Yukon Pacific has developed an estimate indicating the maximum amount of materials that could be purchased by Yukon Pacific for construction of the LNG facility (see table 4.11.3-1). The maximum value of locally purchased materials could be $15,000,000.

Recreational and tourism dependent businesses would not be significantly affected because of project construction. There are many opportunities in the vicinity of Valdez to participate in recreational pursuits other than within project boundaries and safety zones. Most small boat operators and guides could access these areas. Large tour boat operators and cruise ships would most likely continue to visit the city. Some tourists to Valdez are interested in viewing the Alyeska facility; the Yukon Pacific LNG Plant would be an additional attraction for these tourists.

TABLE 4.11.3-1

Construction Materials that could be Purchased from Local Businesses by Yukon Pacific

Material	Value of Material a/	Value to Local Business a/, b/
Welding gases	$5,000,000	$1,000,000
Fuel, oil, and lube	$35,000,000	$7,000,000
Concrete and special aggregates	$5,000,000	$1,000,000
Hauling	$5,000,000	$1,000,000
Other	$25,000,000	$5,000,000
Total	$75,000,000	$15,000,000

a/ In 1990 dollars.

b/ Value assumes that all goods would be purchased from local businesses and that these businesses would realize a 20 percent sales margin.

Assuming construction workers would be paid an average rate of $22.86 per hour for the equivalent of 70 hours per week, working 8 weeks on and 2 weeks off, an annual salary would be greater than $67,000. Yukon Pacific estimates a rate of $6,500 per month for operations employees, with an annual salary totaling $78,000 per year. These estimates far exceed $27,000, the approximate 1990 per capita income level for Valdez. Some dislocation of employment would occur as Valdez employees seek higher wages in construction jobs for the LNG plant. Local employers could be forced to offer higher wages, creating wage inflation. However, the benefits of increased economic activity would offset some of the negative impacts associated with upward pressure on wages. The Yukon Pacific workforce's relatively high paying jobs would benefit the local economy. Construction workers could spend time in town on days off, eating at local restaurants and purchasing goods and supplies. Operational and supervisory staff, living outside the construction camp, would also create a demand on local businesses. Increased activity could attract additional business ventures, boosting local tax revenue.

Average per capita income levels for the City of Valdez would increase as a result of the facility construction, since income levels of temporary construction workers would be included in per capita income estimates for the city. In addition, increased economic activity and potentially higher wages would raise income levels.

4.11.4 Housing

Personnel for initial project mobilization would be housed in the existing camp facilities located near the airport. These facilities would be used during the duration of the project by a small number of personnel ranging from 150 to 250. These facilities have a current capacity of 700 persons. During the first season of construction while the main proposed construction camp (located on the banks of Seven Mile Creek) is being constructed, a floating camp would be established near the creek mouth. The main camp would eventually have a capacity of 4,000 persons. It would be developed in three modules, each with capacity to house approximately 1,300 persons.

Supervisory staff during construction and 200 operational employees would be located in Valdez with their families. Indirect employment would add another 100 persons who could move to Valdez with their families. The exact numbers of newcomers to Valdez would be dependent upon the number of jobs that would be filled by current Valdez residents. Newcomers would generally be interested in rental housing or in buying a home. The current housing stock would not be adequate to meet project-induced demands. As a result, housing prices could rise. Existing lots subdivided for development could be purchased by newcomers, or contractors could begin construction commenced in anticipation of an influx of home buyers. The supply of land currently appears adequate to meet an increase in demand.

In-migrating job seekers would probably stay at local hotels and bed and breakfasts. Demand would likely exceed supply of this temporary housing during the summer months when tourists would compete with job seekers for rooms. In addition, fish processing and construction employment increases during the summer months create even greater demand for temporary housing.

4.11.5 Public Facilities and Services

The number of children enrolled in Valdez schools would increase because Yukon Pacific employees and other indirect employees, and their family members would relocate to Valdez. In the 1990-91 school year, the average number of students enrolled in the Valdez school system was 782 (Clark, 1993). According to the 1990 census, the total number of households in Valdez was 1,277, with an average of 0.61 school age children per household.

In Year 5 of construction, Yukon Pacific employment could peak at 4,000 persons in Valdez. It is unlikely that this level of employment would be sustained for even a 6-month period; therefore, we assumed that indirect employment and the level of public services would not increase commensurate with this temporary employment level. Average employment during Year 5, the peak construction year, would be 2,460 persons, creating a total population increase of 2,850 persons during that year (all population and employment numbers for this section are presented in table 4.11.1-1).

By Year 5, an additional 390 workers would relocate to Valdez with their families. Based on the assumption that there are 0.61 school age children per family, an increase of 390 families implies that there would be 237 school age children. Assuming no other factors influence school enrollment, an increase of 237 students would bring total enrollment to 1,206 persons. This would slightly exceed capacity of the Valdez school system (1,175 persons). An additional 15 teachers would be needed given the current student to teacher ratio of 15 to 1. Additional supplies and books would also be needed.

During project operations, there could be 183 new school age children enrolled in Valdez schools. This number is based on 300 families permanently relocating to Valdez. Total students enrolled in the school system would be 1,152, slightly within capacity limits. But, as noted in section 3.11.4, excess capacity varies with grade level and new additions to the system could pose problems in grades that are currently at full capacity levels. An additional 12 teachers would be needed to maintain the current student to teacher ratio of 15 to 1. Additional supplies and books would also be needed.

The following estimates indicate additional public services that would be required as a result of construction of the plant. The estimates are based on population estimates for two scenarios—during peak average construction employment and employment during operations. These estimates are based on the assumption that current staffing levels are in line with current needs and that additional staff requirements would be proportional to the population increase.

Current hospital staffing equals 1 employee (currently 34 employees) for every 120 residents, 1 doctor (currently 4 doctors) for every 1,017 residents, and 1 bed (currently 15 beds) for every 271 residents. In the State of Alaska, there is 1 doctor for every 760 persons (McHardy, 1993). These numbers indicate that Valdez Hospital could use additional doctors to bring its representation up to the state average.

During construction, additional staffing needed to accommodate a temporary increase in population of 2,850 persons would be approximately 23 employees and 2 doctors. An additional 10 beds would be needed. Permanent additional staffing needed to accommodate an increase in population of 600 persons during operations would be approximately 5 employees and possibly 1 additional doctor. An additional two beds would be needed.

Generally, large influxes of population into a community result in an increase in criminal offenses. In 1989, the year of the Valdez oil spill, total officer responses for the year were 6,734; in 1991, as population returned to more normal levels, responses totaled 4,918 (Valdez Police Department, 1992). Increases in felony crimes, misdemeanors, accidents, and parking and traffic congestion could be anticipated because of project construction. Total arrests in 1989 were 673 versus 338 in 1991. Current police department staffing includes 1 employee for every 170 residents. During construction, additional staffing needed to service a temporary increase in population of 2,850 persons would be 16 employees. During operations, additional staffing needed to accommodate an increase in population of 600 persons would be approximately 3 employees. The 1990 records indicate that there is 1 public service policeman (including patrol officers, detectives, and supervisors) for every 410 persons in the State of Alaska (McHardy, 1993). Therefore, current levels could be adequate.

Fire department staffing currently equals 1 full-time employee (currently 12 full-time employees) for every 339 residents and 1 part-time employee (currently, 25 part-time employees) for every 163 residents. In the State of Alaska, there are 1,250 persons for every full-time fire fighter (McHardy, 1993). There are no numbers available for volunteer fire fighters.

During construction, additional fire department staffing needed to service a temporary increase in population of 2,850 persons would be 8 full-time employees and 17 part-time employees. Permanent additional staffing needed to accommodate an increase in population of 600 persons would be 1 full-time employee and 3 part-time employees.

Since the 1989 Valdez oil spill, Alyeska has consulted with local government and emergency personnel to create an emergency response effort that takes advantage of resources that are available within city services and the private sector. This has increased cooperation between the community and Alyeska. Alyeska has also benefitted from the resources and knowledge available in the City of Valdez.

Current city water supplies are adequate. Some additional wells or improvements on the existing system could be necessary as new subdivisions are developed in the city. Sewage treatment capacity appears to be adequate.

4.11.6 Fiscal Impacts

Demands on city services, including schools, infrastructure maintenance, and public safety would expand with increased population, traffic, and overall activity. Yukon Pacific has estimated potential cost increases associated with the LNG Project by taking current budgeted dollars for the affected services and determining the per capita cost of meeting these needs (see table 4.11.6-1). The per capita cost was then multiplied by an average peak workforce of 2,000 persons, indicating an additional $6,012,000 of city costs. Additional annual property tax revenues estimated at $23,000,000 during the construction period would eventually more than offset the increased costs for the city. Some of the city's costs would be incurred early in the construction phase of the project, before the city received any increased tax revenue.

TABLE 4.11.6-1

Estimated Cost of Services for the City of Valdez
Without the Project and With the Project

	Without Project	With Project	
Service	1992 Budget a/	Estimated Total Requirements a/	Additional Costs a/
Schools	$6,800	$10,200	$3,400
Roads	$1,200	$1,800	$600
Port	$207	$311	$104
Public Safety	$2,500	$3,750	$1,250
Utilities	$1,315	$1,973	$658
Total	$12,022	$18,034	$6,012

a/ Amounts in thousands of dollars.

It is likely that the tax status of the LNG facility would compare to the tax status of the Phillips Petroleum Company and Marathon Oil Company natural gas plant located on the Kenai Peninsula which is not subject to state tax (Benson, 1993). The plant would be subject to property taxes for the City of Valdez. These taxes would be based on the assessed valuation of the plant. Assessed valuation is based on the replacement value of the plant, including the market rate for the property on which it is located, minus depreciation, plus or minus outside economic factors (Haerer, 1993). Outside economic factors include future estimated supplies of LNG, the future estimated market for LNG, and other variables that could affect the value of the plant. The City of Valdez would tax Yukon Pacific, on a yearly basis, according to the plant's assessed value and the city's tax rate for that year. The tax rate, or mil rate, is based on estimated future costs and revenues for the city for the entire year. The rate is determined by city officials according to estimated needs at the beginning of each year.

The city's revenue base would increase with the construction of the LNG plant through increased tax revenues. As a result, the city's mil rate would come down because these revenues could be used to offset costs. Persons and businesses paying property taxes in the City of Valdez could have a lower tax bill.

Yukon Pacific estimates that the assessed value of the plant, based solely on total estimated construction costs, would be $2.3 billion. Taxable construction would begin in Year 2 when working materials would be brought onto the site. For the following 7 years, taxes paid to the city by Yukon Pacific would be based on a percentage of total construction costs. During operation of the plant, taxes paid would be based on the mil rate for each year and the assessed value. Yukon Pacific estimates that property tax payments would be $46 million per year. This number assumes a mil rate of 20 which we believe is unrealistically high based on a current mil rate of 19.

The experience the City of Valdez has in coping with short-term explosive growth and the adequacy of its infrastructure in most areas would avoid any significant adverse socioeconomic effects. The potential also exists for the project to result in net positive effects through job creation, tax revenues, and careful mitigation planning.

Because the current economic, housing, and other community conditions are expected to change before the project would actually start, any specific mitigation should not be developed at this time. However, the ADNR has required Yukon Pacific, before or as part of any final state right-of-way lease, to develop and commit to mitigation measures that address manpower, socioeconomic, and local planning impacts of the TAGS project.

4.12 TRANSPORTATION

The highways, roads, port, marine highway, and airport in Valdez would be affected by an increase in traffic as a result of the proposed LNG project. Roads would be used to transport goods, supplies, and people for the construction site and for businesses within Valdez. The primary mode of transportation would be by water, including the movement of LNG, construction materials and other supplies, and people. Airport traffic would increase with the delivery of people and supplies.

4.12.1 Highways and Roads

Richardson Highway would experience increased traffic with the transport of supplies for construction, supplies for businesses within the City of Valdez, and workers into the Valdez area. This highway has a design capacity far in excess of current average daily traffic loads. Increases in traffic as a result of this project would not exceed capacity levels of the highway.

Roads linking Richardson Highway to the city dock and small boat harbor would experience increased use. The Valdez Airport Road would experience an increase in traffic leading to the airport as well as to the existing camp facilities located near the airport. In general, Valdez roads in the downtown center would experience increased traffic loads with the increase in population. This could pose a problem during the summer months when tourist traffic is high. However, the city dealt with high traffic loads during the Valdez oil spill cleanup. Roads leading to new homes or subdivisions could need expansion or additional maintenance to handle increased loads.

4.12.2 Marine

During the construction phase, materials and supplies would be transported to the Anderson Bay site by water. Yukon Pacific has no plans to build a road leading to the construction site; therefore, all supplies received by truck or plane would have to be loaded onto a boat and delivered by way of the Port of Valdez. An average of two trips per day by tug, barge, or roll-on, roll-off ramp is expected, although peak activity periods may require six trips per day. In addition, one or two small boats per day would transfer materials and personnel.

Yukon Pacific is considering the use of large prefabricated modules for plant construction. This would result in a single shipment of 10 to 15 ocean-going barges ranging in weight of from 500 to 4,000 tons. In addition, there would be one to two ocean going barges per construction season month for the first several years. Ocean-going barges would unload directly at the Anderson Bay cargo dock.

Cargo docking facilities have been proposed to accommodate all marine transport. A cargo/personnel ferry dock located on the west end of the LNG plant site would support plant operations, including the receipt of diesel oil, consumables, potable water, and other supplies for plant operation and maintenance. The cargo dock would have a fuel station for refueling small craft and floating equipment. The cargo/personnel ferry dock would provide permanent moorings for the service vessels and small craft employed by the plant.

During full capacity, Yukon Pacific estimates that it would use 15 tankers of 125,000 cubic meters capacity, making 275 loaded voyages per year. The tankers would dock at two LNG tanker berths located on the plant site (see figure 2.1-3). The LNG would be transported from Anderson Bay, through Valdez Narrows and Valdez Arm, across Prince William Sound. Operation would be governed by current Coast Guard operations and surveillance systems. For more detailed information on LNG tankers and transport see sections 2.1 and 4.15.4. Currently, port activity is not heavy. However, proper precautions would need to be taken to ensure safety (see 4.15.2). Current plans to expand the small boat harbor could be accelerated, thus increasing the number of slips available for small boats.

4.12.3 Airport

Scheduled airline traffic and both fixed and rotary-winged charter service would increase at the Valdez Airport during the construction phase of the project. This would have a positive effect on the regional air transportation industry. The Valdez Airport has the capacity to accommodate the expected increase in passenger and cargo loads, as demonstrated by the Valdez oil spill cleanup operations. Appropriate safety and preventive measures would need to be followed to handle an increase in average traffic. It is possible that additional hangar space would need to be constructed for plane storage.

4.13 SUBSISTENCE

The potential effects of the proposed project on subsistence uses are primarily a function of the impacts on fish and wildlife used for subsistence, access to subsistence resources, and potential interference with or disruption of harvest activities. Potential direct effects of the proposed project on subsistence uses include the following:

- reduction in the availability of subsistence resources due to various aspects of project construction and operation;
- interference with or preclusion of access to subsistence resources and harvest methods;
- competition for subsistence resources by project personnel; and

- new or greater use of subsistence resources in areas made more accessible by new or improved roads or trails.

Potential indirect impacts are adverse effects on communities and individuals from a loss of traditional harvest activities, including loss of traditional supply of foods, increased outlay of cash for substitute foods, reduction in time available for subsistence activities due to employment commitments, and sociocultural impacts from reduced participation in the harvest, processing, and distribution of subsistence resources. Following are some criteria that determine significance of potential effects:

- relative abundance and distribution of the subsistence resource and harvest activities compared to that affected by the project;

- duration of the impact;

- relative importance to the communities/individuals of the affected resources and uses; and

- availability of other sources of affected resources or acceptable replacement resources.

4.13.1 Impacts on Fish and Wildlife

Construction and operation of the project could affect fish and wildlife resources used for subsistence activities in three ways, all resulting in their reduced availability for subsistence harvest. First, mortality could occur from project construction or accidental events. Fish would be most at risk due to the potential for siltation or fuel spills into a waterbody. Second, fish and wildlife such as moose, deer, and bear, might avoid the project area due to construction activities. Finally, construction and operation of project-related facilities could result in habitat loss and a reduced level of utilization of the project area by fish and wildlife. Overall, because the Anderson Bay area and much of Port Valdez are not noted for significant subsistence use, the potential impacts on subsistence are likely to be minimal.

Valdez

No subsistence permits have been issued to residents of Valdez since 1987 when it was classified as nonrural. Although the project would not impact subsistence use in Valdez, it would have an impact on subsistence resources.

Large mammals presently occur in low numbers at or near the project area. Increased human disturbance and hunting from the construction workforce could result in reduced local population levels of goat and bear densities. Although this would result in greater competition for subsistence harvesting, such a reduction is minimal and should not significantly affect subsistence harvesting.

Loss of coniferous forest habitat would likely affect pine marten and mink, and the facility could affect the movement of mink foraging along the shoreline. The impact on these furbearers is unknown but is estimated to be minimal, and should not significantly affecting subsistence users' harvesting (trapping) of pelts for personal use or for sale as a source of cash income.

Sea otters and harbor seals are the only marine mammals that occur in Port Valdez on a more than occasional basis, both being observed in Anderson Bay during ADFG surveys in 1991. The greatest impacts on these species are likely to result from blasting during construction. These impacts can be mitigated by establishing a zone of influence, from which spotters can be used to clear the area prior to blasting. These minimal impacts should not affect subsistence harvests of sea otters (for pelts) and harbor seals (for meat).

Direct facility construction and operational impacts on nesting waterfowl are anticipated to be minimal because of a general lack of nesting habitat in the project area. A greater impact on nesting waterfowl is anticipated from disturbances and hunting from the construction workforce. Overwintering Barrow's goldeneyes and surf scoters are likely to be affected by loss of habitat and blasting during construction and degradation of forage potential.

Overall, minimal impacts on resident freshwater fish resources are likely to occur because of their limited distribution on the site. No resident freshwater fish are present in Terminal, Short, and Strike Creeks so alteration of these channels by the project would not impact any fish resources. Pink and chum salmon are the only anadromous fish using the lower reaches of Seven Mile, Nancy, and Henderson Creeks. Henderson Creek would not be affected because it is on the edge of the project area, and Seven Mile and Nancy Creeks could be affected by increased sedimentation during construction.

Marine water fisheries resources could be affected by loss of 35 acres of habitat, altering nearshore migration, from blast shock waves during construction, increased water temperature, and potential chemical and fuel spills. Pink and chum salmon could be affected by these actions, although the level of impact cannot be determined without additional information, but they are not likely to affect subsistence harvesting because much of the harvesting occurs outside of Anderson Bay and Port Valdez.

It is likely that intertidal and subtidal organisms would be damaged, covered, or killed as a result of blasting, filling, and chemical spills during construction in the project site. Clams and crabs do not occur in significant numbers in Port Valdez and it is unlikely the loss of this habitat will impact them. Thus, these impacts are not likely to be significant on subsistence harvesting.

Tatitlek

A majority of Tatitlek residents' subsistence harvest activities occur outside of Port Valdez and, therefore, would not be affected by the construction-related impacts described for Valdez. However, marine mammal and fishery subsistence use could be affected by increased ship traffic and maritime accidents, should they occur. Increased traffic in the Valdez Arm, Prince William Sound, and its associated bays/inlets would have minimal effects from direct marine resource collisions with vessels. Increased traffic also might have a minimal effect on the local concentrations of marine mammals and their migratory patterns. In the event of an accident, LNG would evaporate relatively quickly and should not significantly affect marine resources.

Increased use and competition for subsistence resources is likely to occur from fishing and hunting activities conducted by project construction and operational workforces. Increased competition has been a concern since construction and operation of the TAPS pipeline and has been a growing concern since the early 1980s (Rural Alaska Community Action Program, 1981). This increased competition might result in the need to limit nonrural (Valdez) and project-related workforce recreational/personal harvesting in Prince William Sound and the Copper River area if subsistence resources become significantly affected.

Overall, reliance on local resources for subsistence does not appear to be high and because effects on these resources would be largely limited to the immediate site area where minimal subsistence harvesting occurs, the impacts are considered to be minor.

4.13.2 Interference/Access Impacts

The Yukon Pacific LNG Project construction and operation have the potential to interfere with some subsistence activities by restricting access to traditional subsistence use areas. Construction activities and placement of facilities, roads, and borrow pits throughout the project area would eliminate or restrict access to a relatively small area traditionally used for subsistence activities. Therefore, the impact would be less than significant.

4.13.3 Increased Sport Hunting, Fishing, and Trapping Competition

The project would introduce large numbers of direct and indirect employees into the area. This workforce and its dependents would participate in sport hunting, fishing, and trapping activities. Left unregulated, such participation would compete with subsistence users for fish and wildlife resources and could threaten maintenance of the populations of fish and wildlife used for subsistence purposes. Although likely to be concentrated around construction camps, these activities could extend into the Copper River area.

Historically, the Joint Boards of Fish and Game have acted to protect subsistence harvest of fish and wildlife when such harvest levels have been deemed to be in jeopardy or inadequate to maintain traditional subsistence use of fish and wildlife. Such protection measures have taken the form of special subsistence hunting and fishing openings, or restrictions on sport and commercial harvest.

The duration of competitive impacts would be limited to the period of construction, although the operational workforce could continue to compete with subsistence users on a smaller scale. These impacts would not result in a significant restriction of subsistence uses.

4.13.4 Relocation/Increased Harvest Effort

The only potential indirect impact of the Yukon Pacific LNG Project, resulting from the primary impacts on subsistence described above, is increased harvest effort required to offset loss of subsistence resources in the vicinity of the project. Any reduction in harvest levels attributable to the project would result in compensated effort in other areas unaffected by the project possibly involving extra time, travel, harvest effort, or cash for fuel and supplies.

4.14 CULTURAL RESOURCES

Background research failed to identify any previously recorded sites in the project area and no new cultural resource sites were identified during the field survey. The survey report concluded that "it appears highly unlikely that undiscovered prehistoric sites exist in the project area," and that the "lack of locales in the project area possessing characteristics associated with prehistoric sites elsewhere in the general region suggests few if any sites will be found there." The Alaska SHPO has reviewed the results of a 1990 cultural resources survey of the project area sponsored by Yukon Pacific. On the basis of the survey report the SHPO concluded in a March 13, 1992 letter, and we concur, that the project would have no effect on properties on or eligible for the NRHP.

The only site of local interest is the monument to Harry Alden Henderson in Anderson Bay (see section 3.14). The island on which it is placed would not be affected by the construction of the project but depending on how the Coast Guard elects to enforce its 200-yard safety exclusion zone, part of the island could fall within it, thereby limiting access. In order to prevent any inadvertent disturbance to the marker, we **recommend that Yukon Pacific not disturb the monument to Harry Alden Henderson at Anderson Bay.**

4.15 ANALYSIS OF PUBLIC SAFETY

The operation of the proposed LNG facility poses a unique hazard that could affect the public safety without strict design and operational measures to control potential accidents. The primary concerns are those events which could lead to an LNG spill of sufficient magnitude to create an offsite hazard.

The first section presents a discussion of the principal properties and hazards associated with LNG (4.15.1). Next follows a summary of our preliminary design and technical review of the cryogenic aspects of the proposed LNG facility and marine terminal (4.15.2). The third section analyzes the thermal radiation and flammable vapor cloud hazards resulting from credible land-based LNG spills (4.15.3). And the final section examines the safety associated with the marine transportation by LNG tankers (4.15.4).

Also of critical safety importance for a facility located in a high seismic area are the seismic design criteria. The reader is referred to Seismicity (3.2 and 4.2) for an analysis of this issue.

4.15.1 LNG Hazards

LNG's principal hazards result from its cryogenic temperature (-260°F), its flammability, and its dispersion characteristics. As a liquid, LNG will neither burn nor explode. Although it can cause freeze burns and, depending on the length of exposure, more serious injury, its extremely cold state does not present a significant hazard to the public, which rarely, if ever, comes in contact with it as a liquid. As a cryogenic liquid, LNG will quickly cool materials it contacts, causing extreme thermal stress in materials not specifically designed for ultracold conditions. Such thermal stresses could subsequently subject the material to brittleness, fracture, or other loss of tensile strength. These hazards, however, are not substantially different from the hazards associated with the storage and transportation of liquid oxygen (-296°F) or several other cryogenic gases which have been routinely produced in the United States.

Methane, the primary component of LNG, is colorless, odorless and tasteless, and is classified as a simple asphyxiant. Methane could, however, cause extreme health hazards, including death, if inhaled in significant quantities within a limited time. At very cold temperatures, methane vapors could cause freeze burns. Asphyxiation, like freezing, normally represents a negligible risk to the public from LNG facilities.

When released from its containment vessel and/or transfer system, LNG will first produce a vapor or gas. This vapor, if ignited, represents the primary hazard to the public. LNG vaporizes rapidly when exposed to ambient heat sources such as water or soil, producing 620 to 630 standard cubic feet of natural gas for each cubic foot of liquid. LNG vapors in a 5- to 15-percent mixture with air are highly flammable. The amount of flammable vapor produced per unit of time depends on factors such as wind conditions, the amount of LNG spilled, and whether it is spilled on water or land. Depending on the amount spilled, LNG may form a liquid pool which will spread unless contained by a dike.

Once a flammable vapor-air mixture from an LNG spill has been ignited, the flame front will propagate back to the spill site if the vapor concentration along this path is sufficiently high to support the combustion process. The rate of flame propagation is called the laminar burning velocity. An unconfined methane-air mixture will burn slowly, tending to ignite combustible materials within the vapor cloud, whereas fast flame speeds tend to produce flash burns rather than self-sustaining ignition.

LNG is explosive if its vapor enters a confined space and is ignited. There is no evidence, however, suggesting that LNG is explosive in unconfined open areas. Experiments to determine if unconfined methane-air mixtures will explode have been conducted and, to date, all have been negative—unconfined methane-air mixtures will burn, but will not explode. Nevertheless, a number of experimental programs are currently being conducted to determine the "amount of initiator charge" required to detonate an unconfined methane-air mixture.

4.15.2 Cryogenic Design and Technical Review

The cryogenic design and technical review places its emphasis on the engineering design and safety concepts, and on the projected operational reliability of the proposed LNG facility and marine terminal. The principal areas of coverage include: a) materials in cryogenic environments, b) insulation systems, c) cryogenic safety, d) thermodynamics, e) heat transfer, f) instrumentation, g) cryogenic processes, and h) other relevant safety systems.

In preparation for this review, the Commission staff sent a cryogenic design data request to Yukon Pacific on February 1, 1990. Yukon Pacific filed partial responses on July 26, 1991, and on March 31, 1992. The Commission staff and its cryogenic consultant conducted a technical conference in Valdez on May 26, 1992, followed by a site inspection. The current phase of the review is presented in "Preliminary LNG Export Facility Preconstruction Cryogenic Design and Technical Review" (see appendix B).

Much of the technical data filed by Yukon Pacific reflects the initial conceptual design phase of the project. In a later phase, Yukon Pacific will develop the detailed design information necessary to assess the facility's adherence to the applicable standards, codes, and engineering practices. The following discussion summarizes the key findings, and the recommendations.

Spill Containment

At the present stage of design, spill containment systems for the proposed facility are tentative; final configurations are to be developed as design progresses. The impoundment systems are to be designed to comply with Federal Regulation 49 CFR Part 193 which requires that each LNG container and each LNG transfer system have an impoundment capable of containing the quantity of LNG that could be released by a credible accident.

For the proposed conventional metal double wall storage tank configuration (Type T-2, see figure 2.1.1-2), containment of LNG in the event of liquid spillage from the inner tank is to be provided by a Class 2 impoundment system, using an external high concrete wall dike capable of withstanding the hydrostatic head of the impounded LNG, the rapid thermal shock, the hydrodynamic action, etc., resulting from a tank failure as required by Part 193.2155. While the containment dike enclosure is to be equivalent to 137 percent of storage tank contents, Part 193.2181 requires a minimum capacity of 150 percent for Class 2 LNG storage tank impoundment.

Each of the other proposed LNG storage tank configurations (Type T-4 and Type T-6, see figure 2.1.1-2) would be constructed with an integral concrete outer wall which Yukon Pacific indicates is to serve as a Class 1 impoundment system capable of holding 110 percent of the tank contents. The use of an outer wall of a double-wall tank as a dike is permitted by DOT regulations in Parts 193.2153(a), 193.2161(b) and 193.2155(c), provided that the concrete wall is designed to withstand the equivalent impact loading of collision by, or explosion of, the heaviest aircraft which can take off at the Valdez Airport. This type of equivalent impact analysis has not been conducted for either of the two double- or increased-integrity tank designs proposed by Yukon Pacific and as such do not presently meet the DOT regulations. We recommend that Yukon Pacific submit to the DOT for approval and to the FERC the equivalent impact load analysis required by DOT regulations. If written approval of the impact analysis cannot be obtained, Yukon Pacific should construct a separate and independent impounding system for such storage tanks consistent with existing standards and codes.

Each LNG storage tank would have an approximately 30-foot wide by 100-foot long by 9-foot high impoundment trench for the 24-inch LNG fill and withdrawal lines. Each impoundment would provide containment of spills associated with the horizontal lines from the common pipe rack to the base of the LNG storage tank. Since all LNG transfer lines would enter or exit through the tank roof, the 24-inch fill and withdrawal lines would have a <u>vertical</u> segment from the base of the tank up to the roof—a distance of 96 feet for type T-2, 112 feet for T-4, and 91 feet for T-6.

Part 193.2161 prohibits any penetrations of a dike in order to accommodate piping. As a result, the vertical piping segments would be external to the outer tank wall of the type T-4 and T-6 tanks, and external to the impoundment as presently configured. The final design of the spill containment systems would also need to provide for impoundment of the <u>vertical</u> segments of the fill and withdrawal lines.

Perhaps the most difficult design task is to develop effective spill containment and diversion for the loading docks and associated trestles. Curbed concrete spill containment is to be provided beneath the LNG loading arms at each dock. Although several arrangements have been proposed to accommodate potential spills and possible diversion to an onshore impoundment, a final configuration has not been presented.

Equally difficult is to design spill impoundment systems that retain the required containment capacity at a site that may experience more than 500 inches of snowfall each year. Various ideas were discussed for snow control (snow removal from dikes, snow roofing, heat traced dike floors, etc.) but the issue remains unresolved. Although it was not discussed at the meeting, in addition to the above concepts, Yukon Pacific should be aware of a concentric "pipe-in-pipe" containment design system. The latter concept may in a limited way reduce snow control and removal activities around some specific piping arrangements, but may be of limited value in its use around flanges, elbows and other non-linear piping. Another potential application of this concept is impoundment for the vertical segments of the fill and withdrawal lines for the LNG storage tanks. However, it should be made clear that this design concept would be in addition to already planned containment systems.

Emergency Access Road

As a result of the remote location of the site and no proposal to construct an all-weather vehicular access road, the primary access/egress to the plant for operating personnel, contractors, materials, and supplies would be waterborne transportation using the cargo/personnel ferry dock located west of the main terminal facilities in Anderson Bay. If an emergency situation necessitated the evacuation of plant personnel, either tugboats present at the terminal or worker transport boats would be used. Similarly, waterborne or helicopter transportation would be required to receive any medical or emergency personnel and equipment at the site. Yukon Pacific also plans to make arrangements with Alyeska and the Coast Guard to mobilize their boats in an emergency situation.

During summer months, an overland emergency egress route would be available at the east end of the site using the TAGS pipeline right-of-way. Yukon Pacific plans to maintain this right-of-way as an unimproved private trail, removing brush to facilitate pipeline surveillance. While this route would allow evacuating personnel to reach the Alyeska Terminal, about 3.0 miles away, it is not envisioned to provide access for emergency personnel and equipment to the terminal.

The need for access to an LNG facility is addressed in the DOT regulations, under Subpart B - Siting Requirements. Specifically, Part 193.2055 requires in part:

> "...In selecting a site, each operator shall determine all site-related characteristics which could jeopardize the integrity and security of the facility. A site must provide **ease of access** so that personnel, equipment, and materials from offsite locations can reach the site for fire fighting or controlling spill associated hazards or for evacuation of personnel." (emphasis added)

Plant access is also addressed in NFPA 59A. Under 2-2.1, some factors to be considered in selection of plant site locations include:

> (b) Accessibility to plant; at least one **all-weather vehicular road** shall be provided. (emphasis added)

The principal reliance on waterborne transportation for emergency evacuation of personnel and for access of medical and emergency personnel and equipment raises several concerns. During severe weather conditions, boats may be unable to reach the terminal to evacuate personnel or to supply emergency personnel and equipment. The cargo/personnel ferry dock, at an elevation of 25 feet, would be well below the 75-foot design tsunami and slide-induced wave runup. Further, an easterly wind could place the cargo/personnel ferry dock—the only year round access point—within the range of flammable vapors under some LNG spill scenarios. These concerns raise questions on compliance with the **all-weather vehicular road** requirement in NFPA 59A. The DOT commented that a road is not required for the **ease of access** requirement <u>if another method of access can be used to comply with Part 193.2055</u>. Yukon Pacific has not presented an alternative which could provide ingress/egress if the emergency is at the dock.

The conversion of the TAGS pipeline right-of-way into an all-season emergency access road could alleviate these concerns as well as providing several benefits:

- the road would provide a second principal access point at the opposite end of the site from the cargo/personnel ferry dock;

- the overland road would provide a second mode of emergency access to supplement or substitute for waterborne transportation;

- medical and other emergency equipment could access the site more quickly by an overland route and would be unaffected by severe marine weather;

- an overland road would provide direct access for contractors, maintenance specialists and their equipment to perform non-routine repairs at the facility. In some cases, early repair or replacement of critical components can prevent a simple problem from developing into more serious consequences; and

- an overland access road connecting with the Alyeska Terminal would enable both facilities to "pool" their mobile fire fighting equipment and provide mutual aid in the event of a hydrocarbon fire or other serious incident at either facility.

However, we recognize several obstacles in converting an unimproved trail—primarily designed to permit the passage of pipeline construction equipment on the right-of-way—into an all-season access road:

- additional clearing, cut and fill, and bridge construction would be required; and

- the high potential for rock slides and avalanches would present continuing maintenance difficulties;

- snow removal for the 3.0-mile road.

Regardless of the above obstacles, we believe that the safety and operational benefits of the all-weather access road clearly offset the problems. Further, the all-weather access road would comply with NFPA 59A and Part 193.2055.

A number of agencies and individuals provided comments on the recommendation to provide a permanent all-weather vehicular access road for emergency uses.

The SPCO commented that other options are available that FERC should address, such as nearby emergency shelter or staging areas, fortification to protect the workers, access via water, and additional emergency equipment. While these are worthy suggestions to enhance plant safety, they do not substitute for the dual purposes of an all-weather access road--to provide a secondary point and mode, both for personnel evacuation from the site, and for access by medical or other emergency equipment to the site.

In a June 2, 1993 letter, Alyeska responded to the staff's April 9, 1993 letter requesting input about emergency and construction access around or through the Alyeska Marine Terminal. Alyeska stated that providing access solely for emergency response purposes is much more preferable and readily manageable than routine access for either construction or operational purposes. In its July 2, 1993 comments on the DEIS, Alyeska opposed the construction and use of any road for any reason through the Alyeska Marine Terminal, whether for construction, operation, or emergency use. However, it does not oppose the seasonal use of the pipeline "work pad" across the southerly portion of its property for routine maintenance and operations. In opposing the road, Alyeska stated that the construction traffic would increase the existing congestion on Dayville Road, and have a major disruption on the safety and operation of the Alyeska Marine Terminal.

Both Alyeska and the SPCO commented that the permanent access road would pressure the state to open the road to the public. The SPCO also stated that such usage would allow activities in the dispersion exclusion zone. Since the only public access to the road would be through the Alyeska Marine Terminal, the staff believes present security controls at the main gate would be as effective in restricting public access to the road, as they presently are in restricting access to the terminal.

In Resolution No. 93-42 passed on June 21, 1993, the City Council of Valdez "believes development of the Anderson Bay Terminal does not require construction of an all-weather road through Alyeska...".

Yukon Pacific commented that it is steadfastly opposed to an all-weather access road since it believes that 49 CFR Part 193 does not require a road and that NFPA 59A is merely a factor to be taken into consideration and not a mandatory requirement. The FEIS accurately states these requirements.

In summary, much of the opposition to an all-weather access road is primarily based on the negative effects that could occur if it is used during construction--increasing congestion on Dayville Road, disruption to operations and safety at the Alyeska Marine Terminal, and the negative socioeconomic effects on Valdez from a construction camp near the airport. These factors are persuasive in finding against its use **during construction** (see section 4.16). However, they have little bearing on the purpose for which staff recommended the all-weather access road, i.e., for emergency access/egress and the ability for both Yukon Pacific and Alyeska to share emergency equipment in the case of an event or for a drill.

Financial Land Investment Corp. agreed completely on the need for an all-weather vehicular access road so that personnel, equipment, and materials from offsite can reach the site for fire fighting or controlling spill associated hazards or for evacuation of personnel. It stated that an all-weather access road is a must since sea rescue methods may well be compromised by destruction at the site, including docking facilities. Similarly the Valdez Star supported the all-weather road citing that while Alaska can muster excellent helicopter, float plane, and boat services, all have their short comings, particularly during periods of bad weather of which Valdez has plenty. These comments reinforce the staff's safety concerns of a marine-access-only facility and our recommendation for a permanent all-weather vehicular access road.

While the Alyeska Terminal would be outside the hazard range of any credible accidents at the LNG facility, communication between the two facilities is essential to ensure that a serious incident at one facility or the associated shipping does not propagate to the other facility. It therefore appears prudent to establish a direct telephonic linkage between the two facilities solely devoted to emergency usage. Further, the respective emergency plans at each facility should identify potential incidents which could affect the adjacent facility and a procedure for notification and response.

Conclusions and Recommendations of Cryogenic Design and Technical Review

Through careful consideration of existing cryogenic design, consistent with and acknowledging the present state-of-the-art, it must be recognized that additional detailed engineering analysis will be required to complete the intended review process. Although considerable care has been taken and extensive effort has been made by Yukon Pacific and its contractors in designing a facility embodying safeguards (including hazard control and safety systems) to either prevent the occurrence of accidents or to reduce the impact of credible accidents, the detail design remains in a preliminary stage.

Notwithstanding the fact that the material submitted by Yukon Pacific to the FERC is extensive, considering the initial phase of design, supplemental information is required before a more definitive assessment can be made on the adequacy of design and on the adherence of the design to various applicable standards, codes, and engineering practices. Areas of particular interest and concern where supplemental information is required include:

1) final selection of LNG storage tank contractor in order to establish design details;

2) confirmation of final design for dock facilities, particularly the details that would define spill containment, hazard detection, and hazard control systems;

3) impoundment for the vertical segments of the storage tanks fill and withdrawal lines;

4) specific manufacturer, number, and locations of hazard detection devices throughout the facility (only general locations without specific numbers have been presented in many instances);

5) specific hazard control systems, including chemical quantity, unit locations, dispersion flow rates, and foam confinement techniques,

6) specific interrelationship between the hazard detection system and the hazard control system that is to provide automatic emergency shutdown and actuation of hazard control devices;

7) design details and hazard control systems for the refrigerant storage vessels;

8) detailed procedures to define snow control and/or removal techniques for the heavy snowfall at the plant site to prevent adverse influence on operations and safety systems (especially spill impoundment systems);

9) analysis of safety considerations relating to the large quantity of refrigerants (MR fluids, propane, and ethane) contained in the process areas and the desirability of containment systems to accommodate potential refrigerant spillage; and

10) the need for a permanent access road for emergency access/egress purposes.

Supplemental filings made by Yukon Pacific will be reviewed as appropriate. In addition to the above requirement for supplemental technical information, the following specific recommendations are made:

1) We recommend that an additional technical conference (or conferences) be held as engineering design develops so that present areas of uncertainty may be more fully explored. These conferences should be held prior to initiating construction at the site. At least one technical conference should be held prior to initiation of construction after designs are finalized and major vendors (including LNG and other major storage tanks) have been selected and complete design details have been submitted to FERC staff. The applicant should also provide design details to the Office of Pipeline Safety of the DOT and the Coast Guard Captain of the Port of Valdez so that they may have the opportunity to participate in the technical conferences to assure compliance with their applicable regulations.

2) We recommend that construction not be initiated without a written notice to proceed from the Director of OPR. Any major alterations to facility design should be filed with the Secretary for review and written approval by the Director of OPR prior to initiation.

3) Onsite staff inspections should be conducted with Yukon Pacific as significant milestones develop during the construction phase and prior to commencement of initial facility operation.

4) Following commencement of operation, the facility should be subject to regular FERC staff technical reviews and site inspections on at least a biennial basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, the company should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations, provision of up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below.

5) We recommend that Yukon Pacific submit quarterly reports to the FERC after initiating construction and semi-annually thereafter continuing through the operational period. During the construction phase the quarterly reports should provide construction status of major components including significant design and schedule modifications required (and/or anticipated). The reports also should address changes in facility design including anticipated future plans. During the operational phase the semi-annual reports should provide changes in facility design and operating conditions, abnormal operating experiences, activities (liquefaction and LNG shipping schedules), plant modifications including those proposed during the forthcoming 12-month period. Abnormalities should include but not be limited to storage tank vibrations and/or vibrations in associated cryogenic plumbing, storage tank settlement, significant equipment and instrumentation malfunctions or failures, nonscheduled maintenance or repair (and reasons therefor), relative movement of the inner vessel, vapor or liquid releases, fires involving natural gas, refrigerants and/or from other sources, negative pressure (vacuum) within the LNG storage tanks and higher than predicted boiloff rates. The reports should be submitted within 45 days after each period ending December 31 and June 30.

Included in the above items should be a section entitled "Significant plant modifications proposed for the next 12 months (dates)". The section should be included in the semi-annual operational reports to provide Commission staff with early notice of anticipated future construction and maintenance projects at the LNG terminal.

6) **We recommend that a permanent all-weather access road be built and maintained year-round to allow emergency equipment and personnel access/egress between the plant and the City of Valdez.**

7) **If double- or increased-integrity LNG storage tanks are selected, we recommend that Yukon Pacific submit to the DOT for approval, and to the FERC, the equivalent impact load analysis required by Section 193.2161(b) and 193.2155(c) of the DOT regulations. If written approval of the impact analysis cannot be obtained, Yukon Pacific shall construct separate and independent impounding systems for such storage tanks consistent with existing standards and codes.**

8) **Yukon Pacific should establish direct telephonic linkage with the Alyeska Terminal and the Coast Guard Vessel Traffic Center in Valdez and ensure that procedures for notification and response to potential incidents are included in the emergency plans for each facility.**

4.15.3 Thermal and Dispersion Exclusion Zones

The DOT regulations governing the siting of an LNG facility appear in Subpart B of 49 CFR Part 193. In general, the siting requirements require that a facility be located at a site of suitable size, topography, and configuration so that it can be designed to minimize the hazards to persons and offsite property resulting from LNG spills. Two sections specifically address offsite hazards. Part 193.2057, Thermal Radiation Protection, requires a thermal exclusion zone for several land uses based on four radiation flux levels. Part 193.2059, Flammable Vapor-gas Dispersion Protection, prohibits various land uses within the range of potentially flammable vapors. Each LNG container and LNG transfer system must have thermal and dispersion exclusion zones.

In order to demonstrate facility compliance with Parts 193.2057 and 193.2059, Yukon Pacific contracted with Quest Consultants, Inc. (Quest) to calculate exclusion zones for the LNG containers, transfer systems, and their impoundments. Yukon Pacific submitted its July 1991 report titled "Trans-Alaska Gas System (TAGS) LNG Facility Siting Report" to the DOT for review.

The DOT contracted with the Volpe Transportation Systems and Applied Technology Corporation (Applied Technology) to review the report. Based on Applied Technology's March 1992 report, "Review of Trans-Alaska Gas System (TAGS) LNG Facility Siting Report—Thermal and Dispersion Exclusion Zones," DOT sent eight questions to Yukon Pacific on July 8, 1992.

Yukon Pacific submitted its response on September 11, 1992. Subsequently, the DOT requested additional information on November 5, 1992, concerning the following outstanding issues:

- Calculations to support the LNG spill rates used in the analysis.
- Significance of having to recalculate using actual pump curves when pumps are selected.
- Calculations for the energy added by the pumps and the heat leak from the piping.
- Assumptions and calculations that snow and ice removal programs will be completely effective in preventing loss of impoundment capacity.
- Explanation of who will approve the final facility design purportedly necessary to negotiate agreements on the use of land and water for exclusion zones.
- Explanation of the significance of the increase in the buffer zone size—from about 2,500 acres in the July 1991 report to about 5,500 acres in the September 1992 response.

Yukon Pacific submitted its responses to these questions on January 8, 1993—they are presently under review by the DOT.

Impoundment Systems

The calculations of both the thermal and dispersion exclusions zones are based in part on the dimensions of the impoundment systems for each LNG container and LNG transfer system. Part 193.2183 requires that the minimum capacity of an impoundment system equal 100 percent of the volume of liquid in a container, plus the maximum discharge from a transfer line failure for a period of time necessary to detect and shutdown the system, but not less than 10 minutes. Part 193.2181 specifies the minimum capacity of the impoundments for LNG storage tanks—110 percent for Class 1, and 150 percent for Class 2. Further, impoundments must have sufficient capacity to provide for displacement by the containers served, and displacement by a higher density liquid—such as rain, snow, ice, or water from the firewater system.

The proposed LNG facility would have the following LNG containers:

- four LNG storage tanks
- one LNG flash drum in each LNG train
- one liquefaction column in each LNG train
- one loading arm drain drum at each berth

Table 4.15.3-1 identifies the principal LNG transfer systems and the design flow rates from the preliminary design criteria. The spill rates used to size impoundments and calculate exclusion zones are derived from the design flow rates with upward adjustments to reflect (1) pump flow at zero discharge head, and (2) maximum storage tank head.

TABLE 4.15.3-1

Principal LNG Transfer Systems and Design Flow Rates

Transfer System	Design Flow gpm	Spill Rate gpm (ft^3/sec)
production from one liquefaction train	4,780	4,760 (10.6)
production from two liquefaction trains	9,560	9,520 (21.2)
maximum ship loading rate - six pumps	44,000	69,750 (155.4)
maximum storage tank sendout - four pumps	30,000	46,500 (103.6)

Table 4.15.3-2 presents the design spill rates and volumes, dimensions, and components served for each of the impoundment systems. This represents the preliminary spill containment dimensions developed in the July 1991 Quest report to the extent necessary to perform the exclusion zone analysis. Subsequently, dimensions were revised in the September 11, 1992 response to DOT's July 8, 1992 data request—the heights of six of the impoundments were increased 50 percent to accommodate larger design spill rates. Figure 4.15.3-1 identifies the location of each impoundment.

The final configurations of the LNG spill containment systems will be developed during a later stage in project design. At that time, it will be necessary to reexamine all calculations to ensure that the analysis based on preliminary impoundment dimensions properly reflects the final design.

Thermal Exclusion Zones

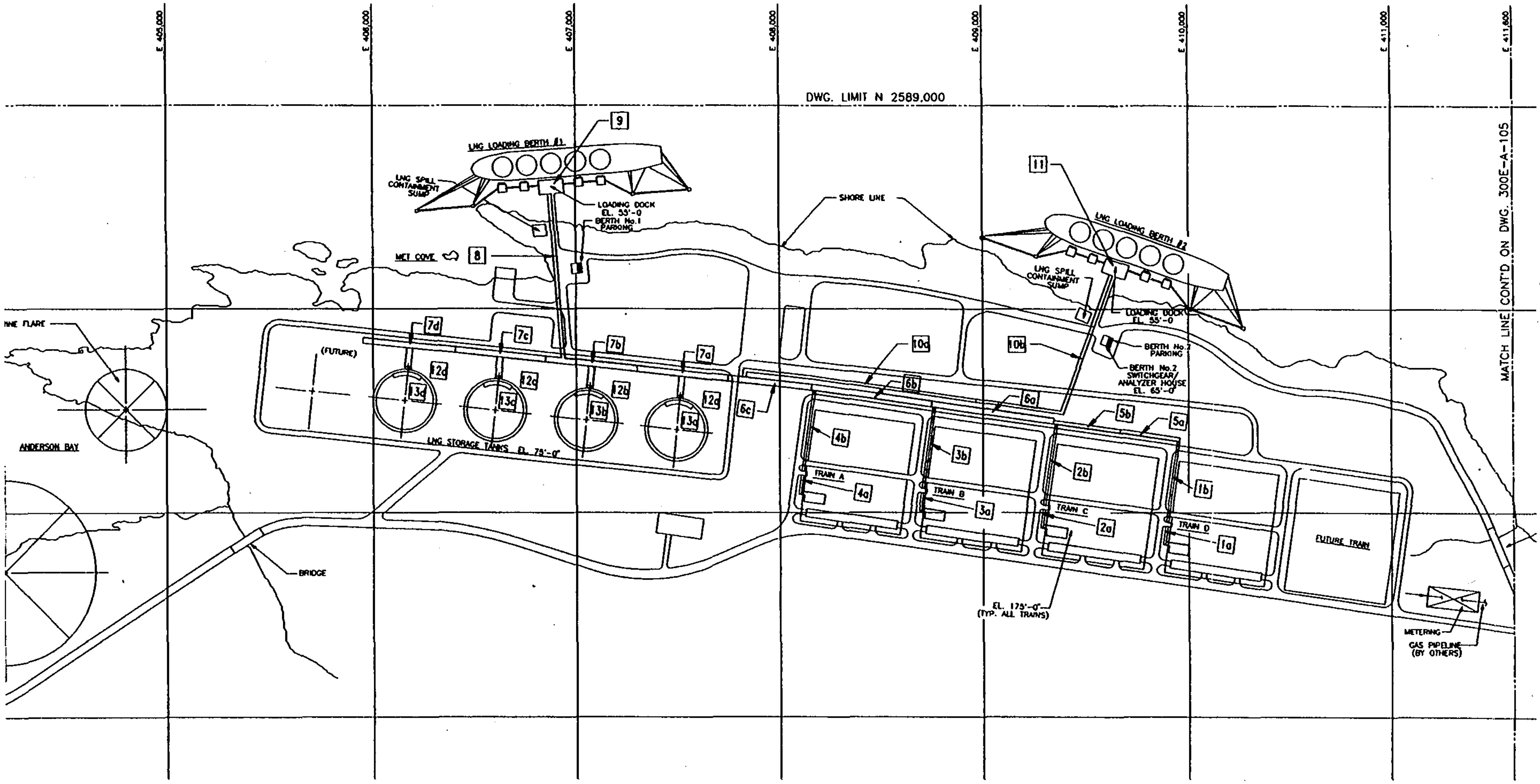
If a large quantity of LNG spilled in the presence of an ignition source, the resulting LNG pool fire could cause high levels of radiation. Exclusion distances for various flux levels were calculated according to DOT's regulations, part 193.2057. The analysis assumes a flame angle of 45 degrees and the incident flux factors listed in subsection (d) for each flux level. Table 4.15.3-3 presents the calculated exclusion distances for incident flux levels ranging from 1,600 to 10,000 Btu/ft^2 hr and the effects of those levels of thermal radiation. The levels represent the maximum thermal radiation permitted by the DOT regulations for offsite targets identified in the table.

Since the exclusion distance length calculated according to the formula in Part 193.2057 is directly proportional to the surface area of the impoundment, the largest exclusion distances occur at the LNG storage tank impoundments. Table 4.15.3-3 presents these distances for the Class 1 and Class 2 impoundment options. Although other impoundments have smaller surface areas, their proximity to the property line may actually create a greater offsite hazard, as in the case of the dock impoundments, areas 9 and 11. The combined effects of the thermal exclusion zones from all impoundments are presented on the map on figure 4.15.3-2.

TABLE 4.15.3-2

LNG Impoundment Systems

Components Served	Impound-ment Designation	Spill Rate (ft^3/sec)	Spill Volume (ft^3)	Component (ft^3)	Total Volume (ft^3)	Dimensions Width x length x height (ft)	Area (ft^2)
Liquefaction column, Flashdrum, product piping - each LNG train	1a, 1b, 2a, 2b, 3a, 3b, 4a, 4b	10.6	6,348	698	7.046	10 x 250 x 6	2,500
Rundown piping - Trains C, D	5a, 5b	21.2	12,696	1,494	14,190	20 x 285 x 6	5,700
Rundown piping - all LNG trains	6a, 6b, 6c	155.4	93,240	9,550	102,970	30 x 543.3 x 9	16,300
Product and sendout piping	7a, 7b, 7c, 7d	155.4	93,240	7,540	100,780	40 x 570 x 9	22,800
Sendout to Dock 1	8	155.4	93,240	10,053	103,293	16 x 800 x 9	12,800
Dock 1 - drain drum, loading arms	9	155.4	93.240	10,053	103,293	155 x 155 x 4.5	24,025
Sendout to Dock 2	10a, 10b	155.4	93,240	14,985	108,225	16 x 1,145 x 9	18,320
Dock 2 - drain drum, loading arms	11	155.4	93,240	14,985	108,225	160 x 160 x 4.5	25,600
Class 2 storage tank option	12a, 12b	103.6	62,160	377	6,737,968	310 ft dia.	75,477
Class 1 storage tank option	13a, 13b	NA	NA	NA	4,941,177	280 ft dia.	61,575



NOTE: REFER TO TABLE 4.15.3-2 FOR A DESCRIPTION OF IMPOUNDMENT DESIGNATIONS

N

0 100 200 300 400 500 1000 FEET

FIGURE 4.15.3-1	
DETAILED LAYOUT OF THE LNG SPILL CONTAINMENT SYSTEM	
SCALE: AS SHOWN	

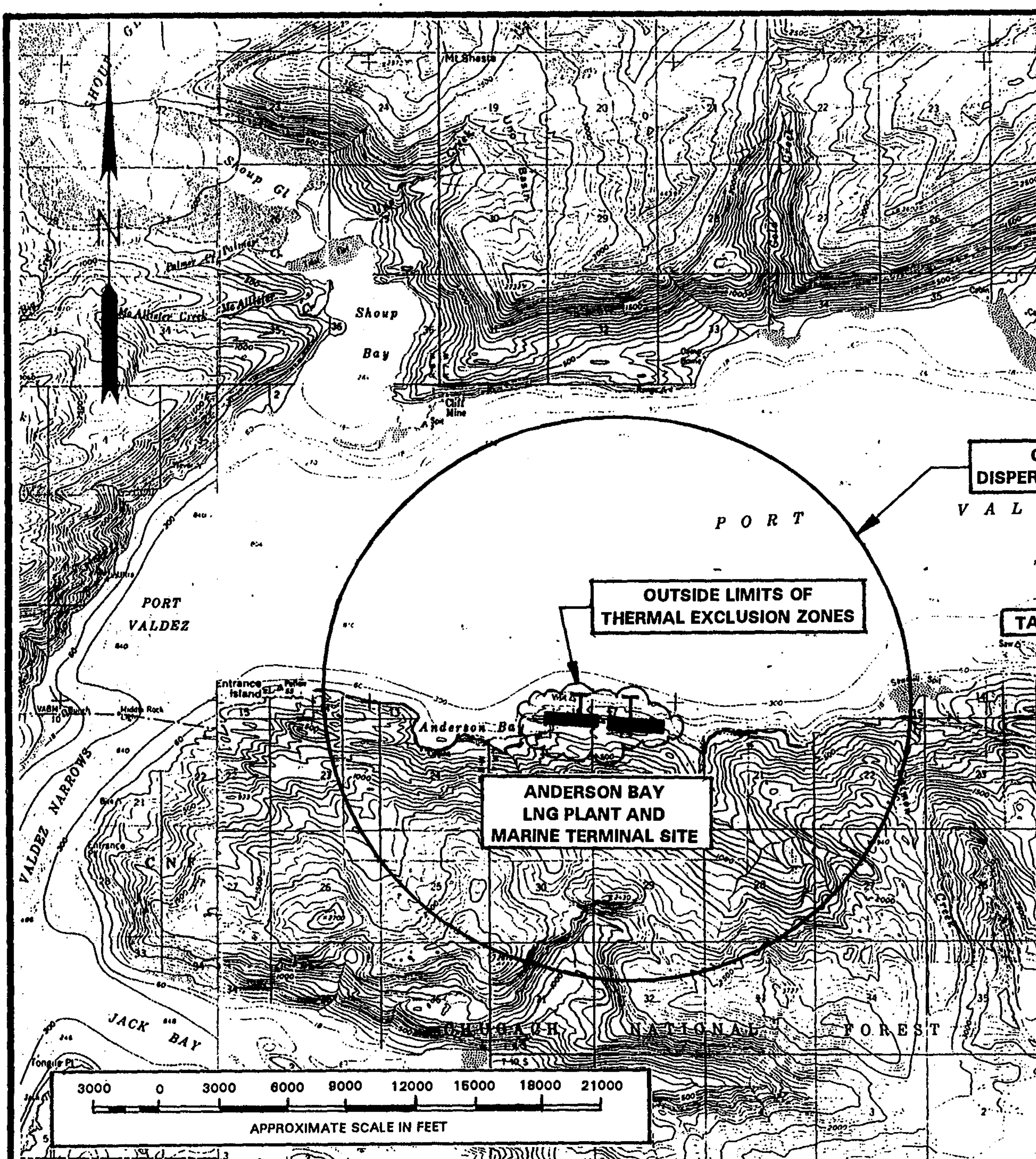


FIGURE 4.15.3-2

LNG PLANT/MARINE TERMINAL THERMAL AND GAS DISPERSION EXCLUSION ZONES

SCALE: AS SHOWN

TABLE 4.15.3-3

Thermal Exclusion Zones
For Storage Tank Impoundments

Incident Flux (Btus/hour/square foot)	Effects of Thermal Radiation	Offsite Targets Exclude By DOT a/	Exclusion Zone (Feet)	
			Class 1 Impoundment	Class 2 Impoundment
1,600	Extreme pain after 10 to 15 seconds, second degree burns within 40 seconds.	Outdoor areas occupied by 20 or more people.	963	1,075
4,000	Extreme pain after 3 to 4 seconds. Second degree burns in 10 seconds.	Residences, non fire-resistant building of historic value and those containing hazardous materials.	471	532
6,700	Second degree burns in 3 seconds; metal loses structural integrity	Fire-resistant structures, public streets, and highways.	296	337
10,000	Clothing and wood can ignite spontaneously	Plant property line	191	221

a/ Summary of offsite targets defined in 193.2057(d)

Dispersion Exclusion Zones

A large quantity of LNG spilled without ignition would form a flammable vapor cloud which could affect offsite areas under adverse meteorological conditions. Part 193.2059 establishes a flammable vapor dispersion exclusion zone which prohibits the following activities, unless it is a facility of the operator:

(1) Outdoor areas occupied by 20 or more persons during normal use, such as beaches, playgrounds, outdoor theaters, other recreation areas, or other places of assembly.

(2) Buildings that are:
- (i) Used for residences;
- (ii) Occupied by 20 or more persons during normal use;
- (iii) Contain explosive, flammable, or toxic materials in hazardous quantities;
- (iv) Have exceptional value or contain objects of exceptional value based on historic uniqueness described in Federal, state, or local registers;
- (v) Could result in additional hazard if exposed to a vapor-gas cloud.

In its comment letter on the DEIS (see appendix E, comment letter FA5), the DOT Office of Pipeline Safety interprets that "the 20-person limitation cited does not apply to transient travel, including travel offshore, within the exclusion zone." Therefore, the exclusion zone would not restrict or pertain to travel by fishing boats, cruise ships, or other transportation vessels. The DOT expects procedures for notifying offshore vessels in the event of an uncontrollable emergency to be incorporated into Yukon Pacific's emergency notification/evacuation plan.

The regulations require that dispersion distances be calculated for a 2.5 percent average gas concentration under meteorological conditions which result in the longest downwind distances at least 90 percent of the time. Alternatively, maximum downwind distances may be estimated for stability Class F and a wind speed of 4.5 mph. The regulations further specify the mathematical models in Appendix B of the American Gas Associations's "Evaluation of LNG Vapor Control Methods." Use of alternative models must be approved by the Director.

The vaporization rate used in the Appendix B model to compute the dispersion distance is the sum of three components: (1) the fraction of the superheated LNG that flashes upon release, (2) the vapors displaced by LNG entering the impoundment, and (3) the vaporization due to heat transfer from the impoundment. The third component varies with time and is calculated using Equation C-9 based on impoundment dimensions, thermal properties of the impoundment surface, and the volume and rate of LNG spilled.

The Quest report computed vaporization rates using thermal properties for structural concrete with a density of 150 lb/ft^3, a heat capacity of 0.156 Btu/lb-°F, and a thermal conductivity of 2.2 Btu/hr-ft-°F. The temperature of the impoundment surface was assumed to be 60°F. A flashing fraction of 0.0063 was used to account for heat leak from transfer lines and heat input from pump energy.

Table 4.15.3-4 presents the time for vapor overflow and the corresponding vaporization rate for each impoundment. The distances to the 2.5 percent methane concentration are based on stability Class F and a wind speed of 4.5 mph. The longest dispersion exclusion zones result from spills at the dock.

TABLE 4.15.3-4

Dispersion Exclusion Zones

Impoundment System	LNG Spill Rate (ft^3/sec)	Time to Overflow (sec)	Vaporization Rate at Overflow (lb/sec)	Exclusion Distance (ft)
LNG Train	10.6	13.2	71.6	2,390
Rundown piping-Trains C, D	21.2	13.5	161.3	4,000
Rundown piping-all trains	155.4	25.2	363.0	6,800
Product sendout piping	155.4	26.5	477.9	8,200
Sendout to Dock 1	155.4	23.9	306.7	6,100
Dock 1	155.4	7.3	924.4	12,850
Sendout to Dock 2	155.4	25.5	406.7	7,350
Dock 2	155.4	7.4	978.5	13,350
Class 2 tank dike	103.6	1,782.0	47.9	945
Class 1 tank dike	NA	NA	NA	NA

Conclusions and Recommendations for Thermal and Dispersion Exclusion Zones

The outer limits of both the thermal and dispersion exclusion zones have been depicted on the map on figure 4.15.3-2. The thermal exclusion zone is either confined to the plant property or the immediate vicinity of the waters at the two LNG tanker docks. None of the excluded land uses are located within the thermal exclusion zone.

The dispersion exclusion zone is by far the controlling exclusion zone for land-base spills at the facility. The dispersion exclusion zone extends northward more than 13,000 feet offshore from the tanker loading docks into Port Valdez. The southern extent of the dispersion exclusion zone depicted on figure 4.15.3-2 probably overstates the true flammable vapor hazard since the Appendix B dispersion model assumes vapor cloud travel over level terrain. As such it does not account for the trapping effects of the steep slopes above Anderson Bay. No prohibited activities or buildings listed under Part 193.2059 currently exist within the dispersion exclusion zone or will occur in the future, since the area is closed to development.

In conclusion, a number of uncertainties exist in the thermal and dispersion exclusion zones analysis which prevent a finding of compliance with Part 193 at this stage in the design process. Most of these uncertainties have been identified in the DOT's November 4, 1992 questions. A further uncertainty is how closely the preliminary impoundment systems used in the analysis will reflect the final design. Although a finding of compliance with Part 193 will await the DOT's evaluation of Yukon Pacific's responses, the remote location of the site and lack of population in the plant vicinity should ultimately permit compliance with the siting requirements.

4.15.4 Marine Safety

The hazards associated with the marine transportation of LNG differ from the land-based spills analyzed in the previous section (4.15.3). Whereas the land-based facilities would have features to limit the duration of LNG spills and contain credible spill volumes, any LNG spill on water would be unconfined and vaporize rapidly due to heat input from water.

While the history of LNG shipping has been free of major incidents, the possibility of a major LNG spill over the duration of the project cannot be discounted. The events most likely to cause a significant release of LNG cargo would be a grounding severe enough to penetrate the tanker's double bottom or collision with another vessel sufficiently large and with sufficient momentum to penetrate the double sides. In addition, potential collisions with a loaded crude oil tanker must also be considered.

Prince William Sound Vessel Traffic

Vessel traffic in Prince William Sound consists of fishing vessels, cruise ships, and oil tanker traffic between Hinchinbrook Entrance and the Alyeska Marine Terminal in Port Valdez, about 3.5 miles east of the proposed Anderson Bay LNG terminal. Approximately 700 crude oil tankers, varying in size from 32,000 to 265,000 DWT, were loaded during 1993 at the Alyeska Marine Terminal. This number is expected to decrease each year into the future as oil production decreases.

Port Valdez also receives refined petroleum products, general cargo, and several foreign freezer ships. About 35 cruise ships visit Valdez each summer. The Alaska State Ferry provides year round service between Valdez and Cordova and between Whittier and Valdez year round, with an abbreviated winter schedule. Whittier, at the terminus of the Alaska Railroad in western Prince William Sound, handles general cargo and some refined petroleum products. Neither Port Valdez nor the Port of Whittier receives more than 200 ships or barges each year.

The Coast Guard regulations in 33 CFR 161.301 through 161.387 prescribe the rules for vessels operating in the Prince William Sound VTS Area. The VTS Area includes the navigable waters north of a line between Cape Hinchinbrook Light to Schooner Rock Light, between longitudes 146° 30'W and 147° 20'W, and including Valdez Arm, Valdez Narrows, and Port Valdez (see figure 4.15.4-1). Highlights of the major requirements of the VTS Area include:

I. General Operating Procedures - The applicability of the regulations to various vessels.

II. Communication Procedures - Radio equipment and watch requirements.

III. Vessel Movement Reporting Procedures - Mandatory reports before a vessel enters the VTS Area and at other points and conditions.

IV. Traffic Separation Scheme Procedures - A TSS comprised of one-way traffic lanes with a separation zone from Hinchinbrook Entrance to Valdez Arm (see figure 4.15.4-1).

V. Valdez Narrows Procedures - One-way traffic in Valdez Narrows whenever a tank vessel of 20,000 DWT or more is navigating therein.

VI. Special Requirements for Tank Vessels - Tank vessels greater than 20,000 DWT operating in the VTS Area must have:

- two separate marine radar systems for surface navigation;
- an operating LORAN-C receiver;
- an operating rate of turn indicator; and
- two operating radiotelephones, one battery powered, capable of operating at the designated VTS Area frequency.

VII. Description and Geographic Coordinates - Navigation coordinates for the separation zone, traffic lanes, and the Valdez Narrows one-way traffic area.

Operation of the VTS Area is controlled by the Coast Guard VTC in Valdez. The VTC maintains radio communications with vessels in the VTS Area, and receives, processes and disseminates information from voluntary and mandatory reports to vessels in the area. The Coast Guard also operates two radar sites—one at Potato Point on the west side of Valdez Narrows, and the other on Valdez Spit—to provide continuous radar surveillance in Valdez Arm, Valdez Narrows, and Port Valdez. The designated anchorage area in Prince William Sound is located east of the TSS and south of Knowles Head.

On July 17, 1992, the Coast Guard issued a final rule amending the Prince William Sound VTS regulations by incorporating the use of Automated Dependent Surveillance using a Differential Global Positioning System. No later than August 1, 1993, tank vessels greater than 20,000 DWT must have an operating ADSSE that meets the requirements of 33 CFR 161.376(a)(5). The ADSSE will automatically provide the VTC in Valdez with position information on tank vessels

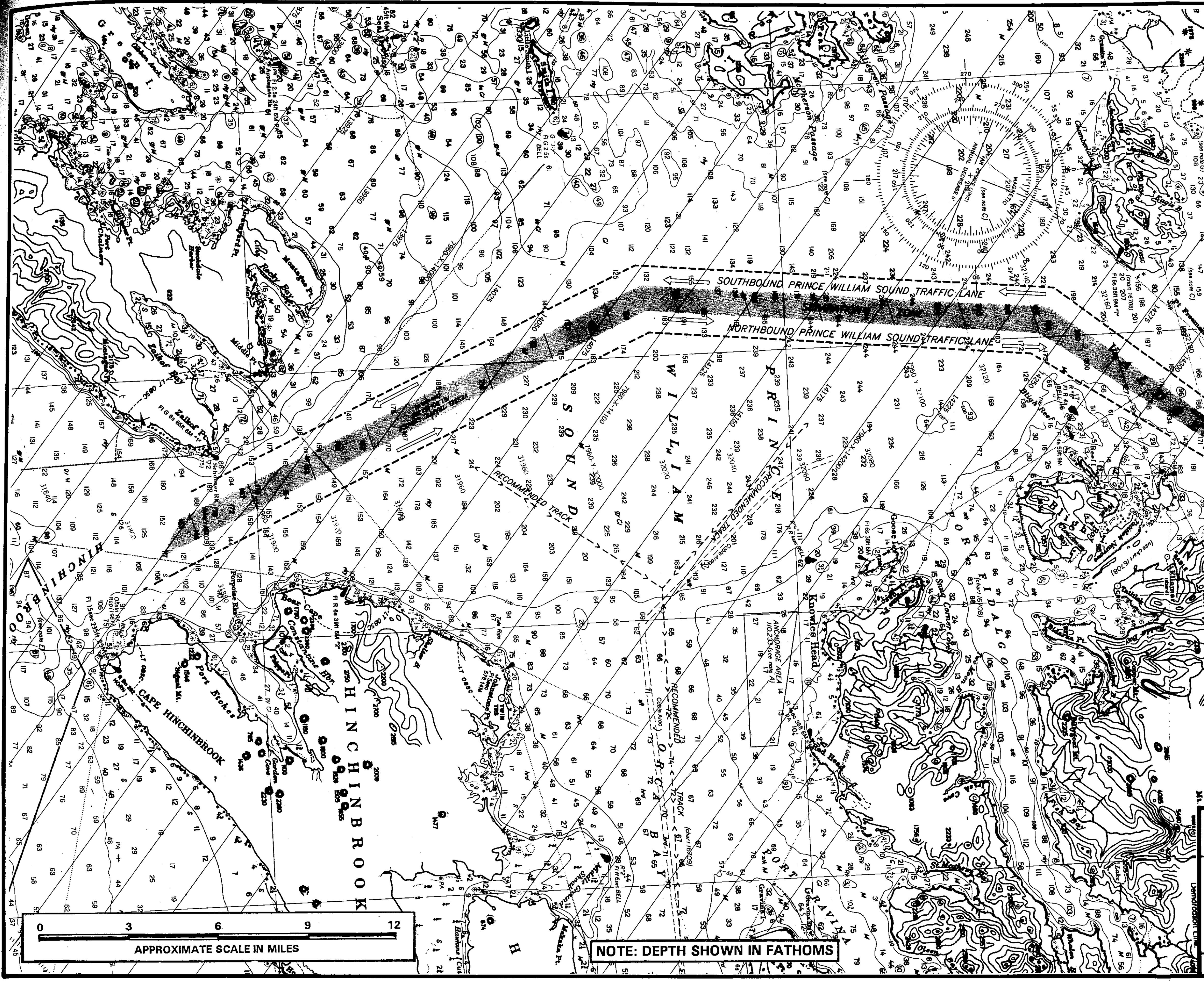


FIGURE 4.15.4-1

PRINCE WILLIAM SOUND MARINE TRAFFIC SEPARATION SCHEME

SCALE: AS SHOWN

at greater distances than now available, allowing for more timely and reliable traffic decisions. In an April 30, 1993 notice, the Coast Guard delayed the compliance date to July 1, 1994.

On March 10, 1993, the Coast Guard issued a final rule in 46 CFR Part 15 concerning pilotage in Prince William Sound. The rule allows coastwise seagoing vessels to navigate south of 60 49' North latitude through Hinchinbrook Entrance with two licensed officers instead of a Federal pilot. Vessels must be under the direction and control of a federally licensed pilot when operating from 60 49' North latitude to Port Valdez.

The State of Alaska imposes additional requirements on crude oil tankers as reflected in Alyeska's Prince William Sound Tanker Spill Prevention and Response Plan. This document requires that all tankers transporting crude oil from the port of Valdez use two escort vessels—a conventional towing vessel and an Escort/Response vessel—for the tanker's transit out of Prince William Sound.

On January 10, 1994, the Coast Guard announced that it had completed part one of a two-part study to assess the capability of escort tugs to control disabled tankers in Prince William Sound. Part one evaluated the existing capability of the 11 tugs and escort vessels operating out of Port Valdez and found them suitable for rescue and towing, but recommended certain improvements in operations.

On August 14, 1994, the Coast Guard issued a final rule to implement section 4116(c) of the Oil Pollution Act of 1990, requiring at least two suitable escort vessels for single hull tankers over 5,000 gross tons operating in Prince William Sound and Puget Sound. The rule establishes performance and operational requirements for the escort vessels, including towing, stopping, holding, and turning under specified conditions, and requires a pre-escort conference between the tanker master, tanker pilot, and the masters of the escort vessels regarding the escort operation.

In a May 25, 1990 memorandum, the Commanding Officer, Coast Guard Marine Safety Office Valdez, stated that it does not anticipate VTS problems with the increased LNG tanker traffic, but has recommended additional restrictions governing LNG tankers in the VTS Area:

(1) an LNG tanker and any other tanker vessel shall not be underway at the same time in Valdez Arm, Valdez Narrows, or Port Valdez;

(2) LNG tankers will enter the TSS at Hinchinbrook Entrance;

(3) LNG tankers will be conned (i.e. direct the steering of the tanker) by a pilot licensed for the portion of Prince William Sound being transited;

(4) an LNG tanker and any other tank vessel will maintain a separation of not less than 5 nautical miles, except when the LNG tanker or the other tank vessel is moored, at anchor, or in the opposing lane of the TSS;

(5) unless moored at the terminal in Port Valdez, an LNG tanker will be attended by an adequate number of ship assist tugs;

(6) while in the VTS Area, all LNG tankers shall have a towing bridle or wire rigged and ready for immediate use; and

(7) all VTS regulations that apply to tank vessels greater than 20,000 DWT should also apply to LNG tankers regardless of size.

In addition, the Coast Guard recommended a study be conducted by a creditable firm to review the operation of the VTS and provide suggestions for reducing the risks involved with the inclusion of LNG tankers in the system. **We recommend that Yukon Pacific comply with the above Coast Guard recommendations prior to commencement of shipping activities.**

Further, the Coast Guard has stated that it would develop a Captain of the Port operating plan specific to LNG tanker operations similar to that in use at other ports with LNG shipping. Captain of the Port operating plans have been developed for LNG operations in a number of ports—Lake Charles, Louisiana; Boston Harbor, Massachusetts; the Chesapeake Bay; Nikiski, Alaska; and the Port of New York. The Coast Guard indicated it would develop an LNG plan for Prince William Sound when facility construction begins.

The Coast Guard has also indicated its intention to impose a 200-yard safety exclusion zone around the operating site to limit possible interference with site vessel traffic by private vessels. This would render virtually all of Anderson Bay routinely off limits to recreational boaters, although emergency needs would not be affected.

The Coast Guard regulations in 33 CFR Part 127, Liquefied Natural Gas Waterfront Facilities, apply to the marine transfer area of new and existing waterfront facilities between the LNG tanker and the last manifold or valve located immediately before a storage tank. Part 127 regulates the design, construction, equipment, operations, personnel training, fire fighting, and security of LNG waterfront facilities. Under Part 127.206, an operator must submit a letter of intent to the Captain of the Port at least 60 days before construction begins. The Captain of the Port then issues a letter of recommendation to the operator and to state and local agencies having jurisdiction of the waterway.

LNG Tanker Safety

Since the marine transportation of LNG began in 1959, there have been more than 16,000 trips by LNG tankers worldwide. This includes more than 430 deliveries to receiving terminals in the U.S. and 740 voyages from Nikiski, Alaska to Japan. During this period, there have been six significant incidents involving LNG tankers—none resulted in spills due to rupturing of the cargo tanks. Those incidents are described below:

- El Paso Paul Kayser grounded on a rock in June 1979 in the Straits of Gibralter. Extensive bottom damage restricted to ballast tanks – cargo tanks not damaged. 90,000m^3 of LNG transferred to El Paso Sonatrach.

- LNG Libra fractured propeller shaft enroute to Japan with full cargo in October 1980. Ship towed, cargo transferred to LNG Leo.

- LNG Taurus grounded in December 1980 near entrance to Tobata Harbor, Japan. Extensive bottom damage, but cargo tanks not affected. Ship refloated, cargo unloaded.

- Ramdane Abane collided with Yugoslavian ship near Gibralter in August 1985. Collision did not affect cargo tanks.

- Tellier blown off berth during storm at Skikda, Algeria in February 1989. Residual LNG in loading arms spilled on deck and fractured some plating.

- Larbi Ben M'Hidi broke from moorings while laid up during storm at Oran, Algeria. Some hull damage, no LNG on board.

LNG tankers returning from Pacific Rim countries in ballast would enter Prince William Sound through Hinchinbrook Entrance and follow the rules of the VTS Area. Tankers would proceed north through the sound into Valdez Arm, then pass through Valdez Narrows. As the LNG tanker approaches Anderson Bay, the vessel and accompanying tugs would make a 180° turn to starboard prior to berthing at the marine terminal. This would enable the LNG tanker to berth on its port side with its bow toward the sea. After securing the tanker with berthing and mooring lines, the loading and vapor return arms would be connected to tanker cargo manifolds and cargo transfer would commerce. Typically cargo loading would require 12 hours, with a tanker turnaround time of about 18 hours.

On the inbound voyage through Prince William Sound, LNG tankers would be in ballast and have only a small amount of cargo, or heel, necessary to maintain cryogenic temperatures in the cargo tanks. In this condition, any release of cargo in a severe accident would be minimal. On the outbound voyage, only a severe grounding or collision would have the potential to cause a significant release of cargo from the loaded LNG tanker.

Unlike many conventional crude oil tankers, all LNG tankers used in this project would have double-hull construction, with the inner and outer hull separated by more than 10 feet. Further, the bottom of the cargo tanks are normally separated from the inner hull by a layer of insulation approximately 1 foot thick. As a result, many grounding incidents severe enough to cause a cargo spill on a conventional single-bottom oil tanker would be unable to penetrate both inner and outer hulls of an LNG tanker. An earlier FPC study estimated that the double-bottom of an LNG tanker would be sufficient to prevent cargo tank penetration in 85 percent of the cases that penetrated a single-bottom oil tanker.

The probability of an LNG tanker sustaining cargo tank damage in a collision would depend on several factors—the displacement and construction of both the struck and striking vessels, the velocity of the striking vessel and its angle of impact with the struck vessel, and the location of the point of impact. The previous FPC study estimated the additional protection afforded by the double-hull construction. While the double-hull would be effective in low energy collisions, overall it would prevent cargo tank penetration in about 25 percent of the cases that penetrated a single-bottom oil tanker.

In the event of a collision of sufficient magnitude to cause the rupture of an LNG cargo tank, it is likely that sparks or flames would ignite the flammable vapors at the spill site. The resulting LNG pool fire would result in intense thermal radiation levels within several thousand feet of the fire. While this event would have little if any impact on the general public, it would pose an extreme hazard to the crews of the vessels involved.

In a grounding of sufficient magnitude to rupture an LNG cargo tank, the damage would occur under water and the potential for ignition is far less than for collisions. In this case an LNG spill on water would rapidly vaporize and form a potentially flammable vapor cloud.

If unignited, the flammable vapor cloud would drift downwind until the effects of dispersion would dilute the vapors below the lower flammable limit for methane. However, if the flammable vapor cloud would encounter a source of ignition, the cloud would burn back to the spill site.

The maximum range of potentially flammable vapors—the distance to the lower flammable limit—is a function of the volume of LNG spilled, the rate of the spill, and the prevailing meteorological conditions. Yukon Pacific's study identified that an instantaneous spillage of 20,000 cubic meters of LNG with a 10 mph wind and typical atmospheric stability could travel up to 3.3 miles in 25 minutes.

The LNG tanker route through Prince William Sound to the marine terminal is far offshore for the majority of the voyage. There exist no populated areas within the maximum range of thermal radiation hazard or flammable vapor cloud hazard for an instantaneous one-tank cargo spill. As a result, the general public would not be exposed to a hazard from these events.

The instantaneous spillage of one cargo tank is considered to be a "worst case" event. Physical constraints on maximum vessel speeds and maximum depths of penetration required to rupture one LNG cargo tank render the possibility of an instantaneous release of more than one cargo tank to be implausible. This is not to imply that the loss of multiple cargo tanks could never occur, but that the extent of the hazard would not exceed that of the instantaneous spillage of one tank.

The possibility of a collision between a loaded outbound crude oil tanker and an inbound LNG tanker in ballast has been suggested as a possible event that could lead to a significant oil spill. In 1988, the number of crude oil tankers peaked at 990, for an average of 2.7 tankers per day. Presently, crude oil tankers make about 700 round trips annually—an average of 1.9 per day—through Prince William Sound. At full capacity, the proposed project would add 275 LNG tanker trips per year, or an average of 0.75 per day. This total tanker traffic of 2.7 per day is well within the limitations of the VTS system and is identical to the number of crude tankers in the peak year of 1988. By the time the TAGS project is operational, the number of crude tankers per year is expected to be under 500. The modest increase tanker traffic in Prince William Sound would not significantly increase the potential for a collision between an outbound crude oil tanker and any inbound tanker, either LNG or another crude oil tanker.

Conclusions on Marine Safety

- LNG tankers have experienced safe operation without cargo tank spillage for more than 30 years. Given the present and planned Coast Guard controls in the Prince William Sound VTS Area, LNG tankers can safely operate in these waters.
- The thermal radiation and flammable vapor cloud hazards from the maximum credible LNG tanker spill would not affect the general public.
- Although it is possible for an LNG tanker to spill cargo in a grounding type incident, the liquid would rapidly vaporize and would not have the long-term environmental consequences associated with a major oil spill.
- The addition of LNG tankers within the VTS Area would not have a significant increase on the percent potential of a collision with an outbound crude oil tanker.

4.16 ALTERNATIVE CONSTRUCTION CAMP SITE AND ACCESS ROAD

Use of the upgraded camp site in Valdez to house the construction workforce would result in environmental impacts in two main areas—the camp site itself, and road access from the camp to the work site. These are discussed below and are summarized in table 4.16-1.

Valdez Camp Site

An existing 700-person camp site, owned and operated by Arctic Camps Limited, occupies a 7.5-acre parcel south of the Valdez Airport. About half of the property is developed with seven two-story dormitories and a 250-person cafeteria. The area immediately west of the property contains the remains of an abandoned (and partially burnt out) trailer park. The area to the south is in scrub-shrub vegetation. Arctic Camps recently purchased an adjacent 10-acre parcel of land, which presumably includes these lands. At least 21 acres are necessary for the 4,000-person camp. Adjacent land uses include the airport, a city park, a National Guard Armory, a trailer park, and the Senior League Field, none of which would be unduly disturbed by the modest construction/erection activities. Arctic Camps would contract any required services locally (e.g., electrical, carpentry).

Use of the camp would, however, impact the City of Valdez in several important ways. Although the city sewer system is adequate to handle the output from the greater than 3,000-person expansion to the camp, the water supply capability is currently insufficient to handle the additional demand. It would be necessary for the city to install a new well to supply the expanded camp.

Off duty construction workers would undoubtedly avail themselves of the goods and services offered in the City of Valdez. This would contribute economic benefit to the town over and above an expanded tax base, however, the increased population would stress public services within the community, as previously discussed in section 4.11. Initially, at public scoping sessions in Valdez, city representatives expressed confidence in the city's capability to handle the influx of people associated with construction, citing their previous experience with both the Alyeska construction and the *Exxon Valdez* cleanup as examples. Following review of the DEIS, the City of Valdez in Resolution No. 93-42, supported the project. It expressed clear preference for the housing of the construction workforce at the site in Anderson Bay provided that the facilities meet or exceed all applicable code and safety requirements. Both the City of Valdez and the SPCO commented that housing workers at the site would reduce the social and public safety impact of the projected peak construction workforce (City of Valdez, 1993).

The presence of as many as 4,000 workers could result in increased pressure on the area's natural resources, in the form of hunting and fishing during off-shift hours. Bear poaching has been a problem identified in remote construction camps, but would be less so with the camp located in an urban environment. Robe Lake is a waterfowl nesting area and is within 4 miles of the Valdez camp site. Encroachment by humans during the critical spring period could affect nesting success.

Use of the Valdez camp would affect local transportation since convoys of buses, reaching a peak of 40 in year 5 (to transport roughly 2,000 workers), would make their way from the camp, south along the Richardson Highway and then along the Dayville Road to the Alyeska Marine Terminal property. These roads are heavily used by local traffic and particularly so during the summer tourist season. With two full shifts operating at the construction site, there would be three inbound (i.e., camp to site 7 a.m., 3 p.m., and 11 p.m.) and three outbound (i.e., site to camp 8

TABLE 4.16-1

Summary of Impacts of the Alternative Camp Site at Valdez

Affected Environment	Valdez Camp Site	LNG Site Access Road Via Alyeska Marine Terminal
Geology and Soils	• erosion and sedimentation control achievable with standard practice • flat gravel outwash from Valdez Glacier requiring little grading	• cut and fill for road bed preparation of 3.0 miles of road over moderate terrain
Water Quality	• no major waterbodies on site • erosion/sedimentation control achievable with standard practice • wastewaters discharged to city sewers	• potential sedimentation during stream crossings at Sawmill, Salmon, and Seven Mile Creeks
Fisheries	• no impact on habitat but there may be increased fishing pressure from offshift workers	• Sawmill Creek, Salmon Creek, Seven Mile Creek crossings required. Schedule May to July to avoid spawning/incubation for pink and chum salmon. • use bridges crossings
Vegetation/Wetlands	• minimal loss; grass and shrub vegetation only • no wetlands (site very well drained)	• only 1 mile of road alignment is new (off right-of-way), requiring clearing of extra 9 acres of predominantly spruce/hemlock/alder forest; minor impact • some small wetlands may be filled
Wildlife	• minimal habitat loss but potential for increased hunting pressure or poaching • potential disturbance of Robe Lake waterfowl nesting	• disturbance of resident wildlife from noise during construction of road and potential increase in road kills during transit periods
Endangered and Threatened Species	• none known or likely	• none known but bald eagles possible (need survey)
Air Quality	• no significant new emissions sources	• minor emissions from bus traffic
Noise	• minor impact expected	• minor noise from bus traffic
Land Use	• compatible with current and adjacent land uses since only involves expansion of existing camp	• infringement on Alyeska operations during bus transit through Alyeska Marine Terminal • most of the road (2.0 of 3.0 miles) is within pipeline right-of-way
Recreation	• some competition of workers with local residents but camp would have its own recreation facilities to lessen infringement • outdoor recreation (hunting, fishing, hiking) would be infringed upon	• impact on Allison Point Recreation Area from passing bus convoys
Visual	• minor impact expected	• minor visual impact as road would be at low elevation and should not require massive rock cuts

TABLE 4.16-1 (cont'd)

Affected Environment	Valdez Camp Site	LNG Site Access Road Via Alyeska Marine Terminal
Socioeconomics	• economic benefit to City of Valdez with worker and camp purchases of goods and services • employment for camp operations • city would have to drill another well to meet water demand • impact on city services but can be planned for • perceived public safety problem	• major disruption to Alyeska Marine Terminal requiring increased security and site traffic or scheduling changes
Transportation	• bus convoys during shift changes on Richardson Highway and Dayville Road would contribute to already congested situation	• interference with local and tourist traffic on Richardson Highway and Dayville Road during shift changes
Subsistence	• no impact expected	• no impact expected
Cultural Resources	• no impact expected	• no impact expected

a.m., 4 p.m., and midnight) transits per day 1/. The roads could be upgraded to handle the additional traffic but there would be some inconvenience to regional travelers during the shift changes. Of particular note in this respect is the Allison Point Recreation Area on Dayville Road just east of the Alyeska Marine Terminal. There is apparently a congestion problem in this area already, which would only be intensified by the passage of six convoys of buses each day. Concern was expressed that public safety would be jeopardized by the additional traffic burden (Alyeska, 1993).

From the worker's perspective, the Valdez camp site is conveniently situated to allow privacy without isolation. Travel out of Valdez would be facilitated by the camp's proximity to the airport and the Richardson Highway. Travel to the Anderson Bay work site would be via a company-owned fleet of buses, which would take a fresh shift of workers directly from the camp to the construction site in about 45 minutes, returning with the offshifting crew. At the end of the last shift the buses would return to the construction site empty, to bring the crew back to camp.

Visually, the Valdez camp site would be unobtrusive, being located well off Richardson Highway. The facilities would consist of single or two-story structures and visual barriers in the form of berms or vegetation could be used to ensure privacy for the camp residents as well as for the passing public.

A last point, raised by Yukon Pacific, was that use of the Valdez Camp as the principal place of residence for the workforce would not eliminate the need for facilities onsite altogether. For reasons of worker safety, some onsite accommodations would be required in the event that weather or other emergency prevented workers from returning to their base camp. It is anticipated that these accommodations could be located other than at Seven Mile Creek since the facilities would be used only sporadically and could be sized to support only a single shift.

Access Road

Although public roads can be used to convey workers as far as the Alyeska Marine Terminal, this alternative would necessitate the crossing of the Alyeska property and the construction of an additional 3.0 miles of all weather road (the western 2.0 miles of which would be within the proposed pipeline right-of-way) extending from the end of the existing Alyeska road on the western edge of the Alyeska Marine Terminal, to the Anderson Bay site as described in section 2.3.1. The out-of-right-of-way road alignment, shown on figure 2.3.1-2, could follow the 100-foot contour for the most part and would therefore require only modest cut and fill to achieve gradients suitable for bus traffic. The moderate slopes would allow standard erosion control practices to be used.

Assuming a 75-foot clearing requirement, this length of road would require the clearing of approximately 9 acres of forested land (excluding backslope cuts), typical of the spruce hemlock habitat within the area. The impact of this loss is not considered to be significant. Although unconfirmed, the presence of small wetland areas along the alignment is likely. If they could not be avoided, they would require delineation and the preparation and approval of mitigation plans prior to construction. It is also possible that bald eagles could be present as they are known to nest in the region.

1/ Scheduling approximate only. The 8 a.m. outbound and 11 p.m. inbound convoy buses would be empty.

The access road alignment requires the crossing of Sawmill, Salmon, and Seven Mile Creeks. All three of these streams are known to be used by spawning pink and chum salmon. Bridge crossings would be required and would be scheduled for construction during the May to July timeframe, outside of the spawning and incubation period. The actual location of the crossings would have to be selected so as to avoid the most critical reaches, as identified in stream surveys prior to construction.

Use of this access route, once constructed, would have a major impact on the Alyeska Marine Terminal operations. The six daily bus transits of Yukon Pacific construction workers would interrupt activities at the Alyeska site. Figure 4.16-1 plots the projected number of buses in each convoy through the 8-year construction period. It follows the projected peak workforce requirements. The actual transit time for a convoy, once past the terminal gate security, would

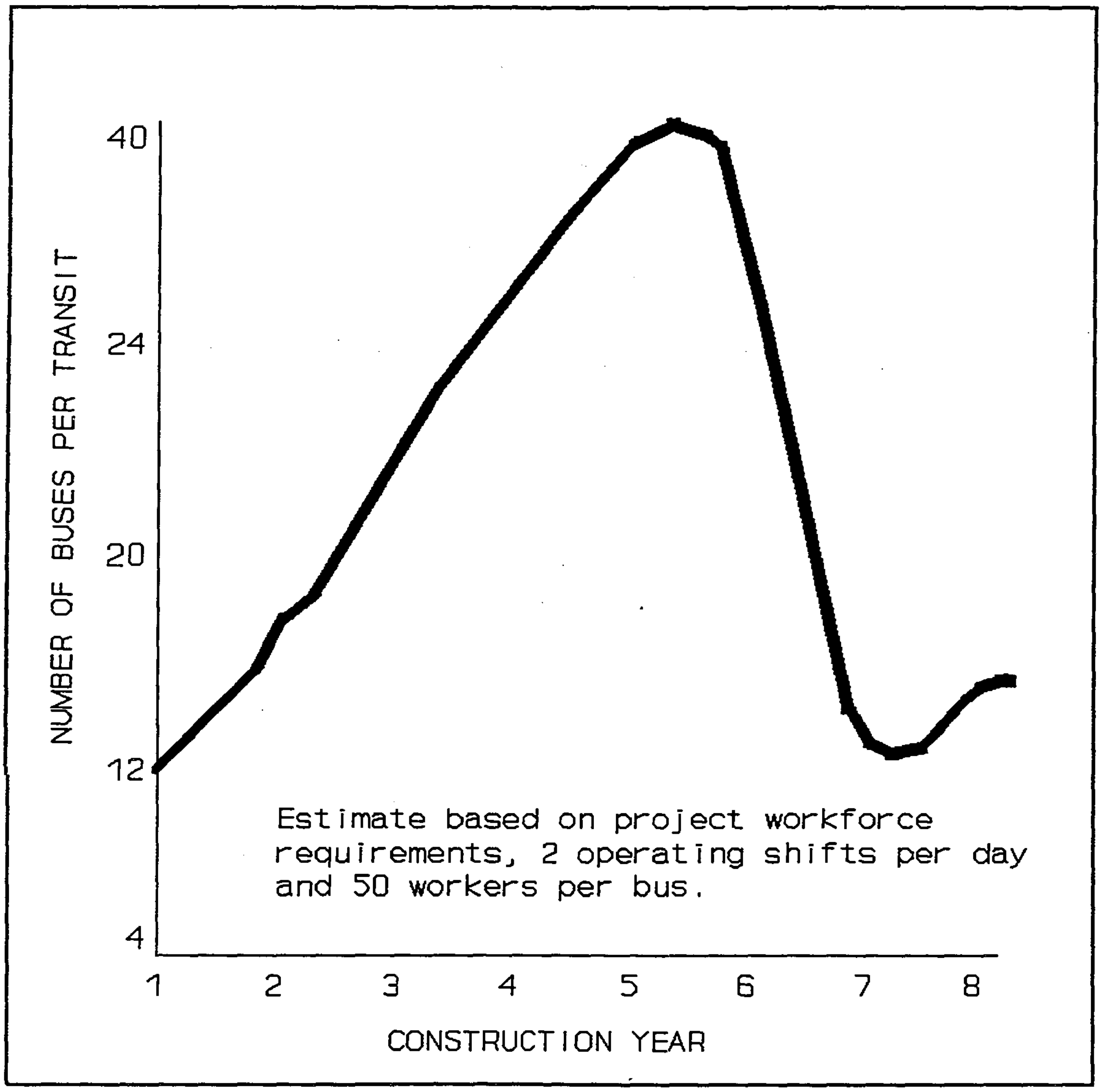


FIGURE 4.16-1 **Anticipated Bus Movements**

be less than 20 minutes (based on a maximum peak workforce using a 40-bus convoy, traveling at 10 miles per hour).

The largest obstacle to this alternative would be the disruption to the Alyeska Marine Terminal safety, security, and operations. In response to the staff's request for comment on this alternative, the City of Valdez, the SPCO, Yukon Pacific, and Alyeska were all firm in their opposition to construction transit through the Alyeska property. The single most urgent objection pertained to security of the plant and the integrity and safety of TAPS. The SPCO identified a risk analysis which determined sabotage to have the highest potential to damage the system.

Although Alyeska currently supports tourist visitation to its facilities, the approximately 12 minibuses per day undergo security procedures at the airport and are then escorted through the property. Supervised disembarkation from the bus is only allowed at the Visitor Center, which is well removed from the operations. The visits are thus totally within Alyeska's control as to the timing and duration of entry to the property, type of access provided, and the number of visitors and frequency of intrusion allowed. The transit of Yukon Pacific construction workers could not, of course, be left to the discretion of Alyeska and the concern is that with such frequent crossings of so many vehicles, even if carefully scheduled, security would be impossible to maintain.

There was also concern related to labor relations, and the potential for interruption of Alyeska operations resulting from labor disputes at the Yukon Pacific construction site (Alyeska, 1993).

In addition to the impacts on the Alyeska operation, the SPCO expressed concern that the very presence of an access road would bring long-term pressure on the area by a public keen to take advantage of it (SPCO, 1993), adding to resource management issues in the longer term.

Comparison with Seven Mile Creek Camp Site

Table 4.16-2 summarizes the comparative environmental and social consequences ascribed to the two options. The Seven Mile Creek site restricts the physical impacts to what is now a wilderness area, with a specific acreage of forest being transformed through grading and clearing, to temporary camp use. Site access is not an issue. The Valdez option expands upon an existing land use for the main camp itself, but access to the construction site becomes a key feature, necessitating the 3.5 miles of new road through currently forested terrain. Since the camp is a commercial venture, it remains in place at the owner's discretion.

There is only one waterway affected significantly by the onsite camp—Seven Mile Creek, which would be impounded to provide the camp water supply. With the Valdez camp, this impoundment would not likely be necessary, as industrial and non-potable water demands at the construction site could be satisfied by direct withdrawals from Seven Mile or Nancy Creek and/or by desalination (see table 4.16-3). Bottled drinking water could satisfy potable needs for a non-resident workforce and emergency supply could be stored in an onsite tank. The access road would, however, necessitate three stream crossings. The impact of the crossings could be limited by construction timing and the limitation of in-stream activities.

If the workforce is housed at Seven Mile Creek, they are forced by limitations in access, to spend the majority of their offshift time in the camp, or in the wilderness environment surrounding it. The latter can lead to undesirable pressure on the local fisheries and wildlife or to encounters with bears, as discussed in section 4.4. If the workforce is housed in Valdez, the

TABLE 4.16-2

Comparative Environmental Impacts of Construction Camp Alternatives

Affected Environment	Seven Mile Creek	Valdez with Road Access
Geology and Soils	• cut and fill .175 million yds^3; 0.1 million yds^3 imported for structural fill	• some cut and fill for emergency camp • cut and fill for 1 mile road to right-of-way
Freshwater Quality and Supply	• dam and 3.5-acre reservoir on Seven Mile Creek	• City of Valdez water supply from well source. Road crossings of Seven Mile, Salmon, and Sawmill Creeks.
Freshwater Fisheries	• impoundment of Seven Mile Creek with flow regulation downstream (potential positive impact on salmon during low flow) • fishing pressure on the creeks within the vicinity of the project area	• road crossings of three salmon creeks would have to be carefully scheduled • fishing pressure on streams in vicinity of Valdez
Vegetation	• 47 acres forest cleared for camp • revegetation of camp site after construction	• 9 acres forest cleared for road (excluding backslope cuts); some additional for emergency camp
Wetlands	• none	• potentially some small wetlands could require filling along 3.0 mile access road route
Terrestrial Wildlife	• forest habitat loss - minor impact • bear/human interaction (risk high) • impact on bears using Seven Mile Creek	• forest habitat loss - minor • hunting pressure near Valdez • low risk bear encounter • Robe Lake waterfowl • road kill along access road
Marine Water Quality	• minor impact during dam construction	• no impact
Marine Wildlife	• no impact	• no impact
Endangered and Threatened Species	• no impact	• no impact
Noise	• minor impact	• minor noise from bus traffic
Land Use	• conversion of 47 acres forest to camp • 3.5-acre reservoir • 0.17 mile stream inundated	• expansion of current land use in Valdez • no clearing for camp in Valdez, 9 acres clearing for road • some clearing for emergency camp
Recreation	• minor impact from competition of offshift workers for limited recreation resources in Valdez	• more competition for recreation resources, particularly outdoor recreation–hunting and fishing • traffic interference with Allison Point Recreation Area
Visual	• camp very visible from Port Valdez but could be dismantled post construction	• not visible; commercially reusable
Socioeconomics	• local employment for camp construction and operation • economic benefit to Valdez through purchase of goods and services for camp • economic benefit from worker purchases • no impact on Alyeska Marine Terminal operations	• local employment for road construction • employment for camp operation • economic benefit to Valdez through purchase of goods and services for camp • camp is commercial operation; therefore, remains in place • pressure on Valdez infrastructure and services—considered major by city • significant negative impact on Alyeska Marine Terminal operation • workers would have direct access to Valdez

TABLE 4.16-2 (cont'd)

Affected Environment	Seven Mile Creek	Valdez with Road Access
Transportation	• marine transport of workers—minor increase in Port traffic	• bus traffic to and from construction site on Dayville Road • increased traffic in Valdez
Subsistence	• no impact	• no impact
Cultural Resources	• no impact	• no impact
Worker/Management Perspective	• isolated from community • minimal travel time to and from work • maximum management control of workforce and schedule	• proximity to City of Valdez for recreation, goods, and services • 30 minutes to 1 hour bus ride to and from work • less management control

TABLE 4.16-3

Water Requirements Without Camp Site at Seven Mile Creek

	7Q10 Nancy Creek (cfs)	7Q10 Seven Mile Creek (cfs)	Average Seasonal Water Requirements (cfs) Industrial	Other a/ Non Potable	Total
Winter					
December	0.1	0.3			
January	0.1	0.2			
February	0.1	0.3	0.0588	0.0309	0.0897
March	0.1	0.2			
April	0.2	0.6			
Summer					
May	2.4	6.2			
June	9.3	26.9			
July	4.9	14.8			
August	2.0	6.0	0.0495	0.1238	0.1733
September	1.4	4.2			
October	0.6	1.9			
November	0.3	0.9			

a/ Assumes 20 gpd per person and summer maximum of 4,000 workers, winter maximum of 1,000 workers.

recreational opportunities available to them are less limited, but the infringement is felt by the residents of the community. Community representatives expressed concern about the city's ability to cope with additional burdens on infrastructure and services, imposed by such a large influx of workers but recognized the economic advantage of providing the necessary goods and services to a nearly doubled population. However, the Valdez Star and Financial Land Investment Corp. identified socioeconomic advantages to a work camp in Valdez--workers could participate in the economic and social aspects of the community.

Visually, the Seven Mile Creek camp site would be conspicuous. Even if the buildings were dismantled and removed following completion of the construction, the tailored configuration of the slope adjacent to the Creek would remain visible permanently, contributing incrementally to the overall visual aesthetics of the LNG facility. The Valdez camp site is not highly visible. Most of the Federal agencies commenting on the DEIS (EPA, COE, NMFS, DOI) expressed their preference for the Valdez camp site to avoid the environmental damages associated with the Seven Mile Creek camp site.

A major distinction between the two camp site options, is the impact on the operations at the Alyeska Marine Terminal. With the Seven Mile Creek site, the oil terminal would be unaffected in any direct way, by the construction of the LNG facility. Obviously the transit of buses through Alyeska's property, as the most expedient access option for worker shift changes at the LNG site, would affect security and traffic movements at Alyeska at its existing level of production.

From the construction workers' perspective, housing onsite would minimize travel time to and from the workplace but would impose social isolation. Housing in Valdez would foster stronger interaction with the community but would add an extra hour of travel to each work day.

In conclusion, the principal negative features associated with the proposed Seven Mile Creek camp site include:

- the clearing of 47 acres of coastal spruce/hemlock forest compared to only 9 acres for the access road for the Valdez camp site. However, 47 acres represents only 13 percent of the total spruce/hemlock forest to be cleared within the construction limits of the site and is even less significant when compared with the Port Valdez forest area.

- the construction of a 3.5-acre dam on Seven Mile Creek. However, this may be partially offset by the potential for the dam to maintain minimum stream flow rates to support salmon spawning.

- the clearing and grading of the gorge at the outfall of Seven Mile Creek. However, the staff has recommended that clearing be minimized within 100 feet of the streambanks.

- lack of support by Federal agencies (COE, EPA, NMFS, DOI).

The principal negative features associated with the Valdez camp site include:

- construction of 1 mile of new access road partially through Alyeska, and converting 2 miles of TAGS right-of-way to a commuter access road.

- the potential disruption of 6 daily convoys with up to 40 buses on Alyeska security and plant operations, as well as on local and tourist traffic on the Richardson Highway and Dayville Road.

- negative socioeconomic impact of the construction camp on the City of Valdez.

Based on the above, we have concluded that the onsite, Seven Mile Creek camp site with marine access, is preferable to the Valdez Camp with road access through the Alyeska Marine Terminal. This decision reflects the staff's conviction that particularly in the case of non-linear projects, where the construction activity remains stationary, greater emphasis should be given to social impact and that the comments of the directly affected local parties should be afforded priority to the extent possible. We also believe the impacts on the Seven Mile Creek environment can be minimized through the implementation of the previously described mitigation measures combined with the further **recommendation that Yukon Pacific confine the camp site to the west bank of Seven Mile Creek and configure the layout so as to leave the shoreline of Port Valdez in a natural (ungraded and vegetated) condition. We further recommend that when the construction period is finished, the camp be dismantled and removed from the site and the area restored vegetatively in accordance with a plan to be developed in conjunction with the Trans-Alaska Gas System Mitigation Policy of April 25, 1994.**

4.17 CUMULATIVE IMPACT

Cumulative impact results when impact associated with a proposed project is superimposed on or added to impact associated with past, present, or reasonably foreseeable future projects within the area affected by the proposed project. Although the individual impacts of the separate projects might be minor, the additive or synergistic effects from all the projects could be significant. Generally, we believe that cumulative impact could result only from the construction and operation of other projects in the same vicinity and timeframe as the Yukon Pacific LNG Project. To identify other projects presently being constructed or planned for construction within the project area, we contacted the City of Valdez. It reported that there are no projects that are presently being constructed or planned.

Past projects (already in place) in the area affected by the proposed project, include the southernmost segment of the TAPS pipeline and Alyeska Marine Terminal completed in 1977 and Petro Star Refinery completed in 1993. In addition, the southern segment of the TAGS pipeline would be constructed within the timeframe of the LNG facility construction. The impact of its construction and operation is documented in the TAGS FEIS. In the context of the entire TAGS project, the Anderson Bay export site is merely the end point of an 800-mile-long pipeline and related production facilities.

This FEIS provides a detailed environmental analysis of the proposed LNG facilities and our recommendations to mitigate environmental impact. In each case, the site resources and marine environment affected by the proposed facilities would be relatively small and no scarce or critical resource would be affected. Selection of the alternative camp site near the Valdez Airport would not result in any construction-related cumulative impact different from developing the proposed camp site at Seven Mile Creek. There are no other past, present, or reasonably foreseeable projects whose construction would result in significant cumulative impact when added to the construction impact of the Yukon Pacific LNG Plant.

Operation of the Alyeska Marine Terminal, Petro Star Refinery, and proposed LNG Project would have cumulative impacts on air quality, socioeconomics, recreation and visual resources, and public safety and marine environment.

Air resources could be potentially affected by the cumulative effects of operation of the proposed LNG facilities, Alyeska Marine Terminal, and Petro Star Refinery. Table 4.17-1 shows estimated and permitted emissions. The proposed LNG facility would increase NO_x and CO emissions most in the Valdez area while less significantly increasing VOC, PM_{10}, and SO_2 emissions. Both Alyeska and the Petro Star Refinery are completed or nearing operation and have the necessary state operating permits. Issuance of the required permits implies the associated impact is acceptable. The Yukon Pacific LNG plant would comply with Alaska Air Quality Control Regulations. No significant cumulative effect would be allowed.

Cumulative operational impacts associated with the local and regional economy in the project area would be positive. The project would add 200 to 300 permanent jobs in the Valdez area. This could have the effect of maintaining employment levels as Alyeska operations phase down and result in more efficient utilization of infrastructure. Declining tax revenues would be offset by LNG plant property taxes.

Cumulative impact would be associated with recreation and visual resources. The LNG facility at Anderson Bay could provide a point of interest for tourists to Port Valdez and tour

TABLE 4.17-1

Permitted and Estimated Emissions (tpy)

Pollutant	Alyeska Marine Terminal a/	Petro Star Refinery a/	Anderson Bay LNG Plant b/	Total
NO_x	1,732	70	2,528	4,330
CO	76	13	780	869
VOC	57,296 c/	70	374	57,740
PM_{10}	296	3	256	555
SO_2	1,043	40	89	1,172

a/ Permitted emissions.

b/ Estimated emissions.

c/ VOC emissions from tanker filling operations are 56,110 tpy.

opportunities. This would be similar to the current situation at the Alyeska Marine Terminal resulting in a beneficial but minor cumulative impact. The addition of the LNG plant to the existing refineries would result in furthering the change in the character of Port Valdez to a modern industrialized port. Although the overall visual impact of each facility may not be significant, the cumulative effect on the landscape quality of Port Valdez would have a moderate adverse impact.

The cumulative risk to public safety and marine environment would be associated with collisions between LNG tankers and oil tankers and the additive effect of shipping operations. Vessel traffic in Prince William Sound is controlled by the Coast Guard through a comprehensive set of regulations. The State of Alaska imposes additional requirements. The total tanker traffic of 2.7 per day is well within the limitations of the Coast Guard's VTS system. Other impact on the marine environment would be related to shipping operations such as introduction of foreign organisms in ballast water, leakage of diesel fuels during loading operations, and collisions with marine mammals, and would be minor.

As a result of the analysis included in this FEIS, mitigation measures have been identified and recommended to reduce or avoid environmental impact associated with construction of the Yukon Pacific LNG Project. We believe that impacts associated with past, present, or reasonably foreseeable future projects which could be identified would not result in significant impact when added to the impact of the Yukon Pacific LNG Project.

5.0 FERC STAFF'S CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations presented herein are those of the staff of the Federal Energy Regulatory Commission (FERC or Commission). This Final Environmental Impact Statement (FEIS) evaluates the environmental impact associated with the construction and operation of the facilities that would be required to liquefy pipeline natural gas, store the liquefied natural gas (LNG), and to export it via LNG tankers to various Asian Pacific Rim countries. These facilities have been proposed to be constructed and operated by Yukon Pacific Company L.P. (Yukon Pacific) as part of the Trans-Alaska Gas System (TAGS) pipeline project and involve only those facilities that are associated with the site of export.

Information provided by Yukon Pacific and further developed from data requests, field investigations, literature research, alternatives analyses, and contacts with Federal, state, and local agencies and individual members of the public indicates that construction of the proposed Yukon Pacific LNG Project would result in a limited adverse environmental impact during construction and operation. As part of our analysis, we have developed specific mitigation measures, including additional studies and field investigations, that we believe to be appropriate and reasonable for the construction and operation of the LNG production and shipping facilities to proceed. We believe that these measures would substantially reduce the environmental impact that would result from construction and operation of the project and ensure the safety of the facility as proposed. Where additional studies or field investigations are recommended, significant impacts that are identified would either be avoided or mitigated to non-significant levels. We have concluded that if this project is constructed and operated in accordance with our mitigation recommendations, it would be an environmentally acceptable action. We are therefore recommending that our mitigation measures be attached as conditions to any authorization issued by the Commission for a place of export and the construction and operation of facilities at this place of export.

5.1 SUMMARY OF THE STAFF'S ENVIRONMENTAL ANALYSIS OF THE PROPOSED ACTION

With implementation of our recommended mitigation measures, the stability and erosion of soils and overburden materials should not significantly affect construction or operation. The extensive excavation proposed for the site would remove and relocate 3,018,000 cubic yards of overburden and 6,655,000 cubic yards of rock. During construction, these materials could be susceptible to slumping and erosion. Slumping can be controlled and should not pose serious adverse effects. Excavation of the benches could affect bedrock stability of the cutslope at the back of the site. Yukon Pacific proposes to install rock bolts in these walls. It also plans to dewater the bedrock using weepholes. These actions would minimize the potential for bedrock instability.

Considering that 392 acres of the site would be exposed, the potential for soil erosion during construction is high. Yukon Pacific has filed an Erosion Control Best Management Practices Manual (BMPM) and has indicated that a detailed site-specific erosion and sediment control plan that conforms to the BMPM will be submitted prior to construction. That plan would detail site preparation, slope stabilization, channel control, sediment retention, and revegetation. To ensure preparation of an adequate plan, we have recommended site-specific drawings and procedures be included in the plan specifying the number, size, and placement of erosion control structures; areas that would be revegetated; seedmixes, and mulching methods. We have also recommended that a full time environmental inspector be onsite during construction to ensure compliance with the erosion control plan and all other recommended mitigation measures. Impacts on soil and those caused by erosion would be minimized by implementing the measures in the BMPM and our recommendations.

The steep slope behind the facility may direct snow avalanches into the rear of the site. Only facilities on the southern edge of the cargo dock may be in the path of one identified snow avalanche path (path No. 3). Further evaluation of this path has been recommended prior to completion of final design. Final design for structures in its vicinity would incorporate mitigation for the potential effects of this avalanche path.

There is a significant probability that the project would experience severe earthquakes during its lifetime. The project area has the potential for being affected by some of the largest earthquakes recorded in North America. The primary areas of concern are surface faulting, shaking of structures, soil liquefaction, and seismically induced waves.

There are no active faults on the site. All of the significant faults in the area are related to ancient ruptures. As a result, the major seismic concerns are shaking of structures, liquefaction, and seismically induced waves.

Once the appropriate design level earthquakes are chosen, the design to protect facilities against earthquake shaking is relatively straightforward. We have recommended some slight modification to the design parameters proposed by Yukon Pacific, and we believe the modified design would afford the facility an adequate level of protection.

For those facilities that are placed on natural soil there are significant hazards from soil failure by liquefaction. Critical facilities would not be placed on natural soils.

Seismically induced waves are a major concern for the marine terminal portion of the facilities, and we have included a recommendation to mitigate their effects in the final design and operation plans. The rest of the plant site is at high enough elevation that there should be little potential from damage with proper mitigation.

We believe that this site satisfies the seismicity-related siting criteria in the U.S. Department of Transportation's (DOT) LNG regulations. However, there are a number of details of design that have not been fully addressed or finalized by Yukon Pacific, and which we believe must be reviewed before they are finalized. A number of these details relate to the type of storage tank that is ultimately chosen. Therefore, we have included recommendations that the Commission be provided the opportunity to review and approve design details and the basis for them.

Key impacts on freshwater and marine water quality include the potential for increased nearshore turbidity from construction and fill activities, localized temperature effects within mixing zones of the desalination and Heat Recovery Steam Generator (HRSG)/Blowdown discharges, and water supply concerns. Grading activities are expected to cause significant short-term impact on Nancy, Terminal, Strike, and Short Creeks due to turbidity increases and rechanneling. Terminal Creek and the associated pond would be permanently lost as natural waterbodies. A detailed water balance and design supply analysis of streamflow requirements has also been recommended in connection with the proposed dam as a water supply on Seven Mile Creek. A Spill Prevention, Containment, and Countermeasure Plan as well as a site-specific Erosion and Sediment Control Plan have also been recommended to ensure that best management practices are followed to minimize impact on water quality.

Overall, there would be minor impacts on resident fish resources because of their limited distribution at the site. Anadromous fish resources spawning in Nancy Creek would not be significantly affected if disturbance to the streambed is avoided or minimized and the runoff of fine sediments is controlled and appropriate construction time windows are observed. The impacts on anadromous fish spawning in Seven Mile Creek are less clear because the flow patterns are not well understood. To identify these flow patterns and how they might be affected by water releases and the damming of Seven Mile Creek, we have recommended that Yukon Pacific, in conjunction with the Alaska Department of Fish and Game (ADFG), conduct an in-stream flow study. Once our recommended in-stream flow study has been completed, Yukon Pacific can coordinate with the ADFG to determine a flow regime to minimize impacts on spawning fish. Grading and clearing the banks would cause some disturbance of the streambed and increased runoff of fine sediments. If the disturbance and runoff are minimized by careful construction and adequate sediment and erosion control, the impacts would not be significant.

Construction and operation of the proposed LNG facility is not expected to have any significant impact on local wildlife. In the case of waterfowl, there is a general lack of suitable nesting habitat at the Anderson Bay site, so the birds are not present to be affected. Similarly, the intertidal zones of Anderson Bay provide only limited foraging habitat for shorebirds compared to elsewhere in the Port Valdez region due to the lack of mudflats and other shallow water areas. Although the project would reduce the intertidal habitat of Anderson Bay, the impact on shorebirds would be minimal.

The greatest concern for raptors relates to the potential disturbance of bald eagle nest sites. To minimize these impacts, we have recommended that Yukon Pacific conduct surveys for bald eagle nest sites in the year prior to the commencement of site activities and in each subsequent year and, if birds move into the site, that consultation with the U.S. Fish and Wildlife Service (FWS) and ADFG be undertaken to determine appropriate action.

A variety of large ungulates and large predatory mammals occur within the Port Valdez area, but most in such low numbers in the vicinity of the project that adverse impacts are not expected. Indirect impacts could occur on mountain goats at Abercrombie and Sulphide gulches, 10 to 14 miles east of Anderson Bay, with the influx of the large construction workforce but would not be significant, given existing regulatory systems. Since both black and brown bears are known to inhabit the site, there is a potential for interaction between bears and people onsite. To reduce the potential conflict with bears at the site, we have recommended at the request of the State Pipeline Coordinator's (SPCO) and U.S. Department of the Interior, Office of Environmental Affairs (DOI/EA) that Yukon Pacific develop a mitigation plan stressing worker education programs and bear-proofing waste disposal areas. Impacts on small mammals and furbearers would be minor, arising from the loss of forest habitat through site clearing and preparation.

Construction of the LNG site would require clearing of approximately 392 acres of vegetation, primarily consisting of mature coastal spruce and hemlock forest. This represents a relatively minor impact since this vegetation covertype is well represented in the areas surrounding Anderson Bay and Port Valdez. Secondary impacts related to clearcutting large tracts may occur. These include increased soil erosion, loss of wildlife habitat, and secondary loss of trees along the edge of the cleared area. Other impacts associated with clearing include potential sedimentation of surface waters due to loss of vegetation. To reduce this impact, we have recommended that a minimum 50-foot-wide natural vegetative buffer strip be maintained between all waterbodies, including marine waters, and construction areas.

Development of the site would also result in the direct loss of approximately 35.7 acres of estuarine and palustrine wetlands and 13.1 acres of non-wetland, subtidal marine habitat. Yukon Pacific has developed a mitigation plan, based on replacement or offset of the loss of wetland functional values. This mitigation includes rectification through repair or restoration, reduction or elimination of impacts through recovery and maintenance, and compensation for impacts through onsite and offsite replacement or substitution. In general, however, the U.S. Army Corps of Engineers (COE), National Marine Fisheries Service (NMFS), and U.S. Environmental Protection Agency (EPA) commented on the need for a thorough analysis of alternatives that would avoid the destruction of shallow intertidal areas, and the lack of information regarding successes and failures of other mitigation efforts that have been done in similar areas. Following publication of the Draft Environmental Impact Statement (DEIS), Yukon Pacific submitted to the FERC a Mitigation Policy Statement for the proposed project. This policy statement outlined Yukon Pacific's mitigation priorities and reasserted the company's commitment to environmental protection. However, it provided only general broad sweeping statements and contained no new site-specific mitigation information regarding wetlands on the proposed LNG facility site.

Other concerns were identified in letters written subsequent to the publication of the DEIS. The COE and NMFS expressed concerns about the proposed mitigation plan. The COE indicated that additional information is necessary regarding the proposed onsite mitigation at the Site B′ disposal area and the NMFS expressed concern that the proposed mitigation at Site B′ might be unsuccessful. The COE also indicated that the proposed onsite freshwater mitigation plan should be refined after the in-stream flow study at Seven Mile Creek recommended in section 4.3.1 and the salmon fry utilization study recommended in section 4.5.1 are completed.

The EPA expressed concerns about the wetland evaluation technique that was used to evaluate wetlands and Yukon Pacific's mitigation policy statement. The EPA indicated that the Mitigation Policy Statement is vague and the wetland technique is flawed.

The DOI/EA indicated that a wetland complex that Yukon Pacific has identified for offsite mitigation supports spawning salmon and waterfowl. The wetland area, located at the Old Valdez townsite, would require a detailed investigation prior to development of wetland mitigation to avoid disrupting spawning salmon and waterfowl using the existing ecosystem.

Other parties whose comments are summarized in a letter from the Joint Pipeline Office (JPO) were also critical of the Mitigation Policy Statement. Some of these parties were concerned about the delayed timing for the development of a detailed mitigation plan and some felt that the mitigation policy statement fails to adequately address marine impact mitigation, the issues of indirect and cumulative impacts, and mitigation monitoring.

The FWS indicated that there are several potential mitigation measures that Yukon Pacific should evaluate and incorporate into the detailed mitigation plan. These include habitat alteration measures that would result in increased tidal and subtidal productivity in areas where existing habitats would be affected.

In view of this information, we believe that additional information about Yukon Pacific's wetland mitigation plan is necessary. However, we do not believe the detailed elements of the mitigation plan need to be addressed in this FEIS. The EPA shared this view in its July 29, 1994 letter to the FERC. Therefore, we have recommended that Yukon Pacific revise its wetland mitigation plan based on the final site grading, excavation, and spoil disposal plans and submit it to the Bureau of Land Management (BLM)/JPO and to the FERC for review and approval prior to construction.

Construction of the Anderson Bay facility would impact the marine environment in several ways. Since estuarine spawning areas at the mouths of Seven Mile and Nancy Creeks are used by pink and chum salmon, these areas would be highly sensitive to changes in the flow regime. Salmon fry use protected, shallow intertidal areas in Anderson Bay. The project would fill approximately 35 acres of this habitat and create changes in the rocky intertidal and subtidal areas in the tanker berthing location and along the face of the cargo dock. Although salmon fry have been observed in this area, the importance of this area relative to other parts of Port Valdez and other habitat types has not been documented. Therefore, it is difficult to determine the degree of impact on these habitat types. As a result, we have recommended that Yukon Pacific conduct a study to determine the importance of this habitat and develop mitigation to minimize impacts on salmon rearing habitat.

The release of heated water from the desalination plant and HRSG/Boiler blowdown may impact the marine environment. To reduce this impact, we have recommended that Yukon Pacific utilize a dilution model to determine the final design of the diffusers and that the mixing zone allowance set strict limits on the vertical extent of the mixing zone in Port Valdez. Shock waves from underwater blasting may injure or kill fish which occur in the area. We have recommended blasting mitigation procedures to minimize the impacts.

Intertidal and subtidal construction, and blasting in the tanker docking area would cause long-term physical changes in bathymetry and benthic substrate. In the short term it is likely that intertidal and subtidal organisms and algae would be damaged, covered, or killed. Disruption of the rocky intertidal zone due to ice scour and extreme weather is common in Port Valdez. The intertidal marine community has adapted to this and tends to recover quickly. The subtidal community is subject to high rates of fine sediment deposition from glacial runoff. The benthos has adapted to this and areas covered by fill are unlikely to cause long-term impacts. The changes in substrate profiles and substrate types may cause changes in the benthic community, but since there is a low species diversity in Port Valdez, it is unlikely these changes would be significant. Finally, we have recommended additional restrictions to the proposed ballast water exchange procedures to further minimize the potential to introduce exotic species or organisms from other geographic areas into Prince William Sound and Port Valdez.

While several species of marine mammals have been recorded in Valdez Arm, only sea otters and harbor seals occur more than occasionally. The greatest potential source of impact to them during the construction and operation of the project is blasting. We have consequently recommended measures to ensure that marine mammals are not present at the time of underwater blasting.

No federally listed or proposed endangered or threatened plant or wildlife species have been reported in the vicinity of the Anderson Bay site. Although occasional transients of listed falcon species may occur in the area, we have determined that they would not be affected by the project. We have also concluded, with concurrence of the NMFS, that no federally listed or proposed endangered or threatened marine mammals would be adversely affected. A Biological Assessment was prepared and submitted to the NMFS as required under Section 7 of the Endangered Species Act.

The Anderson Bay LNG facility would have an impact on air quality in the project area during the 8-year construction period and a long-term impact from operation of the facility. At full capacity, the facility would emit approximately 2,528 tons per year (tpy) of nitrogen oxides (NO_x), 780 tpy of carbon monoxide (CO), 374 tpy of volatile organic compounds (VOC), 256 tpy of particulate matter (PM_{10}), and 89 tpy of sulfur dioxide (SO_2). Primary sources of operational emissions are gas turbine-driven compressors used in the liquefaction process, gas turbines used to generate steam and electricity, and the tankers docked at the facility. The conservative screening model analysis predicted compliance for all pollutants with the National Ambient Air Quality Standards (NAAQS), and compliance for all pollutants with Prevention of Significant Deterioration (PSD) increments except for nitrogen dioxide (NO_2). Supplemental modeling for NO_2 using two sets of meteorological data collected near the proposed Anderson Bay facility depicts a range of potential impacts relative to the screening assessment. While these results cannot be relied upon to make conclusive determinations on the ability of the project to comply with applicable NAAQS and PSD increments, the supplemental modeling shows levels below the respective NAAQS and PSD increments for FEIS purposes. When final equipment selections have been made, Yukon Pacific will perform refined dispersion modeling, using meteorological data from the 40-meter tower, other nearby sources, and background ambient concentrations measured at the Alyeska Marine Terminal, to ensure that the facility would not cause violations of PSD increments, NAAQS, and Alaska standards. This modeling must be done for the facility to obtain any air emission permits from the Alaska Department of Environmental Conservation (ADEC). This modeling and permits must be completed prior to construction of the facilities.

The Anderson Bay LNG facility would increase noise levels in the vicinity of the site during both construction and operation. Anderson Bay is a remote area with the closest permanent buildings being part of the Alyeska Marine Terminal. The nearest noise-sensitive areas (NSAs) are Shoup Bay State Marine Park, approximately 3.7 miles northwest of the proposed LNG main utility building; a camping area north of Dayville Road and east of the Alyeska Marine Terminal's eastern gate, approximately 5.9 miles east; and three residences at the mouth of Mineral Creek in Valdez, approximately 5.0 miles northeast. Yukon Pacific's analysis of operational noise predicted a 24-hour equivalent sound level (Leq(24)) of 46 decibels of the A-weighted scale (dBA) at the site's eastern property line. The resulting impact on all NSAs would be well below a day-night sound level (Ldn) of 55 dBA. This noise analysis was based on the assumption that exhaust stack noise levels would not exceed 85 dBA at 10 feet and no other plant equipment would exceed a noise level of 85 dBA at 3 feet, which does not agree with the design Noise Control Specification A-09. Therefore, we recommend that a revised noise analysis be filed once the actual equipment is selected and manufacturer's noise data are available, and a noise survey taken once the terminal is in service to ensure that noise impacts are below the 55-dBA Ldn limit at the NSAs.

The primary land use impact would be the conversion of 377 acres of spruce hemlock forest and shrub, and 49 acres of palustrine and estuarine wetland and non-wetland, subtidal marine habitat to an industrial use. In addition, public access would be restricted to the 2,630 acres of land which would constitute the site and buffer zone. Restricting access to the upland areas adjacent to the plant site would have little impact, due to the remoteness of the area. For safety reasons, there would be a large dispersion exclusion zone in which normal usage of land-based outdoor areas would be limited to less than 20 people. This would not affect water-based recreation. The 200-yard safety exclusion zone imposed by the U.S. Coast Guard would, however, render most of Anderson Bay off-limits to small craft for all but emergency situations.

The proposed project would not have significant short-or long-term negative effects on recreation in the Port Valdez area, although during the construction period, the noise, dust, and activity could impact recreation in and near Anderson Bay and the popular Seven Mile Creek area. During operation, recreation would be limited in the upland areas adjacent to the plant site because of the buffer zone, and the dispersion exclusion zone would restrict outdoor activities within an approximately 2.5-mile radius of the site. Temporary increased demand on recreational facilities in the City of Valdez from construction personnel would occur but would not be great, with the greatest potential impact being on indoor facilities. This would be limited because the number of workers would be reduced dramatically during the winter when indoor recreational activity would be greatest.

The proposed project would permanently change the visual characteristics of a 2-mile stretch of the south shore of Port Valdez, by regrading the current rocky forested shoreline and forested backshore and constructing large industrial structures, which would contrast sharply with the environment. The overall impact is not considered to be significant, however, because of the low number of possible viewing points and their distance from the site. In addition, the vertical profile of the proposed LNG facility is low when compared with the Alyeska site which will remain the more dominant visual presence. We have recommended that Yukon Pacific prepare a visual mitigation plan which preserves the current shoreline and to develop appropriate landscape and architectural treatments to improve the aesthetic quality of the facility.

The Yukon Pacific LNG Project would significantly increase total employment and population in the City of Valdez during construction and operation of the plant. Temporary impacts associated with construction would be more significant than permanent impacts associated with operation of the project because employment levels would be higher during construction. The increase in population associated with construction and operation of the project would lead to greater demands on public services, creating a need for additional teachers, doctors, police officers, and fire fighters. Housing demand would increase as workers and their families relocate to Valdez.

The project would stimulate economic activity in Valdez. Local businesses would experience an increase in demand for goods and services from Yukon Pacific. Workers and families would frequent local grocery stores, restaurants, and other establishments. Property tax payments by Yukon Pacific would offset increased costs associated with additional public service needs and could finance further growth and development within the city.

The movement of goods, supplies, and people in and out of Valdez would increase because of the project. The port and boat harbor would be significantly affected because access to the project site would only be possible by water. The waterways, in and around Port Valdez, would experience an increase in barge, tanker, and large boat traffic. Road, highway, and airport traffic would increase, especially during summer months when construction activity would escalate and tourists visit the city. Port and airport revenues could rise with greater activity.

Impacts on subsistence use of area resources are anticipated to be minor. Project construction would have minor impacts on subsistence use on Port Valdez, Anderson Bay, and the surrounding land area. These areas receive minor subsistence use and Valdez residents, the greatest users of the area, are in a designated nonrural area (thereby qualifying as recreational rather than subsistence users). Populations of land mammals and fish would be minimally affected by increased competition from the addition of the direct and indirect construction workforce to the area population. Tatitlek residences would also experience minor impacts on fishery resources from increased competition with nonrural (Valdez) users during construction and operation. Increased competition with construction and operational workforces might require restrictions on nonrural residents' harvesting of subsistence resources. Fishery and marine mammal resources and related subsistence uses could be minimally affected from increased shipping in Prince William Sound and the increased potential for accidents.

No previously recorded or newly identified cultural resource sites were identified during background literature research or field studies, respectively. The Alaska State Historic Preservation Officer has reviewed the results of a 1990 cultural resource survey and concluded, and we concur, that the project would have no effect on properties on or eligible for the National Register of Historic Places.

The operation of the proposed LNG facility poses a unique hazard that could affect the public safety without strict design and operational measures to control potential accidents. The primary concerns are those events which could lead to an LNG spill of sufficient magnitude to create an offsite hazard.

The staff and its cryogenic consultants conducted a cryogenic design and technical review emphasizing the engineering design and safety concepts, and on the projected operational reliability of the proposed LNG facility and marine terminal. The review included a technical conference in Valdez on May 26, 1992, followed by a site inspection. Much of the technical data filed by Yukon Pacific reflects the initial conceptual design phase of the project. In a later phase, Yukon Pacific will develop the detailed design information necessary to assess the facility's adherence to the applicable standards, codes, and engineering practices. Although the material submitted by Yukon Pacific to the FERC is in the initial phase of design, supplemental information is required before a more definitive assessment can be made on the adequacy of design and on the adherence of the design to various applicable standards, codes, and engineering practices.

The DOT regulations governing the siting of an LNG facility require the establishment of both thermal and flammable vapor exclusion zones to protect offsite land uses. While the thermal exclusion zone is either confined to the plant property or the immediate vicinity of the waters at the two LNG tanker docks, the dispersion exclusion zone extends northward more than 13,000 feet offshore into Port Valdez. Although Yukon Pacific would need to ensure that normal <u>land</u> usage within the dispersion exclusion zone is below 20 people when the terminal becomes operational, transient travel through the zone, such as fishing boats or cruise ships, would be permitted. Although a finding of compliance with Part 193 will await the DOT's evaluation of Yukon Pacific's responses, the remote location of the site and lack of population in the plant vicinity should ultimately permit compliance with the siting requirements.

While LNG tankers have experienced safe operation without cargo tank spillage for more than 30 years, the possibility of a major LNG spill over the duration of the project cannot be discounted. The events most likely to cause a significant release of LNG cargo would be a grounding severe enough to penetrate the tanker's double bottom or collision with another vessel sufficiently large and with sufficient momentum to penetrate the double sides. Our analysis finds that: (1) given the present and planned Coast Guard controls in the Prince William Sound Vessel Traffic Service (VTS) Area, LNG tankers can safely operate in these waters, (2) the thermal radiation and flammable vapor cloud hazards from the maximum credible LNG tanker spill would not affect the general public, (3) although it is possible for an LNG tanker to spill cargo in a grounding type incident, the liquid would rapidly vaporize and would not have the long-term environmental consequences associated with a major oil spill, and (4) the addition of LNG tankers within the VTS Area would not have a significant increase on the percent potential of a collision with an outbound crude oil tanker.

5.2 SUMMARY OF ALTERNATIVES CONSIDERED

5.2.1 No Action and Alternative Sites

Alternatives considered that would avoid constructing the project at Anderson Bay include locating the project at another site and no action. The U.S. Department of Energy (DOE) previously concluded that the Valdez export site (Anderson Bay) is preferable to all other export sites that were considered in the TAGS Environmental Impact Statement (EIS) and disapproved all sites other than the Valdez site (DOE, 1989). Accordingly, further consideration of alternative sites is outside the scope of this FEIS. However, we have summarized and incorporated by reference the relevant sections of the TAGS Final Environmental Impact Statement (FEIS) on this issue. The no action alternative would avoid all of the environmental effects of the project, but would result in the entire TAGS Project, including the pipeline, not being built.

5.2.2 Alternative Construction Camp Sites

Yukon Pacific proposes to locate the construction camp along the banks of Seven Mile Creek. Several alternatives to the proposed construction camp at Seven Mile Creek were examined. After a preliminary screening, three onsite alternatives were eliminated from further consideration because they offered no environmental advantages over the proposed onsite location. The offsite alternative at Valdez was considered in combination with three different access options. Two (ferry transport and road transport around the Alyeska Marine Terminal) were determined to be impractical but the third, road transport (north road) through the Alyeska property was carried forward for further consideration.

The analysis in section 4.16 compared the proposed camp site with an alternative camp site with access through Alyeska. The principal negative features associated with the proposed Seven Mile Creek camp site are:

- the clearing of 47 acres of coastal spruce/hemlock forest compared to only 9 acres to link the access road for the Valdez camp site. However, 47 acres represents only 13 percent of the total spruce/hemlock forest to be cleared within the construction limits of the site and is even less significant when compared with the Port Valdez forest area.

- the construction of a 3.5-acre dam on Seven Mile Creek. However, this may be partially offset by the potential for the dam to maintain minimum stream flow rates to support salmon spawning.

- the clearing and grading of the gorge at the outfall of Seven Mile Creek. However, the staff has recommended that clearing be minimized within 100 feet of the streambanks and that the camp site be limited to the west bank only.

The principal negative features associated with the Valdez camp site are related to the access road required to transport workers to the site:

- construction of a new 3-mile commuter access road partially through Alyeska and the TAGS right-of-way which could be used during operations as an all-weather emergency access.

- the disruption of 6 daily convoys with up to 40 buses on Alyeska security and plant operations, as well as on local and tourist traffic on the Richardson Highway and Dayville Road.

- social disturbance to the City of Valdez with a virtual doubling of its population through the influx of up to 4,000 workers.

Following solicitation of public comment on these alternatives, it was made clear that there was no local support for the Valdez Camp/Alyeska road option. The City of Valdez, the State of Alaska and the two affected corporations all favored the onsite alternative at Seven Mile Creek. The staff agrees.

5.2.3 Alternative Disposal Sites

Construction of the proposed LNG facilities would require substantial excavation and benching of the bedrock. Although most of the rock and overburden materials produced during excavation could be used as structural fill on the site, the remaining surplus material would require disposal (see section 2.3.2). Yukon Pacific identified and evaluated six potential disposal sites—four entirely on land, one partially on land and in Anderson Bay, and one entirely in the deep water of Port Valdez. Three of the onshore sites were entirely within the boundaries of the proposed construction area. In addition to these alternative sites, we identified and evaluated two other disposal options which involved the use of multiple onshore and offshore sites and the utilization of the completed disposal Site B′ (Yukon Pacific's proposed disposal site) for the construction of the proposed cargo dock facilities to reduce the overall impact on the shoreline and intertidal area of Anderson Bay.

None of the sites located entirely on land had enough storage capacity to store the excess volumes of waste material. Other factors, such as the potential to impact surface waters and the construction of new, offsite access roads further precluded these sites from being acceptable.

We evaluated open-water disposal opportunities but found them to be inadequate since: 1) the dumping of organic materials was unacceptable to the agencies and public; 2) the amount of rock material suitable for disposal in this manner is small relative to the total; and 3) the additional storage and handling facilities required to accommodate barging would partially offset the savings at Site B′ and greatly increase disposal costs.

During our evaluation of the use of the proposed disposal Site B′ for the construction of the cargo dock, we identified several potential problems, including size and area constraints, the need for additional grading and filling of the Anderson Bay intertidal and shoreline areas, and the orientation of the cargo dock at Site B′ resulting in a more difficult, time consuming and possibly less safe approach and departure for barges and cargo ships. Additionally, Site B′ would be used during the last 5 years of construction as a storage and laydown area and even more important from a scheduling perspective, would not even be graded for use until the end of the third construction year. The need for the cargo dock is priority and could not be deferred for 3 years. Temporary solutions could not be found.

We examined ways to increase the holding volume of the upland sites through the placement of retaining structures but the topographic limitations of the site overall finally lead to the conclusion that the cargo dock at Nancy Creek and disposal of excess excavated material at B′, although impacting inter and subtidal wetlands, were the most practical approach to site development.

5.3 FERC STAFF RECOMMENDED MITIGATION MEASURES

To mitigate environmental impact associated with the construction and operation of the proposed Yukon Pacific LNG Project, we recommend that the following measures be included as specific conditions to any authorization issued by the FERC for a place of export and the construction and operation of facilities at this place of export.

1. Yukon Pacific shall follow the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests) and as identified in the environmental impact statement (EIS), unless modified by these conditions. Yukon Pacific must:

   a. request any modification to these procedures, measures, or conditions in a filing with the Secretary of the Commission (Secretary);
   b. justify each modification relative to site-specific conditions;
   c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
   d. receive approval in writing from the Director of the Office of Pipeline Regulation (OPR) **before using that modification.**

2. The Director of OPR has delegation authority to take whatever steps are necessary to ensure the protection of all environmental resources during construction and operation of the project. This authority shall allow:

   a. the modification of conditions of this Order; and
   b. the design and implementation of any additional measures deemed necessary (including stop work authority) to ensure continued compliance with the intent of the environmental conditions as well as the avoidance or mitigation of adverse environmental impact resulting from project construction and operation.

3. Yukon Pacific shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all staging areas, pipe storage yards, new access roads, and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. This includes any alteration to facility locations previously filed with the Commission. Approval for all areas must be explicitly requested in writing. All areas must be approved in writing by the Director of OPR **before construction** in or near that area.

4. **Within 60 days of the acceptance of this authorization** and **before construction** begins, Yukon Pacific shall file an initial implementation plan with the Secretary for review and written approval by the Director of OPR describing how Yukon Pacific will implement the mitigation measures required by this Order. Yukon Pacific must file revisions to the plan as schedules change. The plan shall identify:

   a. how Yukon Pacific will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;
   b. the number of environmental inspectors and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

c. company personnel, including environmental inspectors and contractors, who will receive copies of the appropriate material;
d. what training and instructions Yukon Pacific will give to these personnel (initial and refresher training as the project progresses and personnel change), with the opportunity for OPR staff to participate in the training session(s);
e. the company personnel (if known) and specific portion of Yukon Pacific's organization having responsibility for compliance;
f. the procedures (especially contract penalties) Yukon Pacific will follow if noncompliance occurs; and
g. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:

    (1) the completion of all required surveys and reports;
    (2) the mitigation training of onsite personnel;
    (3) the start of construction; and
    (4) the start and completion of restoration.

5. Prior to construction, Yukon Pacific shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, environmental inspectors, and contractor personnel who will be involved with construction and restoration have been trained as specified in the Implementation Plan provided in response to condition 4d.

6. Yukon Pacific shall employ at least one independent environmental inspector. The environmental inspector shall be:

    a. responsible for monitoring and ensuring compliance with all mitigative measures required by this Order and other grants, permits, certificates, or authorizing documents;
    b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 4 above) and any other authorizing document;
    c. empowered to order correction of acts that violate the environmental conditions of this Order, and any other authorizing document;
    d. a full-time position, separate from all other activity inspectors;
    e. responsible for documenting compliance with the environmental conditions of this Order, as well as any environmental conditions/permit requirements imposed by other Federal, state, or local agencies; and
    f. responsible for maintaining status reports.

7. Yukon Pacific shall file updated status reports prepared by the environmental inspector with the Secretary on a **biweekly** basis until all construction-related activities, including restoration and initial permanent seeding, are complete. On request, status reports will also be provided to other Federal and state agencies with permitting responsibilities. At a minimum, status reports shall include:

    a. the current construction status of the project, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally sensitive areas;

b. a listing of all problems encountered and each instance of noncompliance observed by the environmental inspector during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other Federal, state, or local agencies);
c. corrective actions implemented in response to all instances of noncompliance;
d. the effectiveness of all corrective actions implemented;
e. a description of any landowner/resident complaints which may relate to compliance with the requirements of this authorization, and the measures taken to satisfy their concerns; and
f. copies of any correspondence received by Yukon Pacific from other Federal, state, or local permitting agencies concerning instances of noncompliance, and Yukon Pacific's response.

8. Yukon Pacific must receive written authorization from the Director of OPR before commencing service from each phase of the project. Such authorization will only be granted following a determination that rehabilitation and restoration of the project site is proceeding satisfactorily.

9. **Within 30 days of placing the facilities in service**, Yukon Pacific shall file an affirmative statement with the Secretary, certified by a senior company official:

a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or
b. identifying which of the conditions Yukon Pacific has complied with or will comply with. This statement shall also identify any areas where compliance measures were not properly implemented, and the reason for noncompliance.

10. Yukon Pacific shall provide the SPCO and the COE with a copy of any submittal that is filed with the Secretary in response to conditions in this authorization.

11. Yukon Pacific shall notify the Commission's environmental staff by telephone or facsimile of any environmental problems identified by other Federal, state, or local agencies on the same day that such agency notifies Yukon Pacific.

12. Yukon Pacific shall commence construction of its Anderson Bay facilities within 3 years of the date of the Commission's Order, or shall file for a motion to extend this deadline.

13. Yukon Pacific shall prepare a site-specific erosion control and sedimentation plan that:

- provides detailed procedures for controlling sediment from access road construction including the roadbed, cut and fill materials, culvert installation, and bridge installation;

- provides detailed drawings that show the number, size, and placement of erosion and sediment control structures on the site;

- provides detailed drawings which show the areas that would be revegetated and include a description of the seedmix, seeding methods, soil amendments, and mulching methods that would be used; and

- shall be filed, together with comments of the Alaska Department of Natural Resources (ADNR), if any, with the Secretary for review and approval by the Director of OPR prior to initiation of construction.

14. To avoid the potential for avalanche damage to facilities and hazards to personnel at the construction dock area, further field evaluation of avalanches on path No. 3 shall be undertaken prior to the development of final design in order to determine the need for mitigation.

15. All final seismic design plans and specifications shall be filed with the Secretary for review and approval by the Director of OPR. The seismic design measures shall take into account the specific recommendations and results of studies specified below:

    i. The intracycle earthquake specified for facility design purposes shall be set at moment magnitude (M_w) 8.2.

    ii. The Maximum Design Earthquake (MDE) value for the effective acceleration shall be at least 0.6 gravitational force (g).

    iii. Yukon Pacific shall evaluate the adequacy of the long period levels of the proposed design response spectra using seismological modelling analyses to estimate directly the long period ground motion from postulated critical design earthquakes on the Aleutian megathrust and in the Yakataga Gap. A report on the methods, assumptions, and results shall be filed with the Secretary. The results of that analysis shall be incorporated into the seismic design, as appropriate.

    iv. The vertical design accelerations shall be set as equal to the horizontal acceleration for design purposes.

    v. For all structures not directly supported by rock, design spectra for "competent soil conditions" as recommended by Newmark and Hall (1982) shall be used. Under no circumstances shall the agreed upon criteria be less than proposed in the application.

    vi. Yukon Pacific shall conduct a specific analysis of the duration of strong ground shaking likely to be experienced at the site as a result of the design earthquake, and document that the structures are designed to accommodate the ductility demand associated with the duration of the shaking. A report on the methods, assumptions, and results shall be filed with the Secretary. The results of that analysis shall be incorporated into the seismic design, as appropriate.

    vii. Yukon Pacific shall file with the Secretary a discussion of each of the following issues, as the design of the facility progresses:

        - Unless there is clear and convincing justification for lesser values, the load combination factors specified in ASCE 7-88 (1990) shall be used.

        - Use of the calculated flat-roof snow load of 169 pounds per square foot in conjunction with earthquake loads appears to be conservative. This snow load corresponds to a mean recurrence interval of approximately 100 years and does not account for any load reduction due to snow slide-off on the steeper roof slopes. If the ASCE 7-88 (1990) load combination factors are used, then the design snow load with a 50-year recurrence interval could be used in conjunction with earthquake loads.

- The design load criteria shall account for the possibility of combined seismic and impounded fluid loading for the outer tank. This load combination could be critical for the so-called "double integrity" tank designs.

- Since snow load is one of the controlling design factors, the design basis for snow load shall be consistent with that for earthquakes. Therefore, the design for maximum snow load shall use an annual failure probability of 10^{-4}.

- For the double integrity tanks, the secondary containment is not isolated from the primary containment, thus creating the potential for collapse of the outer tank as the inner tank fails. There does not appear to be a structurally independent impounding system.

- The detail for the joint between the floor of the double concrete wall tank needs additional development to assure proper function under strong ground shaking and possible differential movements and settlement of the tank footing.

- The behavior of the circumferential prestressing for the double concrete wall tank is unclear in the event of a wire failure due to corrosion or wind borne missile impact.

- Weathering effects on the bedrock formation could affect the rock anchors for the tank foundation and rock slopes in the project area.

viii. Yukon Pacific shall develop plans to mitigate the effects of damaging waves (especially those resulting from subsea landslides) on the marine terminal facilities and on tankers at berth.

xi. Yukon Pacific shall conduct an analysis of rock slope stability and potential effects of snow avalanches on the plant, especially under seismic conditions, and incorporate appropriate mitigative measures into the plant design and operation plans.

16. To clearly demonstrate water supply requirements for the proposed facilities, Yukon Pacific shall prepare, in consultation with the ADFG, and file with the Secretary, a detailed water balance and design supply analysis, prior to initiation of construction.

17. Yukon Pacific, in consultation with the ADFG, ADNR, and ADEC and in conjunction with preparation of the detailed water balance and design supply analysis, shall conduct an in-stream flow study to determine the minimum flow requirements to minimize impact on spawning fish and maintain flow through Seven Mile Creek above the minimum levels. The results of this study, based on a minimum of 2 years flow monitoring, shall be

reviewed with the ADFG, ADNR, and the ADEC for consideration of additional flow regulation mitigation. The results of the study incorporating comments of reviewing agencies, shall be filed with the Secretary for review and approval by the Director of OPR.

18. Yukon Pacific, prior to commencing construction, shall develop and file with the Secretary for review and approval by the Director of OPR, a Spill Prevention, Containment, and Countermeasure Plan (SPCC Plan) that would describe the preventive and mitigative measures it would employ to minimize the impact associated with accidental spills, both in freshwater streams as well as those that may occur in nearshore marine waters. These measures shall include but not be limited to: requiring all fueling and lubricating to be done in areas designated for such purposes, with such areas to be located at least 100 feet away from all waterbodies; specifying collection and disposal procedures for wastes generated during vehicle maintenance; requiring each construction crew to have on hand sufficient supplies of absorbent and barrier materials to allow the rapid recovery of any spills; and development of standing procedures regarding excavation and offsite disposal of any soil materials contaminated by spillage. In addition, Yukon Pacific shall ensure that construction contractors are able to demonstrate to environmental, local, or state inspectors their ability to implement the SPCC Plan. The SPCC Plan shall also identify the types and quantities of hazardous materials that would be stored or used on the construction site.

19. To document compliance with Federal and state stormwater discharge requirements, Yukon Pacific shall develop a stormwater monitoring plan. This plan shall be developed in conjunction with the new National Pollutant Discharge Elimination System (NPDES) stormwater permit requirements that will be imposed under Section 402 of the Clean Water Act (40 CFR Part 122.26(c)(ii)). This plan shall be prepared in conjunction with the site-specific Erosion and Sediment Control Plan and shall provide a detailed description of the stormwater collection and treatment process, including best management practices to control pollutants in stormwater discharges during both construction and operation. These plans shall be filed with the Secretary, and provided to the EPA as part of the documentation with the NPDES permit application.

20. To prevent potential disturbance of the limited anadromous and resident fish habitat in Nancy Creek, the cargo dock access road crossing shall be made above a small falls which may currently be acting as a fish barrier.

21. To minimize impacts due to siltation on spawning gravels and incubating redds from construction and from road runoff, (1) any in-stream construction shall be limited to the period between May 15 and July 15 when there are no spawning fish or incubating redds present, and (2) sediment traps shall be placed along the road to prevent fines from running off into the stream. To prevent loss or disruption of habitat, there shall be no other in-stream construction activity or in-stream equipment crossing or fording the streambed at any time. Any temporary crossing structures shall be limited to portable construction bridges or crushed, clean rock and culvert bridges.

22. No construction equipment or in-stream activity shall occur in Seven Mile Creek below the falls and any in-stream construction or activity which may cause siltation (above and below the falls) shall be scheduled between May 15 and July 15 when there are no salmon or incubating redds present in the stream.

23. Yukon Pacific shall prepare a revised site plan that avoids grading and clearing the riparian zones within 100 feet of the streambanks along Seven Mile Creek above the proposed dam. The revised plan shall also avoid grading and clearing to preserve the gorge area surrounding the water falls and the associated intertidal shoreline area located on either side of the confluence of Seven Mile Creek and Anderson Bay. The revised plan shall be filed with the Secretary for review and approval by the Director of OPR.

24. Yukon Pacific shall conduct surveys for bald eagle nest sites during the year prior to the commencement of site activities and each year subsequently, to determine nesting activity at the site. If active nests are found, Yukon Pacific must consult with the FWS to ensure the project does not violate the Bald and Golden Eagle Protection Act.

25. Yukon Pacific shall contact the FWS and ADFG regarding convening a panel of agency bear experts and develop, in consultation with the ADFG, the FWS, and the Valdez Chief of Police, a plan to mitigate impacts on bears arising from both habitat loss and from bear/human interaction. This plan shall detail procedures for avoiding human/animal conflicts and shall stress implementation of an education program for workers, in addition to methods of bear-proofing the site. This plan shall be filed with the Secretary for review and approval by the Director of OPR prior to initiation of construction.

26. Yukon Pacific shall, where feasible, maintain a natural, uncleared vegetative buffer strip at least 50 feet wide between construction areas and waterbodies. Yukon Pacific shall indicate the location and size of these buffer strips on its final site plans that would be filed with the Secretary prior to construction. Where Yukon Pacific believes maintenance of a 50-foot-wide buffer strip would be infeasible, Yukon Pacific shall file with the Secretary for review and approval by the Director of OPR prior to construction a detailed explanation of why the required buffer strips cannot be maintained. Yukon Pacific shall include with this explanation a description of alternative sediment control measures that would be employed on a site-specific basis instead of maintaining the vegetative buffer strip.

27. Yukon Pacific shall file with the BLM/JPO for review and with the Secretary for review and approval by the Director of OPR prior to construction a revised wetland mitigation plan based on the final site grading, excavation, and spoil disposal plans that contains the following:

- field delineations and results from site investigations that verify the size, vegetation, and functional values (including salmon and waterfowl habitat) of the wetlands and subtidal marine habitats that would be affected or enhanced on and off the site;

- identification of, and proposed mitigation for, all the subtidal marine habitats that would be affected by the site's development and a discussion of the proposed mitigation's probability of success;

- identification of the locations and land ownership of the proposed mitigation and enhancement areas;

- a detailed literature review of the other wetland and subtidal marine habitat mitigation projects that have been conducted in the Pacific Northwest, including a summary of the successes and failures of these projects;

- site-specific construction plans that incorporate information learned from the literature review regarding how the proposed mitigation would be implemented including detailed information regarding the key factors that are known to influence the success of wetland construction (e.g., elevation, substrate, hydrology);

- details regarding how the proposed wetland mitigation would be monitored and evaluated following construction to ensure its success; and

- written comments, if received, from the JPO, COE, NMFS, FWS, and EPA on Yukon Pacific's revised wetland mitigation plan.

28. Yukon Pacific shall use a dilution model to design the diffusers for the high temperature of the desalination and HRSG/Blowdown discharges, and determine the vertical extent of the mixing zone so that the surface and bottom thermal layers of Port Valdez are not subject to periodic surges of hot water.

29. Yukon Pacific shall require ballast water discharge/exchange to occur at least 10 kilometers south of Hinchinbrook Entrance, in addition to its proposed 36-hour period, in order to protect against any waiting or slow travel scenarios.

30. Yukon Pacific, in consultation with the ADFG, ADNR, and FERC, shall develop and conduct a salmon fry utilization study, designed to determine the importance of the nearshore areas affected by plant construction relative to other areas in Port Valdez. In particular, the proposed B′ disposal area must be addressed in detail. This study along with proposed mitigation shall be submitted to the ADFG and ADNR and filed with the Secretary for review and approval by the Director of OPR.

31. Yukon Pacific shall prepare a blasting plan that considers the following measures: (1) scare charges and/or bubble curtains to move resident fish away from the area prior to blasting, (2) coordination with the ADFG and the Solomon Gulch hatchery personnel to schedule blasting activities when adult or juvenile salmon are likely to be in the area, and (3) use of NMFS-approved spotters or lookouts, to ensure marine mammals are not present within the zone of influence prior to blasting.

32. Yukon Pacific shall consult with the EPA, ADFG, and NMFS to determine the allowable location, frequency, and duration of warm water discharges into Port Valdez.

33. Yukon Pacific shall file a copy of all air emission permit and open burning permit applications submitted to the ADEC with the Secretary. Specifically, Yukon Pacific must file its PSD permit from the ADEC prior to receiving a written notice to proceed with any construction from the Director of OPR.

34. Yukon Pacific shall file with the Secretary a revised acoustical analysis of the Anderson Bay LNG site reflecting far-field sound data of equipment finally selected (from either the manufacturer or a similar unit in service elsewhere), manufacturer's specifications and

attenuation data for the intake and exhaust silencers finally selected, and the actual noise control equipment, for review and written approval of the Director of OPR before commencing construction of the compressor facilities.

35. Yukon Pacific shall file with the Secretary a noise survey of the Anderson Bay LNG Terminal no later than 60 days after placing the terminal in service. If the noise attributable to the operation of the facility exceeds an Ldn of 55 dBA at nearby NSAs, additional noise controls shall be added to meet that level within 1 year.

36. Yukon Pacific shall file with the Secretary for review and approval by the Director of OPR prior to construction a visual mitigation plan that includes:

- shoreline protection measures that provide a more natural appearance by preserving existing landform and mature vegetation at prominent features along the shoreline, developed in conjunction with the recommended 50-foot-wide vegetation buffer strips; and

- landscape and architectural treatments that reduce the contrast of the aboveground structures with the natural landscape.

37. Yukon Pacific shall not disturb the monument to Harry Alden Henderson at Anderson Bay.

38. An additional technical conference (or conferences) shall be held as engineering design develops so that present areas of uncertainty may be more fully explored. These conferences shall be held <u>prior</u> to initiating construction at the site. At least one technical conference shall be held <u>prior</u> to initiation of construction after designs are finalized and major vendors (including LNG and other major storage tanks) have been selected and complete design details have been submitted to FERC staff. The applicant shall also provide design details to the Office of Pipeline Safety of the DOT and the U.S. Coast Guard Captain of the Port of Valdez so that they may have the opportunity to participate in the technical conferences to assure compliance with their applicable regulations.

39. Yukon Pacific shall not commence construction without a written notice to proceed from the Director of OPR. Any major alterations to facility design shall be filed with the Secretary for review and written approval by the Director of OPR prior to initiation.

40. Onsite staff inspections shall be conducted with Yukon Pacific as significant milestones develop during the construction phase and <u>prior</u> to commencement of initial facility operation.

41. Following commencement of operation, the facility shall be subject to regular FERC staff technical reviews and site inspections on at least a biennial basis or more frequently as circumstances indicate. <u>Prior</u> to each FERC staff technical review and site inspection, the company shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations, provision of up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below.

42. Yukon Pacific shall submit quarterly reports to the FERC after initiating construction and semi-annually thereafter through the operational period. During the construction phase the quarterly reports shall provide construction status of major components including significant design and schedule modifications required (and/or anticipated). The reports also shall address changes in facility design including anticipated future plans. During the operational phase the semi-annual reports shall provide changes in facility design and operating conditions, abnormal operating experiences, activities (liquefaction and LNG shipping schedules), plant modifications including those proposed during the forthcoming 12-month period. Abnormalities shall include but not be limited to storage tank vibrations and/or vibrations in associated cryogenic plumbing, storage tank settlement, significant equipment and instrumentation malfunctions or failures, nonscheduled maintenance or repair (and reasons therefore), relative movement of the inner vessel, vapor or liquid releases, fires involving natural gas, refrigerants and/or from other sources, negative pressure (vacuum) within the LNG storage tanks and higher than predicted boiloff rates. The reports shall be submitted within 45 days after each period ending December 31 and June 30. Included shall be a section entitled "Significant plant modifications proposed for the next 12 months (dates)". The section shall be included in the semi-annual operational reports to provide Commission staff with early notice of anticipated future construction and maintenance projects at the LNG terminal.

43. A permanent all-weather access road shall be built and maintained year-round to allow emergency equipment and personnel access/egress between the plant and the City of Valdez.

44. If double- or increased-integrity LNG storage tanks are selected, Yukon Pacific shall submit to the DOT for approval, and to the FERC, the equivalent impact load analysis required by Section 193.2161(b) and 193.2155(c) of the DOT regulations. If written approval of the impact analysis cannot be obtained, Yukon Pacific shall construct separate and independent impounding systems for such storage tanks consistent with existing standards and codes.

45. Yukon Pacific shall establish direct telephonic linkage with the Alyeska Terminal and the Coast Guard Vessel Traffic Center in Valdez and ensure that procedures for notification and response to potential incidents are included in the emergency plans for each facility.

46. Yukon Pacific shall comply with the following Coast Guard recommendations prior to commencement of shipping activities.

- an LNG tanker and any other tank vessel shall not be underway at the same time in Valdez Arm, Valdez Narrows, or Port Valdez;
- LNG tankers shall enter the Traffic Separation Scheme (TSS) at Hinchinbrook Entrance;
- LNG tankers shall be conned (i.e. direct the steering of the tanker) by a pilot licensed for the portion of Prince William Sound being transited;
- an LNG tanker and any other tank vessel shall maintain a separation of not less than 5 nautical miles, except when the LNG tanker or the other tank vessel is moored, at anchor, or in the opposing lane of the TSS;

- unless moored at the terminal in Port Valdez, an LNG tanker shall be attended by an adequate number of ship assist tugs;

- while in the VTS Area, all LNG tankers shall have a towing bridle or wire rigged and ready for immediate use; and

- all VTS regulations that apply to tank vessels greater than 20,000 deadweight tons shall also apply to LNG tankers regardless of size.

47. Yukon Pacific shall conduct a study by a creditable firm to review the operation of the VTS and provide suggestions for reducing the risks involved with the inclusion of LNG tankers in the system.

48. Yukon Pacific shall confine the camp site to the west bank of Seven Mile Creek and configure the layout so as to leave the shoreline of Port Valdez in a natural (ungraded and vegetated) condition. When the construction period is finished, the camp shall be dismantled and removed from the site and the area restored vegetatively in accordance with a plan to be developed in conjunction with the Trans-Alaska Gas System Mitigation Policy of April 25, 1994.

APPENDIX A

REVIEW COMMENTS ON THE DESIGN CRITERIA FOR THE ANDERSON BAY TERMINAL OF THE TRANS-ALASKA GAS SYSTEM

REVIEW COMMENTS ON THE DESIGN CRITERIA FOR THE ANDERSON BAY TERMINAL OF THE TRANS-ALASKA GAS SYSTEM

Felix Y. Yokel, Richard D. Marshall
National Institute of Standards and Technology
December 23, 1992

SCOPE OF WORK

At the request of the Office of Pipeline and Producer Regulation, Federal Energy Regulatory Commission, a review was undertaken of the geoseismic studies, design criteria and supporting data for the proposed Anderson Bay Terminal of the Trans-Alaska Gas System. Specifically, this review addresses the liquefied natural gas (LNG) storage tanks and compliance of the seismic investigation and structural design criteria with the requirements of 49 CFR Part 193 and related codes and standards. By necessity, certain design criteria and structural details included in this review are preliminary and are subject to change. Activities in support of this review included participation in a public hearing at Anchorage, Alaska on May 20, a visit to the proposed site at Anderson Bay, Port of Valdez, on May 21, 1992, and review of Yukon Pacific Corporation (YPC) responses to queries by the National Institute of Standards and Technology (NIST) and by the United States Geological Survey (USGS).

DOCUMENTS REVIEWED

The comments address the following documents:

1. Yukon Pacific Corporation, "LNG Storage Tank Study, LNG Plant/Marine Terminal, Anderson Bay, Alaska," July 18, 1991.

2. Preload, Inc., "Yukon Pacific Project (4) 800,000 BBL Tanks, Preload Drawing SK-1, Rev. 2, (and Drawing SK-2)," April, 1992.

3. Bechtel Corp., "Yukon Pacific Trans-Alaskan Gas System (TAGS), Anderson Bay Facility Site Design Data," Issued to YPC on 2/14/91.

4. Donovan, N., "Seismic Hazard Study for the Anderson Bay Terminal of the Trans-Alaska Gas System," Dames and Moore, July, 22, 1991.

5. Hall, W.J., "Seismic Design Criteria for the Anderson Bay Terminal of the Trans-Alaska Gas System," July, 22, 1991.

6. Wen, K.Y., and Tang, W.,"Risk Analysis on Zero Period Acceleration (ZPA) at Anderson Bay Site," Executive Summary, July 22, 1991.

7. Geologic and Seismic Studies, Trans-Alaskan Gas System, Anderson Bay LNG Terminal, Port Valdez, Alaska," Dames and Moore, July 1991, Executive Summary.

8. Yukon Pacific, C3 - 4, Seismic Baseline; Seismic Design Criteria, July, 1991.

9. Dames and Moore, "Geologic and Seismic Studies - Trans-Alaska Gas System Anderson Bay LNG Terminal, Port Valdez, Alaska," 2 Vol., July 22, 1991.

10. Yukon Pacific Corporation Responses to National Institute of Standards and Technolog queries 1 to 4 and United States Geological Survey questions 1 to 4.

SEISMIC DESIGN CRITERIA

The seismic design criteria adopted for the site are summarized in Document 8, and are said to be based on studies reported in Documents 4 to 6. These criteria, which apply to sites on rock and controlled compacted fill, are:

1. an **Operating Basis Earthquake** (OBE) with a free field effective horizontal acceleration of 0.4 G.

2. a **Maximum Design Earthquake** (MDE) with a free field effective horizontal acceleration of 0.55 G.

These recommendations are generally supported by Documents 4 to 6. However, in Document 6, Figure 9, the zero period accelerations with an annual exceedence probability of 10^{-4} are recorded as follows:

Upper Bound Estimate	0.72 G
Lower Bound Estimate	0.35 G
Reasonable Estimate	0.51 G
Conservative Estimate	0.62 G

For LNG installations, the provisions of the Code of Federal Regulations, 49 CFR Part 193, apply. Guidelines for site exploration are given in NBSIR 84-2833, "Data Requirements for the Seismic Review of LNG Facilities" (Kovacs et al., 1984).

The CFR requirements for seismic investigation and design forces, as given in § 193.2061 and applicable to this project, are interpreted herein as follows:

> In accordance with (c) the seismic design forces shall be determined on the basis of a detailed geotechnical investigation in accordance with paragraphs (d) and (e). This investigation must include (1) Identification of faults and their Quaternary activity, tectonic structures, static and dynamic properties of the subsurface profile and, as applicable, tectonic provinces within 100 miles; (2) Identification and evaluation of all historically reported earthquakes which could affect the determination of the most critical ground motion or differential displacement; and (3) Evaluation of the hydraulic regime and the potential for soil liquefaction.
>
> In accordance with (d) the most critical ground motion must be determined probabilistically with a yearly probability of 10^{-4} or less, or deterministically with the objective of attaining this probability.
>
> In accordance with (e) the determination of the most critical ground motion includes (1) Use of an appropriate attenuation relationship, (2) Development of a horizontal design response spectrum determined from the mean + 1 standard deviation of the free field elastic response spectra

consistent with the most critical ground motion; and (3) A vertical design response spectrum that is equal to the horizontal design response spectrum when the earthquake source is 10 miles or less from the site, or at least 2/3 of the horizontal design response spectrum otherwise.

In accordance with (f), the site is not acceptable for LNG tank and dike construction if : (1) The estimated design horizontal acceleration exceeds 0.8 G; (2) The data base is sufficient to predict future differential displacements, but displacements not exceeding 30 inches cannot be assured, (3) The data base is not sufficient to predict future displacements, and the estimated cumulative displacement of a Quaternary fault within 1 mile of the tank foundation exceeds 60 inches; and (4) The potential for soil liquefaction cannot be accommodated by suitable design and construction.

Section (g) details the information to be included in the application for approval.

Comments:

A review of the Yukon Pacific seismology study, conducted by USGS, is presented in Appendix A to this document. The following comments are based in part on this latter review. The USGS review includes consideration of the YPC responses to USGS questions 1 to 4 (Document 10).

The seismicity of the region is discussed by Donovan (Document 4). In our opinion the scope of the information provided in Document 4 and in the related geoseismic studies referenced therein satisfies the CFR requirements for seismic information and the evidence presented does not indicate that the site is unsuitable for construction of LNG storage tanks and dikes in accordance with § 193.2061 (f) of the Code of Federal Regulations.

One of the important conclusions of the Yukon Pacific seismologic studies is that, during the service life of the LNG project, the chance for a repeat of a great subduction zone earthquake similar (in terms of moment magnitude and source distance) to the March, 1964 earthquake in the Prince William Sound area is remote, and thus can be discounted. A great subduction zone earthquake is judged possible in the Yakataga region (the "Yakataga Gap") approximately 100 km from the project site.

The "service life" in these studies was defined as 25 to 30 years. However, in accordance with information conveyed in Anchorage on May 20, 1992, the natural gas supply is sufficient to operate the facility for close to 200 years. We therefore believe that serious consideration should be given to the possibility that the facility may be operated for more than 30 years. Additionally, it will take several years to complete the construction of the facility. These years should be added to the projected service life. YPC should develop an acceptable rationale for their choice of a design service life.

While Yukon Pacific presented evidence to support their conclusion that the possibility of a great earthquake in Prince William Sound can be disregarded, we believe the Yukon Pacific scenario is not the only credible one that can be deduced from the available data. In Appendix A to this document it is observed that in the western Aleutian zone an $M_w 8.0$ earthquake occurred in the rupture zone of the 1957 $M_w 8.6$ earthquake after an interval of only 29 years. It is noted in Appendix A that an intracycle earthquake of $M_w > 8$ could conceivably occur near the end of the projected (by YPC) 30-year service life. We therefore believe that the $M_w 7\frac{3}{4}$ intracycle earthquake recommended as the design earthquake may not be conservative enough.

Another factor also should be taken into consideration: For the tank dimensions contemplate hydrodynamic effects would have a fundamental period on the order of 10 seconds and very low dampi (a critical damping ratio on the order of 0.5%). The wavelength associated with a 10-second period approximately 35 km. Thus the applicable low frequency component of a ground motion originating fro a great earthquake in the Yakataga area, about 100 km from the site, would not be significantl attenuated. Therefore, the potential effects of an $M_w > 8$ earthquake in the Yakataga Gap region mus be taken into consideration in the long-period portion of the design spectrum and in the evaluation o sloshing effects.

For the previously discussed reasons we suggest that more conservative seismic design criteria for th LNG tanks should be considered by Yukon Pacific.

Proposed design spectra for the MDE and the OBE earthquakes are presented by Hall (Document 5). Response spectra derived by Donovan (Document 4) on the basis of attenuation relationships for subduction zone earthquakes are shown in Figure 6.1 of Document 4 to fit within an elastic response spectrum for 5% damping derived in the same way as the MDE spectrum presented by Hall. This is taken by YPC as a corroboration of the design spectra proposed by Hall. The Donovan response spectra are discussed in Appendix A. We have several comments on the Hall spectra:

1. **Damping and Ductility**: As previously noted, we believe that the possibility of an M_w8+ near-source earthquake during the service life of the facility should not be categorically ruled out. In a great earthquake the duration of shaking would be longer, and cyclic strength degradation and ductility demand would be more severe than in the assumed $M_w7¾$ magnitude design earthquake. The MDE design spectrum recommended by Hall assumes a damping value of 7% of critical. According to Table 2 in the Hall report, this represents the lower bound of recommended values for prestressed concrete with no prestress remaining. While this damping value seems reasonable for the stated condition of the structure, we question the ability of a prestressed concrete tank to contain LNG without a major spill if this condition were allowed to develop, particularly in the case of a great earthquake where the duration of shaking would be relatively long.

The use of a ductility ratio of 1.2 should also be examined for the case of a longer-duration earthquake. The selection of a ductility ratio carries with it the need to ensure that it actually is achieved reliably through proper selection of materials, proper structural detailing, and reliable quality assurance procedures, and that the deformations associated with this ductility ratio do not cause failure. In Document 10 (7/15/92, last paragraph) it is stated that the selection of overly conservative values for damping and ductility would introduce dangers from overly stiff and brittle behavior mechanisms. However, it is also stated in Document 10 that in the case of an LNG tank the damping (and probably also quasi-ductile behavior) is primarily derived from frictional mechanisms at the double-bottom surface and from the perlite packing, mechanisms which are not associated with the deformation of the tank itself. It is therefore not obvious that a stronger and stiffer inner tank would necessarily lead to brittle behavior mechanisms. Allowable deformations of LNG tanks in the MDE must be predicated on the premise that an LNG spill would lead to failure, even if it is not triggered by total structural collapse.

2. **Effective Acceleration, Velocity, and Displacement**: Hall uses 0.4 G and 0.55 G, respectively, for effective acceleration of the OBE and MDE. The MDE value can be compared with the "reasonable estimate" of the zero period acceleration in Document 6. The "conservative estimate" is 0.62 G, and the "upper bound" estimate is 0.72 G. Thus, even though effective accelerations are generally smaller than the corresponding zero period values, the study in Document 6 suggests that the value of effective acceleration recommended for the MDE may be on the low side. Another source of information is the NEHRP provisions which are resource documents for standards developed by a consensus process (NEHRP, 1988 and 1991). In the appendix to the 1988 version, Figures 1-7 and 1-8 present maps with contours for horizontal accelerations and velocities in rock with a 90% probability of not being exceeded in 250 years. These maps were prepared by USGS and are referred to in the following discussion as NEHRP-250. For Anderson Bay the NEHRP maps show values in excess of 0.8 G for ground acceleration, and in excess of 80 cm/s (800 mm/s) for ground velocity. The service life of the LNG project could be 200 years which is not much less than the 250-year period for which the USGS maps were prepared. The USGS values for maximum ground acceleration and velocity would be associated with a much more conservative design spectrum than that recommended by Hall. We believe that YPC should review their recommendation for effective acceleration for the MDE in view of the possibility that the service life of the facility could exceed 30 years and that the intracycle earthquake could exceed the $M_w 7\frac{3}{4}$ projected in the YPC study.

3. **Design Spectra and Hydrodynamic Effects**: The spectra proposed in Document 5 are plotted as recommended by Newmark and Hall (1982). However, in this instance, long-period motions of long duration could be transmitted from a magnitude 8+ earthquake originating in the Yakataga Gap. The effect of increasing the spectral response for long periods would be to significantly increase the estimated hydrodynamic effects which have a long period. The wave height due to sloshing of the tank contents was evaluated (see Figures 6.5 and 6.6, Appendix C, Document 1) on the basis of TID 7024 (AEC, 1963). There is more recent information on sloshing effects and Hall (Document 5) notes that "... the U.S. expressions for sloshing tend to be on the low side of observations, and that the Japanese standards are believed to be more representative of the observed sloshing." The tank freeboard provided for sloshing and the hydrodynamic forces associated with sloshing should be no less than those associated with an $M_w > 8$ earthquake in the Yakataga Gap region.

4. **Subsurface Conditions:** The spectra recommended by Hall are for structures on rock and compacted fill. We suggest that, for all foundations which are not supported on rock, spectra for "competent soil" as recommended by Newmark and Hall (1982) be used.

5. **Vertical Accelerations**: The level of vertical accelerations recommended by Hall is 2/3 of the horizontal accelerations. In CFR 193 it is stated that for source distances less than 10 miles (16 km) horizontal and vertical accelerations should be assumed equal. It is true that the likely source distance of the design earthquake is 12, rather than 10 miles (20, rather than 16 km). However, the horizontal projection of the source distance is zero. It is therefore suggested that the rationale for the choice of vertical accelerations should not be solely based on a literal interpretation of the CFR provisions.

It is not the intention of this review to recommend specific design spectra. However, it is suggested that consideration should be given to a more conservative approach to seismic design. In particular, consideration should be given to a more conservative value for the free field effective acceleration for the MDE and more conservative spectral values for calculating sloshing effects because of the greater amplification that would result from a great earthquake of long duration.

In their feasibility study of the LNG tanks (Document 1, Appendix C), Chicago Bridge and Iron (CB&I) used effective horizontal accelerations of 0.4 G and 0.6 G for the OBE and the MDE, respectively. CB&I assumed 7% structural damping and 0.5% damping for hydrodynamic effects. The ductility ratio was assumed to be unity. While the CB&I spectra were used for study purposes only, they establish the feasibility of designing the LNG storage tanks using spectra which are much more conservative than those recommended by Hall.

WIND LOADS

49 CFR, Part 193, contains the following applicable requirements for the design of LNG facilities to resist wind forces:

§ 193.2067 Wind forces.

(a) LNG facilities must be designed to withstand without loss of structural or functional integrity:
(1) The direct effect of wind forces;
(2) The pressure differential between the interior and exterior of a confining, or partially confining, structure; and
(3) In the case of impounding systems for LNG storage tanks, impact forces and potential penetrations by wind borne missiles.

(b) The wind forces at the location of the specific facility must be based on one of the following:
(2) For all other LNG facilities:
(i) An assumed sustained wind velocity of not less than 200 miles per hour, unless the Administrator finds a lower velocity is justified by adequate supportive data; or
(ii) The most critical combination of wind velocity and duration, with respect to the effect on the structure, having a probability of exceedence in a 50-year period of 0.5 percent or less, if adequate wind data are available and the probabilistic methodology is reliable.

Comments:

The design wind speed listed in Appendix B (Design Criteria) of Document 1 is 110 mph or 49.2 m/s. Presumably this value was obtained by multiplying the basic wind speed for the proposed site (ASCE, 1990, Figure 1) by an importance factor of 1.05. This factor is intended for use with Category I (ordinary) structures in hurricane-prone regions to provide the same probability of overload that applies to the non-hurricane regions of Figure 1. A Category I structure designation as well as wind speed adjustments for hurricane conditions are inappropriate in this case. The associated mean recurrence interval for the selected design wind speed is 50 years (annual probability of being exceeded equal to 0.02). In view of items (b)(2)(i) and (ii) above, it is clear that an annual probability of 0.02 is unacceptable for the design of LNG tanks to resist wind effects. In fact, the requirement of item (b)(2)(ii) corresponds to an annual probability of 10^{-4}, or a mean recurrence interval of 10,000 years. Unless it can be demonstrated otherwise, the basic wind speed to be used for facility design is 200 mph or 89.4

m/s. Although Appendix C (LNG Storage Tank Study Evaluation) of Document 1 cites this value of 200 mph, no actual wind load calculations are presented.

In response to Query (3a), YPC notes that the design wind speed of 110 mph given in Document 1 was intended to apply to § 193.2067 (b)(1) and not to the design of the proposed LNG storage tanks. For preliminary design evaluation, a sustained wind speed of 200 mph was assumed as is noted in Appendix C of Document 1. YPC state their intention to carry out a formal probabilistic analysis of local wind data to determine whether or not a lower design wind speed is justified.

One approach to satisfying the requirement of (b)(2)(ii), and thus obtain some relief from the 200 mph design requirement, is to utilize the wind speed distributions contained in Simiu, et al. (1979) which extend to return periods of 10,000 years and beyond for extratropical storms. Analyses of data used to develop the wind speed distributions shown in Figure 3.2.3 of ANSI/ANS-2 (1983) indicate that for the western United States, design speeds corresponding to annual probabilities of 10^{-4} are dictated by extratropical storms rather than by tornadoes. Given the relatively lower frequency of tornadoes in Alaska, it is to be expected that extratropical storms also will dictate design speeds of similar annual probability for Alaska. It is reasonable to expect this approach could lead to a substantial reduction in the requirement of (b)(2)(i). However, the resulting wind speed will be the fastest-mile speed (as opposed to sustained speed) at 10 m in open terrain (standard exposure). Adjustments will be required for the over-water wind fetch at the site and for local topographic effects (flow over an escarpment). Although ASCE 7-88 (1990) does not address local topographic effects, guidance can be obtained from other sources such as AS 1170.2 (1989).

Given the magnitudes of the design earthquake and snow loads for the proposed site, it is doubtful that wind loads will have a significant effect on the LNG storage tank design. Nevertheless, it is important that these loads be accounted for. Particularly critical are the uplift forces, both local and global, acting on the roof structure in combination with the design internal positive pressure. Note that this loading will, in certain cases, cause load reversals in members designed for dead load plus snow load.

SNOW LOADS

49 CFR, Part 193, contains the following applicable requirements for the design of LNG facilities to resist loads due to ice and snow:

§ 193.2139 Ice and snow.

(a) Components must be designed to support the weight of ice and snow which could normally collect or form on them.
(b) Each operator shall provide protection for components from falling ice or snow which may accumulate on structures.

§ 193.2189 Loading forces.

Each part of an LNG storage tank must be designed to withstand without loss of functional or structural integrity any predictable combination of forces which would result in the highest stress to the part, including the following:

(h) Predictable snow and ice loads.

Comments:

A ground snow load of 235 psf (11.25 kPa) is cited in Appendix B (Design Criteria) of Document 1 as the basis for design snow loading of the LNG storage tanks. This loading is converted to an equivalent flat-roof loading, p_f, using the requirements of ASCE 7-88 (1990). For Alaskan stations, the conversion formula is

$$p_f = 0.6C_eC_tIp_g$$

where C_e is an exposure factor to account for wind effects on roof snow accumulation, C_t is a thermal factor to account for heating of the structure, I is an importance factor to account for the risk of overload, and p_g is the ground snow load corresponding to a mean recurrence interval of 50 years.

The flat-roof loading is calculated in Appendix C (LNG Storage Tank Study) of Document 1 using the following values for the factors in the conversion formula:

C_e = 1.0 (Locations in which snow removal by wind cannot be relied upon to reduce roof loads because of terrain, higher structures, or several trees nearby)

C_t = 1.2 (Unheated structure)

I = 1.0 (Normal case: mean recurrence interval = 50 years)

p_f = (0.6)(1.0)(1.2)(1.0)(235) = 169 psf = 8.09 kPa

In response to Query (2a), YPC notes that the 100-yr ground snow load provided by the National Weather Service for Valdez is 195 psf (9.34 kPa), and the corresponding value provided by the Soil Conservation Service is 169 psf (8.09 kPa). The higher value was selected as a basis for the 100-yr ground snow load at Valdez. To account for local variations between the south and north shores of Port Valdez, a "local variation adjustment factor" of 1.2 was determined "by consensus." Also, YPC notes that this factor may be adjusted on the basis of additional meteorological data that will become available at Anderson Bay prior to development of final snow load design criteria.

ASCE 7-88 (1990) specifies a 50-yr ground snow load of 170 psf (8.14 kPa) for Valdez and the corresponding 100-yr value is (1.2)(170) = 204 psf (9.77 kPa). If the "local variation adjustment factor" of 1.2 is correct, then the 100-yr ground snow load at the Anderson Bay site would be (1.2)(204) = 245 psf (11.73 kPa). The equivalent 100-yr flat-roof snow load would be (0.6)(1.0)(1.2)(1.0)(245) = 176 psf (8.43 kPa). Note that an importance factor of 1.0 is applied here since the ground snow load corresponds to the 100-yr value. According to the criteria of ASCE 7-88, the annual probability that the equivalent flat-roof snow load of 169 psf (8.09 kPa) proposed by YPC will be exceeded is somewhat greater than 0.01.

The adoption of such a low load intensity (or high annual probability) for the preliminary design evaluation is the subject of Query (2b). YPC's response to this query attempts to justify their use of an importance factor of 1.0 for snow load on the grounds that the only structural classification in ASCE 7-88 that covers LNG tank facilities is Category I. If this were true, then the equivalent flat-roof snow load should be based on the 50-yr ground snow load, not the 100-yr value, and the corresponding annual probability would be 0.02. This obsession with structural classification for snow loads is perplexing in view of the fact that such classification does not appear to be a problem with the development of criteria for wind or earthquake loads, both of which include provisions for structural classification in ASCE 7-88.

If the risk of tank failure due to snow load alone is to be consistent with that due to earthquake or wind, the associated annual probability of the ground snow load being exceeded should be approximately 10^{-4}. The appropriate multiplier (importance factor) to be applied to the 50-yr ground snow load will depend on the cumulative probability distribution function that best models the series of annual extremes for Port Valdez (with due regard for local variations between south and north shore) and an analysis of this series needs to be carried out. Some cumulative probability distribution functions that have been used to model ground snow load data are described by Sack (1989).

The calculated flat-roof design snow load does not account for the likelihood that snow near the perimeter of the tank will slide off due to the steeper roof slope, and this has been noted by YPC in their response to Query (2b). If the tank design and piping details are such that a slippery and unobstructed roof surface is assured, then a slope factor, C_s, should be applied, consistent with the requirements of Section 7.4 of ASCE 7-88 (1990), or with the requirements of other accepted tank design standards.

COMBINED LOADS

While it is appreciated that the load criteria are incomplete and/or uncertain at this time, it is important that deficiencies and inconsistencies be identified so that flawed criteria do not become part of the final design criteria. The design loads and load combinations employed in the preliminary storage tank evaluations are described in Document 1. Specific comments concerning the seismic design criteria, wind loads and snow loads have been presented in other sections of this document. Load combinations that relate to specific containment schemes are discussed in this section.

Load Combination Factors:

In Appendix C of Document 1, the load combination factor of 0.75 for D+S+E as required by ASCE 7-88 (1990) is reduced to 0.66 for the case of the OBE. The justification given for this reduction is that "... the earthquake loads are much higher than contemplated in ASCE 7-88." However, it is also true that the acceptable risk of failure for LNG storage tanks is substantially less than the risks of failure deemed acceptable for ordinary buildings and structures. The load combination factor of 0.75 specified in ASCE 7-88 (1990) should be used unless a more clear and convincing justification for a lesser value can be provided.

Combined Seismic and Snow Loading:

For the design conditions outlined in Appendix C of Document 1, the calculated flat-roof snow load of 169 psf (8.09 kPa) is assumed to act in conjunction with the earthquake loads. This load combination appears to be overly conservative, given that the two loading events are uncorrelated and that the design snow load corresponds to a mean recurrence interval of approximately 100 years. The apparent conservatism is offset somewhat by the choice of 0.66 (vs. 0.75) for a load combination factor. In view of the associated risk, it would appear more reasonable to base the combined snow and earthquake loading on the 50-yr flat-roof snow load and to expect some load reduction due to snow slide-off with the commencement of strong ground shaking. However, this reduced snow load should not be used in conjunction with a reduced load combination factor.

Combined Seismic and Impounded Fluid Loading:

The load combinations considered by CB&I (Appendix C, Document 1) in their evaluation of the o tank do not include the combination of seismic loading and impounded fluid. It is understood that possibility of hydrodynamic loading on the outer tank due to failure of the inner tank is gre diminished by the presence of insulation between the two tanks and the absence of inlets and outlet the bottom of the inner tank. However, there still remains the possibility of rapid leakage fror damaged inner tank, combined with ground shaking of long duration or the effects of aftershocks.

The two containment schemes described by CB&I in Document 1 differ only in the type of outer t employed; one consisting of a conventional steel outer shell and the other consisting of a prestres concrete outer shell. In both designs the outer shell carries the roof loads as well as other imposed lo such as wind, insulation and internal pressure. The major difference, however, is that the conventio double metal wall tank is intended to be used with an independent impoundment structure while the s called "double integrity" tank is not. Thus the consequences of the outer tank failing are quite differe for the two schemes. The same concern for this particular load combination (seismic plus impound fluid) applies equally to the containment scheme proposed by Preload, Inc. and described in Append E of Document 1.

This issue constitutes the first part of Query (4b). The YPC response quotes the Preload Inc. revise report of 4/21/92 and the CB&I report of 5/21/91. In each case full hydrostatic loading of the outer tan plus a design seismic event is not considered to be a credible event. But the outer tanks are designed t accommodate full hydrostatic loading plus aftershocks to the OBE level in the case of the Preload desig and to some lesser event (not defined) in the case of the CB&I design.

In view of the possibility that during the service life of the structure a $M_w > 8$ earthquake could occur i the Yakataga Gap region, and possibly even closer to the project site, and as a consequence the duratio of shaking could be longer than that associated with a $M_w 7\frac{3}{4}$ earthquake, it is recommended tha combined seismic and impounded fluid loading be considered in the design of the outer tanks.

STRUCTURAL DETAILS

Certain structural details presented in Document 1 are cause for concern and raise a number of questions as to the level of performance that can be expected with loading conditions at or near the design level.

Proximity of Inner and Outer Tanks:

There is concern about the expected behavior of the inner/outer tank combination used in the so-called "double integrity" tank design. Because of their close proximity, the tanks cannot be viewed as separate entities in the event of a structural failure. Failure of the outer shell will virtually assure failure of the inner shell, either through interaction of the tank shells or through progressive collapse of the outer wall and roof structure. This concern does not apply to the conventional double metal tank because of its structurally independent impoundment system.

This issue constitutes the second part of Query (4b). The YPC response does not address directly the concern for progressive failure initiating in the outer tank and carried to the inner tank, either through interaction of the tank shells or through the roof structure.

Double Concrete Wall Tank:

Appendix E of Document 1 presents the general details of the double concrete wall tank proposed by Preload, Inc. Both the inner and outer walls rest on 10 mm thick sketch plates which are allowed to move radially to accommodate shrinkage, elastic shortening due to prestressing, and thermal expansion or contraction due to seasonal temperature changes and tank cool-down. The sketch plates are attached to the tank floor plates by means of a welded lap joint and are keyed to the tank walls by weld blocks located 1 m center-to-center around the inside face of the tank wall. No foundation details are shown, although Drawing SK-1 shows the outer wall sketch plate resting on a 5 mm thick fiber cement plate faced with teflon.

The concern with this detail centers on its ability to function properly under strong base shear induced by horizontal accelerations. If there is relative movement between the wall/sketch plate and the foundation, what will be the effect on the bottom plates of the tanks? The possible need for some radial/tangential restraint beyond that provided by friction is mentioned in Document 2, but no specific details are provided. In the extreme case, there is the potential for the tanks to slide off of their footings. And finally, what degree of differential settlement in the footing can be accommodated by the sliding joint detail without loss of the contained fluid?

This concern for proper anchorage is the subject of Query (4c). In their response, YPC notes that it is Preload's opinion that ring-wall foundation anchors are not required to resist overturning and base sliding. YPC also notes that Preload Inc. prepared details of their tank design and submitted them directly to FERC without benefit of technical support or input from the YPC engineering staff. This concern for anchorage details has been noted by YPC and will be evaluated during the detailed design stage and prior to selection of a final tank design.

Circumferential Prestressing:

Another issue of concern with the double concrete wall tank is the behavior of the circumferential prestressing in the event of wire failure due to corrosion or missile impact. What assurances are there against a sudden loss of prestress due to unwinding of the wire helix, or a gradual loss of prestress due to progressive failure of the bond between the wire and the pneumatic mortar coating?.

Rock Anchors:

The rock profiles at the site indicate interbedded phyllite and graywacke, weathered to depths between 15 and 35 feet (4.5 and 11 m). The phyllite may be susceptible to rapid weathering. There is some concern that: (1) rock anchors could experience an initial displacement before developing adequate load resistance; and (2) anchors which initially have adequate load resistance could lose some load resistance during the service life of the structure due to weathering effects. Weathering is primarily caused by water and frost penetration. While it is understood that the base of the tank foundation will be kept at a temperature designed to prevent freezing under the tanks, there still will be frost penetration adjacent to the tanks. Consideration should be given to a suitable surface and subsurface drainage system to prevent weathering in the vicinity of the tank foundations. Document 1 indicates that it is contemplated to proof test a portion, but not all, of the anchors. However, it may be necessary to pre-load all the anchors in order to assure adequate performance during an earthquake.

Rock Slopes:

The rock at the site consists of interbedded layers of phyllite and graywacke. The phyllite layers are very susceptible to erosion. This could result in stability failures, particularly during seismic events. It is suggested that rock slopes should be no steeper than the dip of the layers, should be secured by rockbolts, and should have an internal drainage system monitored by piezometers.

Steel Dome Roof:

Other than the one described by Preload Inc., the roof structure for the proposed containment schemes does not include a concrete overlay, thus making these containments vulnerable to penetration by light aircraft and/or wind-born missiles. What are the criteria for missile resistance and how do the proposed roof designs satisfy those criteria?

AVALANCHE HAZARD

The terrain directly south of the proposed site at Anderson Bay rises to a maximum elevation of 2,400 feet (730 m) over a horizontal distance of 9,000 feet (2,740 m). For approximately half of this distance the average slope is 1 in 3 (Vert., Horiz.) and this raises concerns about the avalanche hazard. By comparison, the terrain to the south of the Alyeska Marine Terminal rises to an elevation of 3,800 feet (1,160 m) over a distance of 9,000 feet and the slope over most of this distance is approximately 1 in 2. Although sliding snow has been a problem in the 15 years that the terminal has been in service, the magnitudes of these slides have been relatively small. Nevertheless, it is our understanding that the avalanche potential is closely monitored and that a plan of action has been developed to selectively trigger the sliding of accumulated snow should that become necessary to forestall a major slide or avalanche.

With regard to the Anderson Bay site, there does not appear to have been any serious consideration given to the avalanche hazard. An assessment of this hazard is needed and should include the stability of snow and loose rock on the slopes above the site, the possible effects of ground shaking on this stability, the volume of material (snow and rock) that is likely to be involved in the event of an avalanche, the volume of material that can be retained at the toe of the slope in such an event, and the probable runout of material into the storage tank area.

SUMMARY:

Seismic Design

1. The scope of the geoseismic study and the data presented appear to meet the requirements of the Federal regulations. The evidence presented seems to indicate that the site meets the requirements for construction of LNG tanks and containment dikes, as stipulated in § 193.2061 (f)

2. We recommend that YPC should justify the design service life of the installation.

3. We have reservations with regard to the validity of the conclusion that an earthquake similar to the 1964 Prince William Sound earthquake should not be considered for the design of the facility. We also suggest that the low frequency components of the ground motion generated by a great earthquake in the Yakataga Gap region would not be

significantly attenuated. We therefore recommend that a conservative approach be taken in the selection of the level of the effective accelerations on which design spectra are based, and that the potential effect of a great earthquake in the Yakataga Gap be considered in the choice of the long-period portion of the design spectra.

4. It is recommended that the design effective acceleration, ductility, and damping ratios should reflect the possibility that an $M_w > 8$ earthquake may occur during the service life of the installation.

5. It is suggested that the choice of vertical accelerations should not be based solely on a literal interpretation of the CFR.

Wind Load

1. The stated design wind speed of 110 mph (49.2 m/s) does not meet the requirements of CFR, Part 193, § 193.2067. Either a design wind speed of 200 mph (89.4 m/s) must be adopted, or a rational analysis must be provided to show that the design wind speed is consistent with an annual probability of 10^{-4} of being exceeded.

2. Even though the wind loads may not have a significant effect on the tank design, they have the potential for causing load reversals in elements of the roof system designed to resist dead load and snow load.

Snow Load

1. The rationale for the design ground snow load of 235 psf (11.25 kPa) requires additional study. To make the risk of overload due to snow consistent with the effects of earthquake and wind forces, an importance factor for use with the 50-year ground snow load needs to be derived.

Combined Loads

1. Unless there is clear and convincing justification for lesser values, the load combination factors specified in ASCE 7-88 should be used.

2. Use of the calculated flat-roof snow load of .169 psf (8.09 kPa) in conjunction with earthquake loads appears to be overly conservative. This snow load corresponds to a mean recurrence interval of approximately 100 years and does not account for any load reduction due to snow slide-off on the steeper roof slopes.

3. The design load criteria do not account for the possibility of combined seismic and impounded fluid loading for the outer tank. This load combination could be critical for the so-called "double integrity" tank designs.

Structural Details

1. For the so-called "double integrity" tanks, the secondary containment is not isolated from the primary containment, thus creating the potential for progressive collapse of the outer

and inner tanks. Without a structurally independent impoundment system, failure of the outer tank could be catastrophic. Additional secondary impoundment should be considered.

2. The detail for the joint between the wall and floor of the double concrete wall tank needs additional development to assure proper function under strong ground motion and possible differential settlement of the tank footing.

3. There is concern about the behavior of the circumferential prestressing for the double concrete wall tank in the event of wire failure due to corrosion or missile impact.

4. There is concern about weathering effects on the bedrock formation. These concerns affect the rock anchors for the tank foundation and rock slopes in the project area.

5. Resistance of the steel dome roof to missile penetration is questionable without the inclusion of a concrete overlay.

Avalanche Hazard

1. There is no evidence that an assessment of the avalanche hazard has been carried out for the Anderson Bay site. This needs to be done in view of the proposed location of the LNG storage tanks.

REFERENCES

American National Standards Institute (1983). "Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites." American National Standard ANSI/ANS-2.3-83, 1983, 19 pages.

American Society of Civil Engineers (1990). "Minimum Design Loads for Buildings and Other Structures." ASCE 7-88, July, 1990, 94 pages.

ICBO (1991). "Uniform Building Code." International Conference of Building Officials, Whittier, CA, 1991.

Kovacs, W.D. et al. (1984). "Data Requirements for Seismic Review of LNG Facilities." NBSIR 84-2833, National Bureau of Standards, Washington, DC, June 1984.

National Earthquake Hazards Reduction Program (1992). "NEHRP Recommended Provisions for the Development of Seismic Regulations for New Buildings." 1988 Edition, FEMA 95/Oct., 1988 and 1991 Edition, FEMA 223/ Jan., 1992.

Newmark, N.M. and Hall, W.J. (1982). "Earthquake Spectra and Design." Engineering Monograph on Earthquake Criteria, Structural Design and Strong Ground Motions, EERI, 1982, 103 pages.

Sack, R.L. (1989). "Designing Structures for Snow Loads." Journal of Structural Engineering. American Society of Civil Engineers, Vol. 115, No. 2, February 1989, pp 303-315.

Simiu, E., Changery, M.J. and Filliben, J.J. (1979). "Extreme Wind Speeds at 129 Stations in the Contiguous United States." NBS Building Science Series 118, National Bureau of Standards, Washington, DC, March 1979, 318 pages.

Standards Association of Australia (1989). "Minimum Design Loads on Structures, Part 2: Wind Loads." AS 1170.2-1989, 96 pages.

Code of Federal Regulations, 49 CFR Part 193 - Liquefied Natural Gas Facilities: Federal Safety Standards, 12-31-91 Edition, 1991.

U.S. Atomic Energy Commission (1963). "Nuclear Reactors and Earthquakes." Technical Information Document 7024, prepared by Lockheed Aircraft Corporation and Holmes & Narver, Inc., August 1963.

APPENDIX A
REVIEW COMMENTS ON THE SEISMIC DESIGN CRITERIA FOR THE ANDERSON BAY TERMINAL OF THE TRANS-ALASKA GAS SYSTEM

Robert A. Page
U.S. Geological Survey
15 December 1992

These comments address the following documents:

1. Geologic and Seismic Studies by Dames and Moore, July 1991
2. Seismic Hazard Studies by Neville Donovan, July 22, 1991
3. Seismic Design Criteria by William J. Hall, July 22, 1991
4. Responses by Yukon Pacific Corporation to FERC-USGS Questions 1-6

SEISMIC SOURCE CHARACTERIZATION

If there are sufficient gas reserves to operate the proposed facility for close to 200 years, the use of project lifetimes of 25 to 30 years in developing seismic design criteria is not conservative. A 30-year lifetime is assumed in Doc. 1 (Chapter 7), and a 25-year lifetime is assumed in Doc. 2 (Appendix C).

1964-type earthquake

There is a large discrepancy between estimates of repeat times for 1964-type earthquakes derived from paleoseismic studies (600-950 years) and from plate tectonic studies (175-333 years) as presented in Doc. 1 (p.7-7). This discrepancy is a long-standing issue of discussion in the research community, and the lack of definitive data assures the issue will not be resolved quickly.

The paleoseismic studies are subject to several difficulties: obtaining sufficient samples over a broad region, constraining ages of events, correlating events between samples over large distances, and knowing that all events have been sampled. Given these difficulties, it is difficult to draw reliable conclusions about the repeatability of 1964-type events. While the available data may be consistent with the conclusion of Doc. 1 (p. 7-7) for 600-950 year repeat times, alternative interpretations are also possible. The possibility of shorter repeat times should be considered.

The plate tectonic estimates provide shorter average repeat times (175-333 years). If earthquakes occur regularly at such intervals, the next 1964-type shock is not due for 150 to 300 years. If the project lifetime is about 200 years, the conclusion that "a repeat of a great 1964-type event should not be considered in seismic hazard analysis and estimation of ground motions" (Doc. 1, p. 7-7) is not justified. Furthermore, consideration should be given to the possibility that major earthquakes do not occur at regular intervals but cluster in time.

Intracycle earthquake

Magnitude $M_w 7\frac{3}{4}$ does not seem to be a conservative value for the maximum intracycle earthquake. To estimate a limiting magnitude, the 1964 source zone is compared to other subduction zones that have generated $M_w \geq 9.0$ earthquakes (Doc. 1., p. 7-10). The comparison may not be appropriate because the tectonic setting of the 1964 zone is much more complex than that of the southern Chile and Kamchatka zones. The relatively short intervals between great shocks in the latter two zones (100-160 years) further suggest that they may not be good analogs to the 1964 zone. Perhaps, the western Aleutian zone is an equally good analog; there, an M_w8.0 earthquake in 1986 occurred in the rupture zone of the 1957 M_w8.6 (as given in Doc. 1, p. 7-10) earthquake, only 29 years after that great earthquake.

As an alternative method of estimating the limiting magnitude, the accumulated slip potential since the last earthquake is calculated for various assumptions about the fraction of slip that occurs coseismically. The possibility that all the slip occurs coseismically is not considered. The assumptions about coseismic slip percentage assume that the recurrence interval for 1964-type earthquakes lies in the range 600 to 950 years, as suggested by geologic investigations, and that no significant slip occurs in intracycle shocks. The latter assumption is inconsistent with the exercise of estimating the maximum magnitude of an intracycle shock. In regard to the former assumption, if the repeat time were significantly shorter than 600 years, the estimate of coseismic slip fraction would approach unity. If all the slip is coseismic, then the maximum intracycle earthquake would range from M_w7.6 in 1995 to M_w8.2 in 2025.

Finally, if a 200-year project lifetime is assumed rather than a 30-year lifetime, the estimate of the maximum possible earthquake at the end of the project life (Doc. 1, Table 7-2, p. 7-13) increases by 1.2 magnitude units. Thus, at the end of a 200-year lifetime, there could be the potential for an M_w8.2 earthquake, even if 80-percent of the slip on the megathrust occurs aseismically.

SEISMIC DESIGN MOTIONS

Doc. 2 states on p. 14 that the "seismic response of the cryogenic product in LNG storage tanks is very sensitive to long period motions in the 8 to 12 second period range", yet the report does not address estimation of ground motion in that critical period range. The response to FERC-USGS Question 5 (in Doc. 4) states that "... the level of long-period motions will be specified through adoption of a broad-band, fixed-shape response spectrum anchored to ground motion at high frequency." The level of long-period motions are to be specified through the Newmark-Hall response spectra method using fixed ratios between controlling values of acceleration, velocity and displacement as defined in Newmark and Hall (1982, p. 45). The use of fixed ratios yields a response spectrum whose shape is independent of magnitude; however, several studies show that the shape of the response spectrum for real earthquakes is strongly dependent on magnitude. Joyner and Boore (1988) state "... at frequencies less than about 3 Hz, large errors can result from the practice of scaling fixed spectral shapes by peak acceleration. These errors can be partially avoided by Newmark and Hall's (1969) method, in which the short-period portion of the spectrum is proportional to peak acceleration, the intermediate portion (about 0.3 to 2.0 sec) to peak velocity, and the long-period portion to peak displacement." In this design study, however. no attempt is made to allow for the effect of magnitude on spectral shape. This raises the question of whether the proposed OBE and MDE response spectra are sufficiently conservative at periods in the range of 8 to 12 seconds, in view of the very large earthquakes that occur in southern Alaska. To assess the adequacy of the long-period levels of the design response spectra, one can use seismological modelling capabilities to estimate directly the long-period ground motion from postulated critical design earthquakes on the Aleutian megathrust and in the Yakataga seismic gap.

An important factor in the damage potential of earthquakes is the duration of ground shaking. This factor is particularly important for major earthquakes of the size that occur along the southern coast of Alaska There is no explicit discussion or consideration of the duration of shaking for the largest earthquakes that could affect the site in either Doc. 2 or Doc. 3. The YPC response to FERC-USGS Question 6 (in Doc. 4) claims that the broad-band design spectrum adequately accounts for duration effects. The issue of duration, however, is not explicitly addressed. Nowhere is the duration of ground shaking estimated. Accordingly, it is difficult to place confidence in the YPC response to Question 6.

The ground-motion attenuation relations for rock sites developed in Doc. 2 appear to seriously underestimate the larger levels of peak acceleration in the data set from which the relations were derived (Figures 3-4 and 3-5) and also the 1-second spectral accelerations at distances beyond 70 km (Figures 3-6 and 3-7). This concern is not adequately addressed in the YPC response to FERC-USGS Question 4 (in Doc. 4). Use of the distance to the energy center in the attenuation relations (Doc. 2, p. 9) should be provided.

The recommendation that "the vertical design spectrum should be taken as two-thirds of that applicable to the horizontal design spectrum" (Doc. 3, p. 19) should be justified, especially with respect to the motions in critical spectral bands (such as the sloshing period) and to the controlling design earthquakes.

REFERENCES

Joyner, W.B., and Boore, D.B. (1988). Measurement, characterization , and prediction of strong ground motion, in Earthquake Engineering and Soil Dynamics II, Proc. Am. Soc. Civil Eng. Geotech. Eng. Div. Specialty Conf., June 27-30, 1988, Park City, Utah, pp. 43-102.

Newmark, N.M., and Hall, W.J. (1982). Earthquake Spectra and Design, Earthquake Engineering Research Institute, 103 p.

APPENDIX B

FERC-NIST QUERIES FOR PUBLIC MEETING

ANCHORAGE, ALASKA, MAY 20, 1992

1. EARTHQUAKE

(a) The spectrum for the Maximum Design Earthquake (MDE) is based on an effective acceleration of 0.55 G. Yet, your probabilistic study cites an upper bound of 0.72 G and a conservative estimate of 0.62 G. A USGS map prepared in 1988 also shows higher values. Is the recommended spectrum conservative?

(b) The level of vertical acceleration recommended by Hall is 2/3 of the horizontal acceleration. While the likely source distance is greater than 10 miles, the assumed source could be directly under the site. Accordingly, wouldn't it be appropriate to make the vertical accelerations equal to the horizontal accelerations?

(c) The Hall report recommends a damping value of 7% and a ductility ratio of 1.2. Values for damping are normally less for prestressed concrete. The use of a ductility ratio greater than 1 is also questioned.

(d) We note that a more conservative spectrum was used in the CB&I evaluation study.

(e) The Newmark-Hall 1982 monograph on which the recommended spectra are based recommends more conservative values for long periods (such as those associated with hydrodynamic effects). The Uniform Building Code also recommends more conservative values for long periods.

(f) In the CB&I evaluations, sloshing effects were considered using NRC Report TID 7024, a 1963 document. More recent information on this phenomenon is available.

2. SNOW LOADS

(a) A ground snow load of 235 psf is cited in the design criteria, but the basis for this number is not explained.

(b) The design roof snow load of 169 psf for the LNG storage tanks is obtained from the specified ground snow load using an importance factor of 1.0. However, use of such a low value is inconsistent with the consequences of failure in the case of LNG storage tanks.

3. WIND LOADS

(a) The specified design wind speed is 110 mph, based on an importance factor of 1.05. This is less than the 100-yr wind for Valdez and substantially less than the 10,000-yr wind required by CFR.

4. DESIGN

(a) In the CB&I evaluation, ultimate earthquake loads are used in conjunction with average strengths (yield and ultimate). However, in present engineering practice, a strength reduction factor smaller than 1 is used in conjunction with ultimate loads. What is the justification for a strength reduction factor of 1?

(b) In your study, the outer container in the double (increased) integrity tank is designed to contain a spill and support the snow load. Potential seismic effects after a spill were not considered. Also, since a failure of the outer tank could also cause the inner tank to fail, there should be additional containment.

(c) There is no evidence that an anchored foundation to resist seismic forces was considered in the evaluation of the tanks proposed by Preload, Inc.

APPENDIX C

FERC-USGS QUESTIONS

1. Discuss how an intracycle $M_w 7\frac{3}{4}$ design earthquake on the Aleutian megathrust can be considered conservative. On the western Aleutian megathrust, an $M_w 8.0$ earthquake in 1986 occurred in the rupture zone of the 1957 $M_w 9.1$ earthquake, only 29 years after that great earthquake.

2. Does the available geologic data require or only permit your conclusions that the 1964 earthquake is characteristic of the major ($M_w 8.0$ or larger) earthquakes on the Prince William Sound part of the Aleutian megathrust and that the average recurrence is about 7800 years? What other conclusions do the data permit? Explain the factors on which you conclude that the characteristic earthquake model is applicable to the Prince William Sound Region.

3. The approximately 700-year recurrence interval inferred for 1964-type earthquakes suggests that such shocks should generate about 40 m of slip on the megathrust if the average relative plate motion of 5-6 cm/yr were accommodated only by such shocks. The slip determined for the great 1964 earthquake was only about half that amount. How does your model account for the release of the remaining accumulated slip?

4. The ground motion attenuation relations for rock sites developed by Donovan appear to seriously underestimate the larger levels of motion in the data set from which the relations were derived (see Figures 3-4 through 3-7 in volume VII (Tab 4) of the application: Donovan, Neville; Seismic Hazard Studies for the Anderson Bay Terminal of the Trans-Alaska Gas System (Yukon Pacific Corporation Project), July 22, 1991). How does this problem affect the conclusion of that report?

5. Donovan states that the "Seismic response of the cryogenic product in LNG storage tanks is very sensitive to long period motions in the 8 to 12 second period range." The report does not address estimation of ground motion in that critical period range. Will there be subsequent reports that address this issue or will the level of long-period motions be specified only through the adoption of a fixed-shape response spectrum anchored to ground motion at high frequency?

6. An important factor in the damage potential of earthquakes is the duration of ground shaking. This factor is particularly important of the size that occur along the southern coast of Alaska. How is the effect of duration of shaking to be accounted for in the seismic design of the proposed facility?

APPENDIX B

PRELIMINARY LNG EXPORT FACILITY PRECONSTRUCTION CRYOGENIC DESIGN AND TECHNICAL REVIEW

Preliminary
LNG Export Facility Preconstruction
Cryogenic Design and Technical Review

Yukon Pacific Company L.P.
Valdez, Alaska

Docket No. CP88-105-001

March 17, 1993

Robert Arvedlund, Chris M. Zerby,
Alan F. Schmidt and Dudley B. Chelton

Office of Pipeline and Producer Regulation
Federal Energy Regulatory Commission
Washington, DC

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Preliminary
LNG Export Facility Preconstruction
Cryogenic Design and Technical Review

Yukon Pacific Company L.P.
Valdez, Alaska

Docket No. CP88-105-001

Introduction

The cryogenic design and technical review of preconstruction design of the proposed Yukon Pacific Company L.P. (YPLP) LNG export facility located near Valdez, Alaska is part of the regulatory review process of the Federal Energy Regulatory Commission (FERC). Additional reviews are anticipated as the facility design is further developed. The present review was performed jointly by FERC staff and cryogenics consultants. Areas of coverage include: materials in cryogenic environments, insulation systems, cryogenic safety, thermodynamics, heat transfer, instrumentation, cryogenic processes and other relevant safety systems. The present review is limited to the cryogenic aspects of the LNG facility and marine terminal. Emphasis has been placed on engineering design and safety concepts and on projected operational reliability. Vapor cloud generation, plume dispersion and seismic considerations are subjects beyond the scope of this report.

The recent technical review and site inspection was held on May 26, 1992 (see Appendix A for attendance list). In preparation for this review, the Company was requested to supply up-to-date technical information on the facility and to respond to specific questions relating to the proposed facility.

Portions of the following descriptive material have been excerpted from submissions made to the FERC and from other applicable documents.

Project Scope

YPLP is proposing to build a 797 mile chilled-gas pipeline to transport natural gas from Prudhoe Bay on Alaska's North Slope to Port Valdez on Alaska's southcentral coast. There it is to be converted to liquefied natural gas (LNG), loaded aboard ships at an adjacent marine terminal and transported to Pacific Rim markets. The entire project is known as the Trans-Alaska Gas System (TAGS). In addition to the above facilities described herein, a Gas Conditioning Facility would be required in the Prudhoe Bay area to deliver to the pipeline natural gas of a quality suitable for pipeline transportation and subsequent conversion to LNG at Anderson Bay.

At full development, the project would utilize 2800 MMSCFD of raw gas at the Prudhoe Bay site. An average of 2300 MMSCFD of conditioned feed gas is proposed for pipeline transportation to liquefaction facilities. After fuel gas utilization by system equipment, an average of 2100 MMSCFD would be converted to LNG. Approximately 14 million tons/yr of LNG is to be loaded into tankers.

Decisions on the Gas Conditioning Facility (GCF) are pending. The GCF would receive natural gas that is presently being reinjected into the oil-producing formation. Although decisions on the GCF have not been finalized, a proposed conceptual GCF could consist of multiple extraction trains schematically consisting of several elements: a low temperature separator to remove entrained liquid hydrocarbons from the feed gas; a treating unit to remove carbon dioxide; mechanical refrigeration for temperature control of dewpoint; and a system to reblend liquids to regulate the BTU value of the natural gas. The extracted impurities, including carbon dioxide which ranges to 12 percent or more, would be reinjected into the north slope fields.

The proposed Trans-Alaskan pipeline is to extend approximately 797 miles from Prudhoe Bay to Port Valdez, Alaska and generally follows the route adjacent to the Trans-Alaska Oil Pipeline System (TAPS). Operational characteristics of the pipeline entail chilled gas flowing through the northern portion and warmer gas flowing through the southern portion. The pipeline would be constructed primarily underground and would be elevated only at active fault and major river crossings that are considered geotechnically and environmentally sensitive.

Seasonal operating temperatures of the natural gas flowing through the pipeline would range from -10° F (minimum) to +32° F for chilled gas operations and above +32° F (minimum) for warm gas operations. Operating pressures would range from 1100 psig to 2220 psig with the gas arriving at the LNG plant at a design condition of 1300 psig and between 30-40° F.

Preliminary plans indicate three compressor stations spaced over the length of the pipeline. A typical compressor station would be equipped with natural gas-fueled turbines to drive centrifugal compressor units. In addition to refrigeration required to maintain chilled gas conditions, additional turbine/compressor units would be utilized to circulate freon or similar refrigerant.

At the southern terminus of the pipeline, LNG plant facilities would receive gas throughput at a design pressure of 1300 psig. After removal of residual moisture and impurities by separators, driers and filter equipment, the gas would be liquefied through a series of refrigeration steps at successively lower temperatures. It is proposed that LNG would be stored in 800,000 barrel aboveground storage tanks. Loading LNG into tankers would be accomplished by a system of cryogenic pumps, transfer lines and articulated loading arms. The transfer system would extend from the storage tanks to the tanker berths along dock trestle structures.

Marine terminal structures including trestles, mooring dolphins and two tanker berths would extend from shoreline to harbor area water depths of about 50 feet. These structures would be designed for berthing 125,000 cubic meter capacity LNG tankers. The tankers are approximately 940 feet long and would have a nominal loading capacity of 125,000 cubic meters. The tankers require about 40 feet of water. At full development, the project would require 15 vessels and an estimated 280 dockings per year at Anderson Bay.

Construction sequencing of major components of the liquefaction and marine facility would be determined by market forces. Although full development, as now conceived, would consist of four liquefaction trains, four 800,000 barrel LNG storage tanks and two marine loading docks, initial construction would be predicated upon market demands for the product. Initial construction, at minimum, would consist of one liquefaction train, one LNG storage tank and one marine loading dock. It is anticipated that a five to six year ramp-up period may occur from the time of initial deliveries to operation at full capacity with a fully developed facility. Expansion possibilities include one additional liquefaction train and one additional LNG storage tank.

In summary, at full development, the principal components of the project as presently conceived are: a 797-mile, 42-inch diameter, buried and chilled natural gas pipeline from Prudhoe Bay to Port Valdez with a design capacity of 2300 MMSCFD of natural gas; compressor stations strategically located along the pipeline; a liquefaction facility at Port Valdez that would include four LNG processing trains to remove impurities from incoming gas and to condense the natural gas to LNG for storage and shipping; four LNG storage tanks, each with an individual capacity of 800,000 barrels; a marine terminal to simultaneously berth and load two LNG tankers and ocean transport vessels having individual cargo capacities of a nominal 125,000 cubic meters.

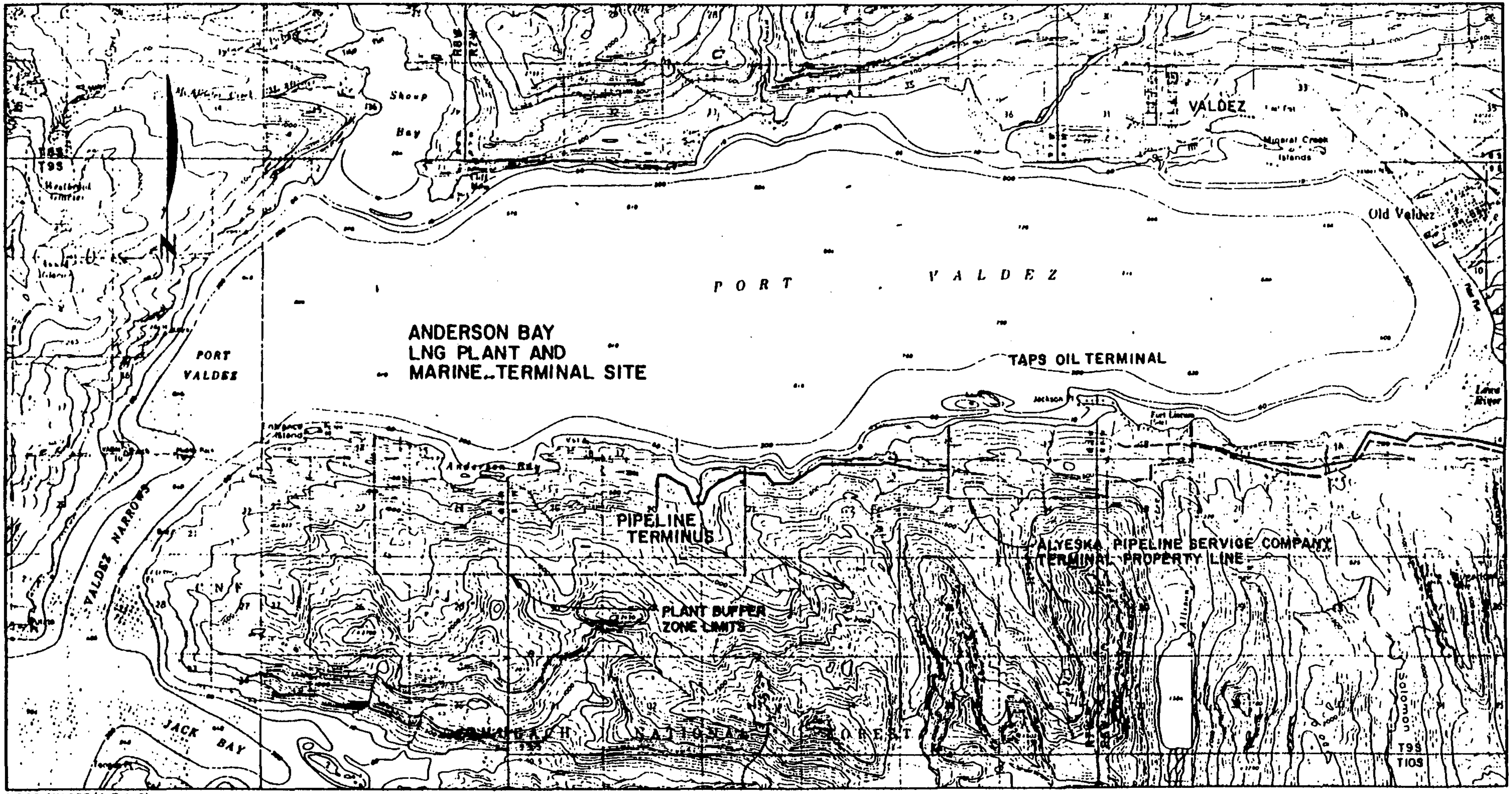
The present study is limited to the cryogenic aspects of the LNG facility and marine terminal.

Facility Location

The LNG facility and marine terminal would be located at the southern terminus of the gas pipeline at Anderson Bay in Port Valdez, Alaska. The facility would be constructed on approximately 300 acres of a 2500 acre site owned by the State of Alaska. The site is 5.5 miles southwest of the city of Valdez, 3.5 miles west of TAPS marine terminal and approximately 3 miles inside the Valdez Narrows. The following figures show the Port Valdez area and an overview of the proposed LNG facility and marine terminal.

The proposed location is the southern shore of Port Valdez near Anderson Bay at approximately 146° 31′ west longitude and 61° 05′ north latitude. Anderson Bay is an indentation on the southern shore of Port Valdez. There is no current or future planned access road to the projected LNG production plant and associated marine facilities. Consequently, all transportation of personnel, supplies and materials for construction and plant operation would be by air and waterborne traffic.

The proposed plant site is located on the northern slope of steep hills and is heavily wooded and intersected by small streams. The steep slope continues into the bay reaching 100 fathoms water depth at 1000 feet offshore.



U.S.G.S. VALDEZ (A-7, A-8)

LEGEND

- PROPOSED TAGS PIPELINE (BELOW GROUND)
- EXISTING TAPS PIPELINE (BELOW GROUND)
- PROPERTY LINE

SCALE 1:63360

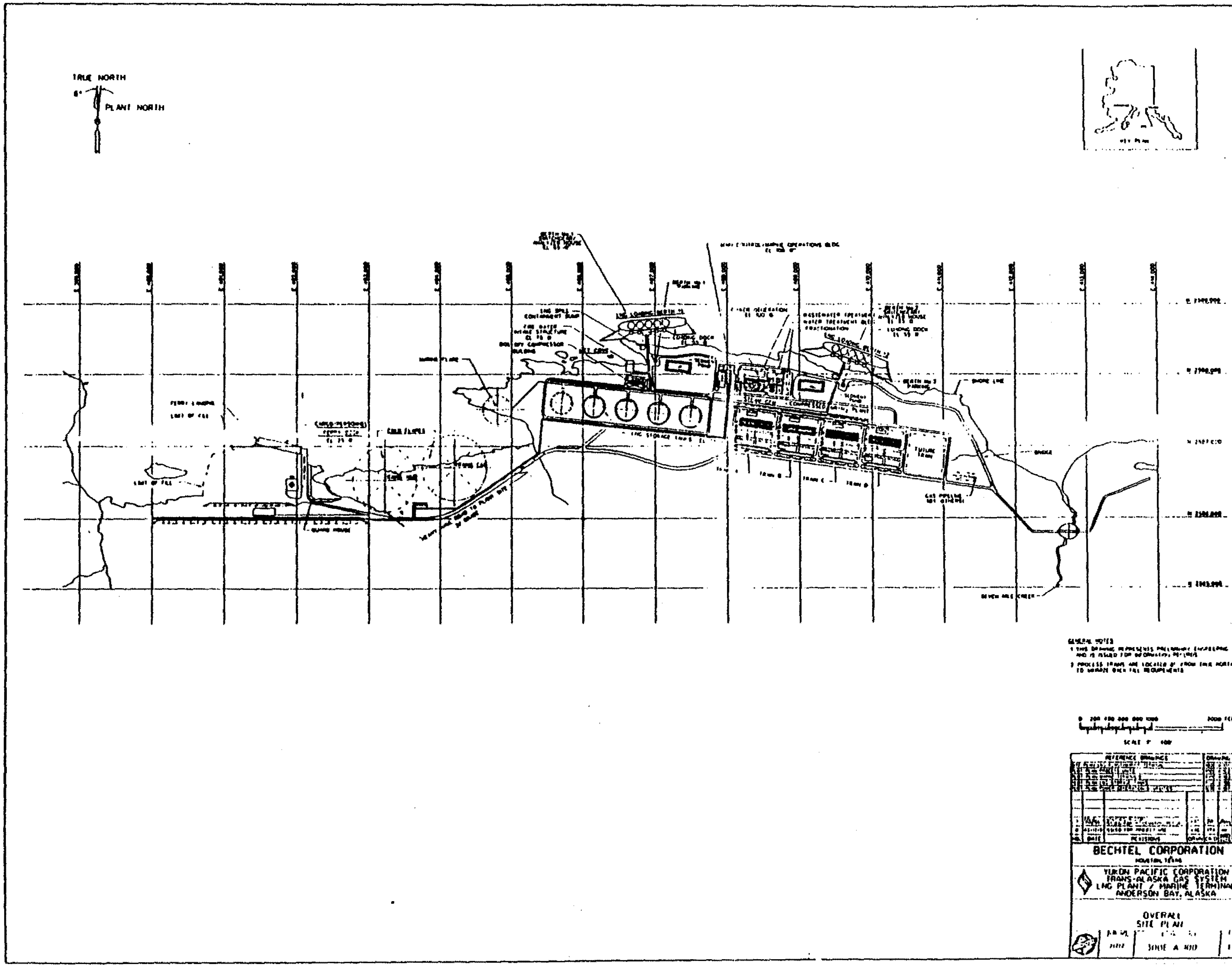
3000 0 3000 6000 9000 12000 15000 18000 21000

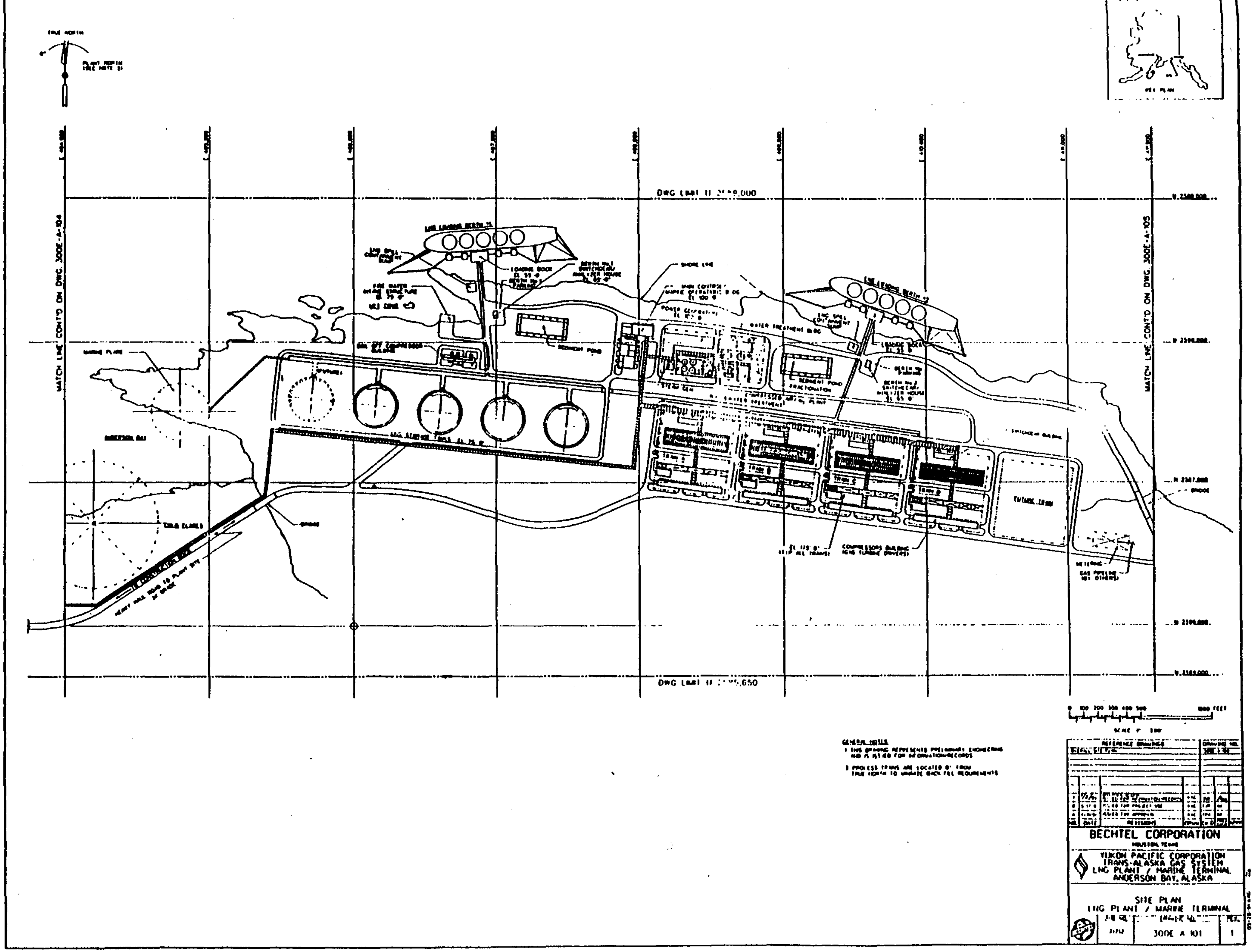
CONTOUR INTERVAL 100 FEET

YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM

LNG PLANT / MARINE
TERMINAL SITE
LOCATION MAP

Figure 8-1


TRUE NORTH
PLANT NORTH
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
OVERALL
SITE PLAN

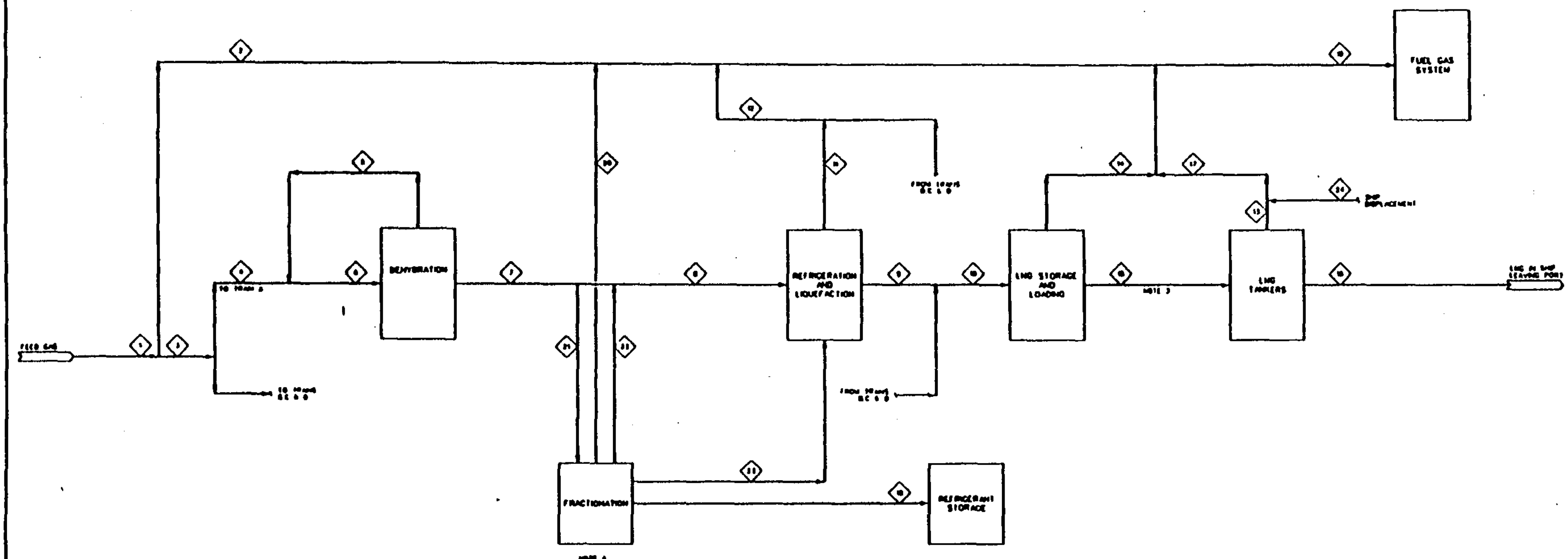

MATCH LINE CONT'D ON DWG. 30DE-A-104
MATCH LINE CONT'D ON DWG. 30DE-A-105
DWG LIMIT
DWG LIMIT
0 100 200 300 400 500 1000 FEET
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
SITE PLAN
LNG PLANT / MARINE TERMINAL
30DE A 101
1

Process Description

The major components of the fully developed proposed LNG facility would include four LNG trains (including dehydration, refrigerant separation and liquefaction systems), four 800,000 barrel aboveground LNG storage tanks, an LNG transfer system to load LNG tanker vessels and marine facilities to berth and load LNG tankers. A cargo dock and personnel ferry landing would be constructed at the west end of the site and would be connected to the LNG plant and marine terminal by a service road. Other facilities would include safety and control functions, power generation, water desalination, wastewater treatment and other utilities.

The total storage capacity of the four LNG storage tanks (3,200,000 barrels) is intended to provide 5.3 days of storage at the proposed LNG production rate of 2100 MMSCFD. The marine terminal is to be designed to simultaneously berth two tankers of nominal 125,000 cubic meter capacity approximately parallel to the shoreline in a minimum of 50 feet of water.

The proposed LNG Export Facility is in a preliminary design stage. Numerical values quoted in the present report are based on design conditions, anticipated performance, equipment specifications and/or material performance data as indicated by YPLP. Actual operating values or performance may differ. In many instances, information is only approximate and should be considered as representative of typical values. In some instances, conflicting numerical values have been reported in material submitted by YPLP - inconsistencies may therefore be present in the technical information presented herein.



NOTES:

1. THIS DRAWING REPRESENTS PRELIMINARY ENGINEERING AND IS ISSUED FOR INFORMATION/RECORDS.
2. THE MATERIAL BALANCE IS BASED ON [illegible] OF THE TIME NON-LOADING AND [illegible] OF THE TIME LOADING ONE SHIP.
3. THE ACTUAL SHIP LOADING RATE IS 10,000 M³/HR (44,000 GPM).
4. THE SIDESTREAM TO FRACTIONATION CAN BE TAKEN FROM ANY ONE OF THE FOUR TRAINS.

STREAM NO.	1	2	3	4	5	6	7	8	9	10	11	12
DESCRIPTION	NATURAL GAS FEED	MAKE-UP FUEL	NATURAL GAS FEED	NATURAL GAS FEED (1 TRAIN)	REACTIVATION GAS (1 TRAIN)	FEED TO DEHYDRATION (1 TRAIN)	FEED AFTER DEHYDRATION (1 TRAIN)	FEED TO LIQUEFACTION (1 TRAIN)	LNG TO TANK (1 TRAIN)	LNG TO TANK	PROCESS FLASH GAS (1 TRAIN)	PROCESS FLASH GAS
MMSCFD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GPM	-	-	-	-	-	-	-	-	[illegible]	[illegible]	-	-
LB/HR TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MOL. WT.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COMPONENT, LB MOLE/HR												
NITROGEN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
METHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ETHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PROPANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
i-BUTANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
n-BUTANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
i-PENTANE	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
n-PENTANE	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
n-HEXANE	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WATER	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL LB MOLE/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DENSITY, LB/FT3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HHV, MMBTU/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LHV, MMBTU/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STREAM NO.	13	14	15	16	17	18	19	20	21	22	23	24
DESCRIPTION	SHIP VAPOR RETURN	TANK VAPOR	COMBINED SHIP LOADING/NON LOADING AVERAGE	LNG IN SHIP	SHIP VAPOR & DISPLACEMENT	ETHANE AND PROPANE REFRIGERANT	VAPOR TO FUEL	DE-ETHANIZER OVERHEAD VAPOR TO FUEL	FEED TO FRACTIONATION	FRACTIONATION RETURN PROCESS TRAIN	REJECTION	SHIP DISPLACEMENT
MMSCFD	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GPM	-	-	[illegible]	[illegible]	-	[illegible]	-	-	-	-	[illegible]	-
LB/HR TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MOL. WT.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COMPONENT, LB MOLE/HR												
NITROGEN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]
METHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ETHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PROPANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
i-BUTANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
n-BUTANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
i-PENTANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
n-PENTANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
n-HEXANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
WATER	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0
TOTAL LB MOLE/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DENSITY, LB/FT3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HHV, MMBTU/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LHV, MMBTU/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

REFERENCE DRAWINGS	DRAWING NO.

NO.	DATE	REVISIONS
B	[illegible]	ISSUED FOR INFORMATION/RECORDS
A	[illegible]	ISSUED FOR REVIEW

BECHTEL CORPORATION
HOUSTON, TEXAS

YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

OVERALL BLOCK FLOW DIAGRAM

JOB NO.	DRAWING NO.	REV.
[illegible]	300E B 001	B

Dehydration System

The feed gas would enter the liquefaction facility via the 42-inch pipeline at approximately 1300 psig. Estimated total throughput is approximately 2300 MMSCFD. A side stream of approximately 2 MMSCFD would be removed from the feed gas stream for makeup for the fuel gas system (actual demand would depend on shortfall in fuel gas requirements and on the status of loading operations). The estimated composition of the feed gas (units in mole percent) is as follows:

Design Feed Gas Composition

Nitrogen	0.70
Methane	89.87
Ethane	5.94
Propane	1.88
i-Butane	0.75
n-Butane	0.82
i-Pentane	0.02
n-Pentane	0.01
n-Hexane	0.01

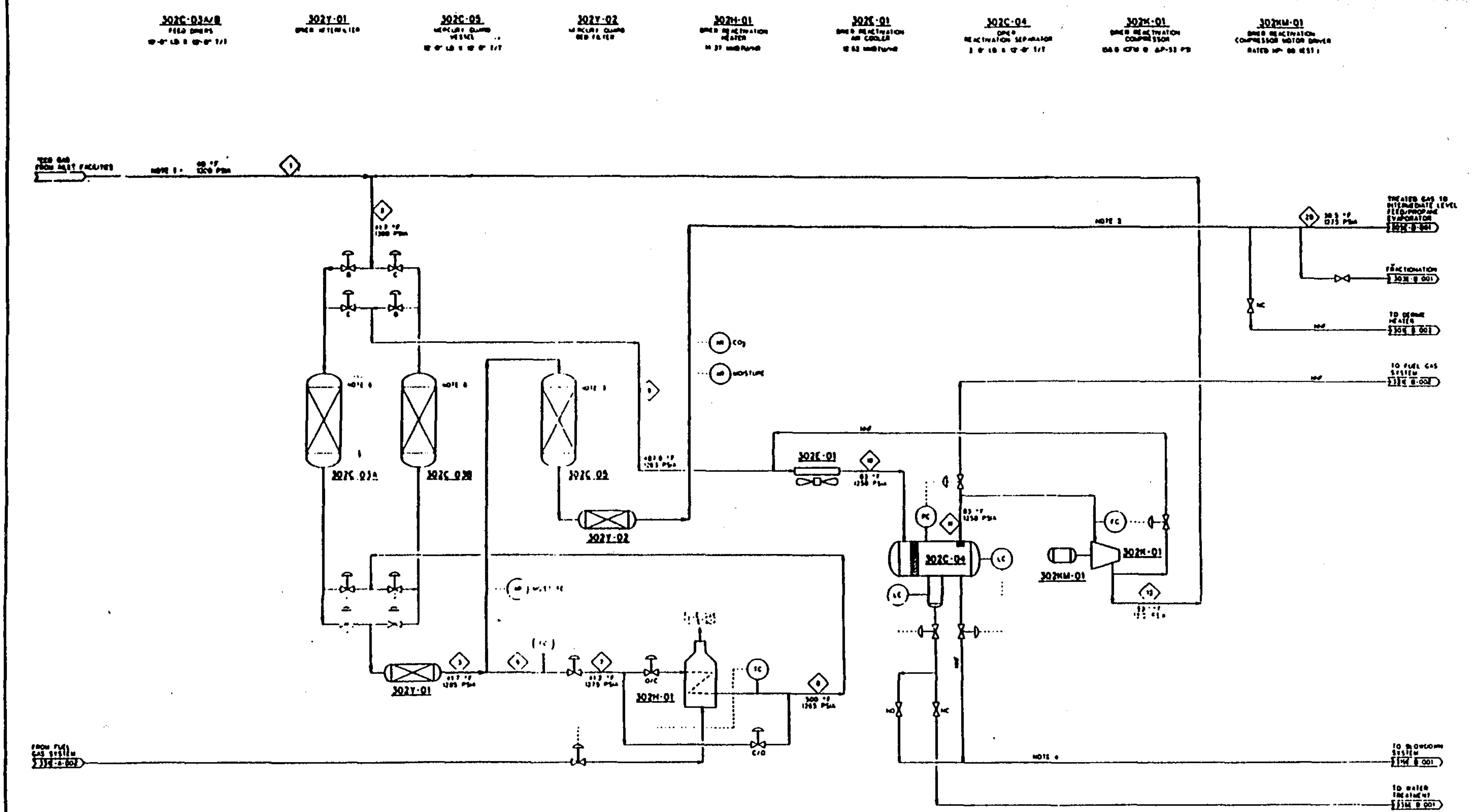
Feed gas water content is estimated to be 4.2 ppmv. Carbon dioxide, most of the water and heavier hydrocarbons are to be removed from the natural gas at the Gas Conditioning Facility (GCF) located at Prudhoe Bay prior to entering the pipeline transmission system. However, for design purposes, a carbon dioxide concentration of 120 ppmv has been assumed. Although construction and operation of the GCF is not presently considered a part of the TAGS application, decisions remain pending.

The feed gas in the 42-inch pipeline would enter the liquefaction system where the first stage of pretreatment is dehydration. Prior to entering the dehydration process, the feed gas would be divided into four 20-inch lines, each going to separate but identical parallel trains ultimately leading to liquefaction and storage. Each train would receive natural gas at a design flow rate of 576 MMSCFD. The description that follows represents typical anticipated characteristics of each of the four trains.

The feed gas would first enter a Feed Separator to remove pipeline liquids - accumulated liquids being removed from the separator via a 2-inch blowdown line utilizing liquid level regulated control. (The proposed dehydration system is shown in the following schematic diagrams.) Exiting the feed gas separator, the feed gas would enter one of two parallel Feed Driers. Each drier is to contain molecular sieves with an anticipated active drying time of 48 hours and an anticipated regeneration time of four hours (two hours heating and two hours cooling). Parallel operation permits reactivation of the offline saturated drier. The water impurity exiting the active drier is anticipated to be one ppmv. Following the drier towers, a Drier Afterfilter would be utilized to remove adsorbent dust from the feed gas.

Reactivation of the saturated drier (offline) column would be performed by a side stream taken from the dried feed gas stream exiting the active drier. The side stream reactivation gas would have a flow rate of approximately 23 MMSCFD. The reactivation gas would be heated to approximately 500^{o} F at a pressure of approximately 1265 psia and would reenter the saturated drier to be reactivated in reverse flow direction. Exiting the top of the drier, the reactivation gas would be cooled in a Drier Reactivation Air Cooler (fin-fan type) followed by a Drier Reactivation Separator to remove liquid water and condensed hydrocarbons. The gas leaving the separator would 1) be compressed to feed gas pressure by a 60-horsepower motor-driven non-lubricated centrifugal Drier Reactivation Compressor and would be piped to the feed gas stream entering the active drier, or 2) be sent to the fuel gas distribution system.

The dried feed gas leaving the Drier Afterfilter would enter a single Mercury Guard Vessel followed by a Mercury Guard Vessel Filter. The presence of elemental mercury in the feed gas stream has been estimated to be 0 ppbv (normal) and 20 ppbv (maximum) pending final analysis of the supply gas. The purpose of the mercury guard system is to adsorb mercury to protect subsequent components (primarily aluminum heat exchangers) of the liquefaction train from the potential of mercury induced corrosion. Such corrosion might occur with the existence of elemental mercury, particularly in the presence of water vapor. The Mercury Guard Vessel is to contain sulfur-impregnated activated carbon with an anticipated operational life of 3-5 years depending on the mercury content of the feed gas. The guard vessel material would be non-regenerative. The saturated adsorbent material would be returned to the manufacturer for reclamation and/or proper disposal. Sample connection points are to be provided at several locations on the vessel to monitor for possible mercury breakthrough.



NOTE 5

STREAM NO	1	2	3	6	7	8	9	10	11	12	20
DESCRIPTION	FEED GAS	FEED GAS TO DRYER	FEED GAS FROM DRYER	REACTIVATION GAS	REACTIVATION GAS TO HEATER	REACTIVATION GAS TO DRYER	REACTIVATION GAS TO AIR COOLER	COOLED REACTIVATION GAS	REACTIVATION GAS TO COMPRESSOR	REACTIVATION GAS TO FEED	FEED GAS AFTER MERCURY REMOVAL
MMSCFD	375.76	390.77	390.75	23.00	23.00	23.00	23.05	23.01	23.01	23.01	375.15
GPM	-	-	-	-	-	-	-	0.1033	-	-	-
LB/HR TOTAL	1,148,700	1,194,000	1,194,000	45,000	45,000	45,000	45,904	45,904	45,917	45,917	1,148,700
MOL WT	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17
COMPONENT LB MOLE/HR											
NITROGEN	443.50	460.10	460.10	17.60	17.60	17.60	17.60	17.60	17.60	17.60	443.50
METHANE	50,818.43	50,070.09	50,070.00	2,200.43	2,200.43	2,200.43	2,200.43	2,200.43	2,200.43	2,200.43	50,818.43
ETHANE	3,734.91	3,904.94	3,904.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	3,734.91
ETHYLENE	0	0	0	0	0	0	0	0	0	0	0
PROPANE	1,180.47	1,235.90	1,235.90	47.67	47.67	47.67	47.67	47.67	47.67	47.67	1,180.47
i-BUTANE	476.11	493.04	493.04	18.94	18.94	18.94	18.94	18.94	18.94	18.94	476.11
n-BUTANE	510.36	530.06	530.06	20.71	20.71	20.71	20.71	20.71	20.71	20.71	510.36
i-PENTANE	10.04	13.15	13.15	0.51	0.51	0.51	0.51	0.51	0.51	3.51	12.66
n-PENTANE	0.33	0.37	0.37	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.33
n-HEXANE	0.33	0.37	0.37	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.33
WATER	0.27	1.05	0	0	0	0	3.05	3.05	1.19	1.19	0
TOTAL LB MOLE/HR	83,214.79	85,741.13	85,739.20	2,525.35	2,525.35	2,525.35	2,531.10	2,531.10	2,528.84	2,528.84	83,211.03
DENSITY LB/FT3	6.01	6.01	5.91	5.01	5.09	2.24	2.27	63.29/6.84	4.90	5.01	5.78
VISCOSITY CP	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.06/0.01	0.01	0.01	0.01
SURF TENSION DYNE/CM	-	-	-	-	-	-	-	71.52	-	-	-

NOTES

1. A DRIER SEPARATOR UPSTREAM OF THE FEED DRYERS MAY BE REQUIRED IF KNOCK OUT DRUM AT THE INLET FACILITIES IS NOT SUFFICIENT TO REMOVE THE BULK OF THE CONDENSED HYDROCARBON AND WATER
2. TRACE COMPONENTS IN TREATED GAS ARE AS FOLLOWS
   - WATER - 1 PPMV (MAX)
   - MERCURY - 0.01 PPBV (MAX)
   - CARBON DIOXIDE - 120 PPMV
   - BENZENE - 2 PPMV
3. THREE SAMPLE CONNECTIONS AT TOP MIDDLE AND BOTTOM PORTIONS OF THE BED ARE TO BE PROVIDED ON THE MERCURY REMOVAL VESSEL FOR MERCURY CONTENT ANALYSIS
4. WATER FLOW IS 4.26 LB MOLE/HR DURING DRYER REACTIVATION CYCLE
5. EQUIPMENT SIZING AND MATERIAL BALANCE BASED ON PRODUCTION FROM ONE TRAIN. THERE ARE FOUR TRAINS TOTAL
6. THERMOWELLS ARE TO BE PROVIDED AT TOP MIDDLE AND BOTTOM PORTIONS OF THE FEED DRYERS TO MONITOR THE REACTIVATION GAS TEMPERATURE

REFERENCE DRAWINGS	DRAWING NO

NO.	DATE	REVISIONS	DRAWN	CHKD		APPR
1		[illegible]				
0		[illegible] CLIENT'S COMMENTS				
B		ISSUED FOR APPROVAL				
A		ISSUED FOR REVIEW				

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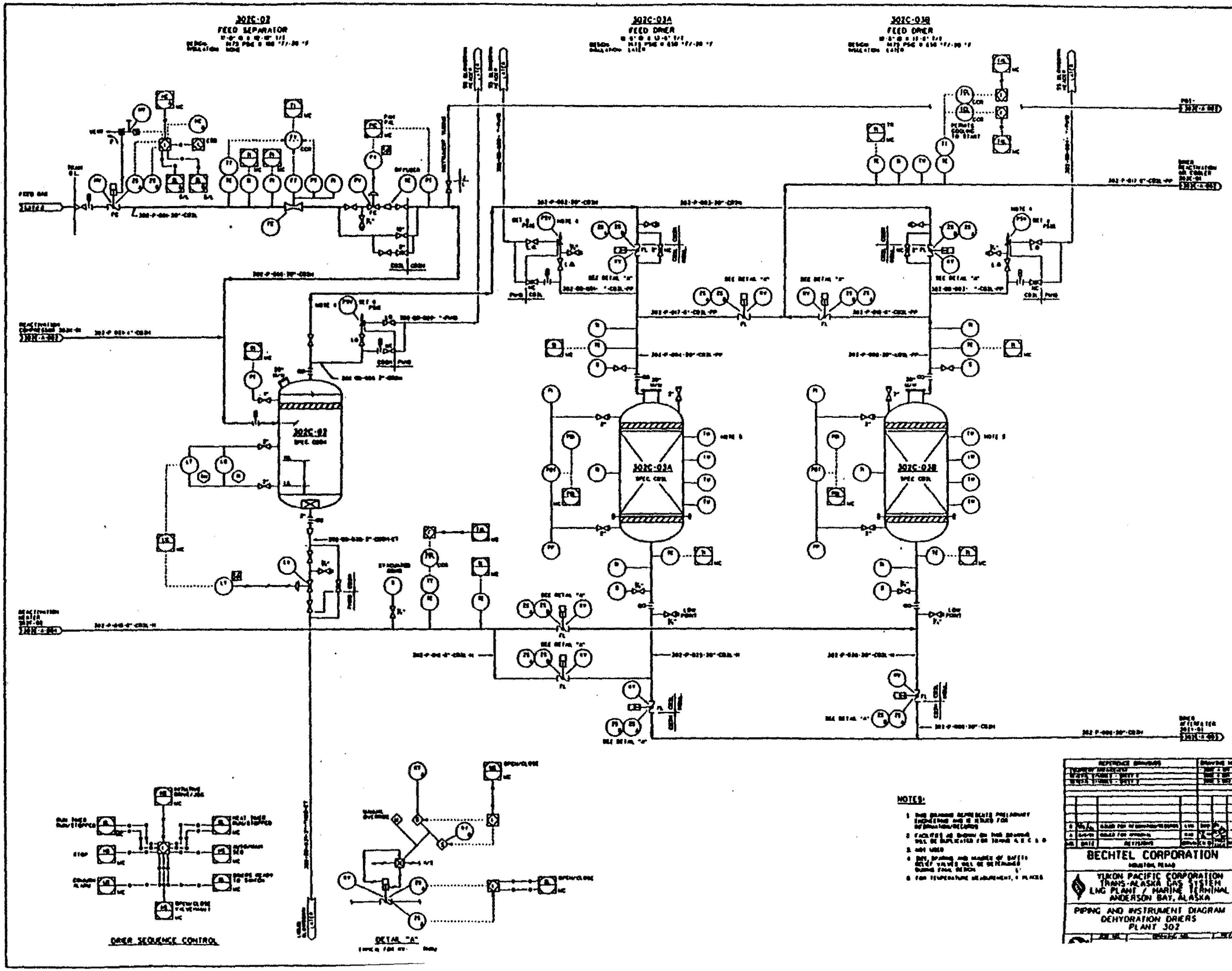
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

PROCESS FLOW DIAGRAM
DEHYDRATION & MERCURY REMOVAL
PLANT 302

JOB NO.	DRAWING NO.	REV.
[illegible]	302E-B-001	1


302C-02
FEED SEPARATOR
302C-03A
FEED DRIER
302C-03B
FEED DRIER
302C-02
302C-03A
302C-03B
DRIER SEQUENCE CONTROL
DETAIL "A"
NOTES:
BECHTEL CORPORATION
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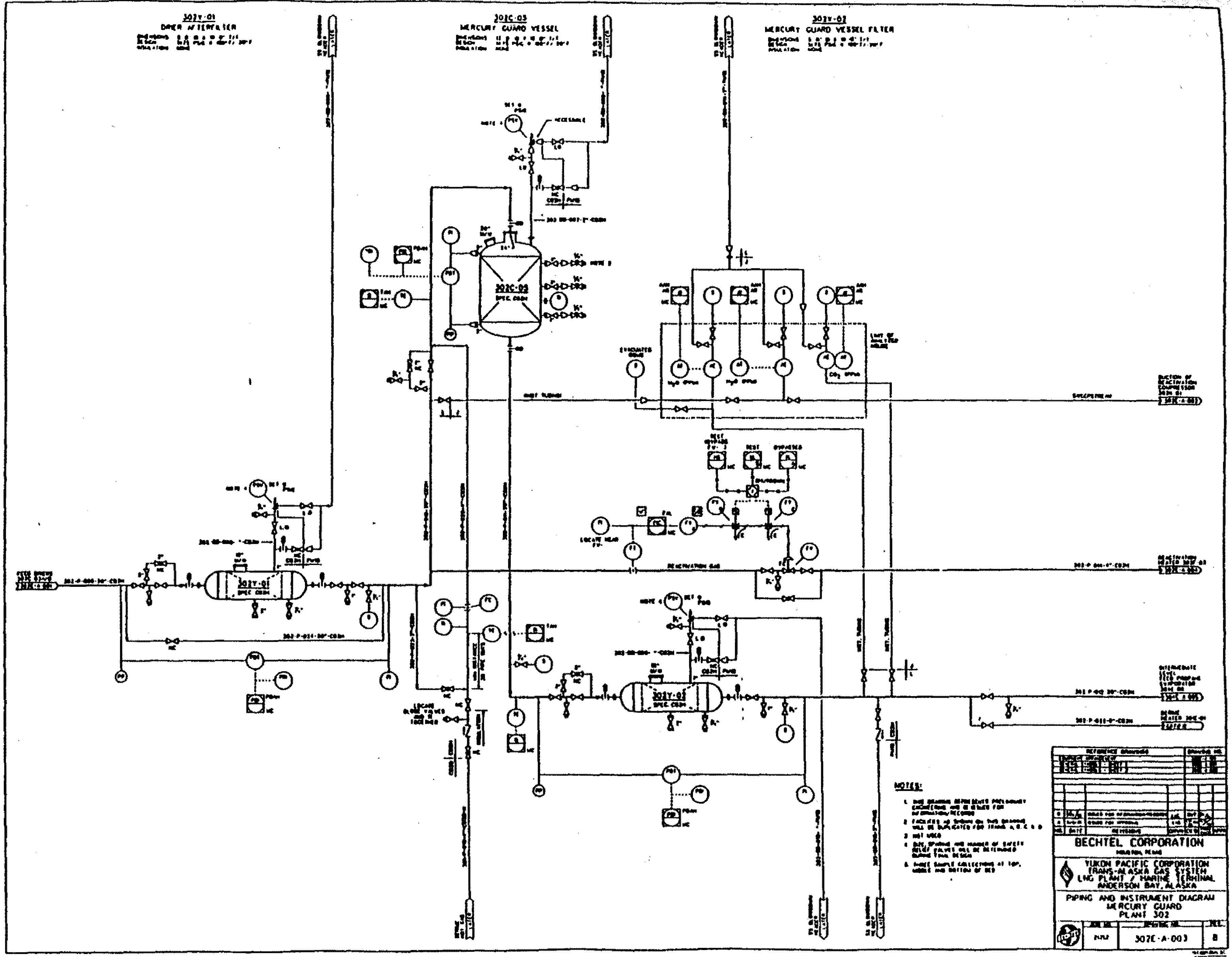
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PIPING AND INSTRUMENT DIAGRAM
DEHYDRATION DRIERS
PLANT 302


302V-01
DRIER AFTERFILTER
302C-03
MERCURY GUARD VESSEL
302V-02
MERCURY GUARD VESSEL FILTER
302C-03
302V-01
302V-02
REACTIVATION GAS
NOTES:
BECHTEL CORPORATION
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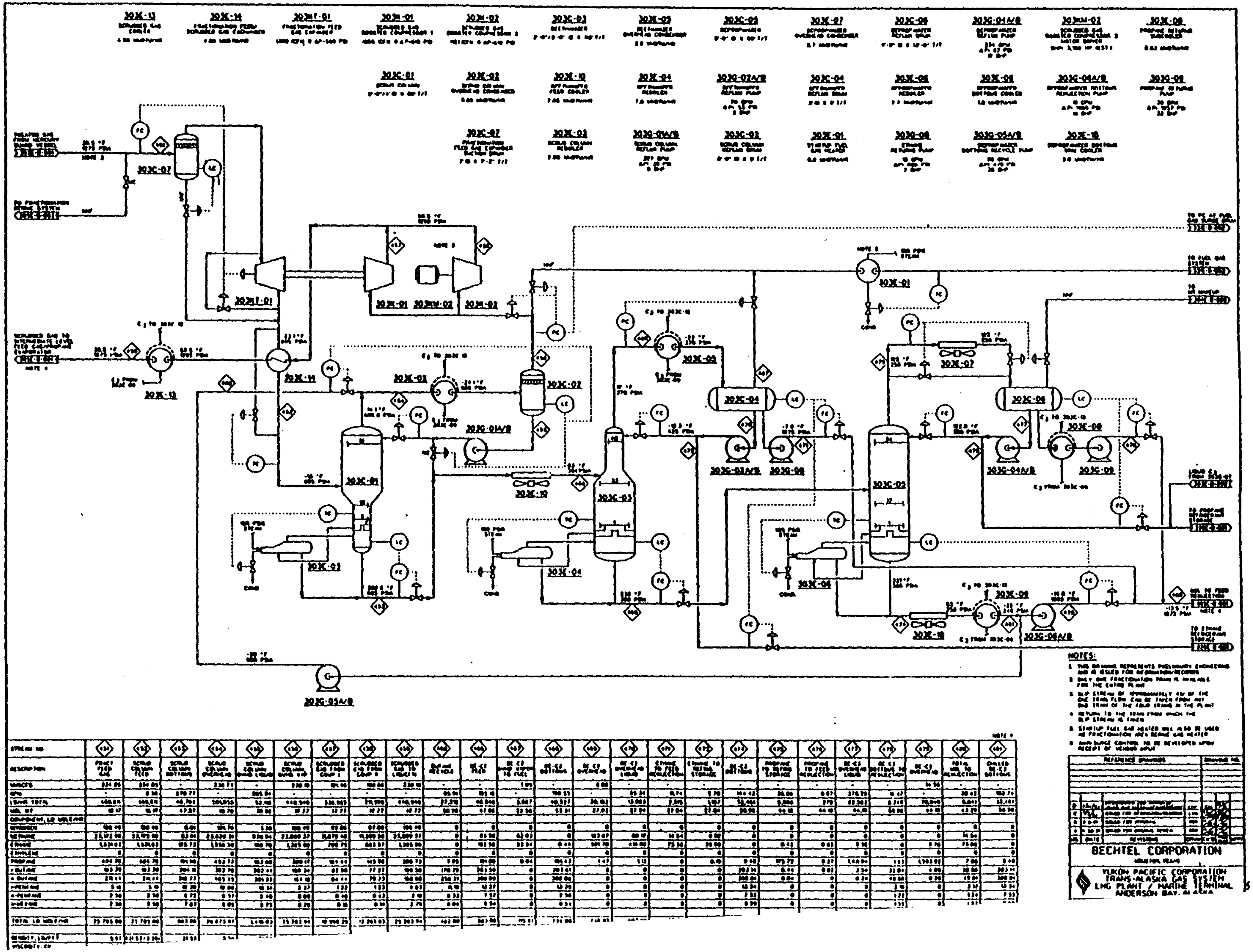
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PIPING AND INSTRUMENT DIAGRAM
MERCURY GUARD
PLANT 302
302E-A-003

Fractionation System

Refrigerants required in the proposed refrigeration system for the natural gas liquefaction portion of the facility would consist of nitrogen, methane, ethane and propane. Nitrogen would be obtained from an onsite air separation plant while methane would be obtained from the feed gas process stream. The other hydrocarbon refrigerants (ethane and propane) are to be extracted from the feed gas by a fractionation system. Only one fractionation system would be provided for the entire facility but would have the capability of utilizing treated feed gas following the dehydration system from any one of the proposed four trains.

Feed gas for the fractionation system would be taken as a slipstream consisting of approximately 235 MMSCFD (41 percent of the total single train flow rate). During the process of extracting ethane and propane, effluent gases consisting primarily of the remaining feed gas components flow back to the liquefaction train from which it was taken (98 percent of the slipstream; thus flow through the liquefaction train is not appreciably reduced). The composition of the return flow to the main feed gas line is estimated at 0.71 percent nitrogen, 91.40 percent methane, 5.41 percent ethane, 1.19 percent propane and 1.29 percent heavier hydrocarbons. Minor quantities of noncondensed gases are to be rejected to the fuel gas system and to the liquefaction system. The extracted refrigerants, ethane and propane, would amount to about one percent of the total slipstream. Ethane would be produced at about 5.7 gallons per minute (1197 pounds per hour) and propane would be produced at about 35.86 gallons per minute (8064 pounds per hour). Onsite refrigerant storage tanks would consist of two insulated 26,000 gallon ethane tanks (design conditions 38° F and 377 psia) and two


NOTES:
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

uninsulated 430,500 gallon propane tanks (design conditions of 38^0 F and 75 psia).

Schematic diagrams for the proposed fractionation system are shown in the following drawings. The slipstream would enter the system through a Feed Gas Expander Suction Drum for possible fluid separation and would be expanded in the Fractionation Feed Gas Expander from inlet conditions to a design discharge pressure of 695 psia (1309 icfm, 580 psi differential pressure). Following expansion, the cooled gas would enter a Scrub Column, where the more volatile components, primarily nitrogen and methane, would be separated from the heavier hydrocarbons. The effluent gases would be compressed and ultimately returned to the liquefaction train from which it was taken by two parallel compressors: Scrubbed Gas Booster Compressor 1 utilizing power from the Fractionation Feed Gas Expander and Scrubbed Gas Booster Compressor 2 utilizing an independent electric-motor drive.

The condensibles from the Scrub Column would be removed and sent to a Deethanizer column. Gaseous ethane is to be extracted from the top of the column, condensed and transferred to the ethane storage tanks. The bottoms from the Deethanizer column would flow to the Depropanizer column wherein propane would be separated from the remaining hydrocarbons. Propane is to be extracted from the top of the column, condensed and transferred to the propane storage tanks.

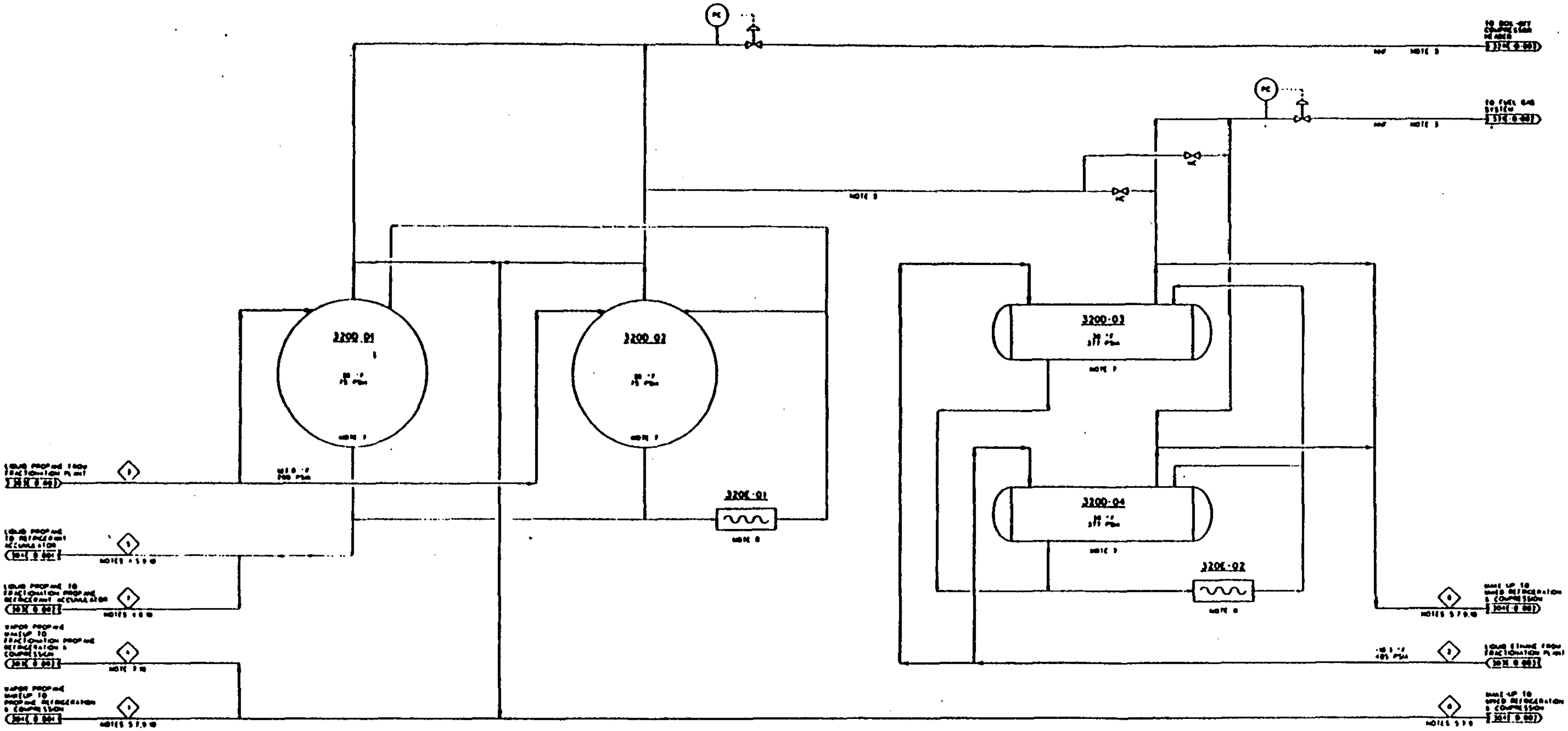
Refrigeration in the fractionation system required for condensers and coolers would be provided by a propane refrigeration loop. Circulation within the loop would be provided by the Fractionation Propane Compressor having an anticipated flow rate of 10,251 icfm and providing a differential pressure of 136.4 psi (158.2 psia discharge pressure). Propane for the refrigeration loop would be derived from the propane storage tanks.

3200-01/3200-02 PROPANE STORAGE TANKS

320E-01 PROPANE VAPORIZER

3200-03/3200-04 ETHANE STORAGE TANKS

320E-02 ETHANE VAPORIZER



STREAM NO.	1	2	3	4	5	6	7	8
DESCRIPTION	PROPANE MAKEUP TO C_3 REFRIG	ETHANE FROM FRACTIONATION	PROPANE FROM FRACTIONATION	PROPANE MAKEUP TO FRACT C_3	LIQUID INVENTORY TO 301C [illegible]	C_2 MAKEUP TO MR REFRIG	LIQUID INVENTORY TO 301C [illegible]	C_3 MAKEUP TO MR REFRIG
MMSCFD	0.33			0.02	16.175	0.05		0.05
GPM	-	0.90	15.03	-	130.04		161.00	-
LB/HR TOTAL	1,587.46	1,463.04	4,070.00	74.00	113,723.56	176.20	37,075.11	224.45
MOL. WT.	44.10	27.00	44.15	44.10	44.10	30.07	44.10	44.10
COMPONENT, LB MOLE/HR								
HYDROGEN	0	0	0	0	0	0	0	0
METHANE	0	0.61	0	0	0	0	0	0
ETHANE	0	43.00	0.15	0	0	5.86	0	0
ETHYLENE	0	0	0	0	0	0	0	0
PROPANE	36.00	0.4	102.00	1.7	2,579.00	0	851.17	5.09
i-BUTANE	0	0	0.75	0	0	0	0	0
n-BUTANE	0	0	0.03	0	0	0	0	0
i-PENTANE	0	0	0	0	0	0	0	0
n-PENTANE	0	0	0	0	0	0	0	0
n-HEXANE	0	0	0	0	0	0	0	0
TOTAL LB MOLE/HR	36.00	33.67	103.00	1.7	2,579.00	5.86	851.17	5.09
DENSITY, LB/FT3	0.71	20.11	30.11	0.71	33.97	1.75	33.07	0.71
VISCOSITY, CP	0.01	0.01	0.08	0.01	0.11	0.21	0.11	0.01
SURF. TENSION, DYNE/CM		3.65	4.05		4.11		4.11	

NOTES:

1. THIS DRAWING REPRESENTS PRELIMINARY ENGINEERING AND IS ISSUED FOR INFORMATION RECORDS
2. TEMPORARY PRESSURING LINE - ONLY USED PRIOR TO INITIAL ETHANE CHARGE TO TANK
3. MAXIMUM VAPOR RATE IS PRODUCED BY FLASHING, VAPOR DISPLACEMENT AND BOIL OFF AS A RESULT OF HEAT LEAK DURING "FILLING" MODE
4. MAXIMUM FLOW TO 301C IS BASED ON [illegible] HOUR FILLING TIME AT AVERAGE AMBIENT TEMPERATURE
5. FLOW RATE IS TYPICAL FOR LINE [illegible]
6. MAXIMUM FLOW TO 301C [illegible] IS BASED ON [illegible] HOUR FILLING TIME AT AVERAGE AMBIENT TEMPERATURE
7. CONDITIONS AT AVERAGE AMBIENT TEMPERATURE
8. VAPORIZER OPERATES INTERMITTENTLY FOR TANK PRESSURE MAINTENANCE
9. DISTRIBUTION SHOWN IS TYPICAL FOR LINE [illegible]
10. [illegible] STREAMS [illegible] ARE EXPRESSED AS PURE COMPONENT [illegible]

REFERENCE DRAWINGS	DRAWING NO.

NO.	DATE	REVISIONS
B	[illegible]	ISSUED FOR INFORMATION [illegible]
A	[illegible]	ISSUED FOR INFORMATION [illegible]

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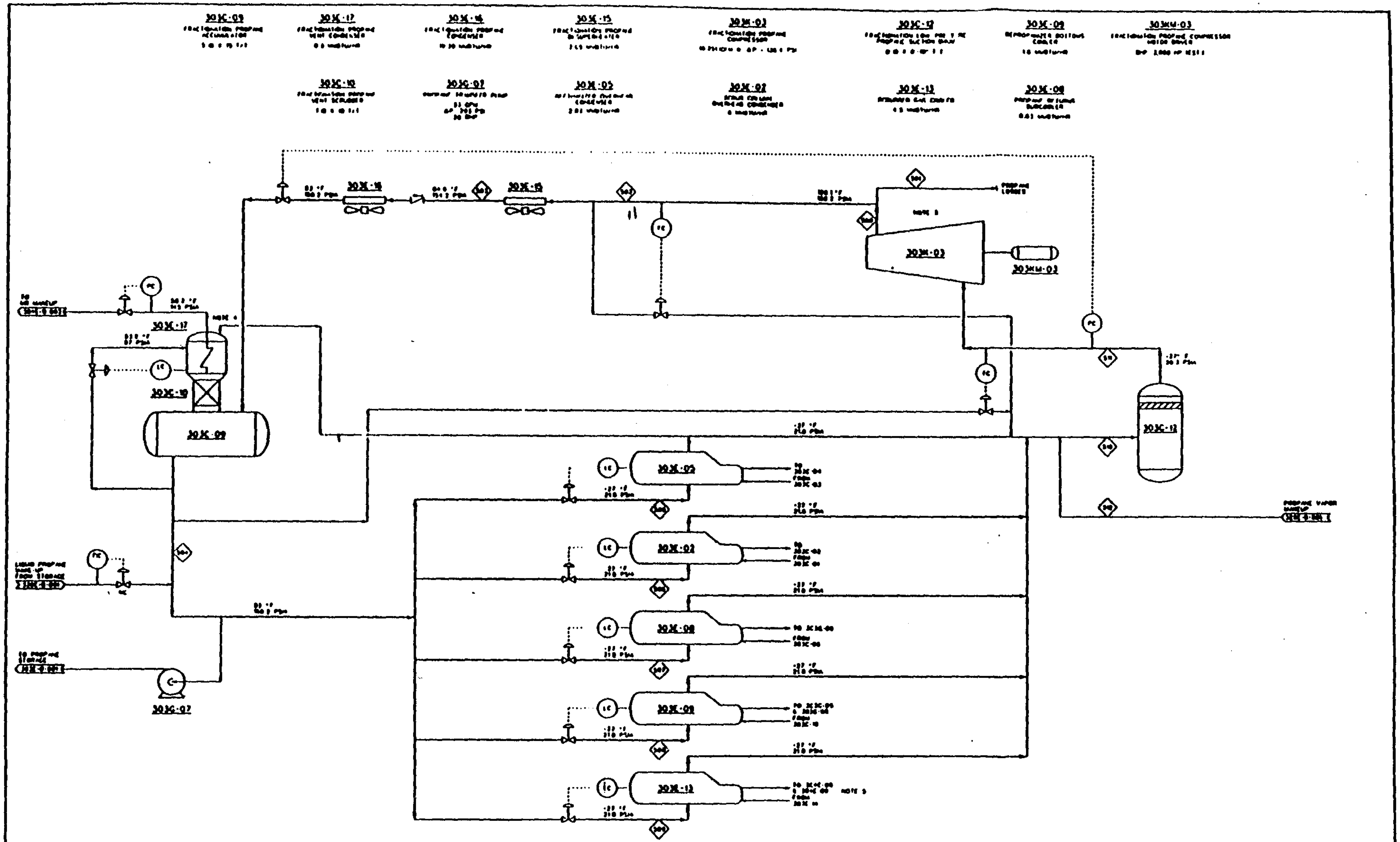
PROCESS FLOW DIAGRAM
REFRIGERANT STORAGE
PLANT 320

JOB NO.	DRAWING NO.	REV.
[illegible]	320E-D-001	B



STREAM NO	300	301	302	303	304	305	306	307	308	309	310	311	312
DESCRIPTION	PROPANE COMPRESSOR DISCHARGE	PROPANE LOSS	PROPANE TO DESUPERHEATER	PROPANE TO CONDENSER	LIQUID PROPANE FROM ACCUMULATOR	PROPANE TO DE C3 OVERHEAD CONDENSER	PROPANE TO SCRUB COL OVERHEAD CONDENSER	PROPANE TO C3 RETURN SUBCOOLER	PROPANE TO DE C3 BOTTOMS COOLER	PROPANE TO SCRUBBED GAS COOLER	VAPOR C3 TO LOW PRESS C3 SUCT DRUM	PROPANE COMPRESSOR INLET	PROPANE MAKE-UP FROM STORAGE
MMSCFD	27.05	0.02	27.03	27.03	-	1.95	0.19	0.02	1.26	3.09	27.05	27.05	0.02
GPM	-	-	-	-	336.21	95.47	67.50	0.54	35.30	88.14	-	-	-
LB/HR TOTAL	135,300	76	135,227	135,227	135,227	25,249	53,520	245	16,007	40,121	135,300	135,300	76
MOL. WT.	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1	44.1
COMPONENT, LB MOLES/HR													
NITROGEN	0	0	0	0	0	0	0	0	0	0	0	0	0
METHANE	0	0	0	0	0	0	0	0	0	0	0	0	0
ETHANE	0	0	0	0	0	0	0	0	0	0	0	0	0
PROPANE	3,068.3	1.7	3,066.6	3,066.6	3,066.6	572.6	1,213.0	5.6	363.0	909.0	3,068.3	3,068.3	1.7
i-BUTANE	0	0	0	0	0	0	0	0	0	0	0	0	0
n-BUTANE	0	0	0	0	0	0	0	0	0	0	0	0	0
i-PENTANE	0	0	0	0	0	0	0	0	0	0	0	0	0
n-PENTANE	0	0	0	0	0	0	0	0	0	0	0	0	0
n-HEXANE	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL LB MOLES/HR	3,068.3	1.7	3,066.6	3,066.6	3,066.6	572.6	1,213.0	5.6	363.0	909.0	3,069.3	3,068.3	1.7
DENSITY, LB/FT³ @ P/T	1.34	1.34	1.34	4.44	30.97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
VISCOSITY, CP @ P/T	0.0093	0.0093	0.0093	0.0086	[illegible]	[illegible]							

NOTE 3

NOTES:

1. THIS DRAWING REPRESENTS PRELIMINARY ENGINEERING AND IS ISSUED FOR INFORMATION/RECORDS
2. ONLY ONE FRACTIONATION PROPANE REFRIG. & COMPRESSION TRAIN IS AVAILABLE FOR THE TOTAL PLANT
3. ANTI SURGE CONTROL SHOWN HERE IS ONLY CONCEPTUAL (TO BE DEVELOPED FURTHER PENDING P&ID AND VENDOR'S INPUT)
4. PROPANE VENT SCRUBBER AND PROPANE VENT CONDENSER OPERATE INTERMITTENTLY
5. TO 30HE 06 FOR BYPASSING EXPANDER OPERATION (NOTE 3 ...)

REFERENCE DRAWINGS	DRAWING NO.

NO	DATE	REVISIONS
0	[illegible]	[illegible]
C	[illegible]	ISSUED FOR [illegible]
B	[illegible]	ISSUED FOR APPROVAL
A	[illegible]	ISSUED FOR INTERNAL REVIEW

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TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

PROCESS FLOW DIAGRAM
FRACTIONATION ...

Liquefaction System

Pretreated feed gas from the Dehydration System would enter the Liquefaction System. Four individual trains are to be provided, each with its individual pretreatment system. The composition of the feed gas remains the same as that entering the facility with approximately 89.87 percent methane, water having been removed in the Dehydration System. The feed gas ultimately would be liquefied utilizing a Mixed Refrigerant (MR) Cycle. The constituents of the mixed refrigerant fluid would be nitrogen, methane, ethane and propane in appropriate proportions to achieve the desired result. Multi-stage precooling both for the MR refrigerant and for the feed gas would be provided by a closed-cycle propane refrigeration system.

Pretreated feed gas would enter the individual liquefaction trains via 20-inch lines at design conditions of 38.5^{o} F and 1275 psia with a flow rate of 576 MMSCFD. The feed gas would be precooled in successive propane evaporators prior to entering the MR refrigeration portion of the system. The final stages of cooling and liquefaction would be achieved in the Main Cryogenic Heat Exchanger.

The source of refrigeration within the Main Cryogenic Heat Exchanger would be the MR fluid. The refrigerant in the closed-cycle MR system would be circulated by three centrifugal compressors each driven by 37,000 horsepower GE Frame-5 turbine. The compressors would be operated in series with individual suction drums and aftercoolers. A proposed plot plan and block diagrams indicating major components of the composite system are presented in the following drawings.

The high pressure MR fluid would be cooled in successive stages by propane evaporators. The precooled high pressure refrigerant then would flow to a liquid/vapor separator. The separated streams would provide refrigeration and ultimately liquefaction and subcooling of the feed gas stream within the Main Cryogenic Heat Exchanger. The combined warmed low pressure MR stream would exit the heat exchanger to reenter the suction of the Low Pressure MR Compressor.

The subcooled LNG exiting the Main Cryogenic Heat Exchanger would be expanded to a pressure of about 18 psia. An LNG Flash Drum is to separate flash gas that then would be warmed in the MR/Flash Gas Heat Exchanger and compressed to the Fuel Gas Distribution Header. Compression of the flash gas to the distribution header line pressure would be accomplished by a 6400 horsepower turbine-driven Flash Gas Compressor. Control of the degree of LNG subcooling in the Main Cryogenic Heat Exchanger is considered critical to preventing overall fuel gas supply imbalance caused by the additional fuel gas generated from ship loading operations with resultant vapor recovery.

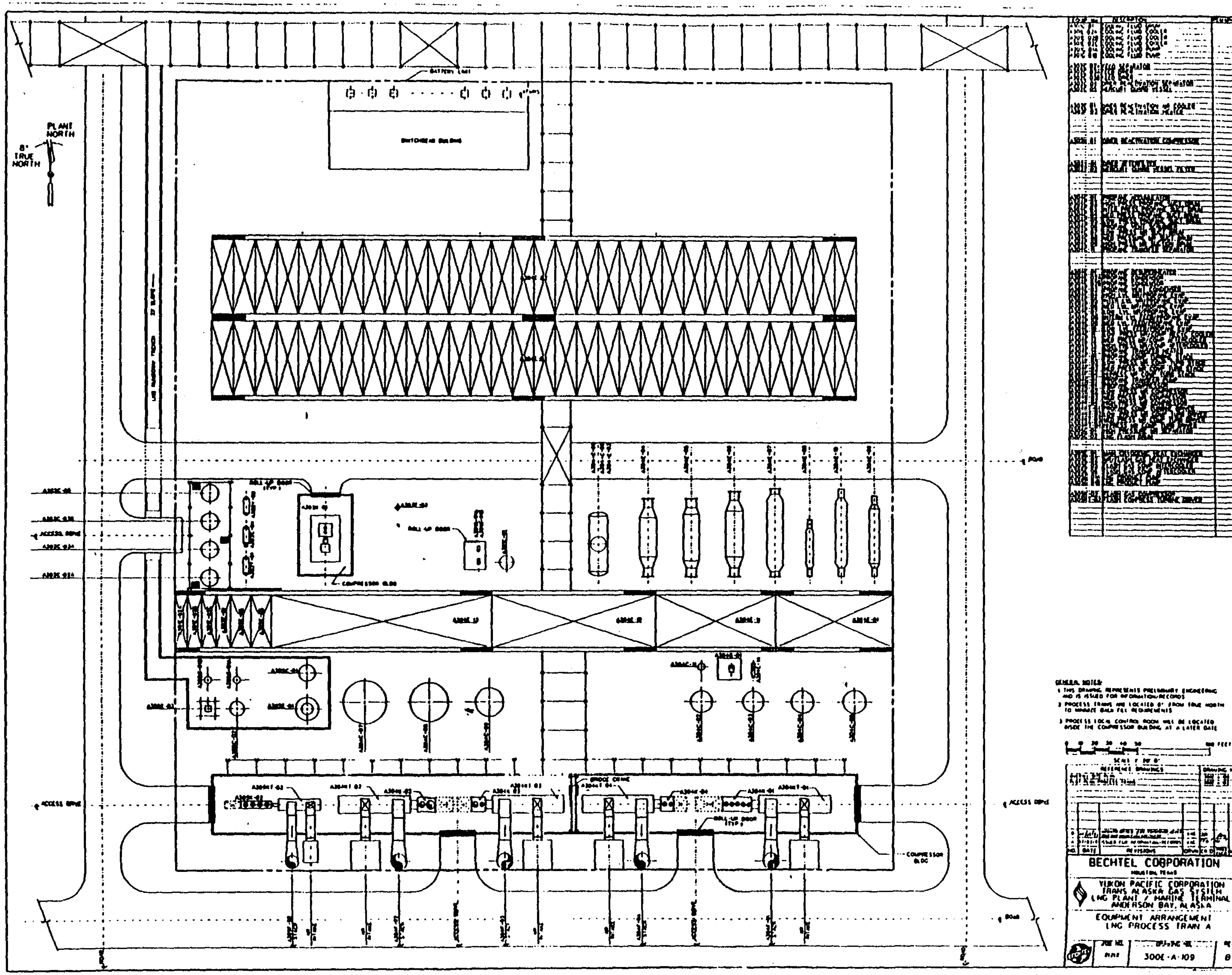
LNG from the LNG Flash Drum of each train would be pumped to the proposed 800,000 barrel LNG storage tanks at a design flow rate of 550 MMSCFD. Final expansion of the LNG reduces the pressure to storage tank conditions. The design density of the LNG to be transferred to the storage tanks is estimated to be 28.6 pounds per cubic foot. Based on the proposed system parameters, the design LNG composition is estimated to be as follows:

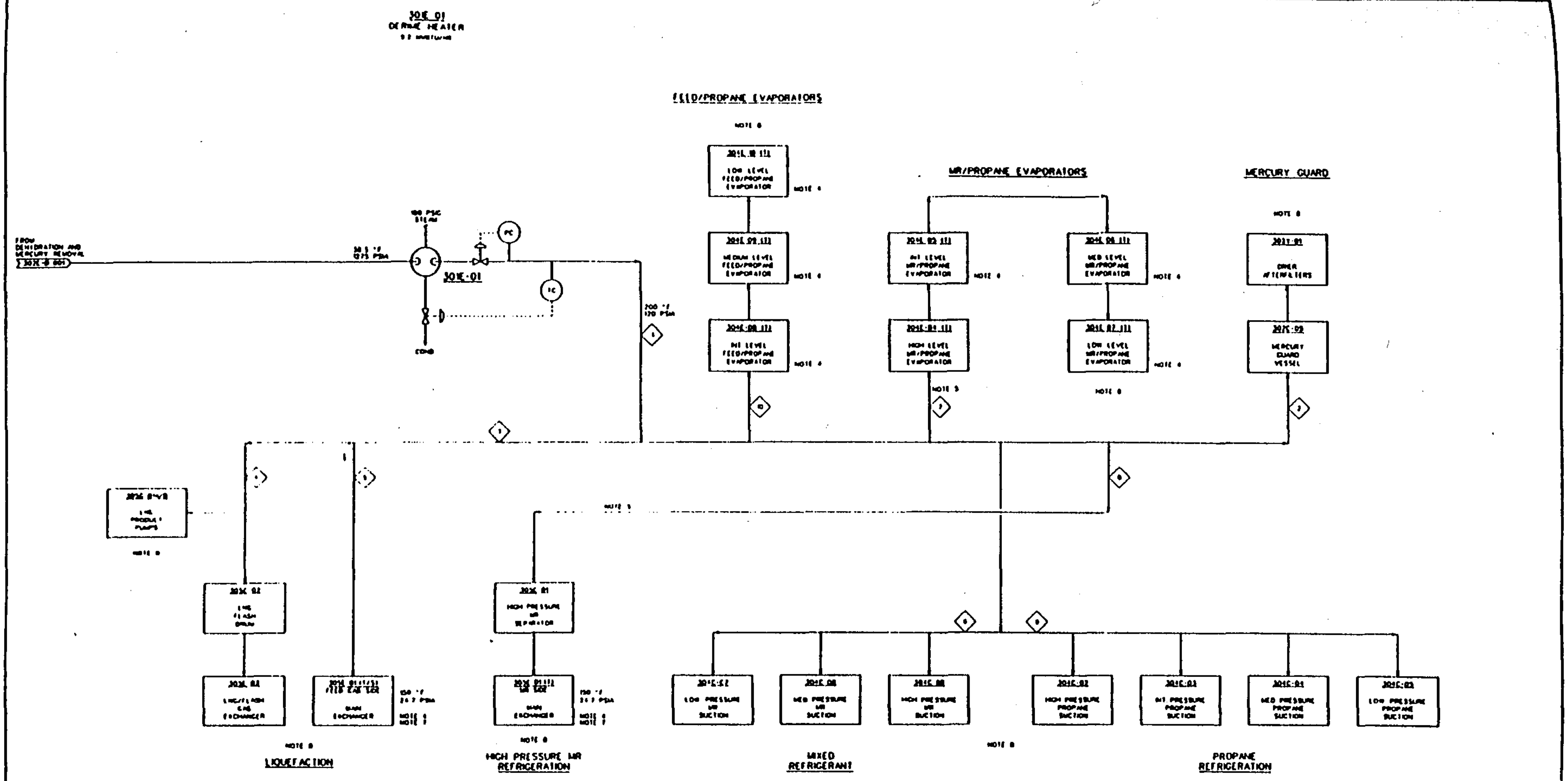
<u>Design LNG Composition</u>

Nitrogen	0.33
Methane	89.81
Ethane	6.20
Propane	1.97
i-Butane	0.79
n-Butane	0.86
i-Pentane	0.02
n-Pentane	0.01
n-Hexane	0.01

The propane refrigeration system to be used for precooling both the feed gas and the MR streams would utilize a single four-stage propane compressor driven by a 37,000 horsepower GE Frame-5 turbine. Refrigerant fluid makeup systems would be provided for both the propane refrigeration system and the MR refrigeration system. The Propane Accumulator is to be designed to retain the propane system contents during system shutdown. The entire propane system (suction drums, evaporators, piping, etc.) is to be designed to retain propane at its vapor pressure at maximum ambient temperature to provide storage for extended shutdown periods without flaring. (It should be noted that the propane refrigerant system contains considerable quantity-estimated to be of the order of 50,000 gallons.)

Retention of the fluids in the MR refrigeration system is to be accommodated primarily by the MR Suction Drum and the Main Cryogenic Heat Exchanger to prevent loss during extended shutdown periods.


PLANT NORTH
8° TRUE NORTH
SWITCHGEAR BUILDING
ROLL-UP DOOR
COMPRESSOR BLDG
ACCESS DRIVE
BRIDGE CRANE
ROAD
GENERAL NOTES:
1 THIS DRAWING REPRESENTS PRELIMINARY ENGINEERING AND IS ISSUED FOR INFORMATION/RECORDS
2 PROCESS TRAINS ARE LOCATED 8° FROM TRUE NORTH TO MINIMIZE BACK FILL REQUIREMENTS
3 PROCESS LOCAL CONTROL ROOM WILL BE LOCATED INSIDE THE COMPRESSOR BUILDING AT A LATER DATE
100 FEET
REFERENCE DRAWINGS
DRAWING NO.
REVISIONS
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
EQUIPMENT ARRANGEMENT
LNG PROCESS TRAIN A
3OOE-A-109
B



NOTES 2,3,6

STREAM NO		1	2	3	4	5	6	7	8	9	10
CASES		MAIN DERIME HEADER	TO DRIERS	TO LIQUEFACTION	TO LNG FLASH	TO MAIN HEAT EXCHANGER LNG	TO MR REFRIGERANT	TO MR/C3 EVAPORATOR	TO MAIN HEAT EXCHANGER	TO C3 REFRIG ERATION	TO FEED/C3 EVAPORATOR
PROPANE REFRIGERATION SYSTEM	LB/HR	12 200	0	0	0	0	0	0	0	12,200	0
	SCFM	4 246	0	0	0	0	0	0	0	4,246	0
MIXED REFRIGERANT SYSTEM	LB/HR	67 500	0	0	0	0	25 000	18 500	20 000	0	0
	SCFM	23 495	0	0	0	0	10 091	6 439	6 961	0	0
LIQUEFACTION	LB/HR	86 400	0	40 200	19 810	20 400	0	0	0	0	6 100
	SCFM	30 106	0	13 992	6 891	7 110	0	0	0	0	2 421
MIXED REFRIGERANT & LIQUEFACTION	LB/HR	151 000	0	40 210	19 800	20 400	25 000	18 500	20 000	0	6 110
	SCFM	53 600	0	13 992	6 891	7 100	10 094	6 439	6 961	0	2 421
MERCURY GUARD	LB/HR	19 910	19 910	0	0	0	0	0	0	0	0
	SCFM	6 897	6 897	0	0	0	0	0	0	0	0

NOTES:

1. THIS DRAWING REPRESENTS PRELIMINARY ENGINEERING AND IS ISSUED FOR INFORMATION/RECORDS
2. EQUIPMENT SIZING AND MATERIAL BALANCE DENOTE DISTRIBUTION FOR ONE LNG TRAIN
3. MAXIMUM EQUIPMENT BACK PRESSURE TO BE DERIMED IS ASSUMED TO BE 10 PSIG
4. (S) DENOTES SHELL SIDE OF HEAT EXCHANGER (T) DENOTES TUBE SIDE OF HEAT EXCHANGER
5. DENOTES LONG RUNS OF MAJOR PROCESS PIPING WHICH REQUIRE DERIMING
6. DERIME ARRANGEMENT IS BASED ON EQUIPMENT ARRANGEMENT FOR LNG PROCESS TRAINS 1 THROUGH 4 REV A, DRAWING NO 300 L A 100
7. TEMPERATURE OF DERIME GAS TO MAIN CRYOGENIC HEAT EXCHANGER NOT TO EXCEED 150 °F
8. EXHAUST GAS FLOWS TO THE FLARE SYSTEM

REFERENCE DRAWINGS	DRAWING NO.

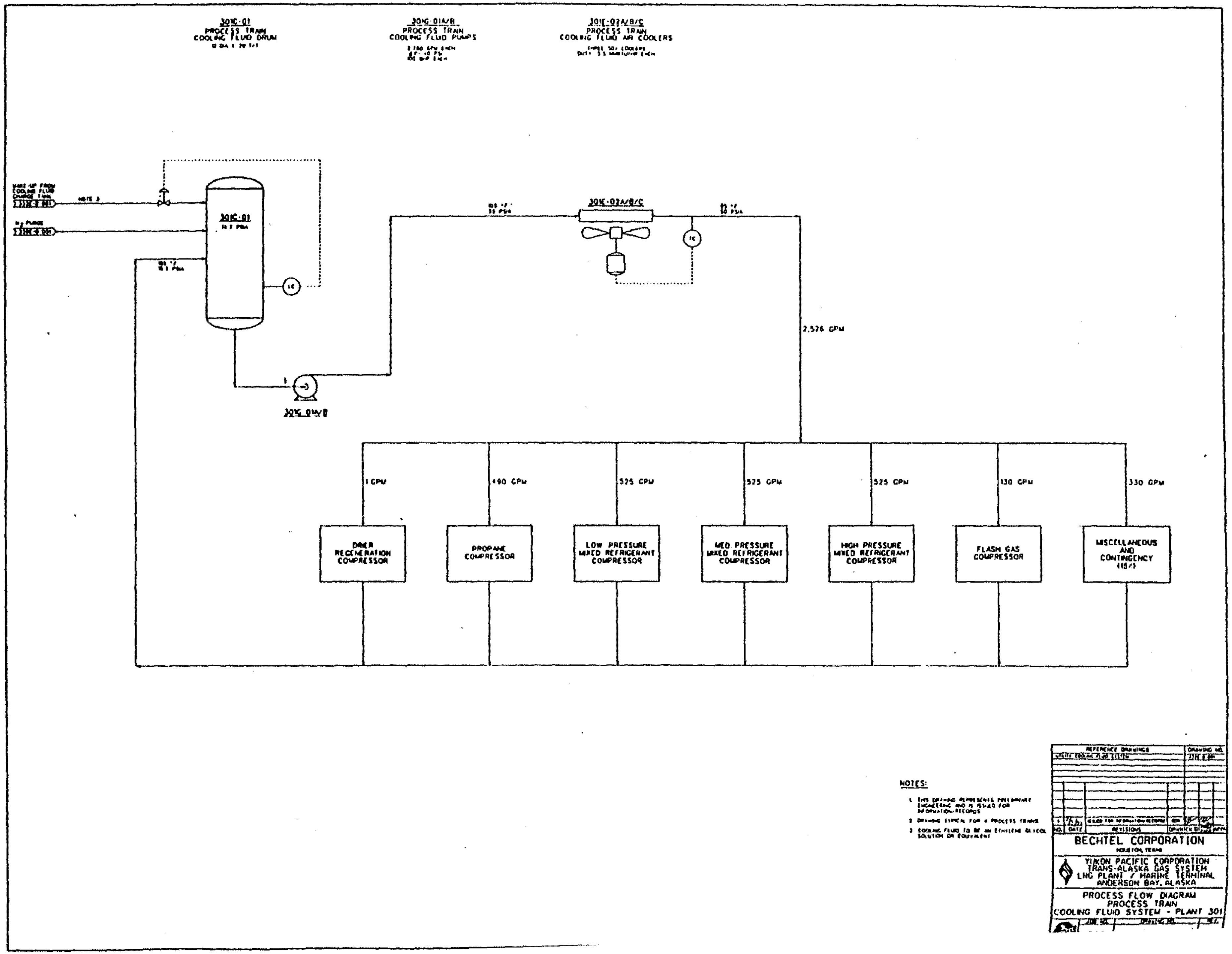
NO.	DATE	REVISIONS	DRAWN	CK'D		APPR
C		ISSUED FOR INFORMATION/RECORDS				
B		ISSUED FOR APPROVAL				
A		ISSUED FOR INTERNAL REVIEW				

BECHTEL CORPORATION
HOUSTON, TEXAS

YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

PROCESS FLOW DIAGRAM
DERIME SYSTEM
PLANT 301

JOB NO.	DRAWING NO.	REV.
21212	301F B 002	C


301C-01
PROCESS TRAIN
COOLING FLUID DRUM
301G-01A/B
PROCESS TRAIN
COOLING FLUID PUMPS
301E-02A/B/C
PROCESS TRAIN
COOLING FLUID AIR COOLERS
301C-01
301E-02A/B/C
301G-01A/B
2,526 GPM
1 GPM
490 GPM
525 GPM
575 GPM
525 GPM
130 GPM
330 GPM
DRIER REGENERATION COMPRESSOR
PROPANE COMPRESSOR
LOW PRESSURE MIXED REFRIGERANT COMPRESSOR
MED PRESSURE MIXED REFRIGERANT COMPRESSOR
HIGH PRESSURE MIXED REFRIGERANT COMPRESSOR
FLASH GAS COMPRESSOR
MISCELLANEOUS AND CONTINGENCY
NOTES:
REFERENCE DRAWINGS
DRAWING NO.
NO.
DATE
REVISIONS
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PROCESS FLOW DIAGRAM
PROCESS TRAIN
COOLING FLUID SYSTEM - PLANT 301

LNG Storage Tanks

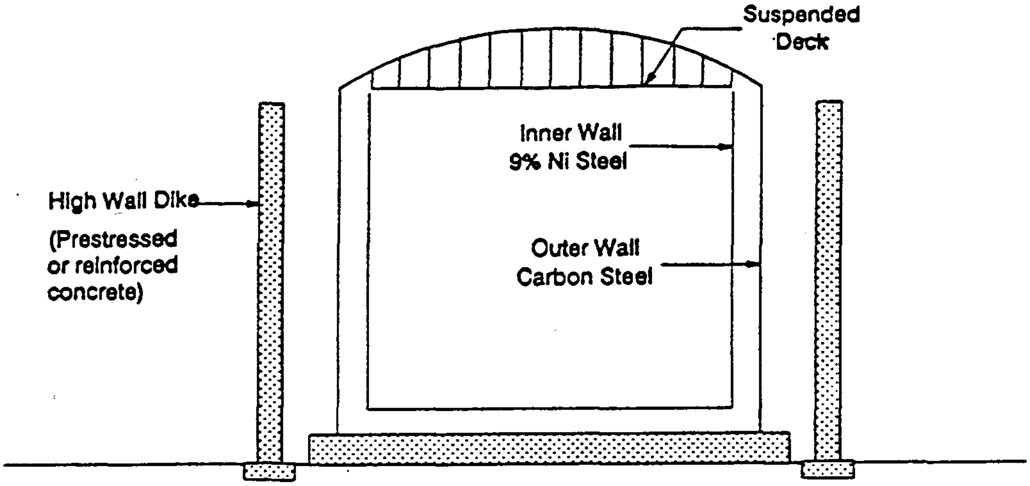
Four LNG storage tanks with a nominal capacity of 800,000 barrels each are planned for the facility with provision made for addition of one storage tank of the same capacity at a later date. The proposed plant site is a hilly area on the bay which will require a significant amount of site clearing, cutting, filling and spoil disposal. The storage tanks are to be located on cut bedrock. The seismic zone classification is Zone 4 UBC. For YPLP study purposes, a 0.6 g critical ground acceleration was adopted. A ground snow load of 235 psf was selected with an estimated equivalent flat-roof conversion loading of 169 psf.

Recognition of the fact that the LNG storage tanks, together with their impoundment systems, constitute a major portion of capitol expenditure for the LNG plant and that federal regulations and construction codes dictate certain minimum design and safety requirements, YPLP conducted a study in which seven types of LNG storage tanks and impoundments were identified for evaluation. Considering project requirements and site specific conditions, the field of systems to be evaluated in detail was reduced to four types. Design and estimated cost information was developed for each of these systems. Chicago Bridge and Iron Company (CBI) provided a design and relative cost study of conventional metal LNG storage tanks with low and high external concrete wall dikes (termed single-integrity since the outer tank shell of carbon steel is not designed to contain LNG spills from the inner tank should it leak or rupture). CBI also studied a metal inner wall and a prestressed concrete outer wall LNG storage tank (designated by the designers to be double-integrity since both walls are to be capable of containing LNG). Preload Incorporated (Preload) was selected to provide similar information for a configuration having prestressed concrete inner and outer wall LNG storage tanks of the double-integrity type, the walls either being precast or cast-in-place. An evaluation of each system on several important parameters led to a tank/impoundment system ranking which indicated advantages in most categories of the double-integrity tanks. The conventional metal double wall tank with a separate high external concrete wall dike was also selected as a possible design configuration. Other design configurations were eliminated for the specific site for various technical and/or economic reasons. Basic selected configurations receiving additional study are shown in the following drawing. It was concluded by YPLP that final selection among the three LNG storage tank design configurations would best be made after further analysis and competitive bidding (including cost and construction schedule).

The following provides a brief description of each of the three selected tank designs based on the limited information available to the FERC at this time. It was indicated that all tanks are to be designed, fabricated, erected, inspected and tested in accordance with Federal Regulation 49 CFR Part 193 - 1989 Edition, API Standard 620, Appendix Q - 1990 Edition and NFPA 59A - 1990 Edition.

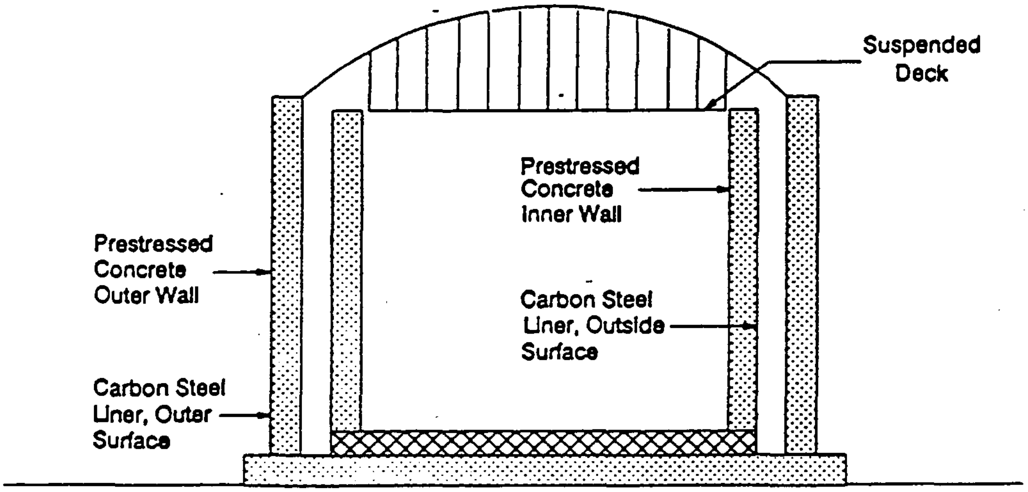
Additional information on the proposed design configurations and partial construction details can be found in the YPLP original material submitted to the FERC - Volume II, Response 7, Tab O.

Type T-2 CBI Conventional Metal Double Wall Tank - The proposed Type T-2 conventional metal double wall tank would be constructed with metal inner and outer walls, a flat bottom and a suspended horizontal inner tank roof deck. The 87′-6" high by 270′ diameter inner shell is to be fabricated with 9 percent nickel steel and the outer shell - 96′ high by 280′ diameter is to



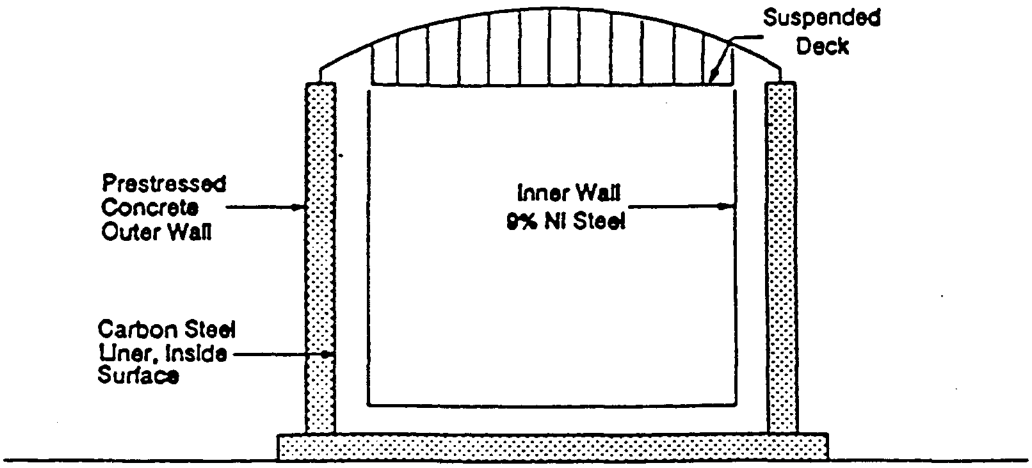
TYPE T-2

CONVENTIONAL METAL TANK, HIGH WALL DIKE



TYPE T-4

DOUBLE INTEGRETY TANK, DOUBLE CONCRETE WALL



TYPE T-6

DOUBLE INTEGRETY TANK, CARBON STEEL ROOF be ASTM A553 - type 1 or ASTM A353 carbon steel. The umbrella type roof is to be fabricated with ASTM A516-70 carbon steel.

Within the inner tank, a distance of 7'-9" is to be provided between the maximum liquid level and the aluminum horizontal suspended deck (which is to support 24 inches of perlite insulation) to allow for calculated internal sloshing wave that may be induced by an earthquake plus 12-inch wave runup. Anchorage of the inner tank against earthquake uplift loads is to be provided by 148 stainless steel straps welded to the inner tank and imbedded in the ringwall foundation which supports the tank.

The annular space between the shells of the double wall LNG storage tank is to be a composite insulation system with a total thickness of 60 inches (48 inches of loose fill expanded perlite and 12 inches of resilient fiberglass blanket insulation fixed to the outside of the inner tank). The resilient fiberglass blanket is designed to control compaction of the perlite insulation due to expansion and contraction of the insulation space.

The suspended deck insulation system is to consist of 24 inches of loose fill perlite supported by a 0.1875-inch aluminum alloy lap welded deck. The deck is to be secured by a series of rods or bars attached to the outer tank roof. Sufficient breathing area is to be provided through the deck to prevent differential pressure from occurring across the suspended deck. The space between the outer roof and the suspended deck is to contain natural gas remaining at essential ambient temperature under normal operating conditions. The inner tank bottom load-bearing insulation is specified as 20 inches of foamglass. In combination the described insulation system is designed to provide a maximum calculated LNG storage tank boiloff rate of 0.05 percent per day of full contents.

The foundation design for the conventional tank is to consist of an annular ringwall (12' wide by 7'-6" thick concrete slab) resting on bedrock. The outer tank is secured to the ringwall by 360 anchor bolts. Rock anchors extending from the ringwall to bedrock are to be designed to resist the uplift forces caused by potential seismic loads; during normal operation there is no uplift acting on the foundations. The rock anchors are to be 1.375 inches in diameter and are to have an imbedded length of 15 feet into the underlying sound bedrock and are to be grouted with a cementitious grout. Bedrock is assumed by CBI to be 6 feet below finished grade. An electrical foundation heating system is to be installed beneath the outer tank in the underlying 10-inch sand cushion to eliminate freezing of the subgrade and prevent frost heave.

Type T-6 CBI Double-Integrity LNG Storage Tank - The proposed Type T-6 double- or increased-integrity LNG storage tank is to be a double wall, horizontal suspended deck tank similar to a conventional double metal wall tank in that the design consists of a double bottom, double shell and single pressure roof - the difference being that the outer wall of the proposed tank is to be prestressed concrete, which is also intended to serve as impoundment for any liquid spill or leakage from the primary inner vessel.

Similar to the previously described conventional metal double wall tank, the 9% nickel steel (ASTM A553 - Type 1 or ASTM A353) inner tank dimensions are 270' outside diameter x 87'-6" high with a maximum liquid height of 79'-9" with similar freeboard above the maximum liquid level to accommodate calculated internal sloshing wave that may be induced by an earthquake plus 12-inch wave runup. Anchorage of the inner tank against earthquake uplift loads is to be provided by 148 stainless steel straps welded to the inner tank and imbedded in the ringbeam foundation which supports the tank. The ringbeam consists of a concrete ringwall and a center concrete slab poured on in-situ material or compacted backfill.

The load-bearing insulation beneath the inner tank is specified as 20 inches of foamglass. High loading beneath the inner tank shell due to tank weight and potential seismic overturning is to be carried by a concrete bearing ring 18 inches thick supported on 12 inches of high strength foamglass.

The annular space between the shells of the double wall LNG storage tank is to be a composite insulation system with a total thickness of 60 inches (48 inches of loose fill expanded perlite and 12 inches of resilient fiberglass blanket insulation) similar to the previously described conventional storage tank.

The suspended deck insulation system is also to be of similar construction consisting of 24 inches of loose fill perlite supported by a 0.1875-inch aluminum alloy lap-welded deck.

The outer container consisting of carbon steel roof, prestressed concrete wall (285′ outside diameter x 96′ high) with carbon steel liner and outer bottom is to comprise a gas-tight boundary for the LNG storage tank. The concrete wall and outer bottom also are intended to provide for containment of LNG in the event of liquid spillage from the inner vessel. The outer concrete wall is to be prestressed both vertically and circumferentially to resist liquid pressure from the full contents of LNG from the inner tank and the coincident thermal gradients through the wall. The carbon steel liner is to be attached to the inside of the concrete wall for vapor tightness. The outer 9% nickel steel bottom is to be connected to the concrete wall by a flexible expansion joint. The joint is intended to accommodate wall movements and bottom shrinkage if a spill occurs. Insulation is to be provided beneath the outer bottom in the region of the wall-to-slab connection to reduce thermal shock from sudden exposure to LNG.

The concrete wall is to be fully fixed to the foundation after it is prestressed. The prestressed concrete wall is intended to be part of the outer container during normal tank operation and is to provide secondary containment in the event of an LNG spill from the inner vessel. The following figures show details of the prestressed concrete wall as well as other tank details.

The top of the outer concrete wall is to be set at the same elevation as the top of the inner tank to provide a minimum net containment volume of 110 percent of the tank contents.

The thickness of the outer wall and the percentage of normal reinforcement is to be governed by earthquake sheer forces that might occur during normal operation. Prestressing steel is to be designed to provide a minimum concrete compression stress of 250 psi with a full product spill, after all prestress losses have occurred. The 250 psi prestress is designed to control cracking caused by thermal gradients induced by spilled LNG.

The ringbeam foundation design for the double- or increased-integrity tank is to consist of an annular concrete ringwall (7′- 2" thick) resting on bedrock and a 2′-thick concrete center slab poured on in-situ material or compacted backfill. Rock anchors extending from the ringwall to bedrock are to be designed to resist the uplift forces caused by potential seismic loads; during normal operating there is no uplift acting on the foundations. The rock anchors are to be 1.375 inches in diameter and are to have an embedded length of 19 feet into the underlying sound bedrock and are to be grouted with a cementitious grout. The center slab is to provide a passive environment to minimize corrosion on the underside of the secondary steel bottom and is an additional barrier in the event of a spill. An electrical foundation heating system is to be installed beneath the outer tank within the center concrete slab to eliminate freezing of the subgrade and prevent frost heave.

The concrete ringwall is to be built in two stages. Stage I concrete is to be placed after the rock anchors are installed. Stage II concrete is to be placed after completion of the horizontal prestressing and prior to construction of the steel expansion joint.

Type T-4 Preload Double-Integrity LNG Storage Tank - The second proposed type of double-integrity LNG storage tank is the double concrete wall tank. Both the inner and outer tank walls would be of prestressed concrete, separated by a perlite-filled annular space. The outer tank would consist of a prestressed concrete wall, a carbon steel subfloor and a 0.3125-inch carbon steel plate roof (with or without a concrete overlay) supported by a framework of radial ribs and the outer tank concrete wall. The inner tank would consist of a prestressed concrete wall, a 9% nickel steel floor and an outer roof-suspended insulation deck.

It is reported that the double concrete wall option is practicable in two alternative construction modes. One is field installed precast concrete; the other is cast-in-place concrete. The precast panels would be full height x 8′ width - manufactured in the Seattle, WA area and barged to the site. If cast-in-place on site, the walls would be constructed in successive rings 6.5′ to 10′ in height. Proposed designs by Preload are presented following the CBI drawings. For either mode, the outer wall height is 111′-6.5"; the inner wall height is 107′-1.5"; and the maximum stored liquid height is 101′. Other wall dimensions depend upon the particular construction mode (precast shown in parenthesis): inner wall outside diameter - 240′-9" (240′-5"); outer wall outside diameter - 251′-2" (250′-7"); inner wall maximum thickness - 16" at base; outer wall maximum thickness - 19" at base. (Top wall thickness of both inner and outer precast walls is to be 12".)

Both the inner and outer prestressed concrete walls would be cast integrally with a 0.25" (ASTM A131 Grade C) carbon steel liner on the outside face. This composite wall would be subject to biaxial compression by means of circumferential and vertical prestressing. Preload indicates that load-resisting capacity derives mainly from this compression and that it would equal or exceed the tensile stresses imposed by the service loads and would be sufficiently large to limit the tensile stresses and concrete cracking imposed by accidental loads. The liner is to be tested by vacuum box or by dye penetrant methods before concrete is placed, depending on mode of erection. It is to form an inseparable and composite part of the wall and is to provide a permanent barrier against vapor and liquid penetration. The bottom 12" to 20" of the barrier is to be 9% nickel steel which is to be welded to the 9% nickel sketch plates that lie under the tank walls.

Horizontal prestressing is to be applied by means of high-strength wires which are to be wound in a continuous helix around the tank. Pneumatic mortar (gunite) applied on each layer of wires is to bond the wires onto the wall and is intended to result in a uniform, monolithic concrete shell. A final covercoat of pneumatic mortar is intended to provide positive protection against wire corrosion. The magnitude of hoop compression (and hence the number of wires) required at a given level is to be equal to or greater than the hoop tension to be induced in the wall by the contained liquid. The profile of the post-tensioning force is to be designed to correspond closely to the hydrostatic pressure as it varies with liquid depth. Vertical prestressing is to be applied by means of linear multi-strand tendons spaced uniformly around the tank circumference either by pretensioning of the precast panels or by post-tensioning in the case of cast-in-place wall construction.

The inner wall is to be designed only for hydrostatic loads, controlled thermal loads (during cooldown) and seismic loads. The outer wall is to be designed for imposed environmental conditions (snow, wind, etc.), the full hydrostatic load of the tank contents, the internal vapor pressure and the specified earthquake loads. The design is to provide for thermal shock from an inner tank spill with crack penetration limited to one-half the concrete wall thickness. Each wall is to have a sliding base which is intended to permit radial movement (i.e., symmetrically with the tank center) in relation to the foundation.

The tank insulation system is to be comprised of a 44" average thickness of perlite in the annular space between inner and outer prestressed concrete walls, a 12" thickness of load-bearing cellular glass blocks beneath the inner tank floor, a balsa block footing beneath the inner concrete wall and a 26" thickness of fiberglass blankets supported by the inner tank insulation deck. The insulation system design is to limit storage tank boiloff to 0.05 percent per day of full tank content. Present design information does not specify the desirability or necessity of a resilient fiberglass blanket within the insulation space to prevent compaction of the perlite insulation.

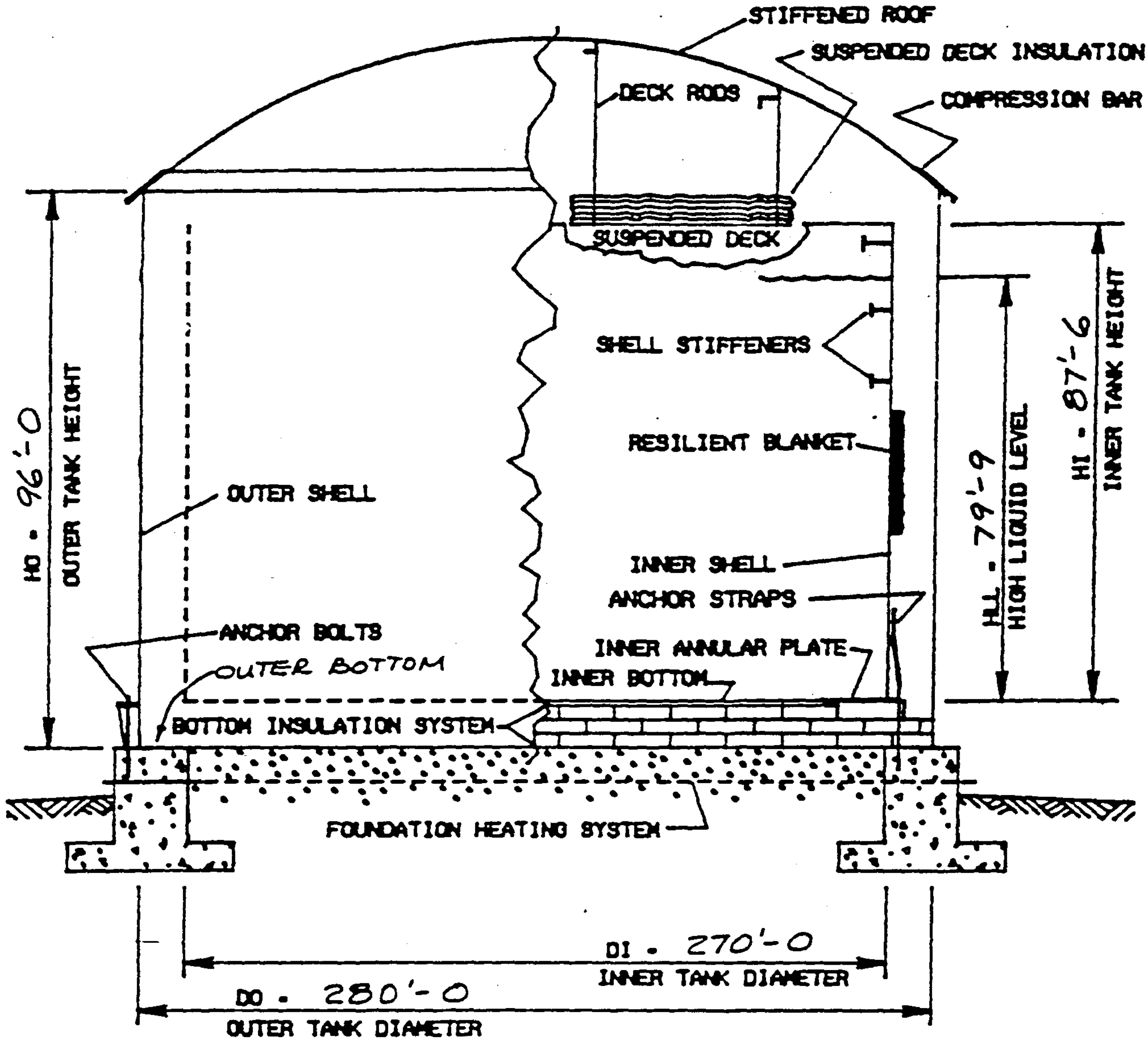
LNG Storage Tank Process Description - Although a decision has not been made on the final selection of storage tank design, certain common factors and operational characteristics exist. The 800,000 barrel storage tanks are to have a design pressure of 2.0 psig with a normal operating pressure of 0.5 psig. Vacuum design is to be 0.05 psig - replacement pad gas being automatically supplied by a four-inch line from the fuel gas header. Pressure and vacuum relief valves have not yet been specified. No process piping is to penetrate the sidewalls of the storage tank - all piping is to enter or exit through the roof. Selected schematic drawings follow proposed LNG storage tank design configurations.

The liquid bottom fill line to the storage tank is to be a 24-inch line terminating at the top of an open-topped standpipe within the inner vessel. The flash break at the top of the standpipe is to be provided to release vapor from the incoming liquid while providing bottom fill of the liquid which has been equilibrated at tank ullage pressure. Capability also is to exist to discharge liquid to the top center of the inner vessel by use of a 24-inch line terminating above an inverted funnel-shaped splash plate. The line may also be used for circulation, recirculation, thermal relief and cooldown functions. Vapor generated from tank boiloff and flash losses is to be removed from the storage tank ullage by a 30-inch line.

Liquid withdrawal and liquid circulating pumps are to be submerged centrifugal units located internal to the storage tanks within individual pump columns. Each storage tank is to contain four LNG loading pumps - each with a flow rate of 7500 gpm. Discharge from the loading pumps is accommodated by separate 16-inch lines combining with a 24-inch header. Additionally, each tank is to have a single liquid circulating pump with a flow rate of 500 gpm. Piping provisions are to be made to provide for circulation through the marine loading lines and for recirculation within the storage tank. Intertank transfer capability also is to be provided.

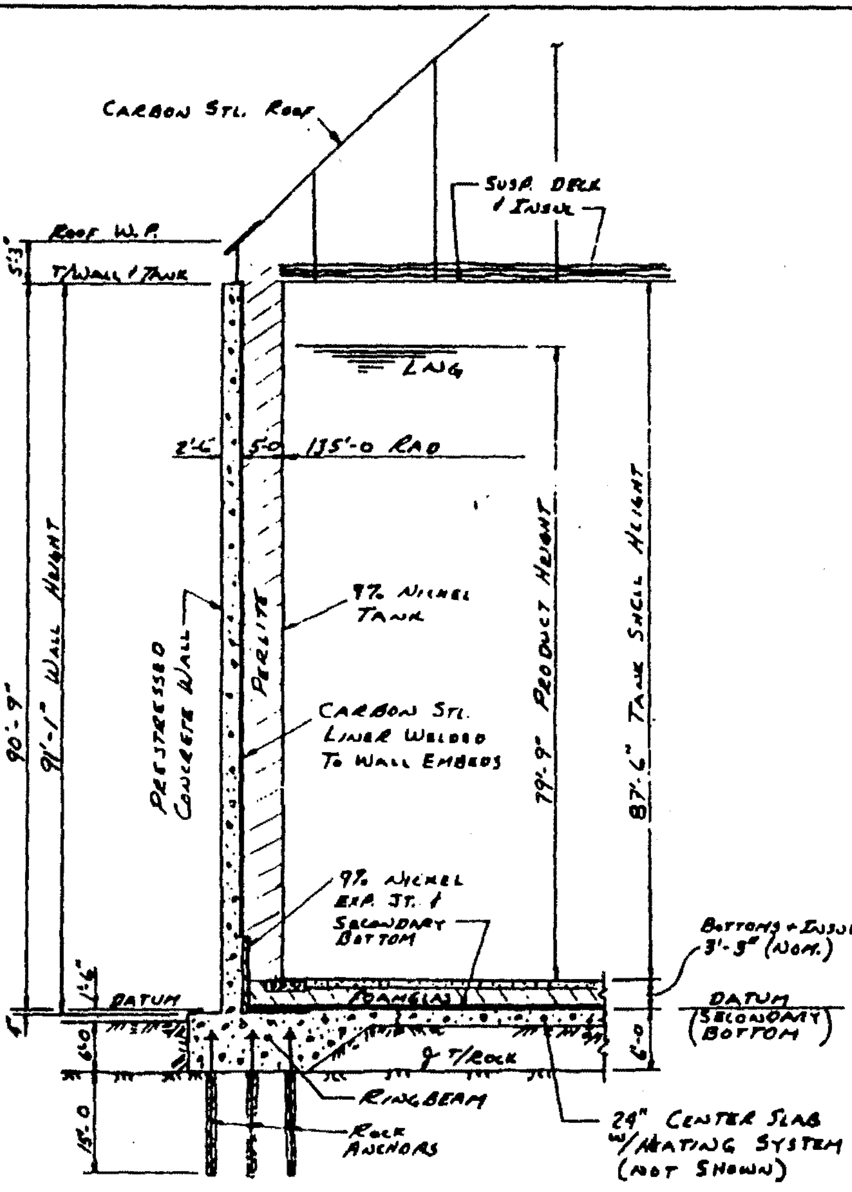
Specific internal storage tank instrumentation is pending. Temperature elements are to be attached to the shell and floor of the inner vessel, in the annular space and in the vapor space between the storage tank roof and the suspended deck - the number and type of elements are to be determined. Liquid level is to be determined by a differential pressure instrument and by redundant combined traveling level, density and temperature measuring systems. Alarms and shutdown features on the level gauges are to include low-level alarm, pump shutdown, high-level alarm and fill valve closure.

Linear and rotational inner tank movement indicators are to be provided within the annular space of each storage tank.

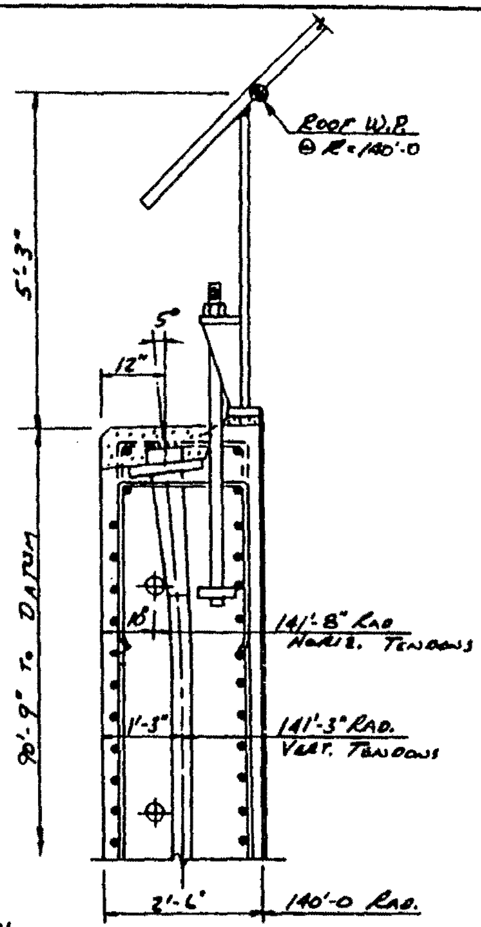


DOUBLE WALL TANK WITH SUSPENDED DECK

SUBJECT	CBI OFFICE		REVISION		REFERENCE NO.
	MADE BY	CHKD BY	MADE BY	CHKD BY	Fig. 3.1-1
	DATE	DATE	DATE	DATE	



TYPICAL SECTION
(Scale: 1/16"=1'-0)



DETAIL AT TOP OF WALL
(Scale: 1/2"=1'-0)

GENERAL NOTES

1) CONCRETE DESIGN PER ACI 318-89.
2) CONCRETE COMPRESSIVE STRENGTH, f'_c=4000 PSI, EXCEPT AS NOTED.
3) ALLOWABLE BEARING PRESSURE ON BEDROCK IS ASSUMED TO BE 10,000 PSF.
4) ROCK ANCHORS TO BE DWIDAG ANCHOR SYSTEM WITH DOUBLE CORROSION PROTECTION.

ASTM MATERIALS

REINFORCING STEEL	
- FOUNDATIONS	A615 GR60
- PRESTRESSED WALL	A706
PRESTRESSING STEEL	A416, LOW-RELAX.
ROCK ANCHORS	A722, GR150, TY II

Indicates change from previous issue

CBI

Supplier's/Purchaser's No

INCREASED INTEGRITY TANK
800 MB LNG TANK

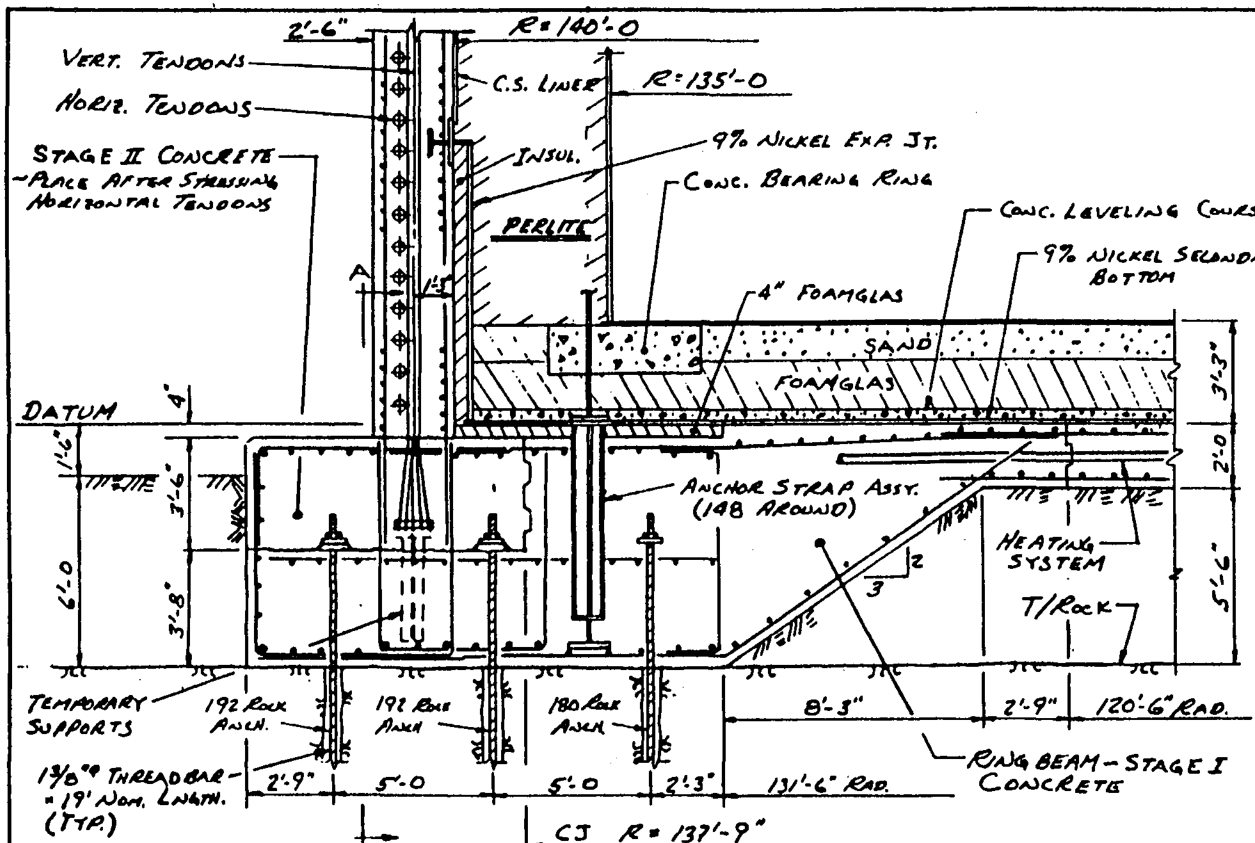
YUKON PACIFIC CORP, ALASKA

Customer's No
By RP Chkd Date 5-21-91
Engineering Supervisor

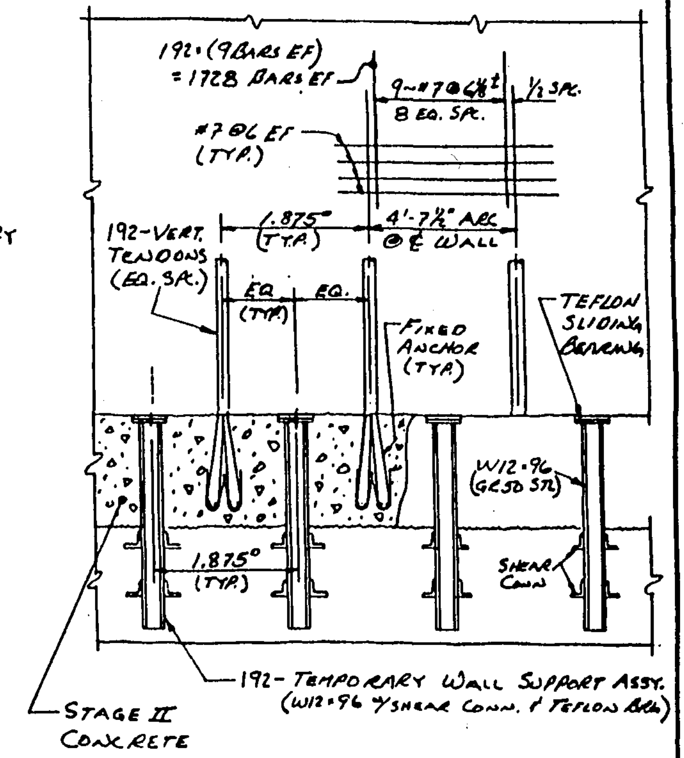
Contract No. S 14520
Dwg 4.0-1
Rev
Sheet

Remarks
Revisions
By | Chkd | Date | By | Chkd | Date

FORM DR 33 A REV OCT 86



DETAIL AT BOTTOM OF WALL
(Scale:



SECTION A-A

CONCRETE & REINF. STEEL QUANTITIES PER TANK

ITEM	CONCRETE		REINFORCING STEEL	
	QUANTITY CY	COMP. STR. f'c	WEIGHT lbs.	ASTM SPEC.
CENTER SLAB	3379	4000 PSI	456,000	A615 GR60
RINGBEAM - STAGE I	3789		540,000	
" - STAGE II	1013			
PRESTRESSED WALL	7893		1,550,000	A706
TOTALS	16,074 CY		2,546,000#	

ROCK ANCHORS

PER ASTM A722, GR 150, TYPE II

SIZE —— 1 3/8"φ × 19' LONG

EST. QTY —— 564 EACH PER TANK

Indicates change from previous issue

CBI

Supplier's/Purchaser's No.

INCREASED INTEGRITY TANK
800 MB LNG TANK
YUKON PACIFIC CORP., ALASKA

Customer's No.

Contract No. S 14520

By RP Chkd ____ Date 5-21-91

Dwg. 4.0-2 Rev

Engineering Supervisor

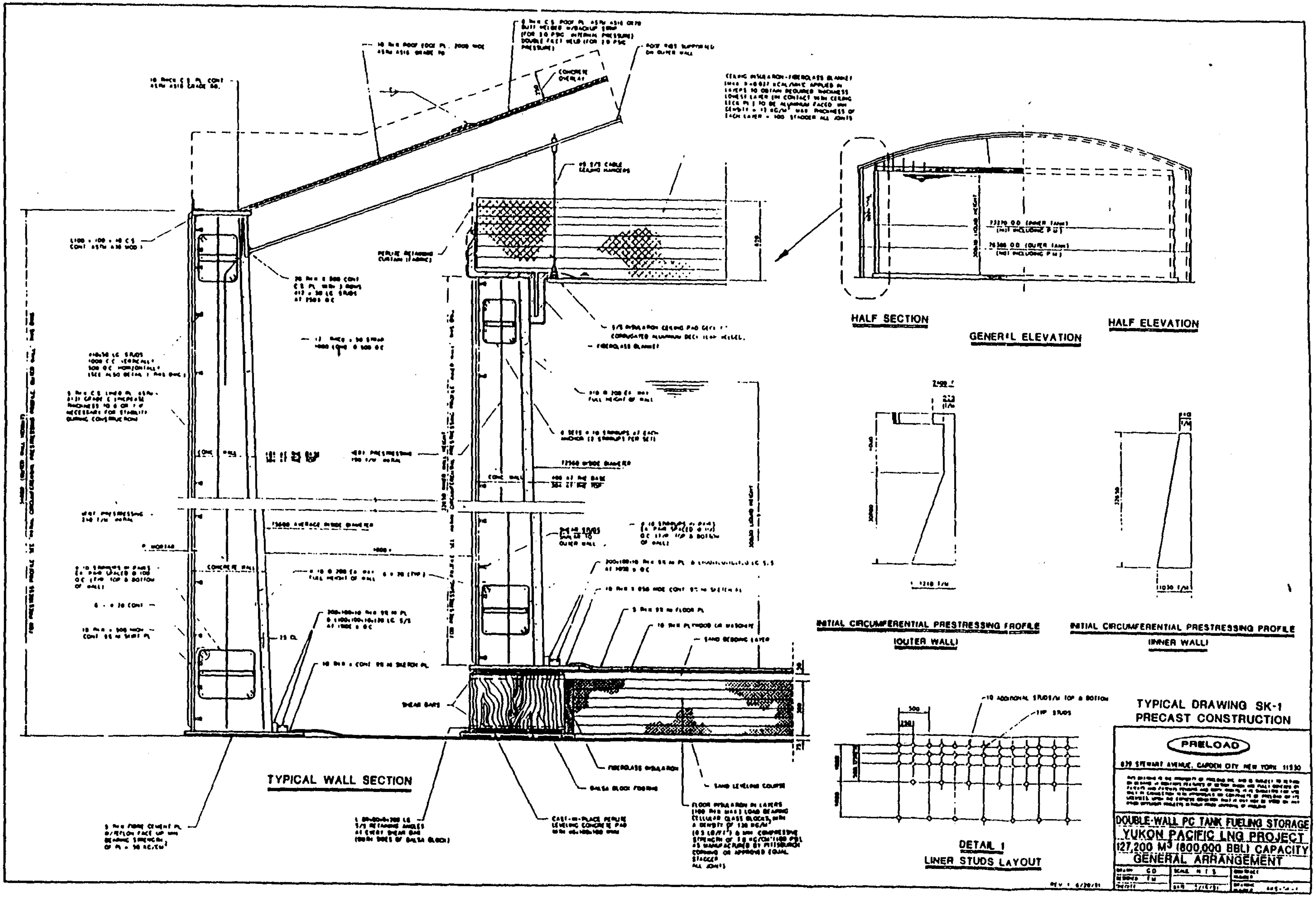
Sheet

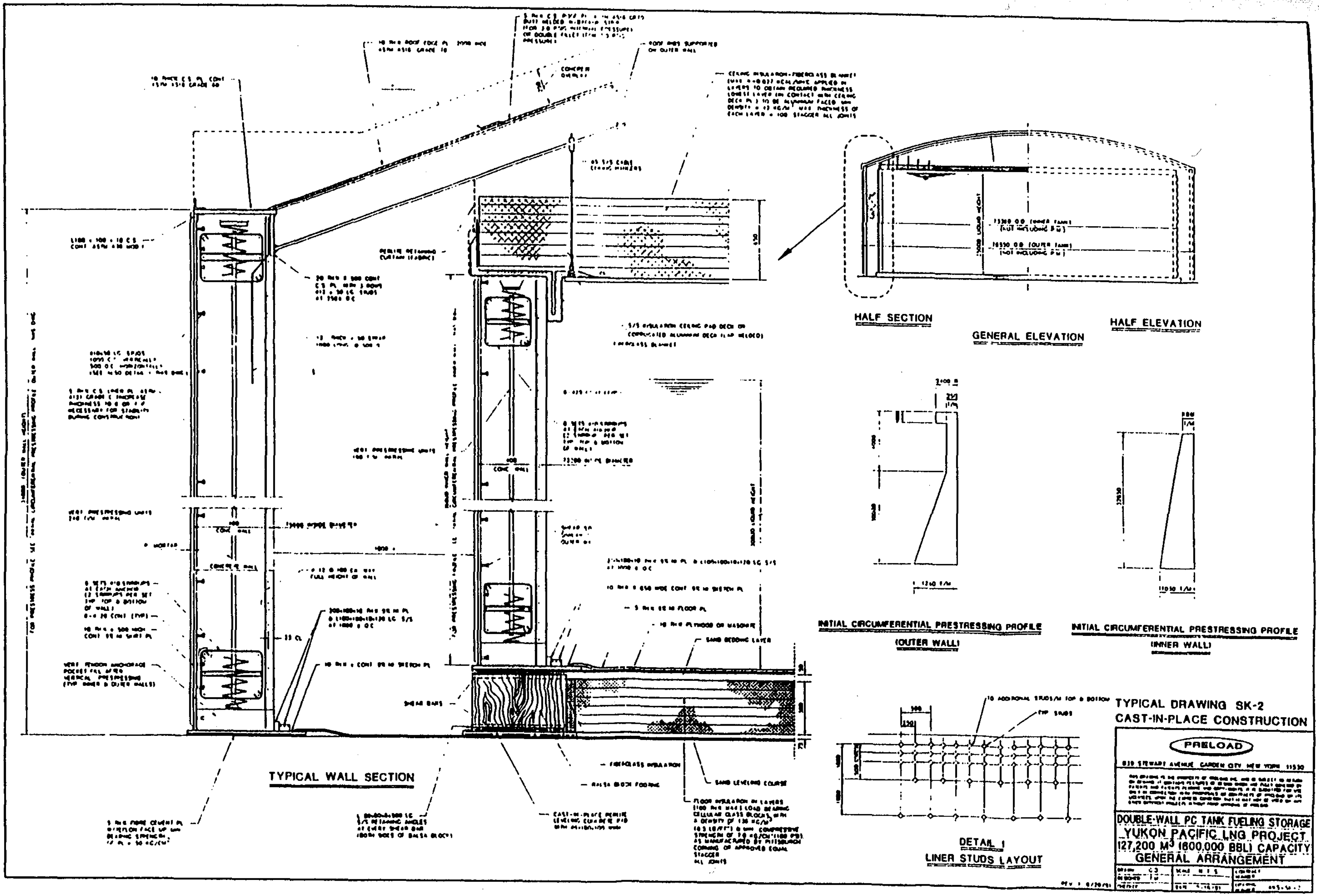
Remarks

Revisions

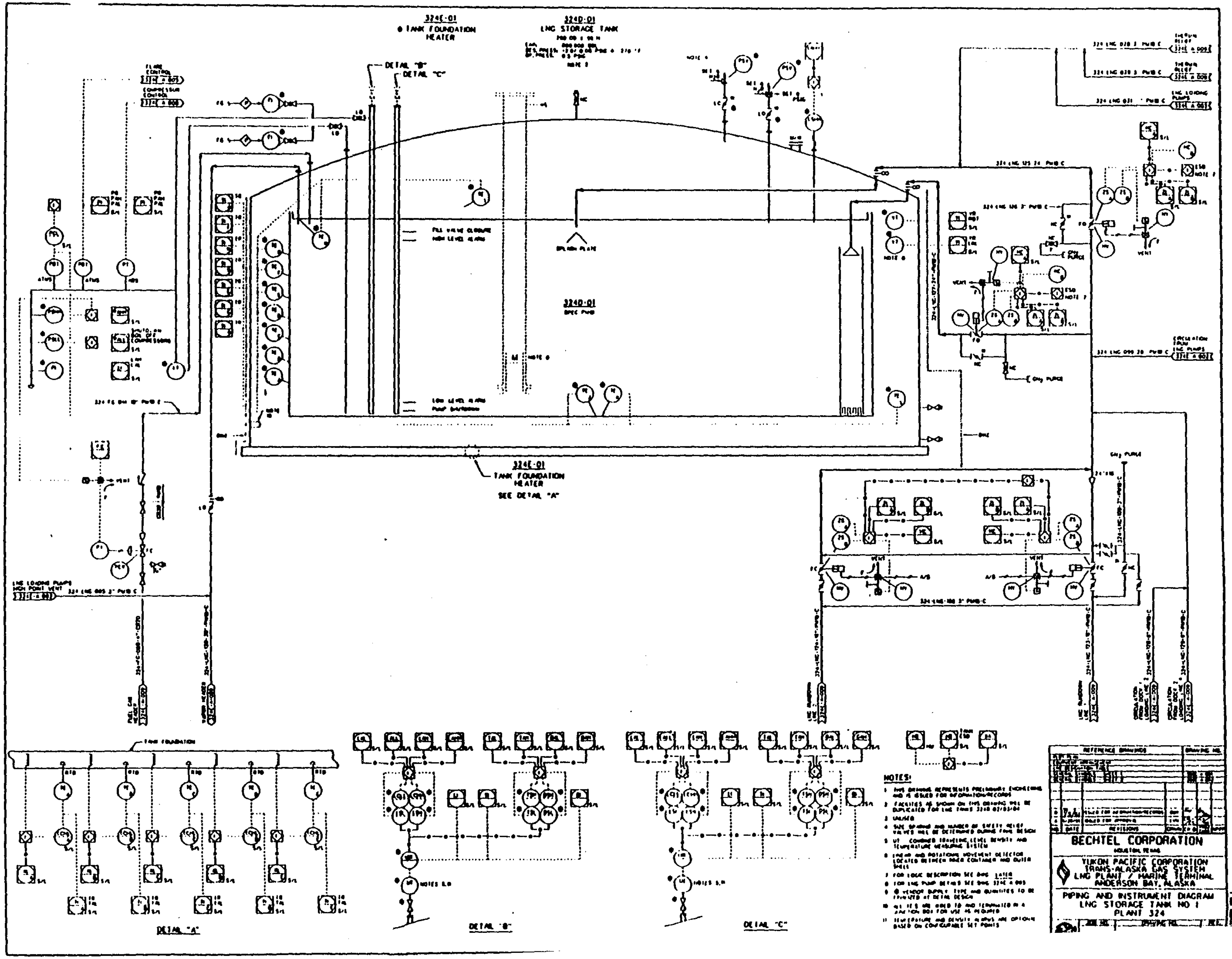
By | Chkd | Date | By | Chkd | Date

FORM DR 33 A REV OCT 86

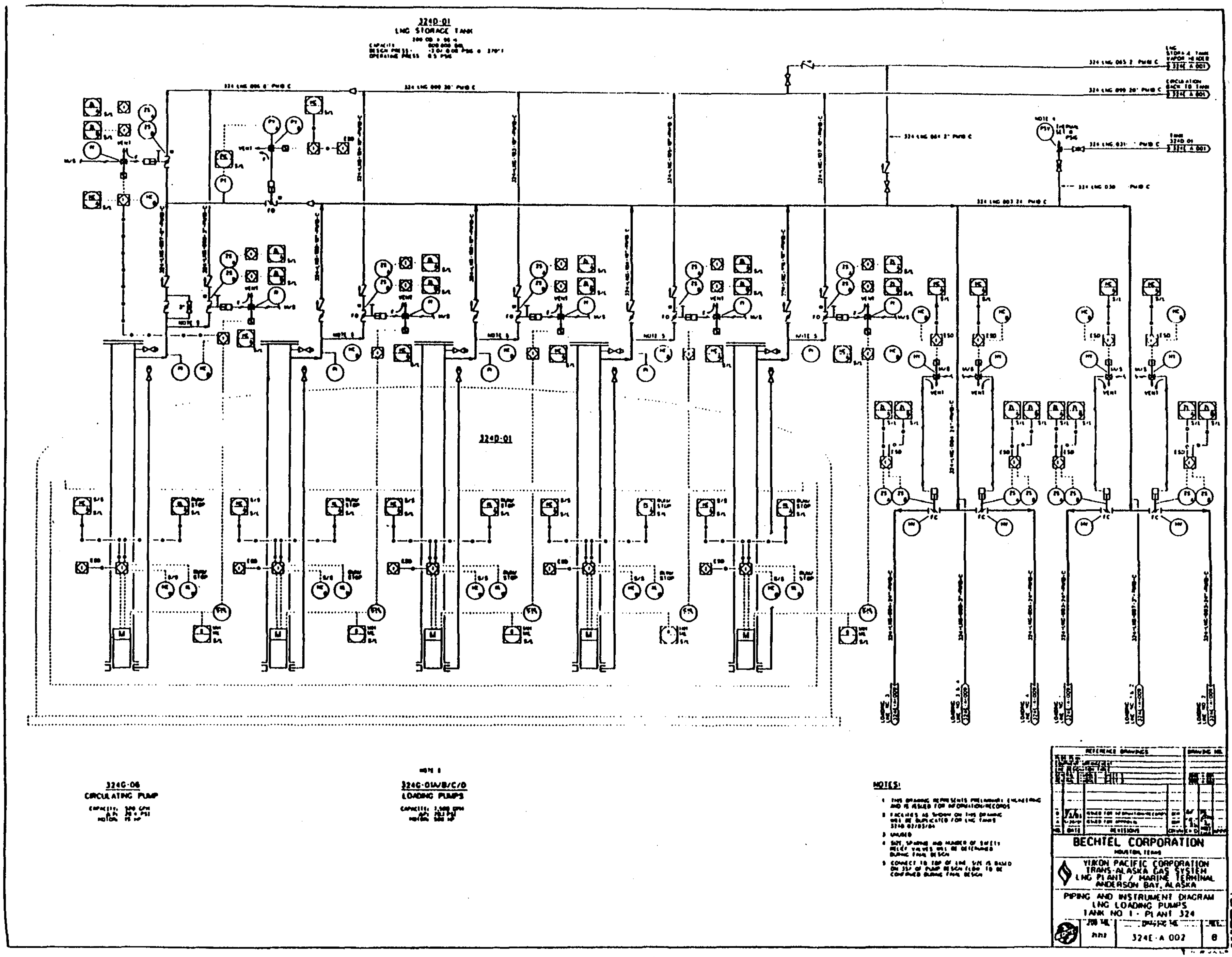

TYPICAL WALL SECTION
HALF SECTION
GENERAL ELEVATION
HALF ELEVATION
INITIAL CIRCUMFERENTIAL PRESTRESSING PROFILE
(OUTER WALL)
INITIAL CIRCUMFERENTIAL PRESTRESSING PROFILE
(INNER WALL)
DETAIL 1
LINER STUDS LAYOUT
TYPICAL DRAWING SK-1
PRECAST CONSTRUCTION
PRELOAD
DOUBLE-WALL PC TANK FUELING STORAGE
YUKON PACIFIC LNG PROJECT
127,200 M3 (800,000 BBL) CAPACITY
GENERAL ARRANGEMENT



TYPICAL WALL SECTION
HALF SECTION
GENERAL ELEVATION
HALF ELEVATION
INITIAL CIRCUMFERENTIAL PRESTRESSING PROFILE
(OUTER WALL)
INITIAL CIRCUMFERENTIAL PRESTRESSING PROFILE
(INNER WALL)
DETAIL 1
LINER STUDS LAYOUT
TYPICAL DRAWING SK-2
CAST-IN-PLACE CONSTRUCTION
PRELOAD
839 STEWART AVENUE GARDEN CITY NEW YORK 11530
DOUBLE-WALL PC TANK FUELING STORAGE
YUKON PACIFIC LNG PROJECT
127,200 M3 (800,000 BBL) CAPACITY
GENERAL ARRANGEMENT



324E-01
TANK FOUNDATION
HEATER
324D-01
LNG STORAGE TANK
DETAIL "B"
DETAIL "C"
324D-01
324E-01
TANK FOUNDATION
HEATER
SEE DETAIL "A"
TANK FOUNDATION
DETAIL "A"
DETAIL "B"
DETAIL "C"
NOTES:
REFERENCE DRAWINGS
DRAWING NO.
REVISIONS
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PIPING AND INSTRUMENT DIAGRAM
LNG STORAGE TANK NO 1
PLANT 324


324D-01
LNG STORAGE TANK
324D-01
324G-06
CIRCULATING PUMP
324G-01A/B/C/D
LOADING PUMPS
NOTES:
REFERENCE DRAWINGS
REVISIONS
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PIPING AND INSTRUMENT DIAGRAM
LNG LOADING PUMPS
TANK NO 1 - PLANT 324
324E-A 002
0

LNG Ship Loading Facilities

The proposed fully developed marine facilities are to include two LNG loading docks. The primary function of the LNG loading facilities would be to transfer LNG from the LNG storage tanks into LNG ships for export purposes. In addition, a liquid nitrogen loading system is to be available at LNG Loading Dock 1 (only). Other services, including supply of potable water, boiler makeup water and bunker fuels are not to be provided at the berths. The LNG loading facilities are to provide access to 55 foot water depth suitable for berthing of LNG ships ranging from 125,000 to 135,000 cubic meters and presumably suitable for next generation LNG ships with capacities of up to 165,000 cubic meters.

Typically, an LNG berth would consist of the following components: a loading platform carrying all piping and equipment required for operating the berth, breasting dolphins, mooring dolphins, an access trestle to shore with roadway and pipeway and interconnecting walkways between dolphins and loading platform. The marine facilities are to include two LNG berths. Under one scenario, construction of Dock 1 would be part of the initial development. The proposed Dock 1 would be suitable for port side or for starboard side berthing to provide maximum operating flexibility. Dock 2 would be built as market requirements indicate.

Facilities at the proposed LNG docks are to include: an LNG loading system, an LNG vapor recovery system, instrument air, gaseous nitrogen, liquid nitrogen (Dock 1 only since supply is normally obtained at the receiving terminal), safety systems and a Dock Operations Building. Loading operations would be controlled from the Main Control/Marine Operations Building.

The proposed LNG loading platform would consist of an upper deck at an elevation of 55 feet above MLLW and a lower deck, providing access to LNG and utility piping, at an elevation of 43 feet above MLLW. (The upper and lower deck configuration is to be determined on the ability to accommodate potential LNG spills at the dock.)

LNG would be transferred from the LNG storage tanks using the internally mounted LNG pumps. Each storage tank is to be provided with four 7500 gpm pumps used for transfer and one 500 gpm pump for circulation. The design ship loading rate is 10,000 cubic meters per hour (44,000 gpm), typically resulting in a 12-hour filling time using seven LNG loading pumps at design flow. LNG would be transferred to the docks using two parallel 24-inch cryogenic insulated loading lines for each dock. During non-loading periods, LNG would be circulated from storage through one of the parallel lines to the dock and return by the other parallel line to storage using the 500 gpm circulation pump to maintain operating conditions within the lines.

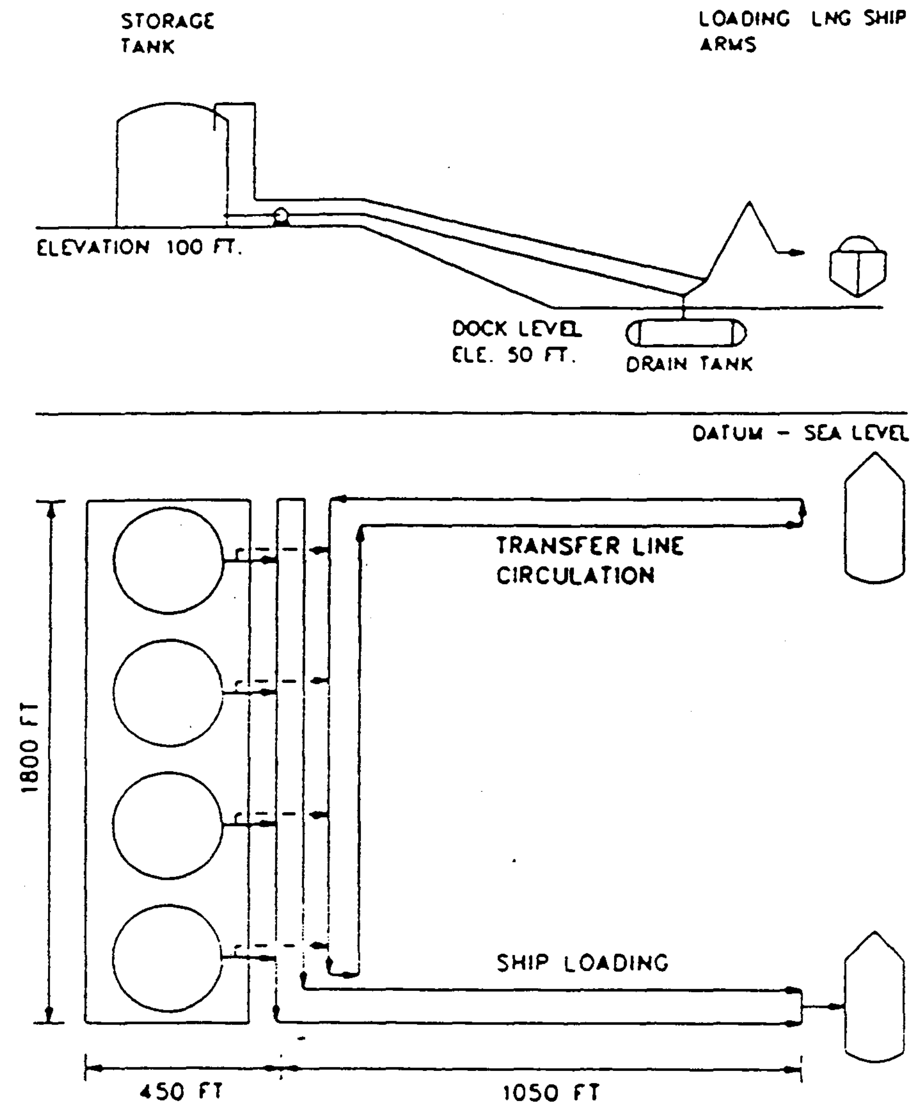
Articulated marine loading arms on each dock are to consist of four 16-inch liquid loading lines and one 16-inch vapor recovery line. Shutoff valves would be located in the 24-inch loading lines both onshore and at the docks. Additionally, each articulated arm would be provided with a hydraulically-operated Powered Emergency Release Coupling (PERC) consisting of double ball shutoff valves and an emergency release coupler. The PERC system would be utilized in emergency situations and not for routine connection/disconnection of the loading arm from the LNG ship during normal operations.

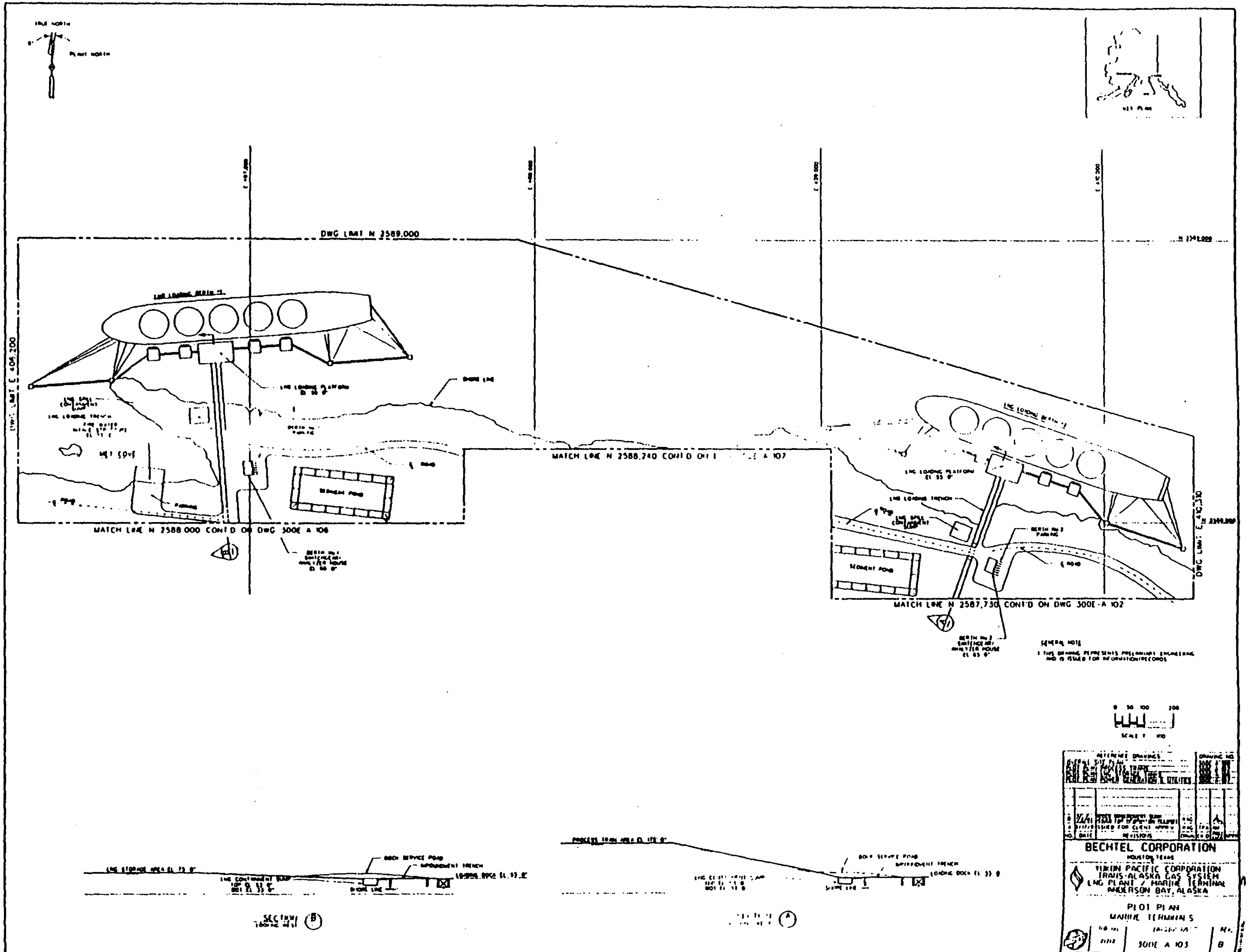
A hydraulically-operated quick connect/disconnect coupler (QC/DC) on each arm may be used to provide connecting and disconnecting with the LNG ship during normal operations. Consideration also is being given to use of bolted flanges. Loading arm controls are to be installed at a strategic location at the upper deck. In addition, a portable remote control unit would be provided for manipulation of the loading arms from locations other than the primary control console.

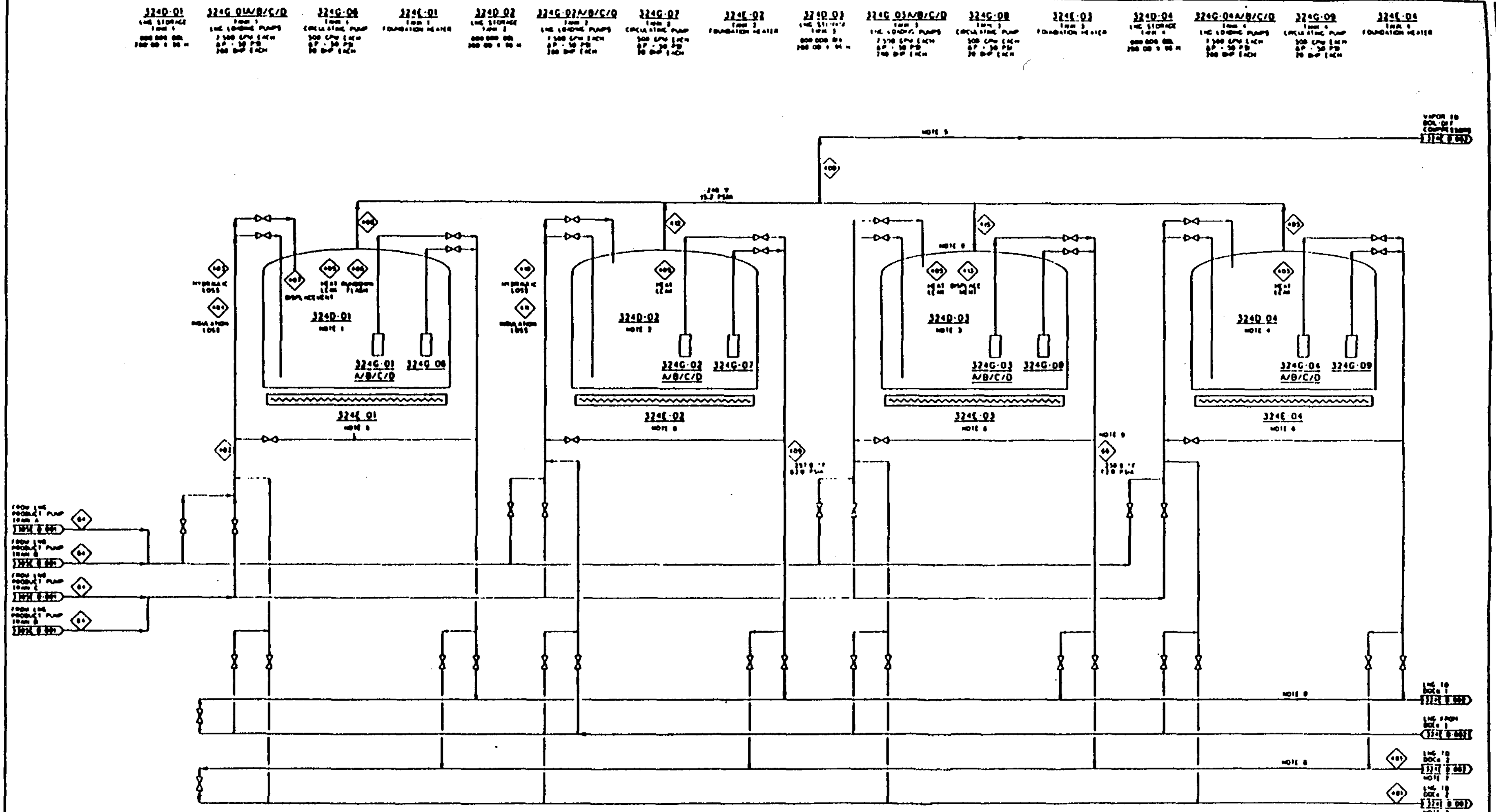
A vapor recovery system would be provided to accommodate vapor evolved from the loading process (and from the normal boiloff vapor from the four LNG storage tanks). Vapor from the loading process would be transported onshore by a 24-inch cryogenic insulated line, combined with boiloff vapor from the LNG storage tanks and compressed in Boiloff Compressors. A Boiloff Vapor Desuperheater would be used to maintain cold temperatures entering the compressors. The boiloff compressors would consist of three 6400 horsepower turbine-driven centrifugal units. Discharge from the compressors is to be sent to the facility Fuel Gas Header at a pressure of 370 psia. One compressor would be required during non-loading operations (to accommodate boiloff from storage tanks), while an additional compressor would be required for each ship being loaded.

Proposed dock facilities and schematic diagrams of the loading and vapor recovery systems are shown in the following drawings.

BASE CASE


STORAGE TANK
LOADING ARMS
LNG SHIP
ELEVATION 100 FT.
DOCK LEVEL ELE. 50 FT.
DRAIN TANK
DATUM - SEA LEVEL
TRANSFER LINE CIRCULATION
SHIP LOADING
1800 FT
450 FT
1050 FT


DWG LIMIT N 2589,000
MATCH LINE N 2588,240 CONT'D ON
MATCH LINE N 2588,000 CONT'D ON DWG 300E A 106
MATCH LINE N 2587,730 CONT'D ON DWG 300E-A 102
SEDIMENT POND
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PLOT PLAN
MARINE TERMINALS
300E A 103
B



STREAM NO	64	66	400	401	402	403	404	405	406	407	408	409	410	411	412	413	415
DESCRIPTION	LNG FROM PLANT (1 TRAIN)	LNG TO SHIP	VAPOR TO/FROM STORAGE TANKS	LNG TO SHIP	LNG TO TANK (4 TRAINS)	HYDRAULIC LOSS	INSULATION LOSS	TANK HEAT LEAK	TANK RUNDOWN FLASH	TANK DISPLACEMENT VENT	TANK VAPOR	LNG CIRCULATION	HYDRAULIC LOSS	INSULATION LOSS	TANK VAPOR	TANK DISPLACEMENT VENT	VAPOR TO [illegible]
MMSCFD	340.2	3,039.1	24,200	3,650.4	3,103.8	3.3700	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	51.03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GPM	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-	-	-	-	-	405	-	-	-	-	-
LB/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MOL WT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
COMPONENT, LB MOLE/HR																	
NITROGEN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
METHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ETHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ETHYLENE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0
PROPANE	[illegible]	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	[illegible]	0	0	0	[illegible]	0
I-BUTANE	[illegible]	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	[illegible]	0	0	0	[illegible]	0
N-BUTANE	[illegible]	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	[illegible]	0	0	0	[illegible]	0
I-PENTANE	[illegible]	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	[illegible]	0	0	0	[illegible]	0
N-PENTANE	[illegible]	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	[illegible]	0	0	0	[illegible]	0
HEXANE	[illegible]	[illegible]	0	[illegible]	[illegible]	0	0	0	0	0	0	[illegible]	0	0	0	[illegible]	0
TOTAL LB MOLE/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HEAT CAPACITY BTU/LB						[illegible]	[illegible]	[illegible]					[illegible]	[illegible]			
DENSITY LB/FT3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						[illegible]	[illegible]			[illegible]		[illegible]
VISCOSITY CP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						[illegible]	[illegible]			[illegible]		[illegible]
SURFACE TENSION DYNE/CM	[illegible]	[illegible]		[illegible]	[illegible]							[illegible]					

NOTES:

[illegible]

8. DOCK 1 TRANSFER LINES ARE CIRCULATING LNG. DOCK 2 TRANSFER LINES ARE LOADING LNG TO SHIP.

9. STREAMS 66, 413 & 415 ARE BASED ON THE MAXIMUM LOADING RATE FROM 1 TANK USING 4 PUMPS. THE ACTUAL LOADING RATE TO 1 SHIP IS [illegible] USING [illegible] LOADING PUMPS.

REFERENCE DRAWINGS	DRAWING NO.
[illegible]	[illegible]

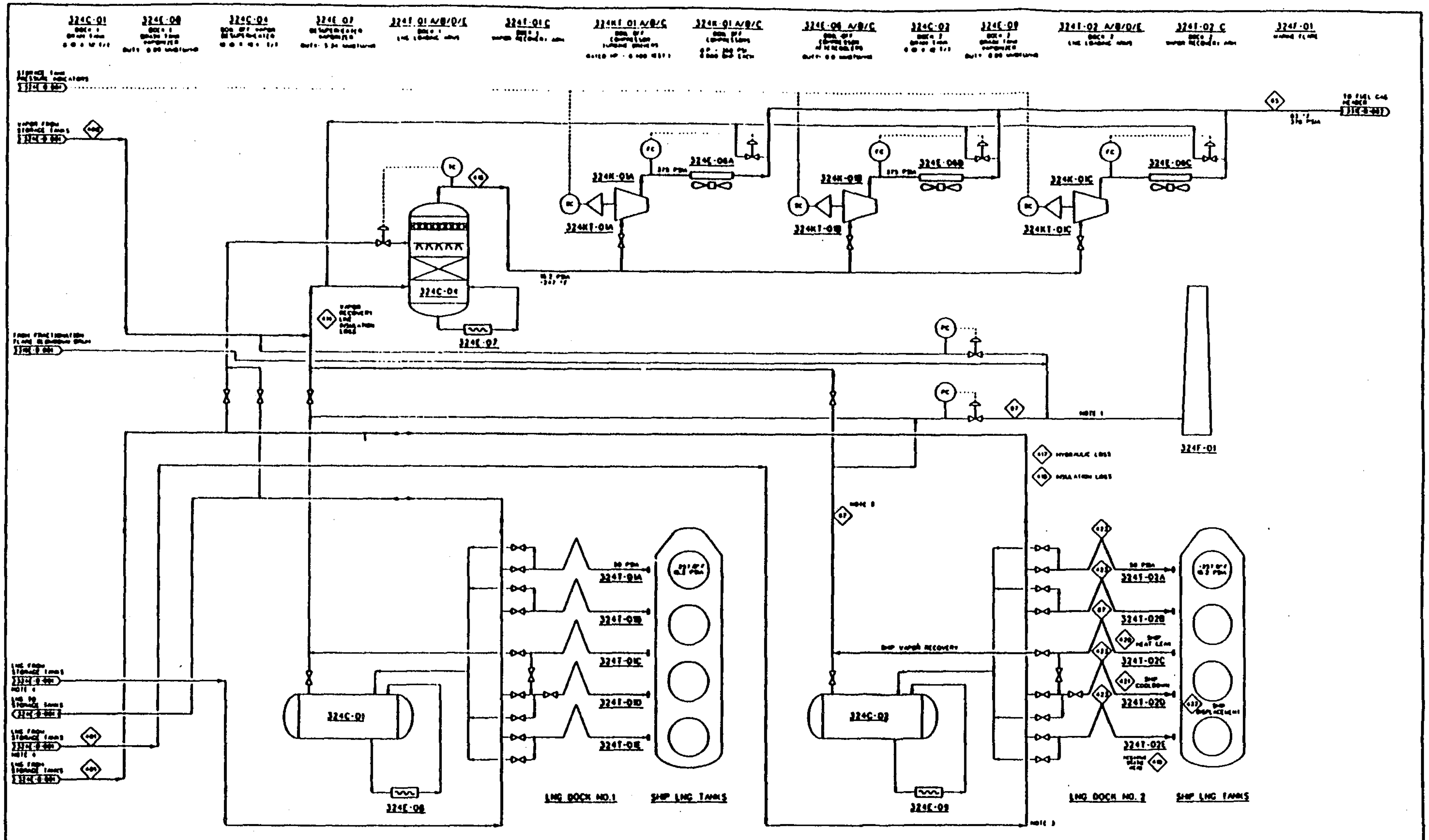
NO.	DATE	REVISIONS
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	ISSUED FOR APPROVAL
[illegible]	[illegible]	ISSUED FOR REVIEW

BECHTEL CORPORATION
HOUSTON, TEXAS

YUKON PACIFIC CORPORATION
TRANS ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

PROCESS FLOW DIAGRAM
LNG STORAGE/LOADING PUMPS
PLANT 324

JOB NO.	DRAWING NO.	REV.
[illegible]	324E-H-001	0



STREAM NO	03	07	400	401	414	415	417	418	419	420	421	422	423
DESCRIPTION	VAPOR TO FUEL GAS HEADER	SHIP VAPOR RETURN	VAPOR [illegible] STORAGE TANKS	LNG TO SHIP	VAP RECOV LINE INSULATION LOSS	COMPRESSOR INLET	HYDRAULIC LOSS	INSULATION LOSS	NEGATIVE STATIC HEAD LOSS	SHIP HEAT LEAK	SHIP COOL DOWN	SHIP DISPLACEMENT VENT	LNG LOADING ARM
MMSCFD	84.370	80.700	24.300	2,030.0	[illegible]	84.370	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24.000	[illegible]
GPM	-	-	-	23.034	-	-	-	-	-	-	-	-	[illegible]
LB/HR	153,000	80,420	43,107.0	[illegible]	[illegible]	153,000.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	43,003	[illegible]
MOL. WT.	16.70	16.00	16.07	[illegible]	16.00	16.70	16.00	16.00	16.00	16.00	16.00	16.00	[illegible]
COMPONENTS, LB MOLE/HR													
NITROGEN	[illegible]	[illegible]	[illegible]	[illegible]	0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
METHANE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ETHANE	0.03	0.00	0.27	[illegible]	0	0.03	[illegible]	[illegible]	[illegible]	0.00	[illegible]	[illegible]	[illegible]
ETHYLENE	0	0	0	0	0	0	0	0	0	0	0	0	0
PROPANE	0	0	0	[illegible]	0	0	0	0	0	0	0	0	[illegible]
i-BUTANE	0	0	0	[illegible]	0	0	0	0	0	0	0	0	[illegible]
n-BUTANE	0	0	0	[illegible]	0	0	0	0	0	0	0	0	[illegible]
i-PENTANE	0	0	0	[illegible]	0	0	0	0	0	0	0	0	[illegible]
n-PENTANE	0	0	0	[illegible]	0	0	0	0	0	0	0	0	[illegible]
n-HEXANE	0	0	0	[illegible]	0	0	0	0	0	0	0	0	[illegible]
TOTAL LB MOLE/HR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
HEAT GAIN, MM BTU/HR	-	-	-	-	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		-
DENSITY (LB/FT³)	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]							[illegible]

NOTES:

1. NORMALLY NO FLOW TO FLARE. ONLY EMERGENCY FLARE IS ALLOWED. FINAL DESIGN PENDING RELIEF STUDY
2. THIS CONDITION IS FOR LOADING LNG TO ONE SHIP
3. LNG LOADING RATE IS [illegible]
4. AS SHOWN, DOCK 1 LOADING LINES ARE CIRCULATING LNG, DOCK 2 LOADING LINES ARE LOADING LNG TO THE SHIP. DESIGN PERMITS SIMULTANEOUS LOADING OR CIRCULATING TO BOTH DOCKS

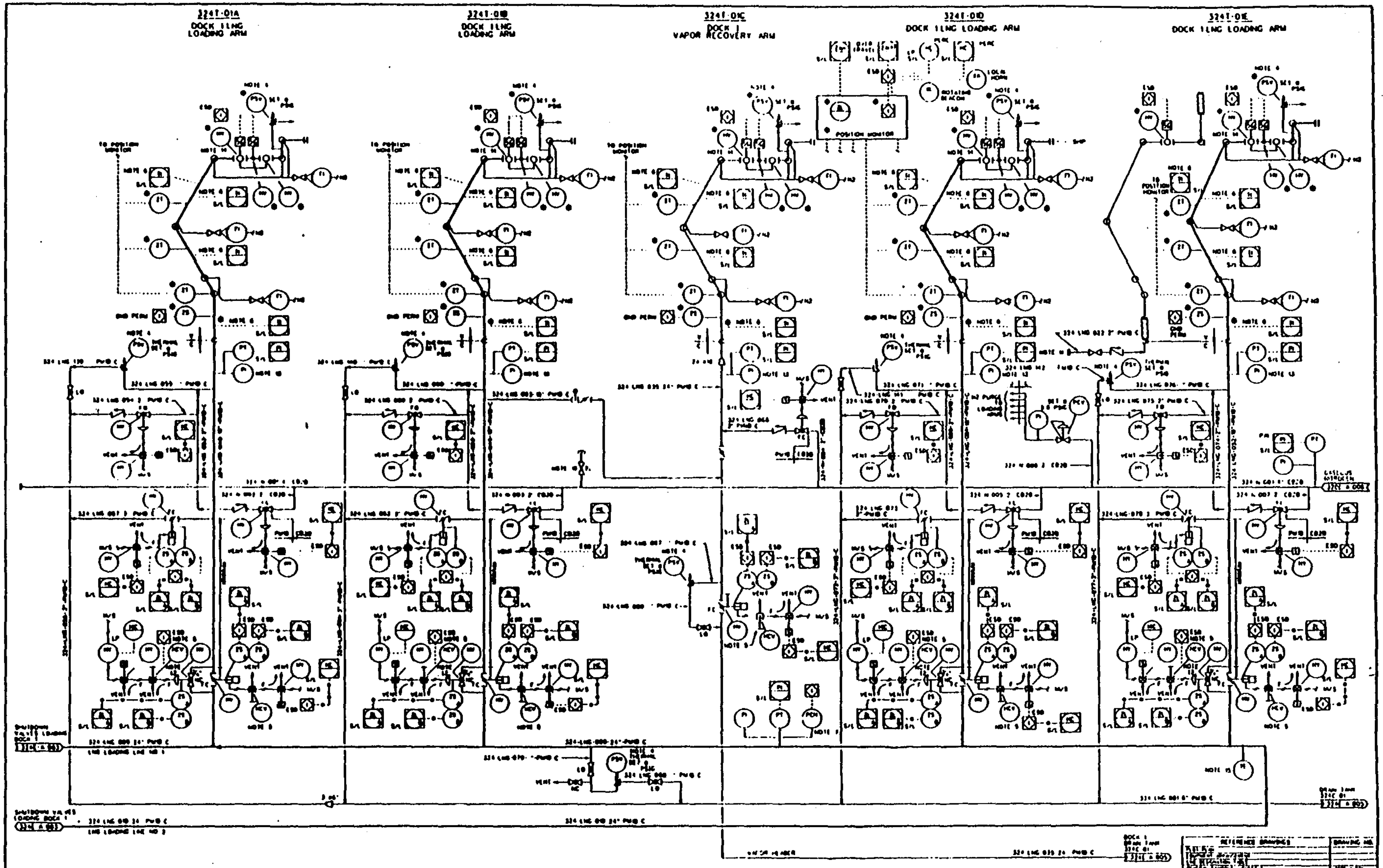
REFERENCE DRAWINGS	DRAWING NO.
[illegible]	[illegible]

BECHTEL CORPORATION

HOUSTON, TEXAS

YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

PROCESS FLOW DIAGRAM
LNG SHIP LOADING/BOIL-OFF
COMPRESSORS PLANT-324



NOTES:

1. THIS DRAWING REPRESENTS PRELIMINARY ENGINEERING AND IS ISSUED FOR INFORMATION/RECORDS
2. FACILITIES AS SHOWN ON THIS DRAWING WITH THE EXCEPTION OF THE LIQUID NITROGEN LINE (SEE NOTE 11) WILL BE DUPLICATED FOR DOCK 2
3. [illegible]
4. SIZE, SPACING AND NUMBER OF SAFETY RELIEF VALVES WILL BE DETERMINED DURING FINAL DESIGN
5. MUTED VALVES TO BE LOCATED IN A LOCKABLE CABINET TO PROVIDE A POSITIVE METHOD OF DISCONNECTING INSTRUMENT AIR SUPPLY
6. TEMPERATURE SENSORS PROVIDED BY LOADING ARM VENDOR. ADJUSTMENT DETERMINED AFTER EQUIPMENT SELECTION
7. PRESSURE SURGE SWITCH WILL OPEN RECIRCULATION VALVES OF PUMPS IN USE
8. [illegible] SUPPLY TYPE & QUANTITIES TO BE CONFIRMED LATER
9. LOADING ARM HYDRAULIC SYSTEM COMPONENTS TO BE STAINLESS STEEL OR OTHER SUITABLE MATERIAL
10. TYPICAL OF FOUR EVENLY DISTRIBUTED ACROSS THE DOCK
11. LINE IS FOR LIQUID NITROGEN DELIVERED BY TRUCK. NITROGEN LOADING ARM IS PIGGYBACKED ON LNG LOADING ARM. APPLIES TO DOCK 1 ONLY
12. ALL CRYOGENIC VALVE STEMS TO BE LOCATED IN VERTICAL UPRIGHT POSITION
13. PRESSURE GAUGE TO BE INSTALLED AT BASE OF EACH LNG LOADING ARM IN A POSITION TO BE PROVIDED BY OPERATIONS
14. LOADING ARMS TO HAVE QUICK DISCONNECT TYPE OF COUPLING (DOUBLE BALL VALVES MECHANICALLY LINKED)
15. (TI) COOLDOWN THERMOCOUPLES STRAPPED TO TOP AND BOTTOM OF LINES WHERE SHOWN

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YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

PIPING AND INSTRUMENT DIAGRAM
LOADING ARMS - DOCK 1
PLANT 324

JOB NO.	DRAWING NO.	REV.
[illegible]	324E A-004	B

Instrumentation and Control System

The control system for the facility is to be based on distributed control and sequential logic hardware using microprocessor technology in the control of continuous analog loops, on/off commands such as start/stop of pumps or open/close of remotely operated valves and alarming of off-normal operating conditions. Normal interlocking and sequencing functions also are to be accomplished with the system. A programmable logic control system (PLC) is to be used for all shutdown logic and hazard controls.

A distributed control system (DCS) design is to be designed to provide continuous operation and to furnish control emergency shutdown logic for the facility. (It also is to provide selected monitoring and control of associated pipeline compressor stations and main line valves.) In addition to providing operators with the ability to monitor and control plant processes and utilities, the control system is to allow shutdown safety and security functions from central consoles located in the plant control centers. The system is to have full-custom graphics and reporting capability.

Initially, under one scenario, the DCS and the PLC systems are to be designed for two process trains, associated utilities, two LNG storage tanks and two marine terminals. Hazard detection and control for all facilities also is to be included in the design. The systems are to be of modular construction and be capable of handling future expansion up to a total of five process trains and associated utilities, storage facilities and hazard detection and control.

The DCS and PLC includes the following control and monitoring areas: Main Control/Marine Operations Building; Dock Operations Building; compressor control rooms; Turbine-Generator Control Room; and the Fire

Station. The DCS is to interface with the PLC and is to include redundant data communication (data highways) which communicate by means of redundant local control networks through highway gateways. The PLC is to transfer data to the DCS using fault-tolerant communication modules and data highway ports. The following overall reliability criteria are intended to apply to the DCS:

No single failure of an operator station control unit (processor) is to jeopardize the function of the operator console or other device on the data highway;

In the event of a control or process interface unit failure, the control system is to be designed to provide for transfer of that units monitoring and control function to a secondary backup unit with identical capabilities;

Sufficient equipment is to be provided to give a fully redundant communication system. Transfer from primary to secondary channels is to be automatic with no disruption in monitoring or control capabilities;

All power supplies within each DCS are to contain redundant power supplies with automatic switchover on failure;

The unit is to have redundant control and communication devices and is to be double ported so it may connect to a redundant data highway system.

A supervisory computer is to be provided as an auxiliary system to the DCS. The auxiliary system is to provide the following:

Access to real-time data acquisition
Advanced control implementation
Expanded data retrieval
Detailed report generation
Process/utilities studies
Process modeling
High speed information transfer
Predictive maintenance
Emergency procedure instructions

The PLC is to consist of state-of-the-art microprocessor-type processing and communication modules that interface fully with the DCS. The system is to be of stand-alone type having its own power supplies, termination racks and fault-tolerant processing modules to provide high reliability. The control and emergency shutdown philosophy is to be based on a "deenergize to trip" scheme which represents what is considered by YPLP to be the safest approach to operations. (It is recognized by YPLP that this philosophy may increase the opportunity for nuisance trips and therefore adversely affect "on-line" time to some extent but its intention is to ensure that the plant is to revert to a safe condition in the event of equipment or instrument failure.) The system is to incorporate fault-tolerant PLC capabilities for shutdown, alarm and critical control logic functions. Field input and output signals for DCS and PLC, both analog and discrete, are to be terminated in racks located at specified locations in the plant.

A more detailed review of the facility control system, including discussion of a Sequence of Events Recorder, an enhanced vibration Machinery Monitoring System (for major rotating equipment), a Management Information (Computer) System, a Supervisory Control and Data Acquisition System and various other items, is provided in the YPLP original material submitted to the FERC - Volume V, Response 10.

Control Centers

The Distributed Control System and the Programmable Logic Control System includes the following control and monitoring areas:

Main Control/Marine Operations Building - The purpose of the centrally located building is to control and monitor the process and utilities areas as well as to provide the same functions for the two marine terminals, the LNG storage tank area and the marine flare. Five four-station and one three-station operator consoles are to be furnished to implement the above. Provisions are to be made for a Management Information System to telemeter facility operations data to Anchorage. The control and information capability also is to provide for Remote Terminal Unit data interchange between the LNG facility, the Gas Conditioning Facility, pipeline compressor stations and mainline valve stations. Shutdown control of compressor stations and mainline valves also is to be included.

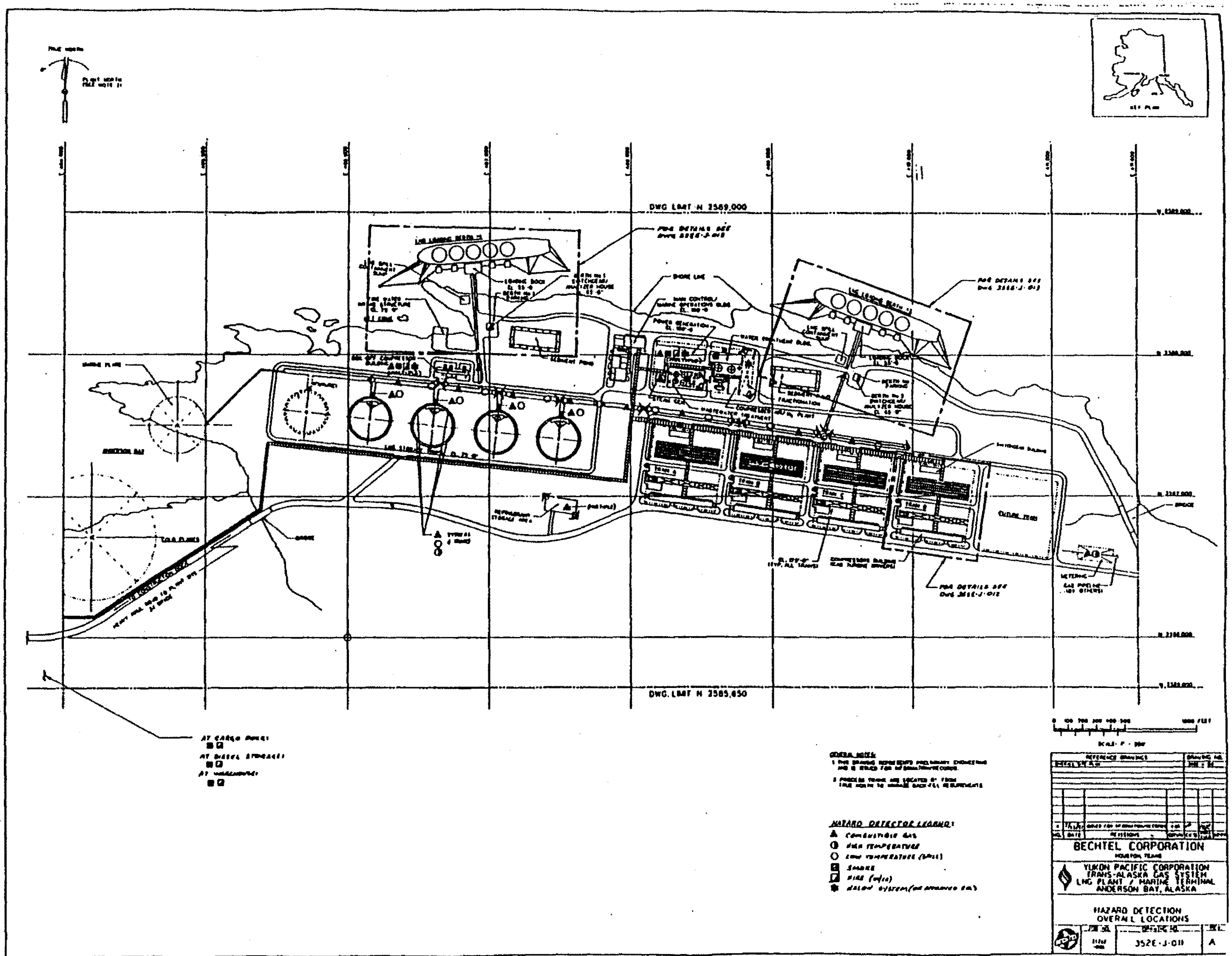
Compressor Control Room - Each liquefaction train includes a Compressor Building that is to contain five turbine-driven process refrigerant compressors and an associated control area, the buildings being located on the south end of each train. These control areas are to provide fully equipped two-station operator consoles for startup, monitoring and control of the turbine machinery equipment.

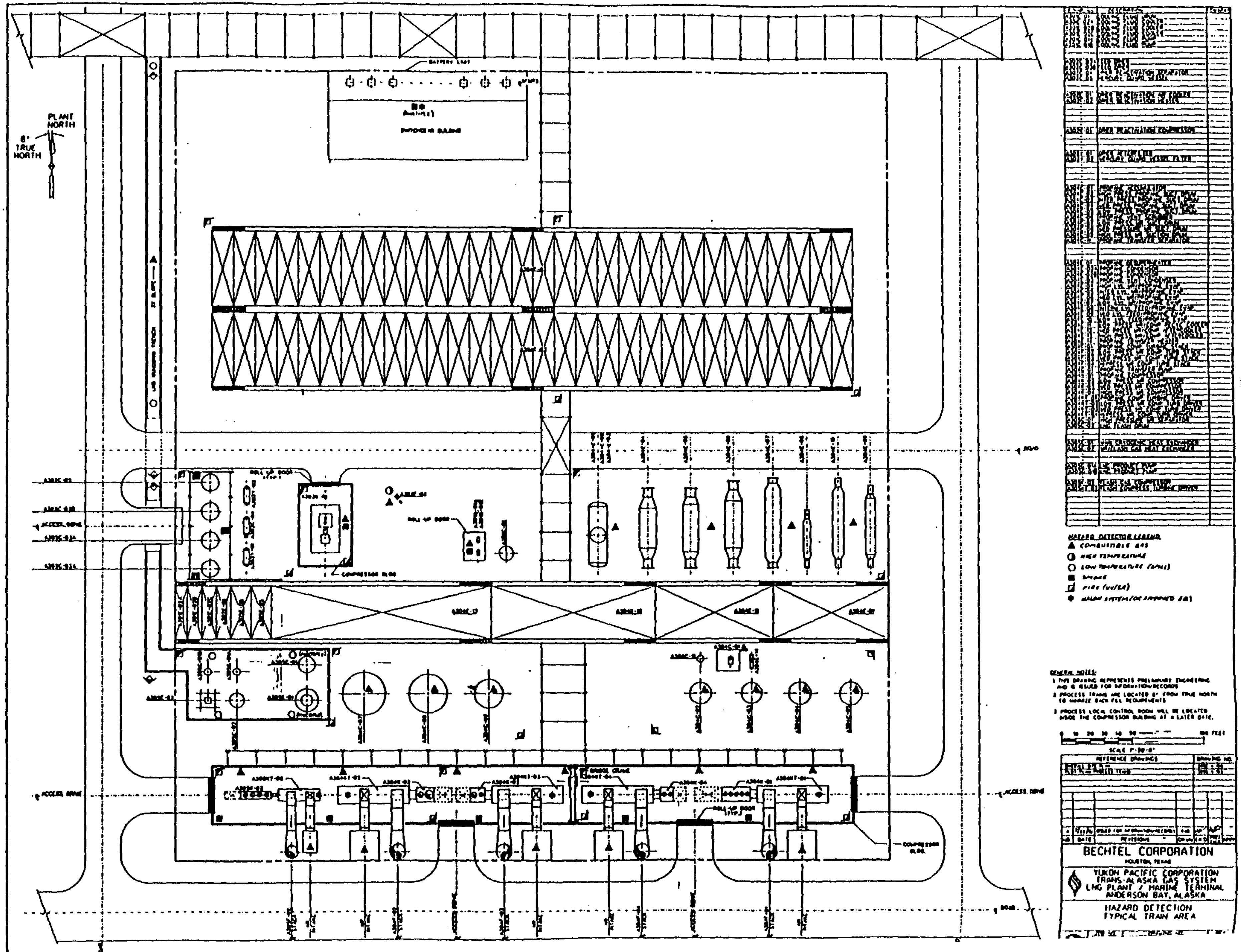
Turbine-Generator Control Room - The facility Power Generation Building is to be located east of the Main Control/Marine Operations Building and north of Liquefaction Train A. To be included in the building is the Turbine/Generator Control Room for control and monitoring of the power generation, utilities, effluent treatment, firewater intake structure, cold flares and refrigerant storage area. The two-station operator console also is to be used for backup control of the utilities facilities.

Dock Control Room - Each dock is to be provided with a Dock Operations Building. The control portion is to be equipped with visual display units and alarms only. Systems are to include hard wire connections for data transfer to the LNG ship computer system.

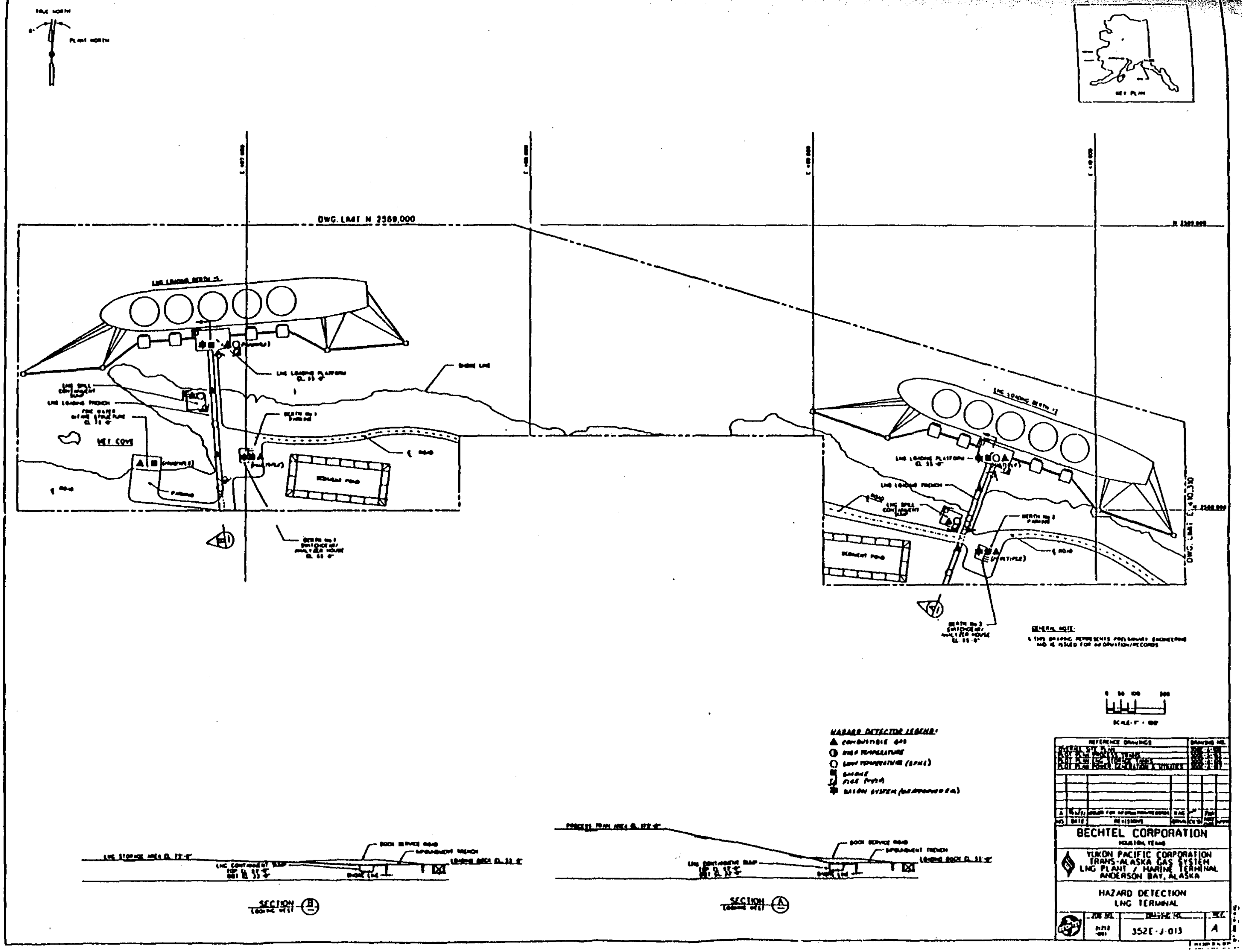
Dock Operator Shelter - The operator shelters to be located on the loading docks are to be used to facilitate connecting and disconnecting the ship to and from the loading arms. Once accomplished, all monitoring and control is to be from the Main Control/Marine Operations Building.

Fire Station - The facility Fire House is to be attached to the west side of the Main Control/Marine Operations Building. This structure is to house a single reduced function operator station for monitoring the plant hazard detection and control system. Presently it is envisioned that the Fire Station would not be manned by full-time staff.


DWG. LMT N 2589,000
DWG. LMT N 2585,850
HAZARD DETECTOR LEGEND:
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
HAZARD DETECTION
OVERALL LOCATIONS
352E-J-011
A



PLANT NORTH
8°
TRUE NORTH
HAZARD DETECTOR LEGEND
COMBUSTIBLE GAS
HIGH TEMPERATURE
SMOKE
FIRE (UV/IR)
GENERAL NOTES:
SCALE 1"=30'-0"
REFERENCE DRAWINGS
DRAWING NO.
BECHTEL CORPORATION
HOUSTON, TEXAS
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
HAZARD DETECTION
TYPICAL TRAIN AREA



DWG. LIMIT N 2389,000
DWG. LIMIT E 410,310
SECTION B
SECTION A
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
HAZARD DETECTION
LNG TERMINAL
352E-J-013
A

Hazard Detection System

Hazard detectors are to be positioned in strategic locations throughout the facility. The detectors are to consist of combustible gas, ultraviolet/infrared (UV/IR), smoke (ionization), high temperature and low temperature units. Precise numbers and locations are to be determined in the final design. The general philosophy of detection devices and logic systems stipulated by YPLP is outlined below.

Hazard detectors are to be installed to provide operating personnel with early indication of releases of flammable fluids and fires; to indicate the general location of the release or fire; to initiate automatic shutdown of equipment in the affected portion of facility; and to initiate automatic discharge of selected fire control systems. Each hazard detector is to actuate visible and audible alarms in the Main Control Room and in the Fire Station. In most cases, automatic shutdown and/or automatic discharge of fire control systems is to occur only if two or more hazard detectors in a given area are in alarm mode simultaneously. See the following figures for preliminary hazard detector locations.

Combustible gas detector installation is to include the following locations:

- Air inlets to all pressurized buildings
- Inside all enclosed buildings
- Air inlets to all fired heaters and gas turbines
- Each flammable liquid pump
- Each flammable gas compressor
- Inside each gas turbine enclosure
- Refrigerant storage area
- Near LNG ship loading arms
- Liquefaction trains
- Fin-fan coolers/condensers
- Fractionation area

Low temperature detectors are to be a minimum of two point-type detectors or one continuous strip-type detector - installation to include each of the following areas:

Each LNG impounding area and spill drainage trench
LNG flash drum, product pumps and main liquefaction heat exchanger for each train
Below LNG loading arms on both docks

It was indicated that the low temperature detectors are to have a factory set point of -40° F with a field adjustment to -50° F.

Smoke detectors (ionization) are to be installed inside all buildings within the plant complex.

Ultraviolet/infrared (UV/IR) fire detectors are to be installed in the following areas:

Each LNG storage tank
LNG loading arms on each dock
Refrigerant storage area
Liquefaction trains
LNG impounding areas
Fractionation area
Diesel firewater pumps
Diesel fuel storage tanks
Natural gas and refrigerant compressors/turbines
Fin-fan coolers/condensers
Compressor lube oil skids

In all cases, UV/IR detectors are to be installed in pairs.

High temperature detectors are to have a set point of +248° F.

Hazard Control Systems

Several different types of chemical agents are to be available for fighting fires within the facility. The type of agent to be used in a specific situation is to depend on the characteristics of a particular event and on the relative effectiveness of the various agents on that particular type of fire. See the following figures for preliminary hazard control locations.

Low-expansion foam is effective for extinguishing fires of ordinary liquid hydrocarbons. Semi-fixed low-expansion foam systems are to be installed on all diesel storage tanks with capacities greater than 200 barrels. Fluoroprotein foam concentrate suitable for use with either fresh water or seawater is to be used to produce the low-expansion foam. Portable devices for producing and dispersing low-expansion foam also would be available.

High-expansion foam is to be applied to unignited pools of LNG to reduce downwind travel of the flammable vapor cloud. When applied to a pool of burning LNG, high-expansion foam is to be used to decrease the size of the flame and thus reduce the amount of radiated heat. Installation of fixed location high-expansion foam generators is to include the following areas:

- Beneath the LNG loading arms on both LNG loading docks
- Curbed area around the Main Cryogenic Heat Exchanger and the LNG Flash Drum in each train
- LNG drainage trench beneath each LNG storage tank piping run to main transfer line impoundment
- Two LNG impounding areas (onshore) for holding dock spills

The number of generators to be installed in each location is to be determined during detailed design. The overall design intent is to provide sufficient generators to produce a six-foot thick blanket of foam over the protected area within two minutes. Portable high-expansion foam generators are to be available to apply foam to other impounding areas. The foam concentrate to be used is to be suitable for use with both fresh water and seawater. The nominal expansion ratio of the foam would be from 400:1 to 600:1.

Gaseous extinguishing/inerting agents are to be used for extinguishing fires in enclosed spaces to limit the access of oxygen to the fuel and to inhibit the combustion process. Approved gaseous extinguishing systems are to be installed in all gas turbine enclosures, in certain control room areas and in other enclosures housing critical electrical/electronic equipment.

Dry chemical powders are to be used for extinguishing LNG fires and fires of other hydrocarbons. Potassium bicarbonate dry chemical agent is to be used on hydrocarbon fires. Monoammonium phosphate is to be used in dry chemical extinguishers intended for fighting Class A fires (wood, paper, cloth). Skid-mounted, fixed dry chemical extinguishers are to be installed on both LNG docks. These fixed systems are to supply dry chemical to close-coupled and remote hose reels. All other plant areas are to be protected by portable or mobile dry chemical extinguishers.

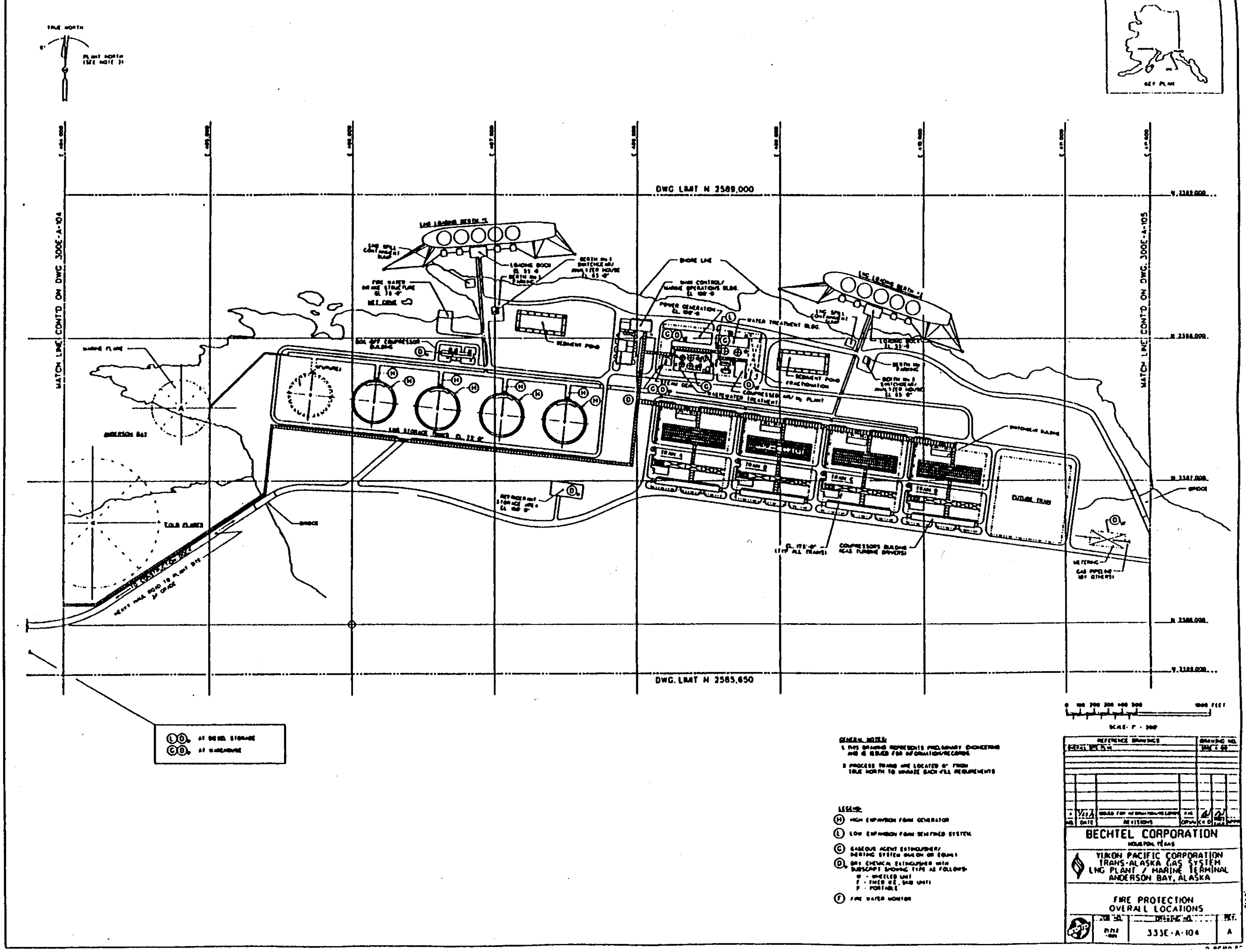
Portable hand dry chemical extinguishers of 20 or 30 lb capacity are to be distributed throughout the process and storage areas, on both docks and in all other locations where flammable gases or liquids are stored or processed. Wheeled dry chemical units of 150 or 350 lb capacity are to be located beneath the east-west pipe racks in each liquefaction train (five per train), in the fractionation area (two) and in all buildings that house gas turbines and/or flammable gas compressors (one wheeled unit per two turbines or turbine/compressor sets).

Hand portable fire extinguishers containing an approved gaseous extinguishing/inerting agent are to be installed in all buildings or rooms that house electrical or electronic equipment.

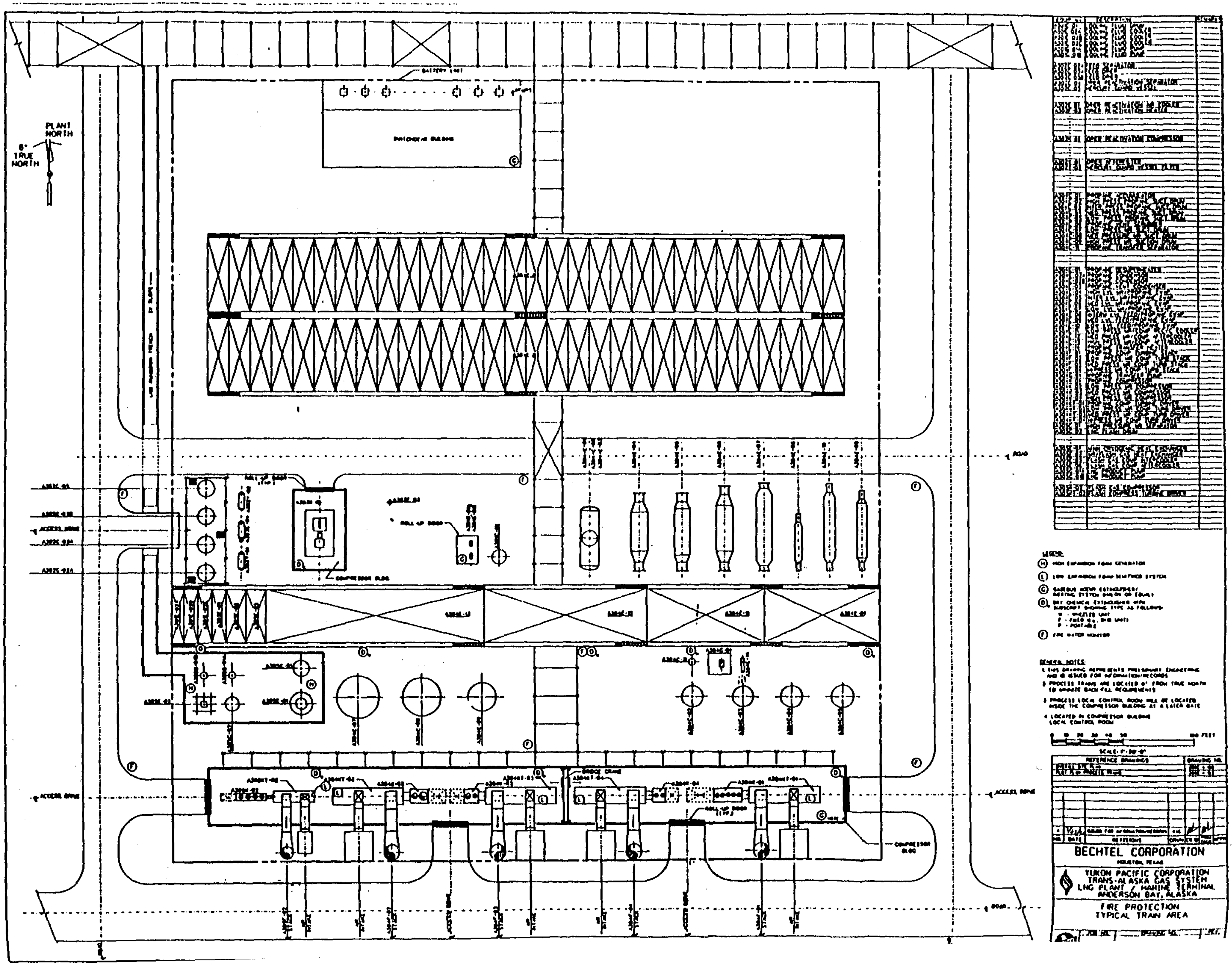
Mobile and portable fire fighting equipment is to include the following:

Two fire trucks (water only)
One fire truck (high-expansion foam)
One fire truck (water and low-expansion foam)
Six portable high-expansion foam generators
One 3000 lb, skid-mounted, dry powder unit on wheels with hose reels and one monitor

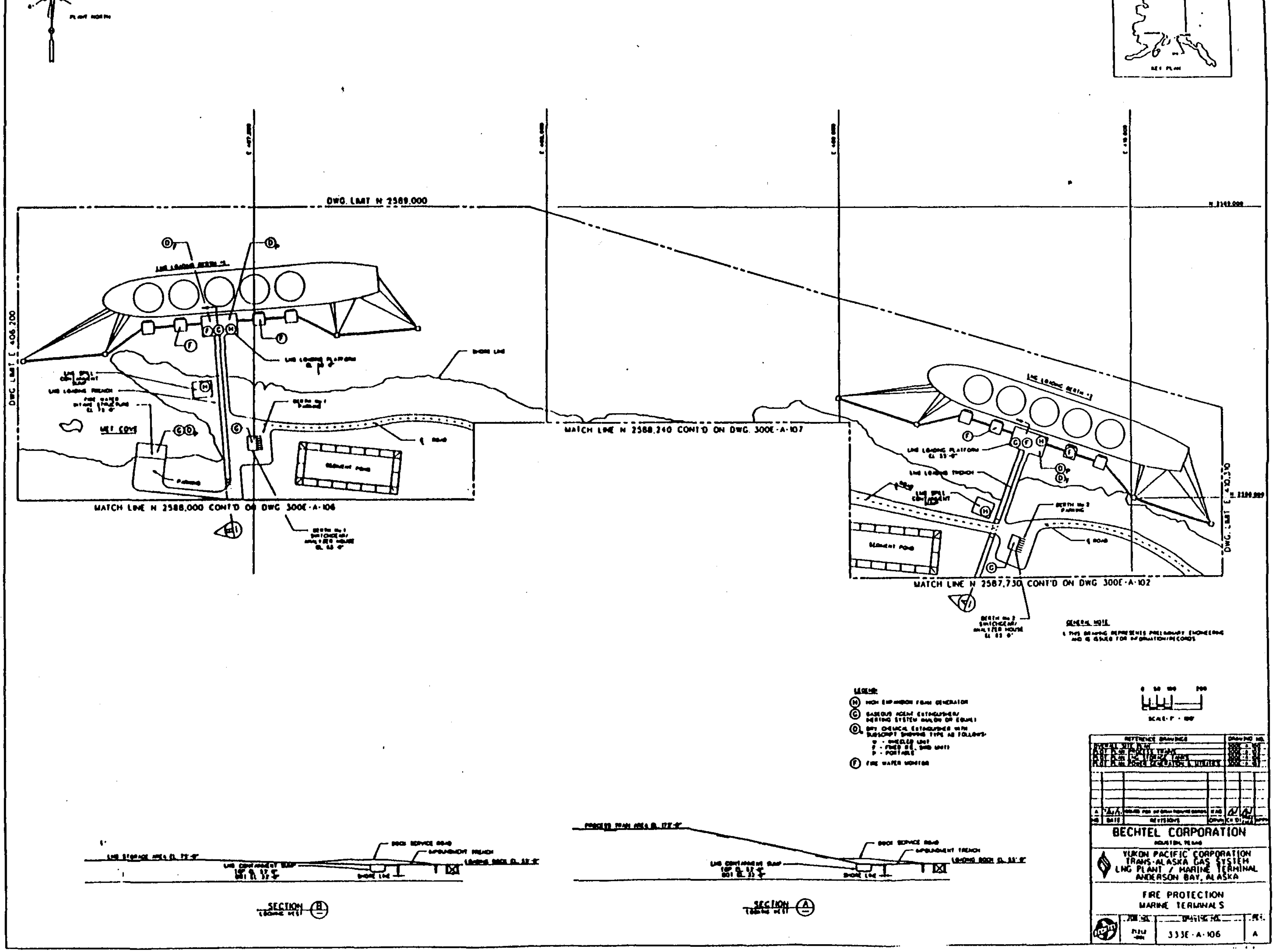
These equipment units are to be located at the Fire Station. Portable and mobile foam producing equipment and the water fire trucks are to be capable of being connected to hydrants on the firewater distribution system.



DWG LIMIT N 2589,000
DWG. LIMIT N 2585,650
MATCH LINE CONT'D ON DWG. 300E-A-104
MATCH LINE CONT'D ON DWG. 300E-A-105
POWER GENERATION
WATER TREATMENT BLDG.
SEDIMENT POND
FUTURE TRAIN
BRIDGE
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
FIRE PROTECTION
OVERALL LOCATIONS
333E-A-104
A



PLANT NORTH
TRUE NORTH
BATTERY LIMIT
COMPRESSOR BLDG.
ROLL-UP DOOR
BRIDGE CRANE
ACCESS DRIVE
ROAD
LEGEND:
GENERAL NOTES:
BECHTEL CORPORATION
HOUSTON, TEXAS
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
FIRE PROTECTION
TYPICAL TRAIN AREA


DWG. LIMIT N 2589,000
MATCH LINE N 2588,240 CONT'D ON DWG. 300E-A-107
MATCH LINE N 2588,000 CONT'D ON DWG 300E-A-106
MATCH LINE N 2587,730 CONT'D ON DWG 300E-A-102
DWG. LIMIT E 406,200
DWG. LIMIT E 410,350
MET COVE
SECTION B
SECTION A
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
FIRE PROTECTION
MARINE TERMINALS
333E-A-106
A

Firewater System

Firewater supply and distribution systems are to be provided for extinguishing Class A fires; cooling tanks, structures and equipment exposed to excessive heat radiation from fires; producing low- and high-expansion foam; and dispersing flammable vapors. The design of the firewater supply and distribution system is to provide for simultaneous supply of all fixed fire protection systems, including monitor nozzles, at their design flow and pressure involved in the maximum single incident expected in the plant, plus an allowance of 1000 gpm for hand hose streams for a period of not less than two hours. Jockey pumps are to maintain 150 psig system pressure.

Firewater is to be supplied from two independent pumping sources. (See the following figure for a schematic representation.) A 570,000 gallon Fire/Utility Water Tank is to be provided to supply fresh (desalinated) water through the fresh firewater pumping station primarily for pressurizing the firewater system and for initial fire fighting capability. A seawater pumping station is to be designed to supply the entire plant distribution loop with seawater if demand exceeds the capacity of the fresh water system. Seawater is to be pumped from the Firewater Intake Structure into the distribution loop by two electric motor-driven submerged seawater fire pumps (11,500 gpm each) with two additional diesel engine-driven spare pumps.

Initial firewater requirements are to be supplied by the motor- and diesel-driven fresh firewater pumps (4000 gpm each). When the firewater demand exceeds the pumping capacity or when the water supply in the Fire/Utility Water Tank reaches the low alarm level, the seawater pumping station is to be automatically activated. The electric fresh firewater pump is to start upon receipt of a low pressure firewater loop signal. The diesel-driven pump is to be activated if the primary electric pump is unable to maintain system pressure. The seawater pumping station is to be placed onstream automatically and is to be designed to maintain system pressure at maximum anticipated demand.

The firewater distribution network is to be a wet underground main with hydrants and monitors strategically located throughout the facility. Sectional isolating valves of the post-indicating type are to be incorporated in the firewater mains to ensure system integrity and to permit isolating the system in the event of a break or for making repairs or modifications. Design details and location of strategic components remain pending.

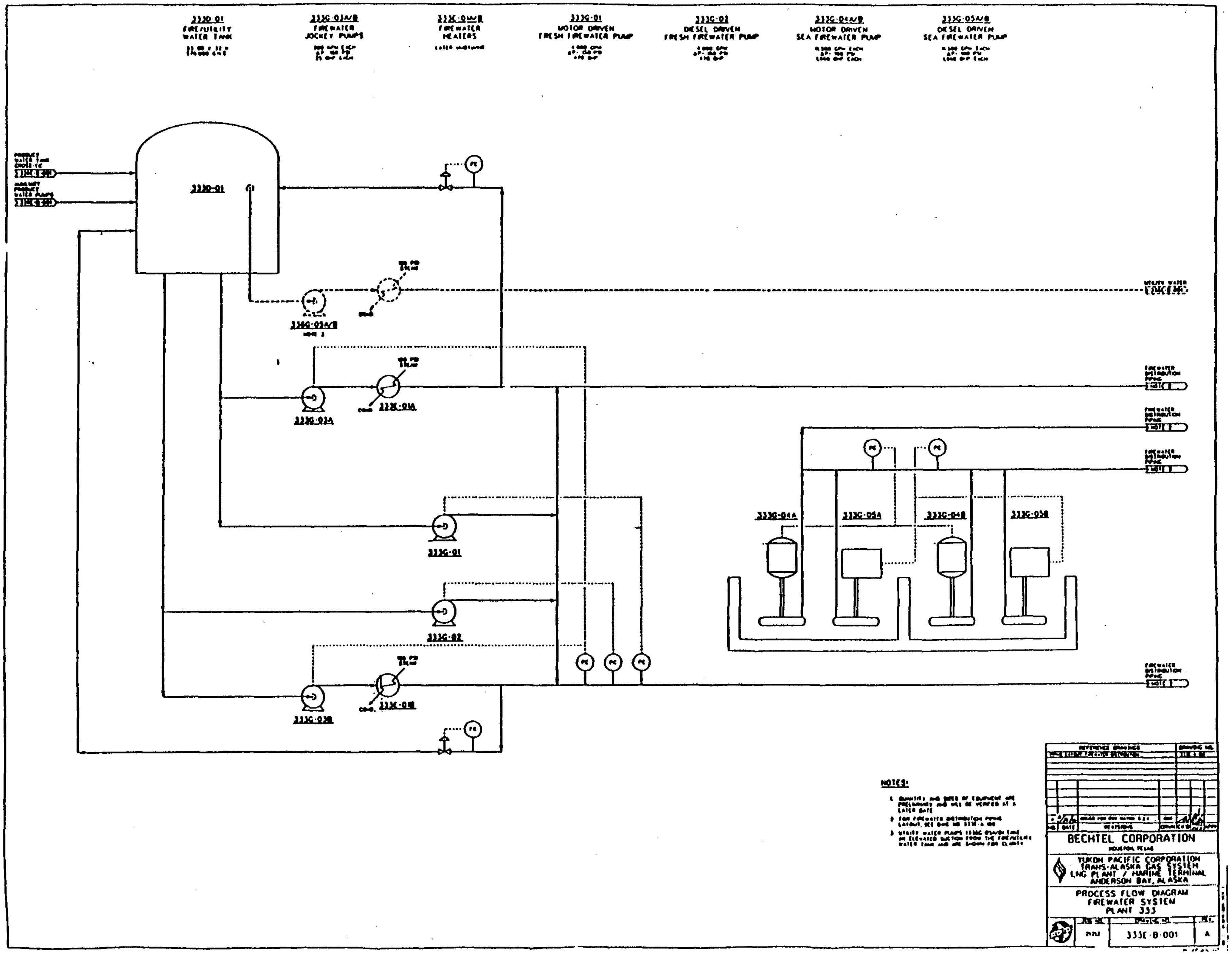
Automatically operated fixed water spray systems are to be installed for the protection of selected tanks, pumps, vessels, columns, heat exchangers and piping. It was indicated that all process vessels that are to contain significant amounts of liquefied gas are to be water sprayed. All fin-fan coolers/condensers that contain flammable fluids or are located above pipe racks carrying flammable fluids are to be water sprayed. Lubrication oil skids located below compressors are to have a combination water spray/low-expansion foam system. All pumps that handle combustible liquids that are above their flash points also are to be protected by fixed water spray systems.

Fixed location, adjustable monitors are to be used to protect tall vessels such as fractionation and liquefaction columns and to provide additional water cooling capability in process areas. Monitors are to have a design flow of 500 gpm and a maximum range of 100 feet.

The firewater loop in the LNG storage tank area is to supply water for fixed water spray systems on the storage tanks, for monitors and hydrants and for producing high-expansion foam. Each LNG storage tank is to be protected by a fixed water spray system on exposed portions of the tank. (The concrete walls would shield much of each storage tank from heat radiation emitted by fires in adjacent tanks.) In order to conserve water and reduce demands on the impoundment area sump pumps, the spray system on each tank is to be sectionalized. Only those sections that are needed in a given situation are to be activated. The piping, valves, etc., from the roof of each tank down to the grade level drainage trench also are to be water sprayed.

The refrigerant storage area is to be equipped with an automatically operated water spray system designed to absorb heat developed by fires and to suppress flames in order to protect piping, refrigerant storage tanks and surrounding equipment.

Fire fighting provisions at each of the two docks are directed to protection of the dock facilities. The firewater systems are to include a firewater distribution system (normally dry), three hydrants (with hose racks) at strategic locations at the loading platforms, two firewater monitors at the inner breasting dolphins, one firewater monitor at the intersection of the loading platform and trestle and two elevated, pre-aimed, remote on-off firewater monitors to protect the loading arms. Additionally, a fixed water spray system is to be provided on the gangway, LNG Drain Drum, LNG piping and critical valves. A fixed water spray system also is to be provided on the outside of the Dock Operations Building.



333D-01
FIRE/UTILITY WATER TANK
333G-02A/B
FIREWATER JOCKEY PUMPS
333C-01A/B
FIREWATER HEATERS
333G-01
MOTOR DRIVEN FRESH FIREWATER PUMP
333G-02
DIESEL DRIVEN FRESH FIREWATER PUMP
333G-04A/B
MOTOR DRIVEN SEA FIREWATER PUMP
333G-05A/B
DIESEL DRIVEN SEA FIREWATER PUMP
333D-01
333C-01A
333G-03A
333G-01
333G-02
333G-03B
333C-01B
333G-04A
333G-05A
333G-04B
333G-05B
NOTES:
BECHTEL CORPORATION
YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA
PROCESS FLOW DIAGRAM
FIREWATER SYSTEM
PLANT 333
333E-B-001
A

Spill Containment

At the present stage of design, spill containment systems for the proposed facility are tentative, final configurations are to be developed as design progresses. The impoundment systems are to be designed to comply with Federal Regulation 49 CFR Part 193 which requires that each LNG container and each LNG transfer system have an impoundment capable of containing the quantity of LNG that could be released by a credible accident. YPLP indicates that containers in the proposed facility requiring such impoundment include: liquefaction system main cryogenic heat exchangers, LNG flash drums, LNG storage tanks and loading arm drain tanks on each loading dock. Similarly, YPLP indicates that LNG transfer systems necessitating impoundment include: lines from the liquefaction trains to the LNG storage tanks, LNG loading lines from the storage tanks to the docks and LNG ship loading arms. Each of the containers and transfer systems are to have an impoundment, although each is not required to have an exclusive system; a properly designed system may serve a combination of containers and/or transfer systems. The volume of each impounding system is to be sufficiently large to contain the volume of LNG that could be released in 10 minutes from the single pipe rupture that would produce the highest release rate, plus the volume of LNG that could drain from the pipe (and associated containers) following an emergency shutdown. Detail configurations are not available at this time.

For the proposed conventional metal double wall storage tank configuration (Type T-2), containment of LNG in the event of liquid spillage from the inner tank is to be provided by a Class 2 impoundment system, using an external high concrete wall dike capable of withstanding the hydrostatic head of the impounded LNG, the rapid thermal shock, the hydrodynamic action, etc., resulting from a tank failure as required by subpart 193.2155 of 49 CFR-193. The prestressed concrete containment dike is approximately 92′-3" high above grade, 314′ outside diameter with a 2′-thick wall to be separated from the storage tank outer shell by a 15′ annulus. The top of the wall is to be set at the same elevation as the top of the inner tank. While the containment dike enclosure is to be equivalent to 137 percent of storage tank contents, subpart 193.2181 requires a minimum capacity of 150 percent for Class 2 LNG storage tank impoundment. Quiescent full tank contents would fill the containment to a level of 67′.

The spill containment system consists of the rock subgrade and the prestressed wall, which is to be keyed into the rock to provide a connection between the elements. The wall is to be prestressed both vertically and horizontally to resist liquid pressure from the full contents of LNG from the inner tank and the coincident thermal gradients through the wall. The prestress levels are to be selected to maintain minimum compression zone in the wall under this condition. The wall foundation is to be an enlarged extension of the wall and keyed into the bedrock. It is the intention that the weight of the wall be sufficiently large to resist the seismic and wind uplift forces acting on the foundation; consequently, rock anchors would not be required.

Because of the high snowfall in the area it is proposed that the annular space be covered with a roof to eliminate the accumulation of snow and ice between the tank and the wall. A gravity drainage system to sump pumps in the annular space is also to be provided. Ventilation fans would be needed to assure a flammable vapor mixture does not collect in the annular space.

Each of the other proposed LNG storage tank configurations (Type T-4 and Type T-6) are to be constructed with an integral concrete outer wall which

YPLP indicates is to serve as a Class 1 impoundment system capable of holding 110 percent of the tank contents. The use of an outer wall of a double-wall tank as a dike is permitted by DOT regulations in Sections 193.2153(a), 193.2161(b) and 193.2155(c), provided that the concrete wall is designed to withstand the equivalent impact loading of collision by, or explosion of, the heaviest aircraft which can take off at the Valdez airport. This type of equivalent impact analysis has not been conducted for either of the two double- or increased-integrity tank designs proposed by YPLP and as such do not presently meet the DOT regulations. We recommend that YPLP submit to DOT for approval and to the FERC the equivalent impact load analysis required by DOT regulations. If written approval of the impact analysis cannot be obtained, YPLP shall construct a separate and independent impounding system for such storage tanks consistent with existing standards and codes.

Potential spills or leakage from rundown piping extending from each of the four liquefaction trains to the LNG storage tanks and from the storage tanks to each dock is to be accommodated by sloped impoundment trenches which vary in width from 10′ to 40′, depending on number and size of pipes in the pipe racks. Concrete walls of these LNG impounding trenches would vary from 4.5 to 9 feet high. The trenches are to be subdivided to limit liquid exposure areas.

Each LNG storage tank would have an approximately 30-foot wide by 100-foot long by 9-foot high impoundment trench for the 24-inch LNG fill and withdrawl lines. Each impoundment would provide containment of spills associated with the horizontal lines from the common pipe rack to the base of the LNG storage tank. Since all LNG transfer lines would enter or exit through the tank roof, the 24-inch fill and withdrawl lines would have a vertical segment from the base of the tank up to the roof--a distance of 96 feet for type T-2, 112 feet for T-4, and 91 feet for T-6.

Part 193.2161 of the DOT regulations prohibits any penetrations of a dike in order to accomodate piping. As a result, the vertical piping segments would be external to the outer tank wall of the type T-4 and T-6 tanks, and external to the impoundment as presently configured. The final design of the spill containment systems will also need to provide for impoundment of the vertical segments of the fill and withdrawl lines.

Each liquefaction train is to have a curbed impounding area for containing LNG released from within the train or from the rundown piping. Each impoundment is to provide local containment with drainage to the west side of each liquefaction train and then north via a rundown trench to the main LNG pipe rack impoundment. The local containment is to surround and to accommodate leakage from the Main Cryogenic Heat Exchanger, the LNG Flash Drum and from associated LNG transfer pumps, MR/Flash Heat Exchanger and High Pressure MR Separator. The concrete curbed containment surrounding the LNG components is estimated to be 50′ x 100′ x 6" to 9" deep. The LNG rundown trench is estimated to be 10′ x 450′ x 6′ deep with a two percent slope toward the main LNG pipe rack impoundment and is to be subdivided to limit liquid exposure area.

Perhaps the most difficult design task is to develop effective spill containment and diversion for the loading docks and associated trestles. Curbed concrete spill containment is to be provided beneath the LNG loading arms at each dock. Although several arrangements have been proposed to accommodate potential spills and possible diversion to an onshore impoundment, a final configuration has not been presented.

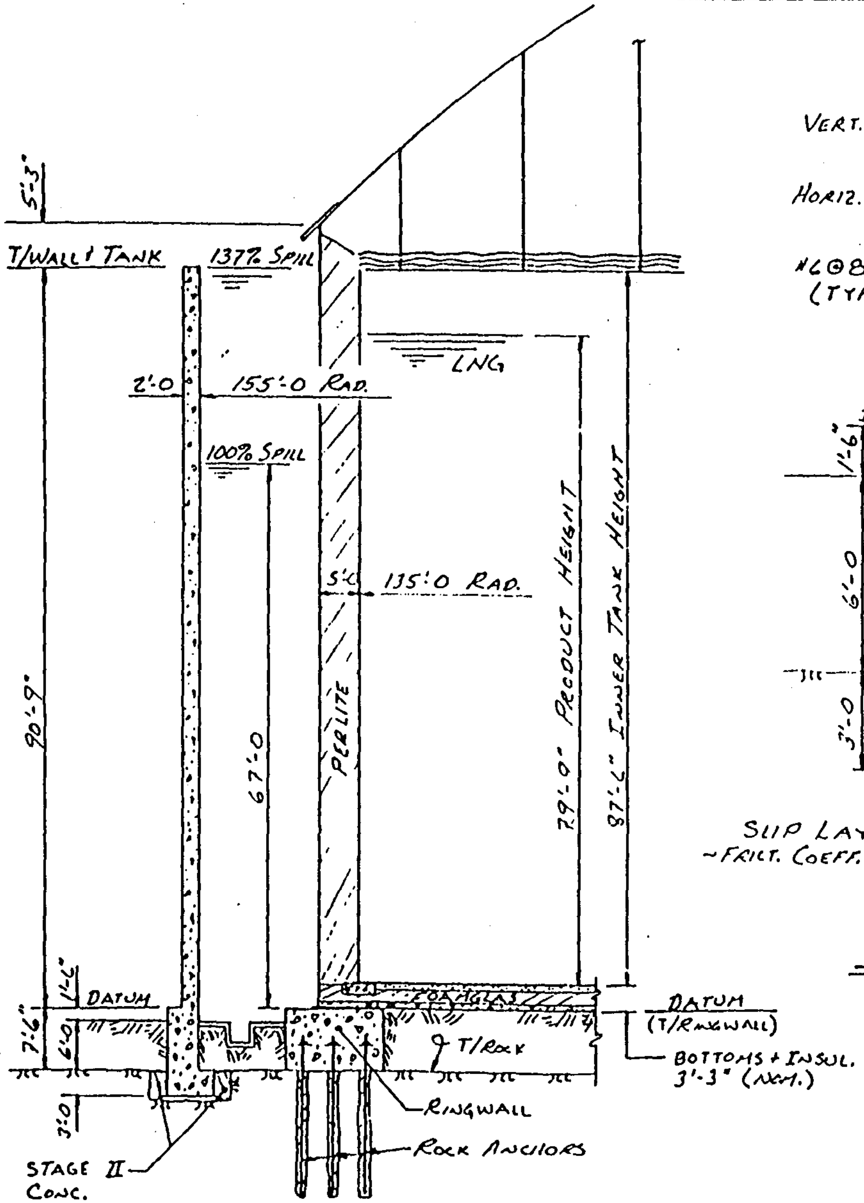
Equally difficult is to design spill impoundment systems that retain the required containment capacity at a site that may experience more than 500 inches of snowfall each year. Various ideas were discussed for snow control (snow removal from dikes, snow roofing, heat traced dike floors, etc.) but the issue remains unresolved. Although it was not discussed at the meeting, in addition to the above concepts, YPLP should be aware of a concentric "pipe-in-pipe" containment design system. The latter concept may in a limited way reduce snow control and removal activities around some specific piping arrangements, but may be of limited value in its use around flanges, elbows and other non-linear piping. Another potential application of this concept is impoundment for the vertical segments of the fill and withdrawl lines for the LNG storage tanks. However, it should be made clear that this design concept would be in addition to already planned containment systems.

The two 26,000 gallon ethane and two 430,500 gallon propane refrigerant storage tanks are to be contained in a remote impounded area approximately 260 feet south of LNG Storage Tank 1. It was indicated that design of the system is to be in accordance with applicable standards recommended by API 2510, Design and Construction of Liquefied Petroleum Gas (LPG) Installations.

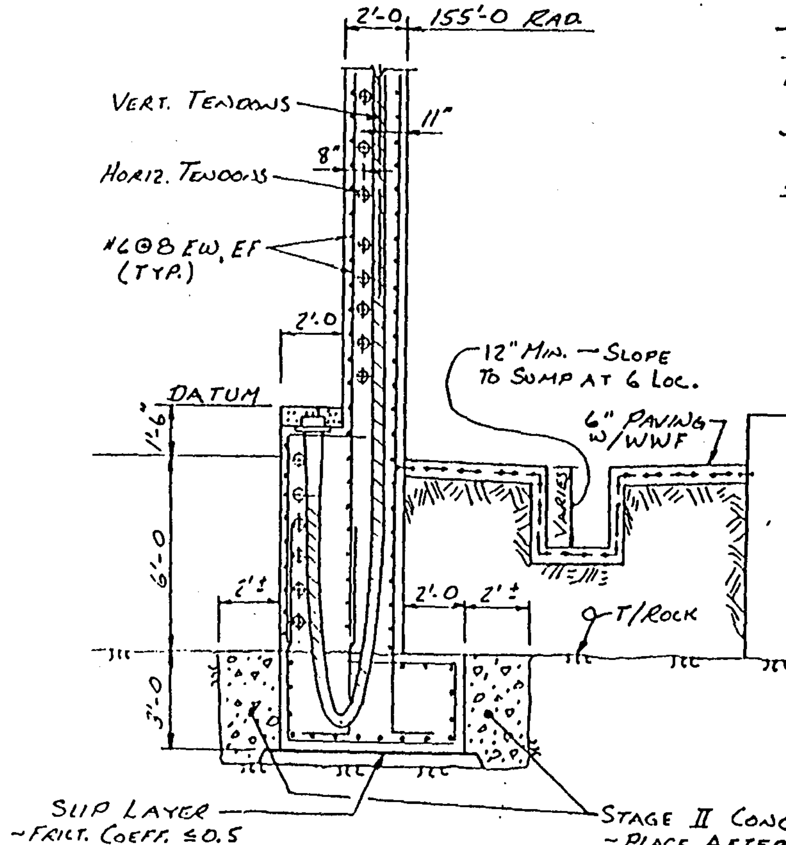
YPLP indicates that the facility is to be equipped with state-of-the-art responsive spill and hazard detection systems. The systems are to automatically actuate shutdown of the affected components as required by 49 CFR Part 193. YPLP also indicates that the detection and shutdown time for any sizable spill should be shorter that 10 minutes. However, in keeping with code requirements, the impounding areas are to be sized to contain 10 minute spills.

General Notes

1) Concrete design per ACI 318-89
2) Concrete compressive strength, f'_c = 4000 psi
3) Allowable bearing pressure on bedrock assumed = 10,000 psf
4) Reinforcing steel in wall to be ASTM A706



Typical Section
(Scale: 1/16" = 1'-0)



Detail at Bottom of Wall
(Scale: 1/4" = 1'-0)

Est. Quantities – One Wall

Item	Concrete	Reinf. Steel
Wall	8100 CY	1,150,000#
Footing	700	100,000
Stg. II Conc.	500	—
Paving	300	**30,000
Totals	9600 CY	1,280,000#

** WWF

Indicates change from previous issue

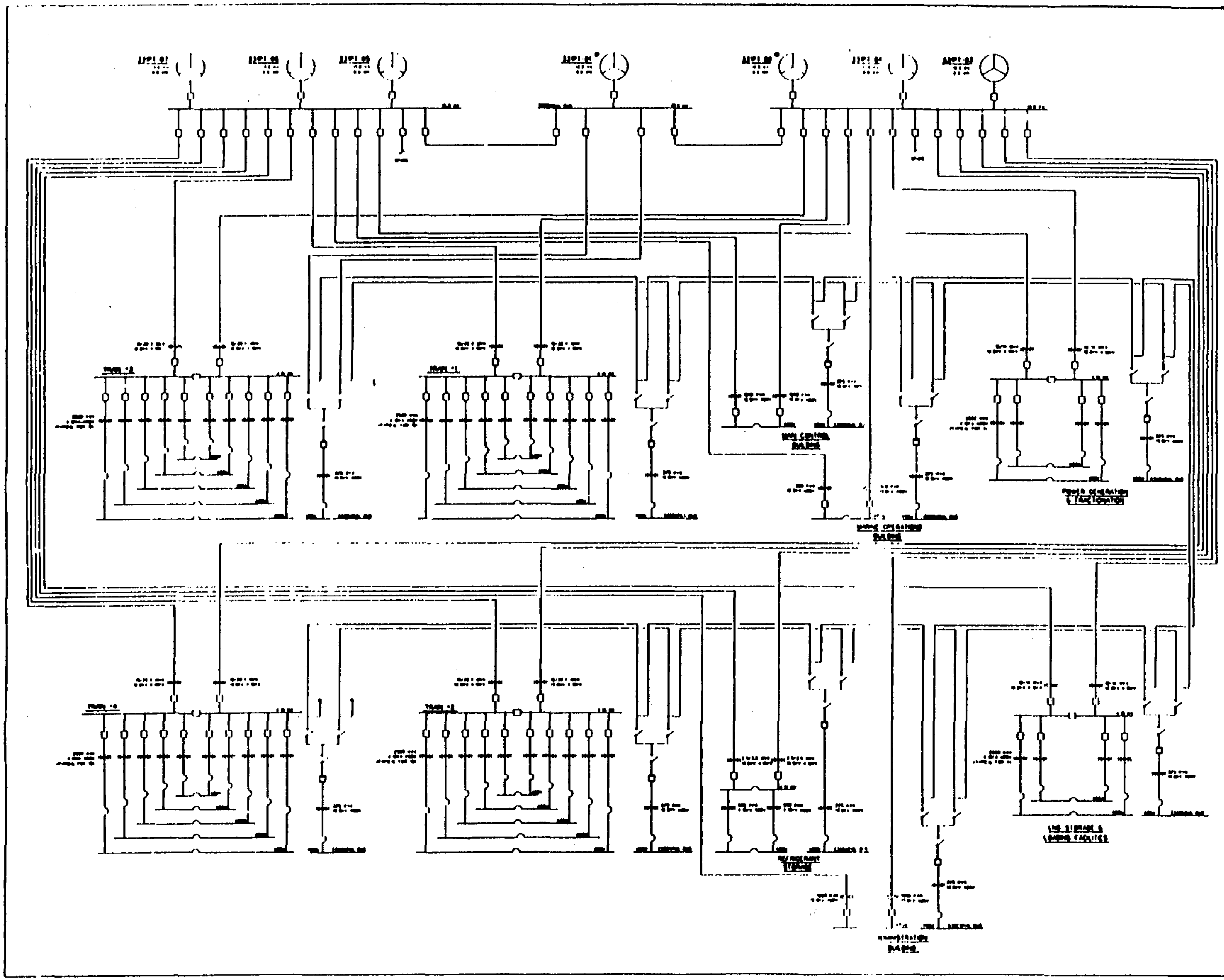
CBI	Supplier's/Purchaser's No
310'φ Containment Wall for 800 MB LNG Tank Yukon Pacific Corp, Alaska	
Customer's No.	Contract No. S 14520
By RP Chkd ___ Date 5-21-91	Dwg. A-1 Rev. 0
Engineering Supervisor	Sheet

Remarks / Revisions: By | Chkd | Date | By | Chkd | Date

Electrical Power Generation

The facility is to be designed to provide total electric power requirements onsite. Power generators are to consist of seven 8.8 MW gas turbine-driven Mars GSC 12000 units manufactured by Solar Turbines. Power is to be generated at 13.8 kV, 3 phase, 60 Hz. Two of the turbine-generator units are to provide "black start" capabilities, i.e. the turbines being capable of operation with diesel fuel in the event that natural gas supply is interrupted. The high voltage power is to be reduced to operating voltage by transformers located at major facility entities. Each major entity is to have an essential bus to provide power to more critical controls and components.

All electrical transmission/distribution lines are to be provided underground.



NOTES:

1 MOTOR LOADS ARE SHOWN ON INDIVIDUAL SWITCHGEAR SINGLE LINE DIAGRAMS ONLY

2 GENERATORS IDENTIFIED WITH AN * HAVE BLACK START CAPABILITIES

REFERENCE DRAWINGS	DRAWING NO.

NO.	DATE	REVISIONS	DRWN	CK'D		APPR
A	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

BECHTEL CORPORATION

HOUSTON, TEXAS

YUKON PACIFIC CORPORATION
TRANS-ALASKA GAS SYSTEM
LNG PLANT / MARINE TERMINAL
ANDERSON BAY, ALASKA

ELECTRICAL
SINGLE LINE DIAGRAM
OVERALL

JOB NO.	DRAWING NO.	REV.
21212	300-D-P-101	A

Emergency Access Road

As a result of the remote location of the proposed site and lack of an all-weather vehicular access road, the primary access/egress to the plant for operating personnel, contractors, materials and supplies would be waterborne transportation using the cargo/personnel ferry dock located west of the main terminal facilities in Anderson Bay. If an emergency situation necessitated the evacuation of plant personnel, either tugboats present at the terminal or worker transport boats would be used. Similarly, waterborne transportation would be required to receive any medical or emergency personnel and equipment at the site. Yukon Pacific also plans to make arrangements with Alyeska and the U.S. Coast Guard to mobilize their boats in an emergency situation.

During summer months, an overland emergency egress route would be available at the east end of the site using the TAGS pipeline right-of-way. Yukon plans to maintain this right-of-way as an unimproved private trail, removing brush to facilitate pipeline surveillance. While this route would allow evacuating personnel to reach the Alyeska Terminal, about 3.3 miles away, it is not envisioned to provide access for emergency personnel and equipment to the terminal.

The need for access to an LNG facility is addressed in the DOT regulations, under Subpart B - Siting Requirements. Specifically, Part 193.2055 requires in part:

> ...In selecting a site, each operator shall determine all site-related characteristics which could jeopardize the integrity and security of the facility. A site must provide **ease of access** so that personnel, equipment, and materials from offsite locations can reach the site for fire fighting or controlling spill associated hazards or for evacuation of personnel. (emphasis added)

Plant access is also addressed in NFPA 59A. Under 2-2.1, some factors to be considered in selection of plant site locations include:

> (b) Accessibility to plant; at least one **all-weather vehicular road** shall be provided. (emphasis added)

The principle reliance on waterborne transportation for emergency evacuation of personnel and for access of medical and emergency personnel and equipment raises several concerns. During severe weather conditions, boats may be unable to reach the terminal to evacuate personnel or to supply emergency personnel and equipment. The cargo/personnel ferry dock, at an elevation of 25 feet, would be well below the 75-foot design tsunami and slide-induced wave runnup. Further, an easterly wind could place the cargo/personnel ferry dock -- the only year-round access point -- within the range of flammable vapors under some LNG spill scenarios. These concerns raise questions on compliance with the **all-weather vehicular road** requirement in NFPA 59A, as well as the ability of waterborne access to meet the **ease of access** requirement in Part 193.2055.

The conversion of the TAGS pipeline right-of-way into an all-season emergency access road could alleviate these concerns as well as providing several benefits:

- the road would provide a second principal access point at the opposite end of the site from the cargo/personnel ferry dock;

- the overland road would provide a second mode of emergency access to supplement or substitute for waterborne transportation;

- medical and other emergency equipment could access the site more quickly by an overland route and would be unaffected by severe marine weather;

- an overland road would provide direct access for contractors, maintenance specialists and their equipment to perform non-routine repairs at the facility. In some cases, early repair or replacement of critical components can prevent a simple problem from developing into more serious consequences;

- an overland access road connecting with the Alyeska Terminal would enable both facilities to "pool" their mobile fire fighting equipment and provide mutual aid in the event of a hydrocarbon fire or other serious incident at either facility; and

However, the staff recognizes several obstacles in converting an unimproved trail -- primarily designed to permit the passage of pipeline construction equipment on the right-of-way -- into an all-season access road:

- additional clearing, cut and fill, and bridge construction would be required.

- the high potential for rock slides and avalanches would present continuing maintenance difficulties.

- snow removal for the 3.3-mile road.

Regardless of the above obstacles, the staff believes that the safety and operational benefits of the all-weather access road clearly offset the problems. Further, the all-weather access road would comply with NFPA 59A and Part 193.2055.

While the Alyeska Terminal would be outside the hazard range of any credible accidents at the LNG facility, communication between the two facilities is essential to ensure that a serious incident at one facility or the associated shipping does not propagate to the other facility. It therefore appears prudent to establish a direct telephonic linkage between the two facilities solely devoted to emergency usage. Further, the respective emergency plans at each facility should identify potential incidents which could affect the adjacent facility and a procedure for notification and response.

Conclusions and Recommendations

Study and evaluation of information submitted by Yukon Pacific Company L.P. (YPLP) has been completed by the authors for the facility in its preliminary design and preconstruction state. Particular emphasis has been placed on cryogenic processes, relevant safety systems and associated utilities. Clarification of specific material was provided by YPLP at the recent technical conference and site inspection conducted by Federal Energy Regulatory Commission (FERC) staff and cryogenics consultants on May 26, 1992.

Through careful consideration of existing cryogenic design, consistent with and acknowledging the present state-of-the-art, it must be recognized that additional detailed engineering analysis will be required to complete the intended review process. Although considerable care has been taken and extensive effort has been made by YPLP and its contractors in designing a facility embodying safeguards (including hazard control and safety systems) to either prevent the occurrence of accidents or to reduce the impact of credible accidents, the detail design remains in a preliminary stage.

Notwithstanding the fact that the material submitted by YPLP to the FERC is extensive, considering the initial phase of design, supplemental information is required before a more definitive assessment can be made on the adequacy of design and on the adherence of the design to various applicable standards, codes and engineering practices. Areas of particular interest and concern where supplemental information is required include: 1) final selection of LNG storage tank contractor in order to establish design details, 2) confirmation of final design for dock facilities, particularly the details that will define spill containment, hazard detection and hazard control systems, 3) impoundment for the vertical segments of the storage tanks fill and withdrawl lines, 4) specific manufacturer, number and locations of hazard detection devices throughout the facility (only general locations without specific numbers have been presented in many instances), 5) specific hazard control systems, including chemical quantity, unit locations, dispersion flow rates and foam confinement techniques, 6) specific interrelationship between the hazard detection system and the hazard control system that is to provide automatic emergency shutdown and actuation of hazard control devices, 7) design details and hazard control systems for the refrigerant storage vessels, 8) detailed procedures to define snow control and/or removal techniques for the heavy snowfall at the plant site to prevent adverse influence on operations and safety systems (especially spill impoundment systems), 9) analysis of safety considerations relating to the large quantity of refrigerants (MR fluids, propane and ethane) contained in the process areas and the desirability of containment systems to accommodate potential refrigerant spillage and 10) the need for a permanent access road for emergency access/egress purposes. Supplemental submissions made by YPLP will be reviewed as appropriate.

In addition to the above requirement for supplemental technical information, the following specific recommendations are made:

1) It is recommended that an additional technical conference (or conferences) be held as engineering design develops so that present areas of uncertainty may be more fully explored. These conferences should be held <u>prior</u> to initiating construction at the site. At least one technical conference should be held <u>prior</u> to initiation of construction after designs are finalized and major vendors (including LNG and other major storage tanks) have been selected and complete design details have been made available to FERC staff. The applicant shall also provide design details to the Office of Pipeline Safety of the Department of Transportation and the United States Coast Guard Captain of the Port of Valdez so that they may have the opportunity to participate in the technical conferences to assure compliance with their applicable regulations.

2) It is recommended that construction not be initiated without a written notice to proceed from the Director of the Office of

Pipeline and Producer Regulation. Any major alterations to facility design should be filed with the Secretary of the FERC for review and written approval by the Director of the Office of Pipeline and Producer Regulation prior to initiation.

3) It is recommended that onsite inspections be conducted as significant milestones develop during the construction phase and <u>prior</u> to commencement of initial facility operation.

4) It is recommended that following commencement of operation, the facility be subject to regular FERC staff technical reviews and site inspections on at least a biennial basis or more frequently as circumstances indicate. <u>Prior</u> to each FERC staff technical review and site inspection, the Company should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations, provision of up-to-date detailed piping and instrumentation diagrams reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below.

5) It is recommended that YPLP submit semi-annual reports to the FERC after initiating construction and continuing through the operational period. During the construction phase the semi-annual reports should provide construction status of major components including significant design and schedule modifications required (and/or anticipated). The reports also should address changes in facility design including anticipated future plans. During the operational phase the semi-annual reports should provide changes in facility design and operating conditions, abnormal operating experiences, activities (liquefaction and LNG shipping schedules), plant modifications including those proposed during the forthcoming 12-month period. Abnormalities shall include but not be limited to storage tank vibrations and/or vibrations in associated cryogenic plumbing, storage tank settlement, significant equipment and instrumentation malfunctions or failures, nonscheduled maintenance or repair (and reasons therefor), relative movement of the inner vessel, vapor or liquid releases, fires involving natural gas, refrigerants and/or from other sources, negative pressure (vacuum) within the LNG storage tanks and higher than predicted boiloff rates. The reports should be submitted within 45 days after each period ending December 31 and June 30.

   Included in the above items should be a section entitled "Significant plant modifications proposed for the next 12 months (dates)". The section should be included in the semi-annual operational reports to provide Commission staff with early notice of anticipated future construction and maintenance projects at the LNG terminal.

6) It is recommended that a permanent access road be built to allow emergency equipment and personnel access/egress between the plant and the City of Valdez.

7) Regarding proposed use of double- or increased-integrity LNG storage tanks, if further consideration is contemplated, it is recommended that YPLP immediately submit to the DOT for approval, and to the FERC, the equivalent impact load analysis required by Section 193.2161(b) and 193.2155(c) of the DOT regulations. If written approval of the impact analysis cannot be obtained, YPLP shall construct separate and independent impounding systems for such storage tanks consistent with existing standards and codes.

8) Yukon Pacific shall establish direct telephonic linkage with the Alyeska Terminal and the U.S. Coast Guard Vessel Traffic Center in Valdez and ensure that procedures for notification and response to potential incidents are included in the emergency plans for each facility.

APPENDIX A

Attendance List
Site Inspection and Technical Review

May 26, 1992

ATTENDANCE LIST
Site Inspection and Technical Review

Yukon Pacific Company L.P.
Valdez, Alaska

Docket No. CP88-105-001

May 26, 1992

NAME	COMPANY	TITLE	PHONE
Robert Arvedlund	FERC	Branch Chief	202/208-0091
Chris Zerby	FERC	Suprv. Mech. Engr.	202/208-0111
Alan F. Schmidt	FERC	Consultant	303/823-5134
Dudley B. Chelton	FERC	Consultant	303/494-6926
Greg Swank	SPCO/JPO	Engineer	907/278-8594
Vic Manikian	SPCO/JPO	Civil Engineer	907/278-8594
Ward Whitmore	YPC	Senior Engineer	907/265-3100
Calvin Ayres	APCI	Lead Process Engr.	215/481-6459
Frank Richardson	Bechtel Corp.	Project Manager	713/235-5137
Michael C. Metz	YPC	Senior Geotech.	907/265-3100
Harry Noah	YPC	Manager, Env. & Permitting	907/265-3100
William Martinsen	Quest Consultants	Principal Engr.	405/329-7475

APPENDIX C

BIOLOGICAL ASSESSMENT
AND
CONCURRENCE LETTER

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D. C. 20426

OFFICE OF PIPELINE AND PRODUCER REGULATION

IN REPLY REFER TO:
OPPR/DEMEA/ECB
Yukon Pacific Company L.P.
Docket No. CP88-105-000

MAR 0 4 1993

Steven Pennoyer
Director, Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, AL 99802-1668

Jeanne L. Hanson
Western Alaska Office
National Marine Fisheries Service
222 W. 7th Avenue, #43
Anchorage, AL 99513-7577

Dear Mr. Pennoyer and Ms. Hanson:

In accordance with Section 7 of the Endangered Species Act, as amended, I am providing you in this letter with a Biological Assessment (BA), prepared by the environmental staff of the Federal Energy Regulatory Commission, on the Liquefied Natural Gas (LNG) facilities proposed for construction by the Yukon Pacific Company L.P. (Yukon Pacific) in the above-referenced docket. This BA addresses the four federally listed species that were identified in your letter to me dated February 11, 1993, as well as the endangered northern right whale. As you are aware, Yukon Pacific's LNG facilities are associated with the proposed Trans-Alaska Gas System (TAGS) Project, a project whose effect on federally listed species was addressed in a letter dated May 19, 1987 from Mr. Jules V. Tileston (BLM, Anchorage) to Mr. Robert W. McVey (NMFS, Juneau).

BIOLOGICAL ASSESSMENT

The following listed species are considered in this BA:

Common Name	Scientific name	Status
Northern right whale	*Eubalaena glacilis*	Endangered
Humpback whale	*Megaptera novaengliae*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Gray whale	*Eschrichtius robustus*	Endangered
Steller sea lion	*Eumetopias jubatus*	Threatened

Project Description

The LNG plant and marine terminal for the proposed TAGS project would be located at Anderson Bay along the southern shoreline of Port Valdez (see figure 1). The marine facility would consist of two LNG tanker berths and a cargo/personnel ferry dock. The tanker berths would be oriented approximately parallel to the shoreline in 50 feet (MLLW) of water.

Construction of the development site would involve considerable blasting (twice per day), overburden removal, and fill. Approximately 9.7 million cubic yards of bulk overburden and rock would require excavation, of which approximately 61 percent (5.9 million cubic yards) would be used for structural fill onsite with the remaining material (3.7 million cubic yards) requiring disposal. The structural fill would cover over approximately 18 to 21 acres of Anderson Bay's intertidal zone in development of the construction dock and off-loading area. An additional 13 acres of subtidal habitat also would be destroyed from disposal of waste overburden and rock at a proposed site at the east end of Anderson Bay. An alternative disposal site located in deeper waters offshore of Anderson Bay is also being evaluated, and would involve only clean blast rock unless this material cannot be separated from the overburden.

When fully operational, the terminal would load approximately 275 LNG tanker ships per year. The tankers would enter Prince William Sound (PWS) in ballast, load with LNG at the terminal, and exit PWS to deliver LNG to Asian markets. Tankers would use existing ship lanes through PWS and the Valdez Arm; however, an additional 1-mile turning radius would be required for berthing tankers at the terminal.

Summary of Species Biology and Status in the Area

Northern Right Whale

This is probably the most endangered whale in the North Pacific. Recent estimates place the North Pacific population at between 100-200 individuals (Braham and Rice 1984). Northern right whales have not been observed in the PWS area in recent times. However, PWS lays adjacent to the Gulf of Alaska where, historically, major concentrations occurred (Scarff 1986). Consequently, the possibility of encountering a right whale in the PWS area does exist given their traditional use of the area. However, this possibility is very slight given the small size of the existing population and the lack of evidence for recovery in the North Pacific (Scarff 1986).

Gray Whale

This whale passes through the PWS area twice each year on its annual migration to and from winter breeding grounds in Mexico and summer feeding grounds in the Bering and Chukchi seas (Braham 1984). Timing of passage is usually in the spring (March-May) and fall (November-January). Gray whales closely follow the coast around the Gulf of Alaska, frequently passing through both Hinchinbrook Entrance and Montague Strait (Hall 1979). Although gray whales occur in PWS, they have seldom been reported in the Valdez Arm and are considered a rare visitor at that locality.

Humpback Whale

This whale occurs primarily in two distinct areas of PWS during two separate periods (Hall 1979). During May to late June they are most frequently reported feeding in the area between Perry, Naked, and Eleanor islands, which is characterized by high primary and secondary productivity during the spring of the year. By early July, most move to near Icy and Whale Bays near Chenega Island (Hall 1979). Individuals are observed throughout PWS and occasionally are seen in the Valdez Arm where they are considered a rare visitor.

Fin Whale

Fin whales occur in the Gulf of Alaska from May to November (Berzin and Rovnin 1966) where they have generally been found feeding in deeper waters along submarine canyons and the shelf break (Consiglieri and Braham 1982; Leatherwood et al. 1983; Brueggeman et al. 1987, 1988). Hall (1979) observed fin whales in PWS from April to June, but believed these animals were primarily transients. A few animals have been known to wander into Valdez Arm, but are considered a rare visitor there.

Steller Sea Lion

This sea lion is found in PWS throughout the year. A major breeding rookery occurs at Seal Rocks at the southern end of the sound and several haulout sites occur throughout PWS. Neither the rookery or any of the major haulout sites occur near Valdez Arm (T. Loughlin, NMFS, pers. comm.). The closest haulout site to Valdez Arm is Glacier Island (west of the mouth of the Arm) which is used only in the winter (D. Calkins, ADFG, pers. comm.). Steller sea lion use of Valdez Arm is only occasional and sporadic (D. Calkins, ADFG, pers. comm.) and there are no haulout sites here. A spring influx into the Arm may occur if spawning herring are present, but herring use of Valdez Arm is also occasional and sporadic (unpublished data, ADFG). Consequently, Steller sea lions are considered occasional visitors to Valdez Arm. All major haulouts occur 10-40 nm west of the shipping lanes. However, the Seal Rocks rookery lies at the mouth of Hinchinbrook Entrance with shipping lanes occurring on both the east and west side of the rocks, and is considered an off-lying danger to traffic.

No critical habitat has been identified for any of the above listed species in the project area or the total PWS area. However, the National Marine Fisheries Service (NMFS) has future plans for designating specific Steller sea lion rookeries and haulouts in PWS as critical habitat. These areas, recommended by the Steller Sea Lion Recovery Team, include the Seal Rocks rookery, and the Needle, Wooded Island, Perry Island, Point Elrington, and Point Eleanor haulout sites (see figure 1).

In summary, gray, humpback, and fin whales can be found seasonally in PWS and may occasionally enter Valdez Arm, with humpback whales the most likely to enter. There are no historic records for northern right whales for PWS. Steller sea lions are found in PWS year-round and may occur in Valdez Arm in numbers if spawning herring are present. But for the most part, major use areas of all five species are located in PWS far from Valdez Arm.

Potential Impacts

Impacts from construction of the marine terminal would consist mainly of noise while building piers and berths for tankers and cargo ships, and from blasting during excavation. These impacts are expected to be very minor on listed marine mammals as they seldom occur in the area.

Impacts from turbidity, which could affect production of food sources, would be slight as little or no dredging operations are anticipated. However, 18 to 21 acres of intertidal habitat (an important food-producing area) and 13 acres of subtidal habitat would be lost due to filling and overburden and rock disposal. The loss of this intertidal habitat would not adversely affect the four whale species or Steller sea lion because Anderson Bay does not appear to be a primary feeding area for these species.

Potential impacts of accidental fuel or oil spills from the terminal site are preventable to a large degree, as fuels and oils would be stored in approved facilities with appropriate spill containment and other safeguards. LNG would not constitute a major hazard to whales or sea lions due to its tendency to vaporize at normal environmental temperatures. Even a worst-case scenario for a fuel or LNG spill within Valdez Arm would not be detrimental to the whales or sea lion, as they seldom occur in that portion of the project area.

Cumulative effects of the project are expected to be inconsequential to threatened and endangered marine mammals. There are no adverse effects from the existing Alyeska Marine Terminal on the four species of whales and the Steller sea lion, and none are expected from the TAGS LNG terminal based on existing information on utilization of Valdez Arm by these species.

Any affect on whales and sea lions from the addition of 275 LNG tankers per year would occur primarily outside of Valdez Arm. Approximately 900 crude oil tankers presently are loaded each year at the adjacent Alyeska Marine Terminal. For whales, these impacts would primarily be noise disturbance from shipping traffic or collisions with tankers. Whales have been observed exhibiting avoidance behavior when subjected to noise from ships and boats. Collisions are known to occur between ships and whales. For sea lions, the greatest danger would be the increased potential of a tanker running aground at the Seal Rocks rookery, which lies between the existing traffic lanes at Hinchinbrook Entrance. While crude oil would not be involved, a LNG fire or general disturbance associated with the incident could impact breeding sea lions, and a LNG tanker grounding at Seal Rocks could be especially harmful to the Steller sea lion if it occurred during the pupping season (May 15 to July 15).

As the shipping traffic that would be associated with the LNG terminal is expected to utilize existing shipping lanes, impact is expected to be minimal. To date, no known major impact on the whale or sea lion populations from normal shipping activities along these lanes has been documented. However, the "Exxon Valdez" oil spill has shown that tankers can stray from shipping lanes with disastrous consequences. Unlike the "Exxon Valdez", the LNG tankers would use double hull construction to protect the cargo tanks in the event of a collision or grounding.

<u>Conclusion</u>

No direct impacts on the populations of northern right, gray, humpback, or fin whales, or Steller sea lions are anticipated as a result of this project. Valdez Arm is not documented as being important habitat or often used by any of these species. The potential increase in shipping will have little or no effect on marine mammals as existing, high use shipping travel lanes will be utilized for transport of LNG to market. There is no documented evidence that normal shipping activities have had any major adverse effects on whales or sea lions in PWS.

No cumulative impacts are anticipated from the construction of the LNG terminal or associated shipping.

Based on available information, the FERC environmental staff concludes that the proposed Yukon Pacific LNG terminal and related activities would not affect federally listed whale and sea lion populations. Therefore, Formal Consultation between our agencies will not be necessary. I would appreciate if, pursuant to 50 C.F.R. § 402.10(j), you would provide me with your comments on and/or concurrence with this BA and its finding of no affect within 30 days of your receipt of this letter.

Thank you for your cooperation in this matter. If you have any questions, please contact Mr. Mark C. Kalpin of my staff at (202) 208-0918.

Sincerely,

Bob Arvedlund

Robert K. Arvedlund, Chief
Environmental Compliance and
Project Analysis Branch

<u>Literature Cited</u>

Berzin, A. A. and A. A. Rovnin. 1966. The distribution and migrations of whales in the northeastern part of the Pacific, Chukchi and Bering seas. Izvestia TINRO 58:179-207.

Braham, H. W. 1984. Distribution and migration of gray whales in Alaska. Pages 249-266 <u>in</u>: M. L. Jones, S. L. Swartz, and S. Leatherwood (eds.), The Gray Whale, <u>Eschrichtius robustus</u>. Academic Press, New York.

Braham, H. W. and D. W. Rice. 1984. The right whale, <u>Balaena glacialis</u>. Marine Fisheries Review 46:38-44.

Brueggeman, J. J., G. A. Green, R. A. Grotefendt, and D. G. Chapman. 1987. Aerial surveys of endangered cetaceans and other marine mammals in the northwestern Gulf of Alaska and southeastern Bering Sea. Final Report prepared for the Minerals Management Service and NOAA Office of Oceanography and Marine Assessment. Contract No. 85-ABC-00093.

Brueggeman, J. J., G. A. Green, R. W. Tressler, and D. G. Chapman. 1988. Shipboard surveys of endangered cetaceans in the northwestern Gulf of Alaska. Final Report prepared for the Minerals Management Service and NOAA Office of Oceanography and Marine Assessment. Contract No. 85-ABC-00093.

Consiglieri, L. D. and H. W. Braham. 1982. Seasonal distribution and relative abundance of marine mammals in the Gulf of Alaska. Final Report prepared for NOAA/OCSEAP, Juneau. Research Unit 68. Contract No. R7120806.

Hall, J. 1979. A survey of cetaceans of Prince William Sound and adjacent vicinity - their numbers and seasonal movements. Final Report prepared for NOAA/OCSEAP. Contract No. 01-6-022-1560.

Leatherwood, S., A. E. Bowles, and R. R. Reeves. 1983. Endangered whales of the eastern Bering Sea and Shelikof Strait, Alaska; Results of aerial surveys, April 1982 through April 1983 with notes on other marine mammals seen. Hubbs-Sea World Research Institute Technical Report No. 83-169.

Scarff, J. W. 1986. Historic and present distribution of the right whale (<u>Eubalaena glacialis</u>) in the eastern North Pacific south of 50°N and east of 180°W. Report to the International Whaling Commission (Special Issue 10):43-63.

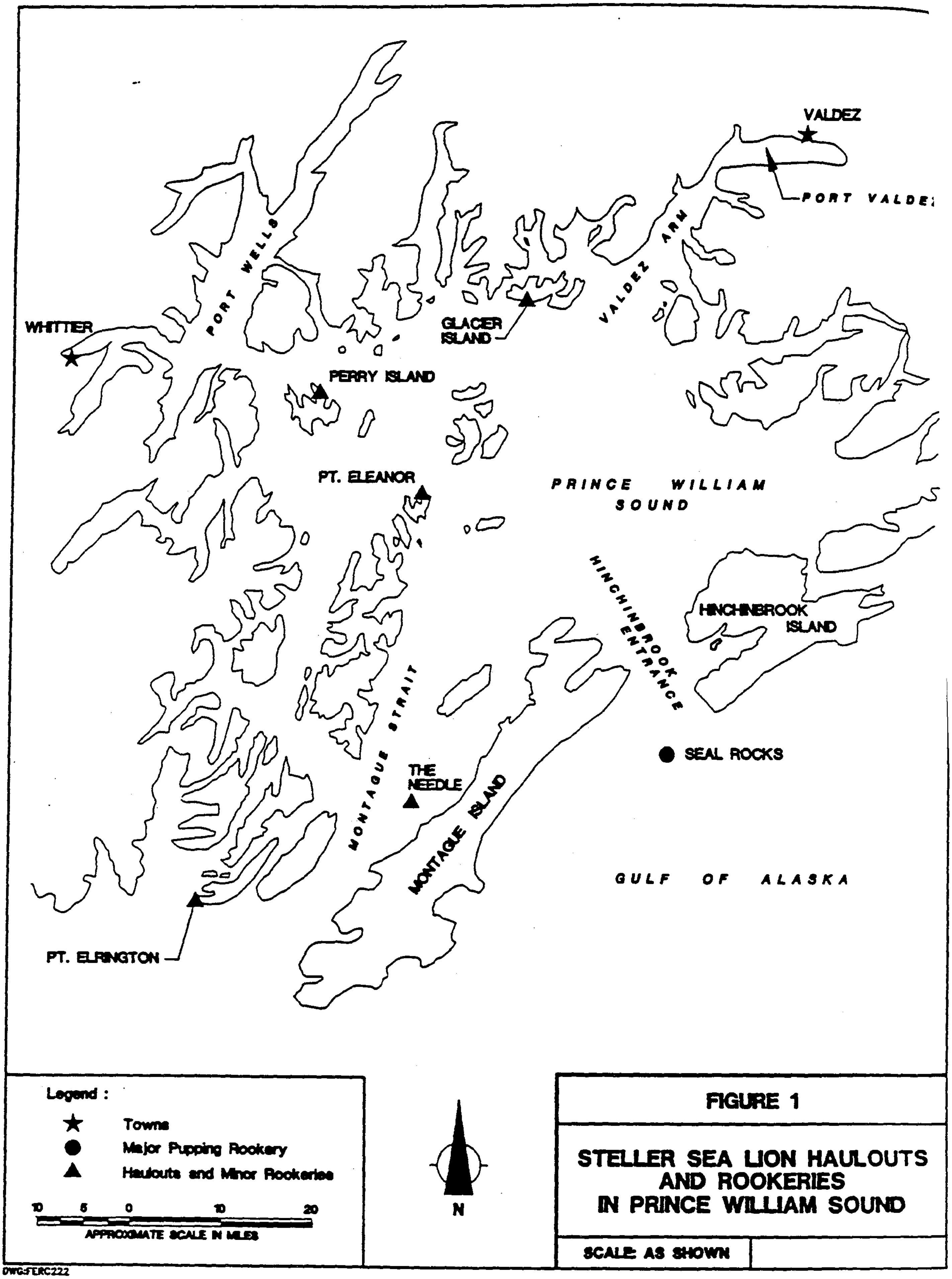


FIGURE 1

STELLER SEA LION HAULOUTS AND ROOKERIES IN PRINCE WILLIAM SOUND

SCALE: AS SHOWN

DWG:FERC222

UNITED STATES DEPARTMENT OF COMMERCI
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

March 17, 1993

RECEIVED BY

MAR 29 1993

Robert Arvedlund, Chief
Environmental Compliance &
Project Analysis Branch
Federal Energy and
Regulatory Commission
825 North Capitol Street
Washington, D.C. 20426

RE: OPPR/DEMEA/ECB
Yukon Pacific Corp.
Docket No. CP88-105-000

Attn: Mr. Mark C. Kalpin

Dear Mr. Arvedlund:

This is in response to your recent submission under Section 7 of the Endangered Species Act of 1973, as amended, of a Biological Assessment to determine the effects of the Liquefied Natural Gas (LNG) facilities proposed for construction by the Yukon Pacific Company (YPC), on endangered and threatened species.

We concur that there is presently no identified critical habitat for any of the four species of the whales concerned. In addition, although we have future plans for designating specific Steller sea lion rookeries and haulouts in Prince William Sound as critical habitat, none of these areas are within Valdez Arm.

Therefore, we agree with your conclusion that construction of the LNG terminal would not have direct impacts on the populations of northern right (Eubalaena glacilis), humpback (Megaptera novaeangliae), fin (Balaenoptera physalus), gray (Eschrichtius robustus) wnales, or Steller sea lions (Eumetopias jubatus). Since we agree that the LNG terminal is not likely to have direct adverse impacts on the species identified, a formal consultation is not required for this project. We wish to point out, however, that this opinion only considers the direct effect of the construction of the LNG terminal and does not consider any potential cumulative impacts as discussed on page 5. Should it be determined that cumulative impacts are occurring, additional consultation may be required to assess the effects of these impacts.

Accordingly, this concludes Section 7 consultation between the Federal Energy Regulatory Commission and National Marine Fisheries Service. Should project plans change or new information become available that changes the basis of this decision, then consultation should be reinititated. Should you require any other additional information please contact Ms. Jeanne L. Hanson of my staff at (907) 271-5006.

Sincerely,

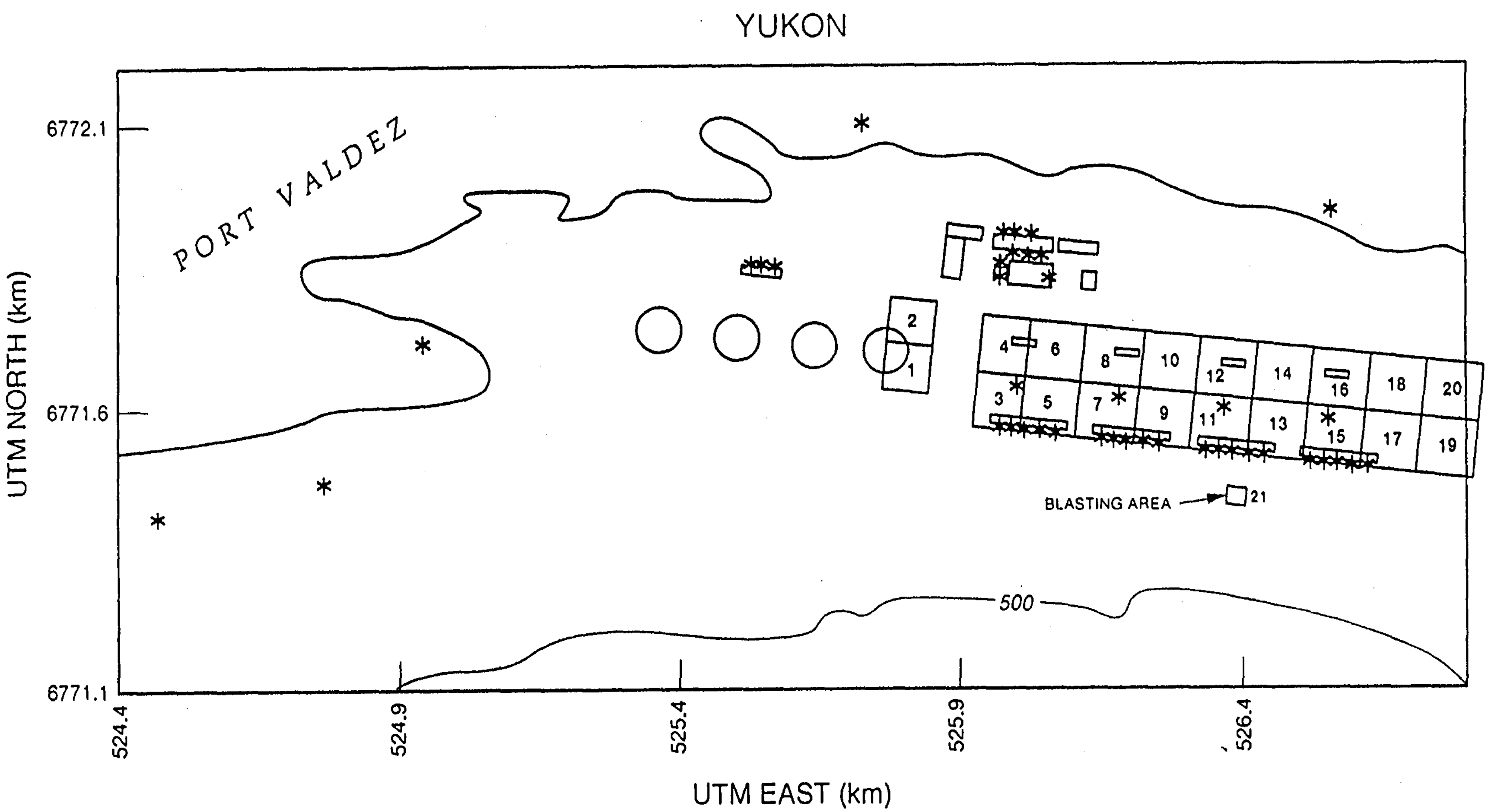
Steven Pennoyer

Steven Pennoyer
Director, Alaska Region

cc: Yukon Pacific - Anchorage
Alaska State Office, Bureau of Land Management, Branch of Pipeline Monitoring - Anchorage
USFWS, EPA, DGC, ADFG, ADEC, Corps - Anchorage

APPENDIX D

SUPPLEMENTAL AIR QUALITY DATA



Locations of Modeled Construction Dust Sources
for Screening Modeling

FIGURE

D-1

Table D-1

BASIS FOR EMISSIONS CALCULATIONS

Source Equipment	Basis for Criteria Pollutants (i.e., NO_x, CO, VOC, SO_2, and PM)		
		Operations	
	Emission Factors	Maximum Hourly	Annual Average
LNG Trains A,B,C,&D • Compressor Drivers - Propane - LP MR - IP MR - HP MR	(from turbine vendor) 0.1 lbs NO_x/MMBtu 0.13 lbs CO/MMBtu 0.017 lbs VOC/MMBtu 0.009 lbs PM/MMBtu 0.0008 lbs SO_2/MMBtu	• Max. Heat Input: 365.60 MMBtu/hr (42,860 HP @ 8,530 Btu/HP-hr @ 15°F) • 100% load	• Average Heat Input: 343.37 MM Btu/hr (39,650 BHp @ 8,660 Btu/HP-hr @ 40°F) • 8,040 hrs/yr @ 100% load (24 hrs/day x 335 days/hr)
LNG Trains A,B,C,&D • Flash Gas Compressor Driver	0.1 lbs NO_x/MMBtu 0.12 lbs CO/MMBtu 0.035 lbs VOC/MMBtu 0.0008 lbs PM/MMBtu 0.0008 lbs SO_2/MMBtu	• Max. Heat Input: 55.76 MMBtu/hr (7,350 HP @ 7,586 Btu/HP-hr @ 15°F) • 100% load	• Average Heat Input: 48.99 mm Btu/hr (6,400 BHp @ 7,655 Btu/HP-hr @ 40°F) • 8,040 hrs/yr @ 100% load (24 hrs/day x 335 days/hr)
LNG Trains A,B,C,&D • Fired Heater	(from AP42, Table 1.4-1) 140 lbs $NO_x/10^6$ SCF 35 lbs $CO/10^6$ SCF 0.06 lbs $VOC/10^6$ SCF 5 lbs $PM/10^6$ SCF	• Max. Heat Input: 14.4 MMBtu/hr • 100% load	• 670 hrs/yr @ 100% load (2 hrs/day x 335 days/hr)
Power Generators • #2 through 6	0.1 lbs NO_x/MMBtu 0.12 lbs CO/MMBtu 0.035 lbs VOC/MMBtu 0.008 lbs PM/MMBtu 0.0008 lbs SO_2/MMBtu	• Max. load: 9,998 kW ea at 10,812 Btu/kW-h (65,198 MW divided equally among 7 turbines)	• Average oprating load: 40,445 kW • 62% average load for 365 days/year

Table D-1 (cont'd)

BASIS FOR EMISSIONS CALCULATIONS

Source Equipment	Basis for Criteria Pollutants (i.e., NO_x, CO, VOC, SO_2, and PM)		
		Operations	
	Emission Factors	Maximum Hourly	Annual Average
Power Generator • #1 and HRSG	(For Turbine see above) for fired Duct Burner: 0.10 lbs NO_x/MMBtu 0.08 lbs CO/MMBtu 0.002 lbs VOC/MMBtu 0.005 lbs PM/MMBtu 0.0007 lbs SO_2/MMBtu	• Max. load 5,430 kW at 11,770 Btu/kW-h • Max. Duct Burner load 71 MMBtu/hr	• Average Turbine load 5,000 kW for 8,760 h/y • Average Duct Burner load 254,900 MMBtu/y
Package Boiler	0.10 lbs NO_x/MMBtu 0.08 lbs CO/MMBtu 0.002 lbs VOC/MMBtu 0.005 lbs PM/MMBtu 0.0007 lbs SO_2/MMBtu	• Max. Heat Input: 0 • Standby only, max case is HRSG at 100% load.	• 122,600 MMBtu/y (8,760 h/y at 10% load)
Boil-Off Compressor Driver (Total of 3 turbines)	0.10 lbs NO_x/MMBtu 0.12 lbs CO/MMBtu 0.035 lbs VOC/MMBtu 0.008 lbs PM/MMBtu 0.0008 lbs SO_2/MMBtu	• Maximum heat input: 55.76 MMBtu/hr @ 7,586 Btu/HP-hr @ 15°F	• Average ea: 192,800 MMBtu/yr. Equivalent to 11,022 operating hours/ year at 6,400 hp and 8,200 Btu/hp-h divided equally among three turbines.
LNG Trains A,B • Dry Flare	(from SCAQMD Form R-6-U) 0.07 lbs NO_x/MMBtu 0.34 lbs CO/MMBtu 0.001 lbs VOC/MMBtu 0.02 lbs PM/MMBtu 0.0007 lbs SO_2/MMBtu	• Pilot Gas Only, 350 lb/h • Feed Gas Average Composite: - 18,900 Btu/lb (Net) - 840 Btu/SCF	• 350 lbs/hr Fuel Gas

Table D-1 (cont'd)

BASIS FOR EMISSIONS CALCULATIONS

Source Equipment	Basis for Criteria Pollutants (i.e., NO_x, CO, VOC, SO_2, and PM)		
	Emission Factors	Operations: Maximum Hourly	Operations: Annual Average
LNG Trains C,D • Dry Flare	(from SCAQMD Form R-6-U) 0.07 lbs NO_x/MMBtu 0.34 lbs CO/MMBtu 0.001 lbs VOC/MMBtu 0.02 lbs PM/MMBtu 0.0007 lbs SO_2/MMBtu	• 350 lb/h Pilot gas only	• 350 lbs/hr Fuel Gas for 8,760 h/y
Marine Flare	(from SCAQMD Form R-6-U) 0.07 lbs NO_x/MMBtu 0.34 lbs CO/MMBtu 0.001 lbs VOC/MMBtu 0.02 lbs PM/MMBtu 0.0007 lbs SO_2/MMBtu	• Fuel Gas firing rate of 100 lbs/hr (pilot only) at 18,800 Btu/lb	• 100 lbs/hr Fuel Gas for 8,760 h/y
Tankers 1, 2	(from SCAQMD, 1981) 20.95 lbs $NO_x/10^3$ gal 0.6 lbs $CO/10^3$ gal 3.1 lbs $VOC/10^3$ gal 7.14 lbs $PM/10^3$ gal 333 lbs $SO_2/10^3$ gal	• Max. hour: Two ships hoteling at 360 gal/h each.	• Average 860,000 gal/y each 269 trips/y 6500 gal/trip hoteling 0.5% fuel

Table D-1 (cont'd)

BASIS FOR EMISSIONS CALCULATIONS

Source Equipment	Basis for Criteria Pollutants (i.e., NO_x, CO, VOC, SO_2, and PM)		
	Emission Factors	Operations	
		Maximum Hourly	Annual Average
Fluidized bed incinerator with water spray scrubber for treatment of biological sludge and non-sludge solids	For biological sludge (AP-42, Table 2.5-1) 4.4 lbs NOx/ton feed 4.0 lbs CO/ton feed 0.44 lbs PM/ton feed 4.0 lbs SO_2/ton feed VOC negligible For non sludge solids (AP-42, Table 2.1-1) 5.0 lbs NOx/ton feed 3.6 lb CO/ton feed 0.74 lb PM/ton feed 1.1 lb SO_2/ton feed VOC negligible	• Actual feed not to exceed 999 lb/hour; assumed breakdown of 25 lb/hour of biological sludge and 974 lb/hour of non-sludge solids.	• 110 ton/year biological sludge and 4,266 ton/year of non-sludge solids

Reference: Halberg (1981).

Table D-2

AIR POLLUTANT EMISSION SOURCES FOR THE ANDERSON BAY FACILITY

	UTM Zone 6, Meters) East	North	Stack Height (meters)	Stack base (m)	Stack Diameter (meters)	Stack Temperature (°K)	Stack Gas Velocity (m/s)	Average NOx Emission Rate (g/sec)	Maximum Hourly Emissions Rate (g/sec) SO_2	PM_{10}	CO
Train A											
Propane refrigerant compressor stack	526074.5	6771543.8	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Low pres. MR refrigerant compressor stack	525995.6	6771553.6	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Med pres. MR refrigerant compressor stack	526018.3	6771550.8	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
High pres. MR refrigerant compressor stack	526047.3	6771547.2	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Flash gas compressor stack	525973.3	6771556.4	38.10	51.42	2.74	733.72	6.78	0.62	0.0052	0.0055	0.843
Drier reactivation heater	526005.0	6771628.2	16.00	51.42	0.91	700.00	5.00	0.02	0.0013	0.0063	0.080
Dry process flare	524465.9	6771409.3	60.96	20.94	2.03	900.00	0.50	0.03	--	0.0065	0.140
Train B											
Propane refrigerant compressor stack	526255.3	6771521.2	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Low pres. MR refrigerant compressor stack	526176.5	6771531.0	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Med pres. MR refrigerant compressor stack	526199.1	6771528.2	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
High pres. MR refrigerant compressor stack	526228.1	6771524.6	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Flash gas compressor stack	526154.1	6771533.8	38.10	51.42	2.74	733.72	6.78	0.62	0.0052	0.0055	0.843
Drier reactivation heater	526185.8	6771605.6	16.00	51.42	0.91	700.00	5.00	0.02	0.0013	0.0063	0.080
Dry process flare	524465.9	6771409.3	60.96	20.94	2.03	900.00	0.50	0.03	--	0.0065	0.140
Train C											
Propane refrigerant compressor stack	526436.7	6771498.5	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Low pres. MR refrigerant compressor stack	526357.9	6771508.3	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Med pres. MR refrigerant compressor stack	526380.5	6771505.5	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
High pres. MR refrigerant compressor stack	526409.5	6771501.9	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Flash gas compressor stack	526335.5	6771511.1	38.10	51.42	2.74	733.72	6.78	0.62	0.0052	0.0055	0.843
Drier reactivation heater	526367.2	6771583.0	16.00	51.42	0.91	700.00	5.00	0.02	0.0013	0.0063	0.080
Dry process flare	524762.2	6771464.1	60.96	5.70	2.03	900.00	0.50	0.03	--	0.0065	0.140
Train D											
Propane refrigerant compressor stack	526618.2	6771475.8	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Low pres. MR refrigerant compressor stack	526539.3	6771485.7	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Med pres. MR refrigerant compressor stack	526561.9	6771482.8	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
High pres. MR refrigerant compressor stack	526591.0	6771479.2	38.10	51.42	3.35	785.94	32.91	4.33	0.0365	0.378	7.37
Flash gas compressor stack	526516.9	6771488.5	38.10	51.42	2.74	733.72	6.78	0.62	0.0052	0.0055	0.843
Drier reactivation heater	526548.6	6771560.3	16.00	51.42	0.91	700.00	5.00	0.02	0.0013	0.0063	0.080
Dry process flare	524762.2	6771464.1	60.96	5.70	2.03	900.00	0.50	0.03	--	0.0065	0.140
Marine flare	524941.3	6771709.1	60.96	36.18	1.07	900.00	7.60	0.01	--	0.0025	0.040
Wet process flare	524941.3	6771709.1	60.96	36.18	0.30	900.00	7.60	0.01	--	0.0025	0.040
LNG tanker, Berth #1	525711.4	6772102.0	38.1	0.00	1.70	450.00	3.00	0.06	3.625	0.28	0.03
LNG tanker, Berth #2	526557.5	6771933.6	38.1	0.00	1.70	450.00	3.00	0.06	3.625	0.28	0.03
Boil off compressor A	525553.8	6771845.1	30.46	20.94	2.74	733.22	6.78	0.62	0.0056	0.0055	0.843
Boil off compressor B	525529.0	6771847.4	30.46	20.94	2.74	733.22	6.78	0.62	0.0056	0.0055	0.843
Boil off compressor C	525513.2	6771848.8	30.46	20.94	2.74	733.22	6.78	0.62	0.0056	0.0055	0.843
Steam boiler	525976.3	6771823.4	38.10	28.56	1.03	450.00	4.00	0.18	--	--	0.141
Incinerator	526066.0	6771818.5	38.10	28.56	1.52	449.83	5.00	0.31	0.0115	0.042	0.233
Gas turbine generator 1, HRSG	525977.6	6771848.7	38.10	28.56	3.05	394.27	6.11	1.28	0.0108	0.112	1.63
Gas turbine generator 2, HRSG	525999.9	6771865.1	38.10	28.56	3.05	733.22	11.36	1.28	0.0108	0.112	1.63
Gas turbine generator 3, HRSG	525982.7	6771904.9	38.10	28.56	3.05	733.22	11.36	1.28	0.0108	0.112	1.63
Gas turbine generator 4, HRSG	526003.3	6771903.0	38.10	28.56	3.05	733.22	11.36	1.28	0.0108	0.112	1.63
Gas turbine generator 5, HRSG	526030.2	6771862.4	38.10	28.56	3.05	733.22	11.36	1.28	0.0108	0.112	1.63
Gas turbine generator 6, HRSG	526033.7	6771900.3	38.10	28.56	3.05	733.22	11.36	1.28	0.0108	0.112	1.63
Gas turbine generator 7, HRSG	526051.1	6771860.5	38.10	28.56	3.05	733.22	11.36	1.28	0.0108	0.112	1.63

Table D-3

ESTIMATED MAXIMUM HOURLY VOC EMISSIONS FOR
THE ANDERSON BAY FACILITY

	UTM Zone 6, (Meters) East	North	Stack Height (meters)	Stack base (m)	Stack Diameter (meters)	Stack Temperature (°K)	Stack Gas Velocity (m/s)	Maximum Hourly VOC Emissions (g/sec)
Train A								
Propane refrigerant compressor stack	526074.5	6771543.8	38.10	51.42	3.35	785.94	32.91	0.829
Low pres. MR Refrigerant compressor stack	525995.6	6771553.6	38.10	51.42	3.35	785.94	32.91	0.829
Med pres. MR refrigerant compressor stack	526018.3	6771550.8	38.10	51.42	3.35	785.94	32.91	0.829
High pres. MR refrigerant compressor stack	526047.3	6771547.2	38.10	51.42	3.35	785.94	32.91	0.829
Flash gas compresor stack	525973.3	6771556.4	38.10	51.42	2.74	733.72	6.78	0.245
Drier reactivation heater	626005.0	6771628.2	16.00	51.42	0.91	700.00	5.00	neg
Dry process flare	524465.9	6771409.3	60.96	20.94	2.03	900.00	0.50	neg
Train B								
Propane refrigerant compressor stack	526255.3	6771521.2	38.10	51.42	3.35	785.94	32.91	0.829
Low pres. MR Refrigerant compressor stack	526176.5	6771531.0	38.10	51.42	3.35	785.94	32.91	0.829
Med pres. MR refrigerant compressor stack	526199.1	6771528.2	38.10	51.42	3.35	785.94	32.91	0.829
High pres. MR refrigerant compressor stack	526228.1	6771524.6	38.10	51.42	3.35	785.94	32.91	0.829
Flash gas compresor stack	526154.1	6771533.8	38.10	51.42	2.74	733.72	6.78	0.245
Drier reactivation heater	526185.8	6771605.6	16.00	51.42	0.91	700.00	5.00	neg
Dry process flare	524465.9	6771409.3	60.96	20.94	2.03	900.00	0.50	neg
Train C								
Propane refrigerant compressor stack	526436.7	6771498.5	38.10	51.42	3.35	785.94	32.91	0.829
Low pres. MR Refrigerant compressor stack	526357.9	6771508.3	38.10	51.42	3.35	785.94	32.91	0.829
Med pres. MR refrigerant compressor stack	526380.5	6771505.5	38.10	51.42	3.35	785.94	32.91	0.829
High pres. MR refrigerant compressor stack	526409.5	6771501.9	38.10	51.42	3.35	785.94	32.91	0.829
Flash gas compresor stack	526335.5	6771511.1	38.10	51.42	2.74	733.72	6.78	0.245
Drier reactivation heater	526367.2	6771583.0	16.00	51.42	0.91	700.00	5.00	neg
Dry process flare	524762.2	6771464.1	60.96	5.70	2.03	900.00	0.50	neg
Train D								
Propane refrigerant compressor stack	526618.2	6771475.8	38.10	51.42	3.35	785.94	32.91	0.829
Low pres. MR Refrigerant compressor stack	526539.3	6771485.7	38.10	51.42	3.35	785.94	32.91	0.829
Med pres. MR refrigerant compressor stack	526561.9	6771482.8	38.10	51.42	3.35	785.94	32.91	0.829
High pres. MR refrigerant compressor stack	526591.0	6771479.2	38.10	51.42	3.35	785.94	32.91	0.829
Flash gas compresor stack	526516.9	6771488.5	38.10	51.42	2.74	733.72	6.78	0.245
Drier reactivation heater	526548.6	6771560.3	16.00	51.42	0.91	700.00	5.00	neg
Dry process flare	524762.2	6771464.1	60.96	5.70	2.03	900.00	0.50	neg
Marine flare	524941.3	6771709.1	60.96	36.18	1.07	900.00	7.60	neg
Wet process flare	524941.3	6771709.1	60.96	36.18	0.30	900.00	7.60	neg

Table D-3 (cont'd)

ESTIMATED MAXIMUM HOURLY VOC EMISSIONS FOR
THE ANDERSON BAY FACILITY

	UTM Zone 6, (Meters) East	North	Stack Height (meters)	Stack base (m)	Stack Diameter (meters)	Stack Temperature (oK)	Stack Gas Velocity (m/s)	Maximum Hourly VOC Emissions (g/sec)
LNG tanker, Berth #1	525711.4	6772102.0	38.10	0.00	1.78	450.00	3.00	0.12
LNG tanker, Berth #2	526557.5	6771933.6	38.10	0.00	1.78	450.00	3.00	0.12
Boil off compressor A	525553.8	6771845.1	30.46	20.94	2.74	733.22	6.78	0.245
Boil off compressor B	525529.0	6771847.4	30.46	20.94	2.74	733.22	6.78	0.245
Boil off compressor C	525513.2	6771848.8	30.46	20.94	2.74	733.22	6.78	0.245
Steam boiler	525976.3	6771823.4	38.10	28.56	1.03	450.00	4.00	0.158
Incinerator	526066.0	6771818.5	38.10	28.56	1.52	449.83	5.00	neg
Gas turbine generator 1, HRSG	525977.6	6771848.7	38.10	28.56	3.05	394.27	6.11	0.477
Gas turbine generator 2, HRSG	525999.9	6771865.1	38.10	28.56	3.05	733.22	11.36	0.477
Gas turbine generator 3, HRSG	525982.7	6771904.9	38.10	28.56	3.05	733.22	11.36	0.477
Gas turbine generator 4, HRSG	526003.3	6771903.0	38.10	28.56	3.05	733.22	11.36	0.477
Gas turbine generator 5, HRSG	526030.0	6771862.4	38.10	28.56	3.05	733.22	11.36	0.477
Gas turbine generator 6, HRSG	526033.7	6771900.3	38.10	28.56	3.05	733.22	11.36	0.477
Gas turbine generator 7, HRSG	526051.1	6771860.5	38.10	28.56	3.05	733.22	11.36	0.477
Leaking Components								0.05

neg = negligibly small emissions

Note: The gas burned and emitted at Anderson by fugitive sources will be almost pure methane, with a VOC content (propane and heavier) of less than 0.08lb/MMBtu, as compared with about 4lb/MMBTU in normal commercial natural gas. Thus emission factors refused to this gas have become adjusted to related the low VOC content.

MAXIMUM NO_X EMISSION RATES ESTIMATION

Turbine horsepower and emission rates vary with temperature. All emissions, other than annual average NO_x, are based on operation of the turbines at 15°F for the entire year regardless of the actual air temperature. This analysis method ensures that pollutant concentrations at 24-hour, 8-hour, 3-hour, and 1-hour averaging periods are not underestimated because the largest potential emission rates are applied over all meteorological conditions encountered during the year.

The annual average NO_2 emission estimates are based on turbine operations at 40°F. The mean annual temperature in Port Valdez per National Weather Service (NWS) data is 38.4°F. Annual average NO_x emissions estimates were calculated on turbine operations at 40°F because the process design for the facility is based on turbine output at this temperature, and because variations in emissions due to the 1.6°F difference in temperature were considered inconsequential for demonstrating air quality compliance. NO_x emissions due to turbine operations at 38.4°F would be approximately 1 percent greater than at 40°F.

Turbine horsepower and emissions data for the turbine drivers on the LNG refrigerant compressors and power generators at 40°F and 15°F were obtained from turbine manufacturers. Because tentative selection of the turbines for the smaller services (e.g., flash gas and boil-off compressors) has not been made, installed horsepower for these turbines was set equal to the output of a known turbine model for which dry low NO_x combustors are available. The emissions for these small turbines were set equal to those of the power generators.

Maximum Turbine Emissions

Turbine emissions for the LNG refrigerant and flash gas turbine/compressors are based on turbine operations at 100 percent of rated horsepower at a temperature of 15°F. Peak emissions from the power generators and boil-off gas compressors also were based on 100 percent of rated capacity at 15°F, although there is no need to use the additional power available from these units at lower temperatures.

It is unlikely that all of the turbine horsepower available at temperatures lower than 15°F will be able to be utilized by the LNG refrigerant compressors. The limits regarding horsepower utilization at low temperature are due to projected limitations of the LNG refrigerant compressors and not the turbines used to drive the compressors.

As temperature decreases, not only is there more turbine horsepower available, but the efficiency of the propane refrigerant system increases, thereby requiring less horsepower per unit of propane circulated. Operating pressures and circulation rates will be adjusted to optimize horsepower within the propane refrigerant system at lower temperatures. Similarly, the mixed refrigerant circulation rate will be adjusted with temperature to utilize available horsepower.

Shifting refrigerant loads changes both the differential pressure across, and the suction volume to, the compressors. The refrigerant condensation duties will vary according to changes in refrigerant system operation. The compressors and condensers cannot be designed to efficiently operate over all potential operating conditions. The process equipment was specified during the preliminary engineering to meet the peak summer LNG market demand at the expense of LNG production capacity during the coldest winter temperatures. The optimum refrigerant compressor and condenser configuration will be determined during the detailed engineering phase of the project.

NWS data for the Valdez Airport show that air temperatures of 15°F or lower occur less than 4.7 percent of the time. It is expected that engineering evaluation will show that it is impractical to design the facility to fully utilize turbine horsepower at temperatures below 15°F due to the low frequency of occurrence. Yukon Pacific considers use of the 15°F temperature to be conservative with regard to air emissions (that is, it overstates air emissions) because it reflects optimum use of refrigerant and flash gas turbine horsepower at unrealistically low temperatures.

Annual Average NO_2 Emissions from the Turbines

Horsepower variation with temperature is an inherent characteristic of all internal combustion engines, not just gas-fired turbines. The issue of emissions variation with temperature is, therefore, not unique to the Anderson Bay facility. Because engine horsepower varies linearly with temperature, modeling annual average emissions based on engine operation at the mean annual temperature is appropriate.

The EPA has raised the theoretical argument that a different annual average NO_2 concentration might be obtained if NO_2 emissions specific to each respective hourly temperature were used instead of applying emissions for the average annual temperature over the entire year. The EPA has recommended that a sensitivity analysis be conducted to evaluate the significance of changes in predicted NO_2 impacts associated with varying ambient temperatures. The EPA commented that without an analysis of the competing influences of the mass emission rates of NO_2, stack release temperature and stack release volume, all of which vary with ambient temperature, it is difficult to determine whether modeling at 40°F ambient conditions is inherently conservative.

The computer code of the EPA approved air quality models would have to be rewritten in order to model hour by hour variations in NO_2 emission rates, stack release temperature, and stack release volume. A simple sensitive analysis can be completed to provide an inherently conservative prediction of NO_2 pollutant concentrations which accounts for the variation in turbine operation with ambient temperature, thus eliminating the need for a comprehensive rewrite of the model code. This sensitive analysis consists of applying the highest pollutant emissions rates (operation at 15°F ambient air temperature) with stack parameters that yield a lower plume rise. Since mixing heights were modeled based upon the plume rise, a lower plume rise should tend to trap pollutants closer to the ground, theoretically resulting in higher predicted concentrations.

The mixing height is set a 1 meter above the calculated plume rise. Mixing height is, among other variables, a function of stack velocity, exhaust temperature, and ambient temperature. The stack velocity from the refrigerant turbines at 15°F is about 1.2 meters per second (4 percent) larger that the stack velocity at 40°F. The turbine exhaust temperature at 15°F turbine operation is about 8.3°K lower than the exhaust temperature at 40°F. Solving for the buoyancy flux of the plume shows that the flux at 40°F (568 m^4s^-3) is less that the flux at 15°F (622 m^4s^-3). Since the flux is lower at 40°F, the resultant plume rise at 40°F will always be lower than at 15°F, regardless of the wind speed and air stability class. Thus, scaling the model results at 40°F to reflect the larger emission rate at 15°F must be inherently conservative.

Annual average NO_2 emissions were modeled by applying turbine emissions at 40°F over the entire year. The NO_2 emissions for the turbines were based on manufacturers' data. The mass rate of NO_2 emissions for the largest turbines (the LNG refrigerant turbines) increases by about 20 percent as air temperature drops from 40°F to 15°F. Since the mass rate of the turbine exhaust varies roughly linearly with temperature, NO_2 emissions at 40°F (25 ppmvd) would be expected to exceed NO_2 emissions at 65°F by about 20 percent.

The largest annual average NO_2 concentration predicted in the supplemental analysis is 18.50 $\mu g/m^3$ (17.95 of which is from the Anderson Bay facility). This value is based on NO_2 emissions at 40°F. The sensitivity analysis that would result in the maximum predicted NO_2 concentration would be a scenario in which NO_2 emissions at 15°F were applied over the entire year. In this scenario the annual average NO_2 concentration would increase by the ratio of NO_2 emissions at 15°F to emissions at 40°F (or approximately 20 percent). The resulting concentration of 22.1 $\mu g/m^3$ is still within the PSD increment. This scenario, of course, clearly overstates the annual average NO_2 concentration since it is based upon overstated emission rates and understated plume rise calculations.

It should be noted that using the emissions rates for the mean annual temperature to model annual NO_2 emissions appears more applicable to the Anderson Bay facility than to other facilities nationwide because of the relatively small variation in air temperature within Port Valdez. Based on 9 years of hourly temperature recordings by the NWS at the Valdez Airport, the temperature in Port Valdez falls between 20°F and 60°F approximately 88 percent of the time.

Operations at 100 Percent of Rated Turbine Horsepower

At the March 15, 1994 Seattle technical meeting, Yukon Pacific was asked to justify the statement that the gas turbines would operate at no more than 100 percent of rated capacity. The underlying premise of this request was that air emissions would increase if the turbines were operated in excess of their rated capacity.

LNG sales revenues would be used to return the investment for the LNG plant and marine terminal at Anderson Bay, plus the gas conditioning plant on the North Slope, the pipeline itself, and the LNG tanker fleet. LNG production would drop by 25 percent if any one of the 16 LNG refrigerant turbine/compressors at the LNG facility is off line. It is imperative, therefore, that the turbine drivers be operated to obtain the maximum horsepower (i.e., LNG production) over time.

Operating a turbine above the rated capacity (overfiring) increases adverse thermal impacts on the metal components downstream of the combustors. Overfiring reduces the on-line time of the turbine by decreasing the interval between inspections and overhauls. Underfiring underutilizes the available horsepower, but extends the maintenance intervals.

The 100 percent turbine rating is the operating point at which the turbine manufacturer believes the turbine will achieve the optimum amount of on-line horsepower considering output and maintenance downtime. If this optimum operating point were at a different horsepower, the 100 percent rating would be set accordingly.

The turbine drivers, therefore, would be operated at, but no more than, 100 percent of rated capacity at any given temperature in order to maximize project revenues.

Turbine On-line Factor Used in Average Annual Emissions

Since spare capacity would be available for the power generation and boil-off gas compressors, the on-line time is based on operation for 365 days per year and does not include any outage for scheduled or unscheduled maintenance.

The on-line times for the LNG refrigerant and flash gas compressors are identical and reflect both the projected scheduled maintenance and unscheduled outages.

Scheduled maintenance is based on one train down for 1 month every other year. This amount of downtime is typical of other LNG baseload facilities. With four trains, this equates to 15 days of system downtime per year.

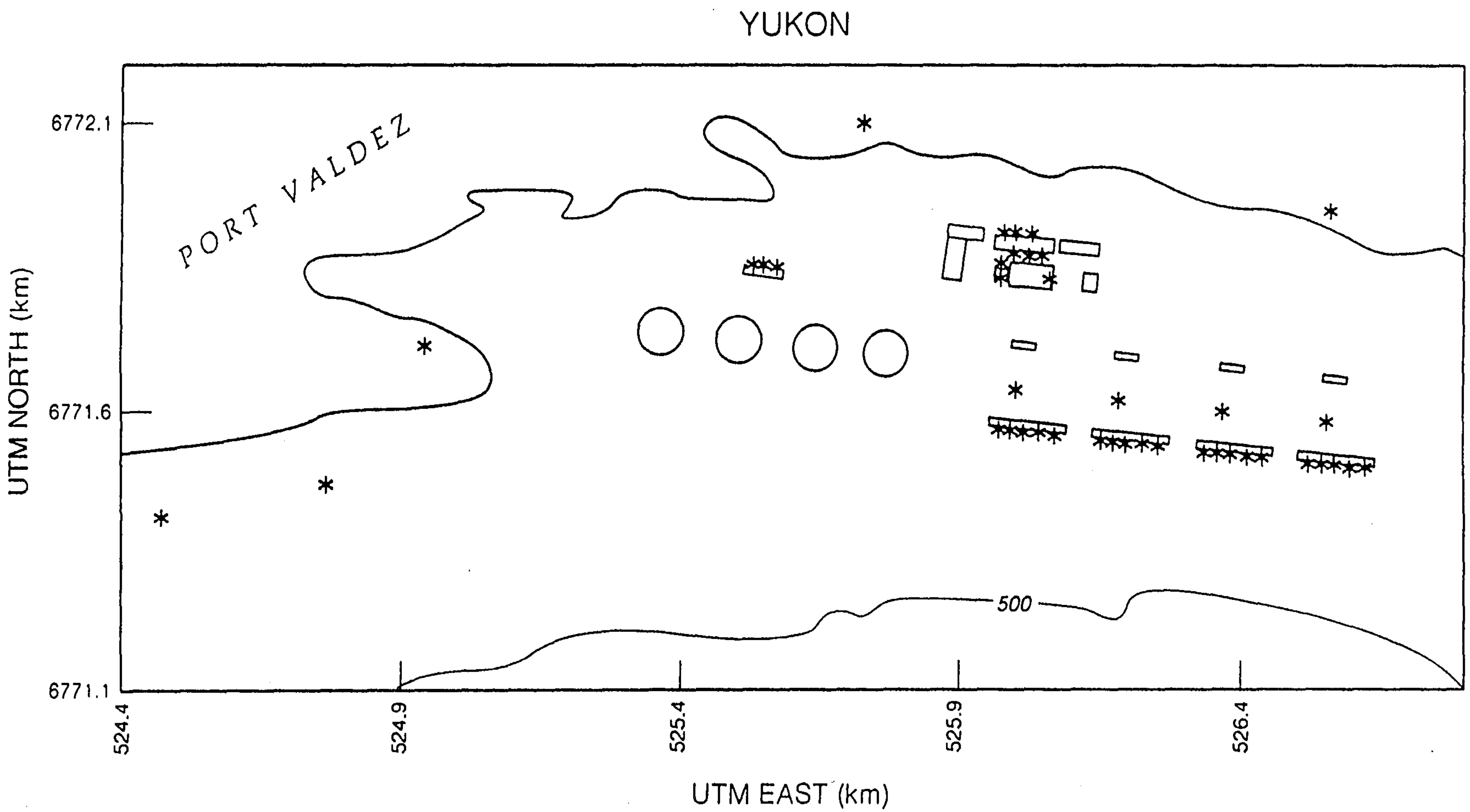
Unscheduled maintenance is set at 15 days of downtime per year. This downtime is an estimate of the cumulative impacts of downtime experienced at the gas conditioning plant on the North Slope, the pipeline compressor stations, the Anderson Bay liquefaction plant, and delays in LNG tanker operations.

The on-line factor for the liquefaction trains is 335 days per year.

Table D-4

COARSE GRID SCREENING MODEL RESULTS
(1-HOUR AVERAGES)

			Location (UTM)		
Pollutnat	Model	Maximum Concntration	East (m)	North (m)	Elevation (m)
NO_2	ISCST2	78.71	524800	6771800	1.52
	BEESTX	701.05	528200	6771000	228.60
PM	ISCST2	13.87	528200	6771500	54.86
	BEESTX	63.01	528200	6771000	228.60
SO_2	ISCST2	179.38	528200	6771500	54.86
	BEESTX	178.93	528200	6771500	54.86
CO	ISCST2	133.74	524800	6771800	1.52
	BEESTX	1,150.13	528200	6771000	228.6



Locations of the YPC Pollutant Source Stacks and the Structures

FIGURE

D-2

Table D-5

SCREENING MODELING RESULTS FOR
YUKON PACIFIC SOURCES ONLY

Pollutant	Averaging Time	Maximum Predicted Concentration ($\mu g/m^3$)	UTMX Coordinate of Maximum (m)*	UTMY Coordinate of Maximum (m)*	Elevation of Maximum (m)*
NO_2	1-hour	701.05	528200	6771000	228.60
	Annual**	42.06***			
PM****	1-hour	63.01	528200	6771000	228.60
	24-hour	15.75			
	Annual	5.04			
CO	1-hour	1150.13	528200	6771000	228.60
	8-hour	805.09			
SO_2	1-hour	189.14	528300	6771450	91.44
	3-hour	170.23			
	24-hour	75.66			
	Annual	15.13			

Notes:

* All screening modeling calulations are for a 1-hour averaging period, with multiple-hour averages determined by scaling the hourly values. Thus, locations and elevations of predicted maxima for a given pollutant are the same for all averaging times

** For the annual average concentration calculation for NO_2, a ratio of 0.75 was applied to the modeled NO_x calculation.

*** Predicted concentration exceeds Class II PSD increment

**** All project PM emissions are assumed to occur as PM_{10}

Table D-6

SCREENING MODELING RESULTS FOR COMBINED YUKON PACIFIC AND BACKGROUND CONTRBUTIONS

Pollutant	Averaging Time	Anderson Bay Contribution ($\mu g/m^3$)	Background Contribution ($\mu g/m^3$)*	Total Concentration ($\mu g/m^3$)
NO_2	Mean**	42.06	27	69.06
PM	24-hour	15.75	100	115.75
	Mean**	5.04	33.5	38.54
CO	1-hour	1150.1	7680	8830.1
	8-hour	805.1	4524	5329.1
SO_2	3-hour	170.2	327	497.2
	24-hour	75.7	81	156.7
	Mean**	15.1	16	31.1

Notes:

* Background concentrations shown in this table are the highest values recorded at any station by the Valdez Air Monitoring System from October 1, 1990 through March 31, 1993

** Reported background value is actually the highest of 10 quarterly averages, rather than an annual average. PM_{10} background value is the highest measured concentration excluding to wind storm events.

Table D-7

Maximum Measured Hourly Ozone Concentrations (ppm) and the Associated Monitoring Dates by Calendar Quarter During Operation of the Valdez Air Monitoring System

Quarter/Year	East Gate Station	West Terminal Station	High School Station	Old Valdez Station
4/1990	0.048 11/3	0.035 11/3	0.035 10/3	0.039 12/17
1/1991	0.056 3/28	0.039 3/2	0.058 3/2	0.043 2/7
2/1991	0.057 4/5	0.047 5/13	0.031 6/17	0.048 5/3
3/1991	0.040 9/26	0.042 9/25	0.030 7/15	0.033 7/16
4/1991	0.029 12/20	0.045 12/20	0.044 10/20	NA
1/1992	0.049 3/17	0.062 2/15	0.049 3/27	NA
2/1992	0.062 4/22	0.059 4/5	0.063 5/23	NA
3/1992	NV	NV	0.046 7/1	NA
4/1992	0.041 11/13	NV	0.042 12/25	NA
1/1993	0.038 1/2	0.041 1/2	NV	NA

NV valid data not collected for this period
NA station discontinued

Table D-8

TIMES AND METEOROLOGICAL MEASUREMENTS CORRESPONDING TO MAXIMUM HOURLY OZONE CONCENTRATIONS DURING THE VAMS MONITORING PROGRAM

Quarter	Station	Month/ Day/Hour	Maximum O_3 Conc. (ppm)	Wind Direction (Degrees)	Wind Speed (mph)	Temperature (Degrees F)	Vertical Temp. Difference (Degrees F)
1/1991	East Gate	3/28/16	0.056	99	3.4	38.8	0.4
	West Terminal	3/2/14	0.039	202	3.3	37.2	1.9
	High School	3/2/9	0.056	87	9.8	37.6	0.8
	Old Valdez	2/7/12	0.043	n/a	1.4	17.8	-1.5
2/1991	East Gate	4/5/17	0.057	207	4.5	41.2	1.2
		4/5/18	0.057	208	4.2	39.4	1.9
	West Terminal	5/13/14	0.047	153	2.8	47	-0.4
	High School	6/17/15	0.031	266	6.8	53.8	-2.1
		6/17/18	0.031	275	6.3	53	-1.8
	Old Valdez	5/3/17	0.048	56	0.9	40.7	0.0
3/1991	East Gate	9/26/11	0.040	71	1.1	47.9	n/a
	West Terminal	9/25/22	0.042	85	7.3	45.1	0.2
	High School	7/15/11	0.03	262	3.6	63	-3.0
		7/15/16	0.03	274	12.3	65.5	-2.4
		7/15/17	0.03	278	10.2	63.1	-1.8
	Old Valdez	7/16/18	0.033	251	2.8	51.7	-1.6
4/1991	East Gate	12/20/13	0.029	122	3.3	33.9	0.5
		12/20/14	0.029	112	3.9	33	0.9
		12/20/19	0.029	118	5.7	32.3	0.5
		12/20/20	0.029	119	4.8	32.5	0.6
		12/20/21	0.029	106	4.2	31.9	0.9
		12/20/22	0.029	120	3.6	30.8	1.0
	West Terminal	12/20/17	0.045	93	11.1	30.2	0.7
	High School	10/20/11	0.044	140	3.4	45.8	0.2
1/1992	East Gate	3/17/11	0.049	121	3.6	38.5	2.7
		3/17/12	0.049	125	4	39.5	2.4
	West Terminal	2/15/17	0.062	89	19.7	24	2.4
	High School	3/27/19	0.049	326	5.7	37.4	-1.8
2/1992	East Gate	4/22/16	0.062	202	4.2	45.1	0.2
	West Terminal	4/5/12	0.059	n/a	n/a	n/a	n/a
	High School	5/23/13	0.063	307	5.8	56.3	-2.4
3/1992	High School	7/1/13	0.046	284	4.9	72.8	-3.4
4/1992	East Gate	11/13/23	0.041	67	7.6	37	0.2
		11/13/24	0.041	83	5.1	31.7	0.0
	High School	12/25/24	0.042	128	1.6	29.7	0.4
1/1993	East Gate	1/2/17	0.038	58	15.7	31.1	0.5
		1/2/20	0.038	59	12.4	30	0.5
		1/2/21	0.038	23	6.0	29.2	0.6
		1/2/23	0.038	122	1.8	27.4	1.0
		1/2/24	0.038	87	3.4	28.0	0.8
	High School	1/2/23	0.041	151	5.2	28	0.4

ATTACHMENT I

SUPPLEMENTAL MODELING ANALYSES

V SEATTLE MARCH 15, 1994, TECHNICAL MEETING TASKS

On March 15, 1994, FERC, EPA, ADEC, and YPC held a technical meeting in Seattle to address the issues raised by the three FERC and EPA letters. In addition to individually addressing most of the technical issues contained in the three agency letters, understandings were reached as to what steps YPC and the agencies would take to resolve the outstanding DEIS issues and allow FERC to finalize the EIS, as well as to give EPA the assurances it needs that air quality issues will be addressed in the proper manner before project development occurs. A summary of those understandings can be found in the two letters in Appendix A.

In brief, it was understood at the Seattle technical meeting that YPC would submit to FERC, by May 2, 1994, this DEIS Issues Resolution Document that addresses, on an issue-by-issue basis, the concerns raised in the three agency letters. In addition, there were three specific tasks YPC was to perform relating to air quality screening analyses and discussions. Each of these three tasks is described below, and the results of the analyses are discussed.

A. *Conduct an EPA-Approved Screening Analysis of Criteria Pollutants from the Anderson Bay Facility and Assess the Results*

It is EPA's position that until data from a new Anderson Bay meteorological station at the location of the proposed LNG trains have been collected, the only air quality modeling analysis that can be conducted in conformance with EPA modeling guidelines is a screening analysis using hypothetical meteorological input data. Approved screening methods use very conservative assumptions (i.e., assumptions designed to ensure that errors in the predicted concentrations will be in the direction of over prediction) to provide rough estimates of the maximum pollutant concentrations that may result from a proposed source's emissions.

As requested by EPA, screening modeling was performed for both operational and construction emissions from the Anderson Bay facility by Ogden Environmental and Energy Services Company. A detailed description of these modeling processes and results is contained in Appendix F of this document.

1. Operational emissions

The results of the screening modeling for operational emissions showed that even with the extremely conservative assumptions used in the model calculations, the maximum predicted concentrations from the Anderson Bay facility for particulate matter (PM), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO) are all well below the applicable National Ambient Air Quality Standards (NAAQS). The predicted PM and SO_2 levels also are below the associated Class II PSD increments (CO has no PSD increment).

For NO_2, however, the screening results showed that while the total concentrations, including background, were below the NAAQS, the incremental contribution of Anderson Bay sources will be higher than their respective PSD increments. Based on these results, supplemental analyses were conducted. A detailed description of the supplemental modeling processes and the modeling results can be found in appendices G and H.

Because of the inherently conservative nature of screening models, the fact that pollutant concentrations predicted using the screening model exceed regulatory thresholds means only that the screening model cannot be used to demonstrate compliance, and that more rigorous air quality models must be used; it does not mean that the facility will actually cause exceedance of these thresholds

2. Construction emissions

The results of the screening modeling for construction emissions showed that high local concentrations of PM_{10} could occur with light wind and stable atmospheric conditions. The predicted maximum concentration of PM was 1,328 $\mu g/m^3$, which is well above the 150 ug/m^3 24-hour NAAQS for this pollutant.

The fact that the screening analysis produced this result should by no means be interpreted as proof that exceedances of the applicable PM_{10} standard will actually occur. The standard methods for estimating dust emissions due to construction are derived from data collected in areas that are markedly different from the conditions that exist at Anderson Bay, and would be expected to greatly overestimate these construction emissions. Furthermore, the experience gained in constructing the nearby Alyeska Marine Terminal showed that visible dust was seldom, if ever, created.

For purposes of the EIS, however, it is concluded that PM_{10} concentrations in excess of applicable standards may occur temporarily during construction periods of heavy earth moving if mitigation methods are not employed. If this result occurs in practice or is supported by more realistic modeling with site-specific meteorological data and emission factors that better reflect the actual climate and soils of the project area, YPC will apply mitigation measures as required to abate dust emissions to acceptable levels. Examples of possible measures that could be adopted include additional use of water or soil surfactants, appropriate, on-site monitoring of particulate concentrations during construction, and phasing of the construction work to minimize the simultaneous occurrence of dust-producing activities.

3. Qualitative assessment of ozone impacts

The proposed YPC project will include a number of gas combustion units, and will thus be a source of both nitrogen oxides (NOx) and volatile organic compounds (VOC). Both NO_x and VOC participate in atmospheric reactions that produce ozone, another pollutant regulated under the NAAQS. While fugitive emissions of VOCs also will occur due to leaks from valves, flanges, pump seals, storage tanks, and tanker loading operations, the gas received at Anderson Bay will be primarily in the form of methane and ethane, with only small amounts of the reactive compounds that are involved in ozone formation. This section discusses the potential effects of the Anderson Bay project's operations on ambient ozone levels in the Valdez area.

There are presently no approved mathematical models that adequately evaluate the effects of individual project emissions on ambient ozone concentrations. Furthermore, application of regional numerical grid models, such as AIRSHED, would require extensive data on the three-dimensional fields of meteorological and air chemistry variables throughout the airshed - data that are not presently available for Valdez and its environs. Given these circumstances, and the fact that the highest ozone concentrations recorded in the Valdez area are well below the NAAQS, EPA Region 10 has agreed that ozone modeling for the YPC project is not required. However, as described in the remainder of this section, there is adequate information available to support a conclusion regarding continued maintenance of acceptable ozone air quality in the Valdez area with the addition of the proposed Anderson Bay project.

Existing ozone air quality at Valdez

The Valdez Air Monitoring System (VAMS), operated by CH2M Hill for Alyeska Pipeline Service Company (Alyeska), provides the best available information regarding recent air quality in the Valdez area. During the period from October 1, 1990, to March 3, 1993, this program collected meteorological and air pollutant concentration data at a network of seven monitoring stations shown in Figure F-5 of Appendix F Pollutants monitored were CO, NO_2, SO_2, PM_{10}, and ozone (O_3). Ozone was recorded for the entire period at the East Gate, West Terminal, and High School stations, and during the first year at the Old Valdez station.

Table V-1 shows the maximum measured one-hour ozone concentrations at each of the four VAMS pollutant monitoring stations for each calendar quarter. During the two and one-half year monitoring program, the highest hourly average O_3 concentration recorded at any station was 0.063 parts per million (ppm), i.e., just over half the NAAQS. The highest hourly concentrations for most quarters were only about one-third of the NAAQS. It is interesting that the highest values at all stations occurred during the first and second calendar quarters, a result that is completely contrary to the patterns of ozone pollution observed in the areas where anthropogenic sources of precursors are responsible for ozone pollution. This may be an indication that natural sources and/or incursion of stratospheric ozone contribute to the maximum concentrations in the Valdez area. EPA has estimated that the concentration of naturally occurring ozone at sea level in the unpolluted atmosphere of the U.S. is in the range of 20 to 35 parts per billion (ppb), or .020 to .035 ppm, i.e., only marginally lower than the highest hourly values recorded during most quarters monitored in Valdez. Apparently, the conditions required to convert precursor emissions to ozone in high concentrations are inhibited to some extent in the Valdez area.

Other Valdez area sources

Table V-2 lists the principal sources of ozone precursor emissions in the Valdez area, and indicated their permitted or estimated emissions. The Anderson Bay facility will be the largest

Table V-1

Maximum Measured Hourly Ozone Concentrations (ppm) and the Associated Monitoring Dates by Calendar Quarter During Operation of the Valdez Air Monitoring System

Quarter/Year	East Gate Station	West Terminal Station	High School Station	Old Valdez Station
4/1990	0.048 11/3	0.035 11/3	0.035 10/3	0.039 12/17
1/1991	0.056 3/28	0.039 3/2	0.058 3/2	0.043 2/7
2/1991	0.057 4/5	0.047 5/13	0.031 6/17	0.048 5/3
3/1991	0.040 9/26	0.042 9/25	0.030 7/15	0.033 7/16
4/1991	0.029 12/20	0.045 12/20	0.044 10/20	NA
1/1992	0.049 3/17	0.062 2/15	0.049 3/27	NA
2/1992	0.062 4/22	0.059 4/5	0.063 5/23	NA
3/1992	NV	NV	0.046 7/1	NA
4/1992	0.041 11/13	NV	0.042 12/25	NA
1/1993	0.038 1/2	0.041 1/2	NV	NA

NV valid data not collected for this period
NA station discontinued

Table V-2

MAJOR SOURCES OF OZONE PRECURSOR EMISSIONS (TONS PER YEAR) IN THE VALDEZ AIR BASIN, INCLUDING THE PROPOSED ANDERSON BAY PROJECT

Pollutant	Alyeska Marine Terminal[a]	Petro Star Refinery[a]	Other Valdez Sources[b]	Proposed Anderson Bay Facility[c]	Total
NO_X	1,752	70	13	2,528	4,363
VOC	57,296[d]	70	179	374	57,919

[a] Permitted emissions
[b] Estimated by scaling from area source emissions from the South Coast Air Basin on the basis of population
[c] Estimated emissions
[d] VOC emissions from tanker filling operations are 56,110 tpy

NO_x source in the airshed. The Alyeska Marine Terminal a few miles east of Anderson Bay, on the south shore of Port Valdez, has emitted substantial quantities of reactive hydrocarbons for many years, primarily during uncontrolled crude oil tanker loading operations. These emissions, however, have lessened over the last several years as the throughput of that facility has decreased because of the depletion of the Prudhoe Bay Oil Field. The Petro Star Refinery began operation in approximately 1993 at the eastern end of Port Valdez and therefore is considered to be increment consuming. This petroleum refinery is permitted by ADEC to emit combustion and process pollutants from a variety of sources.

The population of Valdez is only approximately 4,300, and the precursor emissions associated with space heating, motor vehicle transportation, and other local businesses are far smaller than those in locations where problems with ozone air quality compliance are experienced. Because no data on these emissions are currently available, a rough estimate was obtained by scaling from area source emissions (1987) in the South Coast Air Basin, based on population ratios. While not rigorous, this approach provides a general idea of the magnitude of nonpoint emissions. The Valdez area is heavily forested and some resulting natural VOC emissions undoubtedly occur, although the means to estimate these emissions are lacking.

Unlike some rural areas where high ozone concentrations are recorded, Valdez is not located downwind of any major urban or industrialized area. Thus, there is little opportunity for incoming transport of significant ozone or precursor concentrations to the area.

Meteorological conditions

The Valdez area is notably lacking in some of the most important meteorological conditions that have been related to high ozone levels in urban and rural areas in the lower forty-eight states. In terms of temperature, the annual average mean value at the Valdez NWS station is only 38°F. The average daily maximum temperature at Valdez over the full year is 43.5°F, and the warmest month (July) has an average daily maximum temperature of only about 61°F. A definite link between temperature and maximum ozone concentrations in both urban and rural areas has been established by a number of researchers, with higher values occurring in conjunction with higher temperatures.

Solar radiation is another important meteorological factor in ozone formation, and incoming radiation is severely limited in Valdez. Cloud cover during daylight hours averages 77 percent and the climatological summary prepared for Valdez by the National Oceanic and Atmospheric Administration classifies 259 days per year as cloudy, 40 days as partly cloudy, and only 66 days as clear. At least 0.01 inches of precipitation fall in Valdez on more than half of the days during an average year, and the annual total precipitation (water equivalent) averages almost 68 inches. At least 2 inches of this total occurs in every month of the year.

Table V-3 provides information on all the times and meteorological conditions that accompanied the highest ozone concentrations at the VAMS stations. Attempts to discern a clear pattern in

Table V-3

TIMES AND METEOROLOGICAL MEASUREMENTS CORRESPONDING TO MAXIMUM HOURLY OZONE CONCENTRATIONS DURING THE VAMS MONITORING PROGRAM

Quarter	Station	Month/ Day/Hour	Maximum O_3 Conc. (ppm)	Wind Direction (Degrees)	Wind Speed (mph)	Temperature (Degrees F)	Vertical Temp. Difference (Degrees F)
1/1991	East Gate	3/28/16	0.056	99	3.4	38.8	0.4
	West Terminal	3/2/14	0.039	202	3.3	37.2	1.9
	High School	3/2/9	0.056	87	9.8	37.6	0.8
	Old Valdez	2/7/12	0.043	n/a	1.4	17.8	-1.5
2/1991	East Gate	4/5/17	0.057	207	4.5	41.2	1.2
		4/5/18	0.057	208	4.2	39.4	1.9
	West Terminal	5/13/14	0.047	153	2.8	47	-0.4
	High School	6/17/15	0.031	266	6.8	53.8	-2.1
		6/17/18	0.031	275	6.3	53	-1.8
	Old Valdez	5/3/17	0.048	56	0.9	40.7	0.0
3/1991	East Gate	9/26/11	0.040	71	1.1	47.9	n/a
	West Terminal	9/25/22	0.042	85	7.3	45.1	0.2
	High School	7/15/11	0.03	262	3.6	63	-3.0
		7/15/16	0.03	274	12.3	65.5	-2.4
		7/15/17	0.03	278	10.2	63.1	-1.8
	Old Valdez	7/16/18	0.033	251	2.8	51.7	-1.6
4/1991	East Gate	12/20/13	0.029	122	3.3	33.9	0.5
		12/20/14	0.029	112	3.9	33	0.9
		12/20/19	0.029	118	5.7	32.3	0.5
		12/20/20	0.029	119	4.8	32.5	0.6
		12/20/21	0.029	106	4.2	31.9	0.9
		12/20/22	0.029	120	3.6	30.8	1.0
	West Terminal	12/20/17	0.045	93	11.1	30.2	0.7
	High School	10/20/11	0.044	140	3.4	45.8	0.2
1/1992	East Gate	3/17/11	0.049	121	3.6	38.5	2.7
		3/17/12	0.049	125	4	39.5	2.4
	West Terminal	2/15/17	0.062	89	19.7	24	2.4
	High School	3/27/19	0.049	326	5.7	37.4	-1.8
2/1992	East Gate	4/22/16	0.062	202	4.2	45.1	0.2
	West Terminal	4/5/12	0.059	n/a	n/a	n/a	n/a
	High School	5/23/13	0.063	307	5.8	56.3	-2.4
3/1992	High School	7/1/13	0.046	284	4.9	72.8	-3.4
4/1992	East Gate	11/13/23	0.041	67	7.6	37	0.2
		11/13/24	0.041	83	5.1	31.7	0.0
	High School	12/25/24	0.042	128	1.6	29.7	0.4
1/1993	East Gate	1/2/17	0.038	58	15.7	31.1	0.5
		1/2/20	0.038	59	12.4	30	0.5
		1/2/21	0.038	23	6.0	29.2	0.6
		1/2/23	0.038	122	1.8	27.4	1.0
		1/2/24	0.038	87	3.4	28.0	0.8
	High School	1/2/23	0.041	151	5.2	28	0.4

these data or to relate the highest ozone values to specific factors were largely unsuccessful, perhaps due in part to the fact that the range of observed concentrations was so narrow. In general, peak concentrations tended to occur at or near the same times for the stations on the north side of the Port of Valdez (High School and Old Valdez), and for the stations near the Alyeska terminal (East Gate and West Terminal). Some general observations regarding these data are offered below:

- Maximum ozone levels can apparently occur at any time of day, except early morning. However, more quarterly peaks were seen in the afternoon hours than in other parts of the day.

- For stations on the north side of the Port of Valdez, the highest ozone concentrations were more likely to occur on the warmer days of a given quarter than the maxima on the southern side of the port.

- A wide range of wind speeds accompanied the peak quarterly ozone levels at the different stations, but interestingly, the highest concentration recorded at the West Terminal site occurred with a 19 mph wind from the east.

- The vertical temperature difference measured on the VAMS meteorological tower tended to be negative (i.e., temperature decrease with height, as with neutral or unstable stability) when the peak concentrations occurred on the north side, and positive (temperature increase with height, as with stable conditions) when maximum concentrations on the south side occurred.

- Peak ozone levels on the south side of the port recorded almost all their quarterly peaks when the wind directions was from the east or southeast; westerly flow was usually observed during the highest concentrations on the north side.

While interesting, these characteristic of the highest ozone periods are not easily relatable to particular synoptic weather situations or local physical effects.

Summary

Given the above conditions, it is not surprising that Valdez experiences some of the lowest ozone concentrations recorded in the US, despite fairly substantial local anthropogenic and natural precursor emission sources. Concern has been expressed by regulatory agencies that the light winds and surrounding high terrain may constrict airflow in the area and promote stagnation conditions that could lead to elevated ozone levels. However, while light winds are definitely a characteristic of the area, the lack of any measured concentrations more than half the ozone NAAQS demonstrates that conditions in Valdez do not favor ozone formation. The general coolness of the area and the severely limited supply of sunlight are the most likely factors suppressing production of this pollutant.

B. *Present Supplementary Analyses and Provide a Qualitative Discussion That Shows That Actual Pollutant Concentrations Would be Expected to be Less Than the Increment and NAAQS.*

By their very nature, the screening methods summarized above in Section V.A.1., and described in detail in Appendix F, lead to impacts that are larger than would be expected to occur. Because EPA recognizes that supplemental analyses using other available data can provide important information for EIS purposes, YPC conducted such supplemental modeling analyses.

Two meteorological data sets captured in the vicinity of the Anderson Bay facility were used for supplemental modeling analyses. The first was from YPC's 10-meter tower at Met Cove in Anderson Bay which is approximately 2,000 feet from the proposed location of the LNG processing trains that will be the facility's primary emissions source. The second data set was from Alyeska's 30-meter Jackson Point tower maintained as part of the VAMS. Detailed discussions of the modeling processes and results using these data sets are contained in Appendices G and H, respectively. These results are summarized below.

1. Anderson Bay 10-meter data supplemental analysis

Tables V-4 and V-5 show the results of the Anderson Bay 10-meter data dispersion modeling for PSD increment and NAAQS, respectively. For the three pollutants, compliance with all PSD increments and NAAQS is predicted.

For the PSD increments (Table V-4), total consumption was below 50 percent of the increment with one exception. Only annual NO_2 exceeded 50 percent of the increment (54.52 percent). These results include the contributions of other pollutant sources. Without exception, these other increment consuming sources contributed negligibly to the total concentrations.

For the NAAQS (Table V-5), total concentrations were below 41 percent of NAAQS for SO_2 and NO_2 for all averaging periods. For PM, total concentrations for 24-hour and annual were 74 and 70 percent, respectively. These results include contributions of background sources. Without exception, the background sources contributed at least double the pollution concentrations than did the proposed Anderson Bay facility.

2. Jackson Point 30-meter data supplemental analysis

Tables V-6 and V-7 show the results of Jackson Point 30-meter data dispersion modeling for PSD increment and NAAQS, respectively. For the three pollutants, compliance with all NAAQS and increments is predicted.

Results of the modeling using Jackson Point 30-meter data predict that several pollutants will exist in concentrations greater than 50 percent of the PSD increment. PM concentrations are predicted to be near or below 50 percent. Mitigation measures that can reduce SO_2 and NO_2 concentrations are discussed in Section V.C. of this document. The modeling results included

TABLE V-4

PREDICTED MAXIMUM PSD INCREMENT CONSUMPTION DUE TO THE PROPOSED ANDERSON BAY PROJECT AND OTHER SOURCES IN THE VALDEZ AREA (10 METER ANDERSON BAY METEOROLOGICAL DATA)

Pollutant	Averaging Period	Yukon Pacific Contribution (µg/m3)	Contribution of Other Sources (µg/m3)	Total Increment Consumed (µg/m3)	Class II Increment (µg/m3)	% of Increment Consumed	Location of Maximum (UTM) East (m)	Location of Maximum (UTM) North (m)	Location of Maximum (UTM) Elevation (m)	Mo/day/hour of Maximum
SO_2	3-hour	100.69	0.00	100.69	512	19.67	527200	6771750	0.00	05/25/15
	24-hour	36.10	0.23	36.33	91	39.92	524250	6776500	70.10	11/11/24
	Annual	5.48	0.16	5.64	20	28.20	524300	6776500	60.96	N/A
PM	24-hour	11.46	0.02	11.48	37	31.03	524050	6776750	245.36	11/11/24
	Annual	1.66	0.02	1.68	19	8.84	523950	6776700	237.74	N/A
NO_2	Annual	13.29	0.34	13.63	25	54.52	523900	6776700	243.84	N/A

TABLE V-5

PREDICTED MAXIMUM POLLUTANT CONCENTRATIONS DURING OPERATION OF PROPOSED ANDERSON BAY FACILITIES (10 METER ANDERSON BAY METEOROLOGICAL DATA)

Pollutant	Averaging Period	YPC Contribution (µg/m3)	Contribution of Back-ground (µg/m3)	Toal Concentration (µg/m3)	NAAQS (µg/m3)	Location of Maximum (UTM) East (m)	Location of Maximum (UTM) North (m)	Location of Maximum (UTM) Elevation (m)	Mo/day/hour of Maximum
SO_2	3-hour	100.69	327	427.69	1,300	527200	6771750	0.00	05/25/15
	24-hour	36.33	81	117.33	365	524250	6776500	70.10	11/11/24
	Annual	5.64	16	21.64	80	524300	6776500	60.96	N/A
PM	24-hour	11.48	100	111.48	150	524050	6776750	245.36	11/11/24
	Annual	1.68	33.5	35.18	50	523950	6776700	237.74	N/A
NO_2	Annual	13.63	27	40.63	100	523900	6776700	243.84	N/A

TABLE V-6

PREDICTED MAXIMUM PSD INCREMENT CONSUMPTION DUE TO THE PROPOSED ANDERSON BAY PROJECT AND OTHER SOURCES IN THE VALDEZ AREA (30 METER JACKSON POINT METEOROLOGICAL DATA)

Pollutant	Averaging Period	Yukon Pacific Contribution (µg/m3)	Contribution of Other Sources (µg/m3)	Total Increment Consumed (µg/m3)	Class II Increment (µg/m3)	% of Increment Consumed	Location of Maximum (UTM) East (m)	North (m)	Elevation (m)	Mo/day/hour of Maximum
SO_2	3-hour	218.91	0.00	218.91	512	42.76	528250	6771450	91.44	04/04/24
	24-hour	54.09	3.45	57.54	91	63.23	522150	6771900	60.96	01/11/24
	Annual	10.15	0.45	10.60	20	53.00	522150	6771900	60.96	N/A
PM	24-hour	20.24	0.12	20.36	37	55.03	522200	6771000	274.32	01/11/24
	Annual	2.23	0.02	2.25	19	11.84	522150	6771000	274.32	N/A
NO_2	Annual	17.95	0.55	18.50	25	74.00	522200	6771000	274.32	N/A

TABLE V-7

PREDICTED MAXIMUM POLLUTANT CONCENTRATIONS DURING OPERATION OF PROPOSED ANDERSON BAY FACILITIES (30 METER JACKSON POINT METEOROLOGICAL DATA)

Pollutant	Averaging Period	YPC Contribution (μg/m3)	Contribution of Back-ground (μg/m3)	Toal Concentration (μg/m3)	NAAQS (μg/m3)	Location of Maximum (UTM) East (m)	Location of Maximum (UTM) North (m)	Location of Maximum (UTM) Elevation (m)	Mo/day/hour of Maximum
SO_2	3-hour	218.91	327	545.91	1,300	528250	6771450	91.44	04/04/24
	24-hour	57.54	81	138.54	365	522150	6771900	60.96	01/11/24
	Annual	10.60	16	26.6	80	522150	6771900	60.96	N/A
PM	24-hour	20.36	100	120.36	150	522200	6771000	274.32	01/11/24
	Annual	2.25	33.5	35.75	50	522150	6771000	274.32	N/A
NO_2	Annual	18.50	27	45.50	100	522200	6771000	274.32	N/A

the contributions of other pollutant sources. In the same manner as the modeling results using the Anderson Bay 10-meter data, without exception these other increment consuming sources contributed negligibly to the total concentrations.

For the NAAQS, total concentrations for SO_2 and NO_2 averaging periods ranged from 33 to 46 percent of the corresponding NAAQS. For PM, total concentrations for 24-hour and annual were 80 and 71 percent, respectively. These results included contributions of background sources, and it is the background sources that accounted for the large majority of total PM concentrations. That is, of total 24-hour and annual PM concentrations, background sources accounted for 83 and 94 percent, respectively. This result occurs because the values used for the background PM concentrations were quite conservative, reflecting higher than usual (though not the highest) natural wind events in Port Valdez that carry dust from the Lowe River and airport areas.

3. Summary

The supplemental modeling analyses using the Anderson Bay 10-meter and Jackson Point 30-meter meteorological data predict compliance with all applicable standards and increments. From an EIS perspective, therefore, these supplemental analyses predict that the Anderson Bay facility can be built and operated within the NAAQS and PSD increments. Data from the new meteorological station at Anderson Bay will be included in the formal PSD application process which must demonstrate compliance with all NAAQS and PSD increment standards.

C. Provide a Discussion of Potential Emission Controls and Mitigation Techniques that Could Reduce Emissions from the Facility in Case the Supplementary Analyses Under-Predict Impacts

The supplemental analyses of pollutant emissions from the Anderson Bay LNG and marine terminal facility, discussed in the previous section (V. B.) of this document, show that all pollutants will be within both the NAAQS and the PSD increments. The purpose of this section is to discuss what potential emission controls and mitigation techniques could be used at the facility to reduce pollutants if the supplementary analyses under-predict the impacts, i.e., if future PSD application modeling predicts that the proposed facility would not meet NAAQS or increment standards.

This discussion covers four of the five criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM_{10}), and sulphur dioxide (SO_2). Ozone is not discussed because the facility's effect on ozone concentrations will be through its emissions of NO_2, which were discussed earlier in Section V.A.3. of this document.

1. Carbon monoxide

The 1-hour and 8-hour CO concentrations, including background, predicted by the screening analysis (Table F-6, Appendix F) are about 22 percent and 53 percent of the respective NAAQS.

The contributions to 1-hour and 8-hour CO concentrations from YPC sources (i.e., if the background is eliminated) constitute only approximately 3 percent and 8 percent of the respective NAAQS. Mitigation techniques for CO are not discussed further because compliance with the NAAQS for CO is clearly not dependent on emissions from the Anderson Bay facility.

2. Nitrogen dioxide

Nitrogen dioxide emissions from the Anderson Bay facility can be reduced substantially by adjusting the operation of the fuel combustors in the gas-fired turbines.

More than 95 percent of the NO_2 emissions from the facility will be from the gas-fired turbine drivers on the refrigerant compressors, power generators, flash gas compressors, and boil-off gas compressors. All of these gas-fired turbines will be equipped with dry low NO_x (DLN) combustors.

Air entering the inlet of the turbine is compressed to pressures well above atmospheric. After compression, a portion of the air enters the DLN combustion system where fuel is injected and burned. The DLN combustion system is designed to quench the flame and dilute the combustion products with excess compressed air before the gas enters the power section of the turbine.

NO_x emissions are a function of both the temperature and residence time of the combustion products within the DLN combustor prior to quenching with excess air. Rapid quenching of the flame suppresses NO_x production, but increases CO emissions. Conversely, less rapid quenching will decrease CO production, but not without increasing NO_x emissions. The DLN combustors are adjusted (or tuned) to provide an acceptable balance between NO_x and CO emissions. The DLN combustor rating of 25 parts per million by volume, dry basis (ppmvd) NO_x, which is the value used for modeling in this document, represents only one of many possible balances of these two pollutants.

The supplemental modeling discussed in Section V.2. of this document shows that NO_2 emissions resulting from use of 25 ppmvd DLN combustors will be well within the NAAQS, but may consume approximately 74 percent of the available PSD increment. A prominent supplier of gas turbines stated that DLN combustors presently in operation have been tuned to reduce NO_x emissions from 25 ppmvd to levels below 15 ppmvd.

Tuning the DLN combustors to reduce NO_x will increase CO emissions. Review of the screening model results in Table F-6 of Appendix F shows that the 1-hour and 8-hour CO emissions from YPC sources would have to increase by factors of 28 times and 6.8 times, respectively, before NAAQS limits would be exceeded. It should be noted that the screening model is conservative in that pollutant concentrations are overstated. More rigorous modeling, which was not completed because the screening model clearly demonstrated that CO would be within NAAQS limits, would predict even lower CO concentrations. Sufficient leeway will exist to tune the DLN combustors to reduce NO_x emissions without exceeding CO concentration limits.

The ability to tune the DLN combustors to reduce NO_x emissions by up to 40 of 50 percent is a robust mitigation technique that will ensure NO_x compliance.

3. Particulate matter

The largest contribution of operating PM_{10} emissions is from the gas-fired turbine drivers. There are no mitigation measures to significantly reduce PM_{10} emissions from the turbines, however, this is not a concern because the predicted PM_{10} concentrations from YPC sources are well below the NAAQS and PSD increments. The predicted screening analysis 24-hour and annual PM_{10} concentrations are about 10 percent of the allowable concentrations except the 24-hour increment which is predicted to range from 31 to 55 percent of the limit.

Both supplemental analyses (Anderson Bay 10-meter data and the Alyeska Jackson Point 30-meter data) predict essentially the same PM_{10} concentrations, thus demonstrating that PM_{10} concentrations are relatively insensitive to varying meteorological data sets. It is unlikely that a set of meteorological conditions could exist that would increase the 24-hour PM_{10} concentration by more than 80 percent (that is, from 55 percent of increment to 100 percent of increment).

4. Sulphur dioxide

Both of the supplemental analysis predicted that SO_2 concentrations will be under, but also consume, a large portion of PSD increment.

More than 95 percent of the facility's SO_2 emissions are due to burning sulfur-containing fuel in the boilers of the LNG tankers when they are at berth. Thus, simply burning lower sulfur or sulfur-free fuel in the LNG tankers will eliminate up to 95 percent of the project's operational SO_2 emissions. This is a strong and simple mitigation measure to ensure SO_2 compliance.

The natural gas transported via the TAGS pipeline will be conditioned on the North Slope of Alaska to the specifications of the final LNG product. The gas entering the Anderson Bay facility will be liquefied without additional conditioning. The maximum sulfur content allowable in the LNG product is 0.25 grains per 100 standard cubic foot (scf) gas equivalent of hydrogen sulfide (4 ppmv), and 1.3 grains per 100 scf total sulfur. The facility's fuel gas is derived from the same facility feed gas and will not contain more than 4 ppmv hydrogen sulfide (H_2S).

The air quality modeling has been based on the assumption that 4 ppmv of H_2S will be present in the fuel gas used by the onshore turbines. The modeling results show that the contribution of the SO_2 from fuel gas combustion is dwarfed by SO_2 emissions from the LNG tankers. Even if the fuel gas contained sulfur in a form other than H_2S (which is not indicated), SO_2 emissions from gas combustion could increase by a factor of 5 (1.3 grains / 0.25 grains) at the maximum and the facility's overall SO_2 emissions would still be dwarfed by LNG tanker emissions.

APPENDIX E

COMMENTS AND RESPONSES

APPENDIX E

COMMENTS AND RESPONSES

Document Number	Commenter
FEDERAL AGENCIES	
FA1	U.S. Army Corps of Engineers, Alaska District, Anchorage, Alaska
FA2	U.S. Department of the Interior, Bureau of Land Management, Anchorage, Alaska
FA3	U.S. Environmental Protection Agency, Region 10, Seattle, Washington
FA4	U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Anchorage, Alaska
FA5	U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety, Washington, DC
FA6	U.S. Department of the Interior, Office of Environmental Affairs, Washington, DC
STATE AGENCIES	
SA1	State Pipeline Coordinator's Office, Anchorage, Alaska
LOCAL AGENCIES	
LA1	City of Valdez, Valdez, Alaska
GROUPS AND INDIVIDUALS	
GI1	Alaska Wilderness Recreation and Tourism Association, Valdez, Alaska
GI2	Prince William Sound Conservation Alliance, Valdez, Alaska
GI3	Alyeska Pipeline Service Company, Anchorage, Alaska
GI4	Edwin (Al) Kuhn, McLean, Virginia

APPENDIX E (cont'd)

COMMENTS AND RESPONSES

Document Number	Commenter
GROUPS AND INDIVIDUALS (cont'd)	
GI5	Financial Land Investment Corporation, Agoura Hills, California
GI6	Greenpeace, Anchorage, Alaska
GI7	The Valdez Star, Valdez, Alaska
GI8	The Renaissance Group, Bellevue, Washington
PUBLIC MEETINGS	
PM1	Public Meeting at Anchorage, Alaska
PM2	Public Meeting at Valdez, Alaska
APPLICANT LETTERS	
A1	Yukon Pacific Corporation, Anchorage, Alaska

FEDERAL AGENCY COMMENTS

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 898
ANCHORAGE, ALASKA 99506-0898

18 JUNE 1993

REPLY TO ATTENTION OF:

Regulatory Branch
Project Evaluation Section - South
2-840222

Ms. Lois Cashell
Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington D.C. 20426

Dear Ms. Cashell:

Reference is made to the Draft Environmental Impact Statement (DEIS), Yukon Pacific LNG Project, May 1993, FERC/EIS-0071D, Yukon Pacific Corporation (YPC), Docket Nos. CP88-105-000 and CP88-105-001, concerning the proposed Liquefied Natural Gas (LNG) Plant and Marine Terminal Site at Port Valdez (Anderson Bay), Alaska, for the Trans-Alaska Gas System (TAGS). The following are our comments:

Reference to Corps of Engineers' Cooperating Role and Jurisdiction

FA1-1 * No mention is made that the Corps of Engineers, Alaska District, is a cooperating agency in the preparation of all phases of the EIS, as per the letter to you of February 4, 1992.

FA1-2 * Only one letter with comments from the Corps of Engineers, Alaska District, is cited in Appendix E, "References and Contacts". At a minimum, the letters of February 4, 1992; June 8, 1992; January 26, 1993; and February 12, 1993, (already cited) should be referenced.

FA1-3 * In Section 2.1.7, "Permits, Approvals, and Regulatory Requirements", in particular on page 2-40 and in Table 2.1.7-1, alternate wording is suggested:

FA1-4 In the table for Section 404 (Clean Water Act), it should read: "Permit for the placement of dredged or fill material into waters of the United States"; for Section 10 (Rivers and Harbors Act), it should read, "Permit for placement of structures or work in or affecting navigable waters of the U.S. [33 CFR 322]".

FA1-5 In the text on page 2-40, "The Section 404 permitting process is administered by the COE for all discharge of fill or dredged material into waters of the United States, including wetlands, streams, and navigable waters."

FA1-1 Section 1.3 of the Draft Environmental Impact Statement (DEIS) and Final Environmental Impact Statement (FEIS) names the U.S. Army Corps of Engineers (COE) as a cooperating agency.

FA1-2 Comment accepted. The COE letters of February 4, 1992, June 8, 1992, and January 26, 1993 have been added to appendix G.

FA1-3 Comment accepted. The suggested wording has been incorporated into table 2.1.7-1.

FA1-4 Comment accepted. The suggested wording has been incorporated into table 2.1.7-1.

FA1-5 Comment accepted. The text has been modified as suggested.

FA1-6 * Mention of the number of acres of wetlands that would be affected by each alternative discussed would be useful.

FA1-7 * Clarification of the reference to the need for mitigation for damage or loss of subtidal areas is needed. If the area to be affected is in marine water with depths greater than six feet, but within the three-mile limit, then the area is "a water of the United States", but should not be referred to as a "subtidal wetland" (for example, Recommendation #19, page 5-15). Note that the discharge of unprocessed, excavated material from the site in areas less than three miles from shore would be regarded in this instance as a Section 404 discharge, not a Section 402 discharge. Further, Site B' appears to be deep, subtidal aquatic habitat, not intertidal wetlands, as referred to on page 4-26 (and elsewhere).

FA1-8 Use of Valdez Camp Site with Road Access Through Alyeska Terminal

* The permanent all-weather access road, required in Recommendation #35 on page 5-18, which would allow emergency equipment and personnel access/egress between the plant and the City of Valdez, could also be used by construction and operation workers for access to the site. While Recommendations #14 and #15 (pages 5-14 and 5-15) would be expected to reduce the adverse environmental impacts of the proposed construction camp to Seven Mile Creek, the alternative of avoiding those impacts entirely by use of the Valdez construction camp sites should be explored further. As per the letter of June 2, 1993, from the Alyeska Pipeline Service Company (J.S. Dayton, Vice President, Operations), to Mr. Robert Arvedlund of your staff, with its attached memo, dated May 14, 1992, it would appear that access for construction workers to the proposed Anderson Bay LNG Terminal would be practicable through the Alyeska Valdez Marine Terminal (described on pages 2-52 through 2-54). Use of this alternative would avoid the environmental damages associated with use of the Seven Mile Creek location for a construction camp, summarized on page 4-95, and is consequently preferable.

FA1-9 Concerns about Wetland and Aquatic Mitigation Plan

* Approximately 49 acres of estuarine and palustrine wetlands are reported in Section 4.4.3 on page 4-25, to be located within the proposed construction limits of the proposed site. The Alaska District continues to have the concerns described in "Plan Comments" on page 4-27, and supports the recommendations on pages 4-27 and 4-28 (i.e., Recommendation #19 on page 5-15). Further, additional information is needed concerning the onsite marine mitigation at Site B', described on page 4-26; it would appear that pushing excess rock and soil out into the deeper water at the east end of Anderson Bay could have adverse environmental impacts to water quality and possibly aquatic habitat. Further, the onsite freshwater mitigation proposal (page 4-26) should be refined after Recommendation #9 (page 5-13) and Recommendation #22 (page 5-16) have been implemented.

FA1-6 The estimated acres of wetlands that would be affected by each alternative spoil disposal site have been included in table 2.3.2-2 of the FEIS to the extent that they could be determined.

FA1-7 The classifications of the wetlands and subtidal habitats in the Site B' disposal area were taken from the July 27, 1992 version of the Intertidal and Subtidal Wetlands GIS map submitted by Yukon Pacific. It was determined after subsequent inspections of the site by staff of the FERC and the COE that the majority of the B' disposal area is not wetland but rather subtidal habitats greater than 6 feet in depth.

The discussion of wetlands in sections 3.4.3 and 4.4.3 has been revised accordingly. Areas that were identified as subtidal wetlands in the DEIS are referred to in the FEIS as subtidal habitats or waters of the United States. However, in order to minimize confusion and facilitate implementation of the FERC's recommended mitigation, these areas are still addressed in the wetland sections of the FEIS.

FA1-8 Your comment is reflected in section 4.16, which evaluates the use of the Valdez construction camp with road access through the TAPS terminal. In its July 2, 1993 comments on the DEIS, Alyeska Pipeline Service Company (Alyeska) no longer supported access through its terminal by construction workers.

FA1-9 Comment noted. See the revised discussion and recommendation regarding Yukon Pacific's wetland mitigation plan in section 4.4.3.

FA1-10 Selection of Rock and Overburden Disposal Sites

* At this time it would appear that use of the deep, subtidal area, described as Site B', is the preferred alternative for disposal of rock and organic overburden. The final determination of which disposal site is both environmentally preferable and practicable will depend on confirmation from the National Marine Fisheries Service that the loss of marine resources at that site would not be significant and that the alternative of terrestrial disposal with discharge placed higher than the natural surrounding grade, perhaps in conjunction with a dike, is not practicable.

FA1-11 Construction Dock Site

* If Site B' is confirmed as being environmentally acceptable as the overburden disposal site, then it should also be considered as the site for the construction dock in lieu of the environmentally valuable Nancy Creek site. Therefore, we support Recommendation #40 on page 5-19 (background given on page 5-10) which requires a revised site grading and construction plan reflecting the use of Site B' as the construction dock instead of grading and filling the currently proposed construction docksite at Nancy Creek. Use of Site B' for the construction dock would have the added advantage of consolidating site facilities and potentially allowing the public continued access to Anderson Bay in at least one segment (reference to the Coast Guard safety exclusion zone).

FA1-12 Maintenance of Buffer Strips of Natural Vegetation Along Water Bodies

* Maintenance of naturally vegetated buffer strips along all water bodies including Anderson Bay, wherever such strips would not seriously interfere with operations, would be highly recommended for maintenance of water quality and aquatic habitat (reference pages 4-24 and 4-25, as well as Recommendation #18 on page 5-15). Justification will be required from the applicant if they propose to grade the site to its extreme margins. The vegetated strips would also serve as a visual buffer along the shoreline.

FA1-13 Mixing Zones Associated with Outfalls

* Concern continues about the impact on aquatic life of large temperature differentials (55 to 65 degrees Fahrenheit) of the Heat Recovery Steam Generation blowdown and desalination discharge effluents.

FA1-14 Support for FERC Staff's Conclusions and Recommendations

* The Alaska District generally supports the conclusions and recommendations reached in Section 5. As noted above, details are needed before certain alternatives can be determined acceptable.

FA1-10 **Comment accepted. We have revaluated the subject of excess excavated materials and have revised section 2.3.2.**

FA1-11 **The use of area B′ as a site for the construction (cargo) dock was investigated and reported in the DEIS (section 2.3.2). We have expanded this discussion in the FEIS but the overall conclusion remains the same. The fact that the site cannot be ready for use until well into the construction schedule precludes its use for a critical path function such as the construction dock and concrete batch plant.**

FA1-12 **Comment noted. Recommended mitigation measure 18 will be retained (see recommended mitigation measure 26 in the FEIS).**

FA1-13 **Your concern is noted; however, as described in section 4.5.1 pages 4-28 through 4-31 of the DEIS, the National Pollutant Discharge Elimination System (NPDES) and state receiving water quality standards make provision for temperature control. If a mathematical dilution model is used in the development of the mixing zone as recommended, an appropriate diffuser and/or pretreatment design can be achieved with available technology so that "large temperature differentials" impacting aquatic life will not occur.**

FA1-14 **Thank you for your comment.**

Thank you for this opportunity to comment on the DEIS. If you have any further questions concerning the above, please feel free to have your staff contact Dr. Mary L. Plumb-Mentjes of my staff at the above address or by calling (907) 753-2724. Dr. Plumb-Mentjes is the Corps' regulatory point of contact on this project. Thank you for your consideration.

Sincerely,

Robert K. Oja

Robert K. Oja
Chief, Regulatory Branch

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

Alaska State Office
Branch of Pipeline Monitoring
222 W. 7th Avenue, #30
Anchorage, Alaska 99513-7590

IN REPLY REFER TO

1795 (Ak 983)
TAGS .023
.1403
.0101

June 23, 1993

RECEIVED BY

JUN 29 1993

Chris Zerby, Project manager (room 7312)
FERC
825 No. Capitol St., N.E.
Washington, DC 20426

SUBJECT: Draft EIS Yukon Pacific LNG Project

Dear Chris;

The following comments were forwarded from this office through channels to the Department of Interior. Official comments will come from the Departmental level. These are provided for your information:

BLM, with the Corps of Engineers (Corps) cooperating completed an EIS in June 1988 and subsequently issued a Grant of Right-of-Way for a 36 inch diameter pipeline for this project.

The LNG facility is on land owned by the State of Alaska. Thus, BLM has no authority to issue permits for the terminal facility and will not be duplicating the review of other agencies with jurisdiction.

FA2-1 BLM, however, has one issue. In Section Five, e.g. item 19 on page 5-16, FERC is proposing to require the applicant to "file with the Secretary. . . written comments from the Joint Pipeline Office. . . . " BLM appreciates FERC's attempt to insure that BLM (as part of the JPO) remains fully informed about this project. However, it appears that FERC is requiring BLM/JPO to comment on an item that is under the legal jurisdiction of the Corps and EPA. If we exercise our administrative discretion and do not comment, then BLM/JPO is holding up the process since the applicant is required to file BLM comments with FERC. This appears a bit onerous on both BLM and the applicant.

FA2-1 **Comment noted. Recommended mitigation measure 19 has been modified to reflect submittal of comments "if received" from the various agencies (see recommended mitigation measure 27 in the FEIS).**

FA2-1 As a solution we propose that the applicant only be required to file such documents with BLM/JPO. The JPO, or any agency for that matter, can then decide if they wish to comment and to whom they wish to address those comments.

Sincerely,

Nolan Heath

Nolan Heath
Chief, Branch of
Pipeline Monitorin

cc: Santora, John
Heath, Nolan
Brossia, Jerry

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

JUL 15 1993

REPLY TO
ATTN OF: WD-126

Chris Zerby, Project Manager
Federal Energy Regulatory Commission
825 North Capitol Street, N.E., Room 7312
Washington, DC 20426

Re: Docket No. CP88-105-000

Dear Mr. Zerby:

The Environmental Protection Agency (EPA) has reviewed the draft Environmental Impact Statement (EIS) for the **Yukon-Pacific LNG Project** in Valdez, Alaska. Our review was conducted under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act, which directs EPA to review and comment on all federal EIS's.

We are rating this draft EO-2 (Environmental Objections-Insufficient Information). Our environmental objections are based on the potential for air quality impacts, particularly ozone levels; intertidal wetlands loss; and violations of Alaska Water Quality Standards. Additional information is requested to describe the proposed project in more detail, expand and clarify the air quality impacts analysis, more fully evaluate a deep water disposal option for excavated materials, develop a site-specific wetland mitigation plan, and better describe waste disposal options on the plant site.

We appreciate the opportunity provide comments on this draft EIS. An explanation of the EPA rating system for draft EISs is enclosed for your reference. This rating and a summary of EPA's comments will be published in the Federal Register. If you have any questions about our comments, please contact Ruth Siguenza in our Environmental Review Section at 206/553-2143

Sincerely,

Kathy Veit

Kathy Veit, Chief
Program Coordination Branch

Enclosures (2)

cc: Jerry Brossia, Alaska State Pipeline Coordinator
Lois D. Cashell, Secretary, Federal Energy Regulatory Commission

FA3

U.S. Environmental Protection Agency (EPA)
Review Comments

Federal Energy Regulatory Commission (FERC)

Yukon Pacific Liquified Natural Gas (LNG) Project
Draft Environmental Impact Statement (EIS)
Valdez, Alaska

July, 1993

Details of Site and Facility

FA3-1 The draft EIS repeatedly notes that "...the design of the proposed facility is still in a preliminary phase." (page 4-6) and "Since the project is in the preliminary design phase, Yukon Pacific has not yet selected the actual equipment it would use for its Anderson Bay LNG Terminal." (page 4-47). Further, it notes that "...the detail design remains in a preliminary stage. ...supplemental information is required before a more definitive assessment can be made on the adequacy of design..." (page 4-70). Without these project design specifics, it is difficult to realistically discuss potential project impacts in the detail normally found in a draft EIS. For example, the draft EIS says that

FA3-2 Yukon Pacific's BMPM describes general guidelines and measures that could or would be utilized during construction, but it does not provide detailed information regarding where a particular mitigation measure would be employed or who would be responsible for its implementation. (page 4-4).

In addition, the document notes that

FA3-3 Yukon Pacific's BMPM indicates that buffer strips of uncleared, native vegetation may be left between construction areas and natural waterbodies to minimize erosion and sedimentation. However, no such buffer strips are shown on Yukon Pacific's rough grading overall site plan. Instead, these plans indicate that the entire site would be cleared and graded to the waterline of the...bay and streams. (page 4-24 and 4-25).

FA3-4 Many of the FERC Staff Recommended Mitigation Measures (pages 5-10 to 5-19) relate to plans and mitigation measures that still need to be developed. The draft EIS implies that many of these may not be developed in time for inclusion in the final EIS. This raises the question of whether FERC may need to supplement the EIS at a future date after the LNG proposal is further developed and more specific project design features are known, thus allowing a more complete analysis of the potential impacts of the proposed project.

FA3-5 Further, details of the plant design and its potential discharges will be needed before EPA permits for the project can be issued.

FA3-1 **We believe it is possible to realistically discuss potential impacts using preliminary design data that reflect currently available technology. Conditions have been added to ensure that final equipment specifications meet or exceed the preliminary design used in the analysis.**

FA3-2 **Recommended mitigation measure 4 requires Yukon Pacific to file detailed information regarding how it will implement each of the recommended mitigation measures and who will be responsible for implementation. Other design details such as where the measures will be implemented are required to be filed prior to construction in order to satisfy permitting requirements and conditions of license.**

FA3-3 **Although not shown on figure 2.1-4, recommended mitigation measures 15, 18, and 29 of the DEIS specifically address the need for vegetative protection of shorelines for erosion control and aesthetic purposes. In the FEIS these recommendations have been retained (mitigation measures 23, 26, and 36, respectively) and another, emphasizing the configuration of the campsite at Seven Mile Creek (recommended mitigation measure 48) has been added.**

Air Quality

FA3-6 Section 3.7 of the draft contains a wind rose presentation of wind speed and direction measurements taken at Anderson Bay between September, 1989 and August, 1990. Unfortunately, critical information related to the meteorological measurements program have not been included in the document. Because these data were used in the limited dispersion modeling reported in Section 4.7, a discussion of the quality and representativeness of the measurements is critical to the interpretation of the modeling results. With calm conditions reported to occur for nearly 50 percent of the measurement period, it is important to know if the data truly reflect conditions at the site. Was the tower situated in a location which would be representative of the sources modeled? Was the instrumentation on the tower adequate for capturing data of the quality needed to perform dispersion modeling? What types of quality assurance (QA) practices were employed during the monitoring effort, and what types of data capture rates were achieved? For dispersion modeling purposes, it is also important to know how atmospheric stability and mixing heights were estimated. In short, an understanding of meteorological monitoring program is needed in order to place any conclusions about the wind patterns and the dispersion modeling results into the proper context.

FA3-7 Table 3.7.2-1 presents ambient air quality data collected at the Alyeska Marine Terminal in 1992 as a summary of ambient air quality levels in the vicinity of the proposed LNG project site. Unfortunately, the draft EIS fails to describe the quality of these measurements or cite the reference(s) from which this information was obtained. As with the meteorological data, it is critical to understand the spatial characteristics of the air quality monitoring network, the measurement techniques used, and the QA practices employed before conclusions related to air quality in the area potentially impacted by the project can be made.

FA3-8 The air quality analysis is incomplete. First, there is no detailed description or documentation of the emissions estimates (emission factors, size of equipment, etc.) to judge whether or not the estimates are reasonable. The draft EIS indicates that construction activities would cause a temporary deterioration in air quality levels. However, construction activities are scheduled to occur over the course of eight years. It is not clear how eight years of construction activity can be viewed as temporary. In addition, a concrete batch plant would be operated during a significant portion of the construction phase. Air quality impacts from such an operation could potentially be significant. Further evaluation of construction-related activities should be performed to determine the significance of their impacts on air quality levels.

FA3-4 **The Yukon Pacific LNG Project, under joint agreement between the cooperating Federal agencies, is being reviewed under a tiered permitting process codified in the Federal and state rights-of-way issued pursuant to the Trans-Alaska Gas System (TAGS) FEIS of June 1988. This process recognizes that certain parts of the overall project development will occur in stages, with final site-specific design of the facilities occurring after receipt of some Federal and state permit approvals. As such, site-specific mitigation procedures as referenced in this comment cannot occur at this time. Recognizing this, the FERC staff, as well as other Federal and state agencies responsible for issuance of necessary right-of-way grants and leases, has conditioned Yukon Pacific to develop comprehensive mitigation plans in conjunction with the project's final design planning for review and approval prior to initiation of construction. Further environmental analysis will not be required since the FERC staff assesses the environmental impact first, and then determines net impact with incorporation of the recommended mitigation measures. Since initiation of project construction hinges on prior approval of the referenced applicant-prepared mitigation measures, the mechanism for ensuring appropriate levels of mitigation is valid.**

FA3-5 **Yukon Pacific will provide whatever engineering detail is required to support permit applications for the project. The absence of such detail at this point is reflective of the tiering process mentioned in FA3-2.**

FA3-6 **Questions regarding the accuracy and representativeness of meteorological data collected at the Met Cove tower between September 1989 and August 1990, have resulted in an agreement between Yukon Pacific, the U.S. Environmental Protection Agency (EPA), and the Alaska Department of Environmental Conservation (ADEC) on March 15, 1994, that a new 40-meter meteorological tower would be installed according to a protocol and monitoring plan approved by the EPA and ADEC for use in generating meteorological data for modeling analysis supporting Prevention of Significant Deterioration (PSD) review and the air permit.**

A draft meteorological monitoring plan was submitted to the EPA and ADEC on July 29, 1994 for review and approval. All meteorological data used in the modeling analysis for the PSD review and the air permit will be approved by the ADEC and EPA.

FA3-9 Second, there is no documentation of the air quality modeling analysis to judge its adequacy. The draft EIS indicates that specific equipment to be used in the proposed project have not yet been selected, yet presents results of a dispersion modeling analysis in Table 4.7-2. The document fails to include emissions from the waste incinerator to be used at the facility. This source, as well as others which may not have been addressed in the present analysis must be included in any analysis before it can be judged complete.

FA3-10 It is not clear what the dispersion modeling results represent, as no information is presented related to the sources modeled, how emissions were calculated, and what assumptions were used in the analysis. In addition, in order to adequately determine the potential air quality impacts from operation of the proposed facility, it is necessary to evaluate FA3-11 equipment which would actually be used at the facility. Without knowledge of the equipment to be used and how it will be operated, it is impossible to determine correct emission rates and scenarios, necessary control technologies, and source characteristics needed to conduct the modeling analysis. The draft EIS correctly states that Yukon Pacific would need to conduct a more accurate dispersion modeling analysis as part of Prevention of Significant Deterioration (PSD) permit application to be submitted to the Alaska Department of FA3-12 Environmental Conservation. However, without a reasonable characterization of facility operations, accompanied by supporting documentation, the impacts from the proposed project cannot be adequately defined to make a determination of significance under the National Environmental Policy Act (NEPA).

FA3-13 Third, the draft EIS fails to include a cumulative impacts analysis to determine if the project could meet the ambient standards or PSD increments. The document only indicates that such further analysis will be done for the state's PSD permit (page 4-44). The present modeling analysis fails to adequately address the impact of the proposed project on PSD increment consumption or compliance with the applicable national ambient air quality standards (NAAQS). Such analyses would need to include an adequate definition of baseline air quality levels in the Port Valdez area and an assessment of contributions from all sources in the area potentially impacted by the proposed project.

FA3-14 In addition, the draft EIS fails to address the potential impact of the proposed project on ambient ozone (O_3) levels in the Port Valdez area. With estimated emissions of over 2,500 tons per year (tons/year) of nitrogen oxides (NO_x) and 374 ton/year of volatile organic compounds (VOCs) [both precursors of ozone], the potential exists for significant O_3 formation, particularly considering that the Alyeska Marine Terminal is permitted to emit over 57,000 tons/year of VOCs and over 1,700 tons/year of NO_x.

FA3-15 In short, the air quality analysis falls short of FERC's obligation under NEPA and Section 176(c) of the Clean Air Act to determine whether or not the project can comply with the State Implementation Plan or if mitigation measures are necessary. The final EIS must provide a full disclosure of potential impacts for both the public's review and comment as well as for federal agency decision-making processes. It is inappropriate for a federal agency to

FA3-7 The ambient air quality data collected at the Alyeska Marine Terminal in 1992 presented in table 3.7.2-1 of the DEIS, were maximum values measured at the West Terminal for the entire year of 1992. These data were obtained from the ADEC by personal communication from Jeff Anderson on March 30, 1993, and were used as the most current information available. In supplemental screening modeling done prior to the March 15, 1994 technical meeting in Seattle, Yukon Pacific presented background concentrations based on the maximum concentrations measured at any station in the Valdez Ambient Monitoring System (VAMS) operated for Alyeska for the 2.5-year period from October 1, 1990 through March 1, 1993. The more recent air quality data appears in table 3.7.2-1 and the new appendix D of the FEIS, Supplemental Air Quality Data. At the June 6, 1994 siting meeting, Yukon Pacific proposed to use these data for the modeling analysis supporting the PSD review and permit application.

All ambient air quality data used in the modeling analysis for the PSD review and the air permit will be approved by the ADEC and EPA.

FA3-8 Table 4.7-1 of the DEIS has been revised (see table 4.7.3-1 of the FEIS) to summarize the 44 operational sources. Emission factors and documentation appear in the new appendix D, Supplemental Air Quality Data. Section 4.7 has also been revised to evaluate the impact of construction emissions on ambient air quality levels using a screening model (see section 4.7.4 of the FEIS).

FA3-9 Revised emission estimates from operation of the Anderson Bay LNG facility are summarized in table 4.7.4-1. Forty-four sources are included in these emission estimates, one of which is the waste incinerator operating with the various anticipated loads and another of which is the LNG tankers. A detailed discussion of emissions from all 44 sources is included in revised section 4.7.3 and appendix D.

FA3-10 The emission parameters used in dispersion modeling impact analysis are given in revised section 4.7.3 and appendix D, based on emission rates for worst-case operating conditions discussed in the previous comment response.

FA3-11 Equipment which would generate air pollutant emissions and the worst-case operating conditions emission rates are presented in revised section 4.7.3, and the basis for estimates is in appendix D.

FA3-12 Dispersion modeling done with the revised emission rates was done using SCREEN2, ISCST2, and COMPLEX I. Details on the modeling analyses and the results are included in revised section 4.7.4 and appendix D.

FA3-15 permit, license, or fund a project which cannot comply with applicable air quality requirements by avoiding its responsibility to analyze the potential impacts and deferring to other state and/or federal permitting processes.

Excavated Material Disposal

FA3-16 A deep water disposal alternative for excavated material would be a Clean Water Act, Section 404 regulated discharge. A characterization of the material would be required. EPA believes that there are alternatives for disposing of excavated material that would avoid the filling of wetlands. Therefore, the final EIS should describe a deep water disposal alternative in more detail, including how many barge loads of material per day would be dumped and stockpiling alternatives for those times when bad weather prohibits barge operation. If you have further questions about deep water disposal, you may contact John Malek in EPA's Seattle Office at 206/553-1286.

FA3-17 At this point, EPA does not agree with the U.S. Army Corps of Engineers that site B' is the preferred alternative. In addition to more fully evaluating a deep water disposal alternative, the final EIS should address whether it is possible to build retaining structures at some of the sites so that the material can be piled deeper. If so, the final EIS should identify whether or not it is feasible to increase depths in order to avoid the filling of intertidal wetlands associated with site B'. By combining the reduction of excavation by placing the construction camp in Valdez with increasing other disposal site depth of fill, it may be possible to achieve the needs of the total construction without the impacts to intertidal waters necessary to use site B'.

Wetlands

The draft EIS notes that

> The EPA believes that more field studies are needed to collect additional wetland information, particularly for the intertidal wetlands at the east end of Anderson Bay... Another concern of the COE and EPA is that the wetland mitigation plan lacks sufficient site-specific details regarding how it would be implemented. (page 4-27).

The draft EIS concludes

> ...we agree with the comments of the other agencies and share similar concerns regarding Yukon Pacific's wetland mitigation plan. The plan does not provide mitigation for any of the subtidal areas that would be affected. ...it provides no design plans or details as to how the proposed mitigation would be implemented and monitored, or whether the mitigation is likely to be successful. (page 4-27).

FA3-13 **The cumulative impacts analysis to determine whether the project could meet the National Ambient Air Quality Standards (NAAQS) and PSD increments is discussed in revised section 4.7 and appendix D. Final determination on compliance with state and nation standards and PSD increments will be done during the PSD permit application process, when the representative meteorological data are available.**

FA3-14 **Section 4.7.5 presents an assessment of the project's potential impact on ozone in Port Valdez.**

FA3-15 **Section 4.7 has been revised to include the results of screening model analysis and supplemental modeling to compare project impacts with NAAQS and PSD increments. The current regulations promulgated under Section 176(c) of the Clean Air Act do not require a conformity determination in attainment areas.**

FA3-16 **Section 2.3.2 has been revised to include these concerns in an expanded analysis of deep water disposal as an alternative to filling of wetlands. In a letter to Yukon Pacific dated June 28, 1994, the EPA stated that deep water disposal of spoil material can be eliminated from further consideration due to the environmental, liability, and regulatory concerns. Please refer to comment response FA6-3 for additional information.**

FA3-17 **An expanded analysis of disposal of excess excavated material, including the options of deep water disposal and/or the installation of retaining structures to increase land-based disposal, has been added to section 2.3.2.**

FA3-18 EPA strongly supports the recommendation that Yukon Pacific prepare a wetland mitigation plan prior to construction (pages 4-27 and 4-28), preferably prior to release of the final EIS. This plan should be based on the final plans for site grading and excavation as well as the final choice of the site for disposal of excavated materials. In addition to those elements described on page 4-28, the plan should specifically identify locations of proposed wetland mitigation and enhancement, land ownership, and probability of successful mitigation.

Water Quality

FA3-19 The draft EIS has not correctly represented the application of the Alaska Water Quality Standards to the waters potentially impacted by the project. The draft states that freshwater is to be protected for only Water Supply drinking, culinary, and food processing I(A)(i) (page 3-14, Table 3.3.2-2). Similarly the document asserts that marine waters are only protected for aquaculture II(A)(i) (page 3-30, Table 3.5.2-3). Except as otherwise specified in 18 AAC 70.050(b), state waters are protected for <u>all use classes</u>. None of the freshwater or marine waterbodies potentially impacted by the project are exempted from protection for all use classes. The final EIS needs to clarify that fresh waters are protected for Classes IA, B, and C, and marine waters are protected for Classes IIA, B, C, and D.

FA3-20 The water quality discussion (Section 3.5.2) does not take advantage of more recent environmental monitoring studies conducted primarily by Alyeska Pipeline Service Company in Port Valdez. As a requirement of Alyeska's National Pollutant Discharge Elimination System (NPDES) permit, the company does extensive monitoring in Port Valdez and generates annual reports documenting their findings. These more recent documents should be referenced for the sediment quality (Sect. 3.5.3.) and benthic (Sect. 3.5.5.) discussions.

The draft EIS also notes that

Considering that 392 acres of the site would be exposed, the potential for soil erosion during construction is high. ...a detailed site-specific erosion and sediment control plan that conforms to BMPM will be submitted prior to construction. (page 5-1).

FA3-21 In addition to the erosion and sediment control plan, the draft EIS refers to a number of other undeveloped plans, such as a stormwater monitoring plan. The final EIS should contain these plans so as to facilitate disclosure and review of project impacts and their effective mitigation.

FA3-22 Finally, the document also states that "Short-term increases in sediment may violate Alaska Water Quality Standards..." (page 4-16). The draft EIS indicates that the state may grant a variance from the standards for a temporary activity. The final EIS would be strengthened through an expanded discussion of the factors influencing the granting of a variance as well as the likelihood of obtaining such a variance.

FA3-18 The FEIS recommends that Yukon Pacific prepare a detailed wetland mitigation plan prior to construction; however, we do not believe that this detailed plan needs to be completed before the FEIS is issued. The EPA shared this view in a subsequent letter to the FERC dated July 29, 1994, stating that there is no reason that the FERC FEIS process needs to be stopped or slowed because of the unresolved issues related to Yukon Pacific's mitigation policy or wetland evaluation techniques.

Yukon Pacific's detailed wetland mitigation plan must be submitted to and approved by the FERC as well as other appropriate Federal and state agencies before construction. We have required that the detailed mitigation plan identify locations and landownership of the proposed wetland mitigation and enhancement sites as well as address the probability of the plan's success. See revised text and recommendation in section 4.4.3.

FA3-19 The FEIS has been revised to state that fresh waters are protected for Classes 1A, B, and C and marine waters are protected for Classes IIA, B, C, and D. Originally only the most stringent regulatory class was identified. The text in section 3.3.2.1 has been amended to reflect the protection of freshwater for all uses including drinking, culinary, food processing, agriculture, aquaculture, industrial, recreation, growth and propagation of fish, shellfish, other aquatic life and wildlife, and harvest for consumption of raw mollusks or other raw aquatic life. The text in section 3.5.2.1 has also been amended to reflect the protection of all marine use classes.

FA3-20 The results of recent environmental monitoring studies conducted by Alyeska as part of its NPDES permit have been incorporated into the sediment (section 3.5.3) and benthos sections (section 3.5.5) as appropriate.

FA3-21 As discussed in comment response FA3-4, this project is being reviewed under a tiered permitting process. Site-specific plans such as erosion and sediment control and stormwater monitoring have been required to be prepared and submitted for review and approval by the appropriate agencies prior to authorization to proceed with construction. Please refer to comment response FA3-4.

Vessel Discharges

The draft EIS notes that separate ballast water storage tanks are present on the double-hulled LNG tankers, and there is no comingling of the ballast water and the LNG cargo. Further, the draft says that all LNG tankers will be required to "change all ballast water during the 36-hour period prior to entering Prince William Sound." (page 2-19). Therefore, the ballast water will be clean seawater and no treatment is required.

FA3-23 However, there is no mention of bilge water which collects in the lower internal parts of a vessel's hull which may be contaminated and require treatment prior to discharge. Discharge of bilge water and other liquid wastes at sea is allowed for under U.S. Coast Guard regulations. However, liquid wastes are also formed on smaller support vessels such as tugs, barges, and ferries. If bilge water, sanitary or domestic wastes from any vessels may be off-loaded at the LNG terminal, such wastes should be addressed in the final EIS.

Permits

FA3-24 The draft EIS states that a National Pollutant Discharge Elimination System (NPDES) permit will be needed "during construction and/or operation...for point source discharge of waste waters (e.g., from sewage treatment system)" (page 2-38, Table 2.1.7-1). The final EIS should clarify that EPA will require that a NPDES permit application be filed for the construction and operation of the LNG plant and terminal. A discharge permit must be obtained by anyone who discharges or proposes to discharge pollutants into the waters of the United States. Applications for new dischargers must be made 180 days prior to the commencement of discharging. Discharges of concern include, but are not limited to the following:

- sanitary wastes
- domestic wastes
- non-contact cooling water
- LNG storage tank cleaner and hydrotest discharge
- oily wastewater
- surface runoff (during construction and operation)
- bilge water (see previous discussion)

The NPDES permit application should address additional pertinent discharges not listed above. The application should include information regarding the composition, quantities, and locations of the proposed discharges.

There is a general NPDES permit for stormwater related to construction activities larger than five acres. This general permit may be applicable to the LNG project. For additional information on stormwater permits, contact Steve Bubnick in our Seattle office at 206/553-8399.

FA3-22 The factors influencing the granting of a variance were described in the DEIS on page 4-16 as follows, "The applicant must demonstrate that the activity would be conducted in a manner to mitigate water quality impacts, using methods found by the ADEC to be most effective, and must show that the activity, once completed, will not cause a long-term, chronic, or recurring violation of the water quality standards." If the dam is approved for construction on Seven Mile Creek, George Wilson of the Joint Pipeline Office (JPO) does not anticipate a problem with granting a short-term water quality variance for turbidity and suspended solids although some time restrictions may be required to protect the salmonid habitat downstream (Wilson, 1993) (see revised section 4.3.2.1).

FA3-23 Yukon Pacific has indicated that no bilge water from LNG tankers or support vessels will be discharged into Port Valdez or Prince William Sound. Yukon Pacific also indicated that if bilge water must be disposed of while in Port Valdez, it can be processed through the project's proposed wastewater treatment facility. See revised section 4.5.2.2.

FA3-24 Comment accepted. The text has been revised in section 2.1.7 to state that the NPDES permit application must be filed for the construction and operation of the LNG plant and terminal in table 2.1.7-1.

Construction Work Camp/Access

The draft EIS repeatedly notes that "There are no plans to develop overland access for the regular movement of personnel, equipment, or materials into or out of the Anderson Bay site..." (page 2-36). However, the document also says that

> The principal reliance on waterborne transportation for emergency evacuation of personnel and for access of medical and emergency personnel and equipment raises questions on compliance with the all-weather vehicular road requirement in NFPA 59A, as well as the ability of waterborne access to meet the ease of access requirement in Part 193.2055. (page 2-54).

FA3-25 FERC staff conclude that "...we believe that the safety and operational benefits of the all-weather access road clearly offset the problems." (page 4-68), and "A permanent all-weather access road shall be built to allow emergency equipment and personnel access/egress between the plant and the City of Valdez." (page 5-18). EPA strongly supports this requirement.

FA3-26 While the draft EIS concludes that "based on the above, the information presently available does not support a finding that either the impact of the proposed Seven Mile Creek camp site is unacceptable or that the Valdez camp site is a significantly superior alternative." (page 4-96), EPA believes that an all-weather road between the plant and the City of Valdez makes the camp site location in Valdez the preferred alternative for the following reasons:

- The construction of a road would have fewer excavation impacts than would the construction of a temporary camp site for 4,000 workers.
- No construction impacts nor rehabilitation of the Seven Mile site would be required.
- It would reduce the fresh water supply needs for the plant site as well as the anticipated volume of sewage discharges to Port Valdez.
- Timber harvest and associated impacts would be reduced.
- The magnitude of traffic use on the road would be greatest during the peak construction year, but would be less during the remaining construction years as well as during normal plant operations.
- It would allow workers direct access to City of Valdez services and facilities.

EPA recommends that the camp site be located in the City of Valdez.

FA3-25 **Recommended mitigation measure 35 requiring Yukon Pacific to construct an all-weather access road for use during operations, stands (see recommended mitigation measure 43 in the FEIS).**

FA3-26 **Comments are reflected in section 4.16. However, in response to comments received from the directly affected parties, we have concluded that the negative features of the Valdez camp outweigh the potential benefits.**

Waste Disposal

FA3-27 The final EIS should better describe the waste streams and waste disposal options on the plant site. The draft EIS notes that "Much of the liquid and solid wastes generated on the site would be handled by the Waste Treatment Plant and Incinerator." (page 2-15). In addition, "Ash from the incinerator and incinerator scrubber would be disposed in a permitted landfill located on the plant site. The onsite landfill location has not yet been identified..." (page 2-16). The final EIS should better describe the proposed landfill location, potential environmental impacts of an onsite landfill, and the necessary landfill permit requirements.

FA3-28 In addition, the draft EIS says that solids from the wastewater treatment system "...would be recycled into the aeration process to provide a fresh supply of bacteria for the aerobic treatment." (page 2-15). It is doubtful that the entire volume of sludge produced by the waste treatment plant can be recycled in this manner. Therefore, the final EIS should address how Yukon Pacific plans to dispose of the excess sludge from the plant site.

FA3-27 **The solid waste and ash disposal location, as shown on figure 2.1-4 (sheet 2) is located to the west of the LNG storage tanks and occupies an area of about 0.6 acre. State solid waste disposal permits, as listed in table 2.1.7-1, are required. The landfill will be used for the disposition of incinerator ash almost exclusively, both during construction and to a much lesser degree during operation, and since the location is central to the site, impacts from its use will be negligible.**

FA3-28 **The text in section 2.1.1.5 has been clarified to read "some solids would be recycled [...]. The remainder would be dewatered and incinerated."**

FA3

U.S. Environmental Protection Agency Rating System for
Draft Environmental Impact Statements
Definitions and Follow-Up Action*

Environmental Impact of the Action

LO - - Lack of Objections

The Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC - - Environmental Concerns

The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO - - Environmental Objections

The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU - - Environmentally Unsatisfactory

The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 - - Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 - - Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonaby available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 - - Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
222 W. 7th Avenue, #43
Anchorage, Alaska 99513-7577

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July 14, 1993

Ms. Lois Cashell
Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Dear Ms. Cashell:

This is reference to the Draft Environmental Impact Statement (DEIS), Yukon Pacific LNG Project, May 1993, FERC/EIS-0071D, Yukon Pacific Corporation (YPC), Docket Nos. CP88-105-000 and CP88-105-001, concerning the proposed Liquefied Natural Gas Plant and Marine Terminal Site for the Trans Alaska Gas System (TAGS), at Anderson Bay, Port Valdez, Alaska.

The National Marine Fisheries Service (NMFS) has reviewed the DEIS. NMFS review and comments focus on those portions of the DEIS that may directly impact fishery resources and their habitat. The following are some areas of concern:

FA4-1 <u>Overburden and Waste Rock Disposal Site</u>
The proposed disposal of 2.6 million cubic yards of overburden (trees, roots, soil, etc.) and the 735,000 cubic yards of waste rock at sites B and B′ (YPC's preferred disposal site), would result in the loss of approximately 17 acres of intertidal and subtidal aquatic habitat in Anderson Bay. NMFS Auke Bay Laboratory has conducted numerous studies in Port Valdez. Based on these studies, Anderson Bay is considered one of the most diverse intertidal and subtidal aquatic habitats in Port Valdez. The intertidal region of the bay shows a strong marine influence despite the large freshwater inputs that affect the species composition of most of the intertidal areas in Port Valdez. This balanced system could easily become at risk to over enrichment should this quantity of organics be deposited. Efforts should be made to avoid or minimize burial of intertidal and subtidal regions of Anderson Bay.

Specifically potential problems associated with filling a portion of Anderson Bay and the negative impacts which could occur include: the smothering of the benthos, increased turbidity, decreased oxygen, production of hydrogen sulfide from decomposition of bark, disruption of food chains and loss of critical habitat (e.g., eel grass bed in
FA4-2 east Anderson Bay). We concur with the recommendation in the DEIS (page 4-36), that a salmon fry utilization study be designed to determine the importance of nearshore areas affected by plant construction, as compared to other areas in Port Valdez. In addition, we recommend these studies include baseline studies at site B′. If

FA4-1 We have reexamined the disposal options specifically to try to find ways to avoid disturbing the identified intertidal and subtidal habitats of both Nancy Creek and Site B′. As discussed in section 2.3.2 of the FEIS, the physical constraints of the site limit the upland possibilities without either: a) going offsite to area D; or b) enlarging the project site southward by cutting back into the slope behind. In both instances, the environmental disturbance through excavation and fill requirements to either access, or construct the sites, is very large. We could find no acceptable alternative to filling of Site B′ with excess material.

FA4-2 We concur and have revised recommended mitigation measure 22 to include baseline studies at Site B′ in the salmon fry utilization study (see recommended mitigation measure 30 in the FEIS).

FA4-2 these studies indicate this area is critical habitat (e.g. nursery area for juvenile salmon) compared with other areas in Port Valdez, then this area as a disposal site may not be desired.

FA4-3 We recommend the option of utilizing a combination of sites A, B, and deep offshore (excluding organics), prior to the placement of any fill at site B′ be utilized. We are aware of the disadvantages involved with this alternative. However, NMFS is also aware that the amount of material needed to be disposed of is largely driven by the amount of

FA4-4 material excavated. Thus, we recommend construction practices which avoid and minimize the need for excavation, such as the placement of the construction camp at Valdez, rather than Seven Mile Creek. This would not only reduce the impacts resulting from the need to deposit overburden material, but would also avoid the impacts associated with the destruction of wetland habitat at Seven Mile Creek.

FA4-5 Further, while NMFS recognizes the placement of some fill at site B′ may be unavoidable, we also recognize the impacts to intertidal and subtidal areas as a result of the proposed project can be minimized. Therefore, we concur with the DEIS (page 2-65) in recommending YPC provide a revised site grading and construction plan reflecting the use of site B′ for the construction dock.

Wetlands

FA4-6 NMFS disagrees with YPC's contention that adverse effects on subtidal wetlands would not require mitigation. As stated previously, past work by NMFS Auke Bay Laboratory indicates the habitat in Anderson Bay to be highly diverse. NMFS does not feel the technique used to evaluate habitat along approximately 800 miles of pipeline route adequately reflects the site-specific sensitivity of intertidal and subtidal habitats. We recommend the functional value of each wetland type be determined to evaluate potential losses from construction, and appropriate mitigation strategies be developed.

FA4-7 In addition, we question the proposed on site Marine Mitigation (page 4-26). Since the proposed disposal would completely disrupt the existing communities, revegetation would have to begin from ground zero. Wetland mitigation has had patchy results even in optimal ecosystems; the seasonally adverse weather in Alaska and limited growing season would likely further restrict the potential for mitigative success. Recolonization of the "new" shallow water habitat, however, may take years and result in reduced abundance and diversity of benthic species.

Freshwater Fisheries

FA4-8 A construction "window" of May 1 to July 15 has been proposed (pages 4-20 to 4-21) to minimize disturbance to migrating pink and chum salmon fry and spawning adults in Henderson and Seven Mile Creeks. Studies by NMFS Auke Bay Laboratory have shown that in early May, pink fry are still outmigrating from many Alaska streams. Therefore, shifting the construction "window" from May 15 to July 15, would more adequately protect migrant fry.

FA4-3 Section 2.3.2 evaluates the option of utilizing a combination of Sites A, B, and deep offshore (excluding organics), prior to the use of Site B′ for soil disposal.

FA4-4 We concur that construction practices which minimize the generation of excess spoil should be adopted in the development of the Anderson Bay site. Moving the construction camp site from Seven Mile Creek to Valdez, however, would accomplish very little in this regard as the preparation of the site as proposed would necessitate only 175,000 cubic yards of excavation/fill. This small volume would not be significant in reducing the amount of disposal material. As discussed in revised sections 2.3.1 and 4.16, there are other factors associated with the relocation of the camp site that have been reevaluated.

FA4-5 Section 2.3.2 has been revised and the analysis of using Site B′ as the construction dock was expanded. The conclusion of the FERC, based on this information, is that disposal at Site B′ is the preferred option and further, that the B′ location cannot be utilized for the construction dock, primarily due to construction scheduling issues.

FA4-6 We concur that mitigation is necessary for the marine wetlands and subtidal habitats affected by the proposed LNG facility and recommend in section 4.4.3 that Yukon Pacific submit a wetland mitigation plan for these areas. The recommendation has been revised to include a determination of the functional values of each wetland and provides for comments by the National Marine Fisheries Service (NMFS), and others, on the plan prior to approval.

FA4-7 Your concerns are reflected in the revisions to the recommendation for a wetland mitigation plan (see recommended mitigation measure 27).

FA4-8 We concur and have recommended in section 4.3.3 the adoption of the more conservative May 15 to July 15 construction "window" to protect migrant salmon fry.

FA4-9 We concur with the recommendation in the DEIS concerning vegetative buffers (page 4-25). Whenever possible, standing trees should be left along all freshwater streams in the proposed construction area. Buffers maintain water quality and provide a long-term source of woody debris necessary for the creation of fish habitat. Buffers should also be left along beach and wetland margins for aesthetics and maintenance of fish and wildlife habitats.

FA4-9 Comment noted.

Other Comments

FA4-10 A discrepancy exists in Figure 2.3.2-1 (page 2-56) and Table 2.3.2-2 (page 2-58); the figure shows sites B and B" have the capacity to hold 3.88 million cubic yards of spoil, whereas the table states the site B′ alone has the capacity to hold 3.88 million cubic yards of spoil.

FA4-10 Site B is actually a component of B′. In the text describing Site B′ (following table 2.3.2-2) it states "It [B′] utilizes Site B in its entirety but extends further to the west into the east end of Anderson Bay. This site would be built in two stages, B first and then B′ extension...". Consequently, the total volume of Site B′ includes the volume of Site B.

FA4-11 This DEIS does not include detailed monitoring plans for the construction and early life of the facility. For example, will index sites be established in the intertidal and subtidal areas to monitor changes in biological community structure and health? Who will do the monitoring, how often, what methods, and what are the reporting procedures?

FA4-11 As discussed in section 4.5.4 and recommended mitigation measure 22, a salmon fry utilization study has been recommended to be developed and conducted to determine the importance of nearshore areas that would be affected by construction relative to other areas in Port Valdez (see recommended mitigation measure 30 of the FEIS).

FA4-12 The DEIS also lacks information on the fate of the facility at the end of its 30 year proposed life span. Will structures be left standing, or will they be removed? Are there any post-operational restoration plans (revegetation of hillsides, riparian areas)? What will happen to the dam on Seven Mile Creek?

FA4-12 Under state law and lease requirements, Yukon Pacific is required to address the termination of any part of the pipeline system. These terms are set out in the state right-of-way documents: "Right-of-Way Grant for the Trans-Alaska Gas System from the United States of America to the Yukon Pacific Corporation," October 17, 1988; #F-83 941 and AA-53559) and "Trans-Alaska Gas System Conditional Right-of-Way Lease," December 10, 1988; ADL 413342. As landlord for the Anderson Bay facilities, termination plans and procedures will be developed in coordination with the Alaska Department of Natural Resources (ADNR) at the appropriate time in accordance with state desires.

Many of our other concerns were addressed adequately by the recommendations in the DEIS (pages 5-1 to 5-8). For example, we concur with the recommendation that Yukon Pacific, in conjunction with ADF&G, conduct an instream flow study of Seven Mile Creek to minimize impacts on spawning fish.

We hope this information will assist you in your review process. Please contact this office for further clarification, or if there is any way we can be of assistance.

Sincerely,

for

Steven T. Zimmerman, Chief
Protected Resources
Management Division

cc: Yukon Pacific - Anchorage
Alaska State Office, Bureau of Land Management, Branch of Pipeline Monitoring - Anchorage
USFWS, EPA, DGC, ADFG, ADEC, Corps - Anchorage

FA5

U.S. Department of Transportation

Research and Special Programs Administration

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REGULATORY COMMISSION

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400 Seventh Street, S.W.
Washington, D.C. 20590

AUG 9 1993

Ms. Lois Cashell
Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, DC 20426

Dear Ms. Cashell:

The Department of Transportation's Office of Pipeline Safety (OPS) has the following comments on the Draft Environmental Impact Statement (DEIS), Yukon Pacific LNG Project, May 1993, FERC/EIS-0071D, Yukon Pacific Corporation (YPC) Docket Nos. CP88-105-000 and CP88-105-001. This DEIS concerns the proposed Liquefied Natural Gas (LNG) Plant and Marine Terminal Site at Port Valdez (Anderson Bay), Alaska for the Trans-Alaska Gas System (TAGS). The comments address the Department's LNG safety standards contained in 49 CFR part 193.

Emergency Access Road

FA5-1 Starting on Page 4-68 of the DEIS, there is a discussion of the 49 CFR 193.2055 requirement for "ease of access" to provide for fire fighting equipment to reach an LNG terminal site, controlling LNG spill associated hazards, and for evacuation of personnel, and the requirement for an all-weather vehicular road for accessibility to an LNG plant contained in the National Fire Protection Standard NFPA 59A. YPC is proposing waterborne transportation for primary access/egress to the LNG plant.

Section 193.2055 states in part ". . . A site must provide ease of access so that personnel, equipment, and materials from offsite locations can reach the site for fire fighting or controlling spill associated hazards or for evacuation of personnel." OPS wants to comment that the "ease of access" requirement is a performance standard with the method of access not prescribed. The regulation's history makes it clear that a road is not required for "ease of access" if another method of access can be used to comply with 49 CFR 193.2055. However, we note that it is recommended in the DEIS that a permanent all-weather access road be built to allow emergency equipment and personnel access/egress between the plant and the City of Valdez.

FA5-1 **Comment reflected in sections 2.3.1.2 and 4.15.2.**

Dispersion Exclusion Zone

FA5-2 The prohibited activities contained in 49 CFR 193.2059 within an established flammable vapor dispersion exclusion zone are stated on Page 4-78 of the DEIS. They include in part:

> "Outdoor areas occupied by 20 or more persons during normal use, such as beaches, playgrounds, outdoor theaters, other recreational areas, or other places of assembly."

OPS interprets that the 20 person limitation cited does not apply to transient travel, including travel offshore, within the exclusion zone. Examples of such transient travel through the exclusion zone offshore would include travel by fishing boats or cruise ships. The regulations in 49 CFR Part 193 contain no travel restrictions within exclusion zones.

A public inquiry to us on this subject asked how a vessel travelling in the exclusion zone would be warned of an accident involving LNG. Under 49 CFR 193.2509(b)(2) an operator is required to be able to recognize an uncontrollable emergency and take action to minimize harm to the public and personnel, including prompt notification of appropriate local officials of the emergency and possible need for evacuation of the public in the vicinity of the LNG plant. OPS expects YPC to include offshore vessels in their emergency notification/evacuation plan.

Thank you for the opportunity to comment on the DEIS. If you have any questions on these comments, please contact Lloyd W. Ulrich of my staff at (202) 366-4556.

Sincerely,

George W. Tenley, Jr.
Associate Administrator for
Pipeline Safety

FA5-2 Comments reflected in section 4.15.3.

United States Department of the Interior

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OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

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Honorable Louise D. Cashell
Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

No Project Number Listed

RECEIVED BY

AUG 2 5 1993

Dear Mrs. Cashell:

The Department of the Interior has reviewed the draft environmental impact statement for the Yukon Pacific LNG Project, Port Valdez, Alaska and has the following comments.

Fish and Wildlife Resources

The draft statement presents an accurate description of the existing fish and wildlife resources of the project area. Alternatives regarding camp site placement, spoil disposal, and cargo dock location should receive additional evaluation in the final statement since insufficient information about reasonable alternatives has been presented.

FA6-1 Descriptions of many other project features also have insufficient information to assess the impacts from development. These include:

- final design and locations for all structural components of the project, such as access roads, bridges, Seven Mile Creek dam and impoundment
- site specific plans for erosion control and sedimentation
- instream flow/water supply requirements
- spill prevention, containment, and control plans
- stormwater discharge monitoring and mixing zone impacts within the receiving waters
- a bear proofing plan and mitigation measures to avoid bear/human conflicts
- size and locations of vegetative buffer strips between construction areas and waterbodies

FA6-1 We believe it is possible to realistically discuss potential impacts using preliminary design data that reflect currently available technology. Conditions have been added to ensure that final equipment specifications meet or exceed the preliminary design used in the analysis. The measures required to mitigate impacts associated with the topics referenced in this comment have been required by the FERC as permit conditions to be prepared by the applicant and fully reviewed and approved prior to initiation of construction.

FA6-1

- a revised site plan that would avoid grading and clearing the riparian zones within 100 feet of Seven Mile Creek and the gorge area surrounding waterfalls and associated intertidal areas at the confluence of the creek and Anderson Bay

- a revised wetland mitigation plan to identify all subtidal and intertidal wetlands that will be affected by the project and how those impacts will be avoided or minimized

- location, frequency, and duration of warm water discharges associated with the desalinization plant

- blasting plan and timing to avoid migrating or resident fish and marine mammals; and other planning details to avoid impacts to fish, wildlife, and their habitats.

These details of the project will require coordination with appropriate resource agencies and should be addressed in National Environmental Policy Act documentation as Yukon Pacific progresses through the public review and permitting process.

We note that the potential mitigation options recommended by Federal Regulatory Commission (FERC) staff in Section 5.3 of the draft statement have merit and could offset adverse impacts to fish and wildlife resources. The final statement should describe those mitigation measures that will be implemented.

Fish and Wildlife Coordination Act

FA6-2 The Fish and Wildlife Service (Service) will review and comment on interrelated federal actions that will be needed to implement the proposed Yukon Pacific LNG project. The Service will review and comment on any future supplemental environmental documents and will review applicable Section 10/404 permits from the Corps of Engineers for dredge and fill activities associated with this project. In addition, the Service comments separately for the Department of the Interior in consultations regarding Federal or Federally-permitted actions which affect streams and water bodies under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq., 43 CFR Part 17). The Department of the Interior will continue to work with Yukon Pacific Corporation to ensure that impacts to fish, wildlife, and their habitats are avoided, minimized, or adequately mitigated.

SPECIFIC COMMENTS

FA6-3 Page 2-62; Offshore Site.
We suggest additional investigation regarding regulatory

FA6-2 Comment noted.

FA6-3 Section 2.3.2 has been revised to expand the analysis of the offshore disposal alternative. In a letter dated June 28, 1994, the EPA stated that ocean dumping would create significant environmental and liability concerns and that project logistics, increased costs associated with offshore disposal, and the regulatory permitting schedule make this an infeasible option.

FA6-3 requirements to use this alternative be undertaken. Utilizing an offshore disposal site would reduce the amount of sub-and intertidal habitat destroyed by fill disposal. The use of this alternative should be more fully explored with the concerned agencies and discussed in the final statement.

Page 2-63; Cargo Dock Located at Site B'.

FA6-4 According to the wetlands evaluation technique used on this project, those wetlands proposed to be filled for the construction dock are of the highest value of any in the project area (see Table 3.4.3-1). All alternatives which will avoid or reduce the loss of these wetlands should be fully explored and implemented if at all possible.

FA6-4 See response to comment FA1-11.

Page 3-17; Section 3.4.1.4 Large Mammals; second paragraph, next to last sentence.

FA6-5 All of the brown bears were observed at Seven Mile Creek feeding on salmon. According to local fish guides, brown bears have frequently been seen in this area in previous years. Since this stream is the largest producer of salmon in this area, we suspect it is an important feeding site for these animals. Our observations of the bear trails in the area indicate that the bears access the lower creek from alpine spring and early summer use areas.

The last sentence of this section should be revised to read, "In addition, a skinned carcass of a brown bear was found in Seven Mile Creek during the June 1991 survey."

FA6-5 Text revision in section 3.4.1.4 (section 3.4.1.2 of the FEIS) has been made as suggested.

Page 4-21; Freshwater Fisheries; first sentence.

FA6-6 Proposed temporary crossing structures across all anadromous fish streams should be clarified in this section. At a minimum, an Alaska Department of Fish and Game Title 16 permit may be necessary to engage in these activities and Section 404 permits will be needed for placement of fill in wetlands or waterbodies. The final statement should provide this information.

FA6-5 Text revision in section 3.4.1.4 (section 3.4.1.2 of the FEIS) has been made as suggested.

Page 4-24; Section 4.4.1.4 Large Mammals.

FA6-7 As stated previously, the lower section of Seven Mile Creek appears to be an important feeding area for brown bears. This section should discuss that the location of the project facilities (camp and water supply dam) on or adjacent to this creek will be expected to cause these animals to avoid feeding in this area and increases the likelihood of bear/human conflicts. To better identify the importance of Seven Mile Creek as a bear feeding area, we recommend that a study of these animals be conducted for at least two years prior to construction. The objectives of this study would be:

- to identify the number of animals using Seven Mile Creek for feeding

FA6-7 See revised text in section 3.4.1.2 for a discussion of the importance of the lower section of Seven Mile Creek as a feeding area for brown bears. For a discussion of potential impact on bears and recommended mitigation see section 4.4.1.2. Subsequent to this comment, the U.S. Fish and Wildlife Service (FWS) has consulted with the Alaska Department of Fish and Game (ADFG) and favors convening a bear expert group to develop a preconstruction mitigation plan for bear-human interaction issues instead of the bear study referenced in this comment.

FA6-7
- identify the routes of access in and out of the area
- identify appropriate mitigation which may be necessary to offset the impacts to these animals.

Specific details of this investigation should be coordinated with the Alaska Department of Fish and Game and other concerned resource agencie and presented in the final statement.

FA6-8 The draft statement identified an alternative construction camp location at Valdez with road access to the project area. The use of this alternative would:

- reduce potential impacts to brown bear using Seven Mile Creek
- avoid clearing 38 acres of vegetation
- eliminate potential impacts to salmon due to flow alterations.

Based on this information we support the use of this alternative; however, more information must be presented regarding the road alignment, wetland involvement, raptor nests and the impact on resource use in the Valdez area and how it would be controlled.

FA6-8 See response to comment FA1-8 and the discussion in section 4.16.

Page 4-24; first paragraph.

FA6-9 The issue of bear/human conflicts should be addressed as part of a comprehensive environmental briefing orientation which should be required of all workers who would be present on the project site. We have included an example of the briefing used for the Bradley Lake Hydroelectric project in Alaska. The Joint Federal/State Pipeline Monitoring Office (JPO) and resource agencies may be available to assist in developing this program.

FA6-9 Thank you. We concur that environmental awareness for onsite workers should not be limited to bear/human interaction as there are many sensitive habitats and organisms within and surrounding the project site. To ensure that adequate environmental awareness is achieved, we have required Yukon Pacific to prepare and submit for review and approval prior to construction an implementation plan clearly outlining the types of environmental training and instruction that will be provided to onsite workers (see recommended mitigation measure 4).

Page 4-25; Section 4.4.3 Wetlands.

FA6-10 Although not considered under the wetlands evaluation system developed for this project, subtidal habitats are extremely valuable and need to be addressed as part of the mitigation plan. This section should also discuss the ramifications of using Site B' for the cargo dock, thereby preserving 12 acres of intertidal wetlands.

FA6-10 The possibility of avoiding Site B' for disposal of excess materials was examined in detail (see responses FA3-17 and FA4-5).

Last paragraph, last sentence.

FA6-11 Biologists at the Joint Pipeline Office have observed spawning salmon and waterfowl utilizing the existing pond complex and streams at the Old Valdez townsite. Although the proposed mitigation may have merit, any development must proceed prudently so as not disrupt the existing ecosystem. A detailed investigation must be conducted prior to development of this mitigation option to determine the best way to proceed.

FA6-11 We concur that additional plan development is required and have revised section 4.4.3 to require Yukon Pacific to specifically address in its revised wetland mitigation plan the existing functional values of each site to be altered.

Page 4-64; Section 4.13.2, Interference/Access Impacts.

FA6-12 The project can be expected to restrict fishing access in and around the project area. We recommend that this zone be as small as possible in order to minimize the impact to traditional use in this area.

Appendix F; DEIS Distribution List.

FA6-13 Please not that the name of the Office of Environmental Project Review was changed sometime ago to the Office of Environmental Affairs. Also, the National Forest System listed under the Department of the Interior should be listed under the Department of Agriculture.

It is recommended that copies of all environmental documents also be sent directly to the Joint Pipeline Office in Alaska for review.

FA6-14 Recent information about terrestrial ecology has become available and is enclosed. Appropriate information presented in these documents should be included when revising Section 4.4, Terrestrial Ecology.

We hope these comments will be helpful to you in the preparation of a final statement.

Sincerely,

Jonathan P. Deason
Director
Office of Environmental Affairs

Enclosures

FA6-12 Restricted fishing access in and around the project will fall under U.S. Coast Guard (Coast Guard) jurisdiction. See discussion in section 4.9.1.

FA6-13 Thank you for your comment. The correction has been made to the Distribution List now in appendix H.

FA6-14 The supplemental information you have provided has been used in making revisions to section 4.4.

STATE AGENCY COMMENTS

ORIGINAL

WALTER J. HICKEL, GOVERNOR

OFFICE OF THE GOVERNOR

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JUL -8 AM 10:13

Ms. Lois Cashell
Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

Dear Ms. Cashell:

SUBJECT: Docket No. CP88-105-000
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
YUKON PACIFIC CORPORATION (YPC)
LNG PROJECT

The State of Alaska (the State) has reviewed the Yukon Pacific DEIS that has been prepared by the Federal Energy Regulatory Commission (FERC) to satisfy the requirements of the National Environmental Policy Act (NEPA) and has prepared comments and suggestions on the full range of issues and plans presented. The enclosed comments are compiled from comments received by the Alaska Departments of Fish and Game (ADFG), Natural Resources (ADNR), Environmental Conservation (ADEC), Labor (ADOL), Public Safety (ADPS), the City of Valdez Coastal District. These are presented for your consideration in identifying any deficiencies needed to complete the EIS.

SA1-1 Page 2-15 through 2-16, Wastewater Treatment System: Reference is made that domestic wastewater from personnel facilities is anticipated to be of standard sewage strength. The domestic waste water generated from camp type settings is often stronger than standard sewage. For this reason package type treatment plants often need to be oversized to accommodate these wastes. The DEIS does not make reference to the quantities of domestic waste waters to be discharged both during construction and after operation. Also on page 2-16 it is indicated that desalination operations could result in discharge of 657 to 1,503 gpm. It is not indicated what quality this discharge will be. This is a potential waste water stream that will need to be addressed in the NPDES permit application and one that is not appropriate for discharge to package domestic waste water treatment plants. It may be that this water is of acceptable quality for discharge, however, it must be addressed.

SA1-2 Reference is made to oily waste water on page 2-16. The treatment method proposed for this is oil water separation with subsequent routing to the domestic waste water treatment system. ADEC discourages discharge of oily wastes into domestic waste water treatment plants. This may be the only alternative that exists. As such, ADEC would consider allowing limited quantities of this discharge; however, if alternatives exist for this waste stream they must be identified. The DEIS makes no attempt

SA1-1 **With respect to the strength of domestic wastewater, Yukon Pacific submitted a prediction of treated water quality from the wastewater treatment plant based on "similar sites." Quantity predictions are included in table 4.5.2-2. The statement of "standard sewage strength" has been revised in section 2.1.1.5 to read "...standard sewage strength, although it could be somewhat stronger based on the state's experience with camp-type settings." The predicted water quality of the desalination plant discharge is included in table 4.5.2-1. This effluent would not be run through the wastewater treatment plant.**

SA1-2 **With respect to oily wastewater, following the oil separation process the oily portion would be incinerated and not routed to the wastewater treatment plant. As discussed in section 2.1.1.5, only pretreated oily wastewater would be combined with domestic wastewater for biological secondary treatment to remove organics, some trace metals, and remaining settleable and suspended solids.**

SA1-3 to quantify the volumes of this water and the different sources. There could potentially be several dozen sources of oil contaminated waters, all of which must be addressed. In addition to oily water generated from the facility the issue of bilge water from the tankers must be considered; SA1-4 this could be a large source of contaminated water. ADEC is concerned about the quantity of oily water generated, the treatment technique, and the control which Yukon Pacific has over the generation of such wastes with respect to hazardous wastes entering any oily waste collection systems. For example hazardous solvents could easily be discharged to the system through tanker bilge or shop floor drains. All of these issues must be addressed. ADEC recommends that YPC does some realistic calculations of the quantities and qualities of oily waters to be generated and consider separate treatment for these wastes.

SA1-5 Waste water generated from the batch plant operation will certainly contain large amounts of solids and must be treated prior to discharge to receiving waters. Treatment for this type of waste is typically clarification and discharge, however, this requirement has not been identified or addressed in the DEIS.

SA1-6 Stormwaters generated from this facility have the potential to come into contact with oily waste waters. If this situation occurs these waters will need to be treated as if they are industrial wastes. This scenario is presently not addressed in the DEIS and needs to be included.

SA1-7 Page 2-37, Section 2.1.7, paragraph 3: The DEIS states that "Some individual state and/or local permits may not be required to construct this proposed project due to the Federal pre-emption status of the FERC certificate of public convenience." The DEIS should cite the statutory authority for this pre-emption, and should specifically list those State or local permits which would be pre-empted.

SA1-8 Page 2-37, Permit and Approvals Section: The proposed location for the LNG plant is presently zoned Unclassified by the City of Valdez. In order for this project to proceed, the property needs to be rezoned to Heavy Industrial and a Conditional Use Permit will need to be obtained by the Valdez Planning and Zoning Commissions for the LNG Plant. Prior to the construction of the project, plans and specification will need to be submitted to the City of Valdez for the issuance of the building permits.

Pursuant to the Valdez Coastal Management Program, Section 7.7-Planning for Major Projects, the City of Valdez requests that Yukon Pacific presents a plan to the Valdez Planning and Zoning Commission six months prior to the filing for the permit applications for the project. The plan must include a description, location and scheduling of the proposed project. Issues and conflicts will be identified and addressed during the Conditional Use Permit and rezoning permit processes.

SA1-9 Page 2-38 and 2-39, Table 2.1.7-1: In addition to the ADEC and EPA permits listed in the permits table, the following permits and approvals may also be required:

1. 401 Certification of the COE 404 Permit, Including a Short Term Water Quality Variance and possibly authorization of a Zone of Deposit (ZOD). If a Water Quality Variance or Zone of

SA1-3 Please refer to table 4.5.2-2 for a presentation of quantities and sources of potential pollutants from the site. Specific plant component sources need not be discussed individually, since Yukon Pacific has proposed to treat all oily wastewater from the plant facilities.

SA1-4 As described in sections 4.5.2.1 and 4.5.2.2, bilge water from LNG tankers must be discharged offshore, regulated to less than 100 parts per million (ppm) total petroleum hydrocarbons (TPH) if greater than 50 miles offshore and to less than 15 ppm TPH if within 50 miles. Refer to comment response FA3-23 for additional information on treatment of bilge water.

SA1-5 As stated on page 4-17 of the DEIS, "Water from the concrete batch plant could also affect water quality within outfall Nos. 6 and 7. Water runoff from the batch plant site, potentially high in fines and colloidal material, would be either pumped back into the water tank or allowed to drain to a permitted outfall following containment in the sediment ponds." We believe that containment in sediment ponds would be sufficient treatment for this water.

SA1-6 Please refer to section 4.3.2.1 where a SPCC Plan and a stormwater monitoring program are recommended for development. In addition, as stated on page 4-32 of the DEIS "there would be no uncontrolled site drainage except for drainage from the perimeter of the site," for which a vegetative buffer strip of 50 feet has been recommended. Consequently, most of the stormwater would be discharged to one of the outfalls subject to the new NPDES stormwater permit requirements. These plans, once developed, would be filed with the FERC and provided to the EPA as part of the documentation associated with the NPDES permit application.

SA1-7 Comment addressed in new paragraph on page 2-42 of the FEIS.

SA1-8 Comment noted. The text has been revised in section 2.1.7 to reflect the required zoning changes. Table 2.1.7-1 has also been revised accordingly.

SA1-9 Comment noted and text in table 2.1.7-1 revised accordingly.

SA1-9 Deposit is required the COE application must specifically state this and submit the required information. COE Public Notice should also include these activities as part of the notice.

2. 401 Certification of the NPDES Section 402 Permit.

3. Domestic/Industrial Wastewater Engineering Plan Approval if Septic Disposal is not used.

4. Public Drinking Water System Engineering Plan Approval and Certificate to Operate, size and class of water system.

5. Solid Waste Disposal Permit for the on-site landfill, pg 2-16.

6. Oil Spill Contingency Plan

Waste Water discharges which are not properly addressed are domestic waste waters, oily waste waters, and batch plant waste water.

SA1-10 **Page 2-39, Table 2.1.7-1 (ADFG):** For an ADFG Fish Habitat Permit issued under AS 16.05.870, it is more accurate to say that a permit is required to: "construct a hydraulic project; use, divert, obstruct, pollute; change the natural flow or bed; or to use wheeled, tracked, excavating, or log dragging equipment in the bed." Under AS 16.05.840, a Fish Habitat Permit is required if efficient upstream or downstream passage of any fish species is effected.

SA1-10 Comment noted and text in table 2.1.7-1 revised accordingly.

SA1-11 **Page 2-39 Table 2.1.7-1 (ADNR):** Change "Right-of-Way Lease (AS38.55) ..." to "Right-of-Way (AS38.35)...."

SA1-11 Comment noted and text in table 2.1.7-1 revised accordingly.

SA1-12 **Page 2-39 Table 2.1.7-1, (ADNR):** Salvage Timber Sale Permit needs to be added to the list of ADNR authorizations. In the event of construction of the Anderson Bay facility 478 acres would be cleared (see section 2.3.1) and would be offered for sale as salvage timber.

SA1-12 Comment noted and text in table 2.1.7-1 revised accordingly.

SA1-13 **Page 2-39, Alaska Coastal Policy Council:** This should be changed to the Alaska Division of Governmental Coordination, and the authority to issue consistency determinations should be cited as AS 46.40 and AS 44.19 and Alaska Administrative Codes 6 AAC 50 and 6 AAC 80 of the Alaska Coastal Management Program.

SA1-13 Comment noted and text in table 2.1.7-1 revised accordingly.

SA1-14 **Page 2-39, Table 2.1.7-1,:** Within the State of Alaska the State Fire Marshall is the State Building Official, an all plans for construction of buildings, tanks, dock, construction camps, etc., must be reviewed and approved by his office before construction is started according to AS 18.70.080. The Permit and Approval Section does not include in Department of Public Safety, Division of Fire Prevention. The Department of Public Safety must be included and a Building Permit must be obtained prior to starting any construction.

SA1-14 Comment noted and text in table 2.1.7-1 revised accordingly.

SA1-15 **Pages 2-44 through 2-54, Alternative Construction Camp and Disposal Plans:** The Valdez City Council passed Resolution 93-42 which supports housing workers at the Anderson Bay construction site provided that facilities meet or exceed all applicable code and safety requirements. Housing workers at the work site will reduce the social and public safety impact of the projected peak construction work force of approximately 4,000 people.

The discussion of alternative construction camp sites does not adequately provide the social-economic impacts for using the camp in Valdez. The State requests further presentation and consideration pertaining to the impacts on socio-economic issues, eg. utilities, grocery, recreation and park facilities, school and hospital services, road maintenance, fish and game management, police service, fire protection, housing, etc.

The construction workers will become, at any location a direct affect on the community. As part of the community there will be an increased demand for services. The camp alternative at Anderson Bay greatly reduces these impacts. Lack of housing may constitute the most important negative impact on the community. If the Valdez camp location is chosen as an alternative the cost of the facility will be greatly increased. (ie. It is estimated that there will be a three hour transit time for each worker. This time is non-productive and at the peak of the project will cost approximately 12,000 work hours per day. This time must be compensated for as an additional estimated cost to YPC of $400,000 per day at the peak of construction. These figures were derived using the average rate identified on page 4-56.)

Because of the previously mentioned impacts, the State supports the Seven Mile Creek Construction Camp Alternative. The Valdez camp is still available as an additional option to reduce any overflow housing demands during different peak construction periods.

SA1-16 Pages 2-52 through 2-54: The State opposes the Valdez Camp with Road Access Through the Alyeska Terminal alternative for the reasons stated above. In addition, there exists the potential to negatively affect the security of the Alyeska Pipeline Terminal facility. The integrity and safety of the Trans Alaska Pipleine System (TAPS) and associtae facilities must be maintained. According to a recent risk analysis completed on the TAPS, sabotage is determined the highest potential for damage to the system. This risk is increased every time access across the terminal is required, which will be a daily requirement for approximately 4,000 workers on a round-trip daily basis. This risk is too great to State of Alaska. On page 3-51 the first paragraph recognizes that the lack of road access limits use of the western Port of Valdez.

SA1-17 FERC presents the requirement of an access road through the Alyeska Terminal facility in the event that evacuation is necessary as a result of an emergency for the expedient transportation of emergency equipment and personnel. The State has determined that there are other options available and requests that FERC address other alternatives. Possibilities to be evaluated are additional nearby emergency shelters or staging areas, fortification of proposed structures to protect the workers, access via water, additional and emergency equipment, etc.

SA1-15 Comment reflected in section 4.16. Based on all comments received on the DEIS relative to this issue, the negative features of housing construction workers in Valdez outweighed the onsite camp at Seven Mile Creek. Please refer to the revised discussion in sections 2.3.1, 4.16, and 5.2.2.

SA1-16 The state's position is acknowledged and reflected in section 4.16.

SA1-17 Comment reflected in section 4.15.2.

SA1-18 Finally, the construction of a permanent access road will become an attractive nuisance for the public and will place unnecessary pressure on the State to open this road to the public. The access road would allow activities with in the "Dispersion Exclusion Zone".

SA1-19 Page 3-14 and Table 3.3.2-2: The DEIS has not correctly represented application of the Alaska Water Quality Standards to the waters potentially impacted by the project. The DEIS states that freshwater is to be protected for only Water Supply drinking, culinary, and food processing I(A)(i). Similarly the DEIS states that marine waters are only protected for aquaculture II(A)(i).

The Water Quality Standards set the degree of degradation that may not be exceeded in any body of water as a result of human actions. The criteria set out in 18 AAC 70.020 PROTECTED WATER USE CLASSES AND CRITERIA clarify that the fresh water uses to be protected are drinking, culinary, food processing, agriculture, aquaculture, industrial, recreation, growth and propagation of fish, shellfish, other aquatic life and wildlife, and harvest for consumption of raw mollusks or other raw aquatic life.

SA1-20 Page 3-15, 3.3.3 Fisheries: Fish Surveys conducted by ADFG and USFWS biologists (JPO biologists) found slimy sculpins and three-spined sticklebacks in intertidal pools near the mouth of Nancy Creek behind the island. It is not certain if the Dolly Varden found in Nancy Creek are resident or anadromous.

SA1-21 Page 3-17, 3.4.1.4, and Page 4-23, Large Mammals: JPO biologists have not observed "large concentrations of brown bears at the Anderson Bay" project site as stated in the DEIS. However, both brown and black bears have been observed feeding on salmon in both Sevenmile and Nancy creeks. In addition, numerous tracks, scat, bear trails, and partially eaten fish carcasses have been observed in the lower portions of these streams. Brown and black bears have also been observed by JPO biologists in the alpine and subalpine zones in both the Sevenmile Creek drainage and the adjacent Salmon Creek drainage in early July. A helicopter pilot reported that he observed 14 separate black bears in the upper Salmon Creek drainage in August 1991. The dead brown bear found by JPO biologists was a skinned carcass found in the mouth of Sevenmile Creek. JPO biologists have not made an estimate of brown or black bears using the project area. During the 1992 salmon surveys we had planned to attempt to note obvious characteristics of bears to see if we could determine how many individuals were using the area. Unfortunately, a combination of factors (poor salmon returns in Nancy Creek, heavy public use at Sevenmile Creek, and weather) prevented this. JPO biologists speculate that the number of bears using the project area could be significant depending on the availability of salmon and berries. However, the only way to actually determine the importance of the area to bears would be to conduct a population estimate based on extensive radio collaring of bears. An alternative would be to convene a group of bear experts to predict the number of bears present and potential impacts based on professional judgement, and then to recommend mitigation measures. ADFG clarifies their recommendation on how to address bears in our comments on section 5 of the DEIS (see comment #39).

SA1-18 Comment reflected in section 4.15.2.

SA1-19 Comment noted. Please refer to comment response FA3-19.

SA1-20 Comment noted. The text in section 3.3.3 has been revised accordingly.

SA1-21 The DEIS did not report "large concentrations of brown bears at the Anderson Bay" project site, but at an unmarked stream draining into Jack Bay, 3 miles south of the project area. Nevertheless, the text in section 3.4.1.4 (section 3.4.1.2 of the FEIS) has been modified to reflect the clarifications and additional information provided.

SA1-22 Page 3-30 and Table 3.5.2-3: Except as otherwise specified in 18 AAC 70.050(b), state waters are protected for all use classes. None of the freshwater or marine waterbodies potentially impacted by the project are exempted from protection for all use classes. The DEIS needs to be revised so that 1) fresh waters are protected for Classes IA, B, and C and 2) marine waters are protected for Classes IIA, B, C, and D.

SA1-22 See response to comment FA3-19.

SA1-23 Page 3.7, Air Quality: The first paragraph in this section should be amended as follows:

> Air quality can be affected by both the construction and operation of the LNG plant. Air quality contaminants from onsite construction activities can be divided into two types: 1) the generation of fugitive particulate matter dust, as a result of construction operations and 2) the emissions of gaseous criteria pollutants from construction equipment. Air quality contaminants generated during normal operations would result form natural gas-fired turbines and equipment, fuel use in LNG tankers, operation of an incinerator and wastewater treatment systems.

SA1-23 Comment accepted. The first paragraph of section 3.7 has been revised accordingly.

SA1-24 Pages 3-50 and 51, Recreational Resources: The most current ADFG estimate is that in 1991, 31,088 boat and shoreline anglers made 38,194 trips and spent 67,891 angler days fishing in Port Valdez. ADFG/USFWS biologists have frequently observed numerous small boats fishing at Sevenmile Creek and in Anderson Bay. During site surveys, ADFG/USFWS biologists have occasionally recorded the number of boats observed, but this information is not statistically valid. It should be noted in the appropriate section of the DEIS that the area around Anderson Bay is used for cost recovery fishing by the Valdez Fishery Development Association for their hatchery, and that commercial salmon fishing occurs here as well.

SA1-24 Section 3.9.3.1 has been revised to reflect the more recent figures for angling effort and section 3.9.3.2 addresses cost recovery and commercial fishing around Anderson Bay.

SA1-25 Page 3-50, 1st paragraph: "The Alaska State Parks Department.." needs to be changed to "The State of Alaska, Department of Natural Resources, Division of Parks and Outdoor Recreation..."

SA1-25 The recommended change has been made in section 3.9.3.1

SA1-26 Page 4-2, Surface Erosion: ADGC is not the lead State agency for review of the site specific erosion control plan. Such a plan is a requirement of the State's conditional right-of-way lease; therefore, ADNR would be the lead agency. All State agencies will have the option of participating in the review of the plan.

SA1-26 Comment noted and the appropriate changes have been made to section 4.1.2.

SA1-27 Pages 4-4 and 4-5, Stormwater Control: Reference is made that a plan for stormwater control is to be submitted to the EPA for development and approval. This plan would additionally be required to be developed and reviewed by the ADEC for evaluation with the Water Quality Standards of the State of Alaska. The review and approval process that is being required should be coordinated with the state and local entities so that all state, federal and local requirements are met. The DEIS should also explain, at a minimum, the conceptual process that FERC will be using to evaluate these plans for approval. FERC should clarify if this process is to be a duplication of other state, federal or local approvals and how this review and approval process will be coordinated with other agencies.

SA1-27 Comment noted and text in section 4.1.2 revised accordingly.

SA1-28 Page 4-15, Water Resources: The merits of using various Anderson Bay streams as sources to supplement water withdrawals from Sevenmile Creek are discussed. ADFG would prefer that water be withdrawn from Short, Henderson, Jug, Terminal, and Aquaculture creeks before being taken from Sevenmile and Nancy creeks. Sevenmile and Nancy creeks are the only streams at the project site which the ADFG believes support populations of wild salmon. Although salmon have been occasionally observed spawning in the intertidal zone of some of the other streams, the department believes that these fish are either hatchery or wild strays. The area of potential spawning habitat in the other streams is minimal. The impact of water withdrawals from these other streams would consequently be less than withdrawals from Sevenmile and Nancy creeks.

SA1-29 Pages 4-78 thorough 4-80, Dispersion Exclusion Zones: This section needs further clarification on the expected duration that the listed activities are prohibited (ie. before site approval, during construction, operations of the facility).

SA1-30 Page 4-93, Table 4.16-2, Freshwater Fisheries: Salmon have only been regularly observed in two streams at the project site and not in eight streams.

SA1-31 Page 5-8, Alternative Construction Camp Sites: The State supports the Sevenmile Creek construction camp proposed by YPC as opposed to the Valdez camp; although, there are concerns related to the Sevenmile Creek camp. We believe that using the onsite camp at Sevenmile Creek would result in less long-term environmental impacts than the Valdez camp, which would require constructing a permanent all-weather access road with several additional stream crossings. It is the State's assessment that if the Sevenmile camp is used, the permanent road would not be required. We also understand that regardless of which camp alternative is selected, the dam on Sevenmile Creek would still be required for construction and operation of the LNG facility. Use of the onsite camp would result in potentially significant short-term (for at least the period of construction and until the site is restored) impacts to Sevenmile Creek and fish and wildlife using the area. These impacts can be largely mitigated through careful consideration of environmental concerns during the design and camp operation phases, and during the site restoration phase following construction. It is the State's experience, that housing construction workers in onsite construction camps is preferable because their off-duty activities (related to hunting and fishing and competition with local residents for fish and wildlife resources) can be more closely controlled. In addition, constructing permanent access roads is potentially the most significant

SA1-32 long-term impact associated with many projects. The DEIS does not adequately addresses the long-term impacts associated with a permanent all-weather access road.

SA1-33 Page 5-9, Alternative Disposal Sites: From a biological viewpoint, the State of Alaska supports using alternative disposal sites instead of the proposed construction dock in the intertidal area near the mouth of Nancy Creek. This intertidal area has important biological values, including juvenile salmon habitat and waterbird feeding, although these values are not well understood. The State cannot comment at this time on the effects that other alternatives would have on YPC's construction plans. It is our understanding that YPC has expressed concern that precluding use of the proposed construction dock would be a significant impact to the project. The DEIS does not adequately addresses offshore disposal

SA1-28 The expressed concern has been added to the discussion of water supply in section 4.3.1. As noted in that section, Short Creek was considered as a supplemental source but its flows, being less than 12 percent of Nancy Creek and less than 5 percent of that in Seven Mile Creek on average, were clearly inadequate. Furthermore, Henderson, Aquaculture, and Jug Creeks are outside of the proposed site and Terminal and Strike Creeks are comparable to Short Creek in drainage area.

SA1-29 Please refer to comment letter FA5. The text in section 4.15.3 has been revised to include comments relative to the Dispersion Exclusion Zone made by the U.S. Department of Transportation's (DOT) Office of Pipeline Safety.

SA1-30 Comment noted; however, the point made in table 4.16-2 was not limited to only salmon fishing or to the project site itself, but to fishing in any accessible stream between the Alyeska Marine Terminal and the site and for any species.

SA1-31 Comments reflected in sections 2.3.1.1 and 4.16.

SA1-32 The long-term impacts of the access road are analyzed in section 4.16. While the eastern 1-mile-long segment would require new right-of-way, the western 2 miles would use the last part of the 700-mile-long TAGS right-of-way.

SA1-33 See responses FA3-17 and FA4-5 and the revised text in section 2.3.2.

SA1-33 site alternatives, or reconfiguration of onsite disposal sites. It is recommended that FERC further investigate the offshore disposal site option in consultation with other agencies. If the proposed construction dock is the selected alternative, then the nearshore salmon fry utilization study discussed in FERC staff recommendation 22 should be designed and conducted so that impacts can be assessed and adequate mitigation developed.

Several options are presented regarding excess rock and overburden disposal. Marine disposal is one option presented. The State does not object to rock disposal in the marine environment, however, disposal of organic overburden in the marine environment presents significant environmental problems. The State does not consider organic material disposal in the marine environment an acceptable alternative. This type of disposal can cause suspended solids, turbidity, and color problems as immediate short term impacts and the possibility of significant mineral leaching in the long term. In addition to these impacts, the benthic environment would likely have long term cumulative degradation. Although short term impacts have been traditionally the primary concern of the State, the State has determined that there is insufficient information presented in the DEIS to allow marine disposal of organic material to be considered an option. The State is amenable to allowing solid rock marine disposal. The State recommends that upland sites for disposal of organic materials be further investigated. We understand that there is 3,018,000 Cubic Yards of organic materials and 735,000 Cubic Yards of waste rock which will require disposal.

Also see attached memo from Anne Daily of EPA to Ruth Siquenza of EPA. ADEC concurs with her memo and include it herein by reference. (see attachment I).

SECTION 5.3 FERC STAFF RECOMMENDED MITIGATION MEASURES

SA1-34 Section 5.3, FERC Staff Recommended Mitigation Measures: There appears to be a duplication of requirements between Items 7, 30, and 31 and the State lease requirements for engineering review and the NTP process. Please explain in the DEIS the process FERC will use to approve or disapprove the required listed submittals. Provided these requirements remain in effect for the export license, the State Pipeline Coordinator's Office requests to be listed as an agency to receive the information you have requested.

SA1-35 Based upon ADNR's vapor dispersion calculations for Tank 6, the SPCO recommend that the marine flare be located at least 800 feet and preferably about 1200 feet away from the nearest LNG storage tank. Current preliminary design drawings indicate the flare to be approximately 700 feet from the nearest storage tank.

SA1-36 Page 5-11, FERC Staff Recommendation 4: The ADNR strongly supports the requirement that YPC shall hire at least one independent environmental inspector responsible for monitoring and ensuring compliance with mitigative measures. In our experience with several major construction projects, independent environmental inspectors have been successful in ensuring a high degree of compliance with environmental regulations. Since the inspectors are employed by the company they are often

SA1-34 **Typically, any recommendation that the Commission includes as a condition to the Order and requires review and approval is delegated to the Director of the Office of Pipeline Regulation (OPR). Normally, the Director will issue a clearance only if the technical staff determines that all submittals satisfy the condition for a given component of a project. Also, recommended mitigation measure 10 requires submittals with the State Pipeline Coordinator's Office (SPCO).**

SA1-35 **The exact location of the marine flare is an issue that will be addressed in the detailed design phase of the project. Recommended mitigation measure 10 requires submittals to the SPCO.**

SA1-36 **Recommended mitigation measure 4 has been modified per comment (see recommended mitigation measure 7 of the FEIS).**

SA1-36 aware of information not available to regulatory agencies. FERC and YPC may want to consider agency involvement in selection of independent inspectors, which would give the inspector greater credibility with regulatory agencies. The SPCO requests that FERC revise this recommendation to require submittal of the status reports to all state and federal agencies so that all are kept fully informed of compliance issues.

SA1-37 Page 5-11, FERC Staff Recommendation 5: The FERC requirement for a site-specific erosion control and sedimentation plan appears to duplicate an existing State of Alaska requirement for a similar plan. FERC also includes a requirement that YPC submit the plan to FERC together with the comments of appropriate State agencies. We are concerned that this will place an additional burden on the agencies. What process will FERC use to ensure that it coordinates it's efforts with State agencies (or other Federal agencies)? Is there a need for this FERC requirement if it duplicates an existing State of Alaska requirement? The DEIS should reference State of Alaska requirements and mention that provided the State continues to maintain these requirements there is no need for a duplicate FERC requirement.

SA1-38 Page 5-12, FERC Staff Recommendation 7 ii: The ADNR agrees with your recommendation that the design earthquake effective acceleration of 0.6 g^n be used. ADNR does not agree with the Appendix A conclusion that the 30-year projected life is not properly justified and believe that the conclusion that the project life should be 200 years is unsubstantiated. Previous communications with FERC on this subject including support documentation for the stated position is attached in attachment #2.

SA1-39 Page 5-12, FERC Staff Recommendation 7iv: The ADNR disagrees with the requirement that vertical design accelerations be set equal to horizontal accelerations. The Yakataga Gap Region has a low angle of slip relative to vertical loads. The requirements found in CFR 193 are very explicit with built-in safety that states vertical and horizontal acceleration must be equal if the source distance is 10 miles or closer. Appendix A page 5, Item 5 conclusions state that source distance to be 12 miles. The more correct approach would be to accept Hall's recommendation of 2/3 horizontal accelerations to vertical accelerations.

SA1-40 Page 5-13, FERC Staff Recommendation 8: The ADFG supports this requirement that YPC shall prepare a detailed water balance and design supply analysis in consultation with the ADFG, ADNR, and ADEC. As part of this analysis ADFG recommends that YPC consider importing water from offsite if feasible.

SA1-41 Page 5-13, FERC Staff Recommendation 9: The ADFG supports the recommendation that YPC conduct an instream flow study to determine the minimum flow requirements necessary to maintain adequate flows for fish. This recommendation is consistent with existing ADFG and ADNR requirements under the authority of Alaska Statutes. If FERC includes this requirement in it's approval YPC should be required to consult with ADNR and ADEC as well as the ADFG each of which have different but complementary authority. Under the statutory authority of ADFG a minimum requirement of 2 years of flow monitoring data be gathered to properly evaluate instream flow requirements in

SA1-37 As the lead agency responsible for ensuring that the requirements of the National Environmental Policy Act (NEPA) are met, the FERC must review the adequacy of Yukon Pacific's site-specific erosion control and sedimentation plan. Our recommendation for Yukon Pacific to secure input from the ADNR is an attempt to avoid duplicate approvals from other agencies. The goal of this process is to have Yukon Pacific develop a single plan that satisfies the requirements of all of the various Federal and state agencies involved in the review of the project.

SA1-38 Thank you for your support on the 0.6 g acceleration value. This comment erroneously states that we believe the service life, or the design life, of the facility should be 200 years. Neither the DEIS nor the NIST appendix state that. Both documents state that there is a very high likelihood that there will be enough gas available to support continued operation of the facility beyond 30 years. Please refer to response to comment A1-1.

SA1-39 As we stated, the DOT requirement is based on a 10-mile source-distance. This is the baseline safety standard and applies generally to all active faults whether or not they involve a vertical component of crustal displacement. Because of the following factors, we believe the condition should remain:

- the distance is very close to the minimum specified in the regulation;
- the 12-mile figure is not accurate to the implied precision; and
- the fault in question has a significant vertical component of motion.

However, we have modified the entire condition to allow for modifications based on the final design reports required of Yukon Pacific. Please refer to the response to comment A1-1.

SA1-40 Thank you for the comment.

SA1-41 anadromous fish streams. Ideally, 5 years of flow data should be gathered if feasible. An alternative to an actual instream flow study requiring gathering of streamflow data would be for ADFG, ADNR, ADEC and YPC to agree on use of synthesized data and then to use the Tenant Method to establish minimum flow requirements. This should be noted on both pages 3-11 and 4-14 of the DEIS. Additionally, the assumption of a minimum flow requirement of 0.20 cfs (page 4-14) is probably not correct. We expect that minimum flows would be far greater than that. As previously discussed, this FERC requirement duplicates existing State of Alaska requirements. We recommend that FERC consider referencing these requirements and mention that provided the State continues to maintain these requirements there is no need for a duplicate FERC requirement.

SA1-41 Sections 3.3.1.1 and 4.3.1 have been revised to indicate that minimum flow requirements for these streams would be established following a minimum of 2 years of in-stream flow measurements. As suggested, an alternative option would be for the ADFG, ADNR, ADEC, and Yukon Pacific to agree on the use of synthesized data and the Tenant Method to establish minimum flow requirements. The text in section 4.3.1 has been modified to reflect the state's opinion that a minimum flow of 0.2 cfs is probably inadequate.

SA1-42 **Page 5-13 Through 5-16, FERC Staff Recommendation Mitigation Measures:** Recommendation's 8,9,16,19,22,23, and 24 require action to be taken by state agencies as a condition of FERC's approval of the "Place of Export". Although ADNR agrees that the state agencies wish to be involved in the development of the plans, the ADNR currently has this requirement through the conditional lease issued by the State to YPC.

SA1-42 These recommendations require that Yukon Pacific consult with the various Federal and state agencies to develop monitoring and mitigation plans. It should in no way be construed that the agency is required to participate in consultation. Similarly, it does not preclude various agencies, through their own regulatory process, from review or consultation with Yukon Pacific.

SA1-43 **Page 5-14, FERC Staff Recommendation 12:** The ADFG supports this recommendation concerning the location of an access road crossing of Nancy Creek.

SA1-43 Thank you for the comment.

SA1-44 **Page 5-14, FERC Staff Recommendations 13 and 14:** The ADFG normally includes an instream construction timing window in Fish Habitat Permits issued under AS 16.05.870. In some instances we may approve site specific exceptions to timing windows depending upon the exact nature of the activity, provided that adequate measures are employed to mitigate adverse impacts to fish. Even during the construction window, we do not normally allow instream construction activities that result in significant adverse impacts to fish.

SA1-44 Recommended mitigation measures 13 and 14 now make reference to the ADFG fish habitat permit timing window (see recommended mitigation measures 21 and 22 of the FEIS).

SA1-45 **Page 5-15, FERC Staff Recommendation 15:** The ADFG supports retention of riparian buffers along Sevenmile Creek, where feasible. Retention of buffers will reduce the level of adverse impact to the creek.

SA1-45 Thank you for the comment.

SA1-46 **Page 5-15, FERC Staff Recommendation 16:** Reference is made that ADFG is to be consulted to ensure that the project does not violate the Bald and Golden Eagle Protection Act should be deleted. The department has no authority under this Federal legislation.

SA1-46 Reference to ADFG has been deleted from recommended mitigation measure 16 (see recommended mitigation measure 24 of the FEIS).

SA1-47 **Page 5-15, FERC Staff Recommendation 17:** The ADFG strongly supports this requirement that YPC develop a plan for avoiding bear/human conflicts. The State of Alaska has also included a requirement for a Human/Carnivore Interaction Plan in the conditional lease. The ADFG always stresses methods of preventing conflicts with bears (fencing, incineration of food wastes, worker education) as opposed to moving or destroying problem animals.

As part of efforts to mitigate adverse impacts to bears using the Anderson Bay area, the State recommends that YPC be required to consult with the ADFG concerning implementation of full

SA1-47 Recommended mitigation measure 17 has been augmented to include consultation with the ADFG and the Valdez Chief of Police during preparation of a plan to mitigate impacts on bears from both habitat loss and bear/human interaction (see recommended mitigation measure 25 of the FEIS).

SA1-47 mitigation of adverse impacts to both black and brown bears. Mitigation of preventable human/bear conflicts can be adequately addressed with the plan discussed above. Mitigation of impacts related to potential bear habitat loss is more problematic. This issue involves several questions: how many bears will be impacted; is the number significant; what specifically are the predicted and actual impacts; and what can realistically be done to mitigate the impacts? The ADFG sees two possible options to address these issues. Option A involves developing a study design to document existing bear use of the site and adjacent areas prior to development. At least 3 to 4 years of preconstruction data would be required. A prediction of impacts is then made based on the data gathered. Following construction another study is conducted to determine the actual impact of the project on bears. Based on the actual documented impact YPC would then be required to provide mitigation. This process is expensive and time consuming, and there is no guarantee that definitive population, impact and mitigation information can be developed. Option B involves convening a panel of agency bear experts familiar with similar habitats who, in consultation with YPC, would develop a worst case scenario of potential project impacts. YPC would then be required to provide mitigation based on the predicted impacts. The ADFG recommends that a requirement to mitigate bear habitat loss be included in the EIS. We further recommend that YPC be required to consult with the ADFG to select either option A or B, or some other similar method, to mitigate those impacts.

SA1-48 **Page 5-15, FERC Staff Recommendation 18**: The ADFG supports the FERC recommendation to maintain 50 foot wide buffer zones between construction areas and waterbodies where feasible. ADFG recognizes that this may present a problem for site development in some instances, and would not oppose waivers of this provision where it is not feasible.

SA1-48 **Comment noted.**

SA1-49 **Page 5-15, FERC Staff Recommendation 19**: The ADFG supports the requirement for a wetland mitigation plan but believes that such a plan must be part of a comprehensive mitigation plan for the entire project. Mitigation for impacts to all important resources (not just wetlands) at Anderson Bay must be combined with consideration of impacts and mitigation options for the entire pipeline project. Mitigation options would then be prioritized based on importance of resources, scarcity, feasibility, and likelihood of success. Until we know specifically what the entire project entails, and exactly what resources will be impacted, a meaningful comprehensive mitigation plan cannot be developed. Until that time, only conceptual mitigation measures can be discussed. The State recommends that the agencies and YPC jointly develop a mitigation strategy (which is consistent with State and Federal laws) to guide project development. A successful mitigation strategy would guide agency and YPC decisions, and would provide guidelines for eventual preparation of a project-wide mitigation plan.

SA1-49 **Comment noted.**

SA1-50 **Page 5-16, FERC Staff Recommendation 22**: The ADFG supports the proposed salmon fry utilization study designed to determine the importance of nearshore areas affected by the project. This study should be conducted by YPC in consultation with the ADFG. It is recommended that ADNR also be consulted since they have the authority as the State's land manager.

SA1-50 **Consultation with the ADNR has been added to recommended mitigation measure 22 (see recommended mitigation measure 30 of the FEIS).**

SA1-51 Page 5-16, FERC Staff Recommendation 23: The State supports the requirement that YPC develop a marine blasting plan which considers fish and marine mammals. This is also a requirment by the State's conditional lease.

SA1-51 Thank you for the comment.

SA1-52 Page 5-16, FERC Staff Recommendation 24: The State supports the requirement that YPC consult with various agencies to determine the location, frequency, and duration of warm water discharges into Port Valdez.

SA1-52 Thank you for the comment.

SA1-53 Page 5-17, FERC Staff Recommendation 28: The ADFG is strongly opposed to this requirement that YPC develop for FERC approval an outdoor usage plan to ensure that normal outdoor usage activity does not exceed 20 people within the dispersion exclusion zone. To limit outdoor usage to 20 people would remove a significant portion of the primary sportfishing and recreation area of Port Valdez.

SA1-53 This recommendation has been dropped since the DOT (see response letter FA5) indicated that the 20-person limitation does not apply to water-based activities and there are no established or planned facilities of the type affected on the south shore of Port Valdez within the exclusion zone.

SA1-54 Page 5-18, FERC Staff Recommendation 35: As discussed in comment 11, the State believes that constructing permanent access roads is potentially the most significant long-term impact associated with many projects. The DEIS does not adequately addresses the long-term impacts associated with a permanent all-weather access road to the Anderson Bay site.

In addition, the City of Valdez has passed Resolution 93-42 which states that development of the Anderson Bay terminal facilities does not require construction of an all-weather road through the Alyeska Pipeline Service Company property.

SA1-54 Please refer to response to SA1-32.

SA1-55 Page 5-19, FERC Staff Recommendation 40: As discussed in comment #26, from a biological viewpoint, the ADFG supports using alternative disposal sites instead of the proposed construction dock in the intertidal area near the mouth of Nancy Creek. ADFG believes that this intertidal area has important biological values, although these values are not well understood. However, ADFG cannot comment on the effect that requiring use of the site B' alternative would have on YPC's construction plans and project feasibility. If the site B' alternative presents a significant problem for YPC's site development and utilization, the proposed construction dock location will not be opposed provided that adequate mitigation measures as determined by the proposed salmon fry utilization study are implemented.

SA1-55 Comment noted.

SA1-56 The Alaska Department of Labor (ADOL) enforces various regulations on worker safety and health and on integrity of plumbing, electrical, and boiler pressure systems. ADOL also regulates various labor laws to assure that employees are properly compensated for their work. The DEIS does not address these issues. The DEIS should indicate that employees and employers are required to meet these laws and that they should contact DOL before the project starts to make sure that they meet all of the various requirements of various worker protection laws. Protection of Alaskan workers during the construction of this pipeline and associated facilities is as important as the protection of Alaska's environment.

SA1-56 Your comment is noted and section 2.1.4.1 and table 2.1.7-1 have been revised to demonstrate the need for Yukon Pacific to design both temporary and permanent facilities and to undertake construction and operational practices that meet state worker protection laws.

SA1-57 Finally, it is important that all mitigation studies, reports, and permit issues relating to the Yukon Pacific LNG Pipeline and associated facilities be coordinated by the Pipeline Coordinator's Office. The State Pipeline

SA1-57 We recognize the coordination role of the SPCO and have added recommended mitigation measure 10 to ensure that the office is served with any filing in response to a FERC condition.

Coordinator's Office staff is comprised of many of the State agencies that will be involved with the permitting of this project and also has designated liaisons within other state offices not located in the office.

Thank you for the opportunity to comment on the DEIS. If you have any further questions concerning the above, please feel free to have your staff contact me or the staff at the JPO at the above address or by calling (907) 278-8594.

Sincerely,

Molly Birnbaum

Molly Birnbaum
State Pipeline Coordinator's Office
Division of Governmental Coordination

cc: Distribution list

LOCAL AGENCY COMMENTS

CITY OF VALDEZ, ALASKA
GATEWAY TO THE INTERIOR

RECEIVED BY
JUN 29 1993

June 22, 1993

Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, D.C. 20426

RE: Docket No. CP88-105-000

Dear FERC Official:

At its regular City Council meeting of June 21, 1993, the Valdez, Alaska City Council unanimously passed Resolution No. 93-42. This resolution serves as the written comments of the City of Valdez with regard to Draft Environmental Impact Statement on the Yukon Pacific LNG Project.

The language in this resolution is consistent with earlier verbal remarks made by me at the June 10 hearing in Valdez; however, this resolution is the definitive statement of the City and should be given greater weight.

Thank you for this opportunity to comment on this Draft Environmental Impact Statement.

Sincerely,

Doug Griffin
City Manager

Enclosure: City of Valdez Resolution No. 93-42

cc: ✓Mr. Chris Zerby, Project Manager (Room 7312)
Federal Energy Regulatory Commission
Mr. Jeff Lowenfels, Vice President
Yukon Pacific Company

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LA1

CITY OF VALDEZ, ALASKA

RESOLUTION NO. 93-42

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, SUPPORTING THE YUKON PACIFIC LIQUIFIED NATURAL GAS PROJECT AND COMMENTING ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT ON THE VALDEZ PORTION OF THIS PROJECT PREPARED BY THE FEDERAL ENERGY REGULATORY COMMISSION

WHEREAS, the Federal Energy Regulatory Commission (FERC) has issued a Draft Environmental Impact Statement (DEIS) on the Yukon Pacific proposal to "construct and operate facilities to liquefy natural gas delivered to Port Valdez via pipeline from the north slope; briefly store the liquefied natural gas (LNG); and transfer the LNG at a marine terminal in Anderson Bay to LNG tankers for export to various Asian Pacific Rim countries;" and

WHEREAS, FERC concluded that with proper mitigation measures, permitting, and oversight the construction and operation of the proposed facilities at Anderson Bay in Valdez, Alaska "would be an environmentally acceptable action;" and

WHEREAS, FERC looked at various alternatives and specifically requested additional comment regarding the location of housing for construction workers and means of transporting workers to and from the worksite; and

WHEREAS, the City of Valdez Administration has reviewed the worker housing and transportation infrastructure alternatives contained in the DEIS from a public safety, transportation, social, and economic impact perspective; and

WHEREAS, the City of Valdez has also weighed concerns expressed by the Alyeska Pipeline Service Company and Yukon Pacific Company regarding worker housing and road construction/maintenance.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA , that

LA1-1 Section 1: The City Council enthusiastically supports the Yukon Pacific project with the terminus at Anderson Bay for liquefaction, storage, and loading of LNG for Asian Pacific Rim markets.

LA1-2 Section 2: The City Council believes development of the Anderson Bay terminal facilities does not require construction of an all-weather road through Alyeska Pipeline Services Company property.

LA1-3 Section 3: The City Council supports housing workers at the Anderson Bay construction site provided that facilities meet or exceed all applicable code and safety requirements. Housing workers at the work site will reduce the social and public safety impact of the projected peak construction work force of about 4,000 people.

Section 4: The City Council wants the City of Valdez to work pro-actively with the Yukon Pacific Company, the State of Alaska, and all other relevant government agencies to take necessary actions to reduce, minimize, and mitigate the negative "short-term" impacts the Yukon-Pacific construction may have on long term economic development sectors of the economy like tourism, sports fishing, transportation, post-secondary education, and commercial fishing.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF VALDEZ, ALASKA, this 21st day of June, 1993.

CITY OF VALDEZ, ALASKA

John L. Harris, Mayor

ATTEST:

Jeanne Donald, CMC/AAE, City Clerk

LA1-1 **Thank you for the comment.**

LA1-2 **Comment reflected in sections 4.15.2 and 4.16.**

LA1-3 **Comment reflected in section 4.16.**

GROUPS AND INDIVIDUALS COMMENTS

Alaska Wilderness Recreation and Tourism Association

Secretary
Federal Energy Regulatory Commission
825 North Capitol St., N.E.
Washington, DC 20426

Mr. Chris Zerby
Project Manager (Rm 7312)
Federal Energy Regulatory Commission
825 North Capitol St., N.E.
Washington, DC 20426

RECEIVED BY
JUL 0 6 1993

RE: Docket No. CP88-105-000

Dear Sir:

The Alaska Wilderness Recreation and Tourism Association thanks you for the opportunity to comment on the Yukon Pacific LNG Project. ~~This is a project~~ we support in principle. However, we request that the FERC take the option identified on page 1-3 "postpone action pending further study" for the following reasons:

1. The DEIS does not adequately address the impacts of the project on recreation and tourism and does not identify and recommend mitigation measures to minimize the impact (1-3).

2. Completed studies on environmental factors affecting the project and detailed information on the engineering design and equipment for the facility and for preventing spills and other accidents was not presented to the FERC by Yukon Pacific prior to the completion of the draft EIS. Without the completed studies, design and equipment information, it is premature for the FERC to approve the project with recommendations, because they have not been able to fully examine "the health, safety, and environmental impacts associated with (1-3)" the Yukon Pacific LNG Project at Anderson Bay.

GI1-1

I. Background and Justification: *The DEIS does not adequately address the impacts of the project on recreation and tourism and does not identify and recommend mitigation measures to minimize the impact (1-3).*

The impacts of the project on recreation and tourism are cursorily discussed on pages 4-50-51. A recommendation is made that" "Yukon Pacific prepare and file with the Secretary for review and approval by the Director of OPPR an outdoor usage plan to ensure normal outdoor activity usages does not exceed

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Printed on recycled paper

GI1-1 **At the time of preparation of the DEIS, the restrictions imposed within the dispersion exclusion zone were thought to include recreational uses such as boating and fishing. Subsequent clarification by the DOT revealed that there are no limitations to transient uses such as tour ships, boating, and fishing within the dispersion exclusion zone. The text in section 4.9.1 has been revised accordingly, and the recommendation has been deleted.**

Section 3.9.3.1 has been revised to include updated recreational usage data. These uses would not be excluded from the dispersion exclusion zone.

GI1

GI1-1 20 people within the dispersion exclusion zone but still provides for anchorage and recreational uses (4-50)." The authors then go on to assert: "The proposed project would not have significant short- or long-term negative effects on recreation in the Port Valdez area."

AWRTA finds this assessment inadequately justified for the following three reasons:

1. The DEIS does not discuss precisely which boating activities will be excluded from the dispersion exclusion zone. Will recreational and tourism boats be excluded from all the dispersion exclusion zone? some of it? What is the practice in other coastal dispersion exclusion zones? Will passengers here have the same level of protection as passengers in other areas? Are the proposed regulations here more or less restrictive? Why?

2) The DEIS does not consider the economic and social impact of excluding boating and recreational use of all or part of the dispersion exclusion zone. What would be the economic impact on cruiseships and tourboats if they are excluded? What would be the economic impact on small fishing boat charter and recreational users? Have insurance rates gone up for passenger vessels operating in dispersion exclusion zones elsewhere?

3) The DEIS does not consider ways of mitigating these impacts. Why should the recreation and tourism industry sustain economic and personal use losses of this area without compensation? What types of compensation or mitigation are appropriate?

4) The DEIS does not consider ways of reducing the size of the dispersion exclusion zone or of notifying vessels in or approaching the zone of imminent danger.

AWRTA's concerns: At Anderson Bay, Port Valdez is approximately 16,000 feet wide. The dispersion exclusion zone, if applied to boats, could prohibit the passage of vessels carrying more than 20 passengers or any combination of vessels carrying more than 20 passengers within 13,000 thousand feet of the Anderson Bay. This could confine all recreation and tourism traffic to 2,000 ft. or less along the north shore of Port Valdez opposite Anderson Bay and eliminate the use of one of the most economically valuable sportsfishing areas in Port Valdez.

In the short time provided for testimony, AWRTA has not been able to collect good estimates of current recreation and tourism use of the dispersion exclusion zone from May 15 to September 15. However, information in the DEIS for tourboat and cruiseship traffic is way underestimated. The figure of 25,000 from the Valdez Convention and Visitors Bureau (VCVB) must refer only to passenger landings in Valdez or to cruiseship berths; since passengers pass through the zone both inbound and outward bound, the figure is at least 50,000. According to a recent article in the Valdez Vanguard, the VCVB expects cruiseship traffic to double in 1994 as Regency Cruises moves from Whittier to Valdez. The DEIS gives no figures for the six major tourboats operating out of Valdez. However, Stan Stephens of Stan Stephens Charters, the largest tourboat operator in Valdez, places the figure at about 70,000 passengers or 140,000 passengers crossings of the zone. AWRTA suggests that the DEIS be amended to show the number of passengers passing through the area and the number of charterboat operators and recreational

GI1-1

boats that either pass through during the summer months or spend significant time fishing in the dispersion exclusion zone.

The Draft EIS is distinctly vague on precisely what activities will be excluded from this area. Page 4-50 indicates that "This could restrict non-project related uses, such as boating and fishing and use of Anderson Bay as an anchorage and could result in disruption to present uses." Page 4-80 states "In conclusion, a number of uncertainties exist in the thermal and dispersion exclusion zones analysis which prevent a finding of compliance with part 193 at this stage in the design process. . . . Although a finding of compliance with part 193 will await the DOT's evaluation of Yukon Pacific's responses, the remote location of the site and lack of population in the plant vicinity should ultimately permit compliance with the siting requirements."

AWRTA requests that the DEIS be amended to more accurately describe the number of people passing through and/or staying for extended periods in the area. We request that the DEIS furthermore be amended to 1) provide information on the types of boating activities that will be excluded and maps showing the areas of exclusion; 2) the number of vessels/people affected and the economic impact on them; and 3) steps that will be taken to provide an early warning of any imminent or existing threat to persons passing through the dispersion exclusion zone.

GI1-2 AWRTA recognizes that the probability of an accident is very low and that the probability of persons being present in the area at the time of an accident is even less; however, accidents with low probabilities still occur. In the past we were assured that a catastrophic oil spill had a probability of 1:250 years. After 1989, this figure was revised to 1:13 years. The PetroStar refinery assured us that a release of a vapor cloud had never occurred at their smaller refinery in NorthPole and was most improbable for their larger facility in Valdez. Within the first few months of operation a large gaseous vapor cloud was accidentally released. And worse, no notification was given for 45 minutes. Given these experiences, we are concerned that if passenger carrying vessels do transit the area (which we hope will be permitted), then a very good system of warning vessels will be in place in the event of an accident. This should be part of the DEIS.

GI1-2 **The DOT advises that under 49 CFR 193.2509 (b)(2) an operator (like Yukon Pacific) is "required to be able to recognize an uncontrollable emergency and take action to minimize harm to the public and personnel, including prompt notification of appropriate local officials of the emergency and possible need for evacuation of the public in the vicinity of the LNG plant. [DOT] OPS expects Yukon Pacific to include offshore vessels in its emergency notification/evacuation plan." See section 4.15.3.**

GI1-3 Onshore: Recreational users and commercial guides and outfitters use the 3.5 miles of shoreline, wetlands, and old growth forests for a variety of activities including: beachcombing, intertidal zone exploration, camping, picnicking, clamming, hiking, sportfishing, sport and guided hunting for big game and waterfowl, wildlife viewing, bird watching, and berry picking. The DEIS gives no figures on actual usage or on the economic impact.

Although the area is used by AWRTA members and others for these activities, the comment period has not been long enough for us to develop accurate estimates of total usage. However, contrary to statements in the Draft EIS, the affected 3.5 miles of shoreline is readily accessible by skiff (15 minutes) or kayak (1 hour) from Valdez. It is among the most accessible public shorelines to Valdez residents, because it does not require going through private property. Unlike the Valdez Duck Flats, which is composed of thick glacial muds unsuitable for walking, popular beaches along this 3.5 miles of

GI1-3 **Comments addressed in section 4.9.2.**

GI1

GI1-3 shoreline are composed of cobbles and pebbles. Some, such as Anderson Bay, have interesting geological features including pillars, arches and turbidite sequences. Because the contours are more gentle here than elsewhere along the southern shore and because transiting the Alyeska pipeline is not a problem, backpackers and day hikers use routes in this area for access to the high country.

GI1-4 The actual number of acres of public lands (State owned or part of the Chugach National Forest) which are removed from public use or to which access is eliminated is not stated in the Draft EIS. **AWRTA requests that the FERC postpone further action until this acreage is calculated, the socioeconomic impacts of its removal from public access is determined, and appropriate mitigation measures are recommended.**

GI1-5 AWRTA is hopeful that DEIS will be amended to permit vessel traffic in the dispersion exclusion zone and that an early warning system for notifying vessels of accidents will be required. However, if the dispersion exclusion zone eliminates recreational and commercial use of the shoreline, excludes access to public lands in the backcountry, or inhibits boats from transiting all or parts of the area, then the following socioeconomic impact on recreational use and tourism might occur and should be considered by the DEIS:

1) It is possible that cruiseships and some tourboat operators may choose to use other Alaskan ports either because of the risk or because of the loss of scenic quality. The loss of revenue to the City and to hotels, restaurants, gift shops, etc. should be calculated and considered under socioeconomic effects. We recommend that mitigation measures be required to minimize the economic impact on Valdez businesses in the event that cruiseships relocate to other ports either during or following the construction of the terminal.

2) Tourboat operators normally travel outbound along the northern shore of Port Valdez and return following the southern shore to beyond the Alyeska Marine Terminal before heading north to the small boat harbor. Avoiding the thermal dispersion zone would add time, cost more in fuel, and detract from the scenic diversity of a tour operator's trip, since the outbound and return routes would be substantially the same. Some tourboat operators may choose to relocate to other Alaskan ports such as Cordova, resulting in a loss of income to tourism based businesses in Valdez.

3) Recreational powerboaters would require more time and use more fuel exiting and returning to Port Valdez. If a road is built to Cordova, recreational powerboaters from Fairbanks and Glennallen may choose to relocate to Cordova resulting in a loss of income to the Valdez harbor and tourism based businesses in Valdez.

4) Sailors would be more affected, as over half of Port Valdez would be effectively closed to sailing on any point of sail except downwind. This means sailors would have to motor to Valdez Arm before beginning to sail at increased cost and loss in recreational enjoyment. If a road is built to Cordova, sailors from Fairbanks and Glennallen may choose to relocate to Cordova resulting in a loss of income to the City harbor and tourism based businesses in Valdez.

GI1-4 **Regardless of the acreage in a buffer zone, the DOT vapor exclusion zone would not preclude recreational activities such as hiking, camping, picnicking, and places of assembly for less than 20 people.**

GI1-5 **See response to previous comments GI1-1 through GI1-4.**

GI1-5 5) Recreational and charterboat sport fishermen, who traditionally fish in the protected areas along the southern shore where returning salmon school, would loose access to the last 3.5 miles of coastline open to fishing along this shore. The area is particularly important to small boat operators because winds and seas are less than at the nearest alternative salmon fishing area in Valdez Arm. If a road is built to Cordova, skiff and small trailerable boat owners from Fairbanks and Glennallen may choose to relocate to Cordova resulting in a loss of income to the City harbor and tourism based businesses in Valdez.

Individually, some of these losses may be minimal, but cumulatively they are considerable. Many represent a business that someone has put time, money and effort into developing with a reasonable expectation that access to Port Valdez, its shorelines and public lands would not be significantly restricted. The TAGS LNG Project proposes at best moderate changes and at worst, very significant changes in access to hitherto public lands and waters. These changes would cause economic hardship and dislocation to a number of tourism-related businesses and recreational users.

GI1-6 Although AWRTA supports the TAGS project, we expect that the project's proposers and regulatory authorities to consider the full socioeconomic impacts of the project as required by law. AWRTA is concerned that 1) this DEIS on the LNG project has been done without adequate analysis of the impacts on existing recreational and tourism users, 2) consequently, there has been inadequate notification of the affected parties, and 3) no measures have been proposed to mitigate or minimize the adverse effects on recreation and tourism or provide for their safety.

AWRTA proposes that the FERC postpone further action until it has had an opportunity to fully examine as required by law the true socioeconomic impacts of the proposed LNG Plant at Anderson Bay on recreation and tourism and recommend measures to mitigate the impact.

Mitigation measures should be targeted at those sectors of the recreation and tourism industry most adversely affected by the proposed project. Possible mitigation measures include:

1) Proposed Project: Annual funding of a tourism promotion budget for marketing Valdez as a port of entry to Prince William Sound.

Justification: Construction and operation of the LNG Plant will adversely affect tourism-related boating traffic through changes in route, increased time and fuel costs, loss of visual quality, and noise and air pollution. Those most adversely affected are businesses whose clients spend the most time in the area: charter boat fishermen, smallboat rentals, kayak outfitters & guides, sailing companies, tourboat operators, cruiseships. Marketing funds should be pro-rated among these groups. (get suggested figure from Sandy)

Beneficiaries: *Primary:* Tourism companies doing business in Prince William Sound out of the Port of Valdez. *Secondary:* Tourism-related business that provide support services such as hotels, gift shops, grocery stores.

2) Proposed Project: The construction, staffing and maintenance of recreational and tourism

GI1-6 **Supplemental text regarding recreation/socioeconomic resources and impacts is provided in sections 3.10, 4.9.2, and 4.11.3. In addition, the state's Right-of-Way Lease to Yukon Pacific for its project is conditional upon Yukon Pacific providing to the State Commissioner, Plans and Programs governing the protection of Cultural Resources; Subsistence Resources; Public Health, Safety, and Welfare; Local Hire, Manpower Training, and Alaska Business Utilization; as well as socioeconomic impact. Alternative mitigation and compensation measures specific to the final project design will be put in place at that time. Since the potential recreation/socioeconomic impacts would no longer occur within the dispersion exclusion zone as stated in the DEIS, it is not necessary for the FERC to recommend measures to mitigate the impact.**

GI1-6 **facilities in Valdez to enhance Valdez's attractiveness as a tourism destination.** Possibilities include a marine interpretive center which could focus on Prince William Sound's marine environment and environmentally safe development (eg. the LNG project, Alyeska) or wildlife viewing areas such as a safe (for people and bears) place to watch and photograph brown bears feeding on salmon.

Justification: Studies have shown that some visitors to Alaska avoid Valdez because of the Alyeska Marine Terminal. Alyeska's development of a program for visitors has helped to both attract other visitors to Valdez and to extend visitors stay in Valdez, thus compensating for lost visitor days. If workers are housed in Valdez and access is through the Alyeska Marine Terminal, Alyeska may find it necessary to compensate for the disruption by stopping its visitor program. The development of a natural history interpretive center which focuses both on Prince William Sound's unique ecosystem and on environmentally safe industrial development could compensate for these losses, especially if Alyeska participated.

Alternatively, wildlife viewing is a prime reason visitors come to Alaska. Safe areas for observing brown bears — such as McNeil River— have restricted access, are difficult to get to, and expensive. The development of an alternative bear viewing site near Valdez would serve as a major tourist attraction. Presumably, once these visitors have come to see the bears, they will also book for a fishing charter, trip to Columbia glacier or some other type of tourism activity.

Beneficiaries: *Primary:* Tourism companies doing business in Prince William Sound out of the Port of Valdez. *Secondary:* Tourism-related business that provide support services such as hotels, gift shops, grocery stores. *Tertiary:* Valdez residents and recreational users.

3) Proposed Project: Work with the Valdez Fisheries Development Corporation, AWRTA, and Valdez Charterboat Association to identify alternative areas in Port Valdez where a fishery for small boats might be developed.

Justification: A 2,000 ft. dispersion zone measured from the site of the proposed terminal docks would for all practical purposes eliminate the most important small charterboat and recreational boat coho and king salmon fishery in Port Valdez. Although the boats can be moved outside this zone; the fish will not. Developing an alternative fishery through a terminal fisheries project or restocking of damaged streams in Port Valdez could provide an alternative site for small boat salmon fishermen and help compensate for losses in streams affected by the project.

Beneficiaries: *Primary:* Smallboat sport fishermen, small charter fishing boat operators, boat rentals. *Secondary:* Tourism-related business that provide support services such as hotels, gift shops, grocery stores. *Tertiary:* Valdez residents and recreational users.

4) Proposed Project: Purchase of private lands or the timber and recreation rights on privately owned lands to compensate for the loss of use and access to lands on the southern shore of Port Valdez. Lands might be managed by The Nature Conservancy or the Prince William Sound Conservation Alliance.

GI1-6 **Justification:** 3.5 miles of coastline on the southern side of Port Valdez and access to an undetermined amount of State lands and lands in the Chugach National Forest amounting to thousands of acres will be lost as a result of this project. Acquisition of lands of comparable value or the timber & recreation rights on privately owned lands would compensate for this loss. A possible area might be the Tatitlek-owned lands on the east side of Columbia Bay, Sawmill Bay or Galena Bay.

Beneficiaries: Primary: Onshore users of public resources in the affected area. Secondary: offshore users who have lost use of the viewshed's scenic quality.

5) Proposed Project: Construction of a 60 ft. wide all-weather access road to Federal standards around the Alyeska Marine Terminal to the site which is open to public use for access to State lands and the Chugach National Forest outside of the dispersion exclusion zone.

Justification: 3.5 miles of coastline on the southern side of Port Valdez and access to an undetermined amount of State lands and lands in the Chugach National Forest amounting to thousands of acres will be lost as a result of this project. Construction of an access road would provide direct access to most of the lands from which public access has been denied outside of the dispersion exclusion zone.

Beneficiaries: *Primary:* Onshore users of public resources in the affected area. *Secondary:* Local residents, recreational users, backcountry tour operators, hunters, not currently using the Chugach National Forest highlands.

GI1-7 **II. Background and Justification:** *Completed studies on environmental factors affecting the project and detailed information on the engineering design and equipment for the facility and for preventing spills and other accidents was not presented to the FERC by Yukon Pacific prior to the completion of the draft EIS. Without the completed studies, design and equipment information, it is premature for the FERC to approve the project with recommendations, because they have not been able to fully examine "the health, safety, and environmental impacts associated with (1-3)" the Yukon Pacific LNG Project at Anderson Bay.*

The federal courts have consistently ruled that spillers are not responsible for economic damages sustained by recreational users and the tourism industry as a result of a spill. Because of the adverse publicity and continued media attention on the EXXON VALDEZ Oil Spill and its effects on Prince William Sound, many members of the American public are reluctant to visit the area. As a result, tourism businesses have sustained considerable economic losses as a result of the EXXON VALDEZ spill. Some AWRTA members report their losses at 50% for three years with a gradual recovery to 1988 business levels by 1993. Since AWRTA members have no way of recovering these losses from the spiller, AWRTA is most concerned about the prevention of spills and catastrophic events such as explosions and fires.

Consequently, we have studied the Draft EIS sections on physical and LNG hazards, Cryogenic Design

GI1-7 We believe it is possible to realistically discuss potential impacts using preliminary design data that reflect currently available technology. Conditions have been added to ensure that final equipment specifications meet or exceed the preliminary design used in the analysis. As for GI1-6, the tiered approval process for the TAGS Project provides through the state conditional lease, that plans and programs for oil and hazardous substances control, cleanup, and disposal be submitted and approved prior to lease finalization. Also refer to comment response FA3-4. In the unlikely event of an LNG tanker spill, the product would either vaporize or burn, and not have the long-term environmental consequences associated with a major oil spill (see section 4.15).

GI1

GI1-7 and Technical Review, Thermal and Dispersion Exclusion Zones, and Marine Safety very carefully. It is not comforting to read that many studies and detailed designs such as the seismic design criteria, avalanche study, wind force study, spill containment and diversion systems, hazard detection system, emergency access provisions, etc. have not been completed or were not supplied to the FERC by Yukon Pacific. AWRTA found the discussions of fog, fire-fighting equipment (the nearest marine firefighting equipment is in Seattle), and marine traffic management incomplete. AWRTA recommends that the FERC postpone a decision until all studies related to hazards and all detailed final engineering designs for the proposed facility are completed and studied by their experts. We believe this is required by law in order to determine the environmental effects of the project.

GI1-8 AWRTA also recommends that the FERC require an engineering audit of the plant prior to start-up to insure that it has been constructed as described in the detailed designs submitted to FERC.

AWRTA appreciates the opportunity to submit comments. As a professional business organization, we do not wish to obstruct business opportunities in other sectors of the economy. However, we also have an obligation to protect the resources and business opportunities of our members and the safety of the public our members serve.

We would like to also take this opportunity to thank Yukon Pacific Corporation for the willingness their management has shown in the past in working with the public to identify and resolve issues during the planning stages. The use of the DEIS process to identify possible problems and to seek thoughtful, workable solutions to them makes for a stronger economy and constructive relationships.

Respectfully submitted,

Nancy R. Lethcoe

Nancy R. Lethcoe

GI1-8 **The FERC will perform an engineering audit as part of its review of the implementation of recommended mitigation measures 38 through 42.**

PRINCE WILLIAM SOUND CONSERVATION ALLIANCE

Prince William Sound Conservation Alliance

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July 5, 1993

Secretary
Federal Energy Regulatory Commission
825 North Capitol Street N.E.
Washington D.C. 20426

RE: Comments on Draft Environmental Impact Statement for Yukon Pacific LNG Project at Anderson Bay, Port Valdez, Alaska.

REF: Docket Nos. CP88-105-000 and CP88-105-001

Dear Secretary:

GI2-1 1. Comment period too short and poorly timed to correspond with busy summer schedules of Port Valdez residents.

GI2-2 2. Engineering and design information are too incomplete to allow the EIS to proceed. Further action on the EIS should be delayed until more detailed information is available.

GI2-3 3. Air pollutants that will be released are unacceptable; and should be tied to low sulphur fuel requirements for all large vessels in Port Valdez, and installation of a vapor control system for oil tankers at the Alyeska terminal.

GI2-4 4. Fog problems in and around Anderson Bay facility as a result of thermal release is not even discussed in the draft EIS. (PWSCA comments on this in scoping)

GI2-5 5. The Coast Guard needs to address security/exclusion zones at the terminal and around tankers as they transet Prince Wm. Sound before commercial and recreational boaters can make a decision as to whether it is acceptable.

GI2-6 6. We strongly support the tanker ballast change-out at sea requirement. This is critical as we dont want foreign organisms introduced into Port Valdez or Prince Wm. Sound.

GI2-7 7. Since tankers will be built new for this project, they should be twin engine/prop. for safety.

GI2-8 8. No fill material should be dumped in western uplands or any non-facility uplands. The excess should be used for burying pipeline, or dumped in deep water.

GI2-1 The comment period exceeded the minimum required by NEPA regulations.

GI2-2 The level of engineering and design information is of sufficient detail to perform a NEPA analysis. We believe it is possible to evaluate potential impacts using preliminary design data that reflect currently available technology. Recommended mitigation measures 38 through 42 provide for staff review and approval of detailed engineering and design information.

GI2-3 Impacts on air quality are addressed in section 4.9. There are sufficient regulatory safeguards to ensure that the project will not exceed ambient standards or PSD increments. Therefore, it is beyond the scope of this document to require emission reductions on other sources.

GI2-4 Fog problems in and around Anderson Bay as a result of thermal release are not anticipated. As discussed in section 4.5.1, the release of heated effluent is highly regulated to ensure that dramatic temperature differentials do not occur. Even if one were to assume that the temperature differential within the mixing zone resulted in fog generation, the size of the zone would be in the order of 0.5 acre. The location of the thermal outfall (figure 2.1-4 sheet 2), approximately midway between the tanker berths, places it 1,200 to 1,500 feet from tanker maneuvering (the activity presumably most at risk from foggy conditions). No navigational or other problems are expected.

Fog cannot be generated by the exhaust from the air-cooled heat exchangers proposed for the liquefaction trains since the discharged air is warm and dry. Fog results from the rapid cooling of moisture-laden air.

GI2-9 9. Human usage via boat past the site is grossly under-estimated (page 3-52). Stan Stephens Charters alone carries about 15,000 people past the site. Add to this the Glacier Seas, Glacier Queen, cruise ships, charter fishing, commercial fishing, recreational boaters, the state ferry, tanker crews (about 6,000 annually alone), and this figure is closer to 142,000 - not the 42,000 listed.

GI2-10 10. Coast Guard radar coverage in PWS is limited now and should be upgraded to handle TAGS tankers before they transit the area.

GI2-11 11. To mitigate the loss of coastal forest, near shore habitat, wetlands, recreational coastline, sport and commercial fishing, the development rights to all the native lands in Gravina Bay need to be purchased from the Tatitlek Corporation for a marine park addition.

GI2-12 12. The property line on figure 3.9.3-1 is excessive for the size of the facility. What is the purpose of this? Will the security/exclusion zone come out into the port this far?

Sincerely,

Marnie Graham

Marnie Graham
President

cc: Mr. Chris Zerby, Project Manager, Room 7312, Federal Energy Regulatory Commission (same address as above)

Cheryl Richardson, TAGS Environmental Review Committee, 750 West 2nd Avenue, Suite 200C, Anchorage, AK 99501

Mr. Doug Griffin, City Manager, City of Valdez, Alaska

GI2-5 The Coast Guard has expressed its intention to enforce a 200-yard safety (security) exclusion zone around the operating site.

GI2-6 Thank you for the comment.

GI2-7 Section 2.1.3 identifies some of the principal regulatory requirements governing the design, construction, and operation of LNG tankers, whether single or twin propeller powered. The comment provides no technical support for limiting the LNG tankers to twin engine/propeller.

GI2-8 No excess spoil material has been proposed to be deposited in upland areas. This scenario was investigated by the FERC staff as an alternative to disposal in intertidal and subtidal areas. It was determined not to be feasible, even if combined with offshore disposal, due to the volumes of spoil material and limited upland areas available for disposal (see revised section 2.3.2). Offshore disposal of spoil material has also been determined by the EPA to be unfeasible (see comment response FA6-3). The excess material will also not be used for pipe burial (i.e., natural gas pipeline associated with TAGS) since the material excavated during the digging of the pipe trench will be used for backfill of the trench.

GI2-9 Based on further discussions with charter operators in Valdez, the text in section 3.10 has been revised to read "Approximately 72,000 charter, sightseeing, and Alaska Marine Highway passengers would be expected to pass by Anderson Bay in a year. In 1993, there were approximately 44,000 charter and sightseeing boat passengers that were transported past Anderson Bay (Stephens, 1993; Valentine, 1993). In addition, approximately 28,000 passengers embarked or disembarked from Valdez on Alaska Marine Highway ferries in 1992 (Ashmore, 1993)."

GI2-10 Beginning July 1, 1994, the Coast Guard will require Automated Dependent Surveillance Shipborne Equipment (ADSSE) for all tank vessels greater than 20,000 DWT (see section 4.15.4). In selecting the ADSSE requirement, the Coast Guard considered additional radar sites but did not find them beneficial.

GI2-11 The staff has recommended various mitigation to offset or minimize the significant loss of these resources.

GI2-12 The property line shown on figure 3.9.3-1 includes the buffer zone. The thermal exclusion zone is well within the buffer zone; the dispersion exclusion zone extends as shown on figure 4.15.3-2. The only other security zone is the 200-yard limit stipulated by the Coast Guard.

ORIGINAL

Alyeska pipeline SERVICE COMPANY 1835 SOUTH BRAGAW STREET, ANCHORAGE, ALASKA 99512. TELEPHONE (907) 278-1611. TELEX 090-25-127

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July 2, 1993 APSC Letter No. 93-1445-G

Ms. Lois D. Cashell, Secretary
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington D. C. 20426

RE: FERC Docket No. CP-88-105-000

Dear Secretary Cashell:

We have reviewed the Draft Environmental Impact Statement for the Yukon Pacific LNG Project Marine Terminal dated May, 1993. On behalf of its owner companies, Alyeska Pipeline Service Company, operator of the Trans-Alaska Pipeline System (TAPS), offers the following comments. These comments also clarify our letter offering a preliminary response to Mr. Robert Arvedlund's letter of April 9, 1993 which requested Alyeska input about emergency and construction access to the LNG facility.

GI3-1 Access Road Through TAPS Marine Terminal

Alyeska Pipeline Service Company opposes the construction and use of any road for any reason through the TAPS Marine Terminal for the Yukon Pacific LNG terminal project because it would severely affect TAPS safety, security and operations. The terminal property is owned in fee by the TAPS owner companies who continue to manage its use for the safe operation of TAPS. Alyeska is not opposed to the seasonal use of the LNG pipeline workpad at its presently-planned location across the southerly portion of the TAPS property for routine maintenance and operations. This letter does not address any issues of the LNG pipeline and workpad, but rather the proposal to construct a separate LNG terminal access road, whether for construction, operation or emergency use.

1. Dayville Road Safety: Dayville Road is not designed to handle the additional traffic necessary to construct or operate the LNG project. The initiation of the Petro Star Refinery truck-tanker traffic already has hampered the movement of TAPS traffic whose vulnerability to interference was underscored by the complete closure of Dayville Road during the recent emergency situation at the refinery. Adding another significant user to the road will exacerbate this condition thereby hindering safe operations at the existing facilities and the proposed LNG facility.

GI3-1 **Alyeska's concerns regarding access through the marine terminal property are reflected in sections 4.15.2 and 4.16.**

GI3

GI3-1 During the summer months, visitors and campers crowd the end of Dayville Road at the Allison Point turnout bringing TAPS through-traffic to a crawl. Even at that pace, public safety is compromised. Alyeska is currently entertaining a request by the City of Valdez to alleviate this congestion by improving public access from the turnout to adjacent tidelands. Furthermore, there is currently no State Trooper stationed in Valdez to support effective regulation of this road's use.

2. Valdez Marine Terminal Safety: Once the road enters the Alyeska terminal property (just beyond Allison Point), it is designed for TAPS traffic only. Access to the Valdez Marine Terminal is controlled by guards at the "main gate," approximately one-half mile inside the property line and a vital component in both the routine and the extraordinary operations of the terminal. Such access is restricted to authorized personnel only, including employees, contractors, regulators and properly authorized visitors.

   All vehicles, including TAPS buses, are subject to spot checks to prevent the entry of explosives, firearms, alcohol and drugs. All visitor buses entering during the summer months are completely checked, including deboarding and reboarding of each traveler. During the Desert Storm battle, TAPS security procedures were augmented through the installation of an additional gate resulting in increased congestion.

   The proposed introduction of any LNG project traffic to the TAPS terminal requires consideration of significant changes to the existing security and operations system. None of these changes would be practical because the disadvantages to TAPS operations and safety could not be effectively mitigated. Fencing the access road corridor as required by 43 CFR 195.436 to protect Alyeska facilities would interrupt TAPS in-terminal traffic to the degree that the full range of operations, from routine to emergency, would be rendered unsafe under company guidelines, industry standards and state law.

   Similarly, even if Alyeska were able to institute additional third-party-access control measures such as expanding security check-in procedures and/or placing armed guards on each vehicle, our company could be subjected to considerable additional risk through no fault of its own and without complete control of a remedy. For example, during an LNG project labor dispute, a picket of the LNG site would likely occur at the TAPS terminal main gate, where the public road ends, creating a difficult and potentially hazardous situation for TAPS operations.

In conclusion, Alyeska proposes that the TAGS access road through the TAPS terminal property be eliminated as an alternative because the risks to public safety and to TAPS operations outweigh the benefits. Once a such a road is built for any purpose, the pressure to open it to additional uses, including public access, will surely follow. The highest and best use of the property is to provide a safe and secure operating area for the TAPS marine terminal; opening the gates for third party access under any circumstances would significantly compromise that value.

Crude Oil Movements and Tanker Traffic

GI3-2 1. Alyeska is concerned with the statement attributed to the United States Coast Guard on page 4-83 recommending the restriction of all other tanker movements when an LNG tanker is underway in Port Valdez, Valdez Narrows or Valdez Arm. This recommendation for a twenty-five mile "no move" zone appears to be unduly restrictive of non-LNG tanker traffic. The current VTS Vessel Separation Scheme may be adequate to safely control unladen LNG tanker traffic. We request to be involved in the Coast Guard's development of the Captain of the Port Plan for LNG traffic (p. 4-84) and recommend that the Coast Guard use the Valdez Marine Operations Committee to develop this plan.

Of course, the effects of such restrictions on TAPS operations will depend on the LNG traffic levels. Please note that Alyeska currently imposes various penalties on its carriers if the crude oil is not shipped as scheduled in order to meet target operating efficiencies and tariff obligations. As the volume of crude oil produced and transported decreases over the years, the storage and loading capacities at the TAPS marine terminal will be down-sized appropriately. Therefore, any future shipment delays at the TAPS terminal due to LNG traffic restrictions will be just as significant as a present-day delay would be.

GI3-2 Comment noted. The Coast Guard statement, subject of your comment, was one of several suggestions contained in a May 25, 1990 internal memorandum. A further Coast Guard recommendation, supported by the FERC in this FEIS, is an independent review of the VTS operations to develop strategies to accommodate the additional LNG tanker traffic with minimum risk. These and other requirements are likely to be considered in the Coast Guard's development of the Captain of the Port Plan. Your request for involvement in this process should be directed to the Valdez Coast Guard.

GI3-3 2. Similarly, any disposing of excess, excavated material under the offshore alternative (p. 2-62) should be closely coordinated with Alyeska and the Valdez Marine Operations Committee to avoid restricting navigation in the Valdez Narrows area.

GI3-3 The offshore disposal of excess excavated material has been eliminated as an alternative to onshore or nearshore disposal. Please refer to the revised text in section 2.3.2 for further information.

Public Safety

GI3-4 Alyeska expects that construction and operation of the proposed project will result in a significant increase in air traffic, particularly helicopter. We recommend that such aircraft be fully equipped for water landings in order to avoid the need and tendency to fly directly over TAPS facilities thereby reducing their exposure to damage in case of emergencies.

GI3-4 Comment noted and will undoubtedly be taken into consideration as a safety issue also in Yukon Pacific's and the public interest, during the development of site construction procedures.

GI3-5 Furthermore, Alyeska expects that the LNG project will be required to develop its own emergency response plans and equipment inventory and that any mutual aid agreements with Alyeska would be entered into on a willing party basis.

GI3-5 Section 193.2509 of the DOT regulations requires Yukon Pacific to develop an emergency response plan. Mutual aid agreements between Yukon Pacific and Alyeska would be at the discretion of the participating companies but would require articulation in the emergency response plan for review and approval purposes.

Air and Water Quality

GI3-6 Alyeska agrees with the statement in the DEIS (page 3-39) that, based upon the evidence of all data collected in Port Valdez, the surrounding area is an attainment area for all criteria pollutants. Furthermore, we recommend and expect that whatever air quality permits acquired for the TAGS marine terminal would ensure that Port Valdez maintains its attainment status.

GI3-6 Comment noted.

GI3-7 The discussion on page 3-31 of the DEIS is insufficient to adequately explore the issue of water quality impacts of the TAPS terminal. Attached is a bibliography of all reports, including the one cited in the DEIS, studying the effects of the TAPS Ballast Water Treatment Facility on the receiving waters of Port Valdez. These studies conclude that there has been no evidence of adverse impact attributable to the BWT effluent.

Thank you for providing this opportunity for comment. If we may provide additional information to you on this important matter, please contact me at (907)265-8923.

Sincerely,

J. S. Dayton

John S. Dayton, Vice President
Operations and Engineering

JSD/kdg

Enclosure

cc: Chris Zerby, FERC Project Manager
Jerry Brossia, State Pipeline Coordinator
Doug Griffin, City of Valdez
Jeff Lowenfels, Yukon Pacific Corporation

GI3-7 Although Alyeska's comment appears to be contesting published literature results, it is likely Alyeska is contesting the source identification and effects and not the measured results. According to an article in the July 1, 1993 edition of the Valdez Vanguard, the source identification issue has resurfaced recently and a meeting was held on July 20 to try to resolve source and bioeffects issues. According to Carol Ann Manen of NOAA (Manen, 1993), the meeting was unable to resolve the issues and no regulatory action has been taken. While elevated concentrations of PAH metabolites are found in highest concentration in flatfish near the outfall, the effect and source of these compounds are still under review. Alyeska's NPDES environmental monitoring studies are being reviewed, and a summary has been included in the FEIS in order to incorporate the most up-to-date information.

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Yukon Pacific Corporation) Docket No. CP88-105-000

COMMENTS OF EDWIN (AL) KUHN ON
DRAFT ENVIRONMENTAL IMPACT STATEMENT
YUKON PACIFIC LNG PROJECT

(July 1, 1993)

Introduction

I am responding to the Federal Energy Regulatory Commission's ("FERC") request for comments on a draft environmental impact statement (FERC/EIS-0071D) ("DEIS"), dated May 1993, on the proposed liquefied natural gas ("LNG") facilities at Anderson Bay, Valdez, Alaska.

My background and qualifications for the comments herein are set forth in a previous submission in this docket, entitled "Comments of Edwin (Al) Kuhn on Analysis For a Draft Environmental Impact Statement For The Yukon Pacific Corporation's LNG Project (March 16, 1992)," which is incorporated herein by reference in its entirety.

It is noted, incidentally, that this DEIS covers just one of the three basic, essential components of any complete LNG project to bring Alaskan North Slope gas to market, including Yukon Pacific's proposed TransAlaska Gas System ("TAGS"). The other two components are (1) the gas conditioning plant at Prudhoe Bay and (2) the pipeline from the North Slope to tidewater. A final EIS on the pipeline was completed in June 1988 by the Bureau of Land Management and the Corps of Engineers. There has been, however, no substantive treatment by the TAGS sponsors (or government review thereof), pursuant to the National Environmental Policy Act, of the multi-billion dollar TAGS gas conditioning plant to be constructed at Prudhoe Bay. Environmental review of the TAGS Project, as a statutorily mandated precedent for major federal actions thereon, will remain incomplete in its absence.

Comments on DEIS

GI4-1 (1) Public Safety--The consequences of a major LNG spill at the marine terminal have not been adequately addressed. I submit that the assumed 10-minute release of LNG from a single pipe is not "the worst effect . . . which may predictably occur . . . in a 100 year period," as required by the U.S. Department of Transportation's regulations, 49 CFR Part 193, Subpart B. (See DEIS, p.2-32 and Appendix B, p.43.) Rupture of a moored, loaded tanker's main LNG tanks would be a far more realistic assumption with the enormous forces and almost unimaginably violent conditions that are reasonably foreseeable. (This takes into consideration,

GI4-1 Section 4.15.3 of the DEIS analyzed the vapor cloud and radiation exclusion zones based on a 10-minute release of LNG from various onshore facilities as required by the LNG facility siting requirements in 49 CFR Part 193. Section 4.15.4 of the DEIS analyzes the hazards from the "worst case" event for the marine transportation—the instantaneous spillage of one cargo tank of an LNG tanker.

GI4-2 inter alia, wave height up to 26 feet (p.4-10), 93 foot runup ashore and subsequent rundown (p.4-10), mooring water depth 55 feet (p.2-18) with an anticipated rock bottom, and loaded tanker drafts of 38-40 feet (p.2-21).)

The lack of review of the "worst case" criterion to be used for LNG tankers at the marine terminal and potential mitigating measures is puzzling in light of the general, frank recognition in the DEIS of a major, unresolved hazard existing at the proposed marine terminal. The DEIS states, for example, that "the hazard due to in-basin waves caused by subsea slope failures is high [p.3-8] . . . . [T]he most significant hazard to the LNG plant, other than ground shaking, is the potential effects of damaging waves resulting from seismically induced subsea landslides in Port Valdez [p.4-10] . . . . [W]ith regard to the marine terminal, LNG tankers, and tanker berthing facilities, such waves would be a significant threat [p.4-13] . . . . Seismically induced waves are a major concern for the marine terminal portion of the facilities, not because they present insurmountable design problems for the terminal facilities, but because it would be difficult to protect tankers at berth from wave damage [p.5-2]."

GI4-3 Despite such pronouncements, there is no information to indicate the true nature of a reasonably predictable worst-case event (i.e., spillage of a ship's cargo tanks) in the immediate vicinity of the marine terminal. And, notwithstanding the discussion in DEIS sections 4.15.3 and 4.15.4, consideration is lacking on consequences thereof to the following: (1) the marine terminal, (2) LNG tankers in its vicinity or moored thereto, (3) other ships (e.g., oil tankers underway from the Alyeska facility),
GI4-4 and (4) people and facilities ashore. Indeed, FERC staff's cryogenic and technical review of the proposed facilities explicitly states "Vapor cloud generation [and] plume dispersion . . . are subjects beyond the scope of this report." (See DEIS,
GI4-5 Appendix B, p.1.) And there is nothing else in the DEIS to indicate an independent review of the subject by FERC, including the reasonableness of the "worst case" assumption made by the project sponsors with respect to a disaster involving the marine terminal and LNG tankers. There is, moreover, nothing to indicate
GI4-6 that acceptable mitigation of the hazard--whatever its true nature--is even feasible, other than FERC staff's unsupported assertion, with respect to seismically induced wave damage, that the marine terminal itself (but not necessarily the ships) would present no "insurmountable" design problems.

Concern over this matter is heightened by FERC staff's recognition that "There is a significant probability that the project would experience severe earthquakes during its lifetime. The project area has the potential for being affected by some of the largest earthquakes recorded in North America." [p.5-2]

GI4-2 **The analysis of the impact of slide-induced waves on the marine facilities has been expanded in section 4.2. The section identifies the potential effects of the maximum 26-foot slide-induced wave on the marine terminal and on LNG tankers at berth.**

GI4-3 **Figure 4.15.3-2 shows that the marine terminal, LNG tanker at berth, operating staff, and shoreside facilities would be within both the thermal exclusion and flammable vapor dispersion exclusion zones. This is permitted by the DOT in its siting requirements in 49 CFR Parts 193.2057 and 193.2059. The regulations do not preclude oil tankers or transient vessels from the dispersion exclusion but do require notification procedures. See section 4.15.3.**

GI4-4 **Commenter is correct that appendix B does not evaluate vapor cloud generation and plume dispersion. Appendix B is the technical support for section 4.15.2. Vapor cloud generation and plume dispersion are analyzed in sections 4.15.3 and 4.15.4.**

GI4-5 **The "worst case" assumption was developed by the FERC in its FEISs on LNG import/export terminals since 1975, and has been tested in administrative hearings.**

GI4-6 **Section 4.2 has an expanded analysis of the effects of slide-induced waves on both the ships and the marine trestle. The condition is retained to ensure such a phenomenon is considered appropriately in the final design.**

GI4-6 To relegate such a fundamental consideration (i.e., the effects of seismically induced damaging waves on LNG tankers and the marine terminal) to supplemental studies to be completed at some later date and to merely direct Yukon Pacific to "consider and mitigate, to the maximum practical extent [p.5-13, Condition 7 viii.] . . . ," with no specific criteria to be met, would be a failure by FERC to address a major environmental issue conceivably affecting the basic viability of the project.

GI4-7 (2) Environmental Restoration and Compensation--I reiterate the comments and recommendations on this subject contained in my aforementioned earlier comments in this docket. Specifically, the EIS should address the following: (1) The nature and costs of environmental restoration required in the event of a worst-case LNG disaster; (2) impacts on the public interest from strict liability limitations applicable to LNG operations centered at Anderson Bay; and (3) the extent to which any restoration and compensation funding guarantees by the project sponsors would protect public and private interests in the event of a worst-case disaster, based on a review of applicable law and of the sponsor's financial capability and mandated insurance coverage. (For rationale, see March 16, 1992 submission, pp.4-5.)

Respectfully submitted,

Edwin (Al) Kuhn

Edwin (Al) Kuhn
1230 Perry William Drive
McLean, VA 22101

GI4-7 Section 4.15.4 concludes that a major LNG tanker accident would not have the long-term environmental consequences associated with a major oil spill. Environmental restoration and compensation has minimal applicability to the spillage of LNG. This is supported by 35 years of LNG marine transportation.

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ENVIRONMENTAL POLICY AND PROJECT ANALYSIS BRANCH

July 6 1993

Secretary
Federal Energy Regulatory Commission
825 North Capital Street, N.E.
Washington, DC 20426

Re: Reference Docket No. CP88-105-000. YUKON PACIFIC LNG PROJECT

As a long time property owner in Valdez, I welcomed reading the Draft Environmental Impact Statement dated May 1993.

GI5-1 I agree completely for the need for access to an LNG facility in that selecting a site, each operator shall determine all site-related characteristics which could jeopardize the integrity and security of the facility. A SITE MUST PROVIDE EASE OF ACCESS SO THAT PERSONNEL, EQUIPMENT, AND MATERIALS FROM OFFSITE LOCATIONS CAN REACH THE SITE FOR FIRE FIGHTING OR CONTROLLING SPILL ASSOCIATED HAZARDS OR FOR EVACUATION OF PERSONNEL. AT LEAST ONE ALL-WEATHER VEHICULAR ROAD SHOULD BE PROVIDED.

GI5-2 The work camp near the airport is a more desireable location from both a social and safety factor, than near or adjacent the construction site. Regardless of which location is selected,, the all-weather vehicular road is a must for safety sake and it is indeed foolhardy to gamble with the lives of so many in the event of a major disaster at the construction site in one form or the other. Sea rescue methods may well be compromised by the destruction at the site, including docking facilities. Locating fire fighting facilities, equipment, or supplies near or adjacent the construction site or the housing, without a secondary souce located about 7 to 10 miles in the easterly direction towards the intersection of Dayville Road and Richardson Highway, is again inviting a disaster of major proportions.

We cannot gamble that the possible disaster will occur after the completion of the project, thus the choice of the project developer to build this all-weather road after the completion of the project. Build it initially and avoid the gamble of GI5-3 lives. Build an alternative fire station with ready access to the all-weather road. A work camp where workers are GI5-4 isolated; working 70 hours a week; 8 weeks on and 2 weeks off is not socially desireable, but more in keeping with foreign workers willing to exist under these terms.

Respectfully, Philip J. ~~Matthew, Pres.~~

Philip J Matthew

GI5-1 Comment reflected in section 4.15.2.

GI5-2 Comment reflected in sections 4.15.2 and 4.16.

GI5-3 The LNG facility would have mobile and stationary fire fighting equipment. See appendix B, pages 37-43.

GI5-4 The use of single status remote construction camps is common practice, particularly in areas with poor accessibility. Workers are usually financially compensated for their willingness to work in isolated conditions. The conditions of employment are made clear to prospective workers at the time of hire and only those who find them to be "socially acceptable" would be contracted.

GREENPEACE

P.O. Box 104432, Anchorage, Alaska 99510, Tel. (907) 277-8234, FAX (907) 272-6519

COMMENTS ON THE FEDERAL ENERGY REGULATORY COMMISSION (FERC) DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) FOR YUKON PACIFIC LNG PROJECT (DOCKET NO. CP88-105-000)

July 13, 1993

Introduction

We appreciate your accepting our request for a one-week extension on the July 6 deadline.

Greenpeace is deeply concerned about the environmental impact of Yukon Pacific's LNG facility proposed for Anderson Bay in Port Valdez, Alaska. We are concerned about the direct impacts of the facility to the marine and coastal environment of the region as well as the proposed Trans-Alaska Gas System (TAGS) generally. We do not view the LNG facility as isolated from the larger industrial project. Our comments, therefore, pertain to the specific Anderson Bay facility as part of TAGS.

Direct Impacts

GI6-1 The DEIS states that the LNG project will have negative impacts on a range of habitats and wildlife species. The document cites potential damages to fresh and marine water quality, fishes, waterfowl, terrestrial wildlife and air quality.

Water quality -- The DEIS states concerns about the impacts to water quality and fishes from rock and soil disposal, thermal discharges, ballast water exchange, stream siltation, damming and rechannelization, shoreline grading, de-icing chemicals, turbidity, and contaminants. Industrial contaminants from "emissions, spills, road use, and outfall discharges into streams and areas with significant tidal exchange" (4-16) would adversely affect water quality on a continual basis during operations. The DEIS raises the possibility of environmental consequences from the release of ammonia, hydrocarbons, oil/grease, mercury iron, arsenic, cadmium, lead and other contaminants entering fresh and nearshore waters. (4-17)

GI6-2 The DEIS expresses significant concerns about the availability of adequate water supply for the LNG facility during both construction and operation phases. The DEIS recommends that impacts to spawning fish be examined. The DEIS also states that estuarine spawning

GI6-1 While your comment reflects the concerns on water quality impacts, the DEIS also identifies the established regulatory permitting to reduce impacts to acceptable levels or recommends additional mitigation where necessary.

With respect to iron, arsenic, cadmium, and lead, the possibility for exceedances is mentioned in section 4.3.2.1 since the projected maximum concentrations in the pipe exceed the freshwater standards. However, since the projected average concentrations are lower than the standards, and also since mixing zones are relatively likely, exceedances will probably not occur. Nevertheless, Yukon Pacific will have to document this to the EPA's satisfaction during the NPDES permit application and permit monitoring during facility operation.

GI6-2 The availability of water supply has not been adequately demonstrated by Yukon Pacific. For this reason, recommended mitigation measure 16 requires the filing of a detailed water balance and design supply analysis. If adequate supply from natural sources cannot be achieved while maintaining minimum flows (consultation with ADFG), reliance on desalination may increase.

GI6-3 The DEIS estimates significant damage to all wetlands in the area of the LNG facility and is critical of Yukon Pacific's proposed mitigation measures. (4.4.3)

GI6-4 Seabirds and Marine Mammals -- Greenpeace is very concerned about the impacts of this facility on seabirds, particularly the marbled murrelet which forages in Anderson Bay. The Pacific Northwest marbled murrelet population has been listed under the Endangered Species Act and is considered to be declining in Alaska. Submerged blasting during construction is likely to adversely affect marine mammals in the vicinity of the site. (4.5.6.2) The DEIS states that the LNG project is likely to have adverse consequences for bears inhabiting the area of the facility.

GI6-5 Air quality -- The air quality analysis does not include emissions from the proposed waste incinerator. This incinerator is expected to burn less than 1,000 pounds per day thus escaping State emissions regulations. However, it is of great concern that the incinerator will burn "undetermined amounts of oils, greases, construction debris, and heavy hydrocarbon wastestreams." (p. 4-43) Incineration will release toxic emissions into the atmosphere adding to the load already coming from the Alyeska facility. The EIS is not complete until it contains all the sources of air quality impacts even for those not regulated under federal law.

GI6-6 Greenpeace regards these impacts to the Anderson Bay ecosystem too great to permit the siting of this LNG facility.

Seismic Risks and Thermal and Dispersion Exclusion Zones

GI6-7 The DEIS states that Yukon Pacific has not accurately or adequately addressed risk to the LNG facility from earthquakes. FERC recommends further attention to several issues related to structural soundness in the event of a major earthquake and associated phenomena such as tidal waves. Yukon Pacific has failed to address mitigation measures to protect berthed LNG tankers in the event of what the DEIS terms a "likely" occurrence of damaging waves as a consequence of moderate seismic activity.

GI6-8 In a 1990 report to the House Committee on Interior and Insular Affairs, it was calculated that the "radius of flammability" of an vapor cloud resulting from a 10-minute release of LNG from a loading tanker could extend a distance of 11,920 feet. Loaded supertankers carrying oil from the neighboring Alyeska terminal pass within 7,595 feet of the LNG berth site. The DEIS addresses distances from the Alyeska facility but not the distance from tankers moving through Port Valdez. If such a cloud was ignited in the presence of an oil tanker, a catastrophe involving both facilities could result.

GI6-9 Seismic activity common to the region and the extreme danger of a

GI6-3 The DEIS and FEIS identify the acreage of wetlands and subtidal habitats that would be affected by the project. These documents also review Yukon Pacific's proposed mitigation and identify several deficiencies in the level of detail provided in the wetland mitigation plan. However, neither document concludes that the impact on wetlands cannot be mitigated and is therefore significant.

GI6-4 Comments noted; however, we believe there are mitigation measures available and recommended which will minimize wildlife impacts.

GI6-5 Emission estimates from the incinerator have been revised and included in recent analyses of the air quality impact of the proposed Anderson Bay facility. The incinerator maximum hourly emissions are estimated to be: 0.0115 g/s SO_2, 0.042 g/s PM_{10}, 0.233 g/s CO, and negligibly small VOC emissions. Annual average NO_x emissions from the incinerator are estimated to be 0.31 g/s.

The incinerator would be of a conventional design for municipal and industrial waste disposal (nonhazardous). It incorporates a bed of ground refractory material and/or quartz sand which is fluidized by an air stream from a dedicated blower. Feed to the incinerator will consist of biological sludge from the wastewater treatment plant, spent oils, and various solid facility wastes. Both the preheat burner and the main combustion burner can burn either fuel gas, diesel oil or waste lubricating oil, and hydraulic fluids. No substances with toxic characteristics or other hazardous characteristics would be stored in the spent waste oil tank or introduced into the incinerator. The incinerator would be equipped with a venturi-type scrubber to control emissions.

GI6-6 Comment noted. The staff has, however, concluded that if the recommended mitigation measures are incorporated and the required permits and approvals are correctly obtained from the appropriate Federal, state, and municipal authorities, the consequences to the Anderson Bay environment of constructing and operating this project are acceptable.

GI6-7 Section 4.2 has been revised to incorporate a discussion of the effects of slide-induced waves on LNG tankers and the marine terminal. The condition is retained to ensure proper consideration in the final design.

GI6-8 The DOT commented that transient vessels, such as oil tankers, would not be prohibited from the dispersion exclusion zone. However, procedures for notifying offshore vessels must be incorporated into an emergency plan. See section 4.15.3.

GI6-9 The DOT minimum safety standard determines whether a site is acceptable from the safety standpoint. We believe the site meets those standards.

GI6-9 catastrophic explosion and fire (as a result of an LNG spill and ignition of a vapor cloud) represent dangers far too great for the siting of the facility.

Cumulative Impacts

GI6-10 TAGS represents a huge industrial project that will have widespread adverse environmental impacts. Production of natural gas on the North Slope involves most of the same problems as the production of oil such as toxic drilling waste disposal, hydrogen sulfide treatment, pipeline construction and operations, industrial facilities, disturbance of wildlife and habitat, air emissions, and wetland loss. Transportation of LNG to market cannot be undertaken without damage to the local environment and substantial risk of serious accidents. In the end, the natural gas is used to generate energy which could be saved through advanced energy efficiency measures, reduced through conservation and otherwise generated from safe, renewable technologies.

GI6-11 The proposed Yukon Pacific LNG project in Port Valdez will add environmental degradation to that caused by heavy industry already located there. Each individual facility will not in and of itself cause the destruction of the regional environment. But the cumulative effect of a growing array of oil and gas facilities in Valdez is significant. We request that the Final EIS for the LNG project reflect this reality.

Natural Gas: Bridging Fuel or Roadblock to Clean Energy?

GI6-12 Greenpeace does not regard expanded use of natural gas as a clean alternative to dependence on oil and coal. While sulfur dioxide emissions from natural gas combustion are decidedly fewer than from other fossil fuels, the same is not true for nitrogen oxide or, in some energy sectors, carbon dioxide. Even in the sectors where carbon dioxide emissions are less compared to coal or oil, replacing oil and coal use with natural gas will not provide savings of carbon dioxide sufficient to stabilize the global warming trend. The United Nations' Intergovernmental Panel on Climate Change warns that a 60 percent reduction in carbon dioxide emissions is necessary for the stabilization of global warming. This cannot be done without a significant reduction in all fossil fuel use and a transition to renewable, non-fossil based energy sources. For further information regarding natural gas, a copy of the Greenpeace report entitled "Natural Gas: Bridging Fuel or Roadblock to Clean Energy" is enclosed with these comments.

Comments prepared by Dorothy Smith
Energy Campaign
Alaska Field Office

GI6-10 Comment noted; however, this document is specifically directed at the liquefaction and marine transport aspects of the TAGS Project only, as instructed by DOE Order 350. The pipeline was analyzed in the 1988 BLM/COE TAGS FEIS.

GI6-11 The question of the cumulative impacts generated by superimposing the proposed Yukon Pacific LNG facility on the existing industrial base has been addressed in the document in section 4.0 under the various subject headings.

GI6-12 It is beyond the scope of this document to analyze the end use of natural gas in Japan and other Pacific Rim countries.

GI7

The Valdez Star

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July 2, 1993

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Mr. Chris Zerby, Project Manager (Room 7312)
Federal Energy Regulatory Commission
825 North Capitol Street, N.E.
Washington, DC 20426

Dear Mr. Zerby;

Re: Public Comment on Yukon Pacific Inc. LNG Project

GI7-1 Please add my voice to those who stand vigorously in favor of the Yukon Pacific LNG Project which would convey natural gas from Alaska's North Slope to tidewater at Valdez, Alaska.

Mr. Wally Hickel and the Yukon Pacific people are visionaries of the first water. They deserve our applause and our support and it is my intention to put my shoulder to the wheel in my own small way in support of this most worthwhile endeavor.

I must tell you however, that I have grave misgivings about two elements of the Yukon Pacific plan: the company's preference to forego the building of an all-weather road to the LNG terminal at Anderson Bay until after the terminal is complete, and the building of a remote mancamp adjacent to the LNG construction site.

GI7-2 I object most strenuously to both proposals. The remote mancamp, which I view as little more than a benevolent concentration camp, is designed more for the convenience and profit of Yukon Pacific than for the well being of the construction crews or the economic and social benefit of the City of Valdez. The remote mancamp with its captive workforce will lead unquestionably to the return of the "company store," an exploitive practice that has been almost universally rejected in post world war 11 America.

GI7-1 Comment noted.

GI7-2 Comment noted. Please see response G15-4.

GI7-3 I am the editor & publisher of the local newspaper, The Valdez Star. In the July 1 edition, I have written an editorial expressing objections to the road and mancamp elements of the Yukon Pacific plan. Please include this letter and the enclosed newspaper editorial as part of the public record.

GI7-4 It is my hope that your agency will require the construction of an all-weather road to the LNG terminal site prior to construction, and that the mancamp is located where the workforce can have direct, individual and spontaneous access to the economic and social life of Valdez.

GI7-5 Do I have an ulterior motive in all of this? I most certainly do! As a Valdez businessman, it is my hope that the influx of thousands of working men and women into the Valdez area will have an positive economic and social impact on our community.

It is my hope that these men and women will become a real part of our community during the four to five year construction period. These workers and their families should be given the opportunity to attend our churches and schools, shop in our stores, dine in our restaurants, drink in our bars, attend movies, dances and other functions at the civic center, play Little League and adult softball at the local diamonds, go fishing and boating in our waters, etc.

In effect, they should be given the opportunity to live the most wholesome family life as can arranged during their time in Valdez. I observe in the draft E.I.S. that some 40 or 50 managers will commute daily to work from Valdez to the terminal site although the working stiffs won't be given the same opportunity.

That raises the question: why is the family life of a manager or supervisor more important to him than family life is to a pipefitter or welder?

Does this mean that a Valdez working man who gets a job at the terminal site will be confined to the mancamp for up to 8 weeks, segregated from his wife, children and home which are located just a few miles away across the bay. What about the man or woman from Louisiana who brings his/her family to Valdez only to find that he/she must live at the mancamp for 8 weeks at a stretch.

GI7-3 Comment noted and included as part of public record in this appendix of the FEIS.

GI7-4 Comment reflected in section 4.16.

GI7-5 Comment reflected in section 4.16. It is expected that the influx of workers during construction will have a positive economic impact on the community of Valdez and for this and other reasons, the City of Valdez has endorsed the Yukon Pacific LNG Project. The City Council, however, in its resolution of June 21, 1993, articulated its support for an Anderson Bay work camp... to "reduce the social and public safety impact of the projected peak work force of about 4,000 people."

GI7

GI7-5 There's something seriously wrong here. We talk a great deal about "family life" in America but there's nothing more devastating to family life than segregating the bread winner from his family for 10 months of the year.

GI7-6 My observations do not even begin to touch on environmental considerations such as the clearing of 47 acres near the terminal site for a temporary mancamp, and the building of a water and sewage disposal system, electrical power and telephone service.

GI7-7 All or most of the above services are already in place at several locations in Valdez and along Dayville Road, including the airport site where the mancamp was located during the building of the trans-Alaska pipeline in the 1970s.

GI7-8 With respect to the all-weather road to the terminal site, safety considerations should be paramount. We recognize that Alaska can muster excellent helicopter, float plane and boat services to just about any corner of the state. But these vessels have their shortcomings, particularly during periods of nasty weather of which Valdez has plenty.

You may wish to check with the U.S. Coast Guard to determine how often the Port of Valdez is closed to water traffic because of nasty weather; the FAA will also tell you how many days of the year, especially in winter, when the Valdez airport is closed to the airlines due to bad weather.

Prior to the implementation of the microwave landing system at the Valdez airport, MarkAir and Era Aviation were forced to cancel more than 25 percent of their scheduled flights during the winter months because of poor weather.

Unfortunately, aircraft and waterborne craft function at the pleasure of the weather. All-weather roads are accessible almost all of the time, irrespective of weather conditions.

In my six years in Valdez, for example, I cannot recall a single instance when Dayville Road (to the Alyeska terminal) was closed because of weather conditions.

GI7-6 As described in section 4.16, the staff is of the opinion that with the incorporation of recommended mitigation measures and continued consultations with Federal, state, and local representatives, the impacts associated with the development and operation of the Seven Mile Creek work camp can be kept at acceptable levels.

GI7-7 Comment noted.

GI7-8 Comment reflected in section 4.15.2.

GI7-8 An all-weather road to the LNG terminal site is absolutely essential, in my judgement, during the construction period for reasons for safety, evacuation in an emergency and to give the workforce the option of travelling to Valdez, or other Alaska locations, for R&R, shopping, meeting with family or whatever.

Please make my observations a part of the public record in this matter. Thank you for the opportunity of allowing me to state my case.

Cordially,

Patrick K. Lynn
P.O. Box 123
Valdez, Alaska 99686

ORIGINAL

THE RENAISSANCE GROUP
business restorations

93 JUL -1 PH 1:02

June 28, 1993

Secretary, Federal Energy Regulatory Commission
825 N. Capitol St., N.E.
Washington D.C. 20426

Reference: Docket CP 88-105-000

Dear Mister or Madam Secretary:

GI8-1 Yukon Pacific's basic plan - to bury their pipe in areas of wet permafrost - is fatally flawed. In one area their pipe will be crushed by the re-freezing of the active layer; in another area their pipe will be fractured by ice wedge cracking. Their pipe will be especially vulnerable during the several year construction period, before a flow of refrigerated gas can be established.

I recognize that, as an unknown, my making statements like those above puts me in the same category as the many "Crazy Ottos" you must deal with. If the facts I've stated above were my own views, I'd agree with you. But they are not; they are based on the research findings of two of our foremost arctic scientists; Drs. Max Brewer and Arthur Lauchenbruch, both of the U.S.G.S.

Twenty years ago, I was working on the Anderson Arctic Foundation and Pipeline System. At that time El Paso Natural Gas was planning to build a gas pipeline paralleling Alyeska's oil pipeline. When we met with El Paso, we were surprised to hear that they thought they could bury their cold gas pipe. We told them that we didn't think it was possible and we agreed to run a study to back-up our belief. The study we presented to El Paso - "Burial Of A Cold Pipe In Wet Permafrost" - is the same one enclosed with this letter. El Paso and several Canadian Firms they were working with were able to independently confirm our findings. If you will look at the references page you will see that the data on which the report was based, was developed by Drs. Brewer and Lauchenbruch. Both felt, at the time, that the only error in our study was that we used their research data too conservatively; ie, our doubling the pipe wall thickness from ½ to one inch and our using the least possible frozen soil strength. They stated that had we stayed with the ½ inch wall and used an average frozen soil strength the inevitability of the buried cold pipe being crushed or fractured would have been made crystal clear.

GI8-1 As stated on pages 1-5 and 1-6 of the DEIS, issues associated with the TAGS pipeline are outside the scope of the EIS.

P.O. Box 1003 • Bellevue, Washington 98009 • (206) 454-1003

FERC DOCKETED
JUL - 1 1993

GI8-1 Last year I met with Mr. John Swanson, Yukon Pacific's Pipeline Design Manager. He insisted that it would be impossible to build a gas pipeline above ground; that the continual flexing on the pipe - caused by it's expansion and contraction following both seasonal and daily temperature changes - would result in fatigue failures which would propagate into pipe rips, hundreds of feet long. He was, of course, correct on both counts; if you limit yourself to an all welded pipe, which must take out expansion and contraction in bending, as Alyeska had done. I tried to explain to Mr. Swanson that there was another way, a better way; that you could go with a relaxed pipe, by using expansion joints; limit any rip with tear-stoppers, as we had done in jet aircraft; and that the use of Anderson Pneumatic Pontoons, for pipe support, would be cheaper and more environmentally sound than the refrigerated pilings Alyeska had been forced to use. Mr. Swanson brushed this off with a statement that was, in essence, "don't bother me with the facts, we're going to bury the damn pipe".

If a project is going to create wealth and generally foster the well being of the populace, but will cause some environmental harm, then the pluses must be weighted against the minuses. But, if the project is doomed to failure there is no reason to let it proceed, as planned. In addition to the environmental damage caused by both the quarrying/transporting of millions of yards of fill gravel and the ripping-up of a swath of permafrost hundreds of miles long; the economic damage to the state, caused by the failure of the present Yukon Pacific Plan, would be incalculable.

Sincerely,

Robert Adams
President

PUBLIC MEETING COMMENTS

YUKON PACIFIC LNG PROJECT
PUBLIC MEETING COMMENTS

PM1 ANCHORAGE, ALASKA - JUNE 8, 1993

No comments received.

PM2 VALDEZ, ALASKA - JUNE 10, 1993

	Transcript Page No.	Comment		Response
PM2-1	13	The Valdez Fire Department agrees with the DEIS that the road access south of the Alyeska Terminal is not a viable option because of the excessive grades and switchbacks and that it would be a difficult and sometimes unsafe road to negotiate during many of the winter months. (D. Griffin)	PM2-1	Comment noted.
PM2-2	13	The road access through the Alyeska Terminal is possible and might work from a response time point of view, for fire response, if Alyeska Pipeline Service Company could accommodate it. (D. Griffin)	PM2-2	Comment noted.
PM2-3	13, 14	Our Fire Chief has some personal knowledge of oil and gas facilities in Alaska that are not accessible by an all-weather road. He also considers that emergency response to the LNG facility from Valdez could be timely and practical using marine access. (D. Griffin)	PM2-3	Subsequent to the DEIS, the DOT confirmed that the presence of an all-weather access road is not an absolute requirement.
PM2-4	14, 15	Helicopter and high speed water craft are other fire response options but would require that equipment be available, co-manned with Yukon Pacific's staff, at the site and the fire chief believes the response time by these methods (weather permitting) would be pretty close to the overland route. (D. Griffin)	PM2-4	Comment noted. It is Yukon Pacific's intention to have a virtually autonomous fire response system in place at the site, including all necessary as well as redundant equipment.
PM2-5	15, 16	From a fire protection point of view there's really no objection to the housing of workers in the town except we'd (Fire Department) prefer that the airport fire station be reopened. Housing workers at Anderson Bay could also be an option from a fire protection point of view. (D. Griffin)	PM2-5	Comment noted, although we (the staff) now consider the onsite camp site to be preferable for social reasons to the Valdez Airport camp location.
PM2-6	16	Our police department says that the road in some ways would be nice in certain situations but certainly would not be a requirement. (D. Griffin)	PM2-6	As described in section 4.15.2, the staff is recommending an all-weather access road for emergency purposes.
PM2-7	16	The Valdez Police Chief wishes to be consulted regarding the bear and human conflict potential. (D. Griffin)	PM2-7	Recommended mitigation measure 25 has been revised to include consultation with the Valdez Chief of Police during the development of a mitigation plan for avoiding negative bear/human interaction.

PM2

	Transcript Page No.	Comment		Response
PM2-8	16, 17	It seems obvious that having the workers housed in Valdez would have more impact on the community and has a potential of being somewhat negative I guess, from a public safety point of view. Right now we're probably leaning towards the site with the least impact on the city. (D. Griffin)	PM2-8	Comment noted and confirmed in the City's June 22, 1993 letter to the FERC articulating the Valdez City Council's resolution to support an onsite camp site in order to relieve pressure on the community. The staff concurs and likewise supports the housing of workers at the site of construction.
PM2-9	18, 19	I lived in Valdez during the pipeline construction and the outside housing of construction workers worked very well. The camp by the airport is privately owned and its use should be at the option of the company. It's obvious it's more efficient to have your workforce housed close by and I think the realities of living would dictate that the best place for them would be housing onsite. (W. Wood)	PM2-9	The camp site at Seven Mile Creek is the preferred location of the staff.
PM2-10	20, 21	Let's say I agree with the recommendations regarding the work camp being put out there. I don't think it really matters whether it's out there or here in town. They're going to find town somehow, the workers, and will be part of the business community or part of the social problems here. (M. Kinney)	PM2-10	Comment noted.
PM2-11	21, 22	The one request I have concerning the housing out there is that it be immediately reclaimed as soon as construction is finished. There is a lot of stuff left over from the pipeline construction and I'm wondering who is ever going to clean that mess up. So in some ways I agree with somebody like Yukon Pacific setting up their own camp because I would assume that they would be responsible for tearing it down and getting rid of it and reclaiming the site when they're done. (M. Kinney)	PM2-11	Section 4.16 of the FEIS and recommended mitigation measure 48 address the requirement for Yukon Pacific to dismantle the camp site and restore the area at the end of the construction period.
PM2-12	22	Regarding transportation, in my mind the concept would be to open the road after construction is done and after the start-up of the facility. That would probably ease the concerns of Alyeska's security - they'd only be concerned with some 200 workers instead of 5,000. I am in full support of an all-season road to the Yukon Pacific site. (M. Kinney)	PM2-12	The FEIS recommends the all-weather vehicular access road for emergency access/egress purposes only. The staff did not support its use during construction or for commuting by operations staff (see sections 4.15.2 and 4.16).
PM2-13	22	I am fully in support of this project from an environmental standpoint. (M. Kinney)	PM2-13	Comment noted.

	Transcript Page No.	Comment		Response
PM2-14	22, 23	Regarding the use of Port Valdez for spoil disposal, the separation of organics and inorganics is very important. Floating debris all over the port would not be something I would like, not something tanker traffic would like, nor something small boaters would like. I find it hard to believe that Valdez does not have enough room for landfill capabilities for that type of material in Valdez. It seems like we have a lot of land - across from the airport for example. (M. Kinney)	PM2-14	Section 2.3.2 describes in some detail the pros and cons of the various spoil disposal options considered. It is acknowledged that disposal of organic materials offshore is not acceptable and because the separation process is considered to be infeasible, offshore disposal of any material is not being recommended. The transport of such large quantities of material (in excess of 3 million cubic yards) all the way to Valdez for disposal would be less desirable than the other offsite land options considered in the analysis (Sites C and D).
PM2-15	23	I couldn't find this in the DEIS, but there is an Anderson Bay memorial site which was established after the '64 earthquake. Though some people might not remember, and though it's not listed in the historical archives, I'm sure there are some people that attach some sentimental value to it because somebody paints it every once in a while. This issue should be addressed in the FEIS. (M. Kinney)	PM2-15	Thank you for your comment. Sections 3.14 and 4.14 have been revised to reflect this additional information. The island on which the memorial resides will be unaffected by construction of the project. Depending upon how the Coast Guard enforces its 200-yard safety exclusion zone around the operating site, however, access to the island could be limited, although not totally excluded. We have added a recommendation that Yukon Pacific not disturb the monument to Harry Alden Henderson at Anderson Bay.
PM2-16	23, 24	The issue of air quality concerns me because the DEIS reports that the carbon dioxide levels are going to be 15 times more than they are now and the NO_X doubled. We need to do more on the modeling of the cumulative effect on air quality of adding a new facility and doubling the population. (M. Kinney)	PM2-16	Revised analyses of the air quality impact have been made in response to comments from the EPA Region 10. The cumulative impact on all criteria pollutants and any regulated toxics has been done using preliminary screening analysis and will be done using refined analysis as part of the PSD permit application. Screening results show that 1-hour average CO concentrations will increase 7,680 $\mu g/m^3$ to 8,830 $\mu g/m^3$ and 8-hour average CO concentrations will increase from 4,524 $\mu g/m^3$ to 5,329 $\mu g/m^3$. Screening results for NO_2 show an increase from 27 $\mu g/m^3$ to 69 $\mu g/m^3$. All predicted results are in compliance with NAAQS and state standards. The NO_2 concentration is above the PSD increment level and will need analysis with refined modeling analysis and the new representative meteorological data.
PM2-17	25	I recommend a joint comprehensive air monitoring program in the Valdez bowl shared by Petro Star, Yukon Pacific, and Alyeska. (M. Kinney)	PM2-17	While a joint air monitoring program offers advantages, it is beyond the scope of this FEIS to impose such a requirement on other industries.
PM2-18	25, 26	In recommended mitigation measure 38 of the DEIS, I'd like to add my full support for a radar monitoring system versus a VTS system as recommended by the Coast Guard because the VTS will not pick up all the fishing boats that are not carrying VTS. VTS alone will be inadequate. (M. Kinney)	PM2-18	In discussion with the Coast Guard it is our understanding that VTS, radar systems, and ADSSE will be operating in the Prince William Sound/Valdez area. See GI2-10.

	Transcript Page No.	Comment		Response
PM2-19	26	Not only do I support recommended mitigation measure 2 of the DEIS concerning the submittal of maps and aerial photos, but like to see a similar scale mapping for the whole pipeline from Prudhoe Bay down to Valdez. (M. Kinney)	PM2-19	This is outside the scope of this EIS, see section 1.5.
PM2-20	26	Recommended mitigation measure 19 of the DEIS addresses wetlands mitigation. Would it be possible to purchase private property in the Valdez and the Duck Flats, critical habitat area, to mitigate the loss of wetlands in the Anderson Bay area? (M. Kinney)	PM2-20	A final detailed wetland mitigation plan has not yet been submitted to the agencies by Yukon Pacific. However, based on the initial plan discussed in section 4.4.3 of the FEIS, it is most probable that offsite mitigation for wetlands would involve the acquisition of property and enhancement of existing intertidal flats in the Old Valdez area. At present we are unaware of any plans to acquire property in the area of Valdez to mitigate wetland impacts. However, it is possible that areas near Valdez may be suitable for offsite mitigation.
PM2-21	26	There is a seal haul-out at Terminal Island which is not included on your figure 3.6.3-1. Just last week there were 36 sea lions hauled out there. (M. Kinney)	PM2-21	Figure 3.6.3-1 specifically addresses the haul-outs for the endangered Steller sea lion. Haul-outs for the more common harbor seals, such as those you have observed at Terminal Island, were not mapped.
PM2-22	27, 28, 29	During the pipeline days there was a major influx of people with associated impacts, and this town coped with that. We went through that build-up and construction phase and I think we learned a lot of lessons which could be applied to this project as well. I don't see any reason for being overly concerned about this type of build-up so long as it is understood what we're dealing with. Also, the workings of the plant itself is not and should not be a big concern for the community and we can look to the successful operations at Kenai to know what to expect and the new one would have even further improved safety features. I think that the project represents a great opportunity for the city as well as the state despite the burden to the fire and police departments. I think the police department could cope with a little better training. (D. Taylor)	PM2-22	Thank you for your comment.
PM2-23	29 - 33	A general discussion, initiated by R. Malstrom regarding the use of waste heat to generate electricity was held. Yukon Pacific (J. Lowenfels) confirmed that this potential opportunity will be investigated and that if electricity could be generated through this means, it would be available for local consumption i.e., Alyeska, City of Valdez etc.	PM2-23	No response required.

APPLICANT COMMENTS

PM2

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APPLICANT COMMENTS

ORIGINAL

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YUKON
PACIFIC
CORPORATION
TRANS-ALASKA GAS SYSTEM

JEFF B. LOWENFELS
VICE PRESIDENT

July 6, 1993

93 JUL 14 PM 3:16

FILED

Ms. Lois D. Cashell, Secretary
Environmental Compliance & Project Analysis
Federal Energy Regulatory Commission
825 N. Capitol Street N.E.
Washington, DC 20426

RE: Yukon Pacific Company, L.P.
Docket Nos.: CP88-105-000/CP88-105-001

Dear Ms Cashell,

Yukon Pacific Company L.P. ("YPCLP"), applicant in the above captioned docket, submits the following comments with regard to the Draft Environmental Impact Statement (DEIS) issued pursuant to its application for approval of Anderson Bay, Valdez Alaska as the place of export for LNG for the Trans-Alaskan Gas System (TAGS). In general we are pleased that the Federal Energy Regulatory Commission Staff ("Staff") and its contributing reviewers agree that the Anderson Bay Site is acceptable for the construction and operation of the proposed LNG facilities.

In reaching this conclusion, Staff reviewed the volumes of documentation that YPCLP submitted over the course of the application review period which are part of the record. This documentation accurately depicts our position with regard to all of the issues raised by the DEIS recommendations and need not be repeated here. Staff made several technical recommendations regarding the YPCLP studies. In general, we have few problems with the recommendations. However, there are some areas of disagreement that we believe must be brought to the attention of the Commission and the Staff.

AI-1 In the body of the DEIS analysis, we note there was general agreement that the seismic study conducted by YPCLP and its contractors was conducted pursuant to the requirements of 49 CFR 193. However, the particular values for seismic characterization derived by YPCLP are recommended by Staff to be further studied with a new basis assumption of a project design life of 200 years. This hypothetical and inconsistent (with export authority and application) assumption (see Appendix A & B to the DEIS) requires the TAGS export site facilities to have a service life eight (8) times greater than the Office of Fossil Energy (OFE) export license and drastically alters the manner in which the Department of Transportation's (DOT) regulations are

AI-1 implemented. Moreover, it ignores the fact that YPCLP must make a new application to OFE and FERC followed by full review by them *if* it ever seeks to extend or expand its current 25 year export authority. In short, if the TAGS facilities require additional design work because of an extended service life (which in turn is dependant upon the discovery of reserves on the north slope of Alaska beyond those discovered thus far and receipt of export permission from DOE), the only legally permissible time to require such additional design is when an application is received for an extension. The recommendations in the DEIS attempt to permit a project applicant has not contemplated.

In short, use of a project life greater than 25 years appears to be inconsistent with OFE's Order 350. It is respectfully submitted that the OFE/DOE export approval only authorizes a 25 year export term. Any extensions of the service life of the facility would be preceded by application to DOE which would enable review of seismic characterization criteria based upon *actual* plans and updates of the time-dated seismic data. YPCLP, therefore, submits that the seismic characterization submitted by YPCLP should be accepted as per the YPCLP filing.

YPCLP also has concerns about the recommended seismic design criteria which go beyond what is required by 49 CFR Part 193. YPCLP respectfully suggests that if Staff does not accept YPCLP's seismic studies, then the recommendations in Paragraph 7 allow for flexibility. Inasmuch as the final seismic design plans and specifications are to be filed with the Secretary for review and approval by the Director of the OPPR, YPCLP urges that the preface to recommendations contained in paragraph 7 be revised to allow both the Staff and YPCLP the opportunity to resolve the issues raised in the Appendices before the final design is approved. The FEIS should note the parameters to be utilized will be between those suggested by YPCLP and those suggested by Staff contractors.

AI-2 Second, Staff opposes on-site housing for construction workers. The express rationale for their recommendation, according to comments at the June public hearings, is a Corps of Engineer conclusion that 47 acres of land will be needlessly filled at the site when camp facilities already exist opposite the Valdez Airport. This logic fails to take into consideration the unique nature of Alaska and the site weather conditions. With off-site housing and the potential for heavy snowfall in the area, YPCLP will still have to construct on-site housing for employees who might have to remain at the site overnight. Further, the extra productivity and reduction in lost time afforded by on-site housing will allow for increased efficiency and safety. Finally, off-site housing requires creation of a new road in a virgin area with environmental, security and social impacts greater than those associated with the on-site camp—including construction of the camp as the current facility opposite the Valdez Airport is being dismantled.

AI-3 In this regard, YPCLP is steadfastly opposed to the requirement of an all weather road between Valdez and the LNG site once construction is completed. It is important to point out that the facility will be constructed in accordance with the applicable Department of Transportation performance standards (49 CFR Part 193) which YPCLP believes do not require a road. It is equally important to note that the NFPA 59A standard upon which Staff has relied refers to a

A1-1 The conditions do not require the use of 200 years or any other particular facility design life. The recommendations are based on:

- **a likelihood that the facility will be operated longer than 30 years, and**
- **the fact that the assumptions made by Yukon Pacific are not the only possible ones to be derived from the data, specifically, great earthquakes have occurred in close proximity to one another in the southern Alaska area within 29 years of each other.**

Unfortunately, some of the facilities which are of most concern here might not be capable of being retrofitted if a greater level of design were required in the future. If they could, the cost would likely be much higher than building to an appropriate design level now.

Yukon Pacific also objects to proposed design criteria which it claims go beyond those required by the DOT. Without addressing whether these requirements are in fact beyond the DOT's, the FERC and DOT have a Memorandum of Agreement that recognizes the DOT's authority for "minimum safety standards" but that the FERC is free to add additional requirements.

With respect to Yukon Pacific's desire that the conditions allow for flexibility, we agree that the review and approval process should allow for modification of the requirements. However, the ultimate design values will not be less than those proposed, and are most likely to be those stated in the FEIS.

A1-2 Comment reflected in section 4.16.

A1-3 Comment reflected in section 4.15.2.

AI-3 road as merely a factor to be taken into consideration in selecting a plant site and is not a mandatory requirement. Thus, YPCLP strongly urges that Staff's recommendation 35 (page 5-18) be withdrawn.

AI-4 Finally, YPCLP notes that many of the recommendations made by Staff are already requirements imposed by the State of Alaska and Federal agencies participating in the Joint Pipeline Office (JPO) effort thereby creating the potential for conflicting approvals between the JPO and FERC. It is respectfully urged that FERC, the only major agency involved with the TAGS LNG facility which has not joined the Joint Pipeline Office, either join the JPO or carefully coordinate review of these items with their federal and state counterparts so that construction of the project can be carried out in an orderly and timely manner.

Once again, however, we note our appreciation for the Staff review resulting in the DEIS and look forward to working with FERC Staff as the TAGS project continues to develop.

Sincerely,

Jeff Lowenfels
Vice President & Corporate Counsel

cc: Mr. Chris Zerby
Project Maanager (Room 7312)
Federal Energy Regulatory Commission
825 North Capitol Street, NE
Washington, DC 20426

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A1-4 **The recommendations in the DEIS and as modified in the FEIS require input from the appropriate state and/or Federal resource agencies to provide for a coordinated review.**

APPENDIX F

LIST OF PREPARERS

APPENDIX F

LIST OF PREPARERS

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B.S., Mechanical Engineering, 1991 (University of Maryland)

APPENDIX G

REFERENCES AND CONTACTS

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Abbot, S.M. (ed). 1992. Mountain Goat, Federal Aid in Wildlife Restoration Survey-Inventory Management Report - 1 July 1991 -30 June 1992. Unpublished report Alaska Department of Fish and Game, Juneau, Alaska.

Alaska Department of Environmental Conservation. 1995. Alaska Water Quality Standards 18 AAC 70. Revised January 4, 1995.

Alaska Department of Fish and Game. 1973. Alaska's Wildlife and Habitat, Division of Game, Juneau. pp 144.

Alaska Department of Fish and Game, Division of Subsistence. 1988. Valdez: An Overview. Juneau, Alaska. March.

Alaska Department of Fish and Game. 1992. Letter dated July 22, from P. Brna (Joint Pipeline Office) to H. Noah, included in Appendix A In: Anderson Bay Salmon Enumeration Project. Alaska Department of Fish and Game, Habitat Division, F.M. Thompson. 1993. pp. 20.

Alaska Department of Fish and Game. 1993. Comments referenced in letter dated July 6, from M. Birnbaum (State Pipeline Coordinator's Office) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Alaska Department of Labor, 1992. Data faxed on January 27, from B. Elliott (Labor Economist, Alaska Department of Labor, Research and Analysis, Juneau, Alaska) to P. Reynolds (Ebasco).

Alaska Department of Natural Resources. Undated. State Comprehensive Outdoor Recreation Plan.

Alaska Department of Natural Resources, Alaska Department of Fish and Game. 1988. Prince William Sound Area Plan for State Lands. Anchorage, Alaska.

Alaska Joint Pipeline Office. 1994. Letter dated March 9, from G. Stackhouse (Chairman, Wetlands Evaluation Working Group) to M. Macy (Coordinator, TAGS Environmental Review Committee).

Alaska State Pipeline Coordinator's Office. 1993. Letter dated July 6, from M. Birnbaum to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Alaska Wilderness Recreation and Tourism Association, 1993. Letter dated July 6, from N. Lethcoe (President) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Alyeska Pipeline Service Company. Undated. Marine Terminal. Anchorage, Alaska.

Alyeska Pipeline Service Company, 1993. Letter dated July 2, from J. Dayton (V.P. Operations and Engineering) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Anacker, S. 1993. Telephone communication on March 10, between P. Reynolds (Ebasco) and S. Anacker (Director, Valdez Convention and Business Bureau, Valdez, Alaska).

Armstrong, R.H. 1990. Guide to the Birds of Alaska. Alaska Northwest Books, Anchorage, Seattle.

Ashmore, M. 1993. Telephone communication on October 6, between M. Greenig (Ebasco) and M. Ashmore (Alaska Marine Highway Traffic Management, Anchorage, Alaska).

Baker, C.S., L.M. Herman, B.G. Bays, and G.B. Bauer. 1983. The Impact of Vessel Traffic on the Behavior of Humpback Whales in Southeast Alaska: 1982 Season. Report from Kewalo Basin Marine Mammal Laboratory, Honolulu, Hawaii, for National Marine Mammal Laboratory, Seattle, Washington. pp 30.

Barber, E. 1993. Telephone communication on April 1, between L. Brown (Ebasco) and E. Barber (State Pipeline Coordinator's Office, Alaska Department of Natural Resources).

Barton, J. 1993. Telephone communication on April 28, between D. Lake (Ebasco) and J. Barton (U.S. Environmental Protection Agency, Region 10, Seattle, Washington).

Bauer, J. 1992. Telephone communication on July 7, between K. Godtfredsen (Ebasco) and J. Bauer (Alaska Department of Environmental Conservation, Oil Spill Office).

Behrends, B. 1992. Telephone communication on July 7, between M. Greenig (Ebasco) and B. Behrends (Recreation and Lands Planner, Cordova Ranger District, Chugach National Forest, Cordova, Alaska).

Benson, C. 1993. Telephone communication on March 3, between P. Reynolds (Ebasco) and C. Benson (Property Assessor, State of Alaska, Anchorage, Alaska).

Berzin, A.A. and A. A. Rovnin. 1966. The Distribution and Migrations of Whales in the Northeastern part of the Pacific, Chukchi and Bering seas. Izvestia TINRO 58:179-207.

Bingham, D. 1992. Telephone communication on July 7, between M. Greenig (Ebasco) and D. Bingham (Superintendent, Matsu(?)/Valdez/ Copper River Area, Alaska State Parks, Palmer, Alaska).

Bodine, M. 1993. Telephone communications on August 4, between M. Greenig (Ebasco) and M. Bodine (Operator, Valdez Boat Harbor, Valdez, Alaska).

Bohne, B.A., J.A. Thomas, E.R. Yohe, and S.H. Stone. 1985. Examination of Potential Hearing Damage in Weddell Seals (*Leptonychotes weddelli*) in McMurdo Sound, Antarctica. Antarctica Journal 20:174-176.

Braden, T. 1993. Telephone communication on February 18, between L. Brown (Ebasco) and T. Braden (Alaska Department of Natural Resources).

Braham, H. W. 1984. Distribution and Migration of Gray Whales in Alaska. In: The Gray Whale, *Eschrichtius robustus*. M. L. Jones, S. L. Swartz, and S. Leatherwood (eds.), Academic Press, New York. pp. 249-266.

Braham, H. W. and D. W. Rice. 1984. The Right Whale, *Balaena glacialis*. Marine Fisheries Review 46:38-44.

Bratton, R. 1993. Telephone communication on August 2, between M. Greenig (Ebasco) and R. Bratton (Chief, Coast Guard Facility, Valdez, Alaska).

Brna, P. 1992a. Telephone communication on February 21, between K. Engel (Ebasco) and P. Brna (Joint Pipeline Office, Alaska Department of Fish and Game).

Brna, P. 1992b. Telephone communication on July 23, between K. Godtfredsen (Ebasco) and P. Brna (Joint Pipeline Office, Alaska Department of Fish and Game).

Brna, P. and G. Stackhouse. 1993. Telephone communication in February, between K. Kuzis (Ebasco) and P. Brna (Joint Pipeline Office, Alaska Department of Fish and Game) and G. Stackhouse (Biologist, U.S. Fish and Wildlife Service, Valdez, Alaska).

Broome, S.W. 1990. Creation and Restoration of Tidal Wetlands of the Southeastern United States: In: Wetland Construction and Restoration, J. Kusler and M. Kentula (eds). Island Press, Washington, D.C. pp. 37-63.

Brownell, R.L., Jr., P.B. Best, and J.H. Prescott (eds). 1986. Report of the Workshop on the Status of Right Whales. Report to the International Whaling Commission, Special Issue 10:1-33.

Brueggeman, J.J., G.A. Green, R.A. Grotefendt, and D.G. Chapman. 1987. Aerial Surveys of Endangered Cetaceans and Other Marine Mammals in the Northwestern Gulf of Alaska and Southeastern Bering Sea. Final Report prepared for the Minerals Management Service and NOAA Office of Oceanography and Marine Assessment. Contract No. 85-ABC-00093.

Brueggeman, J.J., G.A. Green, R.W. Tressler, and D.G. Chapman. 1988. Shipboard Surveys of Endangered Cetaceans in the northwestern Gulf of Alaska. Final Report prepared for the Minerals Management Service and NOAA Office of Oceanography and Marine Assessment. Contract No. 85-ABC-00093.

Bureau of Land Management (BLM) and U.S. Army Corps of Engineers (COE). 1988. Final Environmental Impact Statement for the Proposed Trans-Alaska Gas System. Prepared by BLM and COE.

Calkins, D.G. 1978. Feeding Behavior and Major Prey Items of the Sea Otter, *Enhydra lutris*, in Montague Strait, Prince William Sound, Alaska. Fisheries Bulletin 76:125-131.

Calkins, D.G. 1986. Marine Mammals. In: The Gulf of Alaska, Physical Environment and Biological Resources. D.W. Hood and S. T. Zimmerman (eds.). Minerals Management Service Publication OCS-MMS 86-0095. Washington, D.C., U.S. Government Printing Office. pp. 527-558.

Calkins, D.G. and K.W. Pitcher. 1983. Population Assessment, Ecology, and Trophic Relationships of Steller Sea Lions in the Gulf of Alaska. In: Environmental Assessment of the Alaskan Continental Shelf. U.S. Department of Commerce and U.S. Department of Interior, Final Reports of the Principal Investigators, Volume 19. pp. 447-546.

Chester R. and M.J. Huges. 1967. A Chemical Technique for Separation of Ferromanganese Minerals, Carbonate Minerals, and Adsorbed Trace Metals from Pelagic Sediments. Chemical Geology. pp. 2, 249.

City of Valdez. 1986. Valdez Coastal Management Program. City of Valdez, Community Development Department. Valdez, Alaska.

City of Valdez. 1992. Letter dated March 2, from W. Wilcox (City Engineer, City of Valdez, Alaska) to P. Reynolds (Ebasco).

City of Valdez. 1993. Letter dated June 22, from D. Griffin (City Manager) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Clark, M. 1993. Telephone communication on February 25, between P. Reynolds (Ebasco) and M. Clark (Accountant Valdez City Schools, Valdez, Alaska).

Colonell J.M., H.J. Niebauer, and D. L. Nebert. 1988. Processes of Ballast Water Dispersal. In: Environmental Studies in Port Valdez, Alaska, D.G. Shaw and M.J. Hameedi (eds). Lecture Notes on Coastal and Estuarine Studies, Vol. 24, Springer-Verlag Berlin Heidelberg. pp. 39-67.

Columbia Aquatic Sciences (1993) 1992 NPDES Monitoring Program Conducted by Alyeska Pipeline Service Company. Sediment Chemistry, Benthic Infauna, Sediment Toxicity and Flatfish Bile. Report to the USEPA, Region X, May 1993.

Comerci, L. 1993. Telephone communication on April 28, between D. Lake (Ebasco) and L. Comerci (U.S. Environmental Protection Agency, Region 10, Anchorage, Alaska).

Consiglieri, L.D. and H.W. Braham. 1982. Seasonal Distribution and Relative Abundance of Marine Mammals in the Gulf of Alaska. Final Report prepared for NOAA/OCSEAP, Juneau. Research Unit 68. Contract No. R7120806.

Cooney R.T. and K.O. Coyle. 1988. Water Column Productivity. In: Environmental Studies in Port Valdez, Alaska, D.G. Shaw and M.J. Hameedi (eds). Lecture Notes on Coastal and Estuarine Studies, Vol. 24, Springer-Verlag Berlin Heidelberg. pp. 93-115.

Copper Country Alliance. 1994. Letter dated January 8, from E. McHenry to M. Heiman (Coordinator, TAGS Environmental Review Committee).

Coulter, H.W. and R.R. Migliaccio. 1966. Effects of the March 27, 1964 Earthquake at Valdez, Alaska. U.S. Geological Survey Professional Paper 542-C.

Cowardin, L.W., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31.

Craig, G. 1986. Peregrine Falcon. In: Audubon Wildlife Report 1986, R.L. Di Silvestro (ed), National Audubon Society, New York, New York. pp. 806-824.

Crystal, J. 1992. Telephone communication on July 9, between P. Reynolds (Ebasco) and J. Crystal (Administrative Assistant to Chief of Police, Police Department, Valdez City Hall, Valdez Alaska).

Dames and Moore. 1990a. Trans-Alaska Gas Systems, Wetland Functional Assessment Ad Rating: Anchorage, Alaska, 35 p., Preliminary Draft.

Dames and Moore. 1990b. Anderson Bay Marine Engineering and Environmental Reconnaissance Survey Report. Submitted to Yukon Pacific Corporation, December 31, 1990.

Dames and Moore. 1991. In: Environmental Baseline Data, Proposed LNG Plant/Marine Terminal Site, Port Valdez, Alaska. Yukon Pacific Corporation. Anchorage, Alaska.

Darbyshire & Associates. 1991. Valdez Comprehensive Development Plan. Valdez, Alaska.

de Laguna, F. 1956. Chugach Prehistory: the Archaeology of Prince William Sound Alaska. University of Washington Press, Seattle, Washington.

DeGange, A.R. and G.A. Sanger. 1986. Marine Birds. In: The Gulf of Alaska, Physical Environment and Biological Resources, D.W. Hood and S.T. Zimmerman (eds). Minerals Management Service Publication OCS-MMS 86-0095. Washington, D.C., U.S. Government Printing Office. pp. 479-524.

Dehoney B. and E. Mancini. 1984. Aquatic Biological Impacts of Instream Right-Of-Way Construction and Characteristics of Invertebrate Community Recovery. In: Proceedings of the Third International Symposium on Environmental Concerns in Rights-Of-Way Management, A.F. Crabtree (ed). Mississippi State University. pp. 499-507.

Dengel, D. 1992. Telephone communication on July 17, between M. Greenig (Ebasco) and D. Dengel (Community Development Director, City of Valdez, Valdez, Alaska).

Dengel, D. 1993. Telephone communication on February 25, between P. Reynolds (Ebasco) and D. Dengel (Community Development Director, Valdez City Hall, Valdez, Alaska).

Department of Finance. 1992. Comprehensive Annual Financial Report of the City of Valdez (Fiscal Year 1991), Alaska.

Ebasco. 1982. Unpublished. Data compiled from several sources, including a published document on zero-discharge facilities.

Eliason, K. 1993a. Telephone communication on March 16, between D. Lake (Ebasco) and K. Eliason (Project Engineer, Yukon Pacific).

Eliason, K. 1993b. Telephone communication on April 29, between D. Lake (Ebasco) and K. Eliason (Project Engineer, Yukon Pacific).

Estes, J.A., R.J. Jameson, and A.M. Johnson. 1981. Food Selection and Some Foraging Tactics of Sea Otters. In: Worldwide Furbearer Conference Proceedings, J. Chapman and D. Pursley (eds.), Frostburg, Maryland. pp. 606-642.

Exxon Valdez Oil Spill Trustees. 1992. Appendix A - Summary of Injury. In: Exxon Valdez Oil Spill Restoration - 1993 Draft Work Plan. Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

Feder, H.M. and A.J. Paul. 1977. Biological Cruises of the R/V Acona in Prince William Sound, Alaska, from 1970 to 1973. Sea Grant Report No. 77-14. Report No. R77-4, Alaska Sea Grant Program, University of Alaska, Fairbanks, Alaska. pp. 79.

Feder, H.M. and G.E. Keiser 1980. Intertidal Biology. In: Port Valdez Alaska; Environmental Studies 1976-1979. Colonell, J.M. (ed.) Occasional Publication No. 5, Institute of Marine Science, University of Alaska, Fairbanks, pp. 145-233.

Feder, H.M. and G.E. Matheke. 1980. Subtidal Benthos. In: Port Valdez Alaska; Environmental Studies 1976-1979. Colonell, J.M. (ed.). Occasional Publication No. 5, Institute of Marine Science, University of Alaska, Fairbanks, pp. 237-324.

Feder H.M. and S.T. Jewett. 1987. The Subtidal Benthos. In: The Gulf of Alaska: Physical Environment and Biological Resources, OCS Study, D.W. Hood and S. T. Zimmerman (eds). MMS 86-0095, U.S. Department of Commerce and Industry. pp. 347-396.

Feder, H.M. and S.T. Jewett. 1988. The Subtidal Benthos. In: Environmental Studies in Port Valdez, Alaska. D.G. Shaw and M.J. Hameedi (eds.). Lecture Notes on Coastal and Estuarine Studies No. 24, Springer Verlag. pp. 165-202.

Federal Power Commission. 1976. Alaskan Arctic Natural Gas Transportation Systems, Final Environmental Impact Statement. April 1976. Docket No. CP75-96.

Fesler and Fredston, 1991. In: Environmental Baseline Data, Proposed LNG Plant/Marine Terminal Site, Port Valdez, Alaska. Yukon Pacific Corporation. Anchorage, Alaska.

Financial Land Investment Corp., 1993. Letter dated July 1, from Dorothy Smith to FERC.

Forsell, D. J. and P. J. Gould. 1981. Distribution and Abundance of Marine Birds and Mammals Wintering in the Kodiak Area of Alaska. Washington, D. C., U.S. Fish and Wildlife Service, Office of Biological Services, FWS/OBS-81/13.

Fuller, R.G. and J.B. Kirkwood. 1977. Ecological Consequences of Nuclear Testing. In: The Environment of Amchitka Island, Alaska, M.L. Merritt and R.G. Fuller (eds). TID-26712, Energy Research and Development Administration, Springfield, Virginia. pp 627-649.

Gambell, R. 1976. World Whale Stocks. Mammalian Review 6:41-53.

Gilson, T. 1993. Telephone communication on February 26, between P. Reynolds (Ebasco) and T. Gilson (Treasurer, City of Valdez, Valdez, Alaska).

Goering J. J., C.J. Patton, and W.E. Shiels. 1973. Nutrient Cycles. In: Environmental Studies of Port Valdez, D.W. Hood, W. E. Shiels, and E.J. Kelley (eds). Occasional Publication No. 3, Institute of Marine Science, University of Alaska, Fairbanks, Alaska. pp. 225-248.

Gosink T. A. and A.S. Naidu. 1983. Trace Elements. In: Environmental Studies in Port Valdez, Alaska: 1980-1982, Final Report to Alyeska Pipeline Service Company, Institute of Marine Science, University of Alaska, Fairbanks, Alaska. pp. 1-15.

Grant, K. 1993. Telephone communication on March 10, between P. Reynolds (Ebasco) and K. Grant (Alaska Marine Highway System Reservations and Marketing, Anchorage, Alaska).

Greenpeace. 1993. Letter dated July 13, from D. Smith (Energy Campaign, Alaska Field Office) to the Federal Energy Regulatory Commission.

Greenpeace. 1994. Letter dated January 31, from D. Childers to TAGS Review Committee.

Griese, 1991. In: Environmental Baseline Data, Proposed LNG Plant/Marine Terminal Site, Port Valdez, Alaska. Yukon Pacific Corporation. Anchorage, Alaska.

Griffin, D. 1992. Telephone communication on July 10, between P. Reynolds (Ebasco) and D. Griffin (City Manager, Valdez, Alaska).

Griffin, D. 1993. Telephone communication on March 11, between P. Reynolds (Ebasco) and D. Griffin (City Manager, Valdez, Alaska).

Gusey, W. F. 1978. The Fish and Wildlife Resources of the Gulf of Alaska. Environmental Affairs, Shell Oil Co., Houston, Texas. pp. 580.

Hackett, S.W. 1980. Avalanche Zoning in Alaska, U.S.A. Journal of Glaciology, v. 26, pp. 377-392.

Haerer, W. 1993. Telephone communication on March 4, between P. Reynolds (Ebasco) and W. Haerer (Property Assessor, Kenai Peninsula Borough, Kenai, Alaska).

Hall, E.S., Jr. 1990. TAGS: An Archaeological Survey of the Proposed TAGS LNG Plant and Marine Terminal at Anderson Bay (Port Valdez). Ms. on file, Federal Energy Regulatory Commission and Alaska Office of History and Archaeology.

Hall, J. 1979. A Survey of Cetaceans of Prince William Sound and Adjacent Vicinity - Their Numbers and Seasonal Movements. Final Report prepared for NOAA/OCSEAP. Contract No. 01-6-022-1560.

Hanson, A.J. and J.I. Hodges. 1985. High rates of Nonbreeding Adult Bald eagles in Southeastern Alaska. Journal of Wildlife Management 49:454-458.

Hanson, J. 1993. Telephone communication on March 16, between D. Lake (Ebasco) and J. Hanson (National Marine Fisheries Service, Alaska Region).

Hassen, H. 1978. The Effect of European and American Contact on the Chugach Eskimo of Prince William Sound, Alaska, 1741-1930. Ph.D. Dissertation, University of Wisconsin, Milwaukee. University Microfilms, Ann Arbor, Michigan.

Hemming, J.E. and D.E. Erikson. 1979. The Birds of Port Valdez. The Library, State Pipeline Coordinator's Office. Anchorage, Alaska. pp. 31.

Herrero, S. 1986. Bear Attacks: Their Causes and Avoidance. Nick Lyons Books, Winchester Press.

Hill, S.H. 1978. A Guide to the Effects of Underwater Shock Waves on Arctic Marine Mammals and Fish. Pacific Marine Sciences Report 78-26, Institute of Ocean Sciences, Patricia Bay, Sidney, BC. pp 50.

Hogan, M.E. and D.B. Irons. 1988. Waterbirds and Marine Mammals. In: Environmental Studies in Port Valdez, Alaska, D.G. Shaw and M.J. Hameedi (eds). Springer-Verlag Berlin Heidelberg. pp. 225-242.

Hood, D.W. 1973. Summary. In: Environmental Studies of Port Valdez. D.W. Hood, W.E. Shiels, and E.J. Kelly (eds). Occasional Publication No. 3, Institute of Marine Science, University of Alaska, Fairbanks. pp. 481-492.

Hubbard, E. 1993. Telephone communication on March 8, between K. Godtfredsen (Ebasco) and E. Hubbard (Alaska Department of Environmental Conservation).

HYDMET, Inc. 1992. Report dated March 4 from HYDMET, Inc. to Yukon Pacific Corporation cited in response to FERC Query #6.

Isleib, M.E. and B. Kessel. 1973. Birds of the North Gulf Coast Prince William Sound Region, Alaska. University of Alaska, Occasional Paper No. 14, Fairbanks, Alaska. pp. 149.

Jacobs, S. 1993. Telephone communication on March 22, between P. Reynolds (Ebasco) and S. Jacobs (Business Office Manager, Valdez Community Hospital, Valdez, Alaska).

Janka, D. 1992. Communication at public meeting May 26, Valdez, Alaska from D. Janka (Executive Director, Prince William Sound Conservation Alliance).

Jenson, D. 1993. Telephone communication on March 26, between E. Yould (Ebasco) and D. Jenson (Project Manager, Alyeska Pipeline Service Company).

Jewett, S.C. 1990. Preliminary Investigation of the Food and Feeding Habits of Juvenile Pink Salmon in Port Valdez, Alaska, 1989. Annual Report to Alyeska Pipeline Service Company. p. 24.

Jewett, S.C. and T. C. Sark. 1991. Investigation of the Food Habits of Pink Salmon (*Oncorhynchus gorbuscha*) Fry in Port Valdez, Alaska: 1990. Annual Report Submitted To: Alyeska Pipeline Service Co. pp. 42.

Karinen J.F. 1988. Sublethal Effects of Petroleum on Biota. In: Environmental Studies in Port Valdez, Alaska. D.G Shaw and M.J. Hameedi (eds). Lecture Notes on Coastal and Estuarine Studies, Vol. 24, Springer-Verlag Berlin Heidelberg. pp 293-328.

Kawabata, S. 1992. Telephone communication on August 3, between K. Godtfredsen (Ebasco) and S. Kawabata (U.S. Environmental Protection Agency, Region X).

Kirk, M. 1993. Telephone communication on March 5, between P. Reynolds (Ebasco) and M. Kirk (U.S. Bureau of the Census, Washington, DC).

Knight, R.R., B.M. Blanchard, and L.L. Eberhardt. 1988. Mortality Patterns and Population Sinks for Yellowstone Grizzly Bears. Wildlife Society Bulletin 16:121-125.

Kuhn, E. 1993. Letter dated July 1, from E. Kuhn to Federal Energy Regulatory Commission.

Lawson, S. 1992. Telephone communication on February 3, between K. Godtfredsen (Ebasco) and S. Lawson (Alaska Department of Environmental Conservation).

Leatherwood, S., A.E. Bowles, and R.R. Reeves. 1983. Endangered Whales of the Eastern Bering Sea and Shelikof Strait, Alaska; Results of Aerial Surveys, April 1982 through April 1983 with Notes on Other Marine Mammals Seen. Hubbs-Sea World Research Institute Technical Report No. 83-169.

Lloyd (T.) Associates, Prepared for Fish and Wildlife Service. 1984. Physical Impacts of Small-Scale Hydroelectric Facilities and Their Effects on Fish and Wildlife.

LNG/LPG Vessel Management Plan and Emergency Plan. 1988.

Lundfelt, C. 1993. Telephone communication on March 22, between P. Reynolds (Ebasco) and C. Lundfelt (Fire Chief, Fire Department, Valdez City Hall, Valdez, Alaska).

Malinky G. and D.G. Shaw. 1979. Modeling the Association of Petroleum Hydrocarbons and Subarctic Sediments. In: Proceedings of the 1979 Oil Conference (Preventions, Behavior, Control, Cleanup), March 1979, Los Angeles, California. pp. 621-623.

Manen, A. 1993. Telephone communication on August 4, between K. Godtfredsen (Ebasco) and A. Manen (National Oceanic and Atmospheric Administration, Columbia, Maryland).

Mattson, C.R. 1977. Valdez Pipeline Terminus Salmon Evaluation Studies Pink and Chum Salmon Fry Observations, 1971-74 and May-June 1977. Manuscript Report - File no. 143. U.S. Department of Commerce, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Auke Bay Laboratory, Auke Bay, Alaska. pp. 51.

McAllister, T. 1992. Telephone communication on March 25, between P. Reynolds (Ebasco) and T. McAllister (Port/Airport Coordinator, Valdez, Alaska).

McCollum, S. 1992. Telephone communication on July 9, between P. Reynolds (Ebasco) and S. McCollum (Secretary to Chief, Fire Department, Valdez City Hall, Valdez, Alaska).

McHardy, B. 1993. Telephone communication on March 31, between P. Reynolds (Ebasco) and B. McHardy (Labor Economist, Alaska Department of Labor, Juneau, Alaska).

McKnight, D.E. and C.E. Knoder. 1979. Resource Development Along Coasts and on the Ocean Floor: Potential Conflicts with Marine Bird Conservation. In: Conservation of Marine Birds of Northern North America, J.C. Bartonek and D.N. Nettleship (eds). U.S. Fish and Wildlife Service Wildlife Research Report 11, Washington, D.C. pp. 183-194.

McRoy, C. P. and S. Stoker. 1969. A Survey of the Littoral Region of Port Valdez. In: D. W. Hood (dir.), Baseline Data for Valdez Pipeline Terminal Environmental Data Study. Unpublished report prepared by the Institute of Marine Science and the Institute of Water Resources, University of Alaska, Fairbanks, for Trans Alaska Pipeline System, Anchorage. Report No. R69-17. pp. 191-218.

Merrell, T.R. Jr. 1988. Fisheries Resources. In: Environmental Studies in Port Valdez, Alaska. D.G. Shaw and M.J. Hameedi (eds). Lecture Notes on Coastal and Estuarine Studies No. 24, Springer Verlag. pp. 165-202.

Metcalf and Eddy, 1979. Wastewater Engineering: Treatment, Disposal, Reuse. McGraw-Hill. New York. pp. 920.

Mizroch, S.A., D.W. Rice and J. M. Breiwick. 1984. The Blue Whale, *Balaenoptera musculus*. Marine Fisheries Review 46:15-19.

Mobley, C.M. et al., 1990. The 1990 Exxon Valdez Cultural Resource Program. Exxon Shipping Company and Exxon Company, Anchorage, Alaska.

Morsell, J.W. 1979. The Mammals of Port Valdez. The Library, State Pipeline Coordinator's Office. Anchorage, Alaska. pp. 14.

Morsell, J.W. and G. Perkins. 1979. Biological Studies Report: Salmon Fry Dispersion in Eastern Port Valdez. Report to Alaska Petrochemical Company, pp. 22.

Muench R.D. and D.L. Nebert. 1973. Physical Oceanography. In: Environmental Studies of Port Valdez. D.W. Hood, W.E. Shiels, and E.J. Kelley (eds). Occasional Publication No. 3, Institute of Marine Science, University of Alaska, Fairbanks, Alaska. pp. 103-149.

Muench R.D. and C.M. Schmidt. 1974. Variations in the Hydrographic Structure of Prince William Sound. University of Alaska, Institute of Marine Science. IMS and Sea Grant Report R75-1.

Murty, T.S. 1979. Submarine Slide-generated Water Waves in Kitimat Inlet, British Columbia. Journal of Geophysical Research, v. 84, No. C12, pp. 7777-7779.

Naidu A. S., H.M. Feder, and S.A. Norrell. 1978. The Effect of Prudhoe Bay Crude Oil on a Tidal Flat Ecosystem in Port Valdez, Alaska. In: Proceedings of the 10th Offshore Technical Conference, Houston, Texas. pp. 97-104.

Naidu, A.S. and L.H. Klein. 1988. Sedimentation Processes. In: Environmental Studies in Port Valdez, Alaska, D.G. Shaw and M.J. Hameedi (eds). Lecture Notes on Coastal and Estuarine Studies, Vol. 24, Springer-Verlag Berlin Heidelberg. pp. 69-91.

National Marine Fisheries Service. 1993a. Letter dated February 17, from R. Morris (Western Alaska Office Supervisor, Protected Resources Management Division) to R. Arvedlund (Chief, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

National Marine Fisheries Service. 1993b. Letter dated March 17, from S. Pennayer (Director, Alaska Region) to R. Arvedlund (Chief, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

National Marine Fisheries Service. 1993c. Letter dated July 14, from S. Zimmerman (Chief, Protected Resources Management Division) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

National Marine Fisheries Service. 1995. Letter dated January 18, from J. Hanson (Fisheries Biologist, Alaska Region) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

National Wildlife Federation. 1994. Letter dated January 31, from A. Turrini (Counsel) to M. Heiman (Coordinator, TAGS Environmental Review Committee).

Nelson, S.W., J.A. Dumoulin, and M.L. Miller. 1985. Geological Map of the Chugach National Forest, Alaska. U.S. Geological Survey Map MF-1645-B.

Nenahlo, D. 1992. Telephone communication on July 23, between K. Godtfredsen (Ebasco) and D. Nenahlo (Joint Pipeline Office, Alaska Department of Environmental Conservation).

Newmark, N.M. and W.J. Hall. 1982. Earthquake Spectra and Design. Earthquake Research Institute. p. 103.

Nowlin, R.A. 1992. Unit 6 - Prince William Sound and North Gulf of Alaska Coast. In: Mountain Goat, Federal Aid in Wildlife Restoration Survey-Inventory Management Report - 1 July 1989 - 30 June 1991, S.M. Abbot (ed). Unpublished report Alaska Department of Fish and Game, Juneau, Alaska. pp. 46-62.

O'Clair, C.E. and S.T. Zimmerman. 1987. Biogeography and Ecology of the Intertidal and Shallow Subtidal Communities. In: The Gulf of Alaska: Physical Environment and Biological Resources. OCS Study, D.W. Hood and S.T. Zimmerman (eds). MMS 86-0095, U.S. Department of Commerce and Interior. pp. 347-396.

Parks, N.B. and H. Zenger. 1979. Trawl Survey of Demersal Fish and Shellfish Resources in Prince William Sound, Alaska: Spring 1978. U.S. Department of Commerce, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Processed Report 79-2. pp. 49.

Pitcher, K. W. 1975. Distribution and Abundance of Sea Otters, Stellar Sea Lions, and Harbor Seals in Prince William Sound Alaska. Division of Game, Alaska Department of Fish and Game. pp. 76.

Pitcher, K. W. 1990. Major Decline in Number of Harbor Seals, *Phoca vitulina richardsi*, on Tugidak Island, Gulf of Alaska. Marine Mammal Science 6:121-134.

Plafker, G., R. Kachadoorian, E.B. Eckel, and L.R. Mayo. 1966. Effects of the Earthquake of March 27, 1974 on Various Communities. U.S. Geological Survey Professional Paper 542-G.

Prince William Sound Conservation Alliance. 1993. Letter dated July 5, from M. Graham (President) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Prince William Sound Tourism Coalition. Undated. Alaska's Prince William Sound Vacation Guide. Valdez, Alaska.

Purcell, H. 1993. Telephone communication on March 30, between L. Smythe (Ebasco) and H. Purcell (Manager, Arctic Camps Inc., Anchorage, Alaska).

R&M Consultants, Inc. 1992. 7-Mile Creek Water Supply Study. Final Report.

Reger, R. 1993. Telephone communication on February 18, between B. Graham (Ebasco) and R. Reger (Alaska Department of Geological and Geophysical Surveys).

Renaissance Group. 1993. Letter dated June 28, from R. Adams (President) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

Richardson, W.J., C.R. Greene, J.P. Hickie, R.A. Davis, and D.H. Thomson. 1989. Effects of Offshore Petroleum Operations on Cold Water Marine Mammals: A literature review. LGL, Limited, report prepared for Health and Environmental Sciences Department, American Petroleum Institute, Washington D.C. pp 385.

Rieger, S., D.B. Schoephorster, and C.E. Furbush. 1979. Exploratory Soil Survey of Alaska. U.S. Department of Agriculture, Soil Conservation Service, pp. 213.

Ritter R.W. 1984. Water Quality Concerns Associated With Pipeline Stream Crossings. In: Proceedings of the Third International Symposium on Environmental Concerns in Rights-Of-Way Management, A.F. Crabtree, ed. Mississippi State University. pp 447-456.

Robb, N. 1993. Telephone communication on March 4, between M. Greenig (Ebasco) and N. Robb (Director of Parks and Recreation, Valdez, Alaska).

Roberson, K. 1986. Range Extension of the Sitka Black-tailed Deer, *Odocoileus hemionus sitkensis*, in Alaska. Canadian Field-Naturalist. 100: 563-565.

Rural Alaska Community Action Program. 1981. Chugach Region: Community Subsistence Profiles. Alaska. pp. 58.

Scarff, J. W. 1986. Historic and Present Distribution of the Right Whale (*Eubalaena glacialis*) in the Eastern North Pacific South of 50°N and East of 180°W. Report to the International Whaling Commission (Special Issue 10):43-63.

Schlitz, L. 1992. Telephone communication on July 27, between P. Reynolds (Ebasco) and L. Schlitz (Public Works Director, Valdez City Hall, Valdez, Alaska).

Sharma, G.D. and D.C. Burbank. 1973. Geological Oceanography. In: Environmental Studies of Port Valdez, D.W. Hood, W.E. Shiels, and E.J. Kelley (eds). University of Alaska, Institute of Marine Sciences, Occasional Publication No. 3. pp. 15-100.

Shaw, D. 1992. Telephone communication on July 31, between K. Godtfredsen (Ebasco) and D. Shaw (University of Alaska, Institute for Marine Science).

Sheehy, T.J. 1975. Reconnaissance Ecosystem-Soil Inventory and Management Report for the Upper Prince William Sound Planning Unit-B. U.S. Forest Service, Chugach National Forest. pp. 95.

Smith, M. 1992. Telephone communication on February 11, between P. Reynolds (Ebasco) and M. Smith (Property Manager, Alaska State Building Authority, Valdez, Alaska).

Smith, R.L., C.P. McRoy, and S. Stoker. 1969. Biological Studies, Baseline Data survey for Valdez Pipeline Terminal. Report R69-17, Institute of Marine Science, University of Alaska, Fairbanks, pp. 167-235.

Solomon Gulch Hatchery Management Plan. 1990. Valdez Fisheries Development Association, Prince William Sound.

Solomon Gulch Hatchery Management Plan. 1991. Valdez Fisheries Development Association, Prince William Sound.

Spatz, L. 1993. Telephone communication on February 25, between P. Reynolds (Ebasco) and L. Spatz (Regional Economist, Bureau of Economic Analyses, Washington, DC).

Stackhouse, G. 1992a. Telephone communication on February 21, between K. Engel (Ebasco) and G. Stackhouse (Biologist, U.S. Fish and Wildlife Service, Valdez, Alaska).

Stackhouse, G. 1992b. Telephone communication on March 27, between L. Brown (Ebasco) and G. Stackhouse (Biologist, U.S. Fish and Wildlife Service, Valdez, Alaska).

Stephens, S. 1993. Telephone communication on October 6, between M. Greenig (Ebasco) and S. Stephens (Owner, Stan Stephens Charters, Valdez, Alaska).

Steffen Robertson and Kirsten, Inc. 1991.

Sturdevant, D. 1993. Telephone communication on March 5, between K. Godtfredsen (Ebasco) and D. Sturdevant (Alaska Department of Environmental Conservation).

Swem, T. 1993. Telephone communication on February 22 between G. Green (Ebasco) and T. Swem (U.S. Fish and Wildlife Service, Anchorage, Alaska).

TAGS Environmental Review Committee. 1994. Letter dated February 2, from M. Heiman (Coordinator) to G. Stackhouse (Chairman, Wetlands Evaluation Working Group, Joint Pipeline Office).

The Wilderness Society. 1994. Letter dated February 11, from P. Miller (Director, Alaska Program) to G. Stackhouse (U.S. Fish and Wildlife Service/Chairman, Wetlands Evaluation Working Group, Joint Pipeline Office).

Thom, R.M. 1990. A Review of Eelgrass (*Zostera marina L.*) Transplanting Projects in the Pacific Northwest. In: The Northwest Environmental Journal, 6: 127-137. University of Washington, Seattle, Washington.

Thom, R.M. 1990. A Review of Eelgrass (*Zostera marina L.*) Transplanting Projects in the Pacific Northwest. In: The Northwest Environmental Journal, 6: 127-137. University of Washington, Seattle, Washington.

Thompson, F.M. 1993. Anderson Bay Salmon Enumeration Project. Alaska Department of Fish and Game, Habitat Division. pp 20.

Thompson, F.M. 1992. Telephone communication on February 20, between K. Kuzis (Ebasco) and F.M. Thompson (Alaska Department of Fish and Game).

Tillman, D.A. 1991. The Combustion of Solid Fuels and Wastes. Academic Press, Inc., San Diego, California.

Tongen, J. 1992. Telephone communication on February 20, between P. Reynolds (Ebasco) and H, Tongen (Business Manager, Valdez City Schools, Valdez, Alaska).

Tooley, M. 1993. Telephone communication in March, between E. Yould (Ebasco) and M. Tooley (Chief Design Engineer Southcentral Region, Alaska State Department of Transportation).

U.S. Army Corps of Engineers. 1992a. Letter dated February 4, from R. K. Oja (Chief, Regulatory Branch) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

U.S. Army Corps of Engineers. 1992b. Letter dated June 8, from R. K. Oja (Chief, Regulatory Branch) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

U.S. Army Corps of Engineers, 1993a. Letter dated January 26, from L. Reeder (Chief, Project Evaluation Section - South Regulatory Branch) to R. Arvedlund (Chief, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Army Corps of Engineers. 1993b. Letter dated February 12, from L. Reeder (Chief, Project Evaluation Section - South Regulatory Branch) to R. Arvedlund (Chief, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Army Corps of Engineers. 1993c. Letter dated June 18, from R. Oja (Chief, Regulatory Branch) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

U.S. Army Corps of Engineers. 1995. Letter dated January 24, from L. Reeder (Chief, Project Evaluation Section - South Regulatory Branch) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Army Corps of Engineers. Unpublished. Wetland Mitigation Successes and Failures, The Corps Experience.

U.S. Bureau of the Census. 1970, 1980, 1990. U.S. Government Printing Office, Washington, D.C.

U.S. Bureau of Census. 1992. 1990 Census of Population and Housing: Summary Tape file 1A, Pacific Division (Volume 1). CD90-1A-9-1. Washington, D.C. U.S. Bureau of Census, Data User Services Division.

U.S. Department of Agriculture, Forest Service. 1974. National Forests Landscape Management, Vol. 2, Chapter 1, The Visual Management System. U.S.D.A. Agricultural Handbook Number 462, Washington, D.C.

U.S. Department of Agriculture, Forest Service. 1984. Land and Resource Management Plan, Chugach National Forest. Anchorage, Alaska.

U.S. Department of Energy, Office of Fossil Energy. 1989. DOE/FE Opinion and Order No. 350; Order Granting Authorization to Export Liquefied Natural Gas from Alaska, November 16, 1989. ERA Docket No. 87-68-LNG.

U.S. Department of the Interior, Bureau of Land Management. 1993. Letter dated June 23, from N. Heath (Chief, Branch of Pipeline Monitoring) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Department of the Interior, Fish and Wildlife Service. 1993. Letter dated April 19, from M. Nation (Acting Field Supervisor) to R. Arvedlund (Chief, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Department of the Interior, Fish and Wildlife Service. 1995. Letter dated January 20, from D. Allen (Regional Director) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Department of the Interior, Geological Survey. 1986. Water Resources Data for Alaska (1986). U.S. Geological Survey Water Data Report, AK-86-1.

U.S. Department of the Interior, Office of Environmental Affairs. 1993. Letter dated July 28, from J. Deason (Director) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

U.S. Department of Transportation. 1993. Letter dated August 4, from G. W. Tenley (Associate Administrator for Pipeline Safety) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1993a. Letter dated February 17, from C.D. Robinson, Jr. (Chief, Field Operations Section, Alaska) to R. Arvedlund (Chief, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1993b. Letter dated April 16, from C.D. Robinson, Jr. (Chief, Field Operations Section, Alaska) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1993c. Letter dated July 15, from K. Veit (Chief, Program Coordination Branch, Region 10) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1993d. Letter dated December 1, from A. Frankel (Acting Chief, Environmental Review Section) to K. Madden (Director, Office of Pipeline Regulation, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1994a. Letter dated June 28, from K. Veit (Chief, Program Coordination Branch, Region 10) to K. Madden (Director, Office of Pipeline Regulation, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1994b. Letter dated July 29, from K. Veit (Chief, Program Coordination Branch, Region 10) to K. Madden (Director, Office of Pipeline Regulation, Federal Energy Regulatory Commission).

U.S. Environmental Protection Agency. 1995. Letter dated January 30, 1995 from J. Cabreza (Acting Chief, Environmental Review Section) to K. Madden (Director, Office of Pipeline Regulation, Federal Energy Regulatory Commission).

Valdez Convention and Visitors Bureau. Undated. Valdez, Alaska Facilities and Services, 1991-92. Valdez, Alaska.

Valdez Fishing Facts. Undated. Author Unknown.

Valdez Police Department. 1992. Unpublished data received by P. Reynolds (Ebasco) from S. McCollum (Secretary to Chief, Fire Department, Valdez City Hall, Valdez, Alaska).

Valdez Star. 1993. Letter dated July 2, from P. Lynn (Editor) to C. Zerby (Project Manager, Environmental Review and Compliance Branch I, Federal Energy Regulatory Commission).

K. 1993. Telephone communication on September 30, between M. Greenig (Ebasco) and K. Valentine (Owner, Natchik Custom Charter Service, Valdez, Alaska).

Water Resources Data for Alaska. 1979. U.S. Geological Survey Water Data Report, AK-79-1.

Wilson, G. 1993. Telephone communication on August 5, between K. Godtfredsen (Ebasco) and G. Wilson (State Pipeline Office, Anchorage, Alaska).

Workman, W.B. 1970. Report on an Archaeological Survey of the Southern Part of the Route of the Proposed Trans-Alaska Pipeline System: Valdez to Hagan's Hill. Ms. on file, University of Alaska Museum, Fairbanks, Alaska.

Workman, W.B. 1978. Continuity and Change in the Prehistoric Record from Southern Alaska. Paper presented at the Taniguchi Foundation Symposium on Alaska Native Cultures, Osaka.

Wright, D.G. 1982. A Discussion Paper on the Effects of Explosives on Fish and Marine Mammals in the Waters of the Northwest Territories. Canada Technical Report of Fishery and Aquatic Sciences 1052. pp 16.

Wright, D.G. 1985. A History and Scientific Rationale of the Development of Guidelines to Cover the Use of Explosives in the Marine Environment in Canada and Other Nations. In: Proceedings of Workshop on Effects of Explosives Use in the Marine Environment. pp 2-15. Canada Oil and Gas Lands Administration, Environmental Protection Branch, Technical Report 5. Ottawa. pp 398.

Wright, R.A. and W.H. Allton. 1971. Sea Otter Studies in the Vicinity of Amchitka Island. BioScience 21:673-677.

Yelverton, J.T., D.R. Richmond, E.R. Fletcher, and R.K. Jones. 1973. Safe Distances from Underwater Explosions for Mammals and Birds. Report DNA 3114T from Lovelace Foundation for Medical Education and Research for Defense Nuclear Agency, Washington, D.C. pp 67.

Yukon Pacific Corporation. 1991. Environmental Baseline Data, Proposed LNG Plant/Marine Terminal Site, Port Valdez, Alaska. Anchorage, Alaska. February 6, 1991.

Yukon Pacific Corporation. 1992. FERC Query #20 and #51 - Supplemental Data.

Yukon Pacific Corporation. 1993. Letter dated July 6, from J. Lowenfels (V.P. and Corporate Counsel) to L. Cashell (Secretary, Federal Energy Regulatory Commission).

APPENDIX H

FEIS DISTRIBUTION LIST

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Federal Government Agencies

Advisory Council on Historic Preservation, Washington, DC
Advisory Council on Historic Preservation, Golden, CO
Alaska Natural Gas Transmission System, Washington, DC
Centers for Disease Control, Atlanta, GA
Council on Environmental Quality, Washington, DC
Department of Agriculture
- Forest Service, Washington, DC
- Forest Service, Juneau, AK
  - Chugach National Forest, Anchorage, AK
- National Forest System, Washington, DC
- Natural Resources, Washington, DC
- Natural Resources and Rural Development, Washington, DC
- Office of Finance and Management, Washington, DC
- Soil Conservation Service, Washington, DC
- Soil Conservation Service, Anchorage, AK

Department of the Air Force
- Western Region, San Francisco, CA

Department of the Army
- Environmental Projects, Washington, DC
- Army Corps of Engineers
  - Office of Environmental Policy, Washington, DC
  - Regulatory Branch, Washington, DC
  - Alaska District, Anchorage, AK
  - TAGS Project Officer, Anchorage, AK

Department of Commerce, Washington, DC
Department of Commerce, Juneau, AK
- Ecology and Conservation, Washington, DC
- National Marine Fisheries Service, Silver Spring, MD
- National Marine Fisheries Service, Juneau, AK
- National Marine Fisheries Service, Milford, CT
- National Oceanic and Atmospheric Administration
  - Ocean Pollution Data and Information Network, Washington, DC
  - Office of Intergovernmental Affairs, Washington, DC
  - Office of Ocean and Coastal Resource Management, Washington, DC

Department of Defense
- Environmental Planning, Washington, DC

Department of Energy
- Economic Regulations Administration, Washington, DC
- Office of Environment, Safety, and Health, Washington, DC
- Office of Fossil Fuels, Washington, DC
- Office of Fuels Programs, Washington, DC
- Office of Intergovernmental Affairs, Washington, DC
- Office of NEPA Assistance, Washington, DC
- Office of Public Affairs, Washington, DC

Department of Health and Human Services
    Office of Environmental Affairs, Washington, DC
Department of the Interior, Washington, DC
Department of the Interior, Anchorage, AK
    Bureau of Indian Affairs, Washington, DC
        Office of Energy and Minerals, Washington, DC
    Bureau of Indian Affairs, Anchorage, AK
    Bureau of Land Management, Washington, DC
    Bureau of Land Management, Anchorage, AK
        Branch of Pipeline Monitoring, Anchorage, AK
    Division of Acquisition and Grants, Washington, DC
    Office of Environmental Affairs, Washington, DC
    Fish and Wildlife Service, Washington, DC
        Alaska Regional Office, Anchorage, AK
        Division of Habitat Conservation, Anchorage, AK
        Joint Pipeline Office, Anchorage, AK
    Geological Survey, Washington, DC
    Geological Survey, Anchorage, AK
    Geological Survey, Reston, VA
    Land and Minerals Management, Washington, DC
    National Park Service, Washington, DC
    National Park Service, Anchorage, AK
Department of Justice
    Land and Natural Resources Division, Washington, DC
Department of Labor, Washington, DC
Department of Labor, Anchorage, AK
    Office of Regulatory Economics, Washington, DC
Department of State
    Bureau of Oceans and International Environmental and Scientific Affairs
        Washington, DC
    Office of Environment and Health, Washington, DC
Department of Transportation
    Coast Guard, Washington, DC
        Merchant Marine Safety Security and Environmental Protection,
            Washington, DC
        Navigational Safety and Waterways Services, Washington, DC
        Port Safety and Security Division, Washington, DC
    Coast Guard, Juneau, AK
    Coast Guard, Valdez, AK
    Federal Aviation Administration
        Office of Environment and Energy, Washington, DC
    Federal Highway Administration
        Office of Environmental Policy, Washington, DC
    Federal Railroad Administration, Washington, DC
    Office of Acquisition Grants Management, Washington, DC
    Office of Pipeline Safety, Washington, DC
    Office of Pipeline Safety, Anchorage, AK
    Office of Pipeline Safety, Lakewood, CO

Department of the Treasury, Washington, DC
Environmental Protection Agency, Washington, DC
- Federal Agency Liaison Division, Washington, DC
- Grants Policy and Procedure Branch, Washington, DC
- Enforcement and Compliance Monitoring, Washington, DC
- Office of Federal Activities, Washington, DC
- Region 10, Seattle, WA
- Region 10, Anchorage, AK

General Services Administration
- Office of Program Initiatives, Washington, DC

Interstate Commerce Commission, Washington, DC
Office of Program Analysis and Evaluation, Washington, DC
Office of Technology Assessment, Washington, DC

Congressional Representatives

Senator Thomas Bliley, Chairman, Commission on Energy and Commerce
Senator John H. Chaffee, Chairman, Commission on Environment and Public Works
Senator Frank H. Murkowski, Chairman, Commission on Energy and Natural Resources
Senator Larry Pressler, Chairman, Commission on Commerce, Science and Transportation
Senator Ted Stevens
Representative Bud Shuster, Chairman, Commission on Public Works and Transportation
Representative Don Young

State Government Agencies

Alaska:
- Governor Tony Knowles
- Senator Georgiana Lincoln
- Representative Gene Kubina
- Attorney General
- Cooperative Extension Services
- Cooperative Fishery Research Unit
- Cooperative Wildlife Research Unit
- Department of Community and Regional Affairs
- Department of Environmental Conservation
- Department of Fish and Game
- Department of Law
- Department of Natural Resources
  - Division of Forestry
  - Division of Land
  - Division of Parks and Recreation
  - Division of Oil and Gas
  - Division of Water
  - State Pipeline Coordinator's Office
- Department of Public Safety
- Department of Transportation and Public Facilities
- Division of Governmental Coordination

Alaska (cont'd):	Land Government Coordinator Northern Alaska Environmental Center Public Utilities Commission Sea Grant College Program State Historic Preservation Officer TAGS Environmental Review Committee
California:	Public Utilities Commission

__Town Government Agencies__

City of Cordova, AK
Cordova Chamber of Commerce, AK
Fairbanks Chamber of Commerce, AK
Fairbanks North Star Borough, AK
Valdez Fisheries Board, AK
Valdez City Manager, AK
Valdez Director of Community Development, AK

__Libraries__

Valdez City Library, AK
Valdez Consortium Library, AK

Documents Department - KS, CO

__Media__

Anchorage Daily News, AK
Fairbanks Daily News Miner, AK
Valdez Pioneer, AK
Valdez Vanguard, AK

Pipeline Digest, TX
Pipeline and Utilities Construction, TX
Pipeline Industry, TX

__Organizations and Individuals__

Alaska Association of Soil and Water Conservation Districts, AK
Alaska Center for the Environment, AK
Alaska Conservation Foundation, AK
Alaska Environmental Lobby, Inc., AK
Alyeska Pipeline Service Company, AK
Arco Alaska, Inc., AK
Arctic Freight Brokers, Inc.
Mike Barker, AK

BP Pipelines (Alaska) Inc., AK
Donald C. Chesebro, AK
Chugach Alaska Corporation, AK
Cordova District Fisherman United, AK
Exxon Corporation USA, AK
Peter DeMay, AK
Donna M. Fischer, AK
Jennifer Forney, AK
Ernie Hall, AK
John L. Harris, AK
Elden Johnson, AK
Vince Kelly, AK
Matt Kinney, AK
Jerry McCutcheon, AK
Dale and Pat Mundy, AK
National Audubon Society, AK
National Parks and Conservation Association, AK
North Pacific Rim Corporation, AK
Northwest Alaskan Pipeline Company, AK
Henry S. Pratt, AK
Prince William Sound Conservation Alliance, AK
Regional Citizens' Advisory Council, AK
Jim and Pat Shirrell, AK
Sierra Club, AK
Southeast Alaska Conservation Council, AK
David Shaw, AK
Tanana Chiefs Conference, Inc., AK
Don K. Taylor, AK
Helen Wade, AK
Gordon Wetzel, AK
The Wilderness Society, AK
Walter M. Wood, AK
Scott Thorson, AK
Solomon Gulch Hatcheries, AK
Trout Unlimited Alaska, AK
Trustees for Alaska, AK
United Fishermen of Alaska, AK
Wildlife Federation of Alaska, AK
Wildlife Society Alaska Chapter, AK
Valdez Fisheries Inc., AK
Valdez Homes, AK
Yukon Pacific Corporation, AK

Bill McMullen, AZ

Arco Legal Department, CA
Neville Donovan, CA

Pacific Enterprises, Inc., CA
Pacific Gas & Electric Company, CA
Pacific Gas Transmission Company, CA
Pacific Interstate Transmission Company, CA
Roy Patterson, CA
Southern California Gas Company, CA

Michael Metz, CO

CNF Constructors, Inc., CT
Kenetech, CT

Andrews & Kurth, DC
Ballard Spahr Andrews & Ingersoll, DC
Brady & Berliner, DC
Gardner, Carton & Douglas, DC
McHenry & Staffier, P.C., DC
Morrison & Foerster, DC
National Parks and Conservation, Washington, DC
Tennessee Gas Pipeline Company, DC
Karl Wachter, DC
Wright & Talisman, P.C., DC

Donald Gartman, DE
Max Levy, DE

W.J. Hall, IL
Poten & Partners, Inc., IL
Jim Wees, IL

Peter Alpert, MA
Cabot LNG Corporation, MA

Dynamac Corporation, MD

Northern Plains Natural Gas Company, NE

Nicholas Legatos, NY

Greenpeace, OR
Pacific States Marine Fisheries Commission, OR

EcoElectrica, L.P., PR

Enron Development Corporation, TX
Enron Engineering and Construction, TX
Exxon Corporation, TX
Exxon Production Research, TX
Pan National Gas Sales, Inc., TX
Robert J. Lakey & Associates, Inc., TX
Tennessee Gas Pipeline Company, TX
Universal Ensco, Inc., TX
Vinson & Elkins, TX

Kern River Gas Transmission Company, UT
Northwest Alaskan Pipeline Company, UT
Northwest Pipeline Corporation, UT
Alan Parolini, UT

Edwin A. Kuhn, VA
Eric Steadman, VA

Landau Associates, Inc., WA
No Oilport, WA

J.B. Jacks, WI

Foothills Pipe Lines (Yukon). Ltd., Canada

APPENDIX I

SUBJECT INDEX

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