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SUSITNA HYDROELECTRIC PROJECT

EXECUTIVE SUMMARY
OF
ECONOMIC AND FINANCIAL UPDATE

DRAFT

SEPTEMBER 1983

SUBMITTED BY

HARZA-EBASCO
SUSITNA JOINT VENTURE

TO THE

ALASKA POWER AUTHORITY

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1. SUMMARY OF OBSERVATIONS AND CONCLUSIONS

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From the economic and financial studies in this September 1983 update, the following observations and conclusions are offered:

- The project is economically attractive under the conservative oil price forecasts used. Should oil prices increase, it will become even more attractive. and they decline?

- The 1983 construction cost estimate for the Devil Canyon and Watana projects as submitted to the FERC is $5.4 billion. System design refinements and scope changes to the Watana project could result in a revised 1983 construction cost estimate of $3.9 billion and an accompanying 16% reduction in energy output from the two-dam concept.

- The Watana project as defined in the FERC license application is near economic optimum range. Lowering the Watana reservoir by as much as 185 feet (from elevation 2185 to elevation 2000) will not materially change the economic attractiveness of the project.

- The electric energy demand forecast for the Railbelt is 4167 GWh in 1993, using the DOR Mean oil forecast. This is sufficient to completely absorb the output of the Watana project at either elevation 2185 or 2000. The forecast increase in growth will be sufficient to absorb the output of Watana and Devil Canyon prior to 2015, although for economic reasons the Devil Canyon project should be brought on-line before it could be fully absorbed.

- To provide maximum marketability of electricity and reliability to the Railbelt system, Watana should be operated in the load following mode.

- Recommended design refinements will reduce Watana construction costs by $396 million, and Devil Canyon by $25 million. Potential, probable cost savings in addition would reduce the Watana project by as much as another $171 million and Devil Canyon by $85 million.

- Lowering the Watana reservoir to elevation 2000 will reduce initial generating capacity to 475 MW and average annual energy output to 2500 GWh. The accompanying reduction in construction cost is $795 million. Cost reductions from design refinements and lowering the Watana reservoir are additive.

- Forecast prices of oil vary significantly depending on the source. In this study, only forecasts representative of the lower range of oil price trends were considered. It may be prudent to examine historical oil price trends for impact on economic evaluation of major hydroelectric projects which have a useful life of 50 years or more.

- If the cost of electricity from Susitna in its initial year of operation is to be equivalent to the cost of electricity from the most attractive thermal alternative, State equity contributions will be required upfront. However, given the economic attractiveness of the project, the State could choose to recapture its investment at a future date when the cost of fuel would have caused cost of power from the thermal alternative to exceed the cost of Susitna power.

STATE EQUITY OPTIONS

Forecast	Watana Height	Equity Contribution Billion 1983 Dollars
SHCA-NSD	2185	1.6
DOR Mean	2185	1.8
SHCA-NSD	2000	1.2
DOR Mean	2000	1.3

- Decisions made as a result of this study may have a significant impact on the FERC processing of the license application and the date the license is issued. Because critical FERC milestones are imminent, the Power Authority should discuss the results of this study with the FERC at an early date to minimize changes which could result in a material delay in issuance of a FERC license.

2. INTRODUCTION

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This report's purpose is to summarize an economic and financial update on the Susitna Hydroelectric Project. The update has been prepared to reflect changes in world oil price and resulting changes in forecasts of Alaskan economic conditions.

After decades of interagency investigations and several years of Alaska Power Authority study, a license application was prepared for a two-dam project on the Susitna River. It consisted of the Watana and Devil Canyon developments. Capital cost of the initial phase, the Watana development, was estimated at $3,828 million in 1983 dollars, excluding interest during construction. The application was filed on February 28, 1983 with the Federal Energy Regulatory Commission (FERC).

A severe drop in oil prices, from a high of $34 per barrel in 1981 to under $29 per barrel today, reduced the outlook for the State's economy. Since the State's continued outlook predicts depressed oil prices for several years, an update of power demand forecasts and economic analyses was requested by the Power Authority Board of Directors. The same factors generated a similar request from the FERC. The specific FERC inquiries resulted in an update to the application on July 12, 1983; FERC subsequently accepted the application on July 29, 1983. This update incorporates that work and extends it to the Board of Director's questions.

The July 1983 revision of the license application used a forecasting methodology which related the future price of oil to State revenues and electricity demand. Based on current forecasts of oil prices, the July 1983 electricity demand forecast is significantly lower than the forecasts of the license application. The July 1983 revision continued to show that the project would be economically feasible, but the margin of economic attractiveness was reduced.

Forecasting oil prices is very difficult. The prices are related to the world supply and demand for oil, which is determined by the world's economy and OPEC's ability to control oil production. Higher world oil prices provide higher State revenues, more abundant funds and improved borrowing capacity, resulting in greater resources to build the Susitna Project. Conversely, lower oil prices reduce State revenues and make the project less attractive. Section 3 describes the projections of world oil prices that have been used in this update. These projections are significantly lower than the prices projected earlier by the U.S. Department of Energy

The update is specially designed to respond to concerns expressed by the Alaska Power Authority Board of Directors, the Governor, and the Legislature. Moreover, the Governor's Office has requested that the Power Authority reassess the crucial assumptions affecting project feasibility. Meanwhile, parallel engineering studies are continuing and further refinements in the project concept may reduce project costs. Environmental studies are also continuing, and will provide information for mitigation planning.

3. ELECTRICITY DEMAND FORECAST

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OIL PRICE PROJECTIONS

Future world oil price is the most important factor in project feasibility because of its impact on:

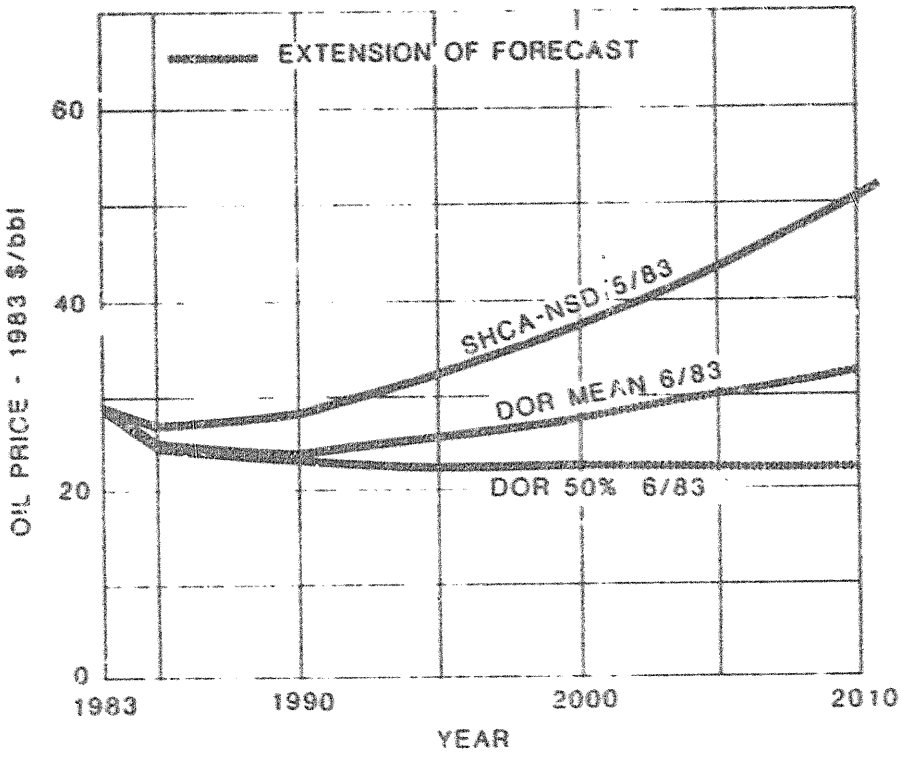
- general economic conditions
- growth in electricity demand
- State revenues (85 percent are dependent on oil price)
- cost of thermal energy generation

Oil prices affect the cost of power generation in the Railbelt, since much of the electrical consumption is supplied by fossil-fueled (gas) generation. There will be no immediate adverse effect in the Railbelt from rising oil prices, because existing contracts for natural gas are independent of oil price escalation. These favorable contracts will expire by 1995, however, and increased fuel costs can be expected thereafter.

This projected rise in thermal generation costs is substantiated by recently negotiated contracts which tie the cost of gas to world oil prices. Other effects of increased oil price may include substitution of other fuels for generating electricity, increased conservation, and stimulation of exploration for North Slope gas.

The Alaska Department of Revenue (DOR) has developed projections of State revenues by forecasting oil prices. Their forecasts extend for a 17-year time period, focusing on the near term. The DOR develops oil price forecasts with varying degrees of confidence; however, the DOR Mean has been used in this study, and is representative of the oil

price that the DOR expects to prevail in the short term. The DOR 50 percent case, which is forecast to have a 50 percent probability of occurrence, was also considered. The latest forecast (June 1983, see graph) is expressed in 1983 dollars.



ALTERNATIVE OIL PRICE PROJECTIONS

The SHCA-NSD forecast was developed in May 1983 by Sherman H. Clark Associates, a firm specializing in projecting world energy supply and demand and resulting oil prices. That forecast was used as the reference case for the July 1983 revision of the FERC license application. It is developed on a rational basis and recognizes the long term supply and demand situation that must be used in the FERC evaluation process.

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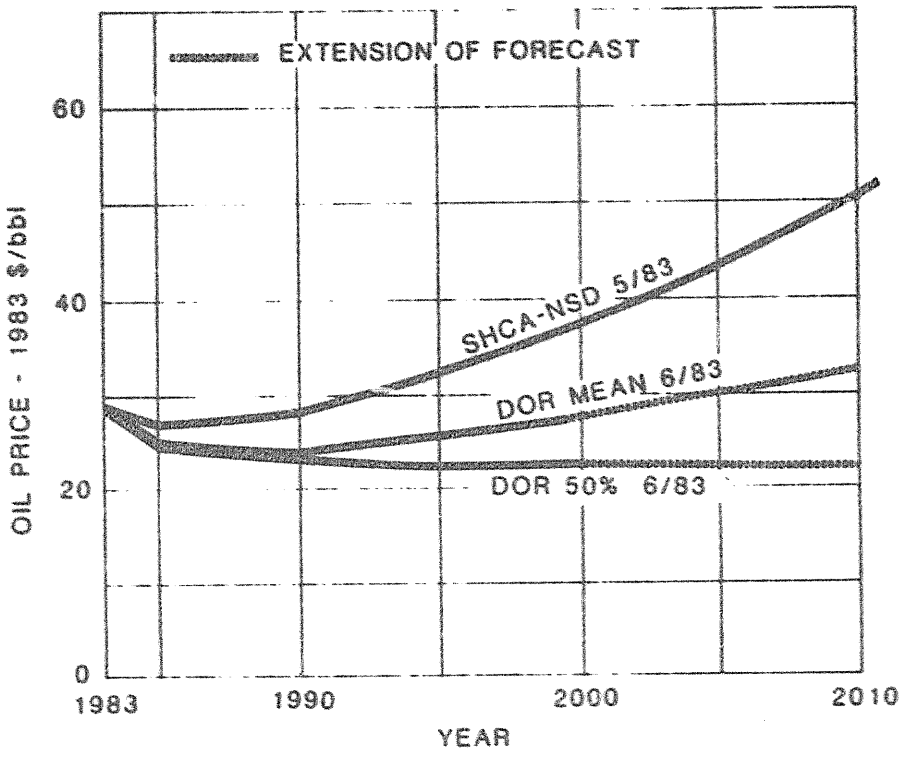

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Except for the DOR forecast, it was among the lowest published long term oil price forecasts.

A summary of recently published forecast oil prices in 1995 and 2010 is provided for comparison.

OIL PRICE FORECASTS 1995

Source	Forecast Date	1983 $ Per Barrel	2010 $ Per Barrel
Department of Energy (DOE)	Summer 1983	46.50	83.60
Data Resources Inc. (DRI)	Summer 1983	39.58	NA
SHCA-NSD	May 1983	32.34	50.39
DOR Mean	June 1983	25.79	32.42
DOR 50	June 1983	22.47	21.71

Clearly, the range of oil prices predicted by SHCA-NSD and the DOR provides a conservative approach to predicting the State's economy, the Railbelt electricity demand, and the economic soundness and financial viability of the Susitna Hydroelectric Project.

The Department of Revenue uses these oil price projections in a computer model called PETREV to forecast State petroleum revenues. PETREV considers the uncertainties of projected future oil prices, petroleum production, and other factors. Given oil price projections, PETREV also forecasts State revenues from royalties and severance taxes together with a range of probability distributions.

RAILBELT ELECTRICITY DEMAND

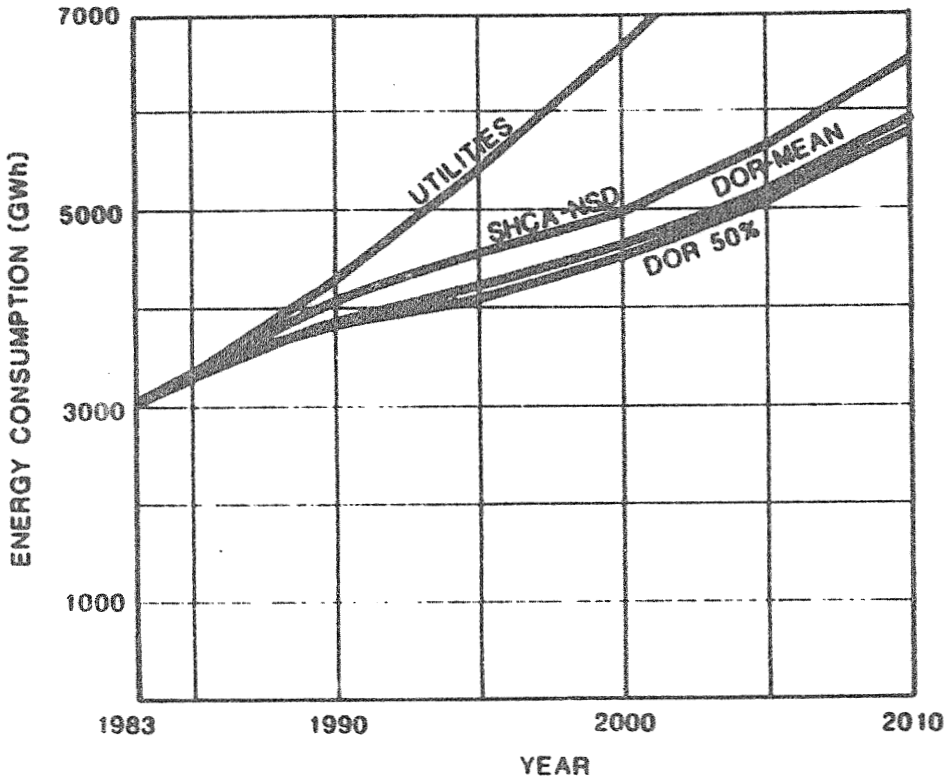
For the purpose of forecasting electricity demand, the Railbelt is defined as the interconnected system serving the Anchorage-Cook Inlet

and Fairbanks-Tanana Valley areas, and portions of the demand at military bases that might be supplied by the Susitna Project.

Two computer models, the Man-in-the-Arctic Program (MAP) and Railbelt Electricity Demand (RED), were used to prepare the demand forecast. Developed by the Institute of Social and Economic Research (ISER), the MAP computer model is used to simulate the behavior of the economy and population of the State of Alaska and to develop economic projections for each oil price scenario. The RED Model was developed for the 1982 Railbelt Electric Power Alternatives Study by Battelle Pacific Northwest Laboratories. It forecasts electricity demand based on the MAP economic projections. Also factored into the forecast are price-adjusted conservation and fuel substitution effects.

Railbelt electricity demand has been forecast for each oil price scenario and is displayed on the next page. The variation in forecasts (SHCA-NSD and DOR 50) is no more than 10 percent up to 1995; the actual forecasts are 4189 and 4588 GWh for DOR and SHCA-NSD, respectively. Beyond 1995, departure is more pronounced, and by 2010 the corresponding forecasts are 5672 and 6444 GWh. These demand projections are substantially lower than the previous forecasts used in the feasibility study. In 1980, electricity demand for the Railbelt was forecast to be 9670 GWh for the year 2010. Subsequently, the feasibility report reduced this projection to 7800 GWh, which is still about 20 percent greater than the SHCA-NSD case.

The electricity demand forecasts developed for this update are also substantially lower than the forecasts of the Railbelt utilities (see graph). The latest (1983) forecast is 7335 GWh for the year 2000, which is more than 60% greater than the forecast under the SHCA-NSD scenario. Consequently, the use of the SHCA-NSD scenario as an upper range of power demand could be extremely conservative (too low) from the standpoint of the Railbelt utilities.



RAILBELT ENERGY DEMAND

The electricity demand for 1993 using the DOR Mean case is 4170 GWh compared to 7100 GWh in the feasibility report. This reduction in energy forecasts notwithstanding, the Railbelt system can still absorb the entire energy output of the Watana development (3500 GWh per year) in 1993 by displacing most of the fossil fuel generation. With the addition of the Devil Canyon project, the Susitna Project output will be increased from 3500 GWh to 7100 GWh per year.

4. ALTERNATIVE SUSITNA DEVELOPMENT SCHEMES

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The Susitna Hydroelectric Project is located on the Susitna River 180 wrong. miles north of Anchorage. Now being reviewed by the Federal Energy Regulatory Commission (FERC), the Susitna license application proposes a project composed of two major developments. In the first phase, construction of the 1020-MW Watana development is planned, with associated access, transmission facilities and appurtenances. The second phase, scheduled for construction following Watana, includes similar components for the 600-MW Devil Canyon development.

DESIGN IMPROVEMENTS AND COST ESTIMATES

The Harza-Ebasco Susitna Joint Venture has made a detailed review of the concept and cost estimates for the project as defined in the FERC license application. That review identified a number of cost effective design refinements. The design refinements reflect more detailed geotechnical data now available from the 1983 Winter Geotechnical Program, and a detailed hydrological study of the Probable Maximum Flood (PMF) and other floods. All refinements recommended by Harza-Ebasco have been reviewed and accepted by the Power Authority's independent External Review Panel.

The following list identifies the major design features where significant cost savings are involved. By incorporating the recommended cost savings, the revised Susitna Project construction costs are reduced from $5,405 million to $4,984 million in 1983 dollars. These savings are summarized on the following page.

SUSITNA PROJECT COST SAVINGS
WITH DESIGN REFINEMENTS

Watana	Million 1983 Dollars
Main Dam	142
Spillway	55
Power Conduits	52
Construction Facilities	65
Other	82
	396
Devil Canyon	
Spillway	25
Total Savings	$421
Total Project Cost with Recommendations	$4984

The cost savings for Watana total $396 million; for Devil Canyon $25 million. The estimated cost of the Watana project as stated in the license application was $3,596 million in January 1982 dollars. When updated for inflation to January 1983, the corresponding cost is $3,828 million. After revision for these recommended design refinements, the current estimate is $3,432 million. Other potential system cost savings of $256 million also appear to be promising but need to be studied further before they can be recommended to the Power Authority. These additional potential cost savings may ultimately result in total cost savings of $677 million. However, at this point, only the recommended changes ($421 million) are assumed.

PROJECT DOWNSIZING

Project downsizing would better match current forecasted power requirements. This can be achieved by a:

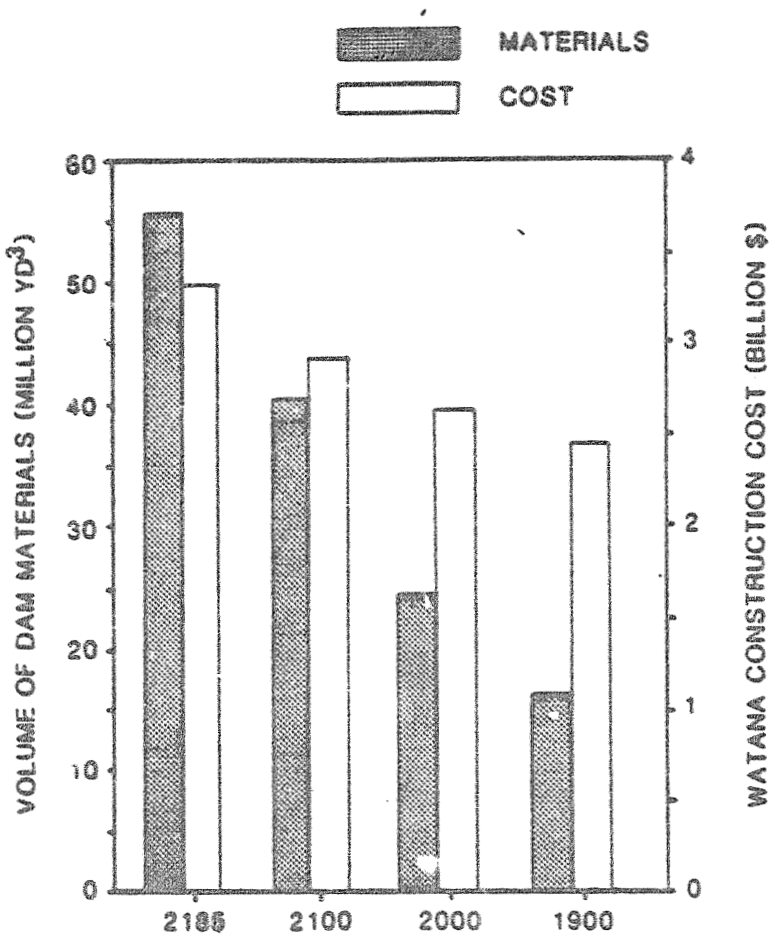
- reduction in initial installed capacity
- reduction in the height of the Watana Dam

The installed Watana capacity of 1020 MW was provided in six generating units, each rated at 170 MW. Units 5 and 6 provide peaking use and spinning reserve but no additional energy generation. Additional initial cost avoidance of $94 million can be achieved by postponing the installation of these two units.

The most significant cost reduction can be achieved by reducing the height of the Watana dam. Such a change would result in a corresponding reduction in generating capability and energy production. For purposes of analysis, alternative reservoir elevations of 2185, 2100, 2000 and 1900 have been used. Construction cost for a four-unit installation could be reduced from $3,338 million for the Watana elevation 2185 to $2,637 million for the Watana elevation 2000. That savings of $701 million, in January 1983 dollars, is shown in the graph below. Also indicated are considerable savings in construction material volumes. Data for various reservoir elevations with four generating units are presented on the following page.

WATANA RESERVOIR ELEVATION, POWER POTENTIAL AND CONSTRUCTION COST

Watana Reservoir Elevation	Initial Installed Capacity (MW)	Ultimate Installed Capacity (MW)	Average Energy (GWh/year)	Construction Cost (Million 1983 Dollars)
2185	680	1020	3500	3338
2100	585	880	3050	2996
2000	475	710	2500	2637
1900	380	570	1950	2414



WATANA DOWNSIZING EFFECTS

UTILIZATION OF SUSITNA PROJECT IN THE RAILBELT

The Susitna Project can meet most of the Railbelt energy demand for many years after Watana enters service. For most effective power

operation, Susitna would follow the load. The license application proposed a base load operation to maintain uniform downstream discharge, a mode compatible with the higher demands then forecast. It should be recognized that the now reduced load forecast and lengthening of the interval between commissioning of Watana and Devil Canyon can materially affect the economic aspects of Watana's mode of operation in the early years. With the reduced load forecast, it appears that a load- following operation would be more efficient.

To allow the Susitna Project to follow load, some relaxation of the downstream flow restrictions would be needed. Without sufficient relaxation, thermal power plants (otherwise on reserve) would have to be operated to provide cycling, peaking and regulation service. Alternatively, a reregulation dam downstream of Devil Canyon could be introduced to allow for load following. Such a dam would cost roughly $200 million but could enhance the overall economics of the project.

ENVIRONMENTAL IMPLICATIONS

For purposes of this analysis, anticipated impacts on terrestrial and aquatic resources are related to the first phase, Watana 2185 dam and reservoir. Lowering the Watana reservoir elevation would result in:

- less area inundated
- less borrow material needed
- shorter construction period
- elimination of emergency release to Tsusena Creek
- less capacity for flood control
- less regulation of downstream flows

Lowering the reservoir elevation significantly reduces the length, width, and area of the reservoir. With less area inundated, as shown below, there would be less impact on the resources of the region.

WATANA RESERVOIR INUNDATION

Elevation	Length of Mainstem (stream miles)	Length of Tributaries (miles)	Area (acres)
2185	54	24	38,000
2100	49	18	28,300
2000	44	14	19,800
1900	39	11	14,500

Reduced inundation will reduce the magnitude of impacts on big game species and, along Watana Creek, may be particularly beneficial for game habitat maintenance. Loss of clear water tributaries, primary grayling habitat, would be reduced as well.

Project operating criteria will produce average winter flows ranging from 9800 cfs for the Watana 2185 development to 6300 cfs for the Watana 1900 development. Average flows under natural conditions for this time period are 1600 cfs. During August, average flows will range from 12,300 cfs for the Watana 2185 development to 19,800 cfs for the Watana 1900 development, as compared to 22,000 cfs under natural conditions. Even the lowest elevation dam would have some environmental impact, resulting in some long-term changes to the downstream fishery and moose habitat.

The primary socioeconomic impacts relate to the presence of the construction work force in the area. Project-related population, employment, income, housing, services, support facilities, and fiscal impacts will be reduced proportionally as the construction schedule is shortened. Lower elevation developments will also progressively reduce the total magnitude of impacts on land use, recreation, aesthetics, and archeological resources in the area.

In summary, studies based on more detailed information have led to design refinements which result in cost saving of $396 million for the Watana 2185 project and $25 million for Devil Canyon. Additional studies in progress have identified other promising design refinements which could yield further savings of $171 million and $85 million for Watana and Devil Canyon, respectively. By reducing the initial installation at Watana 2185 to four units, initial costs could be reduced another $94 million. With the Watana reservoir at 2000, the dam volume would be cut to about 50% of Watana 2185, with an attendant cost reduction of about $700 million for the dam and power facilities. Generally, the environmental impacts would also be reduced with lower reservoir elevations at Watana. Specifically, the reservoir area would be smaller and the inundation of the Susitna mainstem and tributaries reduced. Downstream discharges would show less departure from natural flow conditions under base load operation, but under load following operation, the attendant downstream fluctuation could be mitigated by a reregulating dam.

5. NON-SUSITNA GENERATION ALTERNATIVES

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The most competitive non-Susitna generation alternatives are natural gas-fired combined cycle and simple cycle combustion turbine plants, coal-fired steam plants, and the Chakachamna Hydroelectric Project. These have been established as the most attractive alternatives for servicing the future electric energy demand of the Railbelt. Alternative systems are used to determine the most favorable cost of power in comparison with the cost of power from Susitna.

Alternative system expansion would be provided by gas-fired or coal-fired plants in various combinations, depending on world oil price and Railbelt electric demand. Each alternative system has been tailored to meet expansion needs based on a specific oil price forecast. The various systems considered in this analysis are:

- Natural gas-fired combined cycle and simple cycle plants
- Coal-fired steam plants
- The Chakachamna Hydroelectric Project

In addition, small combined cycle units; simple cycle combustion turbines; or co-generation power plants could also be used. However, for long-term power supply, the most likely and cost-effective generation sources as alternatives to the Susitna Project are those listed above.

GAS-FIRED GENERATION

Natural gas-fired combined cycle combustion turbine plants would be a favorable alternative, provided Cook Inlet gas continues to be available and relatively inexpensive. Simple-cycle combustion turbine plants have low capital cost and high fuel consumption. They are used extensively when the price of natural gas or light fuel oil is low. As

the prices increase, the combustion turbines are still useful and are often adopted for peaking and reserve capacity purposes. Incremental unit sizes of 84 MW have been selected for the Railbelt.

A plentiful supply of natural gas in the Cook Inlet region, together with favorable sales contracts, has led to the use of gas for most of the electrical generation in the Anchorage area since the 1960's. New contracts negotiated in 1982 contemplated increases in the price of gas to $2.32 MMBtu, which is subject to adjustment based on the price of fuel oil, plus severance taxes and demand charges. Proven reserves of natural gas in Cook Inlet are estimated to be depleted by 1997 and undiscovered reserves by 2007. Beyond that date, North Slope gas could be made available to the Railbelt via the proposed Alaska Natural Gas Transportation System (ANGTS) or Trans-Alaska Gas System (TAGS). Construction of either ANGTS or TAGS depends on favorable world oil prices. In the absence of either ANGTS or TAGS, the North Slope gas can be brought to Fairbanks with a small diameter pipeline at a cost exceeding $7.00 per MMBtu.

Natural gas should continue to be available for electrical generation for many years, but the price of new gas will fluctuate with the world price of oil. The floor gas price will be set first by the amount of remaining uncommitted reserve, then the economically recoverable undiscovered reserve, and finally by transmission cost of natural gas from the North Slope to Fairbanks. The floor price has been estimated to be $4.00 MMBtu after 2007.

COAL-FIRED GENERATION

Coal-fired steam plants could be built at the Beluga mine field or near Nenana. Incremental unit sizes of 200 MW are appropriate for the

Railbelt system for favorable cost of construction and thermal efficiency.

Nenana field coal is the primary fuel for electrical energy generation in the Fairbanks-Tanana Valley area. The Nenana mine could be expanded to supply fuel for up to 400 MW of coal-fired steam generation needed to serve the Railbelt. Beyond 400 MW of coal-fired thermal capacity, the Railbelt would probably turn to the Beluga field for coal. The Beluga field is not currently producing coal and totally lacks infrastructure; thus it can only be developed as a large mining operation. On this basis the coal price would be $1.80 per MMBtu from either Nenana or Beluga.

THE CHAKACHAMNA HYDROELECTRIC PROJECT

The Chakachamna Project would include a dam with fish passage at the Chakachamna Lake outlet, an intake, a 10-mile power tunnel, and a power plant on the McArthur River. The installed capacity would be 330 MW; average annual energy generation would be 1,590 GWh; and the project would cost $1,438 million in 1983 dollars.

The major environmental impacts of the Chakachamna Project would be twofold: a fluctuation in lake level of 28 feet above and 45 feet below natural levels, and diversion of flow from the Chakachamna River to the McArthur River. This will have significant impact on the fishery habitat of both the lake and the river downstream.

To summarize, the non-Susitna alternatives provide models for comparing the economics of various system expansion programs and, more importantly, determining life cycle benefits of the least-cost alternative.

6. SYSTEM EXPANSION PROGRAMS

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FORMULATION OF EXPANSION PROGRAMS

Will the Susitna Hydroelectric Project provide the lowest cost electrical energy to the Railbelt in the long term? An optimization generation program (OGP) with appropriate technical and economic planning criteria has been used to aid in that analysis.

The Watana Project is scheduled to enter service in 1993, followed by Devil Canyon some years later. Varying amounts of capacity and energy will be provided depending on the ultimate height of the Watana dam. Combined, the two projects will form the backbone of the Railbelt system generation for many years. By the year 2020, all Susitna Project potential power output would be absorbed into the system even under the lowest load growth scenario.

In the absence of the Susitna Project, a combination of coal-fired and gas-fired thermal and possibly the Chakachamna Hydroelectric Project would be built to serve long-term requirements. Prior to 1993, any expansion of the Railbelt system is considered to be identical in any scenerio. That expansion will be composed of the existing facilities, consisting of simple cycle combustion turbines and small hydroelectric plants, less plants retired from service. The Bradley Lake Hydroelectric Project (90 MW and 347 GWh/yr) and the Grant Lake Hydroelectric Project (7 MW and 25 GWh/yr) are also assumed to be constructed. The inclusion of these hydroelectric projects improves the economics of non-Susitna thermal alternatives, since less electrical demand would need to be met by the thermal-dominated generation system. No major additional generation is considered to be installed.

The 1993 generation system, after allowance for retirement or additions of new capacity in the intervening period, is assumed as follows:

Oil-fired combustion turbines and diesels	181 MW
Natural gas combustion turbines	254 MW
Natural gas combined cycle plants	317 MW
Coal-fired steam	59 MW
Hydroelectric	143 MW
Total installation in MW	954 MW

1993 - 2020 GENERATION EXPANSION

The thermal generation systems in 2020, after allowance for additions and retirements, are given in the table below for the DOR Mean case. System generation expansion varies with the magnitude of the forecast used; consequently, for other forecasts considered, unit size and timing are related to the forecast.

FORECAST OF GENERATION MIX IN 2020 (DOR MEAN)

Generating Plants in Megawatts	Non-Susitna All Thermal	Susitna Base-load Watana 2185	Susitna Base-load Watana 2000
Combustion Turbine	672	588	504
Combined Cycle CT	474	0	474
Coal-fired Steam	800	0	--
Susitna	—	1209	885
Pre-1993 Hydroelectric	143	143	143
Total	2089	1940	2006

Until 1993, when Watana is scheduled to go into service, Railbelt utilities will have to meet the electric energy growth requirements by expansion of their respective systems, probably with thermal plants. After 1993, there will be a choice: the Susitna Hydroelectric Project or further expansion of the thermal system. Alternative thermal expansion schemes have been considered to demonstrate life cycle benefits and provide a basis for selection of the least-cost alternative.

7. ECONOMIC ANALYSIS

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LIFE CYCLE ANALYSIS

The economics of each alternative expansion program are determined by life cycle analysis: comparing the present worth of annual costs of owning and operating the respective electric systems for the period 1993-2050. The generation costs have been developed from the OGP computer program incorporating the following principal criteria and assumptions:

- All costs are expressed in real terms in January 1983 dollars.
- Present worth is computed by discounting future costs using an annual, inflationless discount rate of 3.5%.
- Project economic lives are 50 years for hydroelectric, 30 years for coal-fired steam and combined-cycle plants, and 20 years for combustion turbines. (The real economic life of hydroelectric plants is considerably greater than 50 years.)
- Escalation of fuel cost under different oil price scenarios is included.
- Costs of owning the existing (1993) system are common and excluded from the analysis.

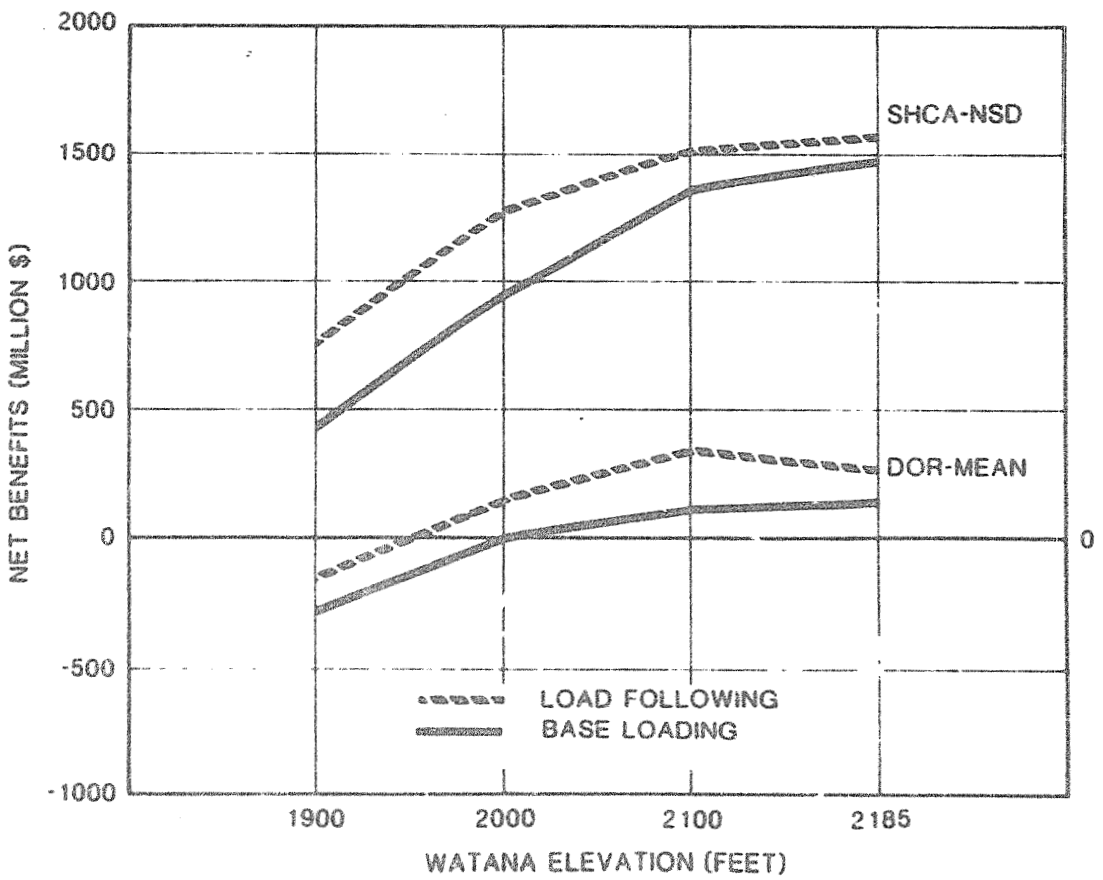
Net Benefits

The net benefit of the Susitna scheme is defined as the difference between the cumulative present worth cost of Susitna and that of the least-cost thermal alternative. Each oil price scenario yields corresponding optimum Susitna and non-Susitna system expansions,

which are compared to one another. The net benefits for the various Watana alternatives are summarized below and illustrated on the graph. With the more optimistic oil price scenario, the net benefit tends to increase as the height of the dam increases, and vice versa.

NET BENEFITS, 1993-2050
(Million 1983 Dollars)

	Watana Elevation			
	2185	2100	2000	1900
Base Loading:				
DOR Mean Scenario	146	93	-2	-293
SHCA-NSD Scenario	1,499	1,364	989	484
Load Following:				
DOR Mean Scenario	261	305	150	-132
SHCA-NSD Scenario	1,522	1,471	1,207	524

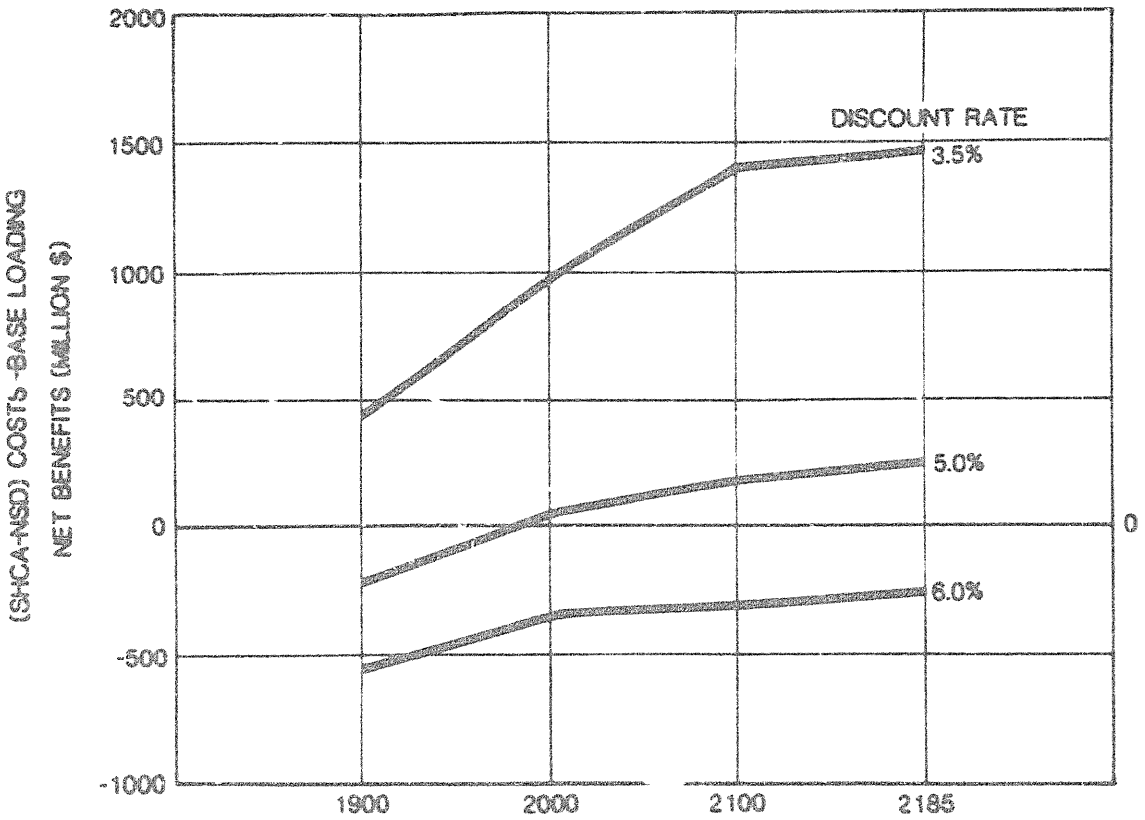


PRESENT WORTH ANALYSIS

THRESHOLD ANALYSIS

Discount Rate

The threshold (or rate of return) analysis provides a means to identify the project that maximizes the return on investment. The threshold value is the discount rate at which the cumulative present worth of the hydroelectric alternative becomes equal to the optimum thermal expansion program. This differs from the net benefit approach, which might maximize net benefit but require very high capital investments. The threshold value of discount rate for the DOR Mean case is slightly greater than 3.5 percent. The following graph shows the results for the SHCA-NSD scenario, and the table following lists each threshold value.



RATE OF RETURN ANALYSIS

THRESHOLD VALUE OF DISCOUNT RATE

	DOR Mean	SHCA-NSD
Watana 2185	3.5%	5.4%
Watana 2100	3.5%	5.3%
Watana 2000	3.3%	5.0%

Oil Price Threshold

The threshold value is defined as the oil price (or oil price trajectory) at which the cumulative present worth of the Susitna Project and the thermal alternative are equal. The net benefits analysis also shows that the threshold price trajectory is very near the DOR Mean with base load operation. The critical estimated price in 1999 is $27.45 per barrel (in 1983 dollars).

Capital Cost Threshold

For any given oil price scenario, there is a capital cost threshold. It is defined as the capital cost at which the Susitna Project would show no economic benefit when compared to the most attractive thermal alternative. Using the DOR Mean oil price scenario, the threshold is essentially the same as the capital cost for the Susitna Project. Using the SHCA-NSD case, the capital cost threshold increases. The percentage of increase is shown below.

THRESHOLD ANALYSIS FOR SHCA-NSD
PERCENT INCREASE IN INITIAL WATANA PROJECT

	Base Loading	Load Following
Watana 2185	59	60
Watana 2100	60	65
Watana 2000	49	63
Watana 1900	N/A	N/A

Life cycle benefits are materially affected by the oil price forecast used and to a lesser degree by the proposed mode of operation (load following or base loading) of the Susitna Project. Net benefits and rate of return are greatest and near the economic optimum for Watana 2185 as defined in the FERC license application. Lowering the Watana reservoir elevation from 2185 to 2000 will not materially change the economic benefits for the DOR Mean forecast, and load following increases the economic benefit.

8. COST OF POWER

8. COST OF POWER

FACTORS INFLUENCING COST OF POWER

Several important and interrelated issues must be resolved before a suitable financing plan can be recommended for the Susitna Project. These issues include:

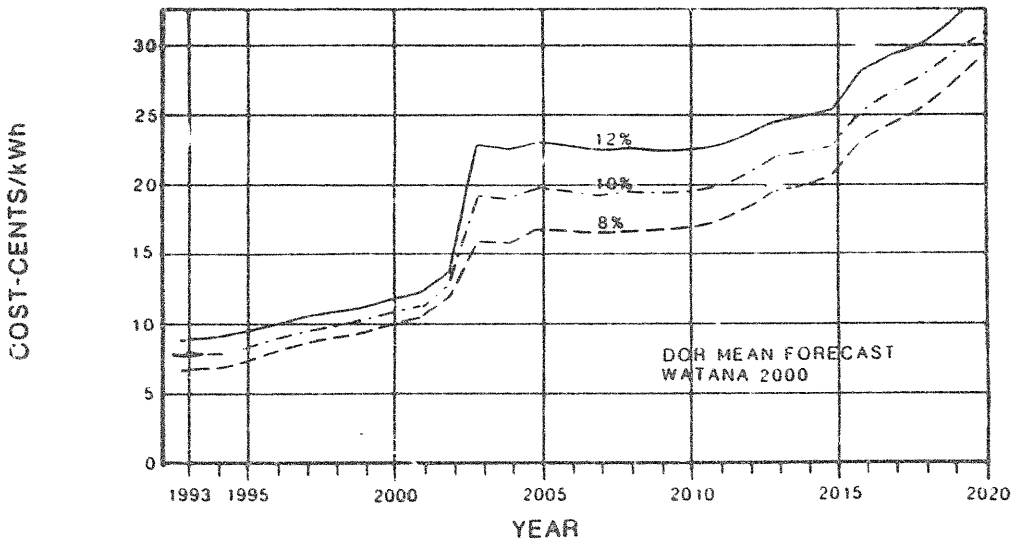
- Size of the Watana project
- Size of the State equity contribution
- Financing terms, including interest rates, tax exempt status of the bonds, inflation rate
- Target cost of power when Susitna comes on-line

Capital costs of the Watana project range between $2.6 billion and $3.3 billion (1983 dollars) for dam heights between elevation 2000 and elevation 2185, respectively. A smaller project would reduce the initial funding requirements, while the larger Watana project provides slightly better long-term economic benefits.

The financial condition of the State is a very important factor in determining the financial feasibility of the Susitna Project. Petroleum revenues determine State income, and may limit the size of the equity contribution which can be made.

The ability to finance the project is influenced by the financing terms available. The interest rate is the dominant factor in determining the magnitude of the debt service. If revenue bonds are used for financing, the interest rate will be lower if tax exempt; hence, debt service will be lower. The State equity contribution should permit the initial

cost of Susitna power to be competitive with alternative sources of generation. A higher interest rate may require a higher State equity contribution to maintain a cost of power competitive with other alternatives and vice versa.



EFFECT OF INTEREST RATE ON WHOLESALE COST OF POWER

It has been previously thought that future electric power demand would have a major influence on the financial viability of the Susitna Project. While this still holds true, it does not appear crucial in the range of the forecasts considered. The effect of electricity power demand forecasts on State equity contribution varies in a relatively narrow range. Other financing options could also influence project viability. Some interests have suggested alternative financing schemes that would improve the financial marketability of the power from Susitna. This subject is currently under study and should be explored further, it has not been treated in this update.

COST OF POWER

The cost of power analysis estimates the amount of State equity contribution that will be needed to bring the wholesale cost of power to the first-year cost of the most competitive alternative thermal expansion program.

The first-year (1993) wholesale cost of power under the alternative thermal expansion plan could range from 7.6 cents per KW (under the DOR Mean scenario with natural gas fired combined cycle plant) to as much as 50 percent higher under the SHCA-NSD scenario (coal-fired steam installation). The validity of either scenario would certainly depend on the actual trend of the oil price.

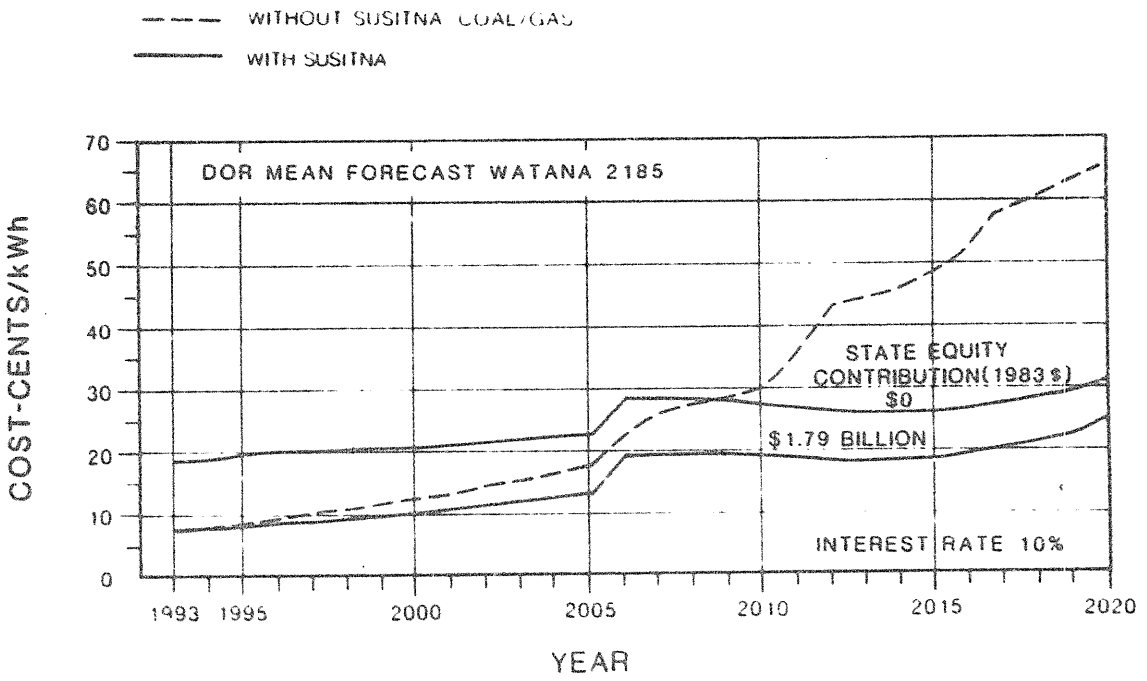
If the State equity contribution is sized to bring first-year cost of power from Susitna to the lowest level, it is likely that the power can be marketed without major problems. The required amounts are shown below.

STATE EQUITY CONTRIBUTION
FIRST-YEAR ELECTRICITY COST
EQUAL TO NON-SUSITNA ALTERNATIVE
(Billions of 1983 Dollars)

	Watana 2185	Watana 2000
DOR Mean	1.79	1.27
SHCA-NSD	1.63	1.17

The State equity requirement would be reduced by about 30 percent with the lower Watana dam height. On the other hand, changes in oil price scenarios do not have as great an impact.

The graph below shows the Railbelt wholesale cost of power by years with a State equity contribution of $1.79 billion (1983 dollars) for Watana 2185 under the DOR Mean scenario. Under similiar conditions, the State equity contribution for Watana 2000 would be $1.27 billion.



WHOLESALE COST OF POWER (WATANA 2185)

In the case of the thermal alternative, the cost of power will rise over time due to inflation and real cost increases in fuel. Conversely, the cost of power for Susitna will be much less susceptible to increase because of its longer life and no fuel costs. As a result, in later years, the wholesale cost of power from Susitna will be a fraction of the best thermal option.

9. GOVERNOR'S CHECKLIST

9. GOVERNOR'S CHECKLIST

The Governor's Checklist is presented on the following pages. It provides a complete set of the key variables, principal assumptions and economic planning criteria used in the study. Major findings are also listed. The exhibit also provides the corresponding information used in the economic and financial analyses in the 1982 feasibility study and the FERC license application of July 1983.

GOVERNOR'S CHECKLIST

September 1983 Update
(January 1983 price level)

	1982 FEASIBILITY STUDY	REVISED FERC LICENSE APPLICATION (REFERENCE CASE)	1983 UPDATE DOR-MEAN	DOR-50	SHCA-NSD
Oil Price Forecast (a) - $/bbl					
1983	38 (b)	28.95	28.95	28.95	28.95
1993	46 (b)	30.49	25.13	22.33	30.49
1999	52 (b)	36.40	27.45	21.71	36.40
2010	65 (b)	50.39	33.35	21.71	50.39
2020	72 (b)	64.48	37.62	21.71	64.48
Long Term Oil Price Growth - %					
1983-1993	2.0	0.5	-1.4	-2.6	0.5
1983-1999	2.0	1.4	-0.3	-1.8	1.4
1983-2010	2.0	2.0	0.5	-1.1	2.0
1983-2020	---	2.2	0.7	-0.8	2.2
Load Forecast - GWh					
1983	3,150	3,027	3,088	3,088	3,088
1993	4,746	4,321	4,167	4,085	4,397
2010	7,791 (c)	6,280	5,945	5,672	6,444
2020	---	8,039 (c)	7,505(c)	7,092(c)	8,312 (c)
Long Term Load Growth Rate - %					
1983-1993	4.2	3.6	3.0	2.8	3.6
1983-1993	2.4	2.7	2.5	2.3	2.8
1983-2020	--	2.7	2.4	2.3	2.7
Cook Inlet Gas Price Forecast (a) - $/MMBtu					
1993	3.2	3.02	2.45	2.22	3.02
1999	4.7	3.61	2.68	2.16	3.61
2010	6.2	5.00	2.97(d)	2.16(d)	4.43 (d)
2020	6.2	6.39	---		---
2050	6.2	9.05			
Cook Inlet Gas Price Growth		Linked with oil price growth			
Cook Inlet Gas Availability Forecast	Assumed unlimited	Assumed unlimited	Assumed Available through 2006 at Above Prices		
North Slope Gas Price Forecast (e) - $/MMBtu					
1993	N.A.	4.22	4.00	4.00	4.22
1999	N.A.	5.04	4.00	4.00	5.04
2010	N.A.	6.97	4.18	4.00	6.97
2020	N.A.	8.92	4.85	4.00	8.92
2050	N.A.	12.63	7.58	4.00	12.63
North Slope Gas Availability Forecast (e)	N.A.	Assumed unlimited	Assumed Available in 2007		

GOVERNOR'S CHECKLIST

September 1983 Update
(January 1983 price level)

	1982 FEASIBILITY STUDY	REVISED FERC LICENSE APPLICATION (REFERENCE CASE)	1983 UPDATE DOR-MEAN	DOR-50	SHCA-NSD
Nenana Coal Price Forecast (a) - $/MMBtu					
1983	1.9	1.80	1.80	1.80	1.80
1993	2.4	2.17	1.80	1.80	2.17
1999	2.7	2.30	1.80	1.80	2.30
2010	3.1	2.57	1.80	1.80	2.57
2020	---	2.84	1.80	1.80	2.84
Nenana Coal Price Growth - %					
1983-1999	2.2	1.5	0	0	1.5
1983-2010	1.8	1.3	0	0	1.3
1983-2020	---	1.2	0	0	1.2
Nenana Coal Availability Forecast	(g)	(g)	(g)	(g)	(g)
Beluga Coal Price Forecast (a) (f)-$/MMBtu					
1983	1.5	1.80	1.80	1.80	1.80
1993	2.0	2.17	1.80	1.80	2.17
1999	2.3	2.30	1.80	1.80	2.30
2010	2.7	2.57	1.80	1.80	2.57
2020	---	2.84	1.80	1.80	2.84
Beluga Coal Price Growth - %					
1983-1999	2.7	1.5	0	0	1.5
1983-2010	2.2	1.3	0	0	1.3
1983-2020	---	1.2	0	0	1.2
Beluga Coal Availability Forecast		Assumed Unlimited			
Real Discount Rate (%)	3.0	3.0	3.5	3.5	3.5
Real Interest Rate (%)	3.0	3.0	3.5	3.5	3.5
General Inflation Rate (%)	7.0	7.0	6.5	6.5	6.5
Susitna Construction Cost - $ x 10^6					
Watana El. 2000	----	----	2,637	2,637	2,637
Watana El. 2185	3,805 (h)	3,750 (h)	3,432	3,432	3,432
Devil Canyon	1,535 (h)	1,620 (h)	1,552	1,552	1,552
Capital Cost Escalation Rate - % 1982 to 1985	1.1	0.0	0.0	0.0	0.0
1986 to 1992	1.0				
1993 on	2.0				

GOVERNOR'S CHECKLIST

September 1983 Update
(January 1983 price level)

	1982 FEASIBILITY STUDY	REVISED FERC LICENSE APPLICATION (REFERENCE CASE)	1983 UPDATE DOR-MEAN	DOR-50	SHCA-NSD
Project Timing					
Watana 2185 / Watana 2000	1993	1993	1993	1993	1993
Devil Canyon (with Watana 2185)	2002	2002	2006	2009	2002
Devil Canyon (with Watana 2000)	----	----	2003	2007	1998
Benefit/Cost Ratio (Watana 2185)					
Base Loading	---	1.33	1.03	0.96	1.28
Load Following	1.17	---	1.06	0.99	1.29
Benefit/Cost Ratio (Watana 2000)					
Base Loading	---	---	1.00	0.96	1.17
Load Following	---	---	1.03	1.00	1.23
State Equity Contribution (1983 $, billions)					
Watana 2185 (base load)	---	1.9 (i)	1.8	n/a	1.6
Watana 2000 (load following)	1.9 (i)	---	1.3	n/a	1.2
Wholesale Cost of Power	Equal to first year non-Susitna cost				
IRS Tax Exemption	Probably yes since interest rate assumed to be 10%				

(a) Acres Feasibility Study fuel costs were inflated to January 1983 price level using the U.S. GNP index of 6.0%.

(b) Based on 2.0% average annual growth rate until 2000, 1.0% until 2040, and 0% thereafter as reported in February 1983 Exhibit D p. D-4-22.

(c) Last year of generation expansion planning studies.

(d) Gas price in 2006, which was assumed to be the last year of Cook Inlet gas availability.

(e) Forecast also represents prices of gas from some other source such as Cook Inlet, and reflect increased prices due to higher exploration and development costs and associated risks.

(f) Assume Beluga field developed for export market, but prices sold to local needs independent of opportunity price.

(g) Acres Feasibility Study up to 200 MW of coal-fired steam plant. Revised FERC License and 1983 Update up to 400 MW of coal-fired steam plant.

(h) January 1982 costs escalated to January 1983 using a 4.3 percent increase.

(i) Escalated from 1982 to 1983.