ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT PROPOSAL

APA-R-82-002

HARZA-EBASCO
JOINT VENTURE

AUGUST 16, 1982

VOLUME 1
TECHNICAL PROPOSAL
BINDER 3

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D(c) ENVIRONMENTAL PROGRAM

INTRODUCTION

Joint Venture Approach to Project Licensing

This portion of the Work Plan addresses the several elements which comprise the overall project environmental program. Our proposed environmental program is conceived as integral to the FERC licensing process, and is designed to meet three major objectives:

- To evaluate and continue, as necessary, ongoing work initiated prior to the FERC License Application

- To provide a coordinated, effective response to all significant issues which arise during the course of FERC License Application review and EIS preparation

- To assist and support engineering activities to ensure proper and efficient implementation of planned environmental features in the project design

The contents of this portion of the proposed work plan therefore overlaps considerably with work plan elements d (FERC License Support), e (Permitting Programs), f (Acquisition of Land Use Rights), h (Public Participation), and k (Field Investigations). The present discussion, however, provides a comprehensive approach to resolution of environmental issues with the overall goal of licensing the Susitna Hydroelectric Project within the Power Authority's desired schedule.

Development of Licensing Strategy

As outlined by Eric Yould during the June 24, 1982 Power Authority Board Meeting, FERC will have three basic options with regard to acceptance of the FERC License Application after it is submitted. The Joint Venture hydroelectric licensing staff is cognizant of each potential scenario and will be prepared to develop a detailed licensing strategy tailored to FERC's specific actions following License Application submittal. The licensing strategy will take the form of an overall guidance document which will serve to focus and direct all subsequent environmental work plans for the licensing period. In order to effectively develop and implement the licensing strategy, the Joint Venture FERC Licensing Coordinator will monitor License Application preparation activities carried out by the present group of environmental subcontractors in the period between contract award and License Application submittal. During the

period between contract award and April 1, 1983 he will work closely with the Joint Venture's Transition Team (see Organization B) to ensure that the environmental team is able to immediately assume FERC License Support activities.

As discussed more fully in Section D(d), "FERC License Support," after submittal of the License Application the following will occur:

1. Review, revision and final acceptance of the License Application

2. Preparation, by FERC, of a Draft EIS for the Susitna Project

3. Review of the Draft EIS by the public, other agencies and the Power Authority

4. Preparation by FERC of a Final EIS

5. Review of the Final EIS by the public, other agencies and the Power Authority

6. Publication by FERC of the Record of Decision regarding the granting of the License (this terminates the required NEPA actions); comments received by FERC on their FINAL EIS may be included in their Record of Decision

7. Establishment, by FERC, in consultation with others, of general and special conditions to the License

Each of these steps includes mandated periods for public review and response and each requires action by the Power Authority to address issues that arise during the review process. The two-year schedule to complete the licensing phase of the project therefore, while achievable, will require rapid, efficient response time on the part of all involved to meet the January 1, 1985 license issue date.

Intervention by public or private entities, requiring hearings before a FERC Administrative Judge must be avoided, if possible, or the number of intervening parties and issues minimized if the desired schedule is to be met.

For these reasons, the Joint Venture proposes a flexible approach to the total environmental program during the 1983-1984 period. A complete team of environmental specialists will be available to develop and implement new or modified field programs, data analyses and design/operation concepts as issues

surface and requests for information are forwarded to the Power Authority from FERC.

Technical Direction, Management and Review

The Susitna Hydroelectric Project environmental studies to date have been comprehensive, involving a varity of participants. The present level of complexity is expected to be gradually reduced after the milestone of License Application submittal is reached, but, with the exception of some of the long-term field monitoring programs, the precise nature of the environmental program during the licensing period is presently uncertain. Since the period between License Application submittal and the granting of a License is essentially a period of review and public evaluation of the Project, it can be expected that much effort will be expended by the entire Project team, as well as by the Power Authority, in responding to questions and comments. In developing this proposal, the Joint Venture environmental team has attempted to minimize uncertainty by analyzing the present and expected status of individual environmental study components, and by developing logical and realistic assumptions. In general, we propose to serve in an overall program management capacity, providing technical direction and review to study participants who will be necessary to the licensing effort. These participants will likely include most of the environmental organizations presently under contract for this project, as well as technical staff from within the Joint Venture organization.

The general approach used to develop the work plans described in this section and the corresponding levels of work effort includes definition of issues and study requirements which are expected to exist during the licensing period, as well as the Joint Venture plan for resolution of those issues. Our proposal does not contain detailed work plans for study participants other than the Joint Venture and its presently identified subcontractors. Significant effort will be expended by other study participants such as the Alaska Department of Fish and Game. Cost estimates are provided for these other study participants but the Joint Venture will review the scope of these continuing studies and make recommendations for their modification, as appropriate, in the light of the overall licensing strategy using FERC, agency and input received form the public participation process.

Issue Management. The scope of the environmental studies program thus far has been based on the requirements for the FERC License Application, with principal emphasis on suggestions from state and federal agencies, interested citizens, and public and private organizations. Significant changes have been made in

the environmental study plans as issues and concerns have been raised. After the License Application has been submitted, the environmental program will shift somewhat in emphasis to meet the objectives described above. The studies are expected to become more oriented to significant, ongoing issues and unanswered questions. Control of the environmental program during the post-submittal licensing period will be facilitated by development of "issue management" mechanisms and strategies, with the objectives of ensuring that the environmental studies are continued only if the accumulated body of information is insufficient, that they are focused on the proper subjects, and that they are pursued to a level commensurate with their significance.

For example, we propose to apply a concept successfully implemented in thermal power project licensing, the development of issue-oriented licensing topical reports (LTR's). An LTR typically presents a technical overview of a single environmental or safety-related issue (e.g., instream flow requirements) on both a generic and site-specific basis. The purpose of an LTR is to provide information to the public, the agencies, and the licensing authority, and to allow broad discussion of an issue through a document outside of the regulatory process.

To some extent, the theme-oriented Susitna Project Newsletters issued by the Power Authority have served this purpose thus far, and in many cases will continue to be the most appropriate forum for discussion of environmental and licensing issues. Where appropriate, more detailed LTR's will be prepared by the environmental program team for publication by the Power Authority. This mechanism will be most useful in situations where reviewing agencies are in substantial disagreement over the procedures, adequacy of data, analytical results or mitigation plans. In such instances an LTR can be a catalyst for discussion, compromise, and consensus, and can serve to move an issue off "dead center".

Ensuring Communication

The Joint Venture project team recognizes the importance of the flow of information among study participants, and will make the enhancement of communications a prime goal in managing the environmental program. This will be accomplished by implementing the following actions:

- The status of the environmental program and its components will be included routinely in monthly progress reports submitted to the Power Authority by project management.

- Priority routing lists will be established for project correspondence to ensure that project personnel are continually aware of information which may not necessarily be directly within the scope of their discipline area.

- Information meetings will be held on a regular basis to allow project participants to voice questions and comments as the studies progress.

- Formal presentations will be made to the Power Authority staff, Power Authority Board, and other designated audiences by principal members of the environmental study team on request. A file of presentation materials (prepared texts, slides, other graphics) will be maintained to document and facilitate these presentations.

In addition to these activities, the Environmental and Regulatory Programs Manager will arrange informal meetings with Power Authority and agency staff personnel at such times as communication among specific individuals appears to be especially desirable. The purpose of this is to minimize the "filtering" effect of a prime contractor so often cited by agency personnel as a negative influence on communications and eventual cause for delay of projects.

Internal communications among the Joint Venture's Environmental Study Team will be maintained by the Program Manager, utilizing the following techniques:

1. All internal correspondence will be distributed to appropriate team members in accordance with standard routing priorities and procedures.

2. All external correspondence will be signed by the Environmental and Regulatory Program Manager or individuals designated in accordance with standard priorities and procedures.

3. Weekly internal briefings will be held in Anchorage, to be attended by all resident personnel.

4. Written summaries of these briefings will be sent weekly to the environmental support staff in Bellevue.

Coordination With Other Project Activities

It is important to ensure that the environmental program remains closely related to the overall project development effort. Specific, continuous actions must be taken to maintain

effective coordination with engineering design, permitting, and quality assurance activities. Proposed actions in each of these areas are described below.

Engineering Design. Project design activities must be undertaken with full cognizance of FERC requirements, other environmental protection criteria, mitigation plans, and agreements made with various regulatory and resource management entities. Coordination of environmental and design work will be most effective at two points in time: 1) development of engineering design criteria, and 2) development of design memoranda. To ensure that environmental concerns are taken fully into account, the Environmental and Regulatory Program Manager will be responsible for contributing to and reviewing all major documents resulting from design activities. In addition, Lead Design Engineers in the various disciplines will participate in the development and review of major environmental documents, particularly those related to specific mitigation plans. Cross-participation of these individuals in both development and review of these documents will help to ensure that the design of project features and development of project operation plans is acceptable from both an environmental and an engineering standpoint.

Permitting Activities. Many project permitting activities, including those necessary for the field geotechnical and project design investigations, include environmental study or protective requirements. These needs will be coordinated including the briefing of engineering personnel, with the overall, ongoing environmental program in order to optimize the use of study resources. As discussed in Section D(e) of this proposal, permitting activities undertaken by our subcontractors will be administered by the Environmental and Regulatory Program Manager, so that such coordination is the responsibility of a single individual.

Quality Assurance

Project design quality control/quality assurance (QC/QA) plans and specifications will include all environmental data collection activities initiated by the Joint Venture. The QC/QA procedures will include processes requiring sign-off by the QC/QA coordinator on such activities as license compliance and permits. Generic QC/QA procedures of each Joint Venture participating firm and its subcontractors will be used to develop a project-specific QC/QA procedures document which assures compliance with agency and federal requirements. Procedures will be specified for QC/QA training of Project personnel, data collection and analysis, reporting, audits and inspections, record keeping, and traceability. Implementation of the QC/QA plan in

environmental data collection activities will be the responsibility of the Environmental and Regulatory Program Manager.

Data Management System

The Joint Venture recognizes that a great deal of quantitative information has been compiled within the framework of the Susitna Project environmental baseline studies by various organizations. One pressing need identified by several participants in the environmental studies is for a uniform, comprehensive data management system. This is needed to 1) properly analyze existing data, 2) assist in identifying information gaps or other deficiencies, 3) provide a usable and efficient means for storage of information, 4) ensure that overall project quality assurance objectives are met, and 5) eliminate the possibility of redoing work previously accomplished.

Because of the diversity of data files and large amount of information contained in them, it will not be cost effective at this time to integrate all of this material into a single, rigorously structured Data Management System. At the same time, however, we recognize the need to implement the best possible management system for all existing and future data. It is proposed, therefore, that two methods for data management be implemented.

First, for existing data files, a more traditional system will be utilized. Files of all participating entities will be inventoried, hand copies of major data files will be obtained, catalogued and maintained in the Joint Venture office. This file will then be continually updated during the course of the project as other information is developed. Computer-based data management systems currently being employed by study participants will be evaluated and continued, where appropriate, based on cost effectiveness.

Second, for all information obtained after the Joint Venture initiates work on the project more rigorous procedures will be followed. Early in 1983, as the licensing strategy is being formulated, the Joint Venture will select, with Power Authority and agency approval, a subcontractor to develop and implement a more rigorous data management system for the ongoing environmental program. It is expected that this Service could be performed by one of the principal entities involved in data collection activities. Our cost proposal includes an estimate for this subcontract.

Data Acquisition. Compilation of data from existing sources will initiate and guide the overall data acquisition effort. As existing information is compiled, it will be catalogued. The data catalog will identify the source, date, and category of each data set obtained. This will be done to avoid later duplication of effort, and to fulfill project quality assurance requirements. Data acquired at any stage of the program will be maintained for inspection by the Power Authority and other participants in the environmental program.

After compilation from existing sources, the data will be evaluated against previously established data specifications for adequacy. Data gaps will be closed by returning, for more exhaustive reference, to agency files and the literature. Existing data sets which we judge to be insufficient for the required studies will be supplemented with a new data collection program. These judgements will be based on an exchange of ideas between the environmental study team and agency personnel, through workshops.

Data Formats. Raw data acquired from existing sources or through field programs will be stored in the form of maps, data lists, and literature references, in both computer-compatible and "hard copy" formats. As data sets are completed in each required technical category, a decision will be made by the Joint Venture project team whether to use the raw information "as is", or to transform it into some other form which is more useful for analytical purposes.

Data Processing. Environmental data will be manipulated, either by manual techniques in map overlay formats, or by computer-assisted techniques in digital formats, depending on the analytical requirements and cost effectiveness. We expect to implement a mix of data processing techniques.

Operation of computer-based techniques is more efficient for manipulation of large numerical data sets. Field studies will generate extensive data bases requiring computerized data handling. All programs and data will be maintained on a single computer system equipped with statistical software packages as well as specialized programs for data reduction, as required. Maintaining all data on a single system will provide maximum flexibility to access diverse data bases.

Early during the development of a licensing strategy and detailed work plans, data base specifications and data analysis computer programs will be developed or modified, as necessary. It is likely that many existing Joint Venture programs may be used directly in these analyses. Standard software packages will be used to accomplish extensive statistical analyses.

Data Display. Display media for environmental data will include maps, charts, tables and other graphic devices. Graphics produced by either manual or computer-assisted techniques will be intermediate products of working quality. These will be used internally for analytical purposes, and also for presentations to other participants in the environmental program. Final, report-quality graphics will subsequently be produced for inclusion in reports.

Overall Scope of Environmental Program

A generalized sequence of environmental work activities and controlling milestones in the development of the Susitna Project is illustrated in Figure D (c)-1. As shown, we envision a continuing environmental program in which management of activities initiated prior to the design contract award will be taken over by the design contractor following submittal of the FERC License Application. From that point forward, permitting, licensing, and related activities will be carried out with the initial objective of securing the FERC License, and with the ultimate objective of providing the smoothest and most efficient transition to construction and operational field monitoring activities which will likely be required by the terms of the FERC License.

The proposed Joint Venture role throughout the environmental program is to provide overall technical and administrative direction and control. After careful evaluation of the development and present status of the environmental studies, we believe that it would be undesirable to either completely redirect those studies following submittal of the License Application, or to propose that the agencies and subcontractors involved be left to determine the future course of the environmental studies without management control by the design contractor.

In accordance with this position, we propose a scope of work and an environmental organization matched to our present perception of the important licensing requirements and ongoing environmental concerns. The basic scoping of the licensing support and post-licensing phases of work assumes that appropriate subcontractors will be utilized to accomplish much of the work. Our proposal addresses the more significant environmental

topics likely to be involved in the licensing process. These topics are discussed individually below.

Environmental Work Plan Assumptions

Several key assumptions underlie the proposed environmental work plans and corresponding time and cost estimates. Scheduling assumptions include the following:

- The FERC License Application will be submitted between January 1 and March 31, 1983.
- The License will be obtained by January 1, 1985.
- Construction will start immediately on issuance of the FERC License.

With respect to the development concept, it is assumed that:

- The concept presented in the March 15, 1982 Draft Feasibility Report will be the subject of the License Application, and the design effort will focus on the Watana phase of project development.
- Licensing-related environmental studies will include both the Devil Canyon and Watana sites.
- The environmental studies will include an access plan as presented in Amendment No. 3 to the Susitna RFP.
- Transmission facilities included in this project work scope extend from the powerhouse to the project switchyard, immediately adjacent to the project site.
- Responsibility for subcontracts in force will pass to the Design Contractor on April 1, 1983. It is further assumed that certain subcontracted work elements will be continued, and others terminated, on the basis of licensing requirements.

Field Investigations

Environmental field studies related to the Proposed Susitna Hydroelectric Project may be divided into four phases:

1. Pre-License Application (work conducted prior to the winter of 1982)

2. Licensing Period (calendar years 1983 and 1984)

3. Construction Period (calendar years 1985 through 1992)

4. Operational Period (beyond 1992)

Our proposal addresses the licensing and construction phases, but is structured in full recognition of both the pre-license application and operational-period field programs. The Joint Venture views the environmental field programs as an ongoing process which 1) changes in each phase to meet the specific regulatory requirements of each phase, and 2) builds on previous work. In general, the scope and level of complexity of individual field investigations will decrease over successive phases. Certain field investigations will cease altogether at the end of certain phases. During its assignment on the Susitna Project, the Joint Venture will strive to achieve three goals with respect to its environmental field programs:

1. To fulfill the specific technical intents of state and federal regulatory requirements;

2. To fully integrate the findings of previous field studies into the design and implementation of new field efforts in order to allocate program resources (personnel and funds) productively; and

3. To ensure that the results of the field data collection programs are effectively utilized to answer project-related questions and to enhance the environmental compatibility of the Project.

It is the Joint Venture's intent to use the input of agency personnel, the mitigation corps team, and committees which have been formed to meet the above goals to establish the precise technical scope of field investigations which will occur after contract award.

Generic Procedures for Field Program Planning

Our overall approach to field investigations begins with study planning. Agencies will be consulted early in the process to assure that schedules are met. Detailed work plans for each field program must be prepared prior to initiation of data collection activities to ensure that all study objectives are met. Each study plan will address the following elements:

1. Incorporation of Power Authority, FERC and agency guidance

2. A clear statement of objectives to be accomplished

3. Delineation of study area boundaries

4. Data specifications and formats

5. Detailed work scopes, including sampling locations, frequency and methodologies

6. QC/QA plans and specifications

7. Data management techniques

8. Coordination (requirements and methods) among study tasks

9. Reporting requirements and formats

10. Schedule and budget estimates for task completion

After review and preliminary approval by the Power Authority, the study plans will be submitted in draft form to pertinent state and federal regulatory and resource management agencies, so that their recommendations can be identified prior to initiating the work, rather than after it has been completed. The study plan will also serve a valuable quality assurance purpose in that it will include agency review and be developed to be in regulatory compliance. As a "blueprint", the study plan can be compared to the study results to ascertain whether the study team has accomplished their stated objectives. Data collection activities will commence upon completion of the work plans for each field program.

Specific objectives and implementation of the licensing and construction phase field investigations are discussed below.

Licensing Phase Field Studies

A wide variety of field data collection activities have been undertaken to date, first to answer questions regarding the overall feasibility of the Susitna Project from an environmental standpoint, and more recently, in a more issue-oriented manner, to support an Application for License to the FERC. To the extent that unanswered questions and licensing issues remain after submittal of the License Application, certain field activities initiated prior to January 1983 will be continued in 1983 and 1984. Specific aquatic and terrestrial ecology programs, as discussed in the Environmental Program Work Plan, will continue, modified to reflect developing issues. In addition, it is expected that FERC and agencies participating in review of the License Application will raise some entirely new questions which

will require additional investigation in the field. These dual requirements -- critical ongoing issues and supplemental analyses -- characterize the general scope of the field programs to be undertaken during the two-year licensing period.

The field investigations will be conducted by subcontractors to the Joint Venture. The detailed scope, schedule and costs of each field investigation will be determined jointly by the Lead Scientists, FERC License Coordinator, or Permits Coordinator as appropriate, and the Environmental and Regulatory Program Manager in consultation with agency personnel. Once the subcontracts are in place, subcontract management and administration will be the responsibility of the Environmental and Regulatory Programs Manager, with technical assistance from the appropriate Lead Scientist(s) responsible for the technical discipline area(s) of the work program.

Examples of specific field activities which may be proposed for the ongoing components of the environmental program (those initiated prior to the License Application which are critical to continue into the licensing period) are listed below:

1. Water Use and Quality

- Meteorologic data collection for reservoir temperature, water quality and ice cover study
- Water quality and sediment sampling
- Stream gaging including flow, depth and velocity measurements
- Ice observations
- Side channel groundwater data collection (temperature and dissolved oxygen)
- Side channel discharge data (flow, temperature, depth, velocity and water quality)
- Water Quality at Eklutna Lake for river-reservoir studies.

2. Aquatic Ecosystems

- Resident and juvenile anadromous studies (distribution and abundance timing, spawning areas)

- Aquatic habitats and instream flow studies

3. Terrestrial Ecosystems

   - Wildlife population census and distribution studies
   - Habitat usage/importance studies

4. Historic and Archeological Resources

   - Pre-construction surveys

5. Socioeconomic Resources

   - Improve data base for railroad communities south of Cantwell and north of Willow
   - Attitudinal surveys

6. Recreation and Esthetics

   - Survey of existing dispersed recreation uses
   - Visual resource data base compilation

The above listed examples may change as agency workshops with project staff explore the merits of each proposed study.

Construction Phase Field Programs

Once it has been issued, the FERC license for the Susitna Hydroelectric Project will include a variety of conditions which must be met by the Applicant for the purposes of environmental protection during construction and mitigation of operation related impacts. Receipt of the FERC License will also mark the completion of environmental studies whose primary purpose is to gather fundamental knowledge of the project area and affected environments for use in predicting impacts and developing mitigation plans. As construction begins, the environmental program's emphasis will shift to verification of predicted impacts, refinement and implementation of mitigation plans, and on-site monitoring of construction activities to prevent environmental degradation. A substantial reduction in overall field effort is expected at this point.

The construction phase will require the addition of field inspection personnel during each construction season to assure compliance with FERC and agency requirements. Individual monitoring programs will be carried out by subcontractors, supervised by Lead Scientists of the Joint Venture staff, under the

overall direction of the Environmental and Regulatory Programs Manager. Because of the size and geographic scope of the project, field inspectors will be hired in several discipline categories (e.g. water resources, erosion control, etc.) and will report to the appropriate Lead Scientists in Anchorage.

Specific field activities anticipated for the construction phase are listed below.

1. Water Use and Quality

   - Construction related water quality monitoring studies
   - Continued stream gaging studies

2. Aquatic Ecosystems

   - Continued resident and juvenile anadromous studies
   - Aquatic habitat monitoring for construction impacts

3. Terrestrial Ecology

   - Investigation of habitat enhancement technique
   - Identification of suitable lands for habitat enhancement
   - Wildlife monitoring studies for construction impacts

4. Historic and Archeological Resources

   - Monitoring construction for cultural resource preservation compliance
   - Construction phase salvage and recovery field programs

5. Socioeconomic Resources

   - Monitor construction work force impacts
   - Monitor mitigation plan implementation

6. Recreation and Esthetics

   - Detailed recreation inventory for master plan development

- Monitor incorporation of recreation mitigation measures into construction activities

Operational Phase Field Programs

Operational phase environmental monitoring programs will be initiated when the project goes on-line. As for the construction phase, the general nature and intent of these programs will be stipulated in the FERC License. While this proposal does not extend to implementation of operational phase environmental monitoring programs, it should be noted that those programs will be designed by the Joint Venture environmental staff. This will ensure that maximum use is made of data obtained during the licensing and construction-phase field investigations, and that the transition to operational monitoring will be technically sound and cost-efficient.

TECHNICAL WORK PLAN IMPLEMENTATION

The remainder of this portion of our proposal provides summary discussions of the Joint Venture approach to the studies proposed, for the duration of the licensing phase, in each of the following discipline areas:

- Water Use and Quality
- Fisheries and Aquatic Habitat
- Terrestrial Ecosystems
- Historic and Archeological Resources
- Socioeconomic Resources
- Soils and Geology
- Recreation
- Esthetic Resources
- Land Use
- Project Alternatives

Each discussion includes an analysis of the significant issues and our proposed approach to issue resolution. Work activities

to be accomplished within each discipline category will include all or part of the following:

1. Transition from previous work effort.
2. Review of baseline programs and data bases.
3. Review of assessment methods and results.
4. Review of mitigation planning and concepts.
5. Review of comments/recommendations from all parties.
6. Recommendation of modifications in baseline program.
7. Recommendation of modifications in assessment methods.
8. Mitigation planning.
9. Subcontract management.
10. Liaison among all parties.
11. Preparation of report and other hard output.
12. Preparation of expert witness testimony.

Water Use and Quality

Major Technical Issues

Extensive work has been conducted on water use and quality in preparation for submittal of the FERC License Application. However, the review comments offered by Alaskan and federal resource agencies and the public to date indicate that there is disagreement on the scope, methodology and goals of some of the water use and quality studies.

The Joint Venture has reviewed these comments, and we have noted that certain key issues have been mentioned repeatedly. Although the Power Authority is currently conducting additional studies to resolve these issues, it is probable that the controversy on some of these key issues may extend into the licensing period. The issues could then become official concerns of FERC, which would require further work to fulfill its own obligations and to satisfy any agency and public concerns. FERC procedures are discussed in Section D(d) of this proposal, "FERC License

The major technical issues which have been referred to most commonly in agency and public review comments to date are listed below.

Impoundments: Watana and Devil Canyon Sites. There are two principle issues.

1. The question of whether or not to clear vegetation from the reservoir areas has not yet been resolved.

2. Existing water quality modeling of the reservoirs is one-dimensional. Modeling of certain critical parameters may need to be two-dimensional, in order to be able to adequately predict future conditions and impacts in the 48-mile long Watana reservoir and the 26-mile Devil Canyon impoundment.

Reservoir Releases. Here there are three areas of concern.

1. Fisheries impact assessments have recommended the development of a model or other synthesis of daily discharge for existing and post-project conditions for a 30-year period for both reservoirs, which the agencies believe would provide better resolution than the existing weekly discharge model for quantitative fisheries and water quality impact prediction.

2. Temperature control and potential water temperature effects on downstream fisheries constitute another frequently mentioned issue. The present design concept for Watana incorporates a multi-level intake which, as presented in the summary report, will be capable of operation over the full reservoir drawdown range. However, the feasibility report indicates that water released from the reservoir will be drawn from the surface or near it. Better temperature control of reservoir discharges may be achievable. Provision of a multi-level intake at Devil Canyon would also have to be considered.

3. The third principal issue is the effect of project releases on downstream dissolved gas concentrations, particularly dissolved nitrogen (DN). The potential of the turbulent canyon for reducing or eliminating downstream DN problems has been discussed, but may need to be examined further.

Downstream Reach: Devil Canyon to Cook Inlet.

1. The present state of knowledge of downstream channel morphology and tributaries has been characterized by some as preliminary and in need of improvement.

2. The downstream extent and magnitude of potential impacts on water quality, hydrology and channel morphology have not been studied as extensively as in the upper river, and the potential importance of the lower mainstem has been cited as an issue of interest.

3. The changes which might occur between Talkeetna and Cook Inlet with the projects have been mentioned in some comments on the Feasibility Report.

4. The agency fisheries impact assessment groups have criticized the resolution and reliability of temperature model studies to date. The existing temperature model is one-dimensional and should be reviewed to determine whether it will permit a reliable assessment of with-project changes in temperature on downstream fisheries resources.

5. Existing turbidity studies have been subject to similar criticism, that is, they are not quantitative and that resolution is poor.

6. No sedimentation modeling has been performed to date. Existing sedimentation and turbidity studies have consisted of empirical observations.

7. The fisheries impact assessment groups have also criticized the locations of river cross sections used for water quality studies to date, and maintain that these locations were not well chosen for assessment of water quality impacts on fish.

Access/Transmission Corridor

1. The agencies have stated that they feel that the data base on which assessment of water quality impacts is based is weak.

Joint Venture Approach

The scope and methodologies of Joint Venture hydrologic studies in support of environmental work (mainly fisheries) will depend primarily on results of FERC, agency and public review of the License Application. However, based on our experience in the FERC Licensing process, our review of agency and public comments, and on our review of the existing studies, we believe it will be necessary to:

1. Review and evaluate previous studies

2. Continue hydrologic and meteorologic data monitoring

Our review will be conducted in close liaison with the principal groups gathering field data and also with the entities engaged in fish impact assessment, principally ADFG and AEIDC, in order to ensure that adequate water quality and hydrological data are collected for fish impact assessment and mitigation planning. Resolution of some of the issues listed above will also require close coordination with the Joint Venture engineering staff.

FERC, agency and public review of the License Application may indicate a need for more detailed water quality and hydrologic studies in support of environmental impact assessment and mitigation planning. In that event, the Joint Venture will be prepared to carry out and direct the required studies. Based on our FERC Licensing experience, our review of agency and public comments and our review of existing studies and scopes of work for ongoing studies, we believe that one or more of the following work items may be required:

1. Update and/or upgrade river-reservoir flow, depth and velocity studies

2. Update and/or upgrade river-reservoir water temperature studies

3. Perform river sedimentation modeling studies

4. Perform river-reservoir water quality modeling studies

5. Update and/or upgrade river-reservoir ice cover studies

There may still be major disagreement on the part of the resource agencies regarding the suitability of using the present one-dimensional river and reservoir water temperature models for fish impact assessment. It will be the goal of this program to discuss and resolve the issue with agencies or other parties involved through the use of the workshop process. While a two-dimensional model is a possibility, it may be neither practical nor cost-effective. Discussions in this forum will be aimed at developing a concensus on the issue.

A more detailed discussion of the work items listed above is presented in Section D(a), "Data Review and Further Studies Required."

Fisheries and Aquatic Habitat

Major Technical Issues

As with water quality and hydrology studies, extensive effort has been expended on fisheries and aquatic habitat work in preparation for the FERC License Application, with extensive comment by resource agencies and the public directed at those studies.

We have reviewed agency and public comments made to date, and find that the following major issues are mentioned in those comments and appear likely to continue into the licensing period:

1. Many of the fisheries agencies have indicated that the fisheries studies require further definition of objectives and tasks.

2. The use of the existing instream flow studies program as a quantitative assessment tool has been questioned by some.

3. Many of the resource agencies have characterized the fisheries studies to date as being preliminary, not yet adequate for quantitative assessment of fisheries impacts. They see a need for one or more years of baseline data collection to quantify fish numbers, distribution, and habitat before quantitative impact assessment and mitigation planning can be completed.

4. The fisheries resource in the mainstem Susitna River downstream of the confluence at Talkeetna have received less attention than those in the upstream section of the river.

5. Impacts on fisheries resources in the access/transmission corridor have not been addressed in a detailed manner.

Joint Venture Approach

The precise scope and methodologies of ongoing and future fisheries programs, which the Joint Venture intends to manage under subcontract, will depend on the results of FERC, agency and public review of the License Application to be submitted during the first quarter of 1983. However, based on our experience with the FERC licensing process, our review of agency and public comments, and on our review of existing studies, we believe the work items described below will be required:

Review Comments/Recommendations From All Parties. The Joint Venture will review formal comments and recommendations on the License Application and related documents made by FERC, the resource agencies and the public sector as regards fisheries and related issues.

Output/Deliverables. The Joint Venture will collate the review comments and prepare a report for the Power Authority which: a) summarizes the FERC/agency/public comments by category, b) summarizes FERC/agency/public recommendations or requirements for any further work, and c) presents the Joint Venture assessment of the implications of any such requirements for additional fisheries work.

Review Baseline Programs and Contribute to Impact Assessment. The Joint Venture will review the data base assembled by ADFG, Mr. Trihey, R and M consultants, and others for completeness and appropriateness. We will also review impact assessment methodologies used by AEIDC and others and those proposed, concentrating on:

- Appropriate assumptions
- Sufficient resolution
- Practicality and quantitativeness
- Appropriate geographic limits

Much of the existing information and programs are suitable for purposes of the FERC licensing procedure and mitigation planning and will have been included in the License Application. However, in other areas additional work may be required, while it may not be necessary to continue with some study aspects for licensing purposes or to answer other questions. Joint Venture recommendations on these points will be based on the review of agency comments on the Application as well as our review of FERC requirements.

All fisheries study programs must have a clearly defined objective, approach, and definitive end point for program completion and issue resolution. Through interaction with agencies, the limitations on data refinement will be established and goals set during the first three months of the study effort.

Prediction of potential impacts on fisheries resources is a difficult task essential for planning purposes. Major questions that exist or may arise concerning the Susitna Hydroelectric Project are:

1. What flows are needed downstream of Devil Canyon to maintain spawning and rearing areas for anadromous fish, particularly in sloughs and side channels?

2. How will timing of upstream migration, spawning, rearing and outmigration be affected?

3. Will groundwater sources be affected, particularly as they influence aquatic habitat?

4. If reregulation by the Devil Canyon Dam does not occur, will peaking use of the Watana Project affect downstream resources by, for example, stranding juvenile fish?

5. What effects will an altered temperature regime have on downstream fisheries resources (including positive or negative effects)?

6. How will potential changes in turbidity affect fisheries resources (including positive or negative effects)?

7. Will supersaturation be a problem?

8. Will bedload movement cease after the Watana Dam is in place?

9. In changing the impoundment areas from a stream to a lake system, what changes will occur in fish populations there?

10. Will there be significant effects on fish resources due to construction and operation of access roads and transmission line corridors?

Although some of these questions have been addressed and tentative conclusions reached, most need to be resolved and answers agreed upon by all parties to the Licensing process, even if the answers represent only the "most likely" case. This is absolutely necessary for mitigation planning. The Joint Venture's approach to defining these answers will be to coordinate communication between the Power Authority, FERC, the agencies and the public (in a workshop forum) and, if required, supplement the existing base with studies as needed to provide the answers. One of the key studies in this regard will be instream flow studies performed to determine the relationships of flow to habitat and fisheries resources.

For example, studies to date have indicated that spawning chum salmon may be adversely affected by low flows that do not allow water in side channels or sloughs. Through determination of an instream flow requirement, either an operational scheme may be needed to allow continued use of these areas, or the number of fish displaced must be estimated for mitigative purposes. The data to answer these questions must come from existing or proposed programs carried out by ADFG, AEIDC and other consultants. The Joint-Venture team will directly manage these efforts to ensure that goals are well defined and definitive answers can be made using the workshops and licensing topical report as tools to develop agreement.

We envision our principal interaction will be with ADFG, AEIDC and Mr. Trihey on their aquatic habitat/instream flow studies and on AEIDC's modeling work. The ADFG effort is baseline data collection and preliminary analysis, while AEIDC will be working primarily on fish impact assessment. Mr. Trihey's role will be principally that of coordinator between the two groups. AEIDC modeling studies will be focused primarily on aquatic habitat and fishery resources, but their scope of work does not include reservoir modeling or river thermal modeling. Therefore, a critical function of the Joint Venture will be to ensure timely fish impact assessment by AEIDC through definition of goals, objectives, schedules, and costs in workshops with the above parties.

Output/Deliverables. The Joint Venture will prepare a report for the Power Authority containing a) our independent impact assessment, b) recommendations on whether to retain, modify, or eliminate particular fisheries work subprograms or to add new subprograms, c) the rationale for these recommendations, and d) our recommendations on the steps the Power Authority can take to implement any changes that may be required.

Contribute to Mitigation Planning. We will review mitigation planning and the mitigation concepts formulated by others to date, as well as the approach to mitigation recommended or required by FERC, agencies, and the public in response to the License Application.

Once the magnitude of impacts of the Susitna Hydroelectric Project are more clearly defined, the Joint Venture environmental studies team will work closely with project design engineers to define ways or methods to find solutions to achieving "no net loss of fish... productivity". In this analysis, both positive and negative impacts must be weighed. For example, peak flood flows can be detrimental to fish egg incubation either by destroying redds or by deposition of silt. By controlling or eliminating these peaks, a distinct positive effect may be realized.

On the other hand, smolts migrate to sea primarily during spring floods. Also, if winter low flows are a limiting factor to fish production, increased flows may exhibit a positive effect.

Output/Deliverables. The Joint Venture will prepare a report for the Power Authority containing: a) our independent recommendations on fisheries mitigation measures, b) the rationale for those recommendations, c) our assessment of the mitigation approach recommended or required by FERC, agencies, and the public, and d) our recommendations on how the Power Authority can proceed with respect to fisheries mitigation.

Liaison Between All Parties. The Joint Venture will conduct close liaison through the use of workshops with all entities having an interest in fisheries impact assessment and mitigation, including FERC, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Alaska Dept. of Fish and Game, Alaska Dept. of Natural Resources, Alaska Dept. of Environmental Conservation, Su Hydro External Review Committee, Steering Committee, Fisheries Mitigation Core Group, and the public. This liaison will insure exchange of data and feedback on data needs and program results.

This liaison will be conducted by the Environmental and Regulatory Program Manager with the technical assistance of the Lead Aquatic Ecologist. Frequent informal and formal communication will be maintained, and periodic workshops will be held to provide up-to-date briefings and to facilitate exchange of information and views.

Output/Deliverables. Monthly summaries of all communications will be provided to the Power Authority, together with copies of telephone logs, letters and memoranda documenting contacts and discussions with the entities listed above, as appropriate. The Joint Venture will also prepare summary reports on the results of workshops as they are held.

Manage Subcontracts. The Joint Venture anticipates significant continuing effort on the part of most of the present Fisheries Group subcontractors. We intend to continue as necessary the services of AEIDC and Mr. Trihey under subcontract to the Joint Venture. These subcontracts will be lead by our Lead Aquatic Ecologist in Anchorage. We also envision significant continued effort by ADFG under subcontract to the Power Authority, as at present. We will, of course, carefully review the programs being carried out by all of these entities and formulate our recommendations on the scope and methods of the continuing studies as described above.

Output/Deliverables. We will submit integrated progress reports quarterly to the Power Authority summarizing the accomplishments of our on-going fisheries work.

Terrestrial Ecosystems

Vegetation and wildlife field studies relative to the Susitna Hydroelectric Project have been conducted in the Susitna Basin since 1979. As a result, an extensive amount of baseline data has been collected. These data have been collected by several consultants, the Alaska Department of Fish and Game, other agencies, and the University of Alaska. In addition, a variety of earlier vegetation and wildlife studies have been conducted.[1/2/3/]

Major Technical Issues

The following major impacts have been identified:

- Direct habitat loss through impoundment upstream of Watana and Devil Canyon Dams due to borrow areas and project facilities
- Habitat modification resulting from altered flow regimes and other hydrologic parameters downstream of Devil Canyon Dam
- Obstructions to mammalian migration and other movement corridors
- Increased wildlife disturbance due to construction and operation activities
- Increased trapping, hunting, and poaching pressures due to increased human access; the extent of these impacts on moose, brown and black bears, wolf, other big game species, furbearers (especially pine martens), and various raptors are of greatest concern from a terrestrial ecosystem viewpoint

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1/ Bos, G.N. 1974. Nelchina and Mentasta Caribou Reports. Fed. Aid Wildl. Rest. Proj. W-17-5 and W-17-6. Alaska Department of Fish & Game. Juneau, Alaska.

2/ Chatelain, E.F. 1951. Winter range problems of moose in the Susitna Valley. Proc. Alaska Scientific Conf. 2:343-347.

3/ Gegg, K.M. 1970. Forest resources of the Susitna Valley, Alaska. USDA Forest Service, Pacific Northwest For. & Range Exp. Sta. PNW-32. Juneau, Alaska.

Joint Venture Approach

Ongoing terrestrial field studies are primarily directed at establishing a basis for quantitative estimates of project impacts on important terrestrial species and investigating opportunities for impact mitigation. A major emphasis of these studies is to determine the importance of various habitat types to the wildlife species concerned so that habitat losses can be quantified in terms of wildlife values. In addition, a quantitative synthesis of data collected through mid-1982 is underway and will be used as the basis for a quantitative impact assessment to be documented in the FERC license application by early 1983.

Mitigation planning is also underway. By early 1983 a mitigation plan may be available encompassing measures which can be implemented during project design and construction. It probably will not be possible, however, to complete the planning for mitigation of impacts that cannot be controlled during project construction and which may require land purchase and/or habitat enhancement. It is apparent that the agencies currently disagree as to which habitat evaluation methodology (whether it be HEP or some other methodology) and other wildlife valuation techniques should be used in quantifying and measuring the appropriate level of mitigation. Our experience with other projects has demonstrated the importance of obtaining an early agreement in this regard, in order to finalize the mitigation plan in a timely fashion and avoid potential project delays.

Except for the monitoring studies that will be initiated when construction begins, most terrestrial field studies need not extend beyond mid-1983. Exceptions to this include investigating habitat enhancement techniques for mitigation purposes and identifying lands having potential for habitat enhancement. For example, a program to monitor browse production and moose utilization in the BLM prescribed burn would extend beyond mid-1983. Although the burn is set for late summer 1982 and 1983 in may be postponed for a year, depending on fuel and weather conditions.

The approach of the Joint Venture team will be to initially perform a comprehensive review of the data collected to date and to evaluate these data in terms of their completeness and appropriateness for quantifying project impacts and for developing mitigation strategies. On the basis of this review and evaluation recommendations we will make will be made to the Power Authority regarding any additional data collection that should be undertaken. These recommendations will follow interactions with appropriate agencies and subcontractors (through the workshop process) and will be limited to those studies with clearly

defined objectives which will lead to resolution of important issues dealing with impact quantification and mitigation strategies. Following approval of any additional study to be undertaken, we will directly manage the data collection efforts to ensure that agreed-upon objectives are maintained throughout the study and that definitive answers will be achieved.

Specifically, additional field studies may be necessary to define habitat relationships for certain wildlife species to enable a habitat-based quantitative assessment of impacts. Habitat-based assessment will be necessary for quantitative mitigation planning. Based on our conversations with ADFG personnel, upstream and downstream impacts to moose are of great concern. Although the objective of the Fiscal Year 1983 studies being conducted by ADF&G is to collect this information for moose, additional studies may be required if this objective is not completely met. For example, previous moose studies have been conducted during winters with mild to average snow conditions. Numbers, distribution and origin of moose utilizing project impact areas may be different during winters of severe snow conditions.

Historic and Archeological Resources

Historic and Archeological Resources field studies were conducted during the summers of 1980, 1981 and 1982 by personnel from the University of Alaska Museum. The objectives of the studies were 1) to identify and document archeological and historic sites in the Susitna study area and 2) to test and evaluate resources found, assess site significance and project impacts, and propose mitigation measures.

We understand that the second annual report on these studies, covering the 1981 field season and laboratory analyses, was completed approximately three months ago. This report outlines findings to date (more than 150 sites identified including 1982 work) and provides recommendations for future archeological work in the project area.

Additional field studies will be required to complete the reconnaissance-level surveys of the area and the detailed evaluation and mitigation of identified sites to provide archeological clearance, on a priority basis, for areas to be impacted by project activities.

We propose to closely coordinate ongoing archeological activities with other aspects of project work so as to ensure that necessary clearances are obtained prior to commencement of any project related field activities. We will also work closely

with the archeological consultant, the State Historic Preservation Officer and Project Engineers to put mitigation programs in final form.

Socioeconomic Studies

Joint Venture Approach

The socioeconomic studies will be performed by Frank Orth and Associates, Inc., as subcontractors to the Joint Venture project team.

Frank Orth and Associates have conducted previous socioeconomic studies. Study continuity will be maintained with their participation during the licensing, design and construction phase.

Socioeconomic studies will be oriented toward identifying, in greater detail, the socioeconomic impacts of project construction and operation, developing and assessing alternative measures for mitigating adverse or undesirable impacts, selecting and implementing mitigation measures, and monitoring socioeconomic impacts to ensure the effectiveness of measures implemented.

Socioeconomic studies will be performed in three basic Work Tasks:

1. Update and expand socioeconomic analyses

2. Develop and implement a program to monitor socioeconomic conditions

3. Develop and implement plans to mitigate adverse socioeconomic impacts

Work Task 1, update and expand socioeconomic analyses, will begin in 1984 and continue through 1991, the end of the peak construction period. Although the thrust of this work unit will occur during 1983 and 1984, it will be important throughout the construction process to maintain current data on socioeconomic conditions and to ensure that projections of social, demographic, and employment factors are current. Work Task 2, develop and implement a program to monitor socioeconomic conditons, will similarly be conducted through 1991 in order to track the appropriateness and effectiveness of project construction mitigation measures. Work Task 3, develop and implement a plan to mitigate adverse socioeconomic impacts of project construction, will begin in 1984 with mitigation planning, and move into implementation by 1986 with the start of construction activities.

These three work units are interrelated, and each will also relate closely to the public information program. Much of the information needed in order to monitor socioeconomic conditions, determine the preferred direction for future socioeconomic conditions, evaluate alternative mitigation measures, and evaluate the effectiveness of mitigation measures will require regular contact with the general public, especially in communities in the vicinity of the project and with social and economic groups particurlarly impacted by project construction and operation. Much of the information collected for and disseminated from the socioeconomic studies program will flow through the public information program.

As the previous sections indicate, socioeconomic studies work tasks and subtasks have been assigned to each discrete work item in order to organize and segment work responsibilities and products. However, these tasks are highly interrelated. Baseline socioeconomic forecasts developed in Task 1 will be combined with forecasted project construction impacts prepared during Phase 1 to produce projected conditions with the project. Data relating to preferred future conditions, also developed as part of Task 1, will then be analyzed along with projected with-project conditions to develop an acceptable mitigation plan for the project area. The plan will be developed and implemented as part of Task 3.

Task 3 will also produce planning criteria for the new town. This effort will be both aided and evaluated by monitoring programs established under Task 2. These monitoring programs will also assist in evaluating the effectiveness of mitigation programs for the project area.

The following sections summarize each of the three major work units which will be conducted, several tasks within work units, and the methodology and principal products associated with each work unit or task.

Work Task 1. Update and Expand Socioeconomic Analyses. Socioeconomic analyses conducted as part of this task will include:

1. Updating and expanding the data base for communities expected to be directly impacted by project construction

2. Developing an information base defining community objectives and priorities and local attitudes and opinions concerning anticipated project effects

3. Revising baseline forecasts of socioeconomic conditions to reflect changing assumptions relating to population and economic growth rates
4. Revising projections of future conditions with project construction

These four subtasks will provide key input data for developing and assessing the plan for mitigating negative or undesirable socioeconomic impacts of Project construction and for providing substantive and quantitative bases for analyzing socioeconomic issues as they arise during the course of the project.

Subtask 1. Updating and expanding the data base for communities expected to be directly affected by project construction will entail developing an improved data base for the smaller railroad communities south of Cantwell and north of Willow and other communities which will be identified when the access route is selected and which were not fully profiled in feasinility studies. Expanding this data base will require both primary and secondary data collection activities, but these data collection activities (i.e., surveys which may be administered by state personnel) will not be defined in detail until after Project access routes have been selected. Data to be collected will include labor force characteristics, population characteristics, income, public community facilities and services, transportation facilities, local governmental fiscal conditions, housing characteristics, and school characteristics.

Subtask 2. Development of an information base defining local objectives and priorities will involve a continuing and systematic effort to define the attitudes of residents of the vicinity of the Project toward the potential socioeconomic changes Project construction may bring. This task will involve conducting public opinion surveys in selected communities to collect information such as the following:

- Desirability of growth in the community
- Adequacy of public facilities and services
- Desirability of changing lifestyle
- Desirability of increased economic activity levels
- Desirability and need for increased economic opportunity
- Desirability and need for diversification in the local economy

- Need for expansion of the local tax base
- Adequacy of local housing

It is anticipated that this information will be obtained through periodic surveys and public meetings and workshops. The results of this task will demonstrate local preferences toward future changes in the communities near the Project. These preferences will provide an important input to the the development of mitigation measures.

Subtask 3. Revising baseline forecasts of socioeconomic conditions will require adjusting current forecasts of economic growth in the Railbelt region (such as those used in the Railbelt Electrical Power Alternatives Study) on the basis of recent uncertainties in projected production rates and revenues from petroleum and natural gas production. It will be these revised projections of baseline socioeconomic conditions against which projected future with Project conditions construction will be contrasted to determine the need for mitigation measures.

Subtask 4. Revising projections of future conditions with-project construction will entail comparing projected baseline conditions with forecast Project impacts developed during the feasibility studies and adjusted to reflect changes in Project plans. By contrasting future with-project conditions results from subtask 2, above, public opinion concerning future community conditions, a framework basis for assessing the need for and extent of mitigation measures will be available to begin formulating a mitigation plan.

Subtask 2 will continue throughout project planning and construction in cooperation with the public participation program. The other three subtasks of this task will be completed in early 1984, in order to provide basic input to mitigation planning, discussed below.

Work Task 2. Develop and Implement Monitoring Programs.

The efforts to monitor socioeconomic conditions of communities and workers directly affected by project construction will include two subtasks: 1) monitoring program. Task 1, will entail monitoring socioeconomic conditions throughout the planning and construction period in Mat-Su Borough communities likely to be affected by project construction, and 2) will involve monitoring socioeconomic conditions of members of the construction work force beginning in 1985.

Subtask 1. During 1983 and 1984 subtask 1, which will be conducted in close cooperation with subtask 1 of Task 1,

above, will be oriented toward defining baseline conditions and producing a long term record of socioeconomic conditions. After the mitigation plan begins to be implemented in 1985, comparison of conditions projected to occur under the mitigation plan with observed conditions will provide an indication of the effectiveness of the mitigation measures. After 1985, therefore, an important part of this task will include the periodic evaluation of the effectiveness and appropriateness of mitigation measures, indicating the need for their reassessment or adjustment.

Subtask 2. Task 2, monitoring socioeconomic conditions of members of the construction work force will begin after construction in 1985. This task will later involve evaluating the effectiveness of planning for the new community and other aspects of the construction workers' living environment. Information collected by survey concerning construction workers will include income, skills, family characteristics, settlement patterns, housing preferences, and attitudes toward living conditions provided for the work force. Effectiveness of planning for the new community and the need for reassessing such plans will be evaluated after construction gets underway and a reliable data base concerning construction work conditions can be developed.

Work Task 3. - Develop and Implement Plans to Mitigate Adverse Socioeconomic Impacts. The purpose of developing socioeconomic mitigation plans is to minimize adverse socioeconomic impacts of project construction and operation on residents in the vicinity of the project, construction workers, and other groups directly affected by the project. An important aspect of developing mitigation plans is the identification of institutional arrangements for most effectively implementing recommended measures and establishment of procedures for implementation. These plans, procedures, and institutional arrangements will be developed under this work unit.

This task will be conducted in two subtasks: 1) mitigation planning for residents of the socioeconomic impact area, and 2) development of planning criteria for the new community to house the construction work force. Subtask 1 will be oriented toward developing plans to respond effectively, and economically to concerns of residents of the project area, while Subtask 2 will be structured as an integral part of planning for the new community.

Subtask 1, mitigation planning and implementation for residents of the project area, will begin immediately with the development of alternative mitigation measures. By early 1984 these alternative measures will be studied along with projected with-project socioeconomic conditions to arrive at a mitigation

plan which, when implemented, will be expected to reduce the extent of adverse impacts as much as possible and practicable. The opportunity for benefits also will be examined.

It is important to note that the mitigation plan may extend to impacted groups outside the immediate socioeconomic impact area, possibly including economic or social groups impacted by project operation. For example, if the project's adverse impacts ultimately will negatively affect a commercial, recreational, or subsistence fishery, mitigation measures to either reduce or offset the impact may be suggested. For this be suggested. For this reason the development of mitigation plans will be closely coordinated with other project work units. Task

Subtask 1 will include implementation of the mitigation plan in 1985, upon inititation of construction. The plan will be implemented through and in close cooperation with state and local governmental organizations. Community workshops will be held to introduce the plans by State agency personnel with support from study team members.

The measures will include means for channeling population movement into areas most suitable for growth, either temporarily or permanently, limiting or controlling growth in less suitable areas, offsetting negative local impacts on services, housing, and schools, and other measures needed to ensure that the project's overall socioeconomic effects are as positive and acceptable as possible to the greatest number of local residents. Implementation of mitigation measures will extend through construction with continued refinement guided by inputs from the public participation program.

Subtask 2 will include socioeconomic planning for the new community. As location and access decisions are made for the new community, criteria for providing living conditions as suit able as possible for construction workers will be developed, while also assessing the probable impacts of life in the new town on its future residents. Plans will be developed in close cooperation with other project work units (i.e. engineering and project control) to develop acceptable socioeconomic conditions and to minimize unavoidable adverse factors. The plans will be developed by assessing construction work force size, composition, and scheduling, establishing facilities and housing criteria, determining access service requirements, defining infrastructure needs, and anticipating socioeconomic problems and issues likely to develop as the new community is inhabited. The new community plan will begin in 1985 as construction is initated, and will require continual adjustment through the completion of construction activities.

Soils and Geology

The Joint Venture's work program for geotechnical aspects of the project is presented in sections D(b) and D(k) of this proposal. These programs will provide the necessary baseline information and analyses for addressing environmental issues on soils and geology. As required, this information will be integrated into the environmental program through the Lead Geotechnical Scientist who will function as a member of the Bellevue Office environmental technical support staff, as well as a member of the geotechnical staff in the engineering group.

Recreation Resources

Recreation resource studies conducted to date for the Susitna Project have focused on identifying existing recreation activities and facilities, and the development of a recreation concept plan for public access to Project lands and waters. Current and ongoing studies are directed primarily at quantifying existing recreation use of the Project area and refining the proposed recreation plan.

Based on review of available material, we believe there are two principal recreation issues needing closer scrutiny with respect to FERC licensing requirements. These are 1) the assessment of project effects on existing recreation and 2) the development of a recreation plan for the period of project operation.

Assessment of Potential Effects on Existing Recreation Resources

The assessment of the potential magnitude and significance of project impacts upon existing recreation resources is an important aspect of project planning, especially in Alaska where recreation contributes significantly to the economic base and is closely associated with the subsistence-level life style of the region. Additionally, assessment of the effects on recreation, both beneficial and adverse, is important in helping to develop the recreation plan and in developing resource protection measures.

A thorough discussion of the impacts on human utilization of the natural resources is a requirement of the FERC Licensing Application. State personnel have expressed concern as to how existing recreation use in the project area would be affected by the Project.

A current debate, for example, is focusing on the issue of limited versus unlimited acesss. The resolution of this debate

could substantially effect the direction of any of the proposed recreational analyses. The present analyses of the magnitude and significance of impacts on existing recreation resources is preliminary. Studies quantifying existing use are underway but to our knowledge, no projection of future use has been made nor has a decision on access been resolved. Projection of future use and comparison with baseline conditions is required for determining the magnitude and significance of the impacts. Basic questions that will need to be addressed in greater detail regarding recreation related impacts are:

- How much will increased access (land, water and air) affect existing recreation use and activities?
- What is future use of the project resources to be?
- What effect will recreation opportunities created by the project have on regional recreation?
- What will be the effect (beneficial or adverse) on area lodges resulting from the increase in accessibility?
- What is the significance of the loss of white water boating?
- What will be the effect of reservoir drawdowns upon recreation?

Most of these questions are directly related to the proposed recreation plan. The recreation development concepts will be refined and detailed plans prepared largely on the basis of recreation visitor use analyses.

Our approach to these analyses will be to first review the existing data base for its adequacy and to supplement it with studies as needed. Workshops will be held with the several agencies responsible for managing natural resources, to develop a consistant approach to improving the data base and defining study objectives. It is likely that we will need to conduct additional studies regarding future use projections for the purposes of assessing impacts. This will be done through coordination with the socioeconomic studies, review of regional supply and demand factors, and surveys. With respect to recreation impacts, potential effects upon recreation resulting from project facilities and increases in use will be identified and their significance will be determined through utilization of the Power Authority's public participation program and agency workshops. Through the use of the public participation program, measures to reduce adverse impacts will be identified for incorporation into the recreation plan.

Development of the Recreation Plan and Estimate of Future Use

Development of the proposed recreation plan to date has been conceptual. Detailed aspects of the recreation plan will be developed during the license phase as part of the project mitigation and enhancement planning. This will be accomplished through the use of workshops with agency personnel where input from the public participation program will be used to help provide guidance to workshop participants. This will include developing goals and objectives for preservation and development which are consistant with this relatively remote resource, site-specific recreation plans, description of management policies, and a development schedule. The recreation concept will be developed in relation to regional supply and demand factors as defined by literature review and agency discussion during the workshops. Evaluation of regional recreation should consider not only the number of facilities present but also the quality of those facilities and the amount of use each receives. For example, if certain facilities at regional recreation sites are being used quite regularly, this often indicates a greater need for that activity, a need which the proposed recreation plan could fulfill. On the other hand, if certain facilities are receiving little use, development of such facilities would likely serve little purpose and might pull users away from the existing facilities leaving them even less used.

In addition to regional demand factors, development of the recreation plan will be closely tied to the resources and opportunities made available by the project. The size and complexity of the Susitna development will in itself present an opportunity for development of viewing areas and educational displays should access to the project be unlimited.

Our approach to the recreation plan with respect to possible pre-license needs is as follows:

- Review all studies and data assembled by others to ensure that the recreation concept is based on a thorough analysis of the potentials and limitations (i.e. project access) pertaining to recreation opportunities.

- If it is necessary to refine the recreation concept based on public, agency and sponsor input, a regional demand/need analysis will be conducted in order to provide recreation facility opportunity surpluses and deficiencies present in the region. This will include close coordination between agencies, local communities and sponsors. Socio-economic studies and the public participation program will be utilized to help determine recreation needs and activity

preferences in relation to the resource based recreation opportunities that exist in the region.

- We will supervise the completion or development of detailed recreation plans that might be necessary for license approval. This will involve the development of schematic recreation plans, updated cost estimates and development of a recreation management plan. Development of the schematic plans will include measures to enhance environmental and esthetic qualities and protect significant or fragile resources through devices such as limited access to project resources.

- Prepare future use estimates pertaining specifically to the recreation plan. This will include consideration of regional factors, instantaneous use, turnover factors and seasonality.

- Provide close coordination with state and local agencies and provide necessary input and supervision with respect to public participation in the recreation plan(s).

Post-License Recreation Development

Upon approval of the license application and in response to its specific conditions, a detailed recreation master plan will be developed along with construction drawings and specifications should improvements be proposed. At this time, detailed inventories of each recreation area's physical and biological qualities will be necessary to ensure that the defined activities take advantage of the recreation opportunities, consider project operation aspects, protect fragile resources and are compatible and coordinated with visual and environmental objectives.

The Joint Venture's role will be to coordinate and supervise Alaskan subcontractors involved in this effort. As in the pre-license phases, we will maintain close liaison with agencies and involvement in the public participation program. During actual construction we will serve in a review capacity to ensure that the design is properly carried out.

Esthetic Resources

Esthetic resource studies to date have been mostly non-systematic, subjective descriptions of existing scenic conditions. Our approach to further work is based on review of the feasibility report and ongoing studies, the magnitude of the proposed Project, and our experience with methodologies recently developed for visual impact assessment and visual simulation. It is likely that the current esthetic resource study, as out-

lined in the feasibility report, may not meet FERC requirements, since it does not demonstrate a clear understanding of the project impacts on the esthetic resources.

This is based on the assumption that an effective esthetic resource study includes the following four interrelated components:

- Systematic collection and development of an objective seasonal data base.
- Establishment of the relative esthetic quality of the existing landscape.
- Development of the means of objectively describing and evaluating the significance of developmental impacts on esthetic resource values.
- Development and incorporation of mitigation measures into the planning, design and construction process.

The approach to further work on these four components will depend on what is finally incorporated into the license application, the degree of public and agency concerns, and of course feed-back from the FERC review process.

Our initial approach with respect to prelicense aspects of the esthetic resource study is to review all material and the license application for completeness, then expand as necessary, using information obtained form the public participation program and guidance by agencies during workshop discusssions. Special attention will be paid to the mitigation aspects of the study, since to date, no plan has been developed. Following our review, any perceived inadequacies will be discussed with the Power Authority and relevant agencies. The degree of effort applied to each of the four principal aspects of the esthetic resource study will be determined at that time.

Development of an Objective, Seasonal Data Base

At present, it appear, that a more complete data base on the area's esthtic resources is required. A systematic photographic record of existing conditions should be developed, as well as mapping of the esthetic resource values, including topographic and visual features and areas of existing key observer points.

The Joint Venture approach will be to create a data file which records visual and auditory phenomena for use as a refer-

ence in design, impact assessment and for public communication. Specific tasks include:

- Systematic photographic records and video tapes will be collected from the air and from key observer positions on the ground during the four seasons

- A spatial data file will be created by collecting and mapping topographic and visual variables. The VIEWIT computer program will be employed. It analyzes and records "times seen" information on a scale that matches Project base maps. Such information is required for determining critical viewpoints and facility viewsheds (the area from which a structure can be seen). Visual variables include slope form, seasonal texture, and color. They will be mapped on transparent bases for analytical flexibility and ease of public communication.

Esthetic Quality Assessment

An evaluation scheme will be developed to provide a baseline against which the proposed project can be compared and to aid in establishing mitigation criteria. It will be reviewed with resource management agency personnel in a workshop format. The methodology employed should seek objectivity and have a traceable rationale.

The Joint Venture approach will be to employ a combination of quantitative and qualitative measures with respect to the following tasks:

1. Divide and map the study area into spatial units based on physiographic characteristics.

2. Evaluate units relative to each other on the basis of the visual variables and photographic record developed in the data base phase.

3. Determine areas of critical viewpoints and viewsheds and map then in order to establish zones of visual sensitivity in the Project area. Other variables considered will include viewer numbers, viewer distance, duration and frequency of views and viewer expectations.

4. Combine map output from 2 and 3 in order to determine overall relative visual quality rankings in the project area. The output will be transparent base maps suitable for public involvement use.

Evaluation of the Significance of Impacts

One of the primary functions of the esthetic resource study is to determine potential visual impacts and their significance. Significance of the impact is based on its relation to the visual quality ranking established in the esthetic quality assessment component and to the level of public and agency concern.

The Joint Venture approach will be to create a means of objectively judging the visual impacts associated with project facilities. This will include the following tasks:

1. Facility viewsheds will be identified and mapped in order to relate to the visual quality ranking established.

2. Photo simulation techniques will be used to objectively portray views of and from project facilities. This technique has been successfully used on projects in Alaska by Robert F. Sheele, who will be serving as a consultant to us for this purpose. A more detailed description of this process can be found in Attachments 1 and 2. A principal reason for using this tech nique is its objectivity. Moreover, it has a value as a communications aid for public participation purposes which will be an important aspect of the visual study. Although transmission facilities are not included in this contract, we could include visual study of the transmission line in our program if desired by the Power Authority. Critical viewpoints from project facilities that will be included are designated recreation areas, scenic overlooks from roads, and areas seen from existing communities and new worker housing.

Mitigation Planning

The development of mitigation measures to reduce potential adverse esthetic impacts resulting from project facilities or to enhance existing esthetic qualities is the culmination of the esthetic resource study. The Joint Venture approach will be to develop a mitigation plan that includes landscaping, architectural treatment and management policies for the facilities of the proposed project both during construction and operation. Photosimulation techniques will be used on some of the more sensitive project facilities in order to involve the public and to portray the effectiveness of the proposed mitigation measures. Particular emphasis will be placed on measures to reduce visual impacts resulting from the access road and borrow areas. Emphasis also will be placed on measures to ensure the quality

of the living experience for year round residents of new communities. Output will be both graphic and written.

Post-licensing involvement with respect to esthetic resources will be in the coordination and supervision of design and implementation of the mitigation program as it relates to Project facilities and recreation development.

Land Use

The major land use aspect of the environmental and licensing support program will concern the permits and authorizations required to conduct environmental studies and design work. A large and varied number of land use authorizations will be needed in advance for such tasks as moving the existing work camp and conducting geotechnical and engineering studies for the access route. Obtaining these authorizations and monitoring compliance with their conditions will require an extensive work effort over the course of the project. Successful accomplishment of the application and monitoring tasks will be critical in maintaining smooth progress on the project, due to the importance of cooperation and good relations with land owners in the project area.

While the land use permitting process is a vital work element, it is fully described in Section D(e & f) of this proposal and will not be described in detail here. Coordination and oversight for this function will be provided through the Environmental and Regulatory Program Management.

Development of the Susitna Project will involve a number of significant land use issues, such as project effects on the communities and private lands along the railroad, utilization of fishery resources, increased hunting pressure and overall effects on native lands.

Our review of the land use studies conducted to date and our survey of ongoing land use policies of the Power Authority indicate that the treatment in the License Application of most substantive land use issues will be sufficient to meet FERC requirements. We expect to apply land use planning expertise during the licensing process largely in support of the recreation, socioeconomic and permitting programs.

Given this situation, the land use effort is expected to consist of intermittent tasks which are components of larger reactive planning or analysis studies. For example, it is quite possible that design work on the access road will result in minor realignments which will require brief environmental assessments to supplement the overall impact analysis and documenta-

tion. Similarly, it is possible that planned locations for work camp facilities will need to be changed, requiring some additional land use planning and evaluation effort. Such land use tasks would have rather limited scopes of work, which would be prepared on an as-needed basis.

A more significant activity, to which the land use planners will contribute, is the development of land management plans for project lands and the surrounding area. This is expected to be a cooperative effort shared by the state, BLM and native corporations. It will be initiated during the licensing period and continue until construction is substantially completed.

Project Alternatives

Technical Parameters

The need for the Watana-Devil Canyon project has been established on the basis of forecast growth of power loads in the Railbelt, limitations of load management and energy conservation programs to restrict power demand in the Railbelt, and the combined engineering, economic, and environmental superiority of the Watana-Devil Canyon Project over other Projects examined. During the permitting and licensing period we will monitor three factors that bear on alternatives to the project as presented in the feasibility study:

- Railbelt power loads
- Environmental impacts of energy alternatives
- Environmental impacts associated with project design alternatives

The basis for analysis of Railbelt power loads and environmental impacts of energy alternatives to the Watana-Devil Canyon project will represent continuations and refinements of the Railbelt Electrical Power Alternatives Study, conducted by Battelle Pacific Northwest Laboratories in 1981. Systematic analysis of environmental impacts associated with project design alternatives will be oriented toward assessing impacts and facilitating refinements in project engineering and design. This task will also play an important role in permitting and licensing functions by providing comparative analyses of individual and cumulative impacts of alternative project designs. This has been critical to the licensing of all types of power generation facilities in recent years, especially in light of the emphasis placed on alternative project analysis by the Council on Environmental Quality in implementing the National Environmental Policy Act.

Analysis of Railbelt Power Loads

The Joint Venture will monitor studies by the state of power loads in the Railbelt area and maintain on file updated forecasts of power demands. This will assist the Power Authority in addressing questions concerning the need for the Watana-Devil Canyon project which will arise primarily during the permitting and licensing processes, but also during project design. An important basis for the recommended project is historic rising demand and a forecast for a continued rise in demand for electric power in the Railbelt.

Refinements and adjustments made to power demand forecasts through 1984 may produce changes in the need for or timing of the recommended project and its attractiveness with respect to alternatives. Demonstrating the need for the project will be critical during permitting and licensing processess and in securing project design and construction financing, regardless of the financing source. Establishing project need will also be important in justifying the irreversible commitment of natural resources which will be displaced as a result of project construction.

Analysis of Environmental Impacts of Energy Alternatives

The Joint Venture will retain and keep up-to-date environmental impact information relating to energy alternatives to the Watana-Devil Canyon project, focusing on non-Susitna River Basin hydroelectric alternatives and potential thermal electric power schemes that use Beluga coal and North Slope natural gas. We will also monitor plans for alternative hydroelectric development within the Susitna River Basin.

Shifts in power demand or generation costs could affect the need for the recommended project, either increasing or decreasing its relative attractiveness with respect to the principal energy alternatives, hydroelectric power development at Chakachamna, Keetna, Snow and possibly other sites, coal-fired thermal electric power at Beluga, and gas-fired thermal electric power located near load centers. Maintaining current economic, engineering, and environmental information concerning those principal options will enable the Power Authority to continue to contrast the advantages of the recommended project with alternatives and to demonstrate the need for the project during project permitting and licensing.

Analysis of Environmental Impacts Associated with Project Design Alternatives

As detailed refinements to the project design are developed, we will determine and assess changes in each project's individual and cumulative environmental impacts. This will provide the Power Authority with the capability of assessing comparative environmental impacts on a continuing basis, a critical factor during permitting and licensing. It also will provide a continuing basis for comparing the overall environmental advantages of alternative project designs, facilitating the full consideration of environmental impacts and management objectives in project design. This approach will be of value to FERC and other reviewing agencies in facilitating their legislatively mandated review and evaluation of the project.

The Joint Venture will implement and maintain a matrix methodology for displaying and analyzing the individual and cumulative environmental impacts of major design alternatives. The matrix will present project environmental impacts by design features and impact type, and give impact differentials between design alternatives in both qualitative and quantitative terms. This function will assist both project licensing and design, and ensure systematic environmental analysis of each design alternative.

POST-LICENSE ENVIRONMENTAL PROGRAM

The FERC License for the Susitna Hydroelectric Project will contain requirements for environmental monitoring and other ongoing activities during project construction and operation. It will be our intent, in providing licensing support, to guide the planning and design of such activities in such a way as to take full advantage of field and analytical activities already initiated. This subject is discussed further in Section D (d) (FERC License Support). The remainder of this section presents our conceptual approach to the finalization and implementation of post-license environmental programs.

During the licensing and permitting processes, various requirements can be expected for monitoring the effects of project construction and operation on fisheries, wildlife, water quality, land use, recreation, historical and archeological resources, and socioeconomic resources.

The purpose of monitoring is to establish whether or not impacts predicted earlier in the study are occurring and whether their magnitude is as predicted, and to measure the efficacy of mitigative measures employed. For both objectives, a plan can be devised that embodies statistical tests and other criteria

useful for evaluating impact significance and the efficacity of mitigative measures within a discrete period of time. The key to developing, initiating, and completing the monitoring programs in each of these potential areas is to interact, at an early stage, with the various agencies to clearly define the objectives of each program, the methodology to be used, the utility of the data to be gathered, and a completion date for the monitoring work. Without a definitive plan, there is greater opportunity for performing needless studies.

The Joint Venture approach to developing post-license monitoring programs will involve the following:

1. A technical review of all programs contained in licenses or permits as to their applicability to answering questions about project-induced effects.

2. Recommendations and technical support to the Power Authority for redesigning monitoring programs, as appropriate.

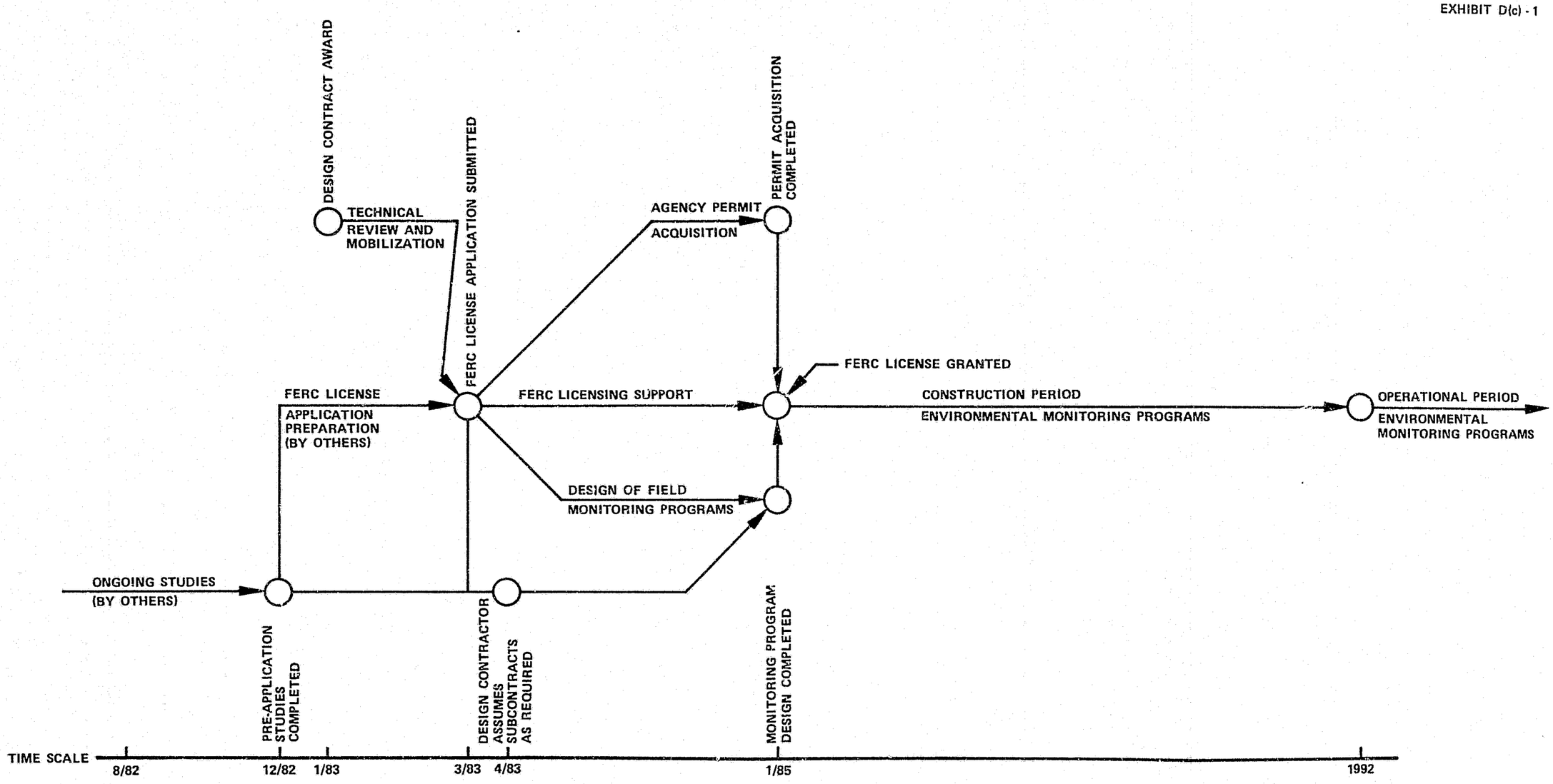
3. Assistance to the Power Authority in taking the initiative in developing and presenting monitoring programs that are technically sound, scientifically defensible, and appropriate to the goals of monitoring impacts and mitigative measures.

4. Provide all monitoring reports quarterly to the Power Authority for transmittal to the agencies, as required.

5. Conduct quarterly workshops with the appropriate local, state, and federal agencies to present findings of the previous quarter's results, evaluate the validity of conclusions concerning the significance of impacts or efficacy of mitigative measures, and revise the program as dictated by the results.

The Joint Venture will consolidate all required monitoring programs into one comprehensive program so that any overlaps will be minimized and the efficiency of implementation increased. A single monitoring management document will be developed which will include not only the objectives and methodologies, but also the quality control/quality assurance procedures to be implemented in the comprehensive monitoring program.

EXHIBIT D(c) - 1



SUSITNA HYDROELECTRIC PROJECT

ENVIRONMENTAL PROGRAM

HARZA-EBASCO

(P)

PERMITTING

PARTIPAZION

HARZA-EBASCO

HARZA · EBASCO

(d)
FERC

PARTICIPATION

PERMITTING

D(d) FERC LICENSE SUPPORT

The overall control of the licensing process is mandated to FERC by the Federal Power Act, but at the same time FERC must fulfill the requirements of the National Environmental Policy Act and those of other federal environmental statutes and guidelines. To carry out its responsibilities, the FERC staff performs a technical review of the various documents and communicates its response and requests for action to the Applicant. The commissioners of FERC, although they have the final authority for granting or denying a license and determining any special or general conditions attached to it, only rarely become directly involved during the license review and EIS process. The most active role is played by the FERC technical staff.

The Joint Venture's proposed FERC License Support Plan is shown in Exhibit D(d)-1. The upper part of the figure shows the FERC licensing procedure, the lower part the Joint Venture license support activities. Communications from FERC to the Power Authority are represented as lines from the upper to the lower part of the diagram. Lines passing from the lower to the upper part of the diagram represent the Power Authority's responses to FERC requests. The subtasks the Joint Venture proposes to conduct in support of the Power Authority's responses to FERC requests, and the relationship between subtasks, are schematically shown in the lower part of Exhibit D(d)-1.

We envision 16 principal subtasks that will need to be performed after the License Application is submitted during the first quarter of 1983. These 16 subtasks, keyed to Exhibit D(d)-1 by number, are discussed below. Subtasks 4, 5, 8, 10, 12 and 15 involve Power Authority output or a response directed to FERC.

As indicated in Exhibit D(d)-1, the FERC License Application Process is an iterative one, involving repetitive FERC, agency and public review. Thus, many of the Joint Venture's license support subtasks, shown in the lower portion of Exhibit D(d)-1, appear to be repetitive. These apparently repetitive tasks are not combined in the discussions presented below, however, as there are subtle but important differences in the amount and type of work required at each iteration.

General Organizational Approach

A major portion of the work required to provide the Power Authority with FERC license support will be directly related to environmental issues. For this reason, the Joint Venture's FERC license support effort will be organizationally centered in the

environmental program, as described in Section D(c), and will be under the day-to-day direction of the FERC License Coordinator. However, engineering, geotechnical and economic issues, both in relation to environmental issues and independently, will be addressed at various times during the License Application and EIS review process.

The FERC License Coordinator will be responsible for bringing together and coordinating the efforts of a License Support Team (LST) including economic, environmental, engineering geotechnical and hydrological specialists. As the work begins this team will include those disciplines and individuals shown in the Environmental Programs Organization Chart (Exhibit B-6), but as new issues arise and the need occurs, participants in the LST will be added or dropped as necessary. An examination of our proposed subtasks will clarify the process.

Subtask 1. Review Project Design and Operation

During the Transition Period, the License Support Team will become thoroughly familiar with the engineering design and operations aspects of the Project, through a review of all feasibility study documents, so that they can effectively communicate with engineers of the Power Authority, the Joint Venture, and FERC during subsequent licensing steps. Informed decisions on potential project impacts and mitigation options will also require a thorough knowledge of project engineering requirements.

Subtask 2. Review Environmental Studies

The LST will become thoroughly familiar with all environmental reports and data and the scope and status of ongoing studies. This review will serve as the initial basis for recommendations to the Power Authority on how to deal with environmental licensing issues as they develop. In addition, the existing environmental data management and information retrieval system will be reviewed and improved as necessary, since the Applicant's ability to provide rapid data analysis (see Section D(c) is of critical importance in keeping FERC's review and evaluation process on schedule.

Output/Deliverables. Both of the following reports will be prepared within the first two months of the contract.

- Report discussing environmental licensing issues, with recommendations on how the Power Authority can best proceed.

- Report summarizing Joint Venture review of the data management system with recommendations for improvement, if necessary.

Subtask 3. Review of FERC Requests for Supplemental Information

Upon completion of initial review of the License Application, the FERC staff will communicate to the Power Authority a list of specific supplemental information requests, and specific deficiencies, with the request that they be corrected. The deficiencies must be corrected before the License Application can be officially accepted. FERC usually allows 90 days for correction of deficiencies. Specific supplemental information requested is for the purposes of FERC Environmental Impact Statement (EIS) preparation, and is not a prerequisite of License Application acceptance. The Commission has discretionary powers in the specification of the deadline for supplying the supplemental information, so schedules for developing such information (and frequently the details of scope of such information) are subject to discussion between the Applicant and the Commission. However, undue delay in satisfying FERC supplemental requests rarely is in the interest of the Applicant, since that would prolong EIS preparation and subsequent licensing activities.

The Joint Venture will review FERC requests for supplemental information and deficiency corrections, and will assist in maintaining close liaison between the Power Authority and the FERC staff, to ensure that all parties are in agreement regarding the precise scope and format of information that is to be provided. Additionally, as both the general public and the other regulatory agencies will have the opportunity to review the initial License Application submittal and an interest in doing so, liaison with these entities will be required. It will be maintained by utilizing the Agency Liaison Group (see Part B, Organization).

Output/Deliverables.

a) Weekly memoranda and telecon logs documenting Joint Venture liaison contacts with FERC, other agencies, and the public.

b, Draft letters and memoranda to the public and to other regulatory agencies for transmittal by the Power Authority presenting proposed actions in response to their review comments.

Subtask 4. Assist in Responses to FERC Requests

The Joint Venture will work closely with the Power Authority to correct deficiencies, and recommend a timely schedule and approach for supplying supplemental information. Response to FERC requests may necessitate revision of environmental study programs and/or the project engineering and operation concept, and could lead to development of additional environmental or engineering data.

The Joint Venture's FERC License Coordinator will assign appropriate members of the LST to each request for supplemental information. The assigned individuals will be responsible for production of a draft document containing:

1. all available information pertinent to the FERC request as obtained from the existing project data base (i.e. feasibility reports and supporting documents);

2. a work program designed specifically to obtain other information not available on the basis of existing data; this work program will include scope, methods, cost and schedule.

The FERC License Coordinator will be responsible for assembling the individual documents into a single draft document to be reviewed by the Environmental and Regulatory Program Manager and Project Manager, prior to submission to the Power Authority for review and approval. As results from new or ongoing programs are obtained, this document will be updated and supplemented by the FERC License Coordinator.

Output/Deliverables.

a) Recommended deficiency corrections for Power Authority approval.

b) Recommended responses to FERC supplemental information requests, including schedule, scope, methods, and cost estimates for any additional environmental or engineering work required.

c) An up-to-date package of supplemental material for transmittal to FERC on an as-needed basis.

d) Reports and memoranda on the results of ongoing or additional work ready for Power Authority transmittal to FERC as supplemental information or to other interested agencies and the public.

Subtask 5. Assist in Preparation of Final License Application

After deficiencies have been corrected, FERC will notify the Power Authority that the License Application has been accepted. We will assist in the revision and editing of the Application, adding the additional information required, and will assist in printing and submittal of the Final License Application to FERC for processing. We also will assist the Power Authority in the distribution of the Final License Application to those agencies and entities specified by FERC. The Commission will specify in a public notice and by letter the time period during which it will entertain agency and public comment on the Final License Application, as well as protests or formal petitions to intervene.

Output/Deliverables.

a) Revised License Application ready for transmittal to FERC and FERC-designated agencies.

Subtask 6. Review Agency and Public Comments on License Application

The LST will assist the Power Authority in collating and categorizing agency and public comments. We will independently evaluate those comments and recommend to the Power Authority how those judged to have merit can best be answered. We will prepare a draft of the Power Authority's response to FERC. Some comments will lend themselves to immediate response on the basis of existing information, while others may require development of supplemental data or analysis in order to provide a satisfactory answer.

Output/Deliverables.

a) Memorandum summarizing Joint Venture review of agency and public comments and recommendations for Power Authority responses.

b) Draft response to reviewer comments.

Subtask 7. Modify Environmental Programs or Project Features

As necessary and in consultation with the Power Authority, we will develop additional data, perform additional analysis, and refine environmental studies and Project Engineering and operation in response to agency and public comments and developing issues. As shown on on Exhibit D(d)-1, this subtask will extend throughout the licensing process.

Decisions on changes in the environmental studies and/or project design features or operation will be made in the following manner:

1. The LST will review all agency and public comments on the Final License Application.

2. Comments having technical merit will be selected by the LST for Power Authority attention. The LST also will assist the Power Authority in preparing responses to comments that lack technical merit.

3. The LST will develop a range of possible actions by which the Power Authority can address these issues that have technical merit.

4. The FERC License Coordinator, Environmental Project Manager and Joint Venture Project Manager will present these options to the Power Authority for consideration.

5. Following a discussion of the options the Power Authority will select those actions which best meet its needs.

6. Programs will be modified as necessary by the LST once the Power Authority and the Joint Venture have agreed on them. The action may lead to modifying subcontracts appropriately, or functions to be performed by other members of the Joint Venture staff.

Output/Deliverables

a) Recommendations for any additional environmental or engineering work required as a result of agency/public comments or in response to developing issues, including schedule, scope, methodology and cost estimates.

b) Reports and memoranda on results of ongoing or additional work on supplemental information items, ready for Power Authority transmittal to the necessary entities.

Subtask 8. Assist in Preparation of Responses to Agency and Public Comments

The Joint Venture will work closely with the Power Authority to communicate directly with the agencies and the public, both by correspondence and in public meetings, based on the updated information base. These responses will also be forwarded to FERC for documentation purposes.

Output/Deliverables

a) Draft responses to agency comments for transmittal by the Power Authority.

b) Assist at public meetings.

Subtask 9. Review Draft EIS and Evaluate Public and Agency Review

Following the review of the Final License Application, FERC will prepare its Draft EIS for the Project.

For the Draft EIS, FERC will use information supplied in the license application, agency and public comments, any supplemental information supplied by the Power Authority, and public comments received during public meetings conducted by FERC. While considering all these sources of information, the FERC staff will conduct its own environmental assessment of the project. This independent assessment will take the form of a Draft EIS, which will be circulated to the Power Authority, agencies and the public for review and comment.

The Joint Venture will assist the Power Authority in its review of the Draft EIS and to collate and categorize agency and public comments on the Draft EIS. As in the review of comments on the Application, the Joint Venture will recommend how comments with merit can best be answered. The FERC assessment of the Project, as expressed in the Draft EIS, must also be critically reviewed. The Joint Venture will also recommend steps that the Power Authority can take in this regard and will prepare a preliminary draft of the suggested response to FERC on the Draft EIS.

Output/Deliverables

a) Memorandum summarizing Joint Venture review of the FERC Draft EIS, review of agency and public comments, and recommendations for Power Authority responses.

Subtask 10. Assist in Preparation of Power Authority Comments on the Draft EIS and on Agency/Public Draft EIS Review.

The Joint Venture will work with the Power Authority to formulate responses to FERC, agencies, and the public. Adequate response may again require the development of supplemental information, further data analysis, or revision of environmental studies or project engineering and operations concepts. Power Authority comments on the Draft EIS will be communicated directly to FERC; comments on the agency and public Draft EIS review

will be communicated officially to the appropriate entities by Power Authority correspondence and also will be discussed in public meetings. Power Authority responses to agency and public review of the Draft EIS will also be forwarded to FERC.

Output/Deliverables

a) Draft response to Draft EIS and agency and public comments for transmittal by the Power Authority.

b) Assist at public meetings.

c) Report to the Power Authority with recommendations for any additional environmental or engineering work required as a result of agency and public comments or in response to developing issues, including schedule, scope, methods, and cost estimates.

d) Reports and memoranda on results of ongoing or additional work on supplemental information items, ready for Power Authority transmittal to the necessary entities.

Subtask 11. Review FERC Final EIS and Evaluate Public/Agencies EIS Review

The Final EIS is a revision of the Draft EIS reflecting new information and review comments supplied by any and all parties during the Draft EIS review period. As with the Draft EIS, FERC Staff is responsible for the content of the Final EIS.

Upon completion of the Final EIS, it will be made available to the Power Authority, agencies, and the public for review. The Joint Venture will assist the Power Authority in its review of the Final EIS and of agency and public comment. The same procedures described in Subtask 9 for Draft EIS review will be followed. However, these final comments will concentrate more heavily on defining in detail the mitigation and enhancement features of the Project which the Power Authority has identified and intends to implement, as well as final environmental monitoring programs as defined by project operation and design features.

Output/Deliverables

a) Memorandum sumarizing Joint Venture review of the FERC Final EIS and review of agency and public comments, and recommendations on Power Authority responses.

Subtask 12. Assist in Preparation of Power Authority Comments on the Final EIS and on Agency and Public Final EIS Review

Although FERC will not solicit public or agency comment on the Final EIS and is not required to do so by law; it is virtually certain that some comment will be made. These comments will become part of the overall project record and, as they will likely represent the concerns of potential intervenors into the license application decision, must be addressed by the Power Authority as thoroughly as is possible. The Joint Venture will assist the Power Authority in the same manner as in Subtask 10 above. Subtask 7 also will continue.

In addition, however, considerable effort will be required at this time in producing a final draft of the Project impact mitigation and enhancement program for FERC, agency and public consideration.

The Final EIS and the comments on and responses to it represent the last set of documents produced before FERC makes its decision on the Project License Application. It is therefore important that the best, and most recent mitigation and enhancement plans be included.

The Joint Venture LST, after review of the Final EIS, and agency and public comments, will develop a final mitigation and enhancement program for the Project. It will be designed to meet all stated concerns judged to have merit. A draft copy of this program, along with detailed cost estimates for implementation, will be provided to the Power Authority for review and approval.

Before finalization of this program and approval by the Power Authority it is anticipated that a series of working meetings will be required. The first will be between the Joint Venture and the Power Authority to discuss the proposed program, possible options to the program and associated cost/risk factors. Following this, meetings between agency personnel, FERC and the Power Authority (assisted by the Joint Venture) will allow further exploration of possible modification to the program.

Output/Deliverables

a) Response to Final EIS and agency/public comments ready for transmittal by the Power Authority.

b) Assistance at public meetings.

c) Recommendations for any additional environmental or engineering work required as a result of agency and public comments or in response to developing issues, including schedule, scope, methods, and cost estimates.

d) Draft of final project mitigation and enhancement program and post-licensing environmental monitoring program.

e) Reports and memoranda on results of ongoing or additional work on supplemental information items ready for transmittal to the necessary entities.

Subtask 13. Evaluate FERC Proposed License Conditions

After the EIS process has been completed, the Commission will render its license decision. Certain requirements will be proposed by FERC as conditions of the License. These requirements will specify responsibilities that the Power Authority must meet or programs for additional studies that must be carried out. Such items usually cover special topics many of which are environmentally related and involve cooperation with natural resource agencies. The Joint Venture will assist the Power Authority in evaluation of the proposed conditions in preparation for negotiation with FERC on final License conditions.

Output/Deliverables

a) Memorandum summarizing Joint Venture review of the proposed License conditions and recommendations on Power Authority responses.

b) Draft position statement on the proposed licensing conditions.

c) Final programs for mitigation, enhancement, and post-license monitoring.

Subtask 14. Modify Environmental Programs and Finalize Project Design and Operations

The Joint Venture will assist in modifying environmental programs and in finalizing the project concept based on Subtask 13 and as required by the definitive License conditions resulting from Subtask 15.

Output/Deliverables

a) Report summarizing Joint Venture recommendations for any additional environmental or engineering work required in response to the proposed license conditions, including schedule, scope, methods and cost estimates.

b) Reports and memoranda on results of ongoing or additional work on supplemental information items, ready for Power Authority transmittal to the necessary entities.

Subtask 15. Assist in Development and Negotiation of License Conditions

The Joint Venture will assist the Power Authority in discussions with FERC and the resource agencies to reach a final, mutually satisfactory agreement regarding License conditions.

Output/Deliverables

a) Assistance to the Power Authority in finalizing the position statement on the proposed Licensing conditions.

b) Assistance in final negotiations.

Subtask 16. Implement Project Monitoring, Mitigation, and Enhancement Programs

The Joint Venture will assist the Power Authority in the implementation of the monitoring, mitigation and enhancement programs required as conditions to the License after the negotiations described under Subtask 15.

Output/Deliverables

a) Final report on monitoring, mitigation, and enhancement programs in response to the definitive License conditions, to include schedule, scope, methods and cost estimate. This report will include end-point criteria for terminating monitoring and mitigation programs.

b) Progress reports and an issues-resolution final report on monitoring and mitigation programs. The programs will be terminated and the final report submitted to Power Authority when the end-point criteria have been met.

Intervention in the License Decision

As shown in Exhibit D(d)-1, before FERC renders a final decision on the License Application it is possible that intervenors may act to bring the project to hearings before a FERC Administrative Law Judge.

As these hearings are lengthy, expensive and time consuming, we recognize the importance of avoiding such an occurrence if at all possible. This is especially important in meeting the 1 January 1985 date for issuance of License.

Therefore, the environmental and FERC License support programs for the Project have been developed so as to minimize the possibility of intervention. Should the project go to hearings, we will supply all the required support to the Power Authority. This support will include the following:

1. Performance of additional special field data and analytical studies to further address those issues upon which the intervention is based.

2. Preparation of expert witness testimony (both direct and rebuttal testimony) for presentation at the hearings. Our experts will present testimony at hearings, where needed.

3. Assistance in identifying and obtaining the services of expert witnesses from outside the Joint Venture, in those cases where nationally recognized specialists having no previous involvement in the project may be required.

4. Managing and coordinating preparation of testimony by appropriate members of other consultant firms which have worked on the project (including Acres American and the various sub-contractors).

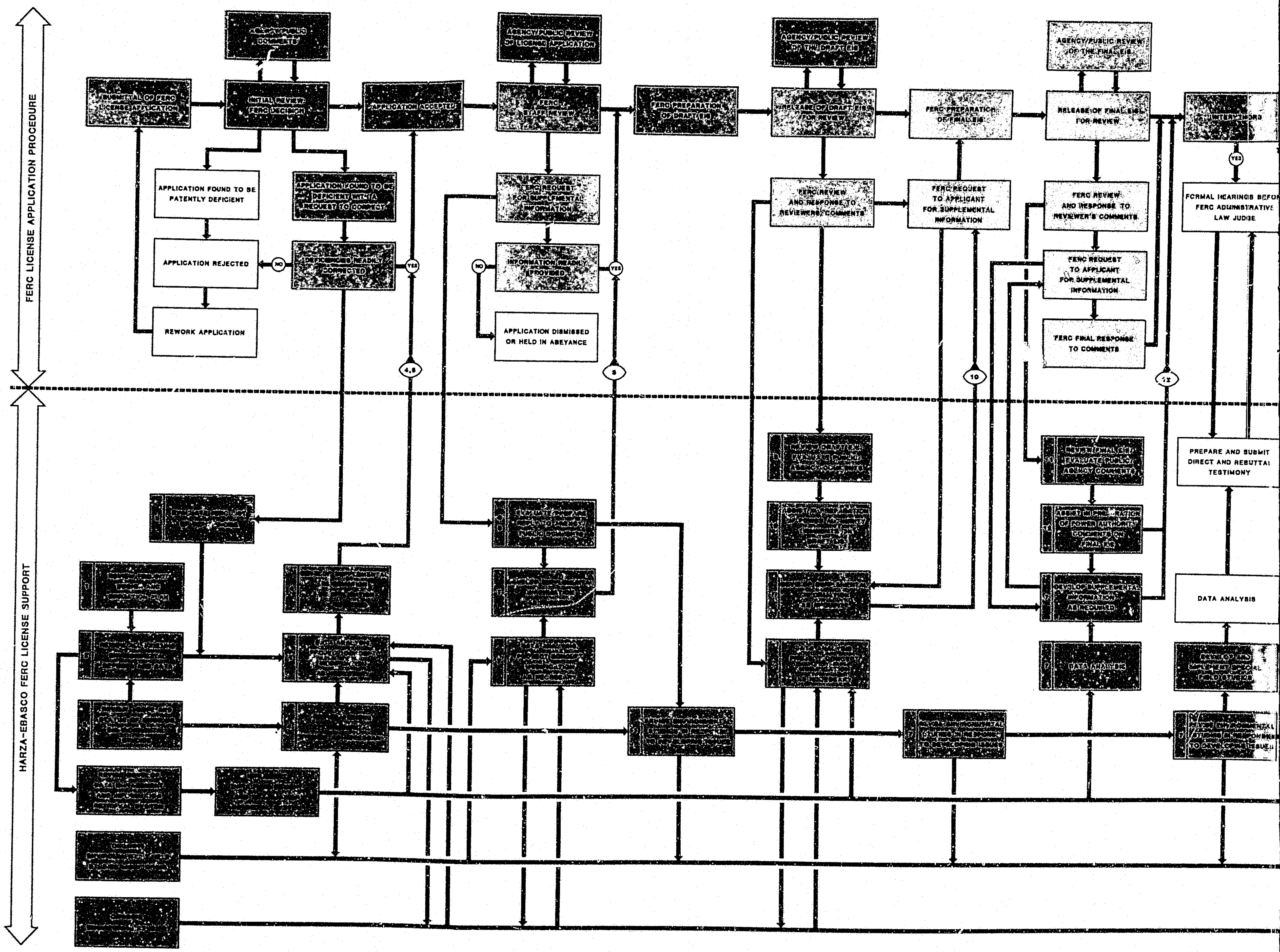

FERC LICENSE APPLICATION PROCEDURE
HARZA-EBASCO FERC LICENSE SUPPORT
AGENCY/PUBLIC REVIEW OF LICENSE APPLICATION
AGENCY/PUBLIC REVIEW OF THE DRAFT EIS
AGENCY/PUBLIC REVIEW OF THE FINAL EIS
APPLICATION ACCEPTED
FERC PREPARATION OF DRAFT EIS
APPLICATION FOUND TO BE PATENTLY DEFICIENT
APPLICATION REJECTED
REWORK APPLICATION
NO
YES
APPLICATION DISMISSED OR HELD IN ABEYANCE
FERC PREPARATION OF FINAL EIS
RELEASE OF FINAL EIS FOR REVIEW
FERC REVIEW AND RESPONSE TO REVIEWERS' COMMENTS
FERC REQUEST TO APPLICANT FOR SUPPLEMENTAL INFORMATION
FERC REVIEW AND RESPONSE TO REVIEWER'S COMMENTS
FERC REQUEST TO APPLICANT FOR SUPPLEMENTAL INFORMATION
FERC FINAL RESPONSE TO COMMENTS
FORMAL HEARINGS BEFOR
FERC ADMINISTRATIVE LAW JUDGE
PREPARE AND SUBMIT DIRECT AND REBUTTAL TESTIMONY
DATA ANALYSIS
DATA ANALYSIS
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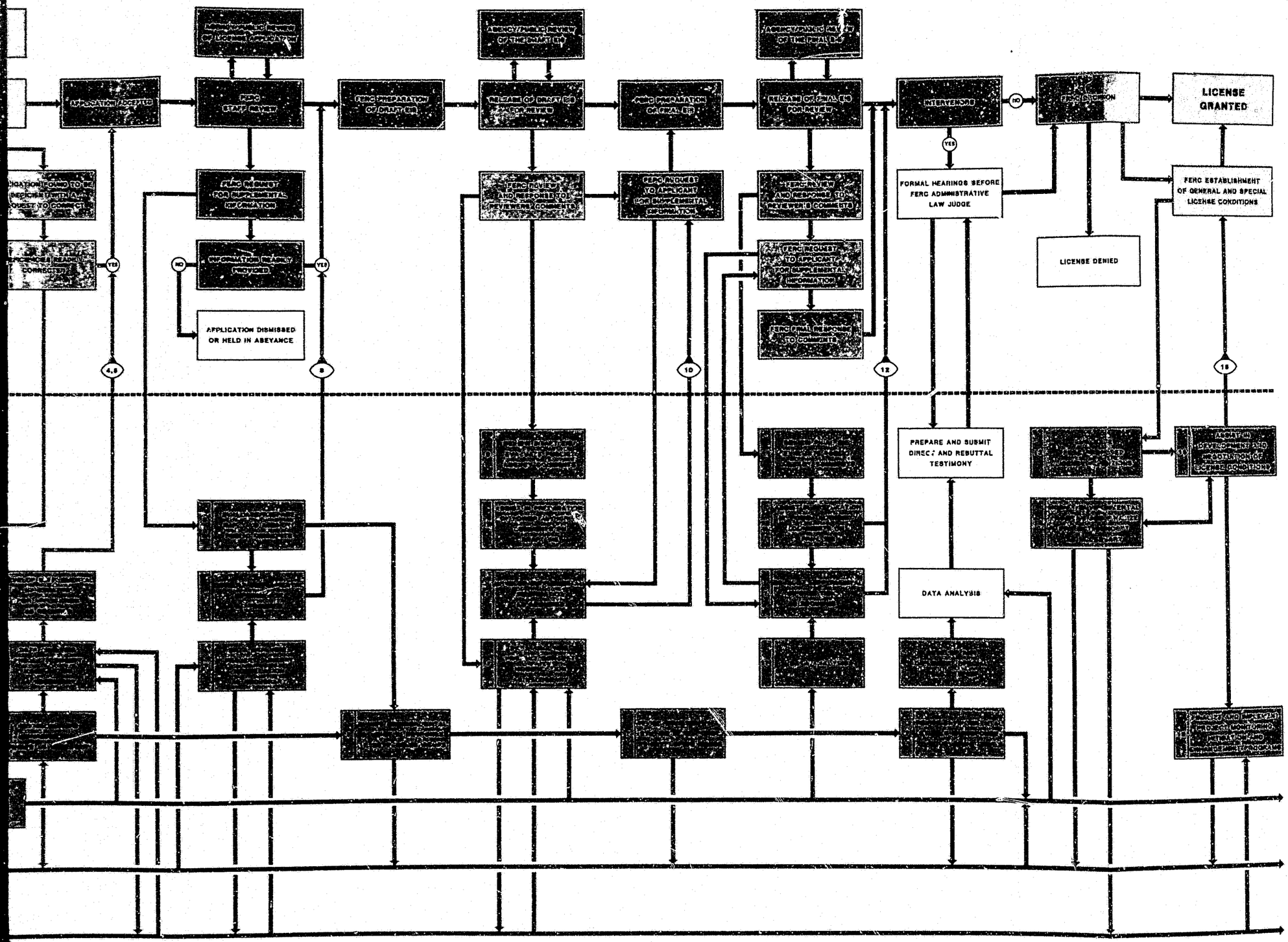
EXHIBIT D(d) - 1



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MANUAL
FEED

HARZA · EBASCO

(e) & (f)
PERMITTING

SUBCONTRACTS | PUBLIC PARTIPATION | LIAISON | FIELD INVESTIGATIONS | LOGISTICS

D(e & f) PERMITS AND LAND ACQUISITION PROGRAMS

The permitting program for both the exploratory geotechnical investigations and ongoing environmental assessment programs during the conceptual and detailed design phase will be addressed on the basis of two distinct sets of requirements: 1) land use authorizations and 2) technical or regulatory permits and/or approvals.

Land Use Authorizations

These can be defined as those authorizations (leases, easements, rights-of-way, land use permits, etc.) which are required for access to or through land for any activity, such as exploration, resource assessment or construction. Non-surface-disturbing activities require prior approval from the land owner or manager with documented concurrence from all parties having vested interest in the land (state or native select land, mining claims, patent lands, etc.) Surface-disturbing activities also require additional authorization from any party holding subsurface or mineral rights on the land, as distinguished from the environmental concerns described below in the regulatory permits and approvals section.

Major shifts in the land ownership and management responsibilities in the project area have resulted from the Alaska Native Claims Settlement Act and the Alaska Statehood Act. Other shifts are related to the Alaska Land Disposal Program, the transfer of railroad ownership, and existing and new mineral claims and leases. All of these changes will necessitate accurate land status determinations and a close liaison with property owners and managers, agency and project management personnel. To secure timely acquisition of land use authorizations while providing environmentally sound and economically acceptable access and activity planning, an interdisciplinary team will review conceptual work plans and provide an analysis of the land use impact of activities. It will consist of representatives from federal, state, local and native governmental levels and project design management. This cooperative approach will minimize delays that would result from conflicting interpretations of projected work plans. It also will provide the expertise needed for identifying alternative routes, actions, and methods which would allow the timely acquisition of necessary field data for design support and project construction. At the same time, the work will be conducted in a manner that addresses the environmental, social, and political concerns of area landholders.

Technical/Regulatory Permits and/or Approvals.

Securing technical permits will require a regulatory management system similar to the land use system described above with multi-agency and project management involvement. Environmental personnel will identify project constraints or anticipated problems prior to and during the application for permits. Early planning during the licensing and permitting process will ensure that permits are obtained well before they are needed, so that design related investigations can proceed in a timely manner with environmentally acceptable work plans.

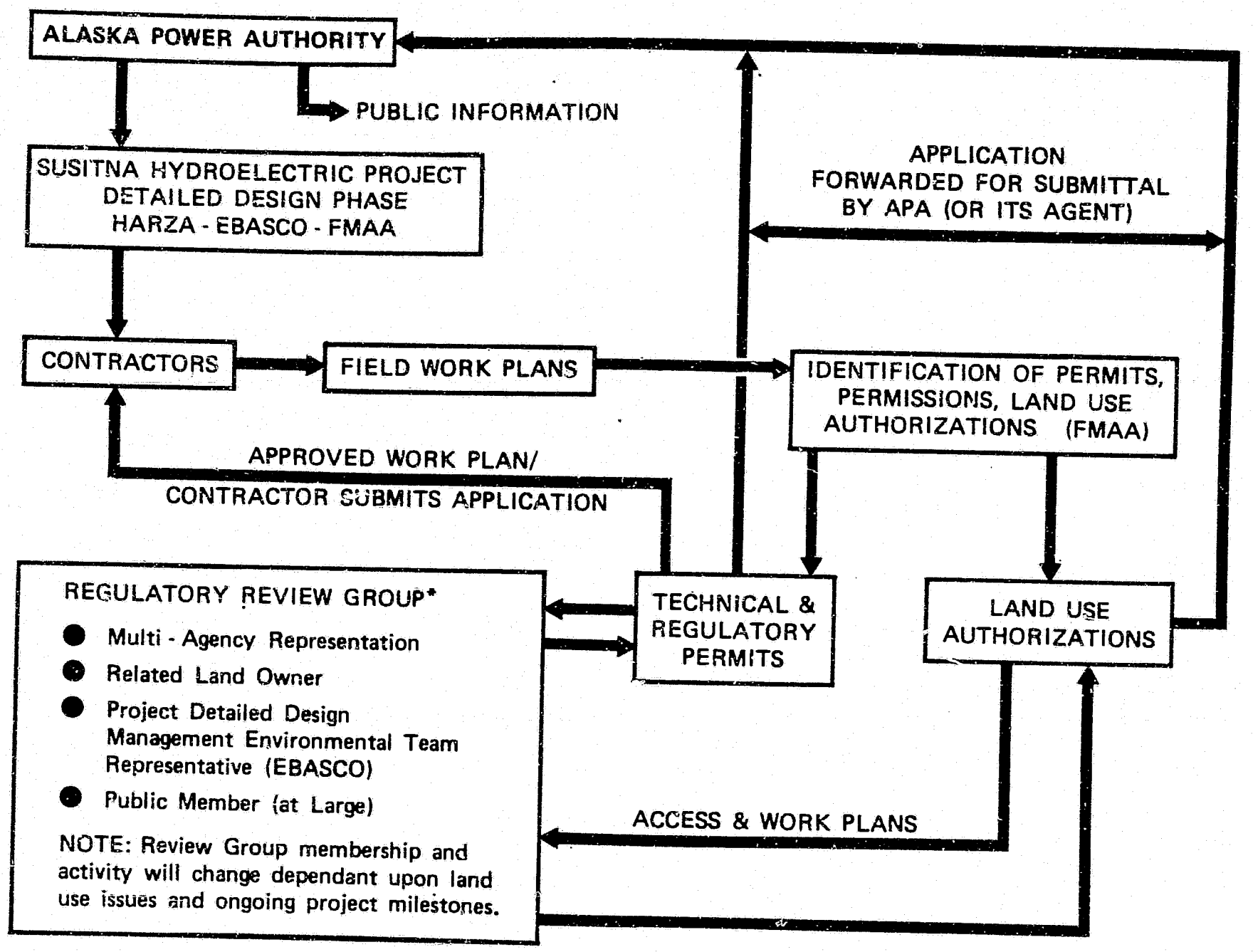
Exhibit D(e-f)-1 depicts the infrastructure to accomplish these goals. Note that the membership of the review group will vary, depending on which land use issues are under consideration.

The Regulatory Review Group will perform the following functions:

- Review contractor work plans, access routes, fuel handling plans, and soil erosion control measures
- Identify environmental, resource or local concerns or constraints
- Recommend alternative and/or mitigation actions
- Review and negotiate stipulated recommendations to agencies and contractor
- Provide expertise in representative fields of responsibility and professional expertise; create a cooperative approach to the area of regulatory functions
- Provide periodic reports on group activities to the Power Authority agencies, project engineers, and the public, identifying potential problem areas, recommending more efficient processing procedures, and resolving conflicts

The following reports are examples of documents that will provide guidelines for the Regulatory Management Team's review of proposed work activity field plans, as well as during the development and identification of field exploratory and construction access and work:

- Wetland Map, 1980 Annual Report Plant Ecology (APA 1981)
- Bald & Golden Eagles Act - (USFWS Eagle Protection Guidelines)



*REGULATORY REVIEW GROUP SCOPE OF REVIEW

- Review Contractor Work Plans including access routes, fuel handling plans, and soil erosion control measures, etc..
- Identify environmental,.resource or local concerns or constraints.
- Recommend alternative and/or mitigation actions.
- Review and negotiate stipulation recommendations to agency/contractor.
- Provide expertise in representative fields of responsibility and professional expertise, and create a cooperative approach to the area of regulatory functions.
- Provide periodic report of group activities a to APA, agencies, project personnel and the public, identifying potential problem areas, recommendations for more efficient processing procedures and resolutions to conflicts.

SUSITNA HYDROELECTRIC PROJECT

PERMITTING
INFRASTRUCTURE

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- Endangered Species Act of 1973
- Soil Erosion Control Plans (Contractors)
- Revegetation Plan (Contractors)
- Minimal Flow Maintenance Requirements (Alaska Department of Fish & Game AS16)
- Water Quality Standards/Water Quality Report 1980 & 1981 (R&M)
- Game Taking in Self Defense, 5AAC 81.375
- Susitna Hydroelectric Project Feasibility Report, Volumes 1-7 (APA 1982)
- Climatic Data (USGS Files)
- Fish & Wildlife Mitigation Policy, Revised Susitna Hydroelectric Project Feasibility Report, Volume 2 (APA 1982)
- All Phase I fish, wildlife, socioeconomics and cultural resources reports (APA Files)
- State Department of Fish & Game regulations and subsistence rights of the area (5AAC1-40; 5AAC42-72; 5AAC81-84)
- Historic and Archeological Resources - Research data from the project area as identified through past investigations and on-site investigations required to fill the data gaps. (Available through APA files, Alaska Resources Library, University of Alaska Research Groups publication and agency files.)
- Susitna Hydroelectric Project, Access Planning Study (APA 1982)
- Other studies and reports - ongoing and/or not identified to date

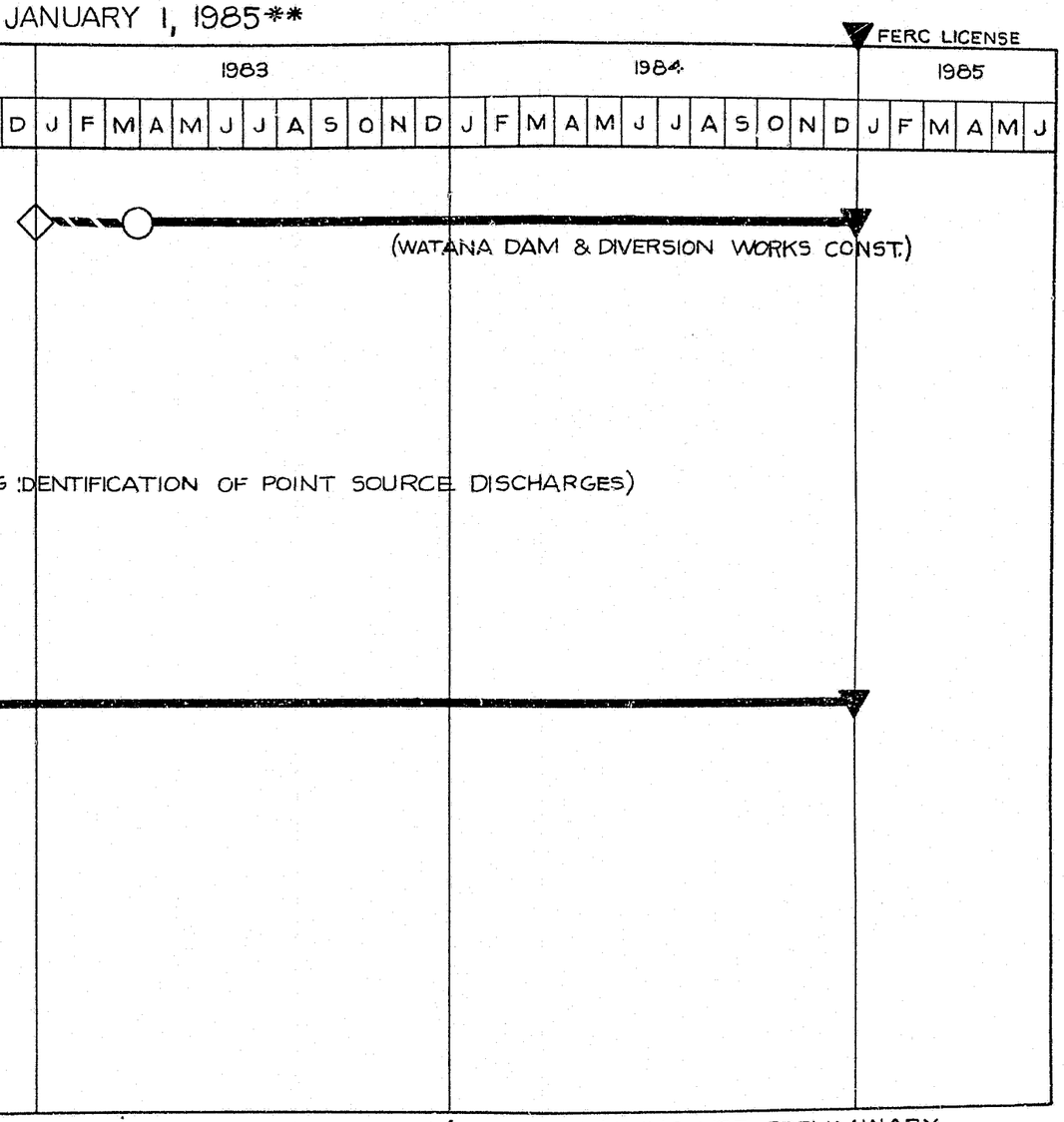
Applications for certain land use authorizations and technical/regulatory permits for the construction of Watana dam and appurtenances, such as permanent access roads, construction camp, and borrow material acquisistion, will be drafted and submitted to the involved land owners and/or agencies on behalf of the Alaska Power Authority within the projected time frames depicted in Exhibits D(e-f)-2. Procurement of these approvals is dependent on the receipt of the FERC Preliminary Permit. This will provide a conduit for agency application reviews and

approvals prior to receiving the FERC License, or in the alternative, the issuance of conditional approvals by reviewing agencies pending issuance of the final FERC License.

Frank Moolin & Associates, Inc., will review planned field investigations during the Detailed Design Phase to identify and catalogue required land use authorizations and technical/regulatory permits and approvals. The status of the permit program will be submitted to the Alaska Power Authority on a weekly basis. To further ensure that field activities are conducted under applicable permits and in accord with the requirements of these permits, field activities will be monitored by the Joint Venture Environmental Team with respect to the technical aspects as well as for compliance with the environmental stipulations and concerns. These assessments of project exploratory work will be documented and forwarded for review by the Project Manager and the Power Authority with the weekly permit status report.

LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985**

LAND USE AUTHORIZATION AND/OR PERMIT/APPROVAL	AGENCY OR LAND OWNER
FEDERAL	
• SECTION 10 RIVERS & HARBOR ACT 1899 33 USC 403	US ARMY CORPS OF ENGINEERS
SECTION 404 CLEAN WATER ACT 33 USC 1344	CORPS OF ENGINEERS
• NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM NPDES PL 92-500 SECTION 402 AMENDMENTS OF 1972	ENVIRONMENTAL PROTECTION AGENCY
• RADIO & WIRE COMMUNICATION/CONST. PERMITS & LICENSES 47 USC 154.303	FEDERAL COMMUNICATIONS COMMISSION
* • NEW SOURCE PERFORMANCE STANDARDS AND PREVENTION OF SIGNIFICANT DETERIORATION OF AIR QUALITY PROGRAM CLEAR AIR ACT AS AMENDED 1977	ENVIRONMENTAL PROTECTION AGENCY



* TO BE DETERMINED

** (PROJECTIONS INCLUDE PRELIMINARY LICENSING DOCUMENTATION ACRES AMERICAN INC. FEBUARY 1982)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

▬▬▬ APPLICATION PREPARATION

▬▬▬ PERMIT PROCESSING/ISSUANCE

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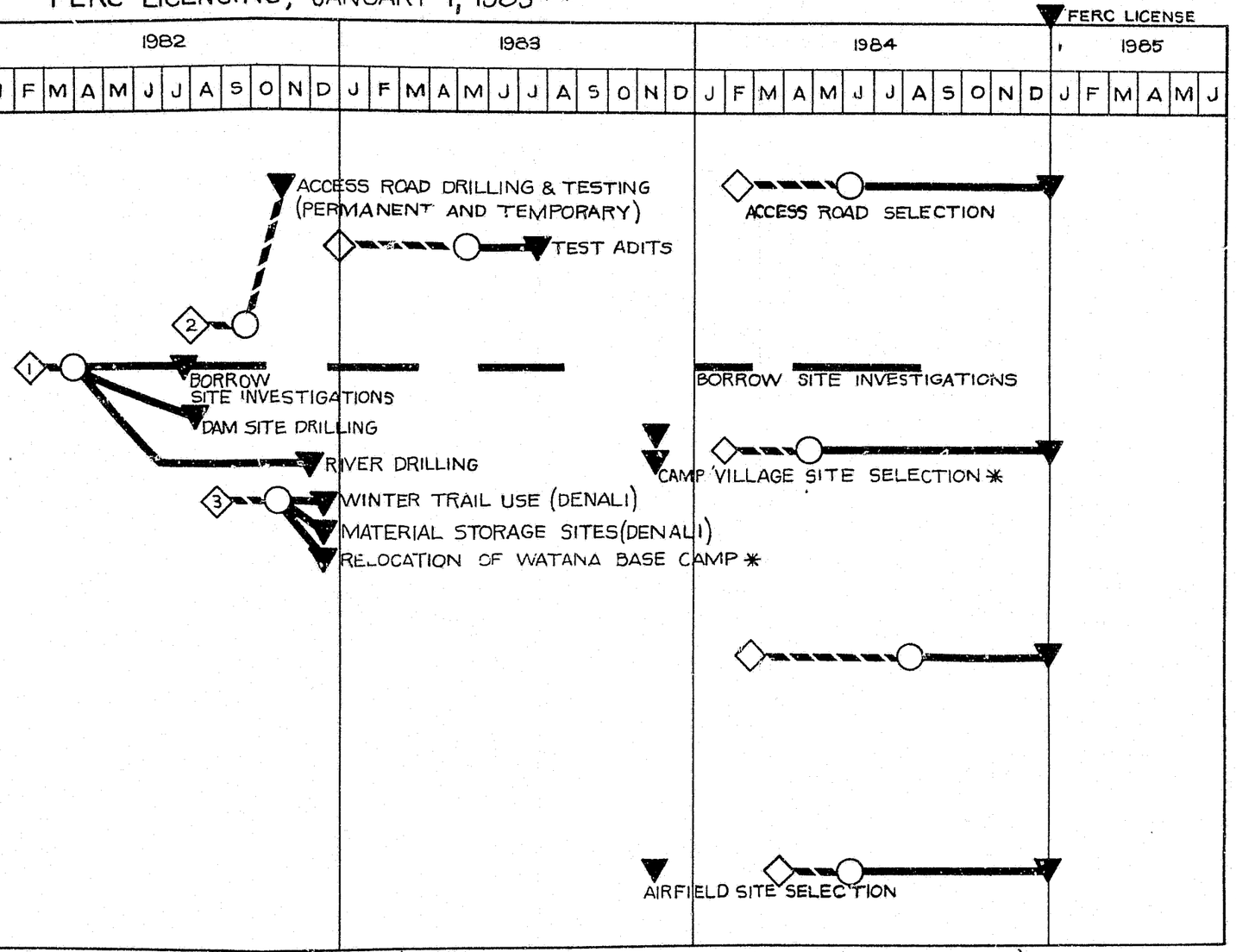
LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985**

LAND USE AUTHORIZATION AND/OR PERMIT/APPROVAL	AGENCY OR LAND OWNER
(FEDERAL CONT.)	
• RIGHT-OF-WAY/LEASES 43 USC 1761-1771	BUREAU OF LAND MANAGEMENT, LETTERS OF NONOBJECTION FROM PARTIES W/VESTED RIGHTS
• TEMPORARY USE PERMITS 43 CFR 2800	BUREAU OF LAND MANAGEMENT, LETTERS OF NONOBJECTION FROM PAPTIES W/VESTED RIGHTS (IF ACTIVITY LOCATED ON FEDERAL LAND)
• VEGETATIVE AND MINERAL MATERIAL-FREE USE PERMIT 43 CFR 2800	BUREAU OF LAND MANAGEMENT
• BRIDGE/DAM CONSTRUCTION* 33 USC SECTION 157	US COAST GUARD
• NOTIFICATION OF PROPOSED AIRFIELD	FEDERAL AVIATION ADMINISTRATION



*TO BE DETERMINED

**(PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

▬▬▬ APPLICATION PREPARATION

▬▬▬ PERMIT PROCESSING/ISSUANCE

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LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985 **

LAND USE AUTHORIZATION AND/OR PERMIT/APPROVAL	AGENCY OR LAND OWNER	1982 J F M A M J J A S O N D	1983 J F M A M J J A S O N D	1984 J F M A M J J A S O N D	1985 J F M A M J
(FEDERAL CONT.)					
• DAM AS AN OBSTRUCTION TO FLIGHT PATHS	FEDERAL AVIATION ADMINISTRATION			◇—○—▼ FERC LICENSE	
• PROJECT ONGOING COORDINATION & REVIEW/FERC					
16 USC 662	US DEPARTMENT OF INTERIOR FISH & WILDLIFE SERVICE	PROJECT ACTIVITY ACCESS AND WORK PLAN REVIEW AS APPROPRIATE			
16 USC 662	US DEPARTMENT OF COMMERCE NATIONAL MARINE FISHERIES	PROJECT ACTIVITY ACCESS AND WORK PLAN REVIEW AS APPROPRIATE			
16 USC 1536	OFFICE OF ENDANGERED SPECIES	PROJECT ACTIVITY ACCESS AND WORK PLAN REVIEW AS APPROPRIATE			
16 USC 470(F)	ADVISORY COUNCIL ON HISTORIC PRESERVATION	PROJECT ACTIVITY ACCESS AND WORK PLAN REVIEW AS APPROPRIATE			

** (PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

▬▬▬ APPLICATION PREPARATION

▬▬▬ PERMIT PROCESSING/ISSUANCE

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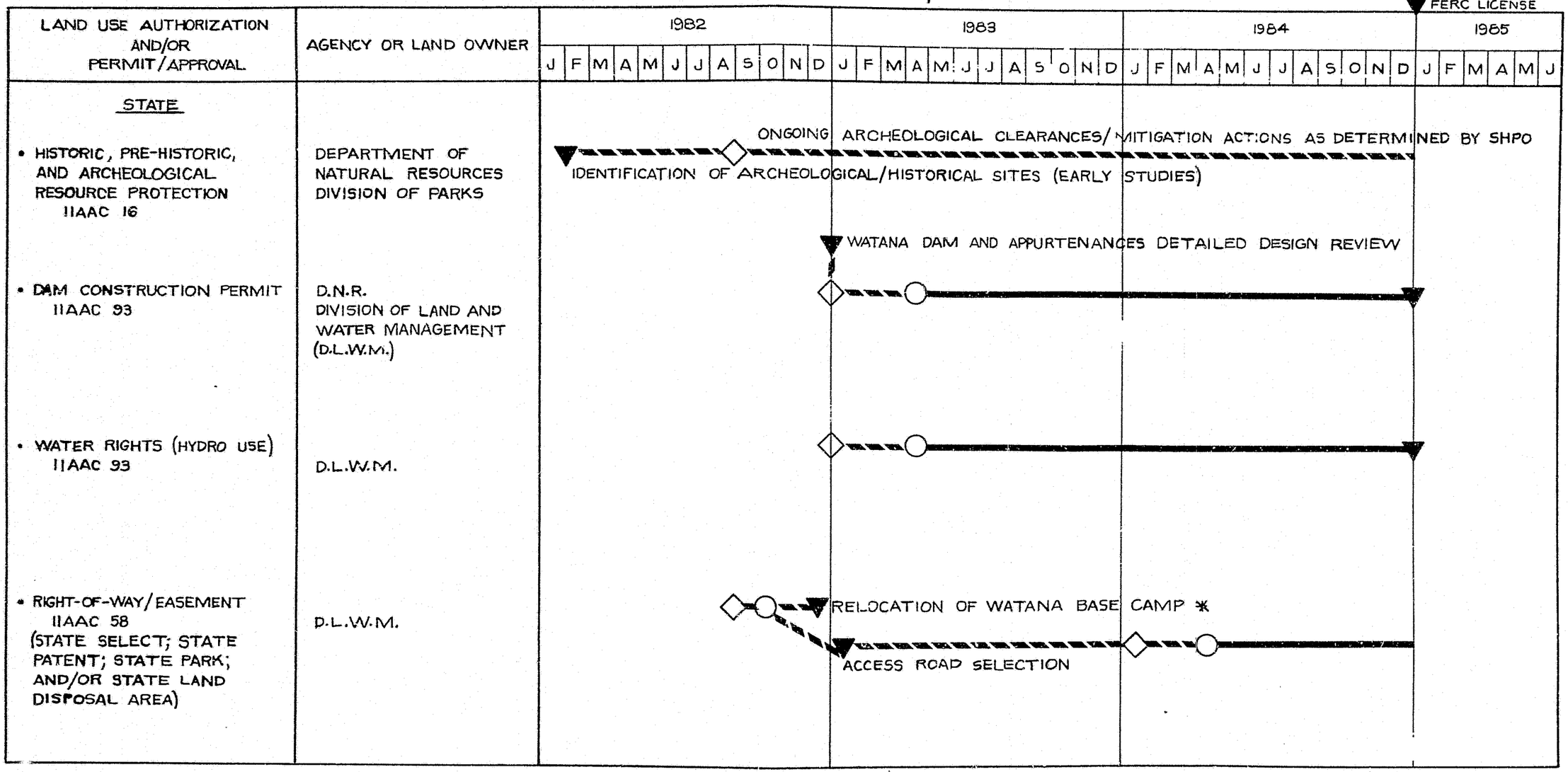
LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985 **



* TO BE DETERMINED

** (PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

APPLICATION PREPARATION

PERMIT PROCESSING/ISSUANCE

HARZA-EBASCO

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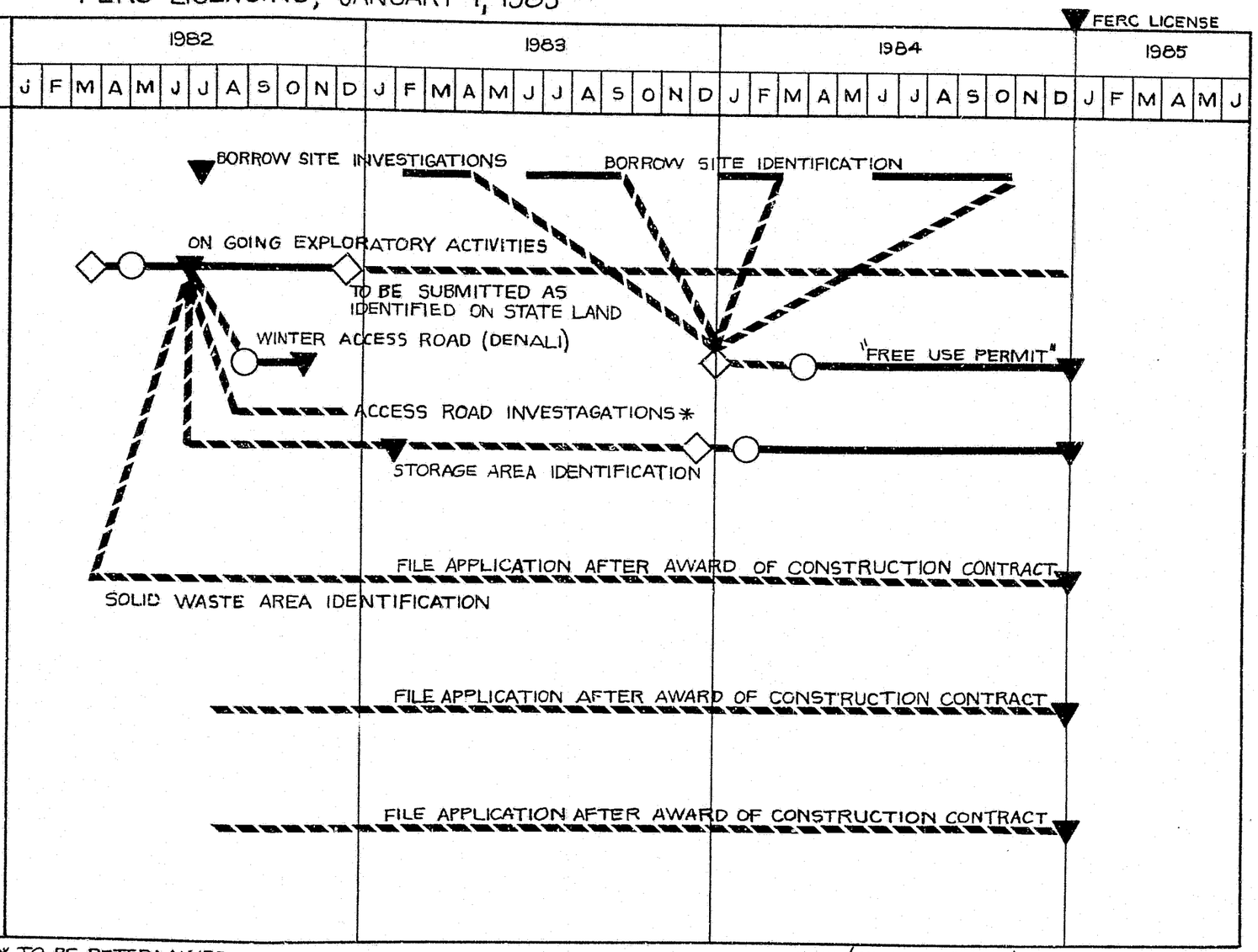
LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985 **

LAND USE AUTHORIZATION AND/OR PERMIT/APPROVAL	AGENCY OR LAND OWNER
(STATE CONT.)	
• RIGHT-OF-WAY/EASEMENT 11 AAC 58 (CONT.)	D.L.W.M.
• LAND USE PERMIT (STATE LAND) 11 AAC 96 & 58	D.L.W.M.
• MATERIAL ACQUISITION FREE USE (STATE LANDS)	D.L.W.M.
• SOLID WASTE DISPOSAL (CONTRACTOR) 18 AAC 60	DEPARTMENT OF ENVIRONMENTAL CONSERVATION (D.E.C.)
• WATER AND WASTEWATER TREATMENT-PLAN REVIEW (CONTRACTOR)	D.E.C.
• AIR QUALITY PERMIT TO OPERATE (CONTRACTOR) 18 AAC 50	D.E.C.



* TO BE DETERMINED

** (PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

▬▬▬ APPLICATION PREPARATION

▬▬▬ PERMIT PROCESSING/ISSUANCE

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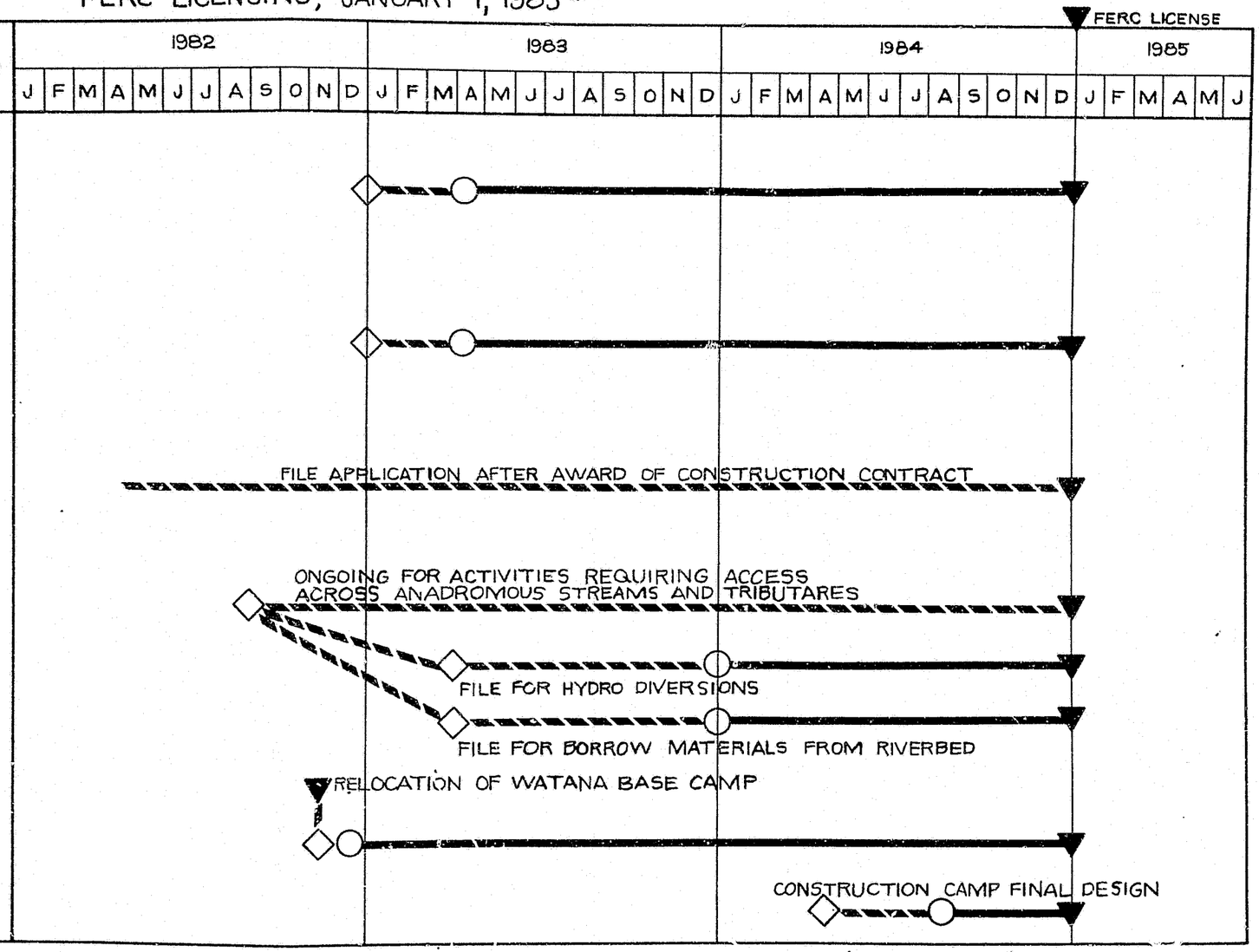
LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985 **

LAND USE AUTHORIZATION AND/OR PERMIT/APPROVAL	AGENCY OR LAND OWNER
(STATE CONT.)	
• COASTAL ZONE MANAGEMENT PROGRAM CONSISTENCY (COE PERMIT) 15 CFR 930 6 AAC 80	OFFICE OF THE GOVERNOR DIVISION OF POLICY DEVELOPMENT & PLANNING
• WATER QUALITY CERTIFICATION REAS. ASSUR. (COE PERMIT) CLEAN WATER ACT 1977 18 AAC 15	D.E.C.
• FOOD SERVICE PERMIT (CONTRACTOR)	D.E.C.
• GENERAL INWATER APPLICATION DAM CONSTRUCTION, DIVERSIONS, ROAD CULVERTS AS16 5AAC 95	DEPARTMENT OF FISH & GAME
• LIFE & FIRE SAFTY PLAN CHECK (CAMPS) 13 AAC 50	DEPARTMENT OF PUBLIC SAFETY



** (PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

APPLICATION PREPARATION

PERMIT PROCESSING/ISSUANCE

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LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985 **

LAND USE AUTHORIZATION AND/OR PERMIT/APPROVAL	AGENCY OR LAND OWNER	1982 J F M A M J J A S O N D	1983 J F M A M J J A S O N D	1984 J F M A M J J A S O N D	FERC LICENSE 1985 J F M A M J
(STATE CONT.)					
• OCCUPATIONAL SAFETY & HEALTH STANDARDS 8 AAC 60.010-75.030	DEPARTMENT OF LABOR-DIVISION OF LABOR STANDARDS AND SAFETY		ALWAYS ENFORCED		
• EXPLOSIVES HANDLERS (CONTRACTOR) CERTIFICATE OF FITNESS 8 AAC 62.010-.070	D.L.S.&S.		ALWAYS ENFORCED		

** (PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

▬▬▬ APPLICATION PREPARATION

▬▬▬ PERMIT PROCESSING/ISSUANCE

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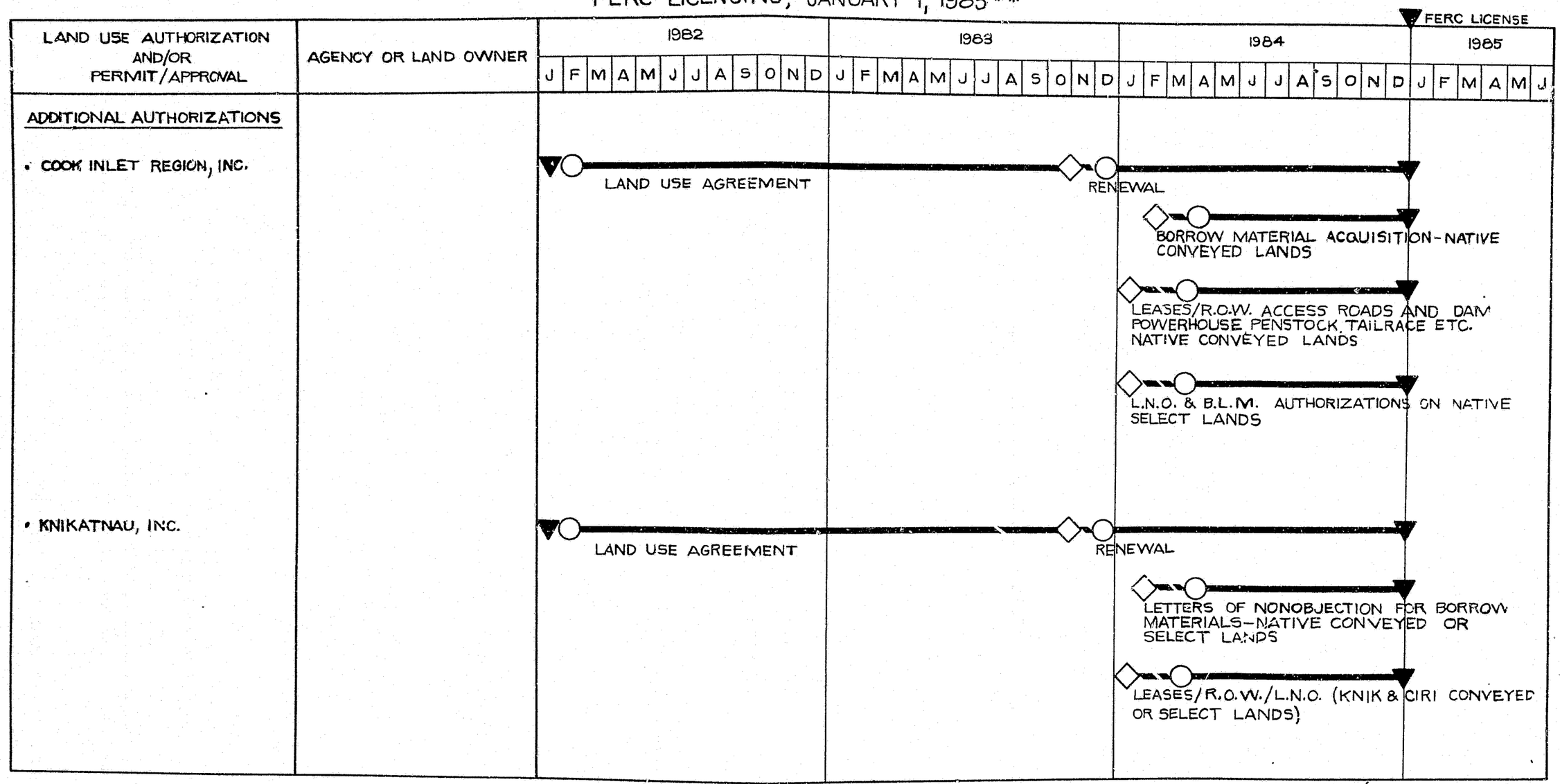
EXHIBIT D(e & f) - 2
Sheet 8 of 9

LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985**



** (PROJECTIONS)

▼ MILESTONE
○ PERMIT REVIEW (AGENCY/LAND OWNER)
◇ DRAFT APPLICATION AND SUBMIT

APPLICATION PREPARATION
PERMIT PROCESSING/ISSUANCE

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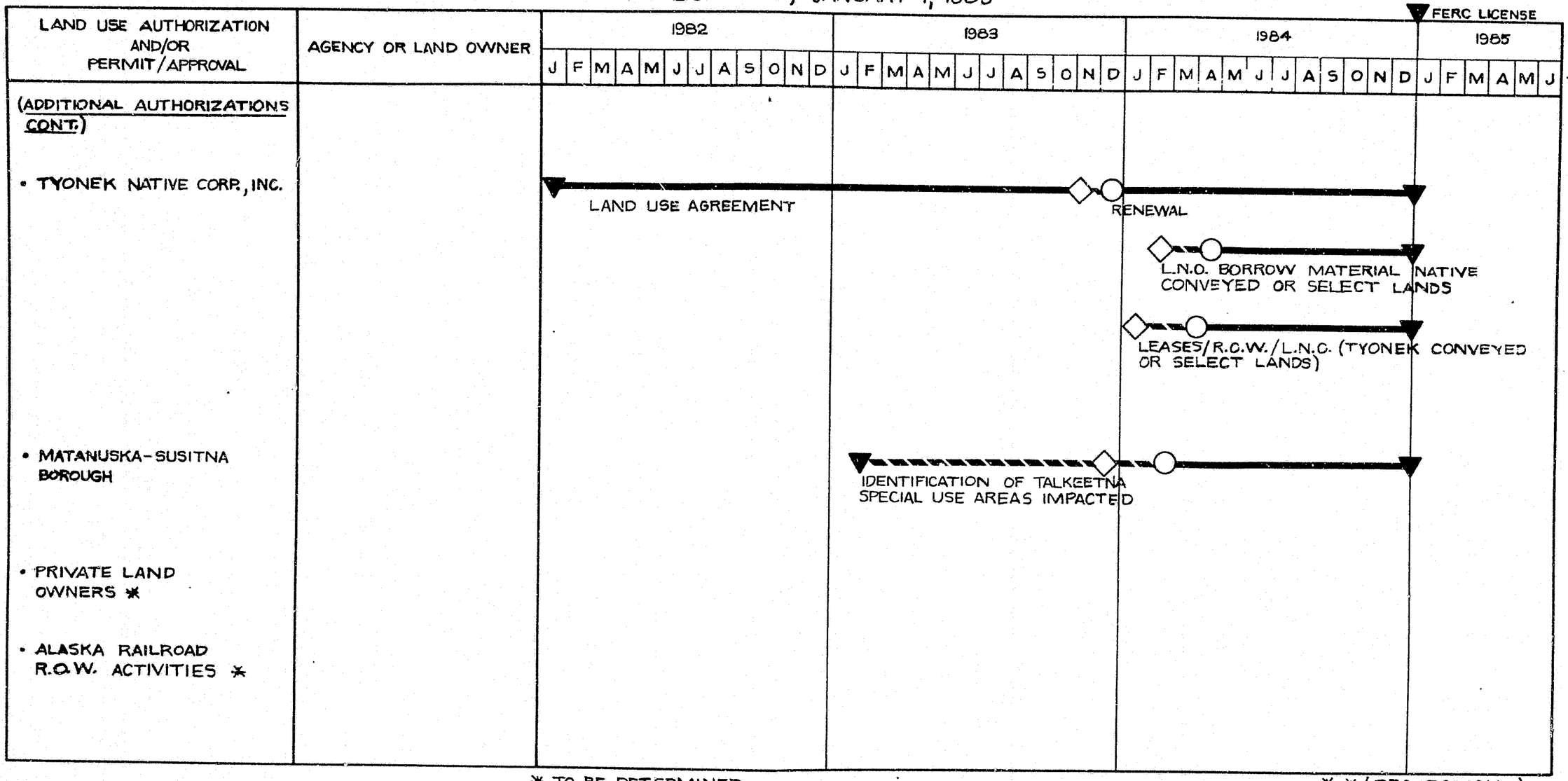
LAND USE AUTHORIZATIONS AND PERMITS/APPROVALS REQUIRED FOR WATANA DAM CONSTRUCTION TO PROCEED FERC LICENSING, JANUARY 1, 1985 **



* TO BE DETERMINED

** (PROJECTIONS)

▼ MILESTONE

○ PERMIT REVIEW (AGENCY/LAND OWNER)

◇ DRAFT APPLICATION AND SUBMIT

▬▬▬ APPLICATION PREPARATION

▬▬▬ PERMIT PROCESSING

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HARZA - EBASCO

(g)

SUBCONTRACTS | PUBLIC PARTIPATION | LIAISON | MANAGEMENT | FIELD INVESTIGATIONS | LOGISTICS

D(g) LIAISON WITH CONSTRUCTION MANAGEMENT AND TRANSMISSION LINE CONTRACTORS

The Joint Venture will interface with the Construction Manager and the other design contractors in order to ensure that engineering and procurement activities fully support the construction schedule. As soon as the Construction Manager (CM) is selected, we will work with him on concerns such as constructibility reviews, contract packages, and schedule development and refinement. Construction aspects of the plan will be discussed with the Construction Manager so as to develop a clear and concise direction for the project. We have identified several key concerns requiring this sort of interface.

Constructibility Review

At the beginning of the Project the Joint Venture will perform a constructibility and design review on basis of information available from the Feasibility stage of study. This will be done in preparation for the awarding of the Construction Management contract in April, 1983. Once the Construction Manager has been selected, we will meet with his representatives to review and discuss our approach. Where possible, the Joint Venture and the Construction Manager will perform the constructibility review jointly. When this is not possible, the CM will also be required to submit his own constructibility procedure review. Both reviews will be discussed and all discrepancies resolved prior to finalizing the design approach.

Contract Package Development

The Joint Venture is proposing, based on the Feasibility Study, to prepare 11 construction contract packages. Detailed discussions with the Power Authority and the Construction Manager will explain the logic behind this breakdown as well as the scope and content of each package. Differences, if any, between the Joint Venture and the Construction Manager on the number and make up of the construction packages will be resolved and the contract packages presented to the Power Authority for approval and subsequent issuance. The Joint Venture will coordinate with the Construction Manager to ensure that specific requirements of the Construction Manager are included in the construction contracts. Specific requirements will include cost and schedule control organization and reporting, material control and handling, procedure development, quality assurance, and others.

Schedule Development and Refinement

We foresee a substantial amount of coordination with the Construction Manager for schedule development and refinement as

it applies to the construction contracts. The preliminary engineering schedules will be based on the task breakdown of construction contracts, equipment orders and design subcontracts included in this proposal. The schedule as presented is flexible enough to accommodate recommendations from either the Construction Manager or Power Authority for additional breakdown of the work packages or acceleration of certain tasks. During the development of the Contract Packages the following will be considered:

- Overall Project schedule requirements
- Scheduling of specifications and drawings which must be included in each package
- Inclusion of adequate time for bid, evaluation and award of contracts
- Evaluation of mobilization time requirements

Coordination with the Construction Manager concerning engineered equipment will provide input regarding equipment required at-site dates and a detailed schedule for all items including multiple items on one purchase order.

Transmission Design Contracts

The transmission design contractor will perform his engineering in accordance with design parameters developed by the Joint Venture as a result of its electrical power system studies. These will be performed during the preliminary engineering phase in 1983-84 to ensure operational compatibility of the Project and its transmission systems with existing or planned power systems.

After the design parameters, environmental constraints, and schedule requirements are established, the information will be provided to the Power Authority as part of the bid proposal documents to be issued with the RFP for transmission line design. This document, along with those for the other design contracts, will clearly define the design interfaces among contractors, such as the starting design point of the transmission line design contract (the switchyard).

Liaison will be maintained with the firm conducting the transmission line design and its progress reports will be integrated into the overall Project monthly reports.

Additional information on our construction phase activities is found in Section D (r).

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(5)
PUBLIC
PARTIPATION

SUBCONTRACTS | CIRI | MANAGEMENT | FIELD INVESTIGATIONS | LOGISTICS

D(h) PUBLIC PARTICIPATION SUPPORT PROGRAM

The Joint Venture approach to the Public Participation Support Program is designed to provide effective mechanisms to communicate different kinds of information about the Susitna project to a wide variety of interested groups, all of which have varying needs regarding the substance of this information. The flow of information between and among major groups is displayed in Exhibit D(h)-1. We recommend the following division of responsibility:

1. The Public Participation Office (PPO) of the Power Authority will direct and coordinate the public participation effort.

2. The Joint Venture team will facilitate this process by providing a Public Participation work group to coordinate activities and information between the PPO and the project investigators; to provide technical input to the Citizens Advisory Committee and task forces; and to assist and support the PPO in the development of its public participation work plan and implementation of all aspects of the work plan, where necessary and desired.

The public participation support program is designed to meet the six goals (Table D(h)-1) identified by the Power Authority in its request for proposals. Achievement of these goals requires a cooperative effort between the Power Authority, its prime design contractors, associated subcontractors, as well as other contractors working on this Project for the Power Authority. The Public Participation Office will guide the public participation program which will require specific assistance and involvement of the other organizations conducting project work. The approach proposed by the Joint Venture is presented below with an overview of the technical approach, a more specific description of activities to be conducted by the other important project participants, and a description of project staffing.

Table D(h)-1

PUBLIC PARTICIPATION GOALS OF THE ALASKA POWER AUTHORITY

1. To inform and educate the general public about the design work.

2. To provide public participation during environmental work, including impact assessment and mitigation planning for both the human and physical environments.

3. To ensure that additional data is collected and an objective monitoring program is established to further define Susitna-related impacts on local communities.

4. To resolve differences between Susitna-related impacts identified by Power Authority contractors and those perceived by agencies or local communities.

5. To participate with other agencies to reduce Susitna-related negative impacts in local communities.

6. To minimize the time between occurrence of a Susitna-related impact in a community and action to mitigate the impact.

Goals and Strategies

The Joint Venture team has developed a set of strategies under which the proposed public participation program will be managed. These principles provide the framework for all activities and will help in the resolution of issues that arise during the project work. These principles are:

1. The Power Authority will guide all public participation efforts. This fact must be recognized by all participants in the public participation process including contractors working for the Power Authority and the general public. The PPO will be the central agency for the public participation process.

2. The Joint Venture team will be structured so that information obtained during the public participation process will be thoroughly considered and incorporated, as appropriate, in the ongoing Project licensing and design activities. The key element in implementing this principle is the establishment of an effective project team that is structured to facilitate the flow of information between the public, agencies, and project design, licensing and environmental teams. Both the FERC licensing procedures (Section D(d)) and the Environmental and Regulatory Program (D(c)) require major elements of public participation. The team will consist of individuals who will be current on the engineering, environmental, and socioeconomic aspects of the Project. The Project organization will be set up so that resolution of issues which arise out

of the public participation process can be dealt with effectively and efficiently. As shown in the organization chart (Exhibit B-3) the project team's Public Participation Coordinator reports directly to the Joint Venture Project Manager. The Public Participation Coordinator, who will work directly with the PPO, will be the key member of this project team.

3. Current technical data on the project will be provided frequently to the PPO personnel by the Joint Venture Public Participation Coordinator. He will be responsible for explaining technical considerations to the public. It is therefore essential that Power Authority personnel working on the public participation program be appised of technical issues as they arise. Our approach places a high priority on the accuracy and timing by which technical data is provided to the Power Authority's Project Manager and PPO personnel.

4. Public participation activities will be thoroughly documented, thereby establishing a clear consistent record involving all groups in the planning process.

5. Joint Venture personnel will make a significant contribution in planning and conducting the public participation activities. We plan to work closely with the Power Authority in planning public participation and providing extensive support in conducting these meetings. This organization includes establishment of a Public Participation Working Group with representatives of The Power Authority, The Joint Venture, and Frank Orth and Associates. Other contractors' will be represented on this working group, if deemed necessary by The Power Authority.

6. Special efforts will be made to develop valid instruments for seeking and evaluating public input. Through their experience on major hydroelectric projects and in preparing questionnaires, conducting workshops, and participating in public meetings. The Joint Venture working team will use its expertise in providing assistance to the Power Authority in developing questionaires as well as in conducting formal content analysis of input received from the public. Implementation will be performed by the Environmental and Regulatory team, who will be assembling data on biological and social aspects of the Project.

7. Public Participation activities will be structured so that both the general public and special interest groups will be reached. We will provide input to the Power Authority regarding specific project features which are likely to concern various special interest groups so that public participation activities can be targeted. Such issues will be identified on the basis of on experience on this and other projects and as a result of information obtained from agencies during meetings which will be held to determine their interests. Special efforts will be made to inform interested agencies and organizations of the status of activities most related to their concerns. This approach results in the public participation program being conducted in an active, rather than reactive mode. This information will be included in monthly reports to The Power Authority.

Overview of Joint Venture Public Participation

Activities Support

As indicated in the previous sections, the Power Authority will be responsible for guiding the public participation program. The Joint Venture will assist as follows:

- Providing support in the planning and implementation of public participation activities
- Establishing a mechanism for linking the findings of the socioeconomic work element with the public participation program
- Ensuring that findings of the public participation program are properly communicated and considered by project management personnel especially those relating to the mitigation plan and other measures that affect project design.

Strategies To Provide Support To The PPO

Assistance in the planning and implementation of the Public Participation Program will be provided by the Public Participation Group which will include personnel from the Joint Venture team. It is envisioned that this group will meet bimonthly and that additional meetings will be conducted before specific public participation activities (e.g., briefing sessions, workshops, etc.) are conducted. It is important in planning the public participation activities that the Power Authority and the Joint Venture team periodically assess the implications of findings being developed. Assessing the ramifications of such findings is consistent with our proposed active, rather than reac-

tive process. The bimonthly meetings will be essential tools to facilitate the smooth functioning of the public participation activities.

Joint Venture personnel also will be available to prepare materials for public participation activities on an as-needed basis. This would include items such as slide/tape presentation materials, briefing packets, posters, advertisements for the various media, and maps, drawings, photographs and text for the Susitna Hydro Studies Newsletter. Joint Venture personnel will be assigned to these activities when needed, recognizing that public participation must be timely.

Incorporation of specific aspects of the public participation which relate to the socieconomic studies will be achieved by making Peter Rogers of the Frank Orth socioeconomic team, a part of the Public Participation Working Group. Mr. Rogers' experience in the current socioeconomic and public participation activities will result in effective coordination of the public participation and socioeconomic work.

In addition to structuring the project team so that elements of the work effort relating to public participation will be communicated directly to the Project Manager, effective and frequent communication with Power Authority PPO personnel will ensure that public input is fully considered. This will be accomplished by the preparation of annual reports on the public participation program. In addition, we will submit periodic reports (monthly, or as needed) to the Power Authority. These reports will highlight Project activities which are likely to be of concern to groups following development of the Susitna Project and will provide input to the Power Authority newsletters and news releases. These materials also will provide additional overall project communication and communication with the general public.

Detailed Work Plan

We have developed a series of specific work tasks as part of the public participation work element. These activities relate to specific concepts regarding the nature of implementing a public participation program. Our approach is intended to provide a consistent and well planned public participation program responsive to public needs. It will build on the strong public participation foundation developed in the earlier activities conducted on the Project.

When evaluating these concepts it should be recognized that further definition of concepts will evolve as the project unfolds and that an effective public participation program must be

flexible, i.e., responsive to issues as they arise. Consequently, this work plan is based on current project concepts and recognized issues. The need to further analyze and refine these concepts within the environment in which they will exist in the future is a recognized part of the overall public participation plan.

Schedule

In this proposal, our approach is presented by identifying the major study concerns related to public participation activities anticipated in 1983. In the subsequent years (1984 and beyond) about which less information is known, less information is presented. This approach recognizes the nature of the public participation process -- that is, the needs to reassess frequently (at least annually). The schedule is also intended to provide the framework for future discussions regarding specific activities which are to be conducted. It is anticipated that the timing of these activities will be reviewed extensively in the initial Public participation Working Group meeting and will be documented in the appropriate public participation report.

The sequence of activities is described below, with most information present on those activities scheduled to occur in the initial two years of the work effort (January 1983-January 1985). Public participation activities in the subsequent years of construction should be a continuation or otherwise similar to those presented in the 1985 program. In the year before the major influx of construction workers an intensive effort to work with the public is anticipated as construction workers enter and leave communities. Similar emphasis will also be placed on the period when the major construction activity is being phased down to ease the transition to the post construction period.

Task 1. Coordinate with FERC Public Participation Activities (January 1983)

The initial work activity will be for Power Authority and Harza/Ebasco personnel to discuss with representatives of FERC their plans for public participation as part of the EIS process. It is important to the Power Authority that FERC conduct their public meetings in a closely coordinated manner. FERC's approach for fulfilling its public participation activities (scoping meetings, draft EIS meetings, and quasi-judicial proceedings) should be fully integrated with the Power Authority's public participation program. Avoidance of redundant public involvement activities should be a common goal. Once public participation activities in which FERC will be involved have been identified, the information should then be incorporated into the Power Authority's public participation plan.

During discussions with FERC representatives, special effort will also be made to determine FERC strategy regarding involving other agencies as cooperating parties. The Authority should encourage and work closely with FERC to see that the CEQ, NEPA Regulations (40 CFR 1500-1508) directives for agency cooperation on project planning, are followed. They should be incorporated into the public participation plan to be prepared under Task 3. Because it is anticipated that coordination activities will be occurring between FERC, the Joint Venture and the Power Authority, it will be important that public participation needs be considered in any discussions and negotiations with FERC regarding the Project schedule.

Task 2. Initial Public Participation Working Group Meeting (February 1983)

An intensive two- or three- day working session related to public participation is planned for February 1983, during which time members of the Public Participation Working Group (the Power Authority's Director and Assistant Director of Public Participation, the Joint Venture Public Participation Coordinator, representatives of Frank Orth and Associates and other Contractors) or other personnel involved will meet to clarify important issues. The transition team will also be represented. The first day of this intensive working session will be scheduled so that both the Joint Venture and Power Authority Project Managers will attend. They will meet with the Working Group to explain their perceptions of project goals as they relate to public participation.

The working group will review previous public participation activities and review ideas and concepts for future activities. Effort at this work group session will focus on accomplishing the three basic goals identified below:

1) Preview of ongoing and previously conducted public participation activities. Through this review all members of the working group will become informed of the Power Authority's activities conducted to date.

2) Review theories of public participation. This will be the major activity at this initial work session. The expertise of the Joint Venture team, together with that of the personnel of the Power Authority can be combined to critically review existing goals and objectives and to identify new ones for public participation.

3) The public participation working group will define the issues, objectives, and approaches to be used in the subsequent public participation activities. The Power

Authority has done considerable work in this regard already, and our work plan presents some of the concepts the we will bring to the public participation program. Based on the combined set of concepts, specific goals and objectives will be discussed, as well as means to achieve them, in the initial year of the Joint Venture team's involvement in the project. These discussions will provide the basis for the public participation plan to be prepared in Task 3.

Task 3. Draft Public Participation Plan (February 1983; Submit in Early March 1983)

The public participation plan will be the framework within which the PPO and the Joint Venture team conduct their public participation activities. There are several components to this overall plan. These include:

- Workplans:
  - A workplan for the Citizens Advisory Committee (CAC). The plan will include general goals, tasks, a schedule and a budget. This will be developed by the CAC, with the Power Authority APA directing and guiding the process. The Joint Venture Public Participation Team will assist the CAC in developing their ideas into a workable document. This will be circulated to the Power Authority for review and comment.
  - A workplan for disseminating information to the general public. This also will have goals, tasks, schedule and budget.
  - A workplan to define the role, tasks and schedule of the Joint Venture Public Participation Work Team.
- Statement of goals, objectives and strategies by Fiscal year.
- Task and activity description for the Power Authority Public Participation Office.
- A budget to accompany the statement of goals,
- A detailed schedule to accompany the statement of goals.

The draft plan will be submitted to the Power Authority for their review and concurrence. The initial review will be conducted by the public participation staff and after their comments are incorporated, it will be circulated to Power Authority and Joint Venture management personnel. Upon incorporation of

comments from these reviewers, the final Public Participation Plan will be prepared for approval by the Power Authority, after which it will provide the framework for the 1983 public participation activities.

Task 4. Prepare Agency and Public Briefing Packets (April 1983)

The two major goals to be accomplished in the task are to:

1) Provide information to agencies which are responsible for conducting studies and issuing permits for this project.

2) Develop a set of data which will help them in understanding the project as presently conceived and will help them conduct their responsibilities efficiently.

Activities for this task will begin at the initial Working Group meeting. Here it will be determined which agencies will be briefed on project activities and what information they are to receive. At a minimum, briefing packets will be prepared for all agencies that FERC is considering inviting to become cooperating agencies within the context of its EIS preparation process.

It is proposed that briefing packets be prepared for both the agencies and the general public. These will provide an overview of the Project features, with a map, a general description of facilities to be constructed, a project schedule, a description of the approach to be followed by the Joint Venture team, an overview of the planned public participation activities, and other important issues identified during the initial Public Participation Working Group meeting. It is anticipated that the briefing packet for the general public will be quite concise and will include the most recent Susitna Hydro Studies Newsletter; while the information put together for each of the agencies will vary in extent depending on the nature of the information required by the agency.

Task 5. EIS Scoping (March 1983)

Although the timing of these scoping sessions is controlled by FERC, it is anticipated that they will be held early in 1983. The Power Authority will participate in these scoping meetings and information that is obtained in them will be fully integrated into the public participation program. It should be recognized that under the Council on Environmental Quality NEPA Regulations, state that it is important that scoping meetings be conducted early in the EIS process. Therefore, the Power

Authority should encourage holding of these meetings at the earliest possible time. This will also help strengthen the record of public participation in the Susitna Project.

Task 6. Conduct Agency Briefing Sessions (May 1983)

These sessions will be held at locations convenient to agency and the Power Authority. Therefore, it is anticipated that several briefing sessions will be conducted in Anchorage, Fairbanks and other Railbelt communities. The interested public may be encouraged to attend but, it should be made clear to all attendees that the major function of these briefing sessions will be to facilitate compliance with various environmental and regulatory requirements.

In addition to reviewing ongoing studies, permit requirements, and the project status, a special effort should made at the briefing sessions to obtain feedback on the Public Participation Plan and on obtaining comments on the monitoring program developed specifically for the Project. It should be clear that a major intent of the briefing sessions is to inform and to document agency involvement, data gathering activities and work planning.

Task 7. Form Citizen Advisory Committees

The Citizen Advisory Committee (CAC) must be formed within the study area and should be representative of each specific community or "region". The Matanuska-Susitna Borough will comprise the study area and the communities of Palmer, Wasilla, Houston, Talkeetna, Trapper Creek, Willow, Big Lake, Cantwell, Gold Creek and others to be identified will be represented. Representation should also be distributed across categories of citizens, such as local officials, business owners, interested citizens with no particular affiliation, and others who may be identified.

The Power Authority will guide the CAC activities coordinating all elments of the CAC workplan and assisting in the implementation. Members of the Joint Venture Working Group will act as facilitators of this process, providing assistance at particular points along the schedule. For example:

- Feed information to the Authority. Interpret and write up technical information to be presented to the CAC.
- Prepare data for input to Authority presentations.

- Provide liaison between project managers in other disciplines and the Power Authority's PPO and the CAC, where necessary.

- Assist with information pertaining to the FERC License Application, the on-going monitoring program and the development and implementation of the mitigation strategies to minimize impacts.

Frank Orth and Associates Inc. will be an integral part of the Joint Venture Working Group providing general assistance and specify input regarding all economic, social and cultural impacts.

The CAC will be subdivided into task force groups which will address specific issues or all issues within a specific community or geographic area. This subdivision will provide for greater information exchange between members of the CAC, and the Power Authority and the consulting teams. A task force is also more amenable to addressing topics in greater detail as will become necessary when mitigation plans are being developed. The CAC provides a good forum for presentation and discussion of impacts and outcomes that will affect the study area in general. The task force is also more conducive to having working discussions to formulate specific measures.

Task 8. Conduct Site Tours

Site tours will be provided to agency personnel, leaders of the Citizen Advisory Committees and representatives of the media. It is anticipated that Public Participation Working Group personnel will be involved in these activities.

All working group personnel will be involved in identifying issues to be addressed during these site tours, and will assist in identifying whom should be asked to participate in the site tour. Logistic arrangements for these site visits will be coordinated by the Harza/Ebasco Public Participation Coordinator. The Harza/Ebasco coordinator and the Power Authority representatives will participate in and conduct the actual site tours.

Task 9. Public Workshops (October 1983)

The next major activity to be conducted by the Harza/Ebasco team will be to conduct Project workshops in October 1983. These workshops will be intended to accomplish four major objectives:

1. To present findings related to the environmental studies already conducted (license application) and to

present the project design concepts as they currently exist.

2. To present the design concepts that exist for new communities (construction camp and village) planned to house the construction workers on the Project.

3. To give specific attention to reviewing and monitoring activities planned for the Project.

4. To help in the development of mitigation plans so that adverse project impacts can be minimized and benefits enhanced.

Specific attention will be given at the workshops to identifying mitigation measures that can be developed on this project. Attention will be paid not only the mitigation measures themselves, but to mechanisms for ensuring that mitigation measures are implemented.

At the workshops, it is anticipated that introductory remarks will be made by Power Authority personnel, but that a substantial contribution will be made by members of the Joint Venture team, who will be responsible for transmitting technical information in a form suitable for public understanding and response. Brief presentations on the status of current activities will be given, followed by working sessions for the various issues. Registration will be encouraged at these workshops using cards such as shown that in Exhibit D(h)-2 and the public will be encouraged to provide comments using forms such as those shown in Exhibit D(h)-3. The Joint Venture team, other contractors, and Alaska Power Authority personnel will record public comments using forms such as shown in Exhibit D(h)-4. This type of workshop has proven effective in gathering data on other projects and in involving individuals in the project planning process before results are finalized and detailed plans formulated. It is anticipated that workshops will be held in Anchorage, Talkeetna, and Fairbanks.

Task 10. Public Participation Working Group Meeting on Proposed New Communities (November 1983)

One of the major socioeconomic issues associated with the Project will be the development of a new community to house the construction workers. Plans for housing Project workers will probably be formulated early in 1983 and the associated public participation activities, aimed at communicating those plans and receiving input, will be most effectively carried out early in 1984.

To facilitate public participation in this part of the planning process, we anticipate that Public Participation Working Group meetings, intended to primarily consider issues related to the proposed new communities will be held late in 1983. Leaders of the CAC will be encouraged to attend this meeting so that it will be clear that the planning process is open and responsive to local public concerns. At this meeting, the planning concepts related to these new communities will be reviewed, as well as specific public participation activities that will be required (for example, the formationof a local planning assistance group). At a minimum, issues relating to transportation to and from the job site will be discussed and the appropriate level of public participation planned. As access to local communities will be an important issue on the Project, it will be necessary to involve other agencies and representatives of the local communities in discussions relating to access. In addition, issues related to the permanent versus temporary nature of changes in these communities is also likely to be controversial. This matter will also be reviewed by the working group and appropriate public participation activities planned so that the various constituencies are properly represented. These and other activities relating to planning the new communities will be discussed at this working group session with the primary intent of identifying interest groups, agencies, and those portions of the general public which should participate in the planning and design of the communities. A task force will be formed to deal with the issues concerning planning and development of the new community.

The general goals and objectives for the 1984 public participation program will be reviewed at this working group session. It is anticipated that strategies for obtaining public participation relative to mitigation and monitoring programs will be developed at this time. Other issues, ranging from some of the detailed design considerations to the potential impact on commercial fisheries also will be discussed. Based on an assessment of such considerations by the Public Participation Working Group, it will be possible to put together a public participation plan for 1984. Concerns to be dealt with in subsequent years will be identified at this meeting.

Subsequent Tasks

Many public participation activities are expected to continue from January, 1984 through completion of construction. Although the activities to be undertaken in this period are difficult to identify at present, it should be noted that the Joint Venture will use a consistent approach in keeping with the goals and principals described earlier in this section. This approach will include continuation of the Public Participation

Working Group, preparation and implementation of annual public participation plans, continued work with Citizen Advisory Committees, and a continued emphasis on communication so that input from public participation activites can be incorporated into the Project design and construction activities. In addition, several areas can be identified as requiring special attention from a public participation standpoint.

Identify Impacts Requiring Mitigation and Monitoring Activities Required. Continuing public involvement in the communities affected by the influx and efflux of construction workers will be needed in order to identify or forecast occurring impacts requiring mitigation. Public participation activities with CAC in Talkeetna, Trapper Creek, or other areas in which Project-related changes in population are occurring will need to be conducted on an ongoing basis. This will include communities which will form or grow to meet the direct needs of the project. Use of questionnaires and interviews with local officials and social service organizations will also be required. Additional surveys, the result of which will become part of the socioeconomic studies will be used in these investigations as well. They will provide detailed information on public concerns and social responses within the region and will assess public attitudes toward economic growth, changing life styles and other factors, as discussed in more detail in the socioeconomic section of D(c), above. Study efforts will be directed at identifying Project-related impacts requiring mitigation for the duration of the Project. This continuing effort is essential to a successful mitigation program. Many mitigation programs have failed because of lack of monitoring and response to "downstream" project-induced changes.

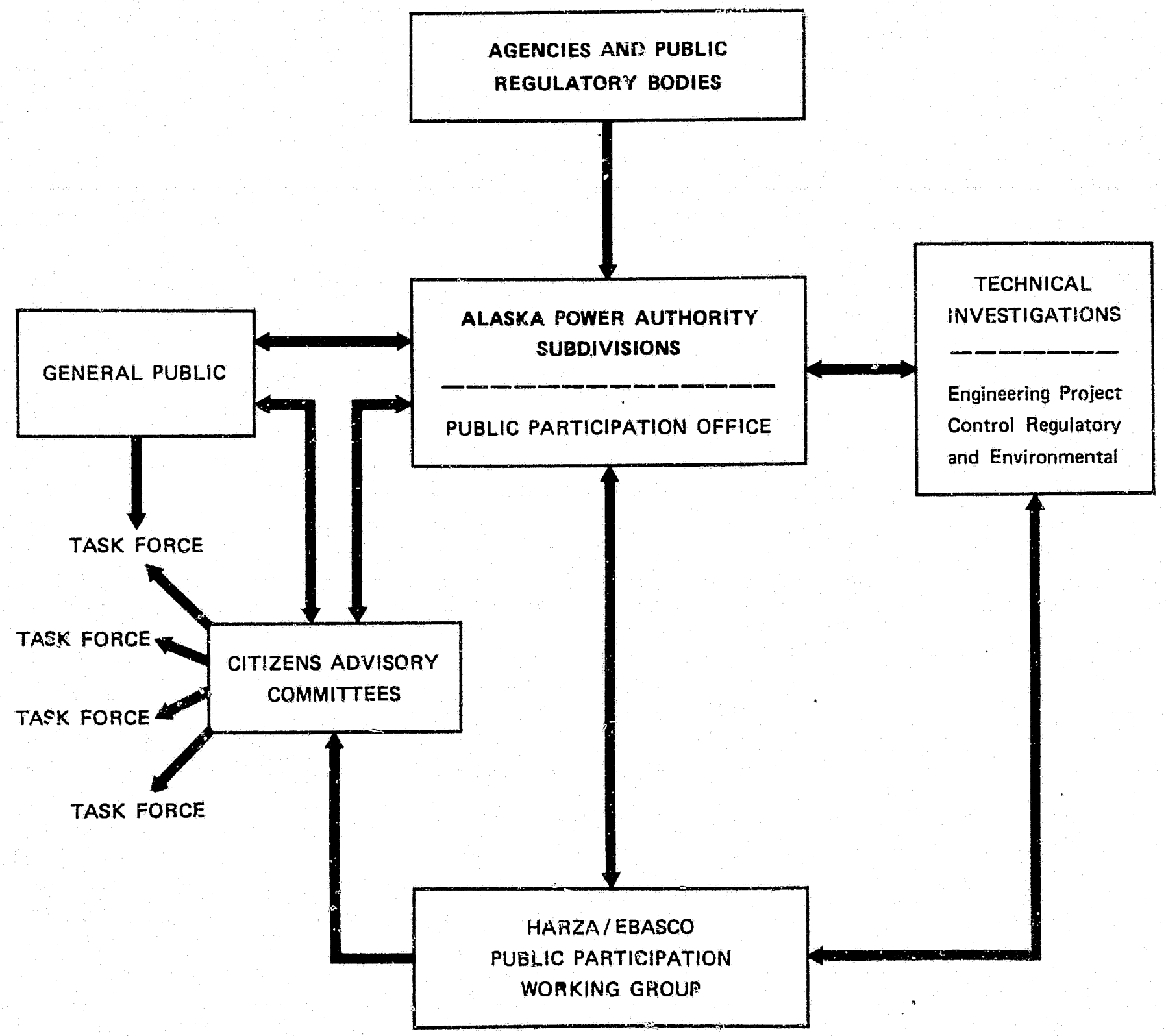
Evaluating the Effectivenss of Mitigation Measures. The effectiveness of mitigation measures will be evaluated in two ways: objective and subjective. First, through monitoring of economic and social indicators, the Joint Venture team will assess whether mitigation measures caused the desired amounts and kinds of changes. Evaluation criteria will be developed, reviewed by Power Authority, agency personnel and the CACs, and used in this objective assessment. The assessment results will be disseminated to agency personnel, the CACs and other interested parties. The knowledge gained through this evaluation of the effectiveness of mitigation measures will be used to improve future mitigation planning and development of mitigation measures.

Subjective evaluation of mitigation efforts will be obtained through the Public Participation Program. The public's opinion concerning whether change has occurred as planned will be solicited. This subjective evaluation also will be used to

improve future mitigation planning and development of mitigating measures.

Mitigation Through Design of New Communities. The design of the new communities (construction camp and village) will influence the magnitude and distribution of economic and social impacts. The Joint Venture Public Participation Coordinator and Frank Orth and Associates, Inc. will meet with the design contractor for the new communities on several occasions. The purpose of these meetings will be to discuss the influence of community design on economic and social impacts and to develop preliminary economic and social design criteria. The design contractor will use these criteria, along with other criteria, to develop preliminary community designs. We will evaluate the designs, comparing the economic and social implications of alternatives and determine which design is most consistent with local preferences regarding types and rates of changes. These results will be provided to the Joint Venture Public Participation Support Program and to those involved in making the community design decisions. This will allow the economic and social objectives of local communities to be weighed against other objectives in an explicit manner.

EXHIBIT D(h) - 1



SUSITNA HYDROELECTRIC PROJECT

PUBLIC PARTICIPATION PLAN ELEMENTS

HARZA-EBASCO

Susitna Project Workshop
Registration Card

NAME _____

ADDRESS _____

How did you hear about this workshop?

- ☐ mailed invitation
- ☐ newspaper
- ☐ t.v., radio
- ☐ club, organization or agency
- ☐ friend
- ☐ other _____

If you are attending as a representative of an organization, club or agency, please indicate name and address below:

NAME _____

ADDRESS _____

SUSITNA HYDROELECTRIC PROJECT

SUSITNA PROJECT WORKSHOP
REGISTRATION CARD

HARZA-EBASCO

EXHIBIT D(h) - 3

Susitna Project Workshop
Concerns and Comments

☐ Anchorage 10/20 ☐ Talkeetna 10/21 ☐ Fairbanks 10/22

Please tell us of any issues, areas, or specific features that you feel should be given special consideration in planning the transmission line near your community:

Would you like to be notified of future activities on this project? ☐ Yes ☐ No

NAME _____

ADDRESS _____

TELEPHONE _____

LOGISTICS
INVESTIGATIONS
SUBCONTRACTS

EXHIBIT D(h) - 4

Susitna Project Workshop
Participant Comment Record

☐ Anchorage 10/20 ☐ Talkeetna 10/21 ☐ Fairbanks 10/22

STAFF _____

WORKSHOP PARTICIPANT _____

RESIDENCE LOCATION _____

ORGANIZATION, IF ANY _____

Brief digest of concerns and comments:

Is follow-up contact needed? ☐ Yes ☐ No

ADDRESS/TELEPHONE FOR CONTACT: _____

_____

HARZA · EBASCO

(i)
SUBCONTRACTS

ACCOUNTING | CIRI | MANAGEMENT | FIELD INVESTIGATIONS | (j) LOGISTICS

D(i) MANAGEMENT OF NON-TECHNICAL FACILITIES SUBCONTRACTS

The management of the design of the non-technical facilities will encompass conceptual design, detailed engineering, and procurement activities. The non-technical facilities include roads, airfields, camps, permanent village, and other facilities considered independent of the technical design.

Relationship With Non-Technical Facilities Subcontracts

During the conceptual engineering phase, we will perform the detailed planning for the non-technical facilities. The scope of these facilities will be defined and the requirements of each facility will be determined, analyzed and modified, if required. A planning document or guide will be prepared to formally define each facility and establish milestone schedules. Also during this phase, we will perform the conceptual engineering for each facility. This will include preparation of site layouts, general arrangement drawings, and basic performance specifications. Alternate approaches will be prepared for review with the Power Authority. As an integral part of the engineering, we will conduct constructability reviews to ensure that the designs selected are the most practical from the construction point of view. The Joint Venture will review permits requirements to identify the agencies involved, the time required and the procedures so that facility can proceed without interruption.

Upon completion of the conceptual design phase, the final design of the non-technical facilities will be packaged and individually subcontracted via an RFP utilizing Power Authority selection and evaluation procedures. Selection and subcontract awards will make Power Authority maximum use of qualified Alaskan firms or joint ventures, subject to the approval of the Power Authority.

The major portion of the engineering for each facility will be performed by the design subcontractors during the detailed engineering phase. We will work closely with each design subcontractor during this phase of the project, monitoring his activities to ensure that appropriate design reviews, constructability assessments, and value engineering considerations are incorporated. In addition, we will institute project control techniques to assess the subcontractor's progress towards design completion. Cost and schedule controls and reports, similar to those utilized for technical engineering and design, will ensure that the products of the design efforts are completed on time to support the proposed construction plans and in accordance with the budgets allocated to each effort. Also included in the

Joint Venture's scope of work is the preparation of the Engineer's Estimate for each of the contracts. We will remain responsible for management of the non-technical subcontracts. A specific example of the work flow for a non-technical design contract is shown in the "Access Road" section of D(b).

As manager of the engineering design of the non-technical facilities, the Joint Venture will review the design of each facility provided by the subcontractors to verify that performance requirements are met. It is anticipated that these subcontractors will be Alaskan engineering firms. The Joint Venture, by virtue of its subcontractor, Frank Moolin & Associates, has in-depth experience in design review of Alaskan engineering and construction projects. This encompasses hands-on design experience in both arctic and subartic environments throughout Alaska.

Administration of Existing Contracts and Programs

The Joint Venture, upon receipt of contract award, will arrange a meeting with each of the existing contractors to discuss the status of the contract. We will request that each contractor submit a status report on his actual progress to date, his payment to date, and the correlation of these to his scheduled progress including variances. This status report should be submitted as close as possible to the Joint Venture's contract award date to allow the Joint Venture to become current in the Project as soon as possible. The meeting between the Joint Venture and the contractors will allow for discussion on any concerns raised in the review of the status report.

The Joint Venture will manage these contracts in a manner similar to that applied to the design subcontractors. Changes in an existing subcontractors method of operation will not be made unless agreed to by both the Joint Venture, the subcontractor and the Power Authority.

HARZA-EBASCO

(j)
LOGISTICS

ACCOUNTING | CIRI | MANAGEMENT | FIELD INVESTIGATIONS | QC/QA

D(j) CAMP FACILITIES AND LOGISTIC SUPPORT

The camp facilities and logistic support for the Susitna Hydroelectric Project must be carefully planned, in order to provide a safe working environment for Project personnel. The first part of this section describes support and supply of the construction camp and non-technical facilities such as roads, airports, warehouses and other ancillary buildings, while the second section describes logistical procurement support for the design phase of the Project.

Camp and Facilities

The overall strategy in the design and supply of the camp and its supporting facilities is to design and supply temporary facilities which are easily convertible to permanent facilities. Additionally, all basing and construction criteria will permit easy expansion of the camp and the support facilities.

The temporary facilities will be utilized for the field investigation and operations of the engineering design phase. These facilities will then be converted and expanded into the camp facilities to support the construction phase. Additional modifications could be made to render the facilities suitable for the long-term operation of the Watana Dam.

Because of the poor soils conditions and drainage observed at the site and commented upon by the camp manager, the present camp location at Watana is not recommended for expansion. It is proposed that the camp be moved to an area with excellent drainage and stable soil conditions. The existing camp will be dismantled, transported to a new site, and integrated with newly purchased camp modules.

To expedite the relocation of the camp and its subsequent expansion, a site should be selected in the same section in which the present camp is situated. The land status will then remain the same. We believe that a new land use permit will not be required; an amendment to the existing permit should suffice. If, on the other hand, another section is selected, a new permit will be required, which could take up to 120 days for approval. Land status (ownership) will be an important determinant in the approval cycle.

The Joint Venture will propose a new location for the temporary camp, with several alternatives, based on studies of topographic features and drainage. We will recommend the procurement of additional modular units and modification of the life support systems, and prepare the conceptual design of the

facility. This new location should be such that it will accommodate the expansion of the temporary facilities to construction phase camp facilities. Following approval by the Power Authority, the detailed design, procurement and construction of the camp will be provided by Cook Inlet Region, Inc./Holmes & Narver, who are currently operating the Acres American camp at the Watana site.

The site will require a review of existing geotechnical data for the area and/or soils testing and sampling to identify subsurface conditions to support pilings as required. Further areas to be reviewed during site selection include:

- Environmental concerns
- Proximity to potable water supplies
- Treated wastewater disposal needs
- Future airstrip and support
- Helicopter accomodations
- Warehousing and storage demands
- Proximity to winter access and planned construction access road alternatives
- Climatic conditions, such as snow accumulation and wind loads

The camp presently envisaged will be similar to the existing Acres American camp at the Watana site and will support approximately 120 persons. These facilities are Atco type units, modular in construction and modular in transport. The modules are complete with utilities such as power, heating, waste disposal and sanitary facilities and include interior finishes, equipment and furnishings. These camps are obtainable in the Southcentral Alaska area. It is likely that use of the previously owned modules such as those that are located in abandoned Trans Alaska Pipeline System camps will be evaluated since purchasing, refurbishing, and transportation may be at a substantially lower cost than for new units.

The camp and its associated infrastructure will provide, in addition to office, sleeping, and dining facilities and life support systems, the following accommodations:

- Recreational. The recreational module(s) will be expanded during camp design to meet the demands of a larger group.

Facilities will include ping pong, billiards, a lounge area, an exercise room, a snack area, and a small movie theater or video cassette recorder facility.

- Medical. A resident paramedic will be on the camp staff with facilities to perform medical services such as emergency first aid, field diagnosis, minor burns and cuts, and perhaps closed reductions. This individual may be the the safety man, cross-trained in paramedical skills. Med-vac services will be established.

- Mail. Mail drop-off and pick-up will be provided.

- Banking and/or Security Area. Consideration will be given to the possibility of banking services being required at the campsite. This would mainly be for deposit transactions and check cashing.

- Communication. Existing communication systems will be reviewed prior to determining if any changes are recommended.

- Security. Control of unauthorized access and disturbances.

- Camp maintenance area.

The newly expanded temporary camp will be operated and maintained by the Joint Venture under subcontract to CIRI/Holmes & Narver.

Transportation

Transportation to and from the Watana site is vulnerable to bad weather. During the winter months, the modules for the camp and ancillary buildings and supplies such as food and fuel should be transported to the Watana site from the Denali highway. We recommend that Roll-A-Gons be used on overland frozen ground with snow cover, as was done in the 1980 supply effort. To reduce costs, fuel and bulk supplies must be transported and stockpiled during these winter months. The Roll-A-Gon method of support will be used during the period 1983 to 1985 or until the access road construction is completed in 1985. Staging areas along the Denali Highway must be permitted and secured during the supply effort.

Air transportation will be provided by both fixed-wing and rotary-wing aircraft. Aircraft will transport both men and material to the High Lake private airstrip and then by helicopter only to the camp site. The private gravel airstrip at High Lake is approximately 1700 feet in length and retractable land-

ing gear is not recommended. Short take-off and landing (STOL) aircraft are available in Alaska and planes like the Twin Otter have a good operating record for transporting personnel and materials to remote sites in Alaska. Helicopter pads will be located on flat, stable ground in close proximity to the camp, with raised wooden pads as required. Field investigations during the design phase will identify the area for airfield and helicopter pad construction after FERC licensing.

Although rail service is available to both Talkeetna and Gold Creek, scheduled service is usually limited to three days per week during the winter months and four or five days per week during the summer months, Lots less than a car load are delivered only once a week. Further study is necessary to determine if dedicated rail service is feasible. If so, Gold Creek may become a viable staging area. Talkeetna can be supported by rail, air and truck on a year-round basis. At this time, the logical staging area for air transport and supply appears to be Talkeetna, which has both highway and rail access.

Communications

Presently, one telephone line exists to the Watana camp. Radio communication is available for both land units and aircraft. Early earth station construction and/or microwave communication certainly is possible. Further detailed studies are required to analyze the economics of such construction. Land communications in the camp/job site vicinity can be adequately handled by CB-type mobile units and base stations.

Roads, Warehouses and Other Supporting Structures

Road construction to support the 120-man camp is not planned at this time, either at the camp site or as access to the camp site. Warehouses and other structures will be prefabricated, easily constructed and transported, and located in staging areas and at the campsite.

Maintenance Facilities

Equipment maintenance facilities will be structured similarly to warehouses, modular in construction, easily, transported and easily assembled. Additionally, mechanics' tools will be supplied with these facilities.

HARZA · EBASCO

(k)
FIELD
INVESTIGATIONS

ACCOUNTING | CIRI | MANAGEMENT | VALUE ENGINEERING | QC/QA

D(k) FIELD INVESTIGATIONS

INTRODUCTION

Further field investigations will be required in the geotechnical and environmental areas. This proposal section is limited to our program for geotechnical investigations. A detailed discussion of our program for continuing the floral and faunal studies, archeological investigations, socioeconomic surveys, and recreation and esthetic surveys is found in D(c), "Environmental Program."

GEOTECHNICAL WORK PLAN

Introduction

The geotechnical field exploration program will be initiated with a thorough review of all reports and supporting data developed by previous investigations of the Watana project from the late 1950's through the summer of 1982. The objective will be to develop complete understanding and insight on the part of the Geotechnical Field team as to the geologic and geotechnical characteristics of the project area and site and the impact of these on the project preliminary designs as interpreted in the recent Feasibility Report.

Our preliminary review of the available site investigation reports suggests that additional investigations will be required at least in the following areas:

- Continued evaluation of major geologic structures that impact on design and construction of project features
- Additional geotechnical investigations to support design effort, estimate grout takes, and identify areas of possible excavation problems
- Determination of the effects of permafrost thawing on strength of foundation bedrock, seepage through the abutments, foundation grouting procedures, and the stability of slopes in the reservoir area

- Treatment of the Watana relict channel area

- Identification of the configuration of the relict channels in the Fog Lakes areas, and determination of the nature of the infilling materials and possible treatment techniques

- Evaluation of the identified units in the borrow areas and quarries with respect to the planned materials distribution in the embankment and associated structures

The following describes the work plan now foreseen by the Joint Venture for continuing field investigations leading to completion of contract documents. The work plan is discussed in three sections:

1. The exploratory methods which are anticipated to be used as a means of data acquisition.

2. A discussion of the scope of exploratory work anticipated to be carried out for each major element of the project. This section references the estimated quantities of each type of exploration activity associated with the various project elements and the proposed schedule for completing the required field work to meet the design schedules.

3. A discussion of the management methods which will be used to assure a fully adequate, cost effective and safe field exploration program meeting all the design requirements in a timely manner.

Exploration Methods

Rock Exploration

Core Drilling. Core drilling becomes an increasingly important tool as exploration moves into detailed design. The extensive undergound civil structures planned for the Project will necessitate extensive drilling both from the surface and from within test adits.

Over 20,000 feet of core drilling is planned prior to construction to provide further data on the geologic structures and on foundation and excavation conditions for all civil structures. The Joint Venture will subcontract the core drilling to an Alaskan contractor, with the requirement that all equipment be adapted for helicopter transport with sufficient spare parts to minimize downtime at this remote site. The schedule allows for four drill rigs during the first summer season, decreasing to two rigs as start of construction is approached. It is our

policy to utilize one of our geologists for each rig to gain maximum data and perform the Quality Control/Quality Assurance functions. Cores will be photographed and logged to document lithology, recovery, rock quality (RQD), joints, fractures, weathering, and other notable features. Field permeabilty tests will be performed as required. Standardized log forms, logging techniques, and close supervisory review will ensure uniformity of data presentation and interpretation. Schedules for rock core drilling are shown on Exhibit D(k)-1 and the allocation of core drilling among the various project features is shown on Table D(k)-1.

Test Grouting. For a dam as large as Watana, a test grouting program may be an economical method of reducing the dependence on "rule of thumb" for determination of depth and spacing of grout holes, and for estimating unit quantities. Such a program could be especially important to establish methods of treating possible areas of permafrost in the left abutment. We anticipate drilling 12 test holes grouted to an average depth of 100 feet. Ideally, a test adit, to be used later as part of the grouting galleries, will be driven into the left abutment to evaluate grouting results and determine in-situ rock conditions. Otherwise, we will grout from an exploratory adit and check the results with core borings.

Schedule and cost estimates allow for this test grouting program, although such a decision will be deferred until results of future abutment borings and tests have been studied.

In-Situ Rock Testing. This will be carried out particularly to furnish design data for the underground features. Some of the questions for which rock mechanics studies can help provide answers for design are:

- Stable shape of the caverns
- Stability of the rock pillars and intersections between tunnels and caverns
- Types and quantities of rock reinforcement required
- Specification details for rock reinforcement
- Amount and effect of in-situ stress
- Strength of discontinuities
- Long-term performance of openings (creep rate)
- Influence of "pore" pressure

- Load carried by rock surrounding pressure tunnels
- Efficient excavation and blasting specifications
- Effective construction saftety monitoring procedures
- Working knowledge of the physical properties of the rock at the project site to be used in discussions with the Contractor during or following construction

Rock mechanics studies will be analyzed in conjunction with exploratory borings, detailed logs, mapping of test adits, and laboratory tests on rock cores to produce the assessment of rock conditions for design. In-situ rock tests will be done through the medium of surface core borings, construction of exploratory adits and core borings drilled from within adits.

Tests, considered in-situ in the broad sense, which will be performed in surface borings will include water pressure testing to define rock mass permeability, down-hole and cross-hole velocity tests, oriented core drilling and borehole imagery by camera or TV monitor to define joint spacing, orientation and character of joint openings and filling materials.

The in-situ rock tests which are planned to be done within adits are discussed further in a subsequent section on exploration for underground power facilities. Multiple position borehole extensometers will be installed in exploratory adit and chamber walls to measure strain rates and patterns around openings. The data from these measurements will be applied to:

- Setting the allowable time to install supports or reinforcement
- The need for reinforcement or support and the effectiveness of the various types
- The long-term stability and residual strength of the openings

The in-situ stresses present within a rock mass have an important effect on the physical properties and behavior of the rock as an engineering material. The intensity and direction of these stresses control the strain patterns and distribution of stress in the rock mass remaining after an excavation has been made. Knowledge of the in-situ stresses is essential to the sound logical design of rock reinforcement systems and excavation procedures.

The in-situ stress field away from the walls will be measured using overcoring techniques. This requires a small diameter (46 to 76 mm) hole in the rock for the six-axes strain recording instrument and then overcoring the instrument with a larger core (150 + mm), thus relieving the ground stress. The instrument records the "elastic" response of the included rock core to the removal of the stress field.

The diorite rock within which the underground structures will be constructed is a strong geologic material of high modulus. The modulus of the rock mass will be affected principally by the joints, shear zones and other discontinuities. Cross-hole seismic velocity measurements, used in conjunction with laboratory static and dynamic modulus tests on rock cores, will allow a reasonable assessment of the rock mass modulus.

Our preliminary review of available exploratory data from the Watana site and our considerable experience in design of underground features on other projects leads us to believe that large scale in-situ tests, such as flat-jack or ram-jack tests are not justified. Should site conditions warrant, we will be prepared to perform large scale or more sophisticated in-situ tests than are currently envisioned in the in-situ rock testing program.

All drill core will be logged in detail using appropriate logging systems for underground engineering purposes. Detailed engineering geologic mapping of the adits will be a task as important to rock mechanics evaluation as the in-situ testing. We will give high priority to logging of the occurrences of discontinuities and their nature with regard to planarity, roughness, continuity, orientation and infilling materials, as well as indications of water inflows.

Laboratory Testing. We will perform laboratory tests on intact rock cores selected as representative of the various rock conditions encountered. Strength tests will consist primarily of uniaxial compression, perhaps with a limited number of tri-axial compression tests. Static and dynamic modulus tests on core specimens will yield data for evaluating the mass modulus of the foundation rock. Petrographic analyses of the sections will be correlated with the rock strength tests to aid understanding of strength variations due to variations in rock fabric, structure, grain size or lithology.

Soils Exploration

Soil conditions vary from fine-grained lacustrine deposits to coarse alluvial and talus deposits containing cobbles and boulders. Both frozen and unfrozen deposits are present, and

groundwater conditions are non-uniform because of topography, confining soil layers and permafrost.

The proposed drilling, sampling and in-situ and laboratory testing procedures have been designed to provide the flexibility needed to investigate the broad range of expected conditions at Watana. The equipment has been selected to permit a variety of drilling and sampling methods so that the most cost effective procedure can be used for the encountered conditions.

The Joint Venture has subcontracted the execution of the soils exploration program to Harding Lawson Associates, a firm with more than 12 years of experience with geotechnical work throughout the State of Alaska.

Hammer Drilling: Equipment. A Becker Hammer Drill will be provided for geotechnical drilling to be performed during the winters of 1982-83 and 1983-84. The Becker Drill is a proven performer in drilling difficult overburden soils. The Becker Drill will be used for drilling and sampling the soil deposits overlying bedrock beneath the river area of the damsite, in the Watana and the Fog Lakes relict channels areas, and in Borrow sites D, E, and I. Although the Becker Drill is well suited for penetrating coarse materials, operational problems such as the freezing of the saturated air used for drilling or the freezing of the sample returns could develop during severe cold. In view of these potential problems, the performance of the hammer drill will be continuously evaluated. If it is found not to perform as satisfactorily as expected, the drilling program will be supplemented by conventional rotary wash drilling using a rig equipped for winter drilling and sampling to depths similar to those attained by the Becker Drill.

Sampling. Soils will be sampled using standard penetration 1-3/8 inch ID split-spoon samplers, thin-wall and Dennison samplers driven with 140-pound safety drop hammers. Sampling will be performed on five-foot intervals. Interval spacing will be changed depending upon the soils encountered. Between sampling locations, loose samples from the drill cuttings will be obtained and place in glass jars. After the samples have been recovered, the sample handling and processing will depend upon the type of material. Samples will be transported from the drill rig to the field lab at each shift change. Those samples selected for secondary testing will be shipped to the laboratory in Anchorage.

Rotary Drilling: Equipment. Soils exploration to be conducted during the summers of 1983 and 1984 will include soils borings drilled in the Fog Lakes and Watana relict channels and in borrow sites. Two Mobile B-61 hyraulic rotary drill rigs,

specially modified for transport by either Bell 205 or 214 class helicopters, will be used for summer drilling. Drilling tools will include eight-inch O.D. hollow flight and six-inch O.D. solid flight augers as well as 2-5/8 inch O.D. Mobloc flush-jointed drill rod, drag and tricone bits, and casing as required for rotary wash drilling. The B-61 is capable of drilling to depths in excess of 400 feet using the rotary wash techniques. Water for rotary wash drilling will be pumped whenever possible from surface water sources in the vicinity of the drill rig. A skid-mounted 500-gallon, helicopter-transportable water tank will be provided for use in areas where drill water is not readily available. All drilling fluid will be collected in a sump and recirculated to the drilling operation. In frozen soils where depths are not excessive, borings will be advanced using hollow stem flight augers to reduce thermal disturbance.

Sampling. Soil sampling in unbonded soils will be carried out using the tools and techniques described above for the Becker Drill. Sampling intervals and techniques will depend upon the actual soil conditions encountered in the borings.

After the samples have been recovered, the sample handling and processing will be similar to that discussed for the winter program.

Trench and Test Pits. Trench and pit excavation will be performed in the Borrow Areas as part of the soils exploration programs during the summers of 1983 and 1984. A backhoe will be used to excavate trenches to a depth of 10 to 12 feet. A geotechnical engineer will be on duty to do the logging of the excavation walls and to collect bulk samples from the bottom and walls of the trench.

In-Situ Soil Testing. In addition to the gathering of Standard Penetration Test data as indicated above, Cone Penetration Tests will be performed with a four-channel electric Dutch cone penetrometer at selected locations in the relict channels areas. The cone penetrometer data will be used to correlate stratigraphy within the relict channels areas. These data will also be used to assess the liquefaction potential of saturated unfrozen soils after correlation with the Standard Penetration Test data. Data from the electric cone will be processed at the surface to produce a continous graph of cone and sleeve resistance, pore water pressure and inclination versus depth. Penetration testing will not be performed continuously but at selected depth intervals within the test borings.

Gamma ray logging will be performed to further develop stratigraphic correlations between boreholes in the relict channels areas. This technique has proven to be an effective indi-

cator of the presence of silts and clay in saturated, unconsolidated formations.

Work performed during the summer will include hydraulic testing in the relict channels areas. The objective of the hydraulic testing is to establish the permeability of the unbonded materials in the relict channel areas that will be hydraulically connected to the reservoir. The permeability of soils in the relict channels will be determined by pump testing from water wells constructed in drilled borings. During pumping, water levels in the test wells and in observation wells will be monitored using piezometers during the pumping and recovery periods.

Laboratory Soils Testing. Soils laboratory testing will be performed at three locations: the field camp site and Harding Lawson's Anchorage and "Lower 48" laboratories.

The field laboratory will be established at the Watana Dam camp site and will function during the summers of 1983 and 1984. The field laboratory will be equipped to perform most primary soil tests, including moisture content, dry density, particle size anlaysis, pinhole dispersion, Atterberg Limits determinations, specific gravity and compaction curves. The laboratory will require about 700 square feet of space at the camp.

The Anchorage laboratory will receive frozen and unfrozen samples and store them as appropriate to prevent thermal degradation. The Anchorage laboratory will be responsible for frozen testing, such as thaw consolidation and thermal conductivity tests and unfrozen secondary testing such as triaxial and direct shear tests and conventional consolidation tests. Specialized testing and overflow secondary testing will be performed in Harding Lawson's "Lower 48" laboratory facilities. Their special capabilities include dynamic testing such as resonant column and cyclic triaxial, and high-pressure/large-scale testing in triaxial equipment which accommodates 12-inch-diameter specimens under confining pressures up to 1,200 pounds per square inch. The expected periods of operations of the various laboratories are shown in Exhibit D(k)-1. An estimate of the number of tests to be performed in the field laboratory and of the numbers of soil samples to be tested in Harding-Lawson's Anchorage and "Lower 48" laboratories is given in Table D(k)-1.

Soils Exploration Manpower on Site. All soils explorations will be coordinated by a field manager during the winter and summer programs of 1983 and 1984. A drilling superintendent/mechanic will also be present on the site during the same period. The winter drilling crew will consist of a driller and two helpers. The summer drill crews will consist of a driller and

helper for each of the two 12-hour shifts per day. During both summer and winter programs, an engineering geologist will be assigned to each shift to direct sampling and log the materials encountered.

Support Exploration Services

Support exploration services consist of geologic mapping, geophysical exploration, groundwater investigations, and survey support. Such services will be provided primarily by joint-venture staff with some specialized subcontractor support.

Geologic Mapping. Geologic mapping to supplement mapping completed in earlier studies will be concentrated during the summer field seasons, with winter work limited to test adits and the river channel. Additional detailed mapping is anticipated in the abutments and main dam area, borrow and quarry areas, relict channels, and along selected parts of the reservoir. Aerial photographs and remote sensing data will be utilized as required. Standard mapping techniques, map scales, and symbols will be used for ease of data presentation and interpretation.

One of the primary goals of the mapping and subsurface programs is to develop a three-dimensional model of the main dam area, showing all significant geologic structures and features. This planning tool will be updated as exploration progresses, to allow for optimizing orientation of civil structures and as a guide to exploration planning.

The geologic mapping will be completed by two teams of two geologists. R.A. Kreig & Associates, Inc., an Anchorage consulting firm highly experienced in airphoto interpretation and terrain analysis, will furnish important support to the field mapping activities and in map preparation.

Geophysical Exploration. Geophysical exploration techniques can provide fast and efficient methods of obtaining subsurface information over large areas. The inclusion of an effective geophysical program during the design phase will result in significant economy in the number of drill holes.

The bulk of the geophysical exploration program will be planned and directed by Joint Venture personnel. Joint-Venture personnel will also perform much of the actual field work, with specialized support provided by Harding Lawson Associates. Harding Lawson Associates has extensive experience in Alaska and will provide their expertise in geophysical surveys under cold weather conditions. The combination of the Joint Venture and Harding Lawson will provide complete capabilities to perform seismic refraction, seismic reflection, down-hole and cross-hole

seismic analysis, ground penetrating radar surveys, and earth resistivity, magnetic, gravity, and borehole geophysical surveys using trained and experienced personnel and field proven equipment. Data reduction and presentation will be accomplished using a full range of computer facilities.

The field work will be accomplished by two crews, comprising a total of three professionals and four to six local hires. Most of the geophysical surveys are planned for the summer seasons, although the additional work in the river channel will be performed during the winter. About 70,000 feet of seismic refraction lines is planned for additional investigations in the main dam area, borrow and quarry areas, the relict channel areas, and the reservoir. Other geophysical surveys have been included in the cost estimates, although their exact nature and location have not been specified. The development of the complete geophysical program will be an ongoing process, as data is received from all disciplines and as the needs of the design effort are developed.

The direct control of the geophysical program from planning and supervision through data acquistion and interpretation ensures that a logical, consistent, cost-effective approach will be followed.

Groundwater. The monitoring of pre-construction groundwater levels and the determination of hydrogeologic parameters are critical to the prediction of future ground and surface water conditions during construction and operation of the Project. The potential for leakage through the abutments, the dam foundation, and the relict channel areas must be determined and addressed in the designs. The anticipated bank storage of the reservoir, and the groundwater conditions at the borrow and quarry areas also must be determined. Permeability testing of foundation rock will guide grouting and foundation drainage programs.

Groundwater investigations will be supervised and performed by Joint Venture personnel. Groundwater programs will be conducted in conjunction with the drilling programs, and will be performed primarily during the summer field seasons.

Surveying. The extensive surveying support required during many of the geotechnical investigations will be provided by an Alaskan subcontractor. Two complete survey teams on-site during the summer field seasons will be needed, with adequate data reduction and presentation facilities available.

Instrumentation

Instrumentation programs are an integral part of both the design exploration and construction phases. The primary instrumentation currently envisioned consists of piezometers and thermistor strings to be installed in soil borings performed in the relict channels areas and borrow sites. Similar instrumentation will be installed in selected rock borings.

Field Investigations

The geotechnical investigations planned in support of the final design programs have been scheduled starting in January 1983 and continuing to the start of construction in January 1985. The anticipated schedule is shown on Figure 1. More definite exploration plans and schedules cannot be determined until evaluation of the results of the ongoing 1983 field investigations. Some level of geotechnical exploration will continue beyond the schedule shown, until about June 1986.

The geotechnical investigations during the design phase of the project must provide the design engineering staff with a maximum of necessary information in a timely and efficient manner. Close coordination with the design group is therefore required, both in documentation and communication of findings of the geotechnical program, and in the planning and reorientation of the program as data are collected and analyzed.

The planned field investigations will be concentrated in several areas: the damsite, the relict channels, and borrow and quarry locations. The purpose and general scope of each of these investigations is discussed below.

Damsite Investigations

Geologic Structures. The geotechnical field investigation of geologic structures has two major objectives:

1. Define and delineate all geologic structures that are significant in making final adjustments in location or orientation of the proposed project facilities. The basic layout already has been established, with the placement of the dam and all power facilities and outlet structures between the two major identified shear zones: "The Fins" and "Fingerbuster".

2. Define and delineate all geologic structures that impact on the detailed design or construction of the dam and associated facilities. One example would be delineating areas of fracturing that might be subject

to excessive overbreak during the excavations for underground facilities. In addition to the definition of these features, remedial programs would be designed, such as appropriate support systems for tunnels or potential requirements for dental work or consolidation grouting.

To meet these two objectives, the geotechnical investigations are divided into two overlapping programs:

1. Investigation of geologic structures

2. Input to design of civil structures

The first part of the geotechnical program is designed to identify and consider all geologic structures in the dam area, including fractures, shear zones, alteration zones, and lithologic variations. Previous work has identified numerous minor fractures and shear zones and two major shear zones. Additional work is required to more fully define these features, as well as to evaluate areas not covered in the feasibility studies. One of the major goals of this task is development of a physical model of the dam site showing data obtained from surface mapping and subsurface explorations.

The evaluation of geologic structures will proceed as follows:

1. Review of Previous Work. All of the available data gathered during earlier studies will be reviewed to provide complete background information to the field geologists. All geologic maps, sections, boring logs, and test data will be reviewed specifically to characterize the known lithologic variations, shear zones, fractures, and areas of alteration in terms of mechanical and hydrologic properties

2. Field Examination of Previously Mapped Structures. In order to ensure consistent terminology and an understanding of the interpretations and conclusions developed during earlier investigations, the field geologists will examine the geologic structures in the field in combination with published geologic maps, sections, and borehole logs. Familiarization with the previous work will allow a smooth transition from the previous investigations to the design exploration program.

3. Identification of Geologic Features Not Discovered During Earlier Work. Any previous undiscovered or unmapped geologic structures of significance to design will be mapped early on the field mapping work.

4. Compilation of All Existing Geotechnical Data, Development of the Physical Model, and Classification of All Known Shear, Fracture, and Alteration Zones. The classification procedure will serve to identify those geologic structures and features that will affect final ajustment to layouts and final design. It also will identify those minor geologic structures or areas that might require remedial work prior to or during construction. All geologic features would be shown on the physical model, to aid in the exploration and design process.

5. Identification of Geologic Structures That Require Additional Investigation. The decision to initiate additional investigations on specific geologic structures depends on their location, nature, extent and potential impact on the project. The exploratory drilling plan for geologic structures will be developed in coordination with exploration plans for civil structures so that drilling can serve both needs to the maximum extent.

Civil Structures. Exploration designed specifically for individual project structures is envisioned as follows:

1. River Channel Foundation Areas. The overburden materials filling the river channel in the main dam and cofferdam areas are highly variable, consisting of sand, gravel, cobbles, and boulders. The decision regarding possible utilization of these in-situ materials as a foundation for the gravel shells in the main dam will depend on additional exploration and testing. The exploration program for both the main dam and the cofferdams consists of additional borings, seismic refraction profiling, and field and laboratory testing. The program is scheduled to begin in January, 1983, since early completion of this work will be required to finalize the decision regarding suitability of all or part of these materials for foundation beneath the main dam shell. The anticipated tasks and schedules are shown on Table D(k)-1 and Exhibit D(k)-1.

The borings in the winter of 1982-83 will be completed using a special, large diameter, heavy duty drill described above, under "Soils Exploration." The borings will provide overburden samples at all depths with Standard Penetration Test data and provide correlation points with the seismic refraction studies for a detailed stratigraphic determination of the various alluvial strata.

The results of these tests and field investigations will be used to predict the performance of the overburden materials as cofferdam foundations and to assess their suitability as main dam foundation material.

2. Main Dam Cutoff. Detailed geotechnical exploration along the cutoff is required to determine excavation characteristics, overburden depths, permafrost conditions, depths and nature of weathering, and permeability of the bedrock. Anticipated work includes additional geologic mapping, core drilling, in-situ testing, surface geophysical exploration, test grouting, and groundwater investigations. Test adits in both abutments will be constructed for in-situ rock mechanic testing, and to provide galleries for additional test borings and possibly for inspection of test grouting results. The test adit in the right abutment will be extended for investigation of the powerhouse and tunnel areas.

Additional borings, mapping, and geophysical investigations are planned for the summer of 1983. Adit excavation and in-situ rock mechanics testing will begin in February 1984, although excavation planning and permitting will need to begin at the start of 1983. Approximate quantities of exploratory items are shown on Table D(k)-1 and schedules on Exhibit D(k)-1.

The results of the explorations will be used to determine the extent of stripping required in the dam foundation, evaluate the effects of permafrost thaw on foundation stability, estimate quantities of grout required for foundation treatment and curtain grouting, and aid in the development of construction specifications. Certain boreholes will be chosen for installation of instrumentation, including thermistors and piezometers.

The evaluation of permafrost effects is a major part of the damsite investigations. Several aspects must be considered:

- The potential requirements for acceleration of the thaw in the foundation and abutments to allow consolidation and curtain grouting

- The possible effects of progressive thawing in rock joints on compressibility and permeability of the rock mass

- The effects of progressive thawing in rock joints on the groundwater regime and slope stability

Analyses of data obtained during these investigations will be used to assess the potential effects of permafrost thawing and to develop instrumention procedures to monitor the rate of thaw and related effects.

3. Main and Emergency Spillways. Detailed geotechnical exploration for the Main Spillway must define the nature and depth of overburden, the configuration of the bedrock surface, the foundation characteristics of the bedrock with special

consideration given to structually disturbed zones, and bedrock permeability. The exploratory work will provide data for design of final foundation grades, excavated rock slopes and rock support systems, remedial foundation treatment (including dental treatment and consolidation grouting), and the design of seepage control features to ensure stability of the spillway elements and their foundation.

The investigations will consist of detailed geologic mapping, seismic refraction surveys to delineate overburden depths and the depth of surficial weathering in bedrock, and core borings. Some exploratory drilling, which will be done to define the nature and spatial distribution of geologic structures and for the main dam cutoff, will serve also to evaluate foundation conditions for the Main Spillway. However, design stage core borings will cover all spillway elements with emphasis on the headworks area and the flip bucket area, where structures are combined for discharge from the spillway, powerhouse and outlet facilities. Selected exploration holes will be instrumented with piezometers and/or thermistors if groundwater or permafrost are encountered. Permeability tests will performed in boreholes to provide data for designing the grout curtain beneath the headworks and the drainage features beneath the headworks and chute.

Field investigations for design of the Emergency Spillway will include geologic surface mapping, seismic refraction profiles and core borings. The objectives are to define overburden depth and the depth of surficial weathering in the bedrock, the excavation characteristics of the bedrock and the foundation conditions in the bedrock which will comprise the fuse plug foundation. The data obtained will guide the design of foundation treatment in the fuse plug foundation area and of stable excavated slopes in rock. Selected holes will be instrumented with thermistors and/or piezometers if necessary.

4. Diversion Tunnels. The exploration program for the diversion is designed to determine excavation conditions and support requirements. Additional mapping and boreholes, possibly augmented by geophysical surveys will serve to better define the conditions along these tunnels. Earlier investigations indicate that the diversion tunnels will cross zones of fracturing, shears, and some alteration zones. The potential for groundwater inflows at these zones during construction and the evaluation of rock mechanics properties at the tunnel level will be evaluated during these studies. Additional data will be gathered during the excavation and testing of the test adit planned for the right abutment.

Conditions at both portals of the diversion tunnels must also be evaluated, as they are near the two major known shear zones. Detailed mapping and at least one borehole at each portal would be completed to fully describe the conditions at these areas. Geologic mapping and core drilling is planned for the summer of 1983. The estimated exploration quantities and schedules are shown on Table D(k)-1 and Exhibit D(k)-1.

5. Outlet Facilities. Since the Outlet Facilities share the Power Intake approach channel and since the gate structure is closely integrated with the Power Intake, the exploratory work described for pertinent portions of the Power Intake will include the upstream elements of the Outlet Facilities. Similarly, since the discharge for the Outlet Facilities is integrated with the Main Spillway flip bucket, the exploration therefore will be accomplished as part of that for the flip bucket. Detailed geologic mapping and subsurface exploration of the outlet area will be especially important inasmuch as the outlet structures for the Main Spillway, power tailrace tunnels and the diversion tunnels are adjacent to one another, requiring close attention to design of stable rock slopes and appropriate rock anchorage systems. Exploration for the Outlet Facilities tunnel will be accomplished as part of the subsurface drilling and testing for the underground facilities which will be done to delineate significant geologic structural features and for detailed design drilling both from the surface and from an exploratory adit.

6. Power Intake and Tunnels. The forebay, power intake structure and the adjacent outlet facilities gate structure as well as the upper portions of the penstocks are shown to be sited between two structurally disturbed zones, "The Fins" and feature GF2. Geologic Feature GF2 is not well understood in the area of the intake, but it has been postulated by the recent studies to intersect both the intake structure for the outlet facilities and the inclined portions of all six penstocks. The spatial relationships of these important geologic structural features, together with others which may exist in the area, and the physical character of the features and of the rock mass surrounding must be carefully explored to evaluate the impacts on the design and constructibility of the intake and penstocks. It is noted that rock cuts in the forebay and at the intakes are as high as 200 feet.

This area will be mapped geologically in detail in conjunction with seismic refraction profiling to determine overburden depths, depth of surficial bedrock weathering and to further delineate the continuity of the structural features. Exploration by core drilling to determine the nature of the disturbed zones at depth will be a priority item during the FY 1983 and

continuing drilling programs. Appropriate down-hole testing will be accomplished which will include water pressure testing to check permeability of the rock mass and the disturbed zones in particular, bore hole imagery, down-hole geophysical logging and hole-to-hole velocity surveys.

7. Underground Power Facilities. Initial geologic field work will involve detailed geologic surface mapping and seismic refraction profiling to fill in data on presence and continuity of significant structurally disturbed zones and the orientation of joint sets. Core drilling to determine the characteristics of structurally disturbed zones at depth and the orientation of the several joint sets at depth will be carried out early in the field program and prior to construction of an exploratory adit. The core drilling will be designed carefully to ensure that no geologic features go unnoticed that could have a potential significant impact on the layout, design and construction of the proposed underground power facilities.

The diorite body within which all underground chambers are sited is an intrinsically high strength rock, therefore the discontinuities in the rock mass are expected to dominate the behavior of the chambers during excavation and with time. Maximum use will be made of practical down borehole methods for defining the nature and orientation of discontinuities at depth and for determining the geomechanical behavior of the rock mass. These methods will include, but not be limited to, water pressure testing, downhole geophysical logging, down-hole and hole-to-hole velocity surveys, and borehole imagery such as borehole photography or TV logging.

The surficial mapping and refraction seismic profiling, together with previous field data, will furnish the basis for initial construction of the geologic model. The data obtained from a carefully planned sequence of core borings will be significant in filling in the three-dimensional character of the model at depth.

An exploratory adit is proposed to furnish data essential for design of the complex of underground chambers and tunnels. It will be driven for about 2,500 feet into the heart of the power chamber complex. It would provide access to small branch adits to investigate major rock structural discontinuities and for excavation of small chambers for field scale testing of the prototypes. The adit will be mapped in detail to record all geotechnical and geologic data pertinent to the design of the underground works. Core drilling from the adit and chambers will be done to investigate geologic features of special design importance and in connection with instrumentation to determine in-situ stress relationships, in-situ modulus of the rock mass

and for estimating the long term performance of openings in the rock. It is our present assessment that large scale in-situ tests such as flat jack tests or plate bearing tests will not be necessary, although the full range of "state-of-the-art" sophisticated in-situ tests will be considered on a most cost-effective basis if the need arises. In addition to providing essential design data, the adit will allow in-situ inspection of the underground rock mass for contractors which will enhance realistic fixed-price bid preparation.

Relict Channels and Reservoir Investigation. Two relict channels have been identified during previous exploration programs and both are scheduled to be investigated further during the summer of 1982. Field investigations carried out in these areas during the Design Phase commencing in January 1983 will be a logical extension of the previous work. The on-going investigations will be planned in detail after careful review of all field data obtained prior to January 1983. Estimated exploration quantities in the areas of the buried channels and in the reservoir rim area are shown on Table D(k)-1 and anticipated schedules are shown on Exhibit D(k)-1.

Watana Relict Channel. A Becker Hammer drill has been contracted for use in exploring the Watana relict channel and other overburden areas during the winter of 1983. It will be capable of penetrating and sampling the full depth of the unconsolidated materials filling the Watana relict channel. The data obtained from the hammer drilling will extend present understanding of the overburden stratigraphy at depth and of the configuration of the buried bedrock surface.

Additional field investigation of the Watana relict channel area will be planned for the 1983 summer field season to provide detailed design data on the geotechnical parameters of concern. Surface geologic mapping aided by aerial photo analysis will be carried out in any areas not adequately covered by previous work. Surface geophysical surveys will include refraction seismic profiling and magnetometer or gravity surveys if these prove practical. Also planned is exploration and detailed sampling of the full depth of overburden to rock using two rotary drill machines especially modified for transport by helicopter. This drilling and sampling will augment the shallow (to 150 feet) overburden drilling done in summer 1982 and the full depth drilling and sampling by Hammer drill in winter 1983. Methods will include Standard Penetration Tests (SPT), cone penetration tests, undisturbed sampling of various types as required, and down-hole geophysical logging. Hydrogeologic testing carried out in these boreholes to further establish the groundwater regime will include down-hole permeability tests and installation of piezometers. Dye tracer tests and pumping tests will be

added to the future programs if required. These holes will expand coverage of the permafrost regime in the relict channel area and will be instrumented with thermistors as required.

Fog Lakes Relict Channel. Field investigation of the Fog Lakes relict channel will be carried on during the 1982 summer program. After careful review of work previously accomplished, it is anticipated that additional geologic mapping aided by airphoto analysis and surface geophysical profiling will be required. The latter will include refraction seismic profiling and perhaps magnetometer and/or gravity surveys. Some drilling and sampling will be done to define overburden stratigraphy, the in-situ nature of the unconsolidated materials, to confirm top-of-bedrock configuration, to define the permafrost regime and to provide hydrogeologic data. Thermistors and piezometers will be installed as part of a long-term observation program. The full scope of exploration that will be needed will be determined and implemented sequentially as field data is obtained and evaluated. Initial design exploration activity in the Fog Lakes area will commence in the summer of 1983, and will continue through the summer of 1984 and beyond if necessary.

Reservoir. Aerial photo interpretation carried out by previous investigators has culminated in a set of Terrain Unit Maps illustrating surface geologic features and geotechnical conditions throughout the entire Watana reservoir area. Only limited field checking to establish ground truth of the airphoto interpretation was completed and only in the immediate vicinity of the Watana site has subsurface work been done to check the geotechnical properties of terrain units at depth.

Reconnaissance geologic mapping of the reservoir area will be scheduled for the summer field seasons of 1983 and 1984 using the already completed Terrain Unit Maps as a base. The reconnaissance will focus primarily on identification of potentially unstable slope areas capable of endangering the project if sudden failure were to occur and on areas of potential excessive reservoir leakage. The need for detailed mapping and subsurface investigation of any such areas can become apparent only as the geologic reconnaissance proceeds.

Construction Materials: Borrow Areas. Several borrow sites have been identified during previous investigations and labeled as Area D (relict channel), Area E, and Area I. The borrow areas will be used as sources of pervious and impervious materials for the main dam and the cofferdams, and as sources of concrete aggregates.

Additional geotechnical investigations in the identified borrow areas will consist of geologic mapping, geophysical pro-

filing, auger/rotary and hammer drilling in soils, test pits and trenches for laboratory and in-situ testing, and groundwater monitoring. The anticipated schedule calls for hammer drilling during the winters of 1983 and 1984, with the rest of the investigations completed during the summers of 1983 and 1984. Tasks and anticipated schedules shown on Table D(k)-1 and Exhibit D(k)-1 are subject to modifications as a result of the ongoing field investigations.

The data acquired during these and previous investigations will help determine the configurations of the source areas, the stratigraphy, material properties and permafrost occurrence within each source. The interpretation of the data will provide the basis for decisions concerning the management of the source areas and the processing requirements to fulfill the needs of the embankment designs and concrete aggregate.

Test Fill. In order to test the validity of the placement criteria adopted for the core material of the main dam, a test fill will be constructed within the confines of Borrow Area D. The construction will be awarded in January 1985 as part of the Diversion Tunnel contract. The test fill will provide essential information regarding compaction criteria, effectiveness of compaction equipment and material properties as compacted.

Quarries for Rockfill. Quarried rock will be needed for rockfill, riprap, and coarse filter material if such materials are not available from potential borrow areas. The 1980-81 Geotechnical report recommends the Quarry A site as the source of rockfill material. This site is adjacent to the left abutment. Rock at this site consists of both diorite and andesite. Additional investigations required at this site will consist of geologic mapping, core drilling, and geophyscial profiling studies to determine available volume of material, percentages of diorite and andesite, spacing of joints and fractures, and identification of any initial stripping required before actual quarry operation. Mapping, drilling, and geophysical exploration in this area is scheduled for the summer of 1984. Tasks and schedules are shown on Table 1 and Figure 1.

If permits can be obtained, blasting tests are planned to determine the actual size distribution of potential quarry material, to fulfill volume and size requirements for rockfill, riprap, and coarse filters. Material from the quarry locations would also be tested to determine the suitability of the diorite and andesite for use as concrete aggregate in the unlikely event that suitable materials cannot be located in any of the potential borrow areas.

Other possible sources of quarry material will be the spoils generated during the extensive underground excavations. The possibility of using this material in other parts of the project will be examined as part of the geotechnical exploration program for major project structures.

Auxiliary Facilities. Geotechnical explorations will be required for the site construction camp, water supply, airfield, roads, switchyard, and related facilities. To date, minimal explorations have been done for these facilities, since the results of such investigations would have little effect on project feasibility.

During the design stage, however, some siting and design activities will be required, and include geologic mapping, seismic refraction surveys, and drilling and testing. These activities have not been firmly scheduled at this time, but would be completed in conjunction with the major exploration to ensure constant use of available staff and equipment.

Management and Control of Field Investigations

General

In planning and conducting the geotechnical investigations, the Joint-Venture will stress four goals: consistency, completeness, flexibility and cost-effectiveness.

Consistency of Data. In conducting a field program of this magnitude, it is imperative that all of the data collected be of uniform high quality, readily comparable with other data collected for this project and for other similar projects reported in the literature. The starting point in attaining this goal is the Joint Venture Field Procedures Manual. This manual will be prepared by the Joint-Venture from the existing Harza and Ebasco geotechnical procedures manuals prior to beginning field activities. Similarly, a joint Quality Assurance Systems Manual will be prepared. All project geotechnical personnel will be thoroughly familiar with in the contents of the Joint-Venture manuals and compliance with the manuals will be monitored closely by the Joint Venture supervisory staff.

All other field and laboratory data collection and reduction will be performed in accordance with the appropriate ASTM AASHTO, COE, USBR, BLM, and USBM procedures and standards as established during the planning stages of the project. Standard forms, such as Joint Venture logs and reporting forms will be adopted so that all data is collected and reported in a uniform way by all members of the project team, including subcontractors.

Completeness. It is vital that all pertinent geologic features be detected and defined so that adequate design provisions can be taken. To do this, we will use a staged exploration technique to obtain all necessary data. In general, initial efforts will be done on a reconnaissance-level basis making maximum use of previous investigations, reconnaissance-level mapping, sampling and other techniques to obtain maximum areal coverage with a minimum of resources. Pertinent features and critical areas revealed by this initial investigation will be studied more thoroughly. Detailed investigations will then be carried out in areas of critical importance and on features which are of particular significance to the project. In a few instances, especially in investigations of critical features, it will be necessary to use state-of-the-art techniques and instrumentation to obtain the information required.

Given the extensive studies which have already been completed, it is expected that relatively little reconnaissance-level effort will be required. The phase approach will ensure that all features of significance for any given aspect of the project will be specifically checked with the level of detail and effort required to meet project requirements.

Flexibility. In a program of this scope, the exploration program must maintain a high level of flexibility. This flexibility must apply to both the type of investigation required to obtain the required information and to the equipment available.

Investigation flexibility is achieved largely through careful planning, organization, and monitoring of results. Use of a phased exploration program and careful attention to program objectives will result in the appropriate level of investigation being used to obtain the required information, with neither too few or too many resources assigned to the solution of a given problem. On-going data reduction and good communication with the design staff in the Bellevue office will allow rapid evaluation of data and will permit timely adjustments. Constant review of data and comparison with multiple interpretive models will allow the on-going revision of those models as well as refinements in the data collection process.

Flexibility in equipment is achieved by using an assortment of versatile equipment having an ample spare parts inventory and ready access to additional specialized tools, equipment and services through a group of highly qualified subcontractors. By having such equipment and the managerial flexibility to shift levels of investigation and areas of study as required, the program will maintain a high level of flexibility.

Cost Effectiveness. A cost effective investigation program will result in large part from adherence to the three principles described above. The data will be of uniform high quality and will be handled efficiently through use of standardized procedures. The investigation will be complete in the sense that geologic features and foundation areas will be investigated to an extent commensurate with their impact on the designs and with the designers' needs while avoiding investigative "overkill." Flexibility of program planning, operations and exploratory methods will be maintained so that the investigation will be fully responsive both to geologic conditions encountered and to the design requirements and schedules. The key element in realizing these aims and a cost effective investigation program will be the highly qualified Harza/Ebasco geotechnical personnel who will be responsible for carrying out and managing the investigation tasks.

Management of Subcontracts

The strength and experience of the Joint Venture's geotechnical team will be augmented by subcontractors offering highly specialized technical services. Subcontractors for professional activities already have been selected as follow:

- Foundation Sciences, Inc. will furnish professional services for performance of in-situ rock testing in exploratory adits and will provide consultation in design activity involving rock mechanics. FSI is recognized as a leader in the applied and theoretical aspects of in-situ rock mechanics testing.

- R.A. Kreig & Associates, Inc., a consulting firm based in Anchorage, will furnish professional services in terrain analysis to complement the Joint Venture's geologic mapping tasks. Professionals of the firm are specialists in air-photo interpretation, remote sensing, permafrost investigations and geologic mapping and have worked on terrain studies throughout Alaska.

- Harding-Lawson Associates (HLA), a nationally known geotechnical consulting firm, will provide professional technical support almost entirely through the sizeable staff and laboratory facilities in their Anchorage office. HLA will furnish auger/rotary capability for sampling and in-situ testing of soils; will perform soils testing in a site laboratory, their Anchorage laboratory, and highly specialized soil testing in their California laboratory; will provide installation of thermistors and piezometers in boreholes; and will perform pump-out permeability tests in soils borings. They also will participate with Joint

Venture specialists in borehole geophysical tests and surface geophysical profiling. HLA's extensive Alaska experience will provide expertise in exploration under sub-arctic conditions.

- Frank Moolin and Associates, Inc. (FMAA), a large Anchorage consulting and management firm, will furnish important non-technical support to the Joint Venture field operations. Their services will include overall management of field camp construction, maintenance and operation; management of logistic support for transport of equipment, supplies and personnel; and subcontract administration accounting. FMAA have broad experience in engineering operations and construction management throughout Alaska.

Subcontractors for production-type work, such as rock core drilling, test grouting and adit excavation, will be selected on a competitive bid basis. Subcontracts will contain a clear, concise, detailed explanation of the objectives of the task, work to be performed, milestones, scope, and specifications.

Subcontracts will be prepared and administered by the Joint Venture, Contract Administration Group. This group will ensure that the business relationships between subcontractors, the Joint Venture, and the Alaska Power Authority function smoothly. The task discipline leaders will provide the contract administrators with on-going data on work accomplished and overall subcontractor performance.

Safety during Site Investigations

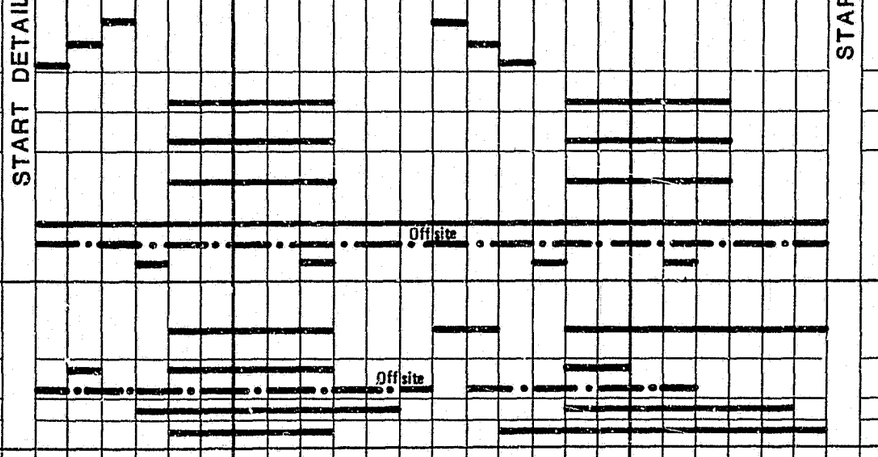
With regard to employees of the Joint Venture that are assigned to the field during these site investigations, the Joint Venture will assume responsibility for providing such employees with the appropriate training in construction safety, as well as other training such as arctic survival, first aid, and helicopter safety. For the purpose of preparing employees of the Engineer for their field assignments, we propose to use the most recent edition of the "Driller's Safety Manual," as published by the U.S. Bureau of Reclamation. Each employee assigned to the field will be provided with a copy of this publication and will be charged with individual conduct in accordance with these safety standards.

Table D(k)-1

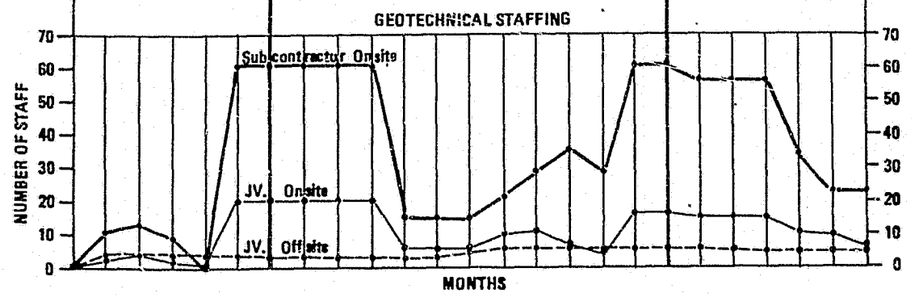
ESTIMATED PRE-CONSTRUCTION EXPLORATION AND MATERIALS TESTING

Task:	Geophysical Profiling	Rock Core Drilling	Hammer Drilling	Soil Auger/ Core Drilling	Trenches Test Pits	Adit Excavation	Watana Site Soils Lab	Anchorage Soils Lab	"Lower 48" Soils Lab
Contractor:	JV/Harding-Lawson	Subcontract To Be Let	Becker Drill	Harding-Lawson	Subcontract To Be Let	Subcontract To Be Let	Harding-Lawson	Harding-Lawson	Harding-Lawson
Units:	Feet	Feet	Feet (no. of holes)	Feet (no. of holes)	No. of Excatvations	Feet	No. of Tests	No. of Samples	No. of Samples
Geologic Structures	3,000	2,000							
Main Dam & Cutoff	3,000	5,000							
Diversion Tunnels	2,000	2,800				3,500			
Underground Power Structures		5,000							
Power Intake & Tunnels		2,000							
Outlet Facilities		500							
Main & Emergency Spillways	5,000	4,700							
Cofferdams	4,000	1,200	1,000 (10)						
River Channel	10,000		1,000 (10)				100	5	
Watana Relict Channel	11,000		3,500 (12)	7,500 (45)			600	20	10
Fog Lakes Relict Channel	12,000		3,500 (10)	6,000 (40)			450	20	
Borrow D	3,000		1,500 (3)	1,000 (10)	20		400	20	10
Borrow E	2,500		2,000 (20)	500 (10)	10		100	10	10
Borrow I	2,500		1,500 (15)	500 (10)	10		100	5	
Rock Quarry	3,000	500							
Auxiliary Facilities	8,000								

METHOD/SUBTASK	DESCRIPTION	REMARKS
1	MANAGEMENT FUNCTIONS – GEOTECHNICAL FIELD INVESTIGATIONS: A. Planning – Coordination B. Quality Control C. Data Compilation D. Data Presentation/Document/Storage E. Data Trans. & Sched. – Out Data Request – Action/Sched.– In F. Staffing – Scheduling G. Safety Assurance – Personnel	Anchorage Staff
2	ROCK EXPLORATION: A. Core Drilling Main Dam and Cutoff Cofferdams Diversion Tunnels Underground Structures Spillways Quarry Evaluation	Four drill rigs first summer season. Two to three rigs winter and summer 84.
	B. Test Grouting – Cutoff	
	C. In-Situ Testing Adit Excavation Rock Mechanics Instrumentation Borehole Geophysics & Imagery	Adit excavation 3500 ft.
	D. Laboratory Testing (Anchorage/"Lower 48") Petrographic Studies; Strength Property Parametric – Cores; Strength Properties – Discontinuities; Aggregate Acceptance	
3	SOIL EXPLORATION: A. Hammer Drilling Borrow Areas River Channel Relict Channels	One hammer drill
	B. Auger/Rotary Drilling Borrow Areas & Relict Channels	Two auger/rotary drills
	C. Trench and Test Pits Borrow Areas & Relict Channels	One backhoe/dozer
	D. Soil Testing In-Situ Laboratories Site Anchorage "Lower 48"	
4	SUPPORT EXPLORATION SERVICES: A. Geologic Mapping: Main Dam; Borrow and Quarry Areas; Relict Channels; Reservoir	Two mapping teams
	B. Geophysical Exploration (Surface): Main Dam; Borrow & Quarry Areas; Relict Channels; Reservoir	Two seismic teams
	C. Groundwater: Main Dam; Relict Channels; Borrow Areas; Reservoir	
	D. Surveying	Two survey teams
5	INSTRUMENTATION & TESTING: Thermistors & Piezometers	



NOTE: Most site activities two 10–hour shifts, 6 day week



HARZA-EBASCO

SUSITNA HYDROELECTRIC PROJECT

GEOTECHNICAL EXPLORATIONS SCHEDULE

HARZA - EBASCO

(l)
MANAGEMENT

ACCOUNTING | (m) CIRI | (q) PROCUREMENT | VALUE ENGINEERING | (o) QC/QA

D(1) COST AND SCHEDULE CONTROL

Planning, Scheduling and Management of Design Activities

The Joint Venture will utilize a fully integrated cost and scheduling system, known as Ebasco Project Information and Control System (EPICS). It is based upon the Department of Defense's Earned Value technique on all major engineering and construction projects since 1977. While the system has been fully operational and effective for over five years we are continually researching ways to modify the system and to improve our techniques. The system is modified to meet the specific requirements of each project. Some of the Engineering and Design Projects where EPICS has been successfully employeed include:

Client	Project
Princetion Plasma Physics	TOKOMAK Fusion Test Reactor Program
Houston Lighting & Power Company	Limestone Units 1 & 2 (2-750MW Lignite)
Peoples Republic of China	Anhui and Shandong (2-300 & 2-600MW Coal)
New York State Electric & Gas Company	Somerset Unit #1 (600-MW Coal)
Carolina Power & Light Company	Shearon Harris Units 1 & 2 (2-1100MW Nuclear)
Washington Public Power Supply Company	WPPSS Unit #3 (1200 MW Nuclear)
Consumers Power Company	Ludington Pumped Storage Project

On all of these project EPICS has been instrumental in controlling Project Milestones and Costs in spite of changing regulations and technical environments.

1. The Princeton Plasma Physics project was a research and development project leading to the design and construction of a new type of Nuclear Power Plant. The project had a very tight budgetary constraint in a highly political environment. The system met all major project objectives.

2. Limestone Units 1 & 2 will be the largest lignite-fired units built to date. They have had a difficult schedule, requiring that all engineering, design and procurement activities be completed within 22 months, in order to support a fixed-price construction bid package. The client also imposed severe cash flow restraints. The project's milestones were met and the budget has been successfully controlled.

3. The People's Republic of China projects also had a very tight schedule and a restricted budget and cash flow. Phase I involved Conceptual Engineering, Technology Transfer and working with Engineers from the Peoples Republic of China. EPICS was employed for project control purposes and Phase I has been successfully completed.

4. The Somerset Project was assumed by Ebasco from another firm after the client experienced major dissatisfaction with the other architect/engineer's control system. To date all major project milestones have been met and the project budget and cash flow have been effectively controlled through the employment of EPICS.

5. The Shearon Harris project has been successfully employing an Earned Value system since it was belatedly introduced onto the project in 1980. The project started before Ebasco employed an Earned Value system for project control but the success of our EPICS program convinced the client that additional controls would be beneficial. The project is supporting all major engineering and construction milestones and is controlled by a strict budget and cash flow. The client continues to show confidence in Ebasco's ability to control the project by continuing with Unit 2 while many other U.S. domestic utilities have canceled nuclear work.

6. On the Washington Public Power Supply System Unit 3 Project, introduction of Earned Value is credited with saving the unit. When the political environment against Nuclear work in Washington state focused upon schedule delay and cost overruns Ebasco was able to demonstrate improved performance through the application of Earned Value concepts to cost and schedule control. The project is now running slightly ahead of schedule and slightly under budget. Unit 3, the Ebasco project, was selected for priority funding over Unit 1 (which is being designed and constructed by

others) because of the confidence the Supply System felt with Ebasco's ability to control this project.

7. The Ludington Pumped Storage Project was the first Ebasco project to utilize a computer-based cost and schedule control system. While the system used on Ludington was in a preliminary stage when compared to the systems being used today, it proved to be a very effective tool in controlling project activities and meeting the established cost and schedule control goals.

Proposed Cost and Schedule Control Program

In order to manage the diverse elements of the Susitna Project, the Joint Venture will implement a comprehensive program designed to coordinate engineering, design and related services in terms of costs and schedules, as well as control the capital cost of the Project. The system will consist of an integrated set of methods, techniques, procedures and tools for organizing, planning, monitoring, and controlling project work and required resources.

Although the control of cost and maintaining schedules are the responsibility of the entire Project team, the primary focal point for the administration of the system will be the Project Control Manager, who will be located in the Anchorage office. He will be responsible for maintaining control of the services being performed in the various work locations (i.e. geotechnical, environmental and licensing work in the field and engineering and design work in Bellevue). The Project Control Manager will maintain close contact with Power Authority management and will be available to review Project status as necessary to verify to the Power Authority that progress is consistent with overall Project goals. The systems and methods to be used in cost and schedule control are described in more detail below.

Control of Technical Services

Technical and support services will be provided by the Joint Venture and various subcontractors primarily in Alaska and Bellevue. In order to control the work at these separate locations, we will establish cost/schedule control organizations in each location which will report to the Project Control Manager. For all of the Project services such as licensing, environmental, geotechnical, and engineering and design, the Joint Venture will provide the control elements identified below. The overall control system will be computer-based using Ebasco's mainframe computer with remote terminals or a separate minicomputer locat-

ed in Bellevue. The specific hardware to be used will be determined after a study of the effectiveness of each approach.

Work Breakdown Structure (WBS)

Early in the Project, we will establish a "Description of Technical Services" which are to be provided on the Project. This description will serve as a baseline for any adjustment of the Scope of Services necessary as the Project progresses and will be used to define specific work elements and tasks which will be required to complete all technical work on the Project. The specific work elements will be reflected in a Project Work Breakdown Structure (WBS).

The WBS is a product-oriented family tree of work elements which organizes and defines the items of work associated with the Project and shows their relationships with to work elements (see sample WBS Exhibit D(1)-1). The WBS will divide the total project into classes such as Project control services licensing, engineering and design. Each of these major classes will then be divided into more detailed work elements and, if desired, into specific tasks until the lowest practical level is reached. The WBS therefore will define specific Project work categories and the corresponding tasks required to complete each category. It is at this task level that basic Project control takes place.

The WBS satisfies two of the basic needs of Project Management. It clearly defines the total scope of work, organizing it in a logical fashion to prevent tasks from being omitted or duplicated and provides a basis for cost and performance monitoring and control. After completion of the development of the WBS, the budgeted work hours for the Project will be allocated to all tasks in the Work Breakdown Structure. The budgeted work hours, therefore, will be assigned to unique activities in the CPM and will be used in resource planning.

Each task is assigned to a Project team member who is directly responsible for its completion. Therefore, while Project Management personnel will use the WBS to assess the overall performance of the Project, individual team members will use it to isolate their own work elements and assess status and performance.

Scheduling System

After identification of all of the Project work elements through preparation of the WBS, we will develop a resource-loaded Project Schedule. The scheduling system which the we will employ consists of three basic types of planning.

Time Planning. We will develop a time-phased Critical Path Method (CPM) schedule consisting of all of the Project work elements defined in the WBS. To develop the CPM, we will use network-based logic diagrams for each specific task. The logic diagram will reflect the specific activities required to complete a task and will also contain, where applicable, constraints on each activity which are caused by the activities of other tasks (e.g., vendor information requirements). The logic diagrams permit a direct correlation of the work elements and the overall WBS and, therefore, ensure that all Project work elements are included in the CPM. Based on the confines of the Project scope, the interdependencies of the Project activities, and the known key milestone dates, early start/late start and early finish/late finish boundaries for activities will be established. Consideration will be given to early and late dates for activities during the resource planning.

Resource Planning. In order to obtain a logical and smooth assignment of personnel to the Project and make the most effective use of the Project Team, we will carefully plan the allocation of manpower resources. In this planning, consideration will be given to the early start/late start and early finish/late finish dates identified during the time planning phase of CPM development. By making a correlation between the workdays required to complete each task (see WBS) and the early/late dates, resource envelopes (or pairs of S-shape curves) will be developed to review cumulative early start and late finish usage of resources.

Action Planning. The final step in development of the resource-loaded CPM involves a review of required manpower resources relative to their availability and most effective usage. This information is entered into a resource planning and scheduling program to test the possible allocation against each activity. The feasibility of staying within the early-late boundaries is examined by going back through the Resource Planning Program as often as necessary to achieve a satisfactory optimum. At this point the Budget Baseline or Resource-Constrained schedule is ready.

Dates established by the Baseline Schedule are then transferred to the Specification and Procurement Schedule and Drawing Schedule as target dates for completing Engineering and Design activities.

Engineering Progress Measurement System (EPMS)

Completion of the resource-loaded CPM schedule will allow the objective measurement of cost and schedule through use of an Earned-Value System.

Essentially, the Earned Value System measures the actual performance of the Project in cost and schedule relative to established budgets and schedules. It provides a numerical indication of this performance. The system contains several types of control. Two basic areas, however, cost and schedule control, are the primary considerations.

Cost Control. Asssessment of cost performance relative to the Project Baseline is provided through identificaion of two numerical factors - the Budgeted Cost of Work Performed (BCWP) and the Actual Cost of Work Performed (ACWP). At any point in time when a specific task is in progress, it has achieved a certain level of physical completion, measured in work hours. The resource-loaded CPM schedule will identify the budget (in work hours) to complete that portion of the task actually accomplished. This is the BCWP. The ACWP is the actual number of work hours which were required to complete the same portion of the task. By comparing the BCWP to the ACWP for the task, it can be established whether the cost of the task is under budget, on target, or over budget. The ratio of ACWP to BCWP provides a Cost Performance Index (CPI) which is calculated for each individual task as well as for the total project.

The following example shows how the system will be applied:

Example 1

Assume:

- Task is preparation of engineering equipment specification.
- Total task budget is 400 workhours.
- CPM indicates that the first draft of the spec was to be issued during the month.
- A budget of 240 workhours has been allocated to preparation of the first draft.
- The first draft was issued during the month and a total of 210 workhours have been expended.

Therefore:

- BCWP = 240
- ACWP = 210

- CPI = $\frac{\text{BCWP}}{\text{ACWP}} = \frac{240}{210} = 1.14$

- Cost performance-to-date is 14% greater than anticipated on the task.

Schedule Control. In a similar manner, a Schedule Performance Index (SPI) can be calculated which identifies task or overall Project performance relative to the established baseline. The items which are compared are, once again, the BCWP and another factor, the Budgeted Cost of Work Scheduled (BCWS). The BCWS reflects the budget in work hours of the work which was scheduled to be completed during the specific time period under consideration. By comparing the BCWS to the BCWP, the SPI can be calculated. This numerical value will indicate whether the task or overall project is ahead of schedule, on target, or behind schedule. Example 2 demonstrates the manner in which schedule control of tasks will operate.

Example 2

Assume:

- Same as Example 1

Therefore:

- BCWP = 240 (workhours budgeted for first draft)

- BCWS = 240 (because first draft was schedule to be issued during the month)

- SPI = $\frac{\text{BCWP}}{\text{BCWS}} = \frac{240}{240} = 1.00$

- Task is on schedule.

Summary. By comparing the CPI (1.14) and the SPI (1.0) it is determined that the task is on schedule and under budget.

CPM Update. Each month, as part of the assessment of Engineering Performance, each team member and/or Task Leader responsible for a scheduled task (or series of tasks) updates his respective part of the Project schedule. The purpose of this update is to report actual activity durations or start/complete dates during the previous month and to forecast realistic activity durations or start/complete dates for future activities. The impact of this update is assessed by the Cost/Schedule Engi-

neer in terms of the Project Baseline Schedule. Exhibit D(1)-2 is a sample schedule progress report.

Use of the Earned Value System as a Management Tool

The objective cost and schedule performance indices can be used as an effective management tool to control the completion of Project tasks. Variances or deviations identified by these indices are reported to Project Management in the form of a Variance Analysis Report. While variances are monitored at the task level of the Work Breakdown Structure (WBS) only significant variances are reported to Project Management and are only at higher levels of the WBS. Variance thresholds will be established at Project inception for Cost, Schedule and Critical Path Activities. When a threshold is exceeded, a Variance Analysis Report (Exhibit D(1)-3) will be prepared. This analysis will include identification of the variance, definition of the problem or reason for the variance and a recommended plan for corrective action. These Variance Analysis Reports comprise an early warning system for the Project as they immediately identify trends which indicate potential problem areas requiring Project Management's attention.

Project Change Control

Recognizing that potential changes to a Project can have a significant impact on service costs, capital cost and schedule, we will implement an established change control procedure on the Project. This procedure requires that potential changes in the Project be identified to Project Management as soon as they are recognized and dictates that no work be performed on a change until an appropriate disposition has been made. Responsibility for identification and notification of potential changes rests with each Project team member and each change is processed through use of a Project Change Request (Exhibit D(1)-4). The Project Change Notice is immediately sent to Project Management for information and action, as well as to the Project's cost and schedule team for impact evaluation. The evaluation includes such items as:

- Total cost of the change including services and capital cost
- Effect on the critical path or end date of the project
- Effect on current schedule

- Effect on cash or staffing requirements for the Project

Once this information is received by project management, a decision can be made which takes the following forms:

- Proceeding or not proceeding with the change

- Determining what corrective action is necessary and possible to bring the Project back in line with the schedule.

Potential changes and their associated impacts are summarized once each month in a Monthly Potential Cost/Schedule Report (Exhibit D(1)-5) which is accompanied by a brief narrative that provides salient explanations for cost variances.

Control of Project Capital Cost

The Joint Venture recognizes the importance of controlling Project capital costs especially considering the magnitude of the Susitna Project. To this end, the Joint Venture will assign a Project Estimator, located in Bellevue, with responsi-bility for the performance of the estimating services described below. As necessary, the Project Estimator will draw upon Project technical personnel and other members of the Estimating Department to complete these activities.

Estimates of Overall Project Capital Cost

During the course of the Project, the Joint Venture will prepare three formal estimates of overall Project cost in the Federal Energy Regulatory Commission (FERC) Code of Accounts. These estimates will increase in accuracy as the amount of detailed project information available at the time of the estimate increases. The estimates which will be prepared are defined below.

Budget Baseline Project Estimates. The Joint Venture recognizes that a significant amount of cost data was generated by Acres and Ebasco in two independent estimates prepared for the project. The Joint Venture will utilize this data as the basis for preparation of a Budget Baseline Project Estimate. The specific work involved will consist of refining the existing data to reflect the optimization of project features that will occur during a review of the existing project design. This estimate will include conceptual quantities of material and installation resources, engineering workhours, construction workhours and cost of these items together with a cash flow schedule by year. Variations between this estimate and the previous estimates will be explained in detail.

- Maximum potential project cost overrun and underrun, as well as the probabilities of various overruns and underruns between these extremes
- Probability of overrunning the estimate
- Level of confidence of the estimate
- Ranking of the potential critical items

This program provides a means of statistically measuring the uncertaintites. Furthermore, the program permits the selection of an appropriate contingency amount and brings the chance of overrunning the estimate to an acceptable risk level.

Engineers Estimates

Equipment or Materials Inquiries

In order to establish a reasonable basis for comparison of Vendors equipment or materials quotations, the Joint Venture will prepare "fair value" estimates of the cost of the 16 major equipment and materials specifications which are to be purchased for the Project. One estimate will be prepared for each Bid Package and will be based on the same inquiry documents which are sent to prospective bidders. These estimates are not intended to identify the low quotation figure but rather to provide a reasonable assessment of cost.

Engineer's Estimate of Construction Packages

In addition to the Engineer's Estimate for Equipment or Material which identifies costs for these items. We will prepare Engineer's Estimates for each of the proposed construction contracts. Due to our experience in Alaska and our construction capabilities, we are well qualified to provide an accurate estimate of construction contract cost to assist in the bid evaluation process and and to support the project cost control programs.

These Engineer's Estimates will be based upon the same inquiry documents as will be sent to the prospective bidders. The format of the estimates will be identical to the bid format required of each bidder, in order to facilitate review of proposals. It will allow a direct comparison with any values generated by the contractors. Preparation of these estimates will include:

- Quantity take-off from the contract/construction drawings
- Collection of data by examination of the site and project area and research of published data:
  - Labor Rates
  - Material Sources
  - Access to Site
  - Port facilities, roads, railroads
  - Climatic Conditions
  - Seasonal Conditions
  - Geological Conditions
- Evaluation of construction method, plant and equipment
- Analysis of diversion schemes
- Determination of production rates for labor, equipment and sequences of work
- Utilization of construction schedules
- Calculation of Contractor's direct costs
- Calculation of Contractor's indirect cost
- Determination of Contractor's profits and contingency allowances
- Unit cost potential
- Any other cost factors unique to the Project.

By using the Engineer's Estimates during the bid evaluation process, we will be able to establish whether or not each contractor completely understands the scope of work in the package and whether or not the bid is comprehensive enough to support his fixed price. In this way we will be better able to determine the validity of the bids, minimize the unit price approach to the base bid and minimize potential changes.

Support of Project Design and Cost Control Systems

As indicated, the Joint Venture will assign a Project Estimator to the project who will be responsible for completion of the specific estimating items described above and will also function as an integral member of the Project Team. His responsibilities will also include support of project design and cost control systems through preparation of study estimates, order-of-magnitude estimates and analyses. Study estimates will be

performed as necessary to assist in the evaluation of alternative designs or equipment in specific areas from a cost point of view. Order-of-magnitude estimates will be prepared for the project to explore design concepts when information is minimal or insufficient time is available for a detailed estimate but an assessment of cost impact is important to he final decision on the design. In addition, the Project Estimator will provide important input to the Monthly Potential Cost/Schedule Report through analysis of the cost impact of Project Change Notices. The input provided by the Project Estimator will be used by Project Management in their final evaluation of all potential project changes.

Construction Control Systems

Our proposed control system, which we have implemented successfully on previous projects, approaches construction control in fundamentally the same way that technical and capital cost are controlled during the engineering and design phase. It relies on task identification, development of a resource-loaded schedule, calculation of earned-value indices and control of capital cost through quantity assessment. Our recommendation is that the system be implemented in one of two ways. The first alternative would be have the Joint Venture provide the full cost and schedule control staff at the site, as part of the overall project management functions. The second alternative would be to have the Construction Manager perform all of the cost and schedule control activities, with a smaller Joint Venture site staff monitoring the implementation of the program as the Power Authority's representative.

In either case, we will discuss the size of our site staff after a decision has been reached concerning the approach to be used. We examine below the highlights of the system.

Development of a Construction CPM Schedule

In order to properly monitor the cost and schedule during the construction phase of the project, it will be necessary to develop a resource-loaded CPM schedule in a manner similar to the development of the engineering and design CPM. To do this will require the assembly of those elements which will form the basis for the CPM. They are:

- The key milestone dates identified by the Power Authority.
- The Engineer's Estimate for each construction contract package which indicates quantities and man-hours by account code.

Using a logic-based scheduling system, the early start/late start and early finish/late finish dates will be identified in a manner similar that in the engineering process. The resources, in this case materials and manhours, are then loaded into each construction task and the appropriate resource envelopes developed. As with engineering, the required resources are reviewed relative to an effective loading regimen, and entered into a resource planning and scheduling program to evaluate their allocation. When a satisfactory optimum is achieved, the resource constrained schedule is ready. Key dates established by this schedule are then identified for use in construction contract bid packages as described below.

Construction Contract Packages

Part of the information included in each construction contract package will be the key milestone dates developed as part of the CPM schedule effort. Each potential contractor will be required to submit, as part of his bid, a schedule or comments on the milestones with a commitment to meeting project schedule goals. In addition, the detailed reporting requirements of the project construction cost/schedule control program will be specified so that each contractor is aware of the information which must be submitted to support the control effort. Compliance with these requirements will be a critical contract evaluation point. The successful bidder will be required to submit, at the start of his construction activities, a resource-loaded CPM. This CPM will be compared with the CPM generated by the Construction Manager or the Power Authority's Project Manager and, after resolution of discrepancies, will become the baseline for monitoring the contractor's cost and schedule performance. Additional information which will be required from the Contractor will include, but not be limited to:

- Contract cost by account code with material costs and quantities, installation costs, craft manhours and unit installation rates
- Monthly cash flow
- Staffing level by month

Monitoring of Cost Performance

The key element of the construction cost control system is the Project Quantity and Manhour Report (PQMR). This report, which should be completed by each contractor, will show actual quantities and manhours for construction tasks for the specified time period. The quantity and manhour values will be accumulated in accordance with the code of accounts and will therefore be

capable of direct comparison with the schedule and the project estimate. These data will be useful to the project cost control group in the assessment of performance. Some of the ways the data can be used are:

- Calculation of productivity rates for craft labor to determine if sufficient labor is available on site to maintain the schedule

- Comparison with reports of installed quantities to verify their accuracy

- Comparison with actual progress

- Calculation of percent complete through use of an earned value concept, i.e., develop a ratio of:

$$\frac{\text{Budget Manhours for Detail Account}}{\text{Budget Manhours for Total Project}}$$

  where the budgeted manhours for the detail account are the budgeted manhours for the work actually completed By compiling these data for each account code, an overall percent complete can be established for the total project.

The above items illustrate just some of the many ways the PQMR data can be used. The Joint Venture system can provide many similar types of analyses and corresponding reports, all of which have been proven to be useful in the control of construction cost and schedule. For this project, the specific needs of the Power Authority will be discussed in detail and a system will be developed which will be responsive to project requirements. In any case, the available systems have been proven to be effective in monitoring the performance of contractor, assessing the validity of the information they provide, and evaluating and reporting on variances to project cost and schedule parameters.

Construction Schedule Control

In addition to the cost control staff, the construction control program includes the assignment of a scheduling engineer to assist in the assessment of project performance and develop scheduling details to minimize project delays. The scheduling engineer works closely with both the construction management staff and individual contractors in performance of his functions. Following are some of the activities of the scheduling engineer:

- analysis of the overall schedule including daily report of potential schedule problems, monitoring of actual progress relative to schedule requirements, providing impact to the cost control staff and updating the schedule to reflect current status

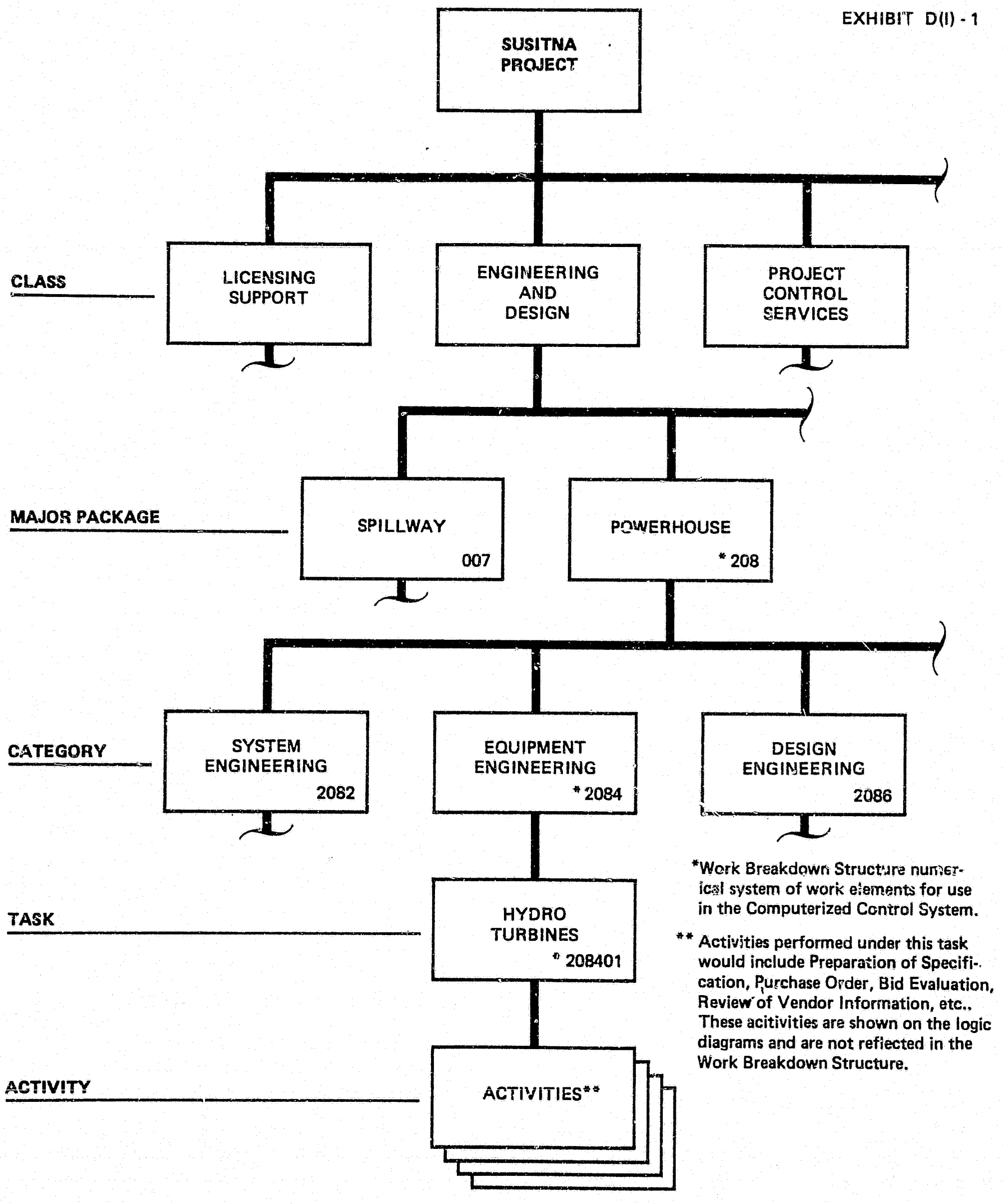
- assistance in project planning for future activities, such as development of new approaches to work, development of plans to accomodate problems caused by material shortages or other conditions, and monitoring of equipment and material deliveries relative to contractor needs.

- review of physical accomplishment curves and manhour reports and coordination with weekly construction schedule plans.

As with the cost control systems, the scheduling activities can be tailored to meet project requirements. The specific needs of the Power Authority and the project will be evaluated and discussed prior to the development of a detailed program in the scheduling area.

As is the case with engineering, design and capital cost control. The Joint Venture recommends the use of a computer-based construction control system. This could be accomplished with a mainframe/remote terminal approach or an on-site minicomputer which could also be used to control other site accounting functions. A final decision on which type of hardware should be used would be subject to analysis and study.

EXHIBIT D(I) - 1



*Work Breakdown Structure numerical system of work elements for use in the Computerized Control System.

** Activities performed under this task would include Preparation of Specification, Purchase Order, Bid Evaluation, Review of Vendor Information, etc.. These acitivities are shown on the logic diagrams and are not reflected in the Work Breakdown Structure.

SUSITNA HYDROELECTRIC PROJECT

SAMPLE ENGINEERING WORK BREAKDOWN STRUCTURE

HARZA-EBASCO

HARZA-EBASCO

SCHEDULE PROGRESS REPORT

PROJECT NAME: ••••••••••••••••••PROJECT X••••••••••••••••••• MASTER FILE: (PLAN)SITEH/MST1300637. STATUS DATE: 01MAY80 PAGE 171

EBASCO SERVICES 87780 CPM RUN TUESDAY 05/13/80, TIME IS 01:19:21 PM.

SORTED BY: PREDECESSOR / SUCCESSOR

BARCHART SCALE := 8 SYMBOLS PER MONTH
BARCHART START := 01MAR80
STATUS DATE MARKER (=A) := 01MAY80
STATUS PERIOD END (=I) := 01JUN80

REPORTING PROGRAM: (ECPM)P/ARCPMREPORT. VERSION = 01P
CURRENT = X (STATUS DATE: 01MAY80) (PLAN)SITEH/MST1300637.
CURRENT (ACTUAL = A, CRITICAL = C)
PREVIOUS = P (STATUS DATE: 01APR80) (PLAN)SITEH/MST0990686.
TARGET = T (STATUS DATE: 01JAN80) (PLAN)SITEH/MST0990907.

1980: M A M J J A / A P A U U U / R N Y N L G

PRED EVENT	SUCC EVENT	ACTIVITY DESCRIPTION	EARLY START	RES (D)	0 0 1 2 0 0 1 2 0 0 1 2 0 0 1 2 0 0 1 2 0 0 1 2	EARLY FINISH
19240521	19240523	RECEIVE PROPOSAL=MOTOR CONTROL CENTERS		GNS	TTTTTTTTTTT PPPPPPPPPP XXXXXXXXXX	
19240523	19240525	BID EVAL & RECMD=MOTOR CONTROL CENTERS		NET	TTTTTTTT PPPPPPPP XXXXXXXX	
19240525	19240527	CLT PURCH AUTH =MOTOR CONTROL CENTERS		TNU	TTTTTTTT PPPPPPPP XXXXXXXX	
19240527	19240528	PREP PURCH REQ =MOTOR CONTROL CENTERS		GN	T PP XXX	06SEP80
19240527	19240529	PREP PURCH SPEC =MOTOR CONTROL CENTERS		GN	T PPPP XXXXX	13SEP80
19240529	19240531	ISSUE P.O. =MOTOR CONTROL CENTERS		GNV	PP X	27SEP80 11OCT80
19240729	19240731	ISSUE P.O. =480 VOLT POWER CENTERS	A03JAN80 A03JAN80	TNV	PPPPPPPPPPP AAAAAAAAAAAA	
19240731	19240732	VDR SUB,REVWERF=480 VOLT POWER CENTE 22JAN80 VDR SUBMIT DWGS =480 VOLT POWER CENTERS		GNX GNX	TTTTTTTTTTTTTTTTTTTT PPPPPPPPPPPPPPPPPPPP AAAAAXXXXXXXXXXXXXXXXXXXX	
19240732	19240732	O=VDR SUB,REVWERF=480 VOLT POWER CENTERS REV=REL FOR FAB=480 VOLT POWER CENTERS		GNX	T PPPPPPPPPP XXXXXXXXXX	
19240752	19240753	FAB & DELIVER =480 VOLT POWER CENTERS		GNY	TTTTTTTTTTTTTTTTTTTTTTTT PPPPPPP X	21OCT80 06JAN81 20JAN81
19240931	19240933	VDR SUBMIT DWGS = STAND-BY POWER TRANS 08JAN80 VDR SUBMIT DWGS =STAND-BY POWER TRANSA26JAN80 A26JAN80		GNX	TTTTTTTTTT PPPPPPPPPPPPPPPPPPPPPP AAAAAAAAAAAAAAAAXXXXXXXX	

EXHIBIT D(i) - 2

HARZA-EBASCO

VARIANCE ANALYSIS REPORT

SHEET ____ OF ____

WBS NO. _____ FILE NO. _____

WBS TITLE _____ DATE ____/____/____

VARIANCE TYPE: ☐ COST ☐ SCHEDULE

CAUSE OF VARIANCE (Explanation of the problems separately for Cost and Schedule)

POTENTIAL IMPACT (On project, other tasks and this task; new Estimate at Completion (EAC) if required)

CORRECTIVE ACTION (If required)

STATUS OF PREVIOUS CORRECTIVE ACTION

	CURRENT MONTH	CUM TO DATE	AT COMPLETION		EXCEEDS THRESHOLD	ACTION REQUIRED BY: (Responsible Individual(s)/ Organization)
BCWS			*	CUMULATIVE SCHEDULE VARIANCE BCWP-BCWS	MH _____ ☐	☐ CLIENT _____
BCWP				CUMULATIVE COST VARIANCE BCWP-ACTUALS	MH _____ ☐	☐ PROJECT MGMT _____
ACTUAL COST			†	AT COMPLETION COST VARIANCE BAC-EAC	MH _____ ☐	☐ OTHERS _____

SUBMITTED BY			APPROVED BY		
SIGNATURE	DATE	PRINT NAME & TITLE	SIGNATURE	DATE	PRINT NAME & TITLE

LEGEND: † Estimate at completion * Total Budget

EXHIBIT D(I) - 3

EBASCO SERVICES INCORPORATED
PROJECT CHANGE REQUEST

CHANGE ORDER NO.			
WBS NO.	Change is Considered to be: In-Scope ☐ Out-of-Scope ☐ Performance ☐		
CHARGE NO.			

IMPACTS OTHER PARTICIPANTS NO ☐ YES ☐ LIST:

DESCRIPTION OF CHANGE COST ☐ SCHEDULE ☐ SERVICES ☐

REASON FOR CHANGE

IMPACT ON BUDGET (Include present budget, change, and new total – by participant)

IMPACT ON SCHEDULE

ATTACHMENTS AS REQUIRED

☐ REVISED CPM ☐ MANPOWER SPREAD EPMS & CPMS FORMS ☐ REVISED SCOPE OF WORK OR REVISED TASK DESCRIPTION

APPROVALS	DATE	APPROVALS	DATE
TASK LEADER		COST/SCHEDULE CONTROL ENGINEER	
DISCIPLINE SUPERVISOR		CLIENT APPROVAL ☐ HAS BEEN RECEIVED FROM _____ ☐ HAS NOT BEEN RECEIVED	
PROJECT ENGINEER			
EBASCO PROJECT MANAGER		EPMS & CPMS INPUT-COMPLETED DATE	/ /
PREPARED BY		DISPOSITION	

DISTRIBUTION	CLIENT	E
PROJECT MANAGER	☐	☐
PROJECT ENGINEER	☐	☐
TASK LEADER	–	☐
COST/SCHEDULE CONTROL	☐	☐
SERVICES COST ENGINEER	☐	☐

DISPOSITION

☐ FORECAST APPROVED - BUDGET APPROVED - PROCEED WITH WORK

☐ FORECAST APPVD - BUDGET NOT APPVD - PROCEED WITH WORK

☐ FORECAST NOT APPROVED - DO NOT PROCEED WITH WORK

HARZA-EBASCO

EBASCO SERVICES INCORPORATED

POTENTIAL PROJECT COST/SCHEDULE SUMMARY REPORT

(ALL AMOUNTS IN $1000)

DATE OF ISSUE: MAY 1980

PREPARED BY: J D

APPROVED BY: R L Y

CLIENT: ABC LIGHTING & POWER COMPANY

PROJECT: TYPICAL POWER PLANT

EST. NO. ABC 1234 D-1 DATE June 1, 1979 ADJ. FOR APPROVED SCOPE Δ'S	PROBABLE COST FORECAST DATE March 1980	POTENTIAL COST CHANGE *		TOTAL POTENTIAL PROJECT COST
		THIS PERIOD	TO DATE	
$ 750 000	$ 760 000	$ 6000	$ (1000)	$ 759 000

REMARKS:

	SCHEDULED	ACTUAL
% COMPLETE: ENGINEERING	80.0 %	82.0
CONSTRUCTION	25.0 %	23.0
BOOKED		$ 150 000
COMMITTED, NOT BOOKED		$ 20 000

The following is a list of potential variances which may significantly impact the Project Cost, but have not yet been included in the Total Potential Project Cost.

1) Potential increase to material and installation costs resulting from escalation exceeding the 8%-per-year currently estimated	$ 20 000
2) Potential increase in installation cost resulting from poorer performance in structural steel erection than estimated	$ 2 000
3) Possible delay of one (1) month in Trial Operation due to Boiler-maker strike	$ 4 000

EXPLANATION OF POTENTIAL COST CHANGES:

1) Increase in estimated quantity of power and control cable	$ 1 000
2) Cost savings resulting from Ebasco performing electrical work on a Force Account basis	($ 5 000)
3) Increase in allowance for funds during construction from 8%/year to 9%/year	$10 000

Potential cost changes are defined as significant changes recognized during the current reporting period. Those estimated on an order-of-magnitude basis will be re-evaluated when more definitive information is available.

EXHIBIT D(i) - 5

HARZA-EBASCO

CIRI

ACCOUNTING | INVOLVEMENT | PROCUREMENT | ENGINEERING | QC/QA

D(m) NATIVE VILLAGE AND COOK INLET REGION AGREEMENT

Introduction

The Joint Venture has examined the agreement between CIRI and the Alaska Power Authority. We find its provisions consistent with practices and experiences of the Joint Venture firms on several prior assignments. Particularly, our experience on projects in the western states of the lower forty-eight has involved programs of the type defined by the terms of the subject agreement. We anticipate no difficulty in implementing such a program.

Our project manager, together with other principals of Harza and Ebasco, have met with George Kriste and members of his staff at CIRI to discuss our proposed Native Village program. We have established the major features of this program based on these discussions.

Management

Frank Moolin and Associates will manage the Native Village program for the Joint Venture. They will maintain close liaison with the Native Village's Inspector. Through this liaison, we will execute the agreement provisions of transfer of information, reports, and studies. Also, disposition or removal of temporary facilities at the site and/or their deeding over to the Native Villages will be handled by the FMA staff, working with the Inspector and individuals designated by the Inpsector. Any new permit required, as well as extensions to existing ones, will be arranged through FMA, who has assigned Mr. W. Turner as their manager for this important implementation effort.

Camp Expansion, Relocation, and Operation

We have secured verbal agreement with CIRI that their joint venture of CIRI/Holmes and Narver will design, construct, and operate a temporary field camp at the site suitable for a maximum residency of 120. This subcontract will be developed and entered into upon acquiring the agreement of the Power Authority. Mr. W. Turner will manage this subcontract for the Joint Venture.

Affirmative Hiring

We will designate an affirmative hiring manager to ensure that all required notices are properly posted at site and office locations, that all contracts include the appropriate affirmative hiring provisions. He will monitor and report on the affir-

mative practices program. We anticipate that a number of positions in the Anchorage office and in the field will be filled by minority hires. We will solicit information from CIRI's skills resources inventory and match candidate employment background with job descriptions as part of the hiring programs.

Training

There are numerous subprofessional and apprentice level positions to be filled in conjunction with the design and construction phases of development of the Watana Dam. The Joint Venture will make available up to ten percent of these positions for individuals with an interest in on-the-job-training in specific skill categories. The categories so targeted will include soils laboratory, concrete laboratory, computer, drafting, and certain clerical work. Also, it may be possible to fill some craftsmen positions in this manner in later stages of the project.

Conclusion

The Joint Venture and its subcontract firms will bring an abundance of professional employees to the Susitna Hydroelectric Project. Numerous opportunities will exist for the hiring and for the training of the local people in association with the work of these professionals. We will appoint a capable manager to implement a program that is oriented toward affirmative hiring and training. Further, we intend to continue CIRI's involvement in the project in an expanded role. We are confident, through past experience, of successfully implementing the program implicit in the Native Village Corporation's agreement with the Power Authority.

HARZA-EBASCO

(a)
ACCOUNTING

PROJECT REPORTING

CONSTRUCTION INVOLVEMENT

(q)
PROCUREMENT

VALUE ENGINEERING

(o)
QC/QA

D(n) ACCOUNTING AND COMPUTERIZED MANAGEMENT

In this section we describe, first for Harza, then for Ebasco, the company accounting systems. Although the proposed services will be provided by a joint venture, the separate in-place accounting systems of the two participating firms are described because Joint Venture system for billing will be developed to be consistent with the existing systems.

The salaries and expenses associated with accounting are not charged directly to projects by either firm, since they are included in the overhead multiplier.

HARZA

Chart of Accounts

Harza's existing chart of accounts has been developed over a period of years specifically to control design projects. The major classifications within the chart (Table D(n)-1) for project costs are:

- Direct Costs - Salaries
- Direct Costs - Expenses
- Direct Costs - Subcontracts
- Indirect Costs - Salaries
- Indirect Costs - Salary benefits
- Indirect Costs - Expenses

Each of these classifications is broken down within the chart to give sufficient detail to management to control individual projects. The total chart includes approximately 400 accounts. Representative samples of direct and indirect costs are attached.

Direct Costs

Direct costs are separated among salaries, expenses and subcontracts. Direct salaries include engineers, draftpersons, technicians and others who work directly on the project. Charges are made on the basis of individual's actual rates for professional and techhnical services. No direct charges are made for executive officers, administrative, financial, accounting, stenographic or office support personnel when performing services in their corporate, administrative or support functions.

Direct expenses are those costs specifically associated with the project such as employee travel, shipping of household goods, prints and reproductions, printing, drafts of project documents and reports and computer services.

Charges from subcontractors are charged directly to the project and labeled as such.

Indirect Costs

Indirect costs are basically distributed among salaries, salary benefits and other indirect expenses and are collectively identified as "overhead" in our internal statements. Overhead salaries are distributed directly from each employee's time sheet on the basis of an overhead number assigned to each designated category of overhead salary expense such as accounting, administrative services or business development.

Salary benefits on our overhead statement include amounts paid for sick leave, vacations and holidays. They flow directly from employee time sheets to the respective overhead accounts.

Other indirect expenses include those associated with payroll, such as F.I.C.A., and unemployment taxes and group medical and life insurance. In addition, indirect expenses cover such items as taxes (other than payroll), insurance, rent, communications, depreciation and stationery and supplies.

Indirect costs are allocated to each project on the basis of a percentage of the direct salaries charged to the project. The percentage is obtained by dividing the total company indirect costs by the total company direct salaries. The direct salaries on each project are then multiplied by this percentage to determine the amount of indirect costs (overhead) to be charged to the project.

Method Proposed to Maintain Each Financial Record

We propose to maintain the financial records using our established systems for payroll, other disbursements and journals. These systems are essentially computerized and have been developed over a period of years.

Computerized Work Activity

Computer support for the project accounting system will be provided by a leased mainframe computer in Chicago. The data supplied to this computer will be fed in through terminals located in Bellevue. The software to be used for payrolls on this project consist of an in-house system of programs developed over

the years to record and distribute payroll charges and prepare payroll checks. The general ledger and cost records will be maintained through another series of programs purchased some years ago as a package and used to record entries into the general and project ledgers.

EBASCO

Chart of Accounts

Ebasco's existing chart of accounts for design projects provides detailed segregation of direct and indirect expenditures. Salaries are recorded in accordance with functional classification codes and salary distribution data are retrievable at the individual employee level of detail. Accounts are defined to segregate costs associated with subcontracts and other direct costs. The attached sample list of direct accounts (Table D(n)-2) represents accounts which are active in 1982. This list is subject to periodic modification. Various direct accounts such as "Drafting Supplies" and "Printed Forms" are used only for purchases of project unique materials. Standard supplies and materials are drawn from corporate stock and are not directly charged to projects.

Direct Costs

All direct labor consists of the individual actual rates of Ebasco's employees plus the actual individual rates of supplementary Drafting Personnel. The principal classes of labor consist of professional and technical personnel directly engaged in performing professional and technical services on the contracts. No direct labor charges are normally made for the time which may be spent by such other personnel as officers, business development, in-house legal, financial and administrative staff or stenographic, clerical and office support personnel when performing services in their corporate, administrative and support functions. Personnel in those categories may charge directly to contracts when they are directly engaged in performing professional and technical services on the contracts.

Other direct costs include out-of-pocket expenses (e.g. employee travel and living expenses, airfare, computer equipment usage etc.). These costs are charged to a contract when they are incurred by an employee performing a specific project function and must be properly identified as project-related in order to be considered a direct project cost.

Table D(n)-1

HARZA ENGINEERING COMPANY
CHART OF ACCOUNTS

720 Indirect Costs, Expenses - Taxes

69	721.10	F.I.C.A. (Engineering)
69	721.11	F.I.C.A. (Administrative)
69	721.14	F.I.C.A. (Other Offices)
69	722.10	Federal Unemployment
69	722.14	Federal Unemployment (Other Offices)
69	722.80	Federal Unemployment (Accrual Estimate)
69	723.10	State Unemployment
69	723.14	State Unemployment (Other Offices)
69	723.80	State Unemployment (Accrual Estimate)
69	724.10	Personal Property
69	724.80	Personal Property (Accrual Estimate)
69	725.10	Franchise, Capital Stock, Licenses
69	726.10	State Income - Illinois
69	726.12	State Income - Alaska
69	726.16	State Income - Colorado
69	726.20	State Income - Indiana
69	726.80	State Income (Accrual Estimate)
69	727.10	Chicago Employer's Expense (Head)
69	727.80	Chicago Employer's Expense (Head) - Accrual Estimate

730 Indirect Costs, Expenses - Insurance

72	731.10	Medical (Engineering)
72	731.11	Medical (Administrative)
72	732.10	Group Life (Engineering)
72	732.11	Group Life (Administrative)
72	733.10	Salary Continuance (Engineering)
72	733.11	Salary Continuance (Administrative)
72	734.10	Travel Accident

72	734.11		Travel Accident - Non-Deductible
72	735.10		Workers Compensation (Domestic)
72	735.11		Workers Compensation (Overseas)
72	735.14		Workers Compensation (Other Offices)
72	735.20		Comprehensive General and Auto Liability (Domestic)
72	735.21		Comprehensive General and Auto Liability (Overseas)
72	735.80		Work Compensation, Comprehensive General and Auto Liability (Accrual Estimate)

610 Indirect Costs - Compensation - Salaries

41	614.10	#060	Accounting
41	615.10	#061	Data Processing
41	615.20	#062	Budget & Costs Control
41	615.30	#063	Personnel
41	615.60	#066	Office Management and Services
41	617.10	#067	Word Processing
41	617.20	#068	Secretaries, Staff & Technical Divisions
41	617.30	#069	Files, Library, Microfilming
41	618.10	#081	Design Guides, Parameters, Standards, etc.
	618.13	#083	Project Management Coordination
	618.20	#082	Quality Assurance
41	618.40	#084	Computer Program Development
41	619.10	#090	Labratories
41	619.20	#091	Professional Activities, Seminars
	619.25	#091D	Board of Directors Seminars & Conferences
41	619.30	#092	Educational Activities, Seminars, etc.
41	619.40	#093	Occupational Safety & Health Act (OSHA)
	619.45	#094	Architectural Contest
	619.48	#095	China Development
	619.50	#096	Construction Management
	619.55	#097	Strontia Springs Dam Models
	619.60	#098	Uscold Lecture
	619.65	#099	Research & Development

630 Indirect Costs - Compensation - Salary Benefits

45	631.10	#073	Sick Leave - Engineering Personnel
45	631.14	#073	Sick Leave - Engineering Personnel (Other Offices)
45	631.80	#073	Sick Leave - (Accrual Estimate)
45	632.10	#077	Vacations - Engineering Personnel
45	632.14	#077	Vacations - Engineering Personnel (Other Offices)
45	632.20	#077	Vacations - Administrative Personnel
45	632.80	#077	Vacations - (Accrual Estimates)
45	633.10	#075	Local Leaves - Engineering Personnel
45	635.10	#079	Holidays - Engineering Personnel
45	635.14	#079	Holidays - Engineering Personnel (Other Offices)
45	635.20	#079	Holidays - Administrative Personnel
45	635.80	#079	Holidays - (Accrual Estimates)
45	636.10	#071	Special Absences - Engineering Personnel
45	636.14	#071	Special Absences - Engineering Personnel (Other Offices)
45	636.20	#071	Special Absences - Administrative Personnel

530 Direct Costs - Expenses 9

25	532.10	Electronic Computer Machine Time - In House
25	532.14	Electronic Computer Machine Time - Outside Service
25	532.20	Inspection Services
25	532.30	Model Studies
25	532.40	Laboratory Tests
25	532.42	Surveys
25	532.44	Drilling
25	532.46	Sub-Contract
25	532.60	Consultants Fees
25	532.62	Consultants Expenses
25	532.65	Commissions (F-F Reimbursable)
25	532.67	Local Representative Fees
25	532.70	Special Procurement Items
25	532.75	Bank Local Currency Charges

Table D(n)-1 (continued)

534 Direct Costs - Foreign Currency Costs

25	534.10	Salaries
25	534.20	Travel - Transportation
25	534.22	Housing
25	534.23	Resident Furniture
25	534.24	Subsistence Costs
25	534.26	Shipping Household Goods
25	534.27	School Allowance
25	534.28	Local Office Operations
25	534.30	Camp Facilities
25	534.32	Living Allowance
25	534.40	Surveys
25	534.44	Field Equipment
25	534.50	Reproductions
25	534.55	Joint Venture
25	534.60	Local Taxes
25	534.65	F-F-F 2% Representative Fee
25	534.67	Local Representative Fees
25	534.70	Other Costs
25	534.80	Communications and Postage
25	534.90	Unclassified
25	534.99	Non-Reimbursable

The attached chart of Direct Accounts identifies categories of cost which may be treated as direct cost when project related or unique.

Manner Proposed for Allocation of Indirect Costs

Each employee in the Company is assigned a payroll number, which is used when identifying charges to projects or overhead functions. The first three digits of this number indicate the department to which the employee is assigned. For accounting purposes, each department is assigned a pool. Pools are named according to their functional participation in the execution of our main business lines. The Primary Operations Pools are as follows:

Pool No.	Name
010	Engineering & Related Services
030	Field Services
040	Materials Engineering and Quality Services

050	Nuclear Engineering and Licensing
060	Materials Laboratory
070	Consulting Services
080	Computer Center
150	Risk Management Consulting Group
160	Envirosphere

Pools 010 and 080 are combined for applied overhead rate purposes.

An applied overhead rate is calculated for each Operations Pool. The applied overhead for an Operations Pool includes the departmental overhead of each of its departments plus an allocated share of General and Administrative expense. The following list provides the major types of indirect costs included in the applied overhead rates.

Salaries
Travel & Living
Legal Fees
Auditing Fees
Outside Drafting Firms Overhead
Outside Services - Consultants
Outside Services - Temporaries
Office Costs
Equipment Rentals
Telephone & Telegraph
Reproduction & Printing
Office Supplies
Depreciation & Amortization
Shipping Expense
Light & Power
Building Maintenance
Postage
Insurance
FICA
Pensions
Major Medical & Blue Cross
Disability Insurance
Group Life Insurance
Workmen's Compensation
Investment Plan
Payroll Taxes
Dues and Memberships
Computer Service - Machine Time

Wiring Expense
Tuition Refunds
Employee Relocation Expense
State and Local Taxes
Equipment Maintenance
Miscellaneous

Method Proposed to Maintain Each Financial Record

Ebasco's costs are normally accumulated and distributed using an automated job order accounting system and it is proposed that this system be used on the Susitna Project. Source documents are maintained in original form or on microfilm in accordance with contractual requirements.

Computerized Work Activity

Ebasco's payrolls, general ledger and other automated cost records are generated using software developed within Ebasco. While Ebasco's systems are designed to afford flexibility, computer support can also be provided to clients utilizing a variety of both hardware and software selected to assure compatibility with clients' automated systems. For the Susitna Project, discussions will be held with the Power Authority to establish the best way of providing the information.

Table D(n)-2

EBASCO SERVICES INCORPORATED

CHART OF DIRECT ACCOUNTS

Account Number	Description
510-XX	Direct Labor - Ebasco Employees
514-XX	Direct Labor - Supplementary Drafting
510 99	Premium Time - Ebasco Employees
514 99	Premium Time - Supplementary Drafting
511 01	Travel and Living
511 02	Local Travel
511 03	Airline Travel
511 05	Travel Allowance
517 01	Statistical Services
517 02	Other Services
517 03	Outside Computer Services
517 05	Insurance Services
517 09	Sub-contract Items
520 01	Telephone
520 02	Telegraph
520 03	Teletype
520 04	Telephone Local
520 09	Automated Call Recording
521 01	Tracing Cloth
521 02	Drafting Suppleis
521 03	Paper Stock

Table D(n)-2 (continued)

521 04	Printed Forms
521 05	Stationary
521 06	Other Supplies
521 07	Printing
521 08	Reproductions
521 09	Multilith Reproductions
521 10	Reproduction Supplies
521 17	Phototypesetting
521 18	Microfilm Processing
521 50	Photocopies
528 23	Computer Machine Time
528 25	Data Processing
528 26	Automated Drafting System
513 00	Legal Service Special
515 01	Film Image
515 02	R&D Image
515 03	Castings Cost
515 06	Model Materials
515 09	Procurement Items
519 02	Rent of Other Offices
519 03	Equipment and Other Rentals
519 04	Amortization Expense
519 06	Equip, Rental - Internal
521 60	Preparation of Reports

Table D(n)-2 (continued)

522 01	Maintenance Expense
522 02	Depreciation Expense
522 07	Leasehold Expense
523 05	Shipping Expense
523 06	Miscellaneous Supplies and Exp
523 07	Postage
523 08	Publications
523 09	Subscripts to Special Services
523 10	Noncapitalized Furn & Equip
524 00	Insurance
528 11	Hiring Expenses - Medical Exam
528 13	Hiring Exp - Interview & Recruit
528 14	Employee Relocation
528 17	Miscellaneous Field Office Exp
528 18	Miscellaneous Other Expenses
528 20	Metallurgical Lab Services
528 31	Work Processing System
528 54	Proc Control Computer
528 55	Dorescope
528 60	Environmental Equipment Rental
528 77	Furniture Allowance
528 80	Environmental Data Proc Service
528 90	Seismic Refraction Equip Sent
528 92	Corrosion Test Equipment Sent

Table D(n)-2 (continued)

529 11	CRT Terminal - 30Char/Sec Tran
529 12	CRT Terminal - 120Char/Sec Tran
529 13	CRT Terminal - 30Char W/Printer
529 14	CRT Terminal - 120Char W/Printer
529 15	CRT Operator
528 16	Work Processing Sys-status Typ
529 17	Metier System USAGE

HARZA-EBASCO

PROJECT REPORTING

CONSTRUCTION INVOLVEMENT

(q)
PROCUREMENT

VALUE ENGINEERING

(o)
QC/QA

START-UP INVOLVEMENT

D(o) QUALITY CONTROL/QUALITY ASSURANCE

The attached copy of the "EBASCO Quality Manual" for Hydroelectric Power Stations will be adapted for use by the Joint Venture. Although the manual is organized to include all phases of a hydroelectric project, the project specific programs will be developed for the Susitna engineering tasks and will concentrate on three areas:

- Design and engineering document control
- Procurement
- Vendor surveillance

As can be recognized on the proposed organization charts, Quality Assurance will function through the Project Manager and the Internal Review Board with corporate responsibility extending from the Ebasco Quality Assurance Organization.

The technical Quality Assurance will be performed by the Joint Venture Internal Review Board as also indicated on the organization charts and the various activity work plans. This Board will consist of experienced hydroelectric-engineers from both Harza and Ebasco, as described in Section B "Organization". It will formally review the technical content and assure the highest technical quality for the Project. They will meet at various intervals, dictated by the Project schedule, each meeting will be formally documented with approvals or recommendations indicated by consecutively numbered Internal Board Meeting Notes. The notes will be distributed to the Project Team through the Project Manager.

Each section of the attached Quality Manual will be adapted to the Project specific requirements. For example, Section 2 will describe the detailed chains of responsibility to be used on the Susitna Project. Where possible, the individual Corporate Officers will be identified and the Project Quality Assurance functions will be described.

Sections 3, 4 and 5, which essentially contain the Programs applicable to the Design and Engineering required for the Project, will be adapted to the project specifics.

Section 3, "Design and Engineering Document Control," will be adapted to the Project. This section essentially ensures that the Project Team utilizes the most up-to-date Joint Venture Standards for design and engineering. It also establishes the required document control for project calculations and drawings, as well as for vendor drawings utilized by the Project Team.

Section 4, "Procurement," will be adapted to the Joint Venture organization and will specify those activities by which control of the purchase of items by the Project Engineering Office is accomplished. It will outline the procedures extending from specification, solicitation, proposal review and leading to purchase orders. All procedures will be discussed with the Power Authority before hand and incorporated into the Quality Assurance Program such that the procurement will function smoothly and efficiently.

Section 5,"Vendor Surveillance," will also be adapted to the project specific requirements. This system of control will provide assurance that items purchased for the Project are supplied in accordance with the requirements of the applicable procurement documents. The system of control provides surveillance over the vendor and subvendor, the extent of which depends on the criticality and complexity of the material or equipment being purchased and past experience with the vendor.

Section 6, "Construction Quality Control," will not specifically be utilized. It is anticipated that the construction manager for the Susitna Project will have the overall responsibility for control of construction quality.

EBASCO QUALITY MANUAL

FOR

HYDROELECTRIC POWER STATIONS

MANUAL NO. 13

EBASCO

TWO WORLD TRADE CENTER

N. Y. ,NEW YORK

(t) START-UP INVOLVEMENT

VALUE ENGINEERING

(q) PROCUREMENT

CONSTRUCTION INVOLVEMENT

PROJECT REPORTING

EBASCO SERVICES INCORPORATED

Two World Trade Center, New York, N.Y. 10048

STATEMENT OF AUTHORITY

The management of Ebasco Services Incorporated recognizes the necessity for a quality program for Hydroelectric Power Stations. Accordingly, this manual represents the Ebasco Quality Program policy applicable to Hydroelectric Power Stations. It is to be used as a standard by personnel in all Ebasco organizational units, including regional offices, for work involving construction (force account or management), engineering and/or procurement services.

The primary responsibility for overall implementation and administration of the Ebasco Quality Program for Hydroelectric Power Stations rests with the Ebasco individual line officer responsible for the applicable operation.

R J Christesen
Executive Vice President Operations

July 15, 1981

EBASCO SERVICES
INCORPORATED

FOREWORD

This manual represents Ebasco Quality Program policy and requirements for the design and construction of hydroelectric power stations. It is to be used as a standard by all Ebasco personnel. The manual reflects Ebasco policy and has been designed to meet the requirements of the latest applicable codes and standards governing hydroelectric station design and construction.

The primary responsibility for overall implementation and administration of the Ebasco Quality Program for Hydroelectric Power Stations rests with the Ebasco individual line officer responsible for the applicable operation.

The Ebasco Quality Program Committee is responsible for modifying this manual in accordance with approved changes to the program. The Quality Program Coordinator, who functions as the committee's secretary, publishes to all manual holders an annual Updating Status Memorandum which summarizes changes made to the manual during the preceding period.

The manual is assigned by the Quality Program Coordinator to individuals as required for their exclusive use. However, it remains the property of Ebasco Services Incorporated and shall be returned upon request. It contains information proprietary to Ebasco Services Incorporated and is loaned in confidence and upon the condition that neither it nor the information contained in it will be reproduced, copied or disclosed in whole or in part. The material herein is copyrighted and protected by the copyright laws.

Should any circumstance arise under which a holder no longer requires the manual for the specific purpose for which it was assigned, it shall be returned promptly to the Quality Program Coordinator. Quality Manuals for Hydroelectric Power Stations shall not be transferred or loaned to any other individual, position, firm or corporation without the written authorization of the Chairman of the Ebasco Quality Program Committee. The Quality Program Coordinator shall be informed promptly of any change in the mailing address of a manual holder.

Manual holders are responsible to maintain their copies in updated condition, including the proper insertion of new or revised sections as furnished and the destruction of all cancelled or superseded section. Sections shall not be removed from manuals except as directed for revision or cancellation.

R J Christesen
Executive Vice President Operations

July 15, 1981

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EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION
B E Terry CHAIRMAN, QUAL PROGRAM COMM	TABLE OF CONTENTS	REVISION 0 DATE 7/15/81

EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION 1
B E T CHAIRMAN, QUAL PROGRAM COMM	BASE QUALITY PROGRAM	REVISION 0 DATE 7/15/81

1.0 SCOPE

1.1 The purpose of the Quality Program for Hydroelectric Power Stations is to provide assurance that requirements as stated in the applicable specifications, drawings, documents, codes and industry standards are met as intended.

2.0 QUALITY PROGRAM

2.1 This manual sets forth the quality requirements that apply to structures, systems and components affecting the reliability and safety of hydroelectric power stations. This program consists of three principal phases:

2.1.1 Phase one concerns Engineering and Procurement and involves the review and control of Ebasco and vendor technical specifications, drawings, documents and calculations.

2.1.2 Phase two concerns vendor surveillance by Vendor Quality Assurance Representatives. Vendor Quality Assurance Representative visits are governed by the requirements of the Purchase Order, specifications, and on the confidence obtained by the representative that the supplier is meeting the requirements of the Purchase Order, specifications and the codes.

2.1.3 Phase three encompasses the control of quality during the performance of the construction by Ebasco forces and/or contractors.

EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION 2
B E Tey CHAIRMAN, QUAL PROGRAM COMM	ORGANIZATION AND RESPONSIBILITIES	REVISION 0 DATE 7/15/81

1.0 SCOPE

This section of the Manual describes the organizational structure, functional responsibilities, levels of authority and lines of internal and external communication for management, direction and execution of the Ebasco Quality Program for hydroelectric power stations.

2.0 GENERAL

2.1 The Ebasco Operations organization consists of four independent quality-related principal divisions headed respectively by the Senior Vice Presidents of Engineering and Construction, Consulting Engineering and Projects and Procurement, and the Vice President Materials Engineering and Quality Assurance. Each of these officers of the company report to Ebasco's President and Chief Executive Officer through the Executive Vice President Operations. Reporting to the Senior Vice President Engineering and Construction are the Vice President Engineering and Vice President Construction. Reporting to the Senior Vice President Consulting Engineering are the President of Envirosphere Company, the Vice President Plant Operations and Betterment and the Vice President Consulting Engineering. Reporting to the Senior Vice President Projects and Procurement is the Vice President Procurement.

A fifth quality-related principal division is headed by the Executive Vice President of Advanced Technology and Special Projects who reports directly to Ebasco's President. Reporting to the Executive Vice President Advanced Technology and Special Projects is the Vice President Advanced Technology.

2.2 Representatives of the Senior Vice President Projects and Procurement; of the Vice Presidents Engineering, Construction, Procurement, Plant Operations and Betterment, Consulting Engineering, and Materials Engineering and Quality Assurance; and of the President of Envirosphere Company comprise the operations organization representatives of the Quality Program Committee, which is responsible for Ebasco Quality Assurance policy. Also included on this Committee is a representative of the Vice President Advanced Technology. This is shown diagramatically by Figure 2-1 at the end of this section.

2.3 The divisions or departments most directly involved in the implementation of the quality assurance program for design, engineering, fabrication, and installation are Materials Engineering and Quality Assurance, Engineering, Construction, and Procurement. The organizational structures of these are shown on Figures 2-2, 2-3, 2-4 and 2-5 at the end of the section. The Projects Department provides overall contractual administration of a project, coordinating the efforts of involved departments and serving as a line of communication between Ebasco and its Clients. The Consulting Engineering, Plant Operations and Betterment, and Advanced Technology Departments are involved in the implementation of Quality Program requirements through the supplemental services they provide.

The responsibilities of each department of the Ebasco Organization for quality assurance requirements applied to Hydroelectric Power Stations are described herein.

3.0 ENGINEERING

Primary responsibility for engineering and design rests with the Vice President Engineering (See Figure 2-3).

3.1 Chief Engineers of the various engineering disciplines (Mechanical, Electrical, Civil, Instrumentation and Control) report to the Vice President Engineering and are responsible for technical and administrative aspects of the engineering and design phases of their disciplines.

3.2 A Project Engineer is assigned to each project. Project Engineers lead and coordinate the various technical functions performed in connection with their projects and insure that the requirements of this manual relating to Engineering and Design are implemented by the responsible Engineering discipline.

3.3 A Lead Discipline Engineer from each Engineering discipline is responsible for providing commitments to the Project Engineer and is technically responsible to the Supervising Engineer who reports to an Assistant Chief Engineer or to a Director who in turn reports to a Discipline Chief Engineer. One Lead Discipline Engineer from each Engineering Discipline is continuously assigned to each project. Additional Engineers are assigned to assist the Lead Discipline Engineer as needed.

3.4 Design Supervisors report to a Group Supervisor or Supervising Design Engineer who reports to a Division Chief who in turn reports to a Chief Engineer. Design Supervisors supervise the work of Draftsmen and Designers in the preparation of drawings.

3.5 The project team, as administered by the Project Engineer, may consist of additional technical disciplines which organizationally do not report to the Vice President Engineering such as:

a. Consulting Engineering and Plant Operations and Betterment reporting to the Senior Vice President Consulting Engineering.

b. Materials Applications reporting to the Vice President Materials Engineering and Quality Assurance.

Each such discipline will assign Discipline Engineers to the project to the extent required and such personnel have similar reporting relationships to department heads (Chief Engineers, Directors), Supervising Engineers and Project Engineers as outlined for disciplines reporting to the Vice President Engineering.

3.6 The Standards and Procedures Department is responsible for administrative control of Ebasco's Standard Source Documents (i.e. materials specifications, engineering specifications, design guides and procedures). This department is headed by the Manager, Standards and Procedures who reports to the Vice President Engineering.

4.0 CONSTRUCTION

Primary responsibility for construction rests with the Vice President Construction. The Construction Department has the prime responsibility for carrying out the program for control of site quality functions. (See Figure 2-4).

4.1 Construction Managers report to the Vice-President Construction and are responsible for overall construction and administrative aspects of various projects.

4.2 The Manager of Construction Services reports to the Vice President Construction and is responsible, through his designees, for the following quality related activities.

4.2.1 Inclusion of quality requirements in construction contracts

4.2.2 General review of procedures for the control of quality and assisting site personnel in the development of their respective site procedures.

4.2.3 Performing periodic audits of the programs for the control of quality.

4.2.4 Keeping abreast of the current status of codes and standards and advising appropriate construction management of pertinent information.

4.3 For individual projects, the Project Superintendent reports to a Construction Manager and is responsible for performing overall site supervision of construction in accordance with drawings, specifications, other documents and contractual obligations.

4.4 The Construction Superintendent reports to the Project Superintendent and has the responsibility for assuring that jobsite fabrication and performance of construction work is in accordance with the drawings, specifications and other prevailing documents.

4.5 The Resident Engineer reports to the Project Superintendent and is responsible for all phases of site office engineering, field engineering, and Quality Program administration of the site activities including:

4.5.1 Performing inspections in required areas of construction to assure that quality requirements have been met.

4.5.2 Identifying and initiating correction of nonconformances to requirements indicated by the drawings, specifications, codes or procedures for items, and rejecting nonconforming items or services, or when necessary requiring the stoppage of work until such nonconformance is corrected.

4.5.3 Preparing inspection requirements based upon the requirements of specifications, drawings, codes, standards, etc. as established by the Engineering Department.

4.5.4 Supervision of the NDE Group who are responsible for performance and/or monitoring of all nondestructive testing activity.

4.6 The Field Purchasing Agent reports to the Senior Construction Accountant, who reports directly to the Project Superintendent, and is responsible for obtaining necessary documentation from vendors of field purchased items.

5.0 MATERIALS ENGINEERING AND QUALITY ASSURANCE

Primary responsibility for quality assurance and materials requirements rests with the Vice President of Materials Engineering and Quality Assurance. (See Figure 2-2).

5.1 Materials Engineering and Quality Assurance - This unit, under the administration of the Vice President Materials Engineering and Quality Assurance consists of the following departments, each of which contributes directly to the implementation of the Quality Program:

(a) Quality Assurance Engineering
(b) Materials Application
(c) Vendor Quality Assurance
(d) Materials Engineering Laboratory

5.1.1 Quality Assurance Engineering is administered by the Chief Quality Assurance Engineer who reports to the Vice President Materials Engineering and Quality Assurance. The Quality Assurance Engineering Nondestructive Examination Group is responsible for the nondestructive examination program which consists of the following functions:

a. Review and comment on NDE procedures and interpret radiographic films submitted by manufacturers, site construction forces and/or clients.

b. Advise manufacturer and site construction forces as to proper NDE procedures, applications, techniques, equipment and personnel qualifications.

c. Certify and maintain qualification records for Ebasco NDE personnel.

5.1.2 Materials Applications is administered by the Chief Materials Engineer who reports to the Vice President Materials Engineering and Quality Assurance. The Materials Applications Department includes two subdivisions: Materials Engineering and Welding Engineering. A Materials Engineer and a Welding Engineer are assigned to each project. The basic qua. 'ty-related activities of Materials Applications personnel include the following as requested by a Lead Discipline Engineer, the Project Engineer, or Construction Department personnel:

a. Review project specifications and pertinent drawings to enhance the selection, by components vendors, of materials appropriate for the intended service and to ensure the specification of appropriate weldment integrity test requirements.

b. Review component suppliers' materials selection and fabrication procedures, for adherence to national codes and Ebasco generic specifications to minimize component fabrication and erection difficulties and to improve components service life.

c. Provide technical guidance for critical piping installation and assist in the resolution of vendor or site materials fabrication problems.

d. Resolve requests for deviations to materials, welding, or integrity test requirements.

e. Develop generic specifications concerned with materials; their processing, fabrication, and soundness testing.

5.1.3 Vendor Quality Assurance is administered by the Chief, Vendor Quality Assurance who reports to the Vice President Materials Engineering and Quality Assurance.

a. The Chief, Vendor Quality Assurance is responsible for the administration of the vendor surveillance program. A qualified Vendor Quality Assurance Representative is assigned responsibility for each purchase order according to the particular areas of expertise required (electrical, electronic, mechanical and welding, transformer, cable).

5.1.4 The Materials Engineering Laboratory performs field nondestructive examination, and soils, concrete and reinforcing steel testing services at construction sites, as applicable. The Laboratory is administered by a Manager who reports to the Vice President Materials Engineering and Quality Assurance.

6.0 PROJECTS

Primary responsibility for project administration rests with the Senior Vice-President Projects and Procurement.

6.1 Managers of Projects report to the Senior Vice President Projects and Procurement and are responsible for overall supervision of the various projects.

6.2 Each hydroelectric project is assigned a Project Manager who reports to a Manager of Projects. A "project team", consisting of a Project Engineer, Project Superintendent and other assigned engineers and representatives from each discipline as appropriate, is assembled for each project. The overall coordination of the activities of this team is the responsibility of the Project Manager.

6.3 The Project Manager is the prime point of contact between Ebasco and the Client.

6.4 The Project Manager is responsible for establishing, at the earliest possible point, the Project Distribution Schedule. This is a complete listing of the various forms of communication such as letters, purchase orders and reports, as well as all of the various organizations, both internal and external to Ebasco. The Project Distribution Schedule is a matrix which provides a uniform distribution system for the overall project in order to assure an orderly, consistent flow of communication.

7.0 PLANT OPERATIONS AND BETTERMENT

Primary responsibility for operational engineering for equipment systems and total plant rests with the Vice President Plant Operations and Betterment.

7.1 The Chief Engineer of Operations Engineering and the Director of Engineering and Special Projects report directly to the Vice President Plant Operations and Betterment and are responsible for technical and administrative aspects of the respective groups.

7.2 Lead Engineers from each group, who report to their Director or an intermediate Supervisor, are assigned to hydroelectric projects as required.

7.3 Principal areas of responsibility for Plant Operations and Betterment include the following to the extent included within the scope of the project:

7.3.1 Operations Engineering provides engineers for guidance and advice on testing of hydroelectric power stations. They prepare start-up schedules, coordinate the start-up activities between Client personnel and Ebasco construction personnel and vendors' service engineers and supervise performance tests conducted by Client operating personnel to demonstrate guarantee performance of the major equipment and plant. They determine with vendors' engineers if equipment modifications are necessary. They assist in preparation of pre-operational start-up and maintenance procedures for the project in preparation for putting equipment into operation.

7.3.2 Engineering and Special Projects manage the development and implementation of the Ebasco Reliability/Availability Program as a viable support and stand-alone product service. They coordinate PO&B, Engineering Design and other Ebasco organizational units in controlling the Feedback Procedure and implementation of high technology applications on practical power plant problems to improve the Reliability/Availability of Ebasco designed plants. They implement Ebasco product services in the area of real-time computer applications to power plants.

8.0 PROCUREMENT

Primary responsibility for procurement, traffic and expediting functions rests with the Vice President Procurement, who reports directly to the Senior Vice President Projects and Procurement. (See Figure 2-5).

8.1 Project Procurement Supervisors report to the Director of Purchasing through the Purchasing Agents and the Manager of Project Purchasing. The Director of Purchasing is responsible to the Vice President of Procurement. Contract Administrators and Buyers, who report to the Project Procurement Supervisor, are responsible for the phases of purchasing to which they are assigned.

8.2 The Purchasing organization among other things is responsible for the following:

8.2.1 Obtaining prequalification quality program information from prospective bidders.

8.2.2 Transmitting technical and quality program requirements to qualified prospective bidders by inquiry.

8.2.3 Advising potential commercial effects on quality programs.

8.3 The Manager of Traffic and Freight Forwarding reports to the Vice President Procurement and is responsible for the transportation of purchased equipment from the points of origin to the construction sites.

8.4 The Manager of Expediting reports to the Vice President Procurement and is responsible for monitoring the progress of material and equipment through suppliers shops and taking whatever expediting action is necessary to assure conformance to schedule.

Ebasco Services Incorporated

OPERATIONS AND ADVANCED TECHNOLOGY ORGANIZATION SHOWING QUALITY PROGRAM COMMITTEE REPRESENTATION

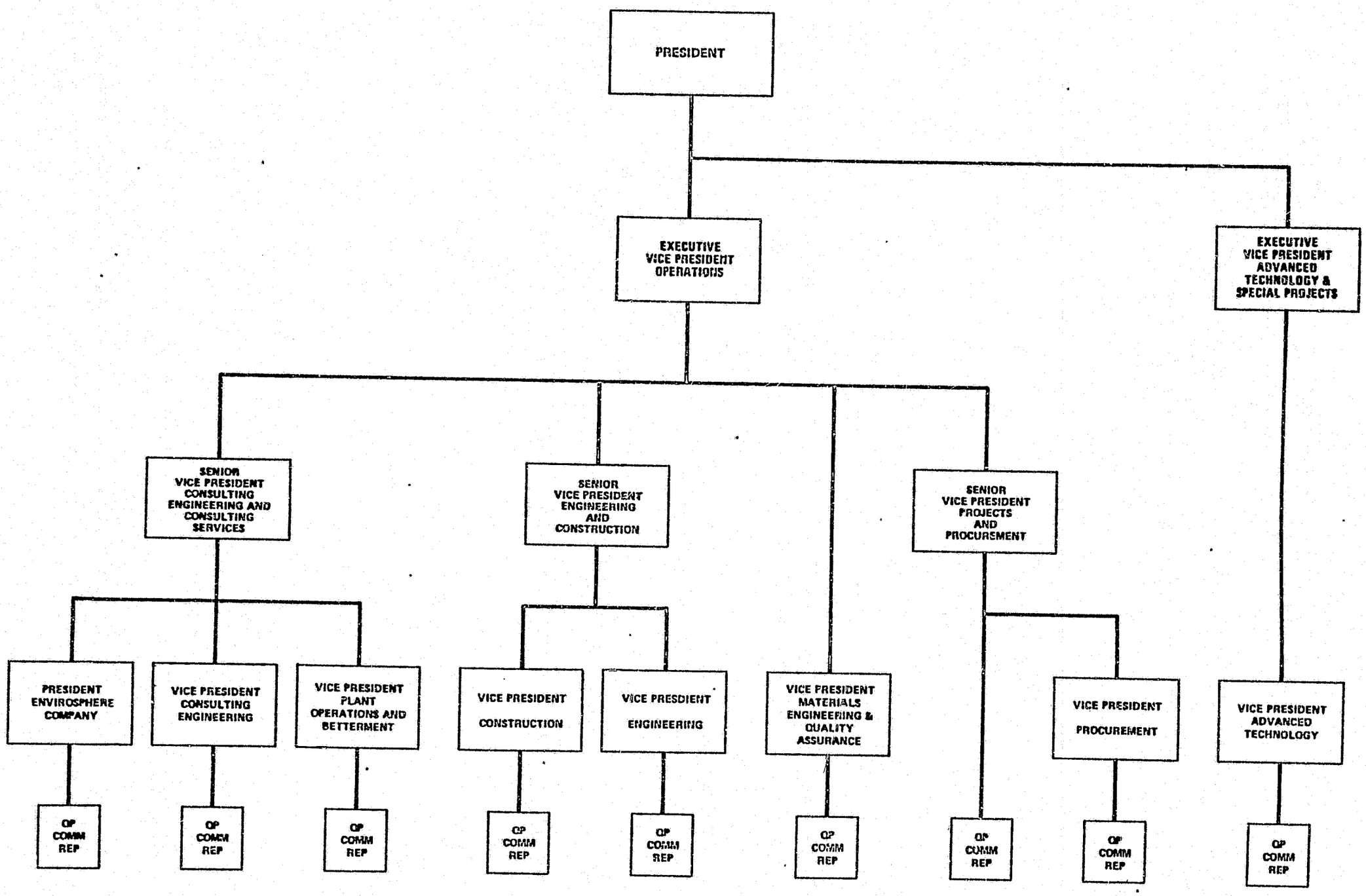


Fig. 2-1

Ebasco Services Incorporated

MATERIALS ENGINEERING & QUALITY ASSURANCE ORGANIZATION

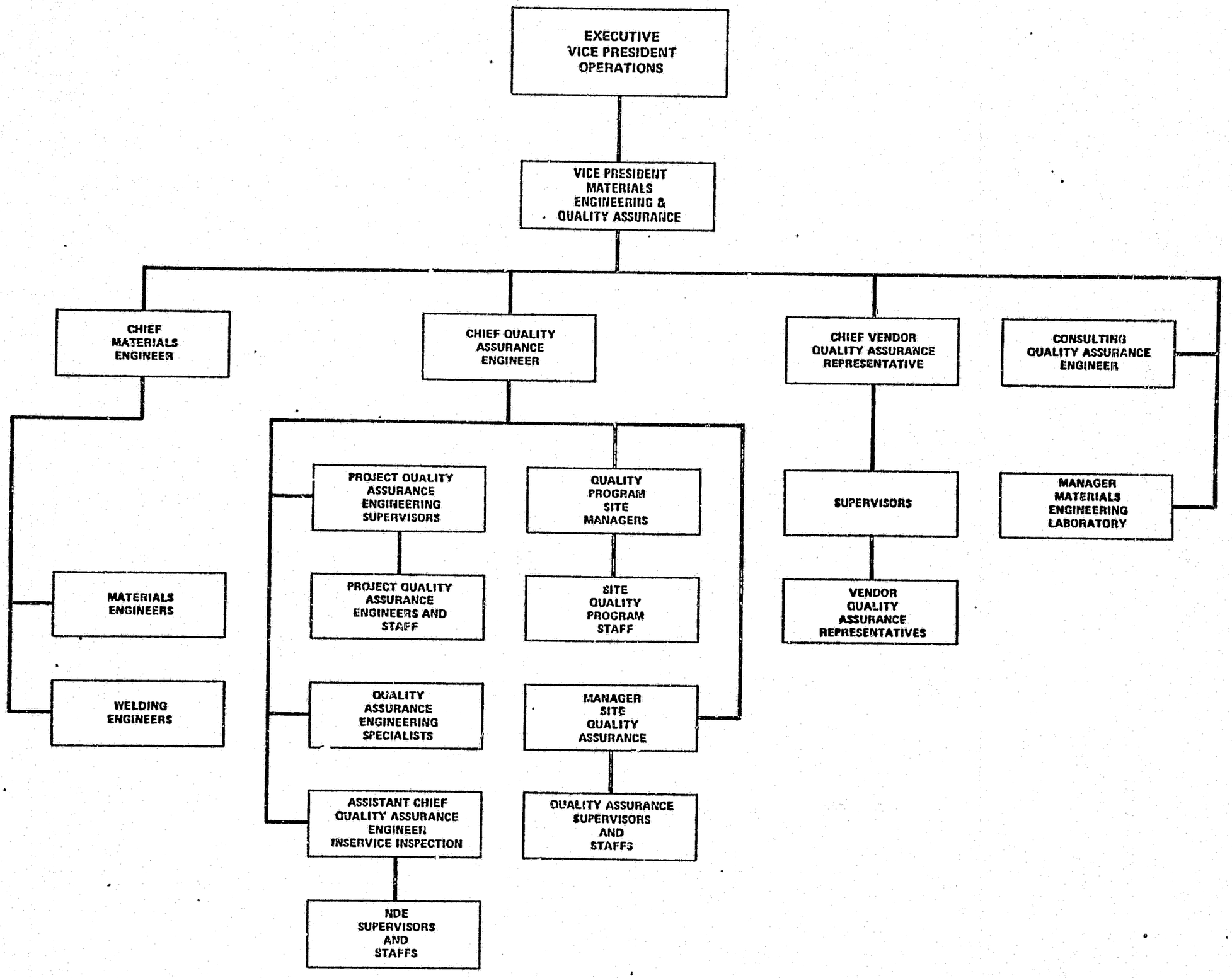
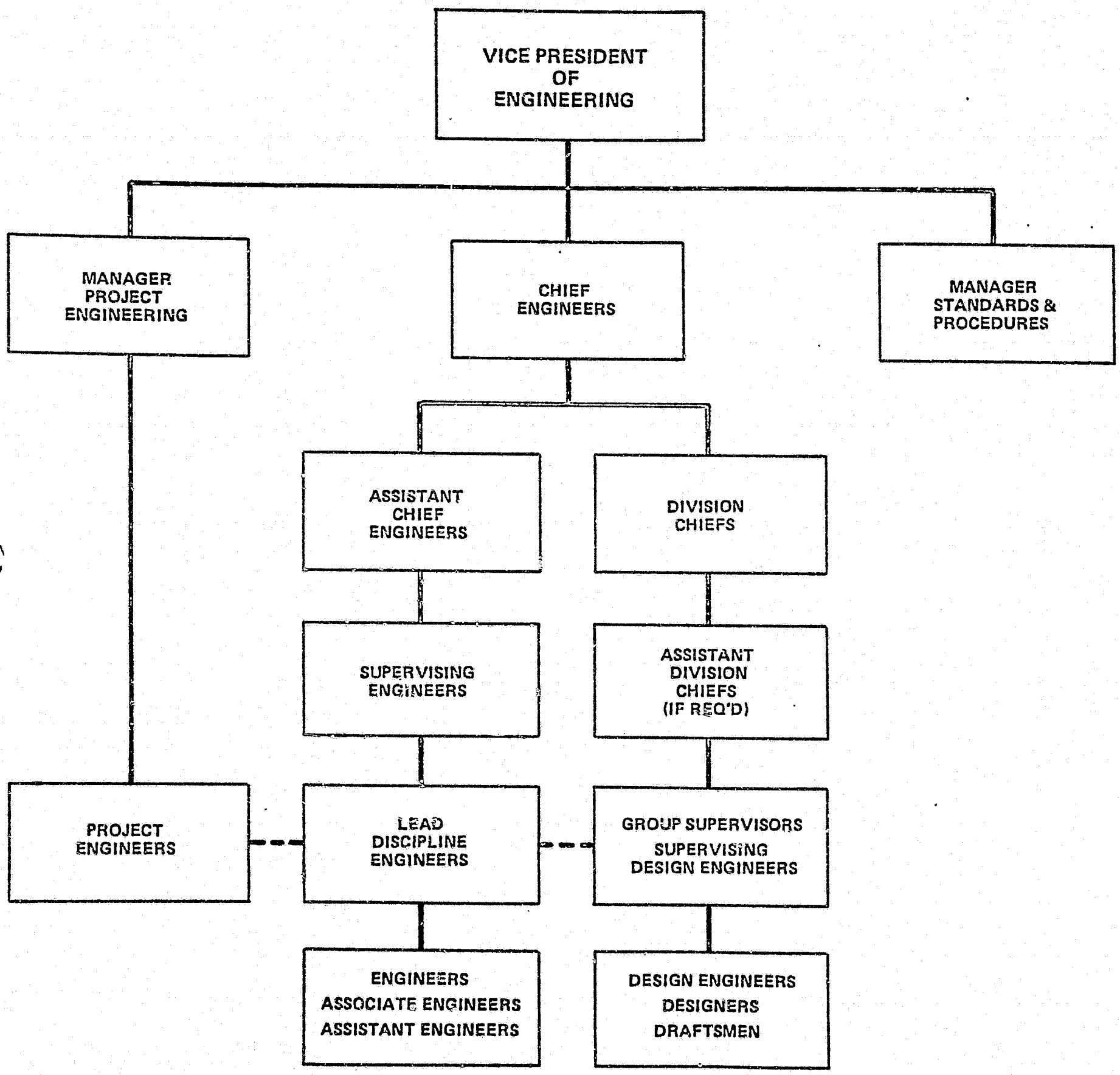


Fig. 2-2

Ebasco Services incorporated

ENGINEERING DEPARTMENT ORGANIZATION



LEGEND:

——— LINE OF AUTHORITY

- - - EXCHANGE OF DESIGN INFORMATION

FIGURE 2-3

Ebasco Services incorporated

ORGANIZATION FOR CONSTRUCTION

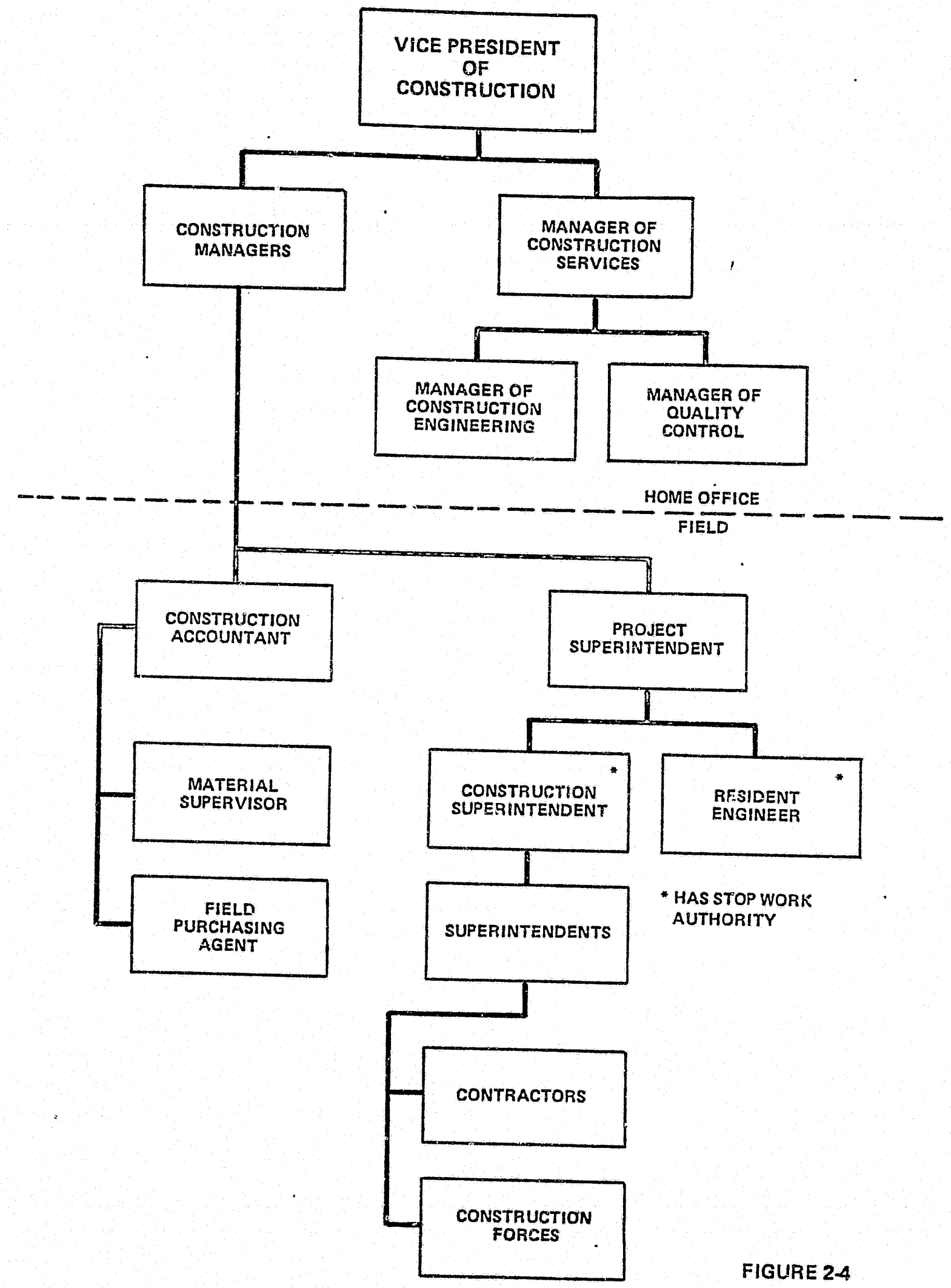


FIGURE 2-4

Ebasco Services Incorporated

PURCHASING & TRAFFIC DEPARTMENTS
ORGANIZATION CHART

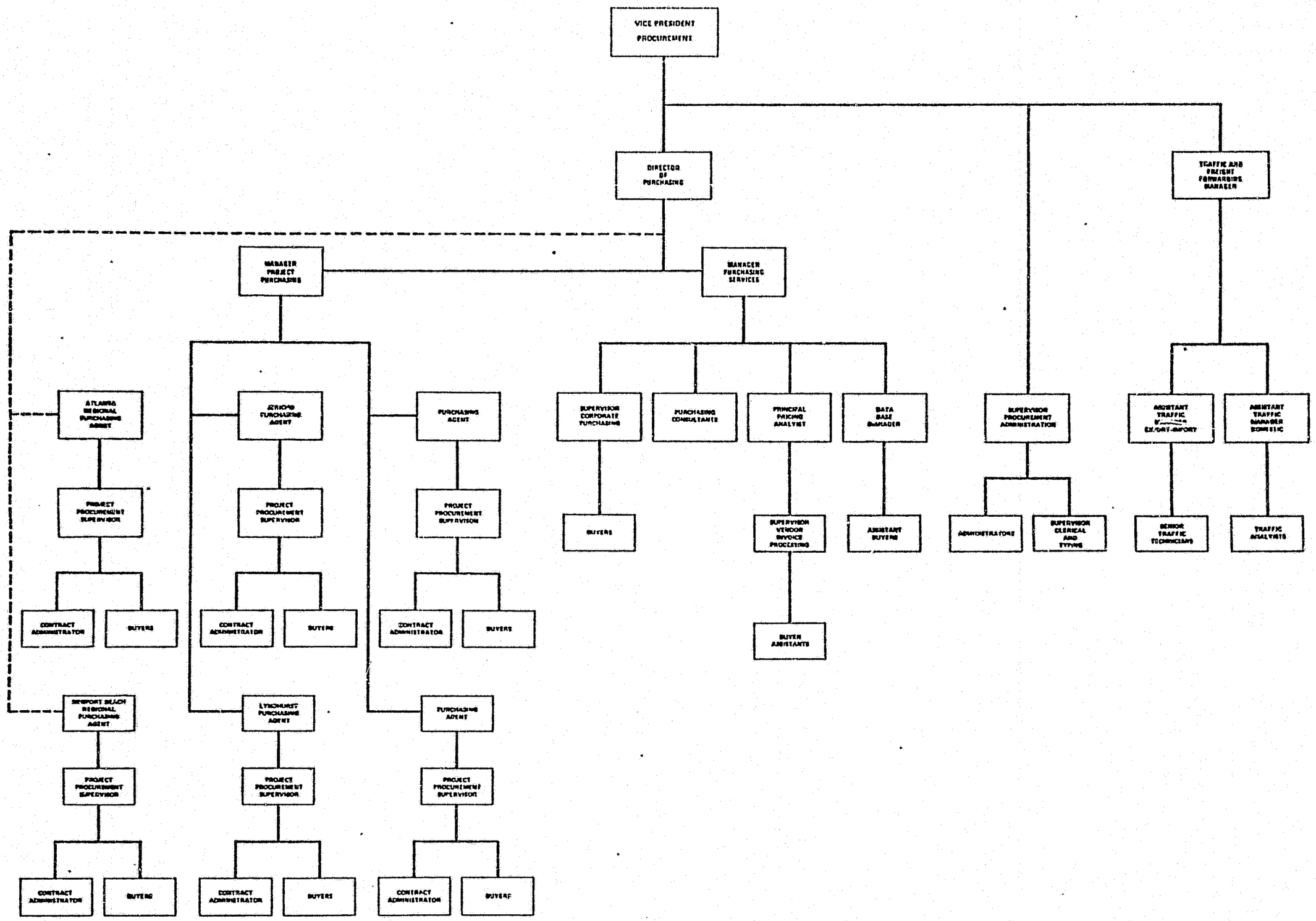


Fig. 2-5

EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION 3
B E Tuy CHAIRMAN, QUAL PROGRAM COMM	DESIGN AND ENGINEERING DOCUMENT CONTROL	REVISION 0 DATE 7/15/81

1.0 SCOPE

This section specifies those activities by which control of Ebasco engineering and design documents for structures, systems and equipment of hydroelectric power stations is accomplished. The activities discussed hereafter are governed by Ebasco company and departmental procedures and guides.

2.0 DESIGN AND ENGINEERING DOCUMENT CONTROL

2.1 Source Documents

The Standards and Procedures Department maintains, controls and up-dates a central file of Ebasco source documents used as a reference base for application on any project. This reference base assures that design criteria for structures, systems and equipment consistent with current industry practice, Ebasco established quality levels and statutory requirements are reflected and applied to Ebasco projects. This reference base includes the following:

a) Ebasco Standard Specifications are prepared for various equipment defining general requirements and permitting specific project information to be filled in. Materials and requirements for testing and documentation are also included for use as reference and supplemental information to the basic equipment specifications. All specifications are identified by a specification number and preprinted for project use.

b) Engineering and Design Guides are prepared, as the title implies, to provide technical guidance to the engineers and designers in performance of their duties on a project. These guides provide information ranging from format of drawings to design criteria for pumps to weld end preparation details.

c) Engineering Procedures are prepared to reflect company and departmental policy by providing direction, instructions or rules to be followed in order to attain an efficient process and communication system for administrative, technical and quality functions.

d) Position on Industry Standards are initiated by Ebasco, as considered appropriate, where a published document of a trade association, technical society or ANSI standard which is utilized in Ebasco specifications and/or by sellers furnishing equipment and/or services to Ebasco, impacts on the manner in which work is conducted. In such cases an Ebasco review group will be formed to establish a company position with regard to that document.

2.0 DESIGN & ENGINEERING DOCUMENT CONTROL (Cont'd)

To provide assurance that the foregoing source documents reflect the latest industry practices, Ebasco quality levels and statutory requirements, feedback mechanisms are provided whereby information, regardless of source or nature, which impacts the stated requirements is transmitted to the affected department for evaluation, resolution and modification of the source document.

2.2 Project Reference Documents

To assure a uniform and consistent approach on a project by all participating disciplines, the following documents are prepared:

a) Project Specification consisting of Project Description including general arrangement drawings, flow diagrams, electrical one line diagrams and Description of Services. The document is a statement of the technical objectives to be provided on a project including technical scope and content. Overall coordination and preparation of sections relating to technical matters is the responsibility of the Project Engineer. Technical content is the responsibility of the respective Lead Discipline Engineers who prepare assigned sections, with the guidance of the Project Engineer, and which are reviewed and approved by respective discipline Supervising Engineers for technical content and conformance to sound engineering practice. Copies of the Project Specification are distributed to all assigned Supervising Engineers, Lead Discipline Engineers, Client and others in accordance with project requirements. The Project Specification serves as the principle guide to the project team with regard to scope and technical content. It is revised from time to time as considered necessary to reflect changes in scope and technical content.

b) Procedures Manual defines the procedures to be used for executing the administration, engineering, procurement, accounting, construction and other activities as required to satisfy Ebasco's contractual obligations for the project. The Project Manager, with the aid of the Project Engineer, will identify those Engineering Procedures (Source Documents-see this section 3, item 2.1c) that are applicable to the project. He may amend these, or prepare new procedures as may be appropriate to fulfill contractual requirements or address special considerations for the project. The Procedures Manual will then become the guiding document to the project team for procedural aspects of the project. When company or departmental procedures are revised or new ones prepared, they will be evaluated for impact on the project and accepted or rejected by the Project Manager. If accepted, the Procedure Manual will be revised accordingly.

c) Document Control List is compiled by the Project Engineer and consists of a listing of applicable engineering and design guides, and cross-referencing lists of Ebasco Standard Specifications vs. project specifications. This listing assures that all disciplines are uniformly applying and referring to the same revision of Ebasco source documents. The listing further enables the Project Engineer to identify and evaluate the impact of revisions to Ebasco source documents on the project effort.

d) Drawing and Specification Lists are included in the Description of Services section of the Project Specification and identify those drawings and specifications to be prepared by Ebasco during the course of the project. In addition, these lists are updated and included in the monthly Project Progress Report issued by the Project Manager and further identify the disciplines responsible for issurance of the document as well as record the issue date and revision number.

2.3 Discipline Documents

The discipline, identified as the Responsible Discipline for a drawing or specification in the listing defined in item 2.2 (d) above takes full responsibility for that document. Initialling or signing by prescribed discipline representatives represents the verification that all aspects have been considered with regard to that document. It is understood that the discipline representatives will obtain agreements and resolutions with other disciplines, in writing, where such representative considers it to be prudent, but in the absence of such, takes full responsibility for the document. More specifically these documents will be processed as follows:

a) Calculations are performed by the responsible discipline who prepares calculations necessary to support engineering and design requirements. Correctness of calculations is the responsibility of the originator. Appropriate checking is performed by a second person who has not had substantial contact with the specific details.

b) Specifications are prepared consistent with the Project Specification, applicable industry codes, Ebasco standards and local, state and federal regulations. The Lead Discipline Engineer or his designee is responsible for preparation of the specification in accordance with these requirements and for obtaining comments from other departments and resolution of such comments that he in his judgement considers necessary or appropriate. He will initial the specification cover sheet next to his name which will denote that the foregoing has been accomplished to his satisfaction. The specification will then be reviewed by the discipline Supervising Engineer, who will review for technical adequacy, good engineering practice and conformance to contract requirements. He will also probe the LDE to assure that necessary inputs and comment resolutions have been achieved. When the foregoing are completed to his satisfaction, he will initial the specification next to his name in the "reviewed by" column. PE stamp will be included as required by applicable project procedures.

2.0 DESIGN & ENGINEERING DOCUMENT CONTROL (Cont'd)

2.3 Discipline Documents (Cont'd)

c) Inquiry, Bid Evaluation & Purchase Order procedural aspects for the equipment procurement cycle are defined in Ebasco Procedures. These procedures delineate interface responsibilities between Purchasing and Engineering and provide a uniform method for preparing and processing required documentation. (See Section 4)

d) Drawings are prepared under the supervision of a Design Supervisor with direction by the LDE for that discipline (Project Engineer for general arrangement drawings). The Design Supervisor or his designee is responsible for preparation of the drawing consistent with good engineering practice, Ebasco Design Guides and guidance as provided by the LDE or his designee. The Design Supervisor with the assistance of the LDE is also responsible for obtaining input and comments from other departments, and resolution of such comments that he, in his judgement, considers necessary and appropriate Drawings are checked and when satisfactory, the approval process is initiated in accordance with appropriate procedures. Each subsequent approval will denote satisfaction, to extent applicable, that the drawing is technically acceptable, conforms to good engineering and/or design practice, meets contract requirements, and that necessary inputs and comment resolutions have been obtained.

e) Vendor Drawing Control when specified in the purchase order, the vendor shall provide certified drawings for review by Ebasco prior to start of fabrication. These drawings are normally entered into Ebasco's computerized drawing file system (EMDRAC) where each drawing is numbered and copies are distributed to concerned parties, as identified by the Responsible Discipline, for review. Comments are transferred to the original reproducible and copies returned to the vendor. If additional vendor action is required, the vendor re-submits drawings as before until all problems are resolved. The system is programmed so that vendor drawings are entered into a listing as they are submitted. The listing is continuously updated and issued monthly.

EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION 4
B E Tsai CHAIRMAN, QUAL PROGRAM COMM	PROCUREMENT	REVISION 0 DATE 7/15/81

1.0 SCOPE

This section specifies those activities by which control of the purchase of items by the Ebasco Engineering Office is accomplished. The activities discussed hereafter are governed by Ebasco procedures.

2.0 RESPONSIBILITIES

2.1 Engineering Department is responsible for:

a) Preparation of Inquiry Memorandum, initiation of inquiry process.

b) Technical evaluation of Bidder's proposal, including exceptions to inquiry package.

c) Preparation of recommendation for purchases jointly with Purchasing.

d) Revision of specification to accommodate acceptable exceptions prior to issuance of Purchase Order.

e) Maintenance of information, calculations and documents supporting bid evaluations.

f) Obtaining Client concurrence to the technical aspects of purchase recommendations throught the Project Manager (where required).

g) Resolution of and timely response to vendor drawing and other submittals by the discipline originating the order.

h) Maintenance of appropriate records.

2.2 Purchasing Department is responsible for:

a) Preparation of Bidder's List and obtaining Client approval through Project Management.

b) Soliciting bids from approved Bidders (Note: Where erection or erection options are requested, the Construction Department provides the necessary input to inquiry).

c) Clarification of Bidder's proposal.

d) Commerical evaluation of Bidder's proposal.

e) Participation in preparation of letters of recommendation for purchase, jointly with Engineering Department.

f) Preparation and issuance of Purchase Order and supplements and obtaining acceptance by the vendor, and reconciling as necessary all conflicts and misinterpretations.

g) Maintenance of appropriate records to support the procurement activity.

3.0 SOLICITATION OF BIDS

3.1 After a specification has been reviewed in accordance with the engineering requirements, the Lead Discipline Engineer initiates the purchasing process by preparing an "Inquiry Memorandum" which is sent to the Purchasing Department.

3.2 A Buyer, assigned within the Purchasing Department, prepares an inquiry, consisting of the specification(s) and attachments, commercial terms and conditions and Instructions to Bidders. The Buyer reviews the inquiry to assure that specification and attachments are as specified in the Inquiry Memorandum and that all parts of the inquiry document are complete, complementary and consistant.

3.3 The Buyer sends inquiry to prospective suppliers selected from the approved Bidder's List for the particular item. Such Bidder's List is compiled and maintained by the Purchasing Department. Prospective suppliers are included on such lists on the basis of the following:

a) Favorable past experience.

b) Satisfactory evaluation of qualifications in accordance with Ebasco procedures.

3.4 The Purchasing Department has the responsibility for all contacts with Bidders during the bidding stage for purposes of interpreting inquiry documents.

3.5 Distribution of the inquiry package is made to prospective Bidders and individuals and/or organizations as shown on the Project Distribution Schedule for each project.

4.0 BIDDERS PROPOSALS

4.1 Bidder's proposals are received by the Buyer who distributes copies internally to the appropriate Lead Discipline Engineer and others as required. The Purchasing Department performs a commercial evaluation and analysis of the Bidder's proposals.

4.2 The Lead Discipline Engineer performs technical evaluations and analysis of the Bidders proposals.

4.3 The Purchasing Department has the responsibility for all contacts with Bidders during the evaluation stages for clarification of bids.

4.4 The Purchasing Department has the overall responsibility for assuring that required bid evaluations, both technical and commercial, are performed and completed prior to issuance of a Purchase Order.

5.0 PURCHASE ORDER

5.1 Upon completion of all prerequisites, the Purchasing Department prepares the Purchase Order which includes component specification(s) and attachment(s), drawing(s) and commercial terms and conditions. The Purchase Order is prepared by the responsible Buyer in accordance with Purchasing Department procedures and/or instructions which shall include, as a minimum, provisions for the following:

a) Reconciliation of successful Bidder commercial exceptions.

b) Reconciliation of successful Bidder technical exceptions.

c) Special considerations (such as Client approval).

d) Package completeness (assure that specifications and attachments thereto are present and of the proper revision).

5.2 Purchasing transmits the Purchase Order to the selected Supplier and distributes copies to those individuals or organizations as indicated on the Project Distribution Schedule.

5.3 Supplements to Purchase Orders are subject to the same process as the original Purchase Orders. A change to the technical content of a Purchase Order may only be made by revision of the subject specification. Supplements to Purchase Orders receive the same distribution as the original Purchase Order.

5.4 Purchasing Department assures that signed copies of Purchase Orders and supplements are returned for Purchasing Department files.

EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION 5
B E T CHAIRMAN, QUAL PROGRAM COMM	VENDOR SURVEILLANCE	REVISION 0 DATE 7/15/81

1.0 SCOPE

This describes the system of control which provides assurance that items purchased by Ebasco are supplied in accordance with the requirements of the applicable procurement documents. The system of control provides surveillance over the vendor and subvendor, the extent of which depends on the criticality and complexity of the material or equipment being purchased and past experience with the vendor.

2.0 RESPONSIBILITIES

2.1 The Chief, Vendor Quality Assurance is responsible for the administration of the vendor surveillance program. A qualified Vendor Quality Assurance Representative is assigned to each purchase order according to the particular area of expertise required (electrical, electronic, mechanical and welding, transformer, cable). Surveillance is normally performed on the following items to the extent specified by the contract with the Client:

ITEM NO.	DESCRIPTION
1	Pump Turbine
2	Generator Motor
3	Pony Motor
4	Accessories for Pump Turbine and Motor Generator and Pony Motor
5	Steel Outlet Pipes
6	Pennstock Sperical Valves
7	Low Level Outlet Gate & Valve
8	Potable Water System
9	Oil Purification System
10	Centrifugal Pumps & Motors
11	Rotary Pump & Motors
12	Sump Pumps
13	Strainers
14	Centrifugal Air Compresssors, Motors and Accessories
15	Reciprocating Air Compressor, Motor and Accessories
16	Structural Steel
17	Pennstock
18	Trash Rakes
19	Station Cranes

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ITEM NO.	DESCRIPTION
20	Unloading Bay Crane
21	Draft Tube Crane
22	Bridges
23	Miscellaneous Hoists
24	Instruments for Dams & Structures
25	Generator Isolated Phase Bus
26	Generator Circuit Breakers
27	Generator Transformers
28	Auxiliary Transformers
29	480 Volt Switchgear
30	480 Volt Motor Control Center
31	Lighting & Distribution Panels
32	Station Battery
33	Battery Charger
34	Vital AC Supply
35	Emergency Diesel Generator
36	Power Cable
37	Control Cable
38	Instrument Cable
39	Thermocouple Cable
40	Control Boards
41	Load Frequency Control
42	Remote Control System
43	Lighting & Miscellaneous Transformers

ITEM NO.	DESCRIPTION
44	Communication System
45	Cathodic Protection Equipment
46	Miscellaneous Control Equipment
47	Data Logger

2.2 The Vendor Quality Assurance Representatives visit the vendor's shops to ensure confidence that the requirements of the purchase orders are met by using the following methods:

a) Review all purchase order requirements, and establish a sequence of visits with vendor during his initial visit.

b) Determine that necessary drawings and procedures are available at time of examination.

c) Examine the purchased item during shop fabrication to generally determine that the item is being fabricated in accordance with the requirements of the purchase order.

d) Release of material for shipment by a Vendor Quality Assurance Representative (This does not constitute an acceptance thereof and does not relieve the vendor, manufacturer or contractor of any and all responsibility or obligation imposed by the purchase contract. It does not waive any rights the purchaser may have under the purchase contract, including the purchaser's right to reject the material upon discovery of any deviations from requirements of the purchase contract, drawings and specifications after arrival at destination).

3.0 VENDOR QUALITY ASSURANCE VENDOR SURVEILLANCE

3.1 The Chief, Vendor Quality Assurance is responsible for providing Vendor Quality Assurance Representatives with the following:

a) Purchase order and supplements, including specifications and appropriate attachments.

b) List of Ebasco-reviewed supplier drawings.

c) Instructions and procedures.

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3.0 VENDOR QUALITY ASSURANCE SURVEILLANCE (Cont'd)

3.2 The Vendor Quality Assurance Representative is required to document each surveillance visit to a vendor's facility on a Vendor Quality Assurance Report in which he includes the names and titles of vendor's personnel contacted, a description of his activities, including nonconformances noted, as well as any other discrepant areas to be checked during future surveillance visits. Vendor Quality Assurance Reports are distributed in accordance with the Project Distribution Schedule.

3.3 Rejections for all nonconformances to Ebasco purchase order requirements are logged and reported to Ebasco Engineering by the Vendor Quality Assurance Representative. This log enables the Vendor Quality Assurance Representative to maintain close control to assure that all outstanding nonconformances are cleared prior to release of the item for shipment. Corrective actions required to clear nonconformances are verified by the Vendor Quality Assurance Representative to ensure proper corrective action has been taken.

3.4 The Vendor Quality Assurance Representative reviews, as denoted by his stamp, all required documentation (i.e. test records, material test reports) prior to release of item for shipment. For those records requiring Engineering Office review (i.e. radiographic film, performance curves, special process procedures), the Vendor Quality Assurance Representative assures that the required reviews have been performed prior to releasing the item for shipment.

EBASCO SERVICES INCORPORATED	QUALITY MANUAL FOR HYDROELECTRIC POWER STATIONS	SECTION 6
CHAIRMAN, QUAL PROGRAM COMM	CONSTRUCTION CONTROL OF QUALITY	REVISION 0
		DATE 7/15/81

SCOPE

This section specifies those activities by which the control of quality at the construction site is accomplished. The activities discussed hereafter are governed by Ebasco procedures.

1.0 INSPECTIONS AND TESTS

1.1 The Resident Engineer or his designee reviews all design documents for the Project and provides for inspection, test and documentation coverage as required for the Project. Inspections are recorded by the Inspectors on Inspection Reports for both contracted work and for work performed by Ebasco forces. These reports indicate any quality deviations observed.

1.2 Inspection and testing personnel are knowledgeable of the specifications, codes and/or procedures to be applied to the specific work in their area or designated as their responsibility and they are qualified through educational training or field experience on power plant construction work.

1.3 The Resident Engineer, or his designee, ascertains the qualifications of inspection and testing personnel prior to work assignment, and where indoctrination and training is required, individuals are assigned to work with qualified personnel until adequate competence is attained.

1.4 Measuring and testing equipment to be used in inspection and testing operations is periodically inspected for any necessity of recalibration. The Resident Engineer or his designee arranges for recalibrations to be performed by qualified personnel.

1.5 The Resident Engineer reviews all field purchase requisitions and contracts prepared in the field in order to provide for inclusion of specified quality-related requirements. Any exceptions to specified requirements taken by bidders are reviewed by the Resident Engineer and, where required, resolved after consultation with the Design Engineer.

2.0 FIELD DEVIATIONS AND FIELD DESIGN CHANGES

2.1 Deviations

2.1.1 Deviation control, involving nonconformity, pertains to any offsite inspections performed by field forces, inspections of equipment and materials as received at the site, and to deviations detected during in-process supervision and inspection of the work.

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2.0 FIELD DEVIATIONS AND FIELD DESIGN CHANGES (CONT'D)

2.1 Deviations (Cont'd)

2.1.2 All nonconformity to Drawings, Specifications, Codes, Standards and other prevailing documents are reported to the Resident Engineer when detected. Reporting of such deviations includes sufficient detailed description to enable the Resident Engineer to review the deviation and pertinent documents. Minor deviations (i.e., those not affecting the quality, function or safety aspects of the item(s)) will be resolved by the Resident Engineer.

2.1.3 For major nonconformity deviations (i.e., those affecting the quality, function, or safety aspects of the item(s)), the responsible Design Engineer is contacted by the Resident Engineer to obtain resolution of the deviation. All resolutions of deviations shall be documented in the field file and, where required, recorded on Engineering Documents.

2.1.4 Corrective actions are implemented as required by resolution of deviations, and reinspection, where necessary, performed in accordance with established inspection procedure.

2.1.5 Where warranted, the Project Superintendent stops affected work until the deviation is resolved.

2.2 Design Change Control

2.2.1 All requests for major design additions or revisions to Engineering documents are addressed in writing to the Project Superintendent. The Project Superintendent, or his designee, prepares a Field Change Memorandum and submits it to the responsible design personnel and and other designated disciplines for resolution.

2.2.2 The Resident Engineer may authorize minor field design changes. If in the judgement of the Resident Engineer, responsible design personnel should be advised, a telephone call or TWX is initiated from the field. However, the Resident Engineer immediately follows up with a memorandum to the Design Engineer which records the details of such field changes.

2.2 Design Change Control (Cont'd)

2.2.3 All required design changes to Engineering Documents are recorded by either incorporation with original documents or by the maintenance of "as-built" sketches and/or marked documents in the field. The extent to which original design documents are updated is established in accordance with project procedures. The Resident Engineer, or his designee, maintains records at the site for turnover to the Client at the termination of the Project. These record those field design changes and resolved nonconformity deviations not shown on updated design documents.

3.0 DOCUMENT CONTROL

The Resident Engineer, through the Office Engineer, is responsible for the collection, storage, safekeeping and distribution of all documents and records such as drawings, specifications and reports, including revisions thereto. Documents are controlled in accordance with the following outline, subject to modifications as required by prevailing project organization:

3.1 Each document is stamped to record the date of receipt.

3.2 An appropriate record, such as a card file is maintained to record the current status of each document received. The record includes document title, number, revision number, date received, approval status and detailed distribution of copies.

3.3 Distribution of documents is in accordance with a predetermined system, and documents not distributed shall be maintained in a controlled file.

3.4 Transmittal reception forms are routed, where required, and later filed.

3.5 Distribution of documents from the Ebasco Field Office to disciplines and contractors are recorded by written transmittal and where required by project procedures, written acknowledgement of receipt is obtained.

3.6 Only current copies of documents are maintained in active files and at least one copy of void documents shall be maintained in a separate file.

4.0 RECORDS CONTROL

4.1 Quality control records encompass inspection records, certification documents and other surveillance records as required to record compliance to drawings, specifications and related design engineering documents, as well as to as-built drawings.

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4.0 RECORDS CONTROL (Cont'd)

4.2 The records are given a general review by the Resident Engineer, or his designee, in order to assure that records are legible and that there is sufficient correlation between the records and the items or activity to which the records apply. Spot checks are made to verify proper reporting in quality control records, relative to established requirements.

4.3 A records checklist is maintained in order to assure that complete sets of records are received. The location of all records in the files is recorded by use of an index.

4.4 Records are maintained in a safe place. Access to the files is controlled and any issue of records recorded at the time of removal from the files.

4.5 Records are maintained during the term of the Project and formally dispositioned to the Client at the completion of the Project in accordance with written instructions from the Construction Manager.

5.0 MATERIALS RECEIVING AND STORAGE

5.1 Non-Contractor furnished material and equipment is inspected before unloading to assure that it is free of any visible damage or defects.

The receipt inspection includes, but is not to be limited to, the following documented, visual examinations prior to unloading:

a) Improper Handling

Rough or improper handling during transportation as indicated by torn or crushed materials. In the event impact recorders are used to determine the impact or safe transportation, such recorders are reviewed.

b) Exposure to Fire, Inclement Weather

Indications are recorded of any traces of charred wood, paper, traps, etc., which could indicate possible exposure to high temperatures.

Indications are recorded of any weather-beaten, rusted, frayed or stained articles which could indicate a condition of improper protective measures during transit.

If such conditions occur, the material and/or equipment is visually inspected for any damage and the results recorded.

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5.0 MATERIALS RECEIVING AND STORAGE (Cont'd)

c) Proper Tie-Down

Any dislocation of material indicated by dislodged, broken or twisted shipping ties and hold down arrangements is documented.

d) Miscellaneous Observations

Any observed entry of road salt, chemicals, oil and water into critical components is recorded.

5.2 The material and/or equipment received is also compared with the requirements of the applicable purchase orders and shipping documents.

5.3 Any deficiencies or variations are reported as a deviation and the material and/or equipment placed in a "Hold" status, using serial Hold Tags, until such time as the deficiency is resolved and the material and/or equipment is released by the Resident Engineer.

5.4 The Contractor is responsible for receiving, inspecting, storing and handling all material furnished by him. Ebasco forces will perform sufficient inspection to assure that all contractual requirements are met.

5.5 Defective materials and/or equipment which must be returned to Vendors is documented on the Return Materials Report and Shipping Memorandums.

5.6 When an item on "Hold" status is urgently required for installation and the deficiency can later be corrected with the item in place, the Resident Engineer will release the item for installation and document same on the Hold Tag Summary Log and on the Hold Tag.

5.7 Upon completion of inspection of shipments, the material and/or equipment is stored and maintained in storage in accordance with the requirements of the Specifications or the Vendor or with the requirements of the Contract with the Contractor. Any material and/or equipment damaged during handling will be place in "Hold" status until release by the Resident Engineer.

6.0 CONSTRUCTION COMPLETION AND OPERATING STATUS

6.1 During the preoperational and start-up operations, the status of construction completion and the readiness of equipment and/or systems for turnover and operation is verified by means of marking and tagging, carried out by the construction forces and the Plant Operations and Betterment Engineer if applicable. Only equipment and/or systems which have met the required inspection and tests are turned over for operation.

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6.0 CONSTRUCTION COMPLETION AND OPERATING STATUS (Cont'd)

6.2 Where physical tagging or marking is either impractical or insufficient, other appropriate means of control such as logs are used to record the status of the equipment and/or systems.

6.3 Logs are also maintained which indicate the status of equipment and/or systems which are in test or rework and also provides a record of boundaries for partial systems and complete systems turned over to the Owner for pre-operational testing and start-up.

7.0 AUDITS

7.1 Periodic audits of quality programs are conducted at each site by the Manager of Quality Control or his staff. Reports, including recommendations for corrective actions, are submitted to the Construction Manager and Project Superintendent concerning the status of the Quality Program for the particular site.

7.2 Audit reports are reviewed by the Manager of Quality Control with the respective Construction Manager and Project Superintendent and the Client's representative where so required. Any corrective actions affecting the contractual status are also reviewed with the Project Manager.

Reports concerning the overall status of the Quality Program for all sites including any recommendations for corrective actions to the program are submitted to the Vice President-Construction and to the Manager of Construction Service.

HARZA - EBASCO

PROJECT REPORTING

CONSTRUCTION INVOLVEMENT

(q) PROCUREMENT

(p) VALUE ENGINEERING

OTHER INFORMATION

START-UP INVOLVEMENT

D(p) VALUE ENGINEERING

Application to the Susitna Project

The Joint Venture will assemble a Value Engineering Team in the design stage to participate in optimizing the cost effectiveness of the Project in the areas of capital, life cycle, and maintenance costs. The team will be composed of professionals with experience on many successful hydroelectric developments. Their experience will be broad and current but on the Susitna Project, they will be involved exclusively in the Value Engineering Review. The team also will include a representative from the Construction Manager.

We anticipate that the participation of this team will take place in the Conceptual Design Phase, during the preparation of the civil construction contract drawings for project facilities, and during the specifications conceptual stages. At these times, Value Engineering permits the introduction of real savings without disrupting of engineering schedules and without having to face the defensive attitudes of the designers, which would have to be overcome in later periods.

We believe that the Value Engineering Team can be most effective reviewing the power facilities, structural layout and proposed mechanical and electrical systems. We envision that VE reviews will be carried out on the work done by the engineering subcontractors for the design of the non-technical facilities such as the permanent town layout and major facilities such as schools, public buildings, potable water treatment plant and distribution system and the sewage treatment plant and collection system.

The Joint Venture has representatives in every technical discipline, who have attended the 40-hour Value Analysis Workshop prescribed by the Public Building Services of the General Services Administration and sponsored by the American Institute of Architects, the American Consulting Engineers Council and the American Institute of Consulting Engineers. A list of personnel who have completed the 40 hour workshop, with technical discipline is presented in Table D(p)-1. A Value Engineering Team Coordinator will be engaged from the outside to lead the value engineering studies and focus activities on the most promising areas for improvement.

However, we will also arrange to analyze and process VE suggestions proposed by the contractors and equipment suppliers. We propose that VE teams, consisting of engineering and construction management personnel, as well as Power Authority rep-

resentatives, be formed to handle such suggestions, which will be encouraged by value engineering incentive clauses in fixed price contracts. The VE team coordinator, selected jointly by the three participating entities, will ensure the appropriate staffing and budgeting for the effort.

In the course of Ebasco's work on the independent check of estimates for the Susitna Project, several features were discovered which we believe would be candidates for the VE approach. For example, we might cite the coordination of the diversion tunnel upstream intake gates and hoists used for closure at Watana and Devil Canyon so that a common design would permit salvage and reuse of the Watana equipment at Deveil Canyon. Savings in excess of $1 million at the 1982 cost level could be achieved, although the Watana gates might have to be slightly larger and more costly than presently contemplated.

Harza Value Engineering Example

The Seattle District of the Corps of Engineers, early in 1975, issued contract documents to bidders for raising Chief Joseph Dam. Shortly after the documents were on the street, the Seattle District decided to have an independent constructability review of the documents. They negotiated a lump sum contract with Harza to conduct the review. The final report on the review had to be submitted in 84 days, in view of the fact that the documents were on the street. Addenda to the Corps contract documents, as a result of the review, had to be processed and issued to bidders so as not to unduly delay receipt of bids.

Harza assembled a VE team of experienced hydroelectric designers and field construction engineers from all disciplines. Certain of the team members and the team leader visited the Seattle District's office for a briefing and then visited the site. Since time was of the essence, abbreviated VE techniques were used and the Corps was advised of the team's findings on a day-to-day basis, in order to permit early processing of addenda to the documents in the hand of Bidders.

The Harza team met the Seattle District deadline. In the final report, Harza indicated that potential estimated savings to the Corps of $1,152,000 could result if all the proposed design and drawing modifications were implemented. The report also pointed out errors, potential conflicts between contractors, and omissions in the contract documents that would result in significant cost to the Corps; however, no value was included for these items in the $1,152,000. Also included in the report was a question with respect to the design criteria used by the Corps. After considering Harza's question, the Corps

indicated that, as a result of Harza's raising the matter, they had indirectly saved $13,000,000.

Attached, as Exhibit D(p)-1, is a copy of a letter from the Seattle District recognizing Harza's contribution. The $75,000 lump sum paid by the Corps for Harza's services was returned manyfold in savings to the Chief Joseph Project.

Ebasco Value Engineering Example

Ebasco employed value engineering techniques to redesign a concrete baffle wall in the front of the intake structure at the Ludington Pumped Storage Project, with an estimated cost reduction of $600,000. Model tests of this intake, which had to pass 80,000 cu ft per second to the 1,870-MW power plant, had indicated that huge vortices would cause undesired vibration and reduce the power output. A reinforced concreted wall 230 feet long and 74 feet high was placed at the approximate centerline of the vortices and solved the hydraulic problem. However, this 1500 cu yd of cast-in-place concrete, heavily reinforced, would have created a critical manpower situation at the peak of the construction season.

Recognizing the desirability of reducing field manpower, as well as costs, an Ebasco in-house team of construction, design and estimating engineers established the functional requirements and the design parameters of the baffle wall for alternate precasting schemes. When preliminary in-house studies proved promising, an outside consultant specializing in prestressed concrete components was engaged to design the baffle wall. After the design was accepted, the 77-foot-long prestressed concrete beams were fabricated off site and erected by Ebasco with a minimum work force. Thus, the value engineering approach resulted in the significant cost savings mentioned above and also permitted Ebasco to place 180,000 cu yds of reinforced concrete in the power plant structures during the May through October, 1971 construction season on schedule and under budget.

An article covering this operation reprinted from Civil Engineering - ASCE (March 1973), is included in the proposal as Exhibit D(p)-2.

ACEC-AIA

VALUE ENGINEERING WORKSHOPS

Name	Discipline	Date Attended
W.T. Bristow Harza	Hydroelectric Projects II Division (Civil Design Department II)	August 25-30, 1974
M.E. Schuchard Harza	Pumped Storage Division (Electrical Department)	June 1-6, 1975
G.H. Post Harza	General Mechanics Division (Mechanical Department)	June 1-6, 1975
R.D. Witte Harza	Hydroelectric Projects I Division (Civil Design Branch II)	June 1-6, 1975
J.R. Ghia Harza	Planning and Process Division (Environmental/ Sanitary Engineering Branch	April 11-16, 1976
E.R. Paul Harza	Architecture Section	April 11-16, 1976
J.R. Fotheringham Ebasco	Civil Design Engineering	January 19-23, 1981

Exhibit D(p)-1

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
PO BOX C-3755
SEATTLE, WASHINGTON 98124

NPSEN-DB-ST

12 January 1976

RECEIVED
HARZA ENGINEERING COMPANY
JAN 19 1976

Mr. W. T. Bristow
Harza Engineering Company
150 South Wacker Drive
Chicago, Illinois 60606

Dear Mr. Bristow:

Reference contract No. DACW67-75-C-0083, Construction Management, Chief Joseph Structural Modifications (expired contract).

The purpose of this letter is to inform you of the present status of our bidding documents on Chief Joseph Dam Structural Modifications and actions we have taken as a result of your report, "Constructibility Review of the Pool Raising Structural Modification for Chief Joseph Dam, Columbia River, Washington."

We have reviewed the design and basic criteria for prestressing. We have modified this criteria, using the actual weight of the concrete in the dam which is 155 pounds in lieu of 150. We have deleted the ice loading since the history of the existing dam shows this to be a remote condition. In addition, we have found additional rock line data for the foundation which modifies our previous design assumptions. The result of this criteria change reduces the prestressing to only four monoliths in the spillway requiring prestressing to the foundation. This change is being processed as Amendment 16.

Due to your comment on cost of the trunnion bridge, we have made a value engineering study of the bridge. This study has resulted in changing the bidding documents by providing a contractor's option for a precast concrete bridge. This is being processed as Amendment 19 to the bidding documents. Present schedule for bid opening is 12 February 1976.

Our comments on your recommendations and actions taken are in Inclosure 1. We appreciate your comments. Due to your review and recommendations,

savings in excess of $600,000 have been realized, excluding drilling and prestress savings. Though entire savings on prestressing is not all attributable to your comments, the study of method of drilling holes did start further studies on prestressing and stability, resulting in a total savings of $13,000,000.

Sincerely yours,

GERRETT L. JOHNSON
Contracting Officer's Representative

1 Incl
As stated

At hydro plant, value engineering saves $600,000

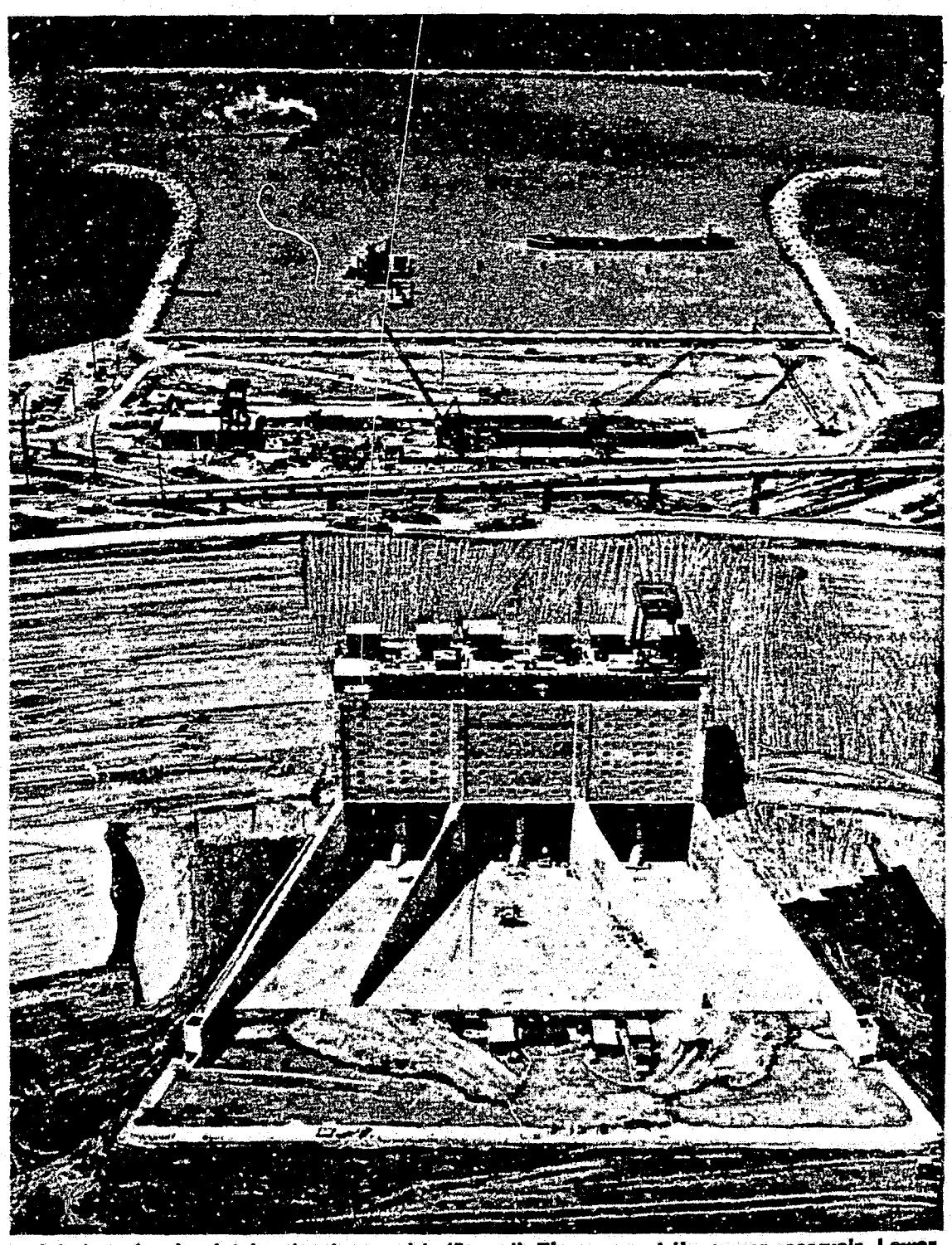
In construction, particularly when dealing in a one-time product, there is rarely time for repeated design studies. An alternate design in precast, prestressed concrete saved an estimated $600,000 on the Ludington Pumped Storage Power Plant near Ludington, Mich.

NORMAN L. SCOTT, M. ASCE
President,
The Consulting Engineers Group Inc.
Glenview, Illinois

C. T. McCREEDY
Resident Engineer,
Ebasco Engineering Corporation
Ludington, Michigan

An alternate design in precast, prestressed concrete saved an estimated $600,000 on the Ludington Pumped Storage Power Plant near Ludington, Michigan. The process by which this savings was effected has, in recent years, been called value engineering, which means looking at an original design and determining whether it can be redesigned at less cost without sacrificing quality or integrity.

Value engineering has been widely used by companies manufacturing electrical and mechanical equipment and is now occasionally applied in civil engineered construction. Within an integrated manufacturing organization, there are obviously strong incentives to come up with a quality product at minimum cost. Since a manufactured item may be duplicated hundreds, thousands, or even millions of times there



Aerial view showing intake structure and baffle wall. These are at the upper reservoir. Lower reservoir is Lake Michigan (in background).

are impressive gains to be realized for the industrial firm by engineering and re-engineering every part until an optimum solution is found. The process is also extended to the purchasing function in order to make use of cost saving ideas or products offered by vendors. In construction, the incentive is less dramatic since it generally applies only to initial cost.

In construction, particularly when dealing in a one-time product, only occasionally is there time for repeated design studies. There also may not be money available for additional engineering and value analysis, especially since additional design studies do not automatically guarantee cost savings or design improvements.

Fortunately, these problems were circumvented by the Engineer-Constructor, Ebasco Engineering Corporation, at the Ludington Project. Precast prestressed beams were used instead of a cast-in-place baffle wall on a project built for Consumers Power Company and the Detroit Edison Company. The $340 million hydro electric power plant is located on the eastern shore of Lake Michigan, approximately five miles (8 km) south of Lurington. The first pump/turbine-motor generator was placed in commercial operation on January 17, 1973; the plant will be capable of generating 1870 Mw of power. The remaining five units will be in operation before the end of the year. The Ludington project is the largest pumped storage plant in existence or under construction.

The upper reservoir at the Ludington plant is enclosed by an earth embankment six mi long with a crest 370 ft (113 m) above mean water level of Lake Michigan, which serves as the lower reservoir. The reversible pump/turbines (Hitachi) pump water out of Lake Michigan through six penstocks and discharge into the upper reservoir. During the generating mode, the water flows back through the same penstocks and reversible pump/turbines-generator motors from the upper reservoir to Lake Michigan.

At the upper reservoir the water is drawn through the intake structure where fluctuation in the water level will be 67 ft (20.4 m). (See photo.) Model tests of the intake showed that if the water going into the penstocks was not properly controlled, there could be huge vortices formed at the intake as these big tubes tend to gulp both air and water. The vortices could then cause undesired vibration and reduce the power output. To smooth out the flow of water entering the intake, a perforated concrete wall was designed by Ebasco and a model tested at Worcester Polytechnic Institute. This wall in the full scale structure is 230 ft by 74 ft (70.2 by 22.6 m). The wall is located approximately along the centerline of the vortices, as determined from the model tests, that would form if the wall were not present. The bottom edge of the wall is 50 ft (15.3 m) above the concrete apron forming the intake channel.

Ebasco's preliminary design considered a wall of reinforced concrete 3 ft (0.9 m) thick containing 1,500 cu yd (1,150 m^3) of concrete. The wall was perforated with 4 ft (1.2 m) holes spaced 7 ft (2.1 m) vertically and from 14 to 24 ft (4.3 to 7.3 m) horizontally. The wall also featured waffle-like recesses to reduce total weight and this, coupled with the holes, required large amounts of reinforcing steel to minimize the inevitable cracking due to restrained volume changes.

Construction labor peak

Ebasco was to do the concrete construction with its own forces, and a review of the 1971 schedule showed that the baffle wall project would create a critical manpower situation.

The construction schedule called for placing 30,000 cu yd (23,000 m^3) of concrete per month in the spring and summer of 1971 in all areas of the powerhouse, intake structure and penstock encasement. Since the entire project is constructed on clay and sand foundations, the design required much more extensive and complicated reinforcing than in similar structures constructed on rock foundations. For example, in the powerhouse alone about 100,000 sq ft (9300 m^2) of forms and 1,000 tons (907,000 kg) of reinforcing steel were scheduled per month.

Construction of a cast-in-place baffle wall would require an extensive shoring system for the first lift, starting 50 ft (15.2 m) above the intake aprons. The form system, because of the 4 ft holes, the waffle recesses and the difficult access was expected to require about double the manpower used in the 1970 season on the intake structure. The reinforcing steel ratio (190 lb/cu yd or 112 kgl. m^3) was high and was further complicated by the setups and special shapes around the holes and recesses in the wall.

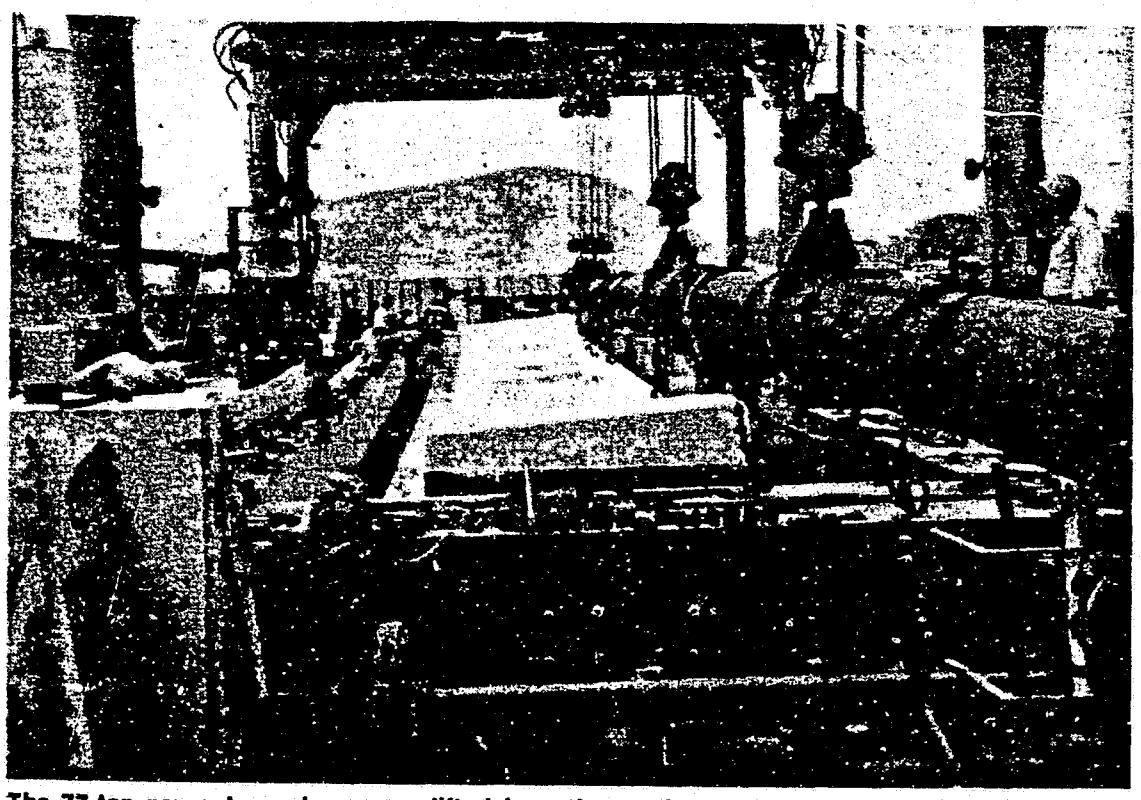
The baffle wall not only contributed significantly to the high expected total manpower (Fig. 1) but it placed the peak in the early part of the season when the manpower buildup for other essential work was already severe.

Preliminary study of precasting schemes indicated that Ebasco could not only reduce total manpower, but move the peak out of the crucial early part of the season. Ebasco believed this justified additional value engineering and invited The Consulting Engineers Group Inc. (CEG) to prepare an alternate design using precast, prestressed concrete components.

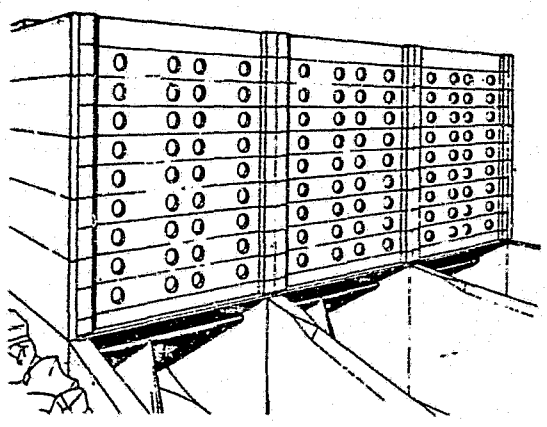
Design parameters

The design parameters were relatively simple and there were few constraints to inhibit innovation. The wall must sùstain a lateral load of five kips per linear foot (73 KN/m) due to ice pressure. This horizontal force was considered as a line load that could occur at any elevation up and down the wall. The four ft diam holes had to be roughly in the same positions as in the original design, since the location and size of these holes had been determined from the hydraulic model studies. After a review of the site capabilities for handling and erecting the wall, Ebasco and CEG decided that the most practical member would be 7 ft (2.13 m) high and 77 ft (23.47 m) long. This would allow casting repetition and only three types of steel forms would be required. These members would be stacked on each other to the required height of 74 ft (22.56 m).

Inverted tee beams were used for the bottom members of the baffle wall



The 77-ton precast members were lifted from the casting bed by two Drott Travelift straddle carriers and this pipe strongback.



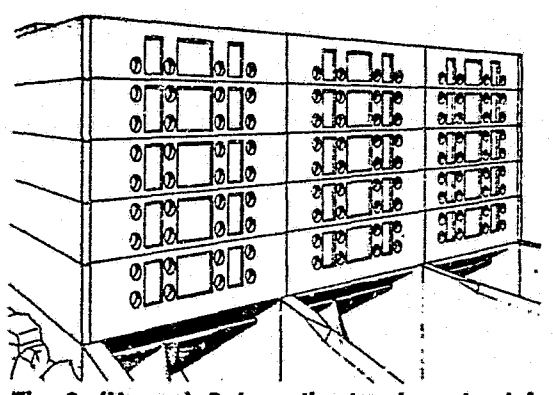
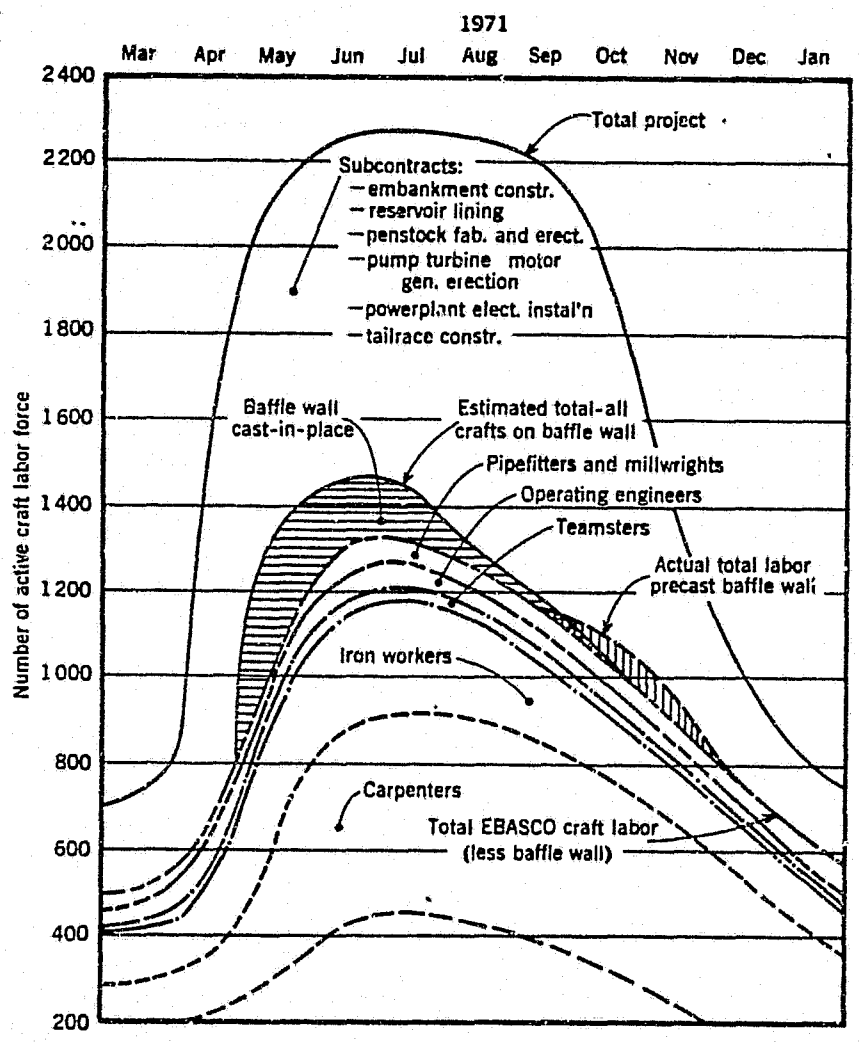


Fig. 2. (Upper.) Schematic drawing of original baffle wall design in the cast-in-place concrete.

Fig. 3. (Lower.) Alternate design selected, with precast prestressed concrete components retained the size and position of 4 ft diameter perforations.

Fig. 1. 1967 estimate of 1971 on-site labor requirements. The precast baffle wall reduced the peak labor requirement.



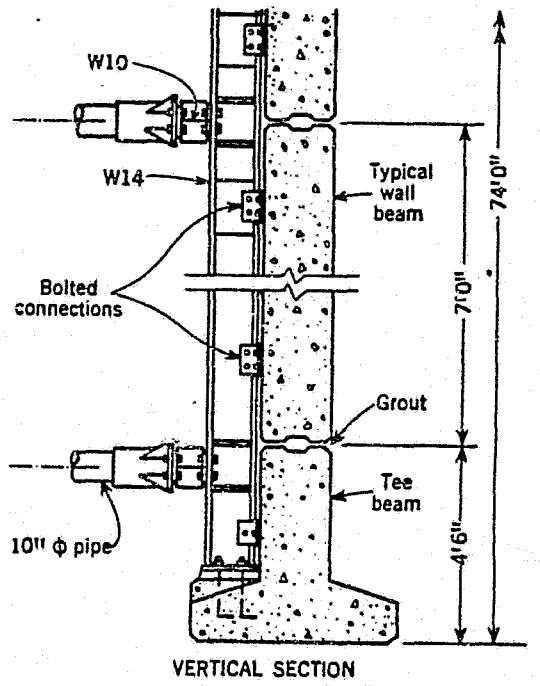


Fig. 4. Vertical cross-section shows how precast elements are tied to the steel bracing system.

system. These members were designed to support the vertical steel beams of the backup structure which transfers the lateral force of the ice pressure back to the intake structure. The original cast-in-place design called for this backup structure to be structural steel and this concept was merely enlarged to provide additional support framework for the precast members.

A preliminary design considered using precast beams of constant width (18 in.) along the 77 ft length, bearing at points near each end. Since four or more beams could be placed each day, bearing stresses at the ends would be high. It was decided that these stresses could be significantly reduced and stability greatly improved by adding end blocks, 3 ft-6 in. (1.07 m) wide and 5 ft (1.52 m) long. The end blocks also proved to be helpful in stabilizing the members during storage in the casting yard, as well as during shipping and storage at the jobsite.

Each main component was designed to be pretensioned with sixteen ½ in. diam strands in the bottom and ten ½ in. diam strands on top. Since these two prestressing forces are widely separated in the top and bottom of the beam, there is a tendency for the member to split horizontally through the holes. The presence of the holes also complicates the distribution of strains resulting from volume changes during the curing process which would also tend to split the member horizontally. To control the cracking in this

Table 1—General statistical information

	ORIGINAL DESIGN	ALTERNATE DESIGN
Length	230 ft	230 ft
Height	74 ft	74 ft
Area	17,020 sq ft	17,010 sq ft
Concrete	1,500 cu yd	900 cu yd
Reinforcing Steel	190 lbs/cu yd	Prestressed
Forms	30 sq ft/cu yd	Precast
Structural Bracing	48 tons	145 tons

direction, each beam has vertical post-tensioning bars. Bars with a diameter of 1 in. (25 mm) were placed vertically on each side of the holes and a bar was placed in the end blocks at each end.

CEG considered post-tensioning all the beams together vertically during the erection process. Further study disclosed that this additional post-tensioning would not be necessary and would increase field construction costs without an attendant benefit in improving performance. Fig. 2 shows a schematic drawing of the preliminary cast-in-place design and Fig. 3 illustrates the wall as finally built in precast, prestressed concrete.

Ebasco took competitive bids from several prestressers in the region and awarded a contract for furnishing and delivering to the F. Hurlbut Co. of Green Bay, Wisc. Hurlbut built a special casting bed for members, consisting of two 80 ft (24.38 m) long prestressed beams on each side to take the reaction from the end stressing headers. A steel form for casting the members was placed inside the rectangle composed of the two beams and the headers. The four ft diam holes were formed with steel rings which could be reduced in size for stripping. (See photo). To meet the construction schedule, the members were cast on a one-day cycle. A rich mix consisting of seven bags of high early strength cement and mixed to a slump of 4 in. (10/mm) was used for the beams. The concrete strength exceeded 4,000 psi (281 Kg/cm^2) after 18 hours of stem curing. This permitted casting of the members on a daily cycle. The seven day strengths were over 4,500 psi (316 Kg/cm^2) and the 28 day strength exceeded 7,000 psi (492 Kg/cm^2). Fig. 4 shows a vertical cross-section of the baffle wall.

The Tee beams were erected first, followed immediately by the structural steel support stru. system (photo) in the south bay, using a 150 ton crawler crane (Manitowac).

Erection of the precast beams was begun with the 200 ton (182,000 Kg) crawler crane in the south bay, while steel erection continued in the center and north bays. Each beam was set in a bed of sand-cement grout spread over the flared ends and immediately bolted to the structural frame. An average of 4 beams were erected each day.

After completion of steel erection, the remaining precast beams were erected using both cranes to facilitate accurate placing. Neat cement grout was used to complete the grouting of the horizontal joints and the outside vertical joint. The two center vertical joints were filled with a foam plastic insulation board and sealed with a polysulfide compound. All of the field connections were then welded and the entire steel framework protected with a coal tar epoxy coating system.

Ebasco placed over 180,000 cu yd of complicated, heavily reinforced concrete in the period, May through October, 1971, in the power plant structures. The precast baffle wall was completed for $600,000 less than originally estimated and even more significantly, all of the projected concrete work for the 1971 construction season was completed on schedule and at less than the estimate, due in part to the flattening of the manpower curve made possible by the change to the precast baffle wall. A comparison of the original and alternate designs appears in Table 1.

Norman L. Scott (left) received his degree in civil engineering from the University of Nebraska in 1954. He was formerly executive secretary of the Prestressed Concrete Institute. In 1967 he started The Consulting Engineers Group which is located in Glenview, Illinois. His firm was technical editor of the recently published PCI Design Handbook. Scott has been Chairman of ACI-ASCE Joint Committee 425 Prestressed Concrete for the past four years. He has been a member of ASCE since 1950.

C. T. McCreedy (right), Construction Superintendent, Ebasco Engineering Corporation, graduated from Rensselaer Polytechnic Institute in 1954 with a degree in Building Construction and has been involved in power plant construction for Ebasco for the past 19 years. Mr. McCreedy has specialized in construction engineering and management of large subcontracts for power projects. The construction plant for the Ludington Pumped Storage Project including many of the facilities mentioned in the article was developed under his direction.

The Readers Write

(continued from page 71)

Best shore protection

To THE EDITOR: In his article, "Best Shore Protection: Nature's Own Dunes, (September 1972, pp. 66-70), Dr. McHarg presents a point of view which he feels is contrary to the philosophy of beach protection in current use by the engineering community. I beg to differ. Most engineers working in the field would agree that sand, either natural or artificially placed, results in the most benefit for recreational, aesthetic, and protection purposes.

Unfortunately, there are many coastal areas in the United States that support towns where a sand buffer between the ocean and highly valued real estate does not exist. The "let's see who can get closest to the ocean" race which resulted in this condition was an outgrowth of public pressure and local policy decisions and should not be attributed to the engineer, as Dr. McHarg seems to imply. I believe the implication that engineers created the present circumstances is unwarranted.

The second point to be made is that regardless of the blame, Dr. McHarg's article represents only a partial solution. The total solution would involve obtaining a suitable stock of sand before any stabilizing influences can be brought to bear.

Since Dr. McHarg has used New Jersey as an example, we can do the same, confining ourselves to developed areas without suitable dune protection. Initially, it must be realized that sand in lagoons or marshy areas behind these barrier beaches is unsuitable for two reasons. Because of grain size, sand in these estuaries will rapidly erode on the beach face and so not be available for long-term protection. More importantly, removal of sand from these estuaries will result in major ecological damage. The question then arises, where can new sand be obtained to build dunes?

The Coastal Engineering Research Center in Washington has determined that there is at least 480 million cu yd (367 M) of adequate beach fill material located offshore in suitable dredging depths between Manasquan and Egg Harbor, and close to two billion yards (1.5 Gms) off Cape May. The total solution then would involve bringing this sand to eroding beaches and landscaping technology to hold it in place.

The Corps of Engineers, Philadelphia District, sponsored a three year research program at the University of Pennsylvania's Towne School of Civil and Mechanical Engineering to tackle the engineering aspects of an offshore sand retrieval project. The results of this study, completed in 1971, show promise that present machinery may be innovatively used to bring this offshore sand to an eroding beach both economically and feasibly.

I suggest that all knowledge be used to arrive at a solution which is both environmentally sound and within the present bounds of engineering technology. I hope that Dr. McHarg's group and our engineering group can discuss this problem.

GEORGE C. GOVATOS

Bear, Del.

(continued on page 82)

HARZA - EBASCO

(q)
PROCUREMENT

PROJECT REPORTING

CONSTRUCTION INVOLVEMENT

(u)
OTHER INFORMATION

(t)
START-UP INVOLVEMENT

D(q) PROCUREMENT PROCEDURES FOR LONG LEAD-TIME ITEMS

The Joint Venture proposal includes a preliminary selection of 15 separate supply contracts for items of permanent equipment requiring, in some instances, substantial lead time before delivery. These separate supply contracts are:

- Turbines and Governors
- Generator and Excitation
- Microwave System and Towers
- Willow Control Center, Diesel Generator, Uninterrupted Power Supply, Security System and Fire Protection System
- Trashracks, Gates and Gate Operators
- Generator Voltage Switchgear
- Computer Control
- Switchyard Structures-Busses and Accessories
- Cranes and Hoists
- Outlet Works Valves, including High Pressure Valves
- Slide Gates for Emergency Release
- Transformers
- Control Switchboards
- High Voltage Switchgear
- Station Service Switchgear
- Power Cables-furnish and install

In addition to the long lead time aspect of some of these contracts, the list is based on our knowledge that many of these equipment items require particularly careful vendor selection, coordination in the submittal, review and approval of design information, expediting, and inspection of fabrication, packing and shipment.

The tentative scheduling of these contracts has been discussed under Item D(b) above. In general, the scheduling is governed by the need for early submittal of design information as work on the civil construction contracts progresses to permit complete detailing for lump sum bids. However, both the selection of equipment for separate supply and its scheduling will be a joint effort with the Construction Manager and subject to Power Authority approval.

Procedures

The Power Authority has mandated in RFP Amendment III that the design engineer's involvement in procurement will be limited to "evaluation of bids and assistance in acceptance inspection of the items." This discussion of our procedures includes only those aspects of the total procurement function and our related capabilities.

The procurement function will begin with the Joint Venture establishing a detailed specification and procurement schedule, showing all procurement related activities from the issuance of the technical specifications through the actual equipment delivery, inspection, erection and/or installation. This schedule will specifically include the dates to be met for the issuance of the technical specifications, the Invitation to Bid, receipt of proposals, completion of bid evaluation, purchase recommendations to the Power Authority, award of contract, issuance and receipt of vendor drawings, material/equipment "due-at-site" dates and performance of the work called for under the contract. A preliminary listing of what the dates might be the 15 supply contracts is presented in Exhibit D(q)-1.

Preparation of the detailed schedule will require coordination between the Joint Venture, the Construction Manager and the Power Authority to make certain that the technical specifications are scheduled for completion in sufficient time to receive manufacturers drawing information. The latter will be necessary for construction contracts and for meeting equipment delivery dates. The Joint Venture will provide critical equipment lead times (see Exhibit D(q)-1). Specifications for long lead time items will be requested first so that the procurement cycle can be completed as expeditiously as possible. Early procurement of long lead material and equipment would then commence in accordance with the schedule agreed to by the Power Authority.

As specifications are being prepared, we will assist in development of Bidder Lists. To aid in this the Joint Venture Vendor Performance System is available. In a centrally computerized, single-source, data base management system, the Vendor Performance System retains statistics on over 1,500 vendors qualified by the Joint Venture, suppying more than 1,300 capital equipment commodities. The system capability includes rating vendors on criteria such as cost, delivery, quality, financial strength, technical capability and problem resolution.

Upon receipt of bids in response to the Invitation for Bids, we will participate in their evaluation in a manner to be agreed upon with the Power Authority. As a minimum, however, we would suggest substantial participation by our electrical and

mechanical engineering groups in the technical evaluation. Our Purchasing Sections will be available for the commercial evaluation should the Power Authority require it.

Occasionally, where the contract documents permit splitting the contract award, review of the bids will indicate that significant savings can be made by the award of items between two or more vendors. Many factors, in addition to the price, will be considered prior to the recommendation to split an award. For example, if two awards are made, the separate vendor locations must be expedited in addition to the preparation and administration of two purchase orders. Additional coordination will be required in the review of suppliers' drawings and there will be additional costs of inspection of two locations versus one. At times an award may be split to ensure on-time delivery in the event that the review determines that one vendor's plant may be overextended. We will carefully consider all of the costs associated with splitting a proposed award and prepare a short justification in the bid analysis.

In connection with the award, we will assist in negotiations and be available for pre-award and post-award meetings with bidders as necessary.

As each procurement contract is initated we will establish with the vendor a system of indexing submittals and for review and approval according to the requirements of the contract documents. Our proposal includes not only the reiview and approval function itself, but a specific expediting process to ensure timely submittals and reviews with appropriate reports to the Construction Manager and the Power Authority.

Expediting

In addition to expediting the submittal of engineering documentation, the Joint Venture will provide equipment expediting services for major equipment items. This function will include continuing contact with vendors during the fabrication process to ensure that material procurement, fabrication and shipping schedules support the construction schedule. When delinquencies are detected, pressure will be exerted on the vendors to maintain compliance with contract schedule commitments.

Inspection

Vendor inspection activities on the Project will be provided through a joint effort by project design engineers and Ebasco's regionally located Vendor Quality Assurance Representatives

(VQAR). The VQARs will visit manufacturing facilities on a scheduled basis to perform the following activities:

- In-process surveillance of quality-related activities
- Verification of required procedure approval
- Participation in Vendor inspection and/or testing at required notification points
- Identification and documentation of non-conforming conditions including formal notification to engineering for resolution of non-conformances
- Final release for shipment

Support of the Vendor Quality Assurance Representatives will be provided by the project engineering staff. At key points of assembly check-out and test on the critical equipment our mechanical and electrical design engineers will make in-plant inspections to assure that specification requriements are met. The design engineers will also participate in factory acceptance tests and/or review the documented results of these tests prior to authorization for shipment.

842/9-74

CURRENT MATERIALS/EQUIPMENT SHIPPING PROMISES FOR HYDROELECTRIC STATIONS

▮▮▮▮ AS OF JANUARY 15, 1982

▮▮▮▮ AS OF APRIL 15, 1982

EXHIBIT D(q) - 1
Sheet 1 of 2

MATERIAL/EQUIPMENT	BID TIME (IN WEEKS) 2 4 6 8	SHIPMENT (IN MONTHS) 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34	EST. ERECTION TIME TO TRIAL OPERATION (A) 4 8 12 16 20
TURBINES, HYDRAULIC OVER 150,000 HP MEDIUM HEAD		TOTAL D&E 30 MONTHS	
TURBINES, HYDRAULIC UP TO 150,000 HP MEDIUM HEAD		TOTAL D&E 28 MONTHS	
GENERATORS, WATERWHEEL		TOTAL D&E 24 MONTHS	
BATTERIES, STATION STORAGE			
BUILDINGS, PREFAB, WAREHOUSE			
BUS, ALUMINUM INTEGRAL WEB			
BUS, ALUMINUM BAR/TUBING			
BUS, COPPER BAR/TUBING			
BUS, METAL ENCLOSED, ISOLATED PHASE			
CABLE, POWER & CONTROL			
CARRIER CURRENT EQUIPMENT		EARLIER POSSIBLE ON SMALLER UNITS	
CATHODIC PROTECTION EQUIPMENT			
CIRCUIT BREAKERS, OIL TO 230 KV			
CIRCUIT BREAKERS, OILLESS 115-230 KV			
CIRCUIT BREAKERS, 345 KV & ABOVE			
COMMUNICATION EQUIPMENT		NOT INCLUDING CARRIER CURRENT	
COMPRESSORS, STATION & INSTRUMENT AIR			
CONTROL BOARDS, MAIN			
CRANES, GANTRY			
ELEVATORS		TOTAL D&E 16 MONTHS	
FIRE PROTECTION – CO_2 SYSTEM			
FIRE PROTECTION–SPRINKLER SYSTEM			
GAGES & THERMOMETERS		SOME STOCKS POSSIBLE	
GATES, INTAKE (TAINTER)			
GATES, INTAKE (OTHER)			

a) TRIAL OPERATION MEANS DATE ON WHICH GENERATOR IS SYNCHRONIZED WITH SYSTEM FOR FIRST TIME. ESTIMATED ERECTION TIME INDICATES NORMAL NUMBER OF MONTHS REQUIRED AFTER START OF SHIPMENT.

NOTE: TO ALLOW FOR UNANTICIPATED DELAYS SUCH AS STRIKES, ETC., ONE MONTH SHOULD BE ADDED TO BOTH SHIPMENT AND ERECTION (WHERE APPLICABLE) TIMES FOR EACH YEAR SHOWN IN THESE CATEGORIES.

(CONTINUED)

PREPARED BY EBASCO PURCHASING

(v) PROJECT REPORTING

(w) CONSTRUCTION INVOLVEMENT

(u) OTHER INFORMATION

(t) START-UP INVOLVEMENT

542/9-74

CURRENT MATERIALS/EQUIPMENT SHIPPING PROMISES FOR HYDROELECTRIC STATIONS

▮▮▮▮ AS OF JANUARY 15, 1982

▮▮▮▮ AS OF APRIL 15, 1982

EXHIBIT D(q) - 1
Sheet 2 of 2

MATERIAL/EQUIPMENT	BID TIME (IN WEEKS) 3 6 9 12	SHIPMENT (IN MONTHS) 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34	ESS. ERECTION TIME TO TRIAL OPERATION (A) 4 8 12 16 20
HEATING, VENTILATING & AIR CONDITIONING		EARLIER POSSIBLE ON SMALLER UNITS	
HOISTS, INTAKE GATE			
INSULATORS – BUS & SWITCH			
INSULATORS – POST TYPE			
MOTORS			
PANELS, LINE CONTROL			
PENSTOCKS, LARGE		TOTAL D&E 20 MONTHS	
PENSTOCKS, SMALL		TOTAL D&E 18 MONTHS	
PIPING (FABRICATED)			
PUMPS, MISCELLANEOUS			
PURIFIERS, LUBE OIL			
SWITCHES, DISCONNECT			
SWITCHGEAR, LOW VOLTAGE			
SWITCHGEAR, MEDIUM VOLTAGE			
TANKS, SMALL STORAGE			
TANKS, SURGE			
TRANSFORMERS, MAIN POWER ABOVE 200 MVA			
TRANSFORMERS, MAIN POWER 10-200 MVA			
TRANSFORMERS, STATION AUXILIARY			
TRASH RACKS			
VALVES, BUTTERFLY (MOTOR OPERATED)			
VALVES, CONTROL			
VALVES, DISCHARGE			
VALVES, MISCELLANEOUS			
VALVES, (SPHERICAL)			

a) TRIAL OPERATION MEANS DATE ON WHICH GENERATOR IS SYNCHRONIZED WITH SYSTEM FOR FIRST TIME. ESTIMATED ERECTION TIME INDICATES NORMAL NUMBER OF MONTHS REQUIRED AFTER START OF SHIPMENT.

NOTE: TO ALLOW FOR UNANTICIPATED DELAYS SUCH AS STRIKES, ETC., ONE MONTH SHOULD BE ADDED TO BOTH SHIPMENT AND ERECTION (WHERE APPLICABLE) TIMES FOR EACH YEAR SHOWN IN THESE CATEGORIES.

PREPARED BY EBASCO PURCHASING

(r) PROJECT REPORTING

(s) CONSTRUCTION INVOLVEMENT

(u) OTHER INFORMATION

(t) START-UP INVOLVEMENT

HARZA - EBASCO

(r)
CONSTRUCTION
INVOLVEMENT

(q)
PROJECT
REPORTING

(u)
OTHER
INFORMATION

(t)
START-UP
INVOLVEMENT

D(r) PROCEDURES AND PROPOSED INVOLVEMENT DURING CONSTRUCTION

In order to support construction activities, the Joint Venture will assign a Resident Engineer supported by a site engineering and environmental staff at the Watana Site to serve as liaison with the Construction Manager's staff. They will be available to interpret drawings and specifications, perform engineering and environmental tasks and direct a Bellevue engineering and design site support group. Key responsibilities at the site will include control of documents and handling of design changes. The Resident Engineer's site staff will comprise the following:

- Engineering Geologist
- Soils Engineer
- Construction/Civil Engineer
- Mechanical Engineer - Gates
- Mechanical Engineer - Power Plant
- Electrical Engineer
- Draftsman

The Project Manager in Anchorage will schedule the posting of individuals to the Site Staff acting on the recommendations from the Resident Engineer. The Resident Engineer will submit weekly reports to the Project Manager who will then determine as Project events or the Power Authority may require, participation of engineering or environmental specialists from the Bellevue or other offices of the Joint Venture.

The Joint Venture will interface with the Project Contractors through the Construction Manager to resolve any construction, engineering, or environmental conflicts or problems related to engineering, design, interferences or constructibility.

At the site there will be controlled distribution of documents such as specifications and drawings. This will involve setting up a Control List with identification of the responsible parties, providing for timely issuance of revisions and acknowledgement of receipt of the specific document.

In regard to as built drawings, it is the Joint Venture's standard approach to reflect "as-built" conditions on formally revised and issued drawing in the following cases:

a. General Arrangement Drawings

b. Electrical One-Line Diagrams

c. Phsyical Drawings where change is hidden

d. Phsyical Drawings where change is considered "significant" as determined by procedures developed by the Joint Venture and approved by the Power Authority.

All other "as-built" conditions will be recorded by collecting properly executed and approved Field Change Requests (FCR's). The Joint Venture may elect to formally revise a drawing where changes of this nature affecting that drawing is extensive. The Project Procedure Manual will stipulate the amount of revision to the various documents to be handled by the Site Staff and the Bellevue Site Support Group. Minor changes and revisions will be perfo med by the Site Staff, but extensive changes, if required, will be handled by the Bellevue Site Support Staff. This minimizes the drawing tasks at the site while utilizing the greater amount of resources in the Bellevue Office.

One of the key functions of the site support groups both in Bellevue and at the site will be the processing of design changes. Design changes developed for drawings which have been issued for construction will take one of two forms; 1) Design Change Notices (DCNs) originated by either the Bellevue or site support engineering groups or 2) Field Change Requests (FCRs), which are requests for design changes initiated by the construction contractors. Control of either type of change is critical to maintaining control over the cost and schedule of the project.

Design changes will be required for a variety of reasons. Among these are enhancement of project constructibility, cost savings resulting from the value engineering program or to correct errors in design. One of the key elements in the control of these changes is the definition of changes as major or minor and the development of procedures to describe how they will be processed. It is the Joint Venture's intent to have minor changes, those with minimal impact on design integrity, cost and schedule, processed by the site staff. A DCN or FRC for minor change will be handled entirely by the site staff under the guidance of the Resident Engineer. The assessment of the impact of the change will be made by his staff, the change will be approved and issued and a copy of the DCN or FCR will be sent to Bellevue for review and recording as an as-built condition. Major changes must be processed by the Bellevue design office. For major changes, the technical impact will be assessed by the affected engineering and environmental disciplines while the

estimating and cost/schedule control staffs will assess the cost and schedule impact. The assessment of the validity and reason for the change will be documented and maintained as part of the project records while the approved change is sent to the field engineering group for issuance to contractors.

A major part of the Joint Venture involvement during Construction will be participation in the meetings of the Power Authority's External Review Panel. This will carry forward a similar activity begun during the design phase. It is expected that the Panel will meet during this phase at approximately four-month intervals, increased to six-month intervals during construction. The Joint Venture will prepare formal presentations, in conjunction with the Construction Manager to acquaint the Panel with the progress of the construction and the validity of the critical design assumptions as actual site conditions are disclosed. Where problems arise because of changed conditions, the prepared solutions will be presented to the Panel. Studies requested by the Panel will be performed between those regular meetings, however, the Panel will be kept informed of significant events during these periods.

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(s)
PROJECT
REPORTING

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OTHER
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START-UP
INVOLVEMENT

D(s) REPORTING AND PROJECT BRIEFING PROCEDURE

Although continuous working level meetings will occur consistent with our standard practices, the Joint Venture will establish Monthly Project Status Meetings with the Power Authority and the Construction Manager. These meetings will generally consist of Project Management Level personnel from the key organizations.

The Power Authority and the Construction Manager will be apprised of engineering decisions or milestone accomplishments, such as equipment contract awards, potential budget and cashflow deviations, contructibility considerations, and all other changes to the latest approved project plan. We will welcome the Construction Manager's participation at the Monthly Project Status Meetings to enhance project communication. Minutes taken at such meetings will indicate appropriate action item assignments.

The Monthly Status Meetings will serve as the means of coordinating progress and objectives with requirements to be fulfilled. The establishment of these meetings and the recognition of their function should demonstrate the Joint Venture policy of the client-engineer-construction manager exchange of information at regularly scheduled intervals. On the basis of action items developed at these meetings, dates and times for specific participation and decision making by the Power Authority will be determined.

In addition to these meetings, we will submit comprehensive Monthly Progress Reports to the Power Authority. The purpose of these report will be to document project status, progress and problems or concerns to the Power Authority Management. The sections of the report will be as follows:

- Executive Summary
- Project Management Overview
- Project Control
- Narrative and Status Report

The Transmittal Letter (Executive Summary) will provide the Power Authority's executives with an identification of project critical items. These are the items identified by the Joint Venture which have led to or could lead to major deviations from the planned project cost or schedule. The Transmittal Letter will contain summaries of project percent completion figures,

identification of major exceptions, both positive and negative, to planned accomplishments, cash flow requirements, and any other specific information requested by the Power Authority. For each critical item the Joint Venture will identify its cause and indicate remedial action to be taken.

The Project Management Overview will contain a summary of the key concerns, assessments and corrective plans established to respond to developments on the Project. Also contained in this section will be a statement of deviations from planned costs and schedule with an explanation of cause and corrective action. These deviations and concerns will address those items which serve as output from the various Cost/Schedule Reports. (For a description of the Cost/Schedule System see Section D(1), above). Corrective action for these deviations or resolution of concerns will be decided upon after discussion with the responsible parties. The letter will include accomplishment curves reflecting target, current and actual accomplishments and expenditures will be provided. Each curve will be accompanied by a commentary explaining the basis for measuring significant variations between planned and actual accomplishment.

The Project Control section will contain summaries of the cost/schedule report whose outputs have initiated the corrective actions described in the Project Manager Overview. These summaries allow the Power Authority to see the Project progress as it relates to cost and schedule, the concerns and deviations that have developed, and the potential effects on the Project. They will measure Project progress against the planned and revised scope. A key item to be found in this section will be the Monthly Potential Cost/Schedule Report which will summarize the potential changes and their associated impacts. It will be accompanied by a brief narrative that provides further explanations for cost variances. Further items to be included in this section are:

- Management Implementation Schedule for the Management Control System
- Critical Path Analysis
- Project Milestone Schedule
- Project Cost/Schedule Summary
- Services Cost
- Project and Services Cash Flow
- Project Changes

The Narrative and Status Report Section will be subdivided into five categories: Engineering, Procurement, Construction, Licensing and Quality Assurance. Each subsection will highlight major activities and concerns of its respective topic. Specific attention will be given to any variations in the original plan.

It should be emphasized that, although the Monthly Report will identify concerns and problems together with proposed corrective plans, any major decisions regarding changes in project scope or schedule will be made by The Power Authority. In each case, however, the Joint Venture Project Management personnel will make appropriate recommendations and assist in the decisions making process as requested.

(1) START-UP INVOLVEMENT

(J) OTHER INFORMATION

HARZA-EBASCO

D(t) RESPONSIBILITY DURING START-UP

The Joint Venture responsibilities during Project start-up may be outlined as follows:

Tasks to be Performed in the Engineering Office

- Review Project design form a test standpoint.
- In advance of start up, scope systems to define system test content, define documentation for each system, and identify requirements to the Construction manager.
- Develop a preliminary test schedule and coordinate with the Construction manager and the Construction Contractor any changes in construction sequence logic. This will eliminate or minimize delays in testing that would result from late delivery of material or delays in planned construction progress.
- Assist in the review and development of a detailed integrated sequence of testing, showing the dependency of each system (or part of system) on other systems and relation of start-up activities to other Project activities.
- Prepare a phased construction release date schedule.
- Review applicable technical documents.
- Prepare a start-up administrative and procedures manual, including such topics as:
  - Organization
  - Adminstration (logs, records, reports)
  - System Turnover Program
  - Safety Clearances
  - Sequence of Start-up Operations
  - Hydrostatic, Pneumatic and Static Generic Tests
  - Electrical Tests
  - Instrumentation and Control System Calibration and Tests

- Component Cleaning Procedures

- System Cleaning and Flashing Procedures

- Initial Operation of Equipment and Systems

- Systems Testing Programs

  Test Specifications Index
  Test Procedures Index

- Start-up Quality Control Program

- Assist in developing the administrative program delineating how changes in test procedures or test schedules are initiated, approved, disseminated and documented by the participating orginizations.

- Prepare electrical test and I & C test schedules.

Start-up Tasks to be performed at the Project Site

- Construction Turnover Phase

  - Coordinate and expedite construction to achieve reasonably complete systems at scheduled construction release dates

- Prerequisite Test Phase

  - Supervise the conduct of the prerequisite check-out activities

  - Maintain records and documents of all prerequisite check-out results.

- Start-up Phase

  - Prepare and implement system specific cleaning/flushing procedures, as required

  - Prepare and implement system preoperational/functional test procedures, as required

  - Supervise the collection and analysis of baseline performance data, assist in obtaining warranted performance of plant equipment and determine plant auxiliary load

- Direct the resolution of equipment design and operational problems including resolution of vendor or constructor deficiencies through the start-up period

- Maintain records of all start-up documents

- Supervise major equipment performance testing

- Direct all other necessary start-up activities from construction turnover through trial operation and acceptance

- Develop, through detailed study, all system control and protective relay settings and critical parameters

- Prepare, in conjunction with the Construction Manager, technical procedures, preparation of nameplate summaries, operation manuals, maintenance manuals, as-built drawings, and a Project maintenance schedule

Start-up Tasks to be performed at the Willow Control Center Site

- Construction Turnover Phase

  - Coordinate and expedite construction to achieve complete systems at scheduled construction release dates

- Prerequisite Test Phase

  - Supervise the prerequisite check-out activities

  - Maintain records and document all prerequisite check-out activities

- Start-up Phase

  - Prepare and implement system preoperational/functional test procedures

  - Supervise the collection of baseline performance data and assist in obtaining warranted performance of communication, computer and building auxiliary systems

  - Direct the resolution of equipment design and operational problems including resolution of vendor or constructor deficiencies through the start-up period

- Conduct training sessions in equipment operation and maintenance

- Conduct training sessions and develop plant safety program

- Conduct training sessions in dam instrumentation program, data collection and data interpretation

- Conduct training sessions for operating personnel

- Conduct training sessions on start-up using the prepared start-up administrative and procedures manual

- Plan, schedule and coordinate visits of Power Authority operating staff to projects and utilities to get background in similar plant operation.

In regard to the actual performance of the start-up testing, it is the Joint Venture's practice to perform the managerial function of the start-up and testing phase, with the Power Authority's operating and maintenance personnel assisting in all the tasks and testing functions. This allows the Power Authority's personnel to gain immediate "hands on" experience and provides up-front knowledge of the various aspects of the systems prior to the actual operation and maintenance phase. Using this approach, the Power Authority's personnel will become intimately familiar with all facets of the operations and will be able to immediately assume responsibility for operating and maintaining the plant and energy management system. We assume a joint Project Team would be created from the staff of the JV, the Construction Manager and the Power Authority to allow full implementation of the above training and hand-over concept.

- Maintain records of all start-up documents

- Supervise major equipment performance testing

- Direct all other necessary start-up activities from construction turnover through trial operation and acceptance

- Develop through detailed study all computer application software critical parameter

- Prepare technical operation procedures and develop operation manuals, maintenance manuals, as built drawings and preventive maintenance schedule from vendor data.

- Issue a periodic start-up progress report including analysis of schedule variances and punch list status. These reports will also suggest priorities for correcting any deficiencies encountered during the scheduled procedures.

Technical Training for Project Staff

The Joint Venture responsibilities insofar as training the Power Authority's staff for project operation are as follows:

- Develop a Project Permanent Staffing Chart for submittal and approval to the Power Authority

- Assist the Power Authority in staffing the key positions that cannot be filled from within the Authority's Staff in advance of Project start-up

- Screen the "on-site" staff of the Power Authority, Construction Manager and Contractor for individuals having gained background on the Project during construction that have the ability and interest to fill other positions on the permanent staffing chart or near completion of construction

- Power Authority's key operating personnel should participate with Joint Venture personnel in inspection of major shop assemblies

- Assemble Project Staff and commence training in advance of start-up

  - Conduct training sessions on systems, system functions, system operations and system maintenance

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(u)
OTHER
INFORMATION

D(u)OTHER INFORMATION

We are providing, in this "miscellaneous" section, discussions of our ability to assist The Power Authority in the development of power purchase agreements and descriptions of our office support facilities.

SUSITNA PROJECT POWER PURCHASE AGREEMENTS

The Susitna Hydroelectric Project will provide electrical power to meet the demand requirements of load centers in the Railbelt region. The City of Anchorage is served by Chugach Electric Association, Inc. and Anchorage Municipal, with Homer, Matanuska and Seward serving customers in the greater Anchorage area. Homer, Matanuska and Seward have agreements with Chugach for the sale of wholesale power to satisfy their needs. The utilities in the Fairbanks area include Golden Valley and Fairbanks Municipal; Copper Valley serves the Glenallen and Valdez areas. Anchorage, Fairbanks, and Seward are municipal electric systems while the rest are rural electric cooperatives.

The purchasing utilities will have different needs to be recognized in their power purchase agreements with the State of Alaska. These different needs should be recognized in the conceptual design of the Project. The Joint Venture is prepared to perform the detailed studies needed to establish the rate structure. Firm purchase agreements would entitle the utility to a share of the generating capacity of Susitna Hydroelectric power and the energy provided with that entitlement throughout the contract period. In return, a purchasing utility could pay a flat, fixed capacity charge ($/KW) allowing the utility to use that capacity (but no more) any time as required under the contract; an additional energy charge (¢/kWh) is charged for power actually used. It is likely that the Alaska Power Authority will agree to firm power purchase agreements of a "take and/or pay" type which would reduce the financial risk to the State and maintain their revenues to offset the cost of supplying electrical power. The purchasing utilities would treat this type of power as an equivalent generating unit in their own system to sell power to their retail customers or in the case of Chugach, firm wholesale sales.

Demand rate purchase power agreements can be complex in form. As a rule, the purchasing utility pays a fixed energy charge (¢/kWh) for the electrical energy actually obtained and used. In addition, the purchasing utility pays a demand charge ($/KW) for the capacity (KW) actually used. The demand charge may be determined by the largest demand during any specified time period (typically one month or one year). When the purchasing utility's load causes power purchased under such an

agreement to attain a new monthly or annual peak, the cost consequences may be large during the entire month or year.

The municipalities and REAs may want to enter into emergency peaking power agreements with the State of Alaska. The need for this type of agreement will depend upon the type and operating costs associated with the purchasing utility's own generation and the availability of Susitna power for such use. Normally, the purchasing utility obtains this capacity and energy only during emergency conditions or times of shortage. The purchasing utility does not pay a capacity charge in advance for the opportunity to obtain such capacity when needed. The rate for such purchases is high compared to firm power, since the rate (¢/kWh) includes an implicit capacity charge.

Special types of purchase agreements include those for supplementary power and standby power. Supplementary power would be power purchased by a municipal utility or an REA such as Chugach which is in excess of their contract as set forth in their firm power purchase agreement with the Alaska Power Authority. The agreement for supplementary power and energy would entail demand and energy charges and perhaps a support charge. Standby power may be desired in the event of unscheduled forced outages or plant breakdown. Various rate forms can be found in the industry. Chugach, a wholesaler of power, attempts to meet the total requirements of Seward, Homer and Mantanuska. In their wholesale power agreement, Chugach (seller) requires that in the event that seller is unable to furnish power to City of Seward (purchaser), that the purchaser will supply the electrical requirements for its utility system from its own generation plants.

OFFICE FACILITIES

Anchorage Facilities

The Harza/Ebasco Joint Venture intends to conduct this work assignment from two primary locations. The Project Management staff for the job will be located in Anchorage, Alaska. The Joint Venture has identified suitable and ample space in Anchorage for the project office. Upon award the Joint Venture will implement the following actions:

1. November 1, 1982 - Lease negotiations will commence with a December 1, 1982 target date for completion.

2. Concurrent with negotiations the office layout will be developed which will describe all tenant improvements, furnishing and equipment including space for communications and computer equipment.

3. Quantities of office equipment required will be established from the drawings to draft orders for procurement.

4. Project Contract Signed -
   a. Sign lease
   b. Issue drawings to landlord
   c. Issue orders to suppliers
   d. Develop complete leasehold improvements in 45 to 60 days after receipt of drawings
   e. Complete Project Manager offices by January 31, 1983
   f. Entire facility completed by March 1983.

Bellevue Facilities

Ebasco currently has first refusal rights to the fourth floor (16,000 sq. ft.) of its present office building in Bellevue, Washington. Upon award of contract, The Joint Venture will exercise the right to the space and finalize layouts to initiate tenant improvements at its location at 400-112 Ave. NE, Bellevue, Washington. An amendment will be drafted to cover the term required, with the base lease already negotiated by Ebasco.

Major support elements (Remote Job Entry System, Word Processing, Reprographics) are already in place. Furniture to complete office area will be ordered upon contract award.

Communications Systems

Telephones - Bellevue. Ebasco has installed a private telephone switch in its Bellevue offices which will be available to the Joint Venture. It provides network access across the country and utilizes WATS lines and tie lines. Currently, three tie lines exist between Bellevue and New York Three Band 6 WATS are also in place, which will enable the Joint Venture to reach Alaska at reduced rates. The existing switch will be expanded to accomodate additional telephone instruments in the Joint Venture office.

An additional Band of WATS capability can be added if traffic justifies its need. Additional WATS capability is available to serve both Anchorage and Chicago as well as any where else in the country, except Washington state.

Telephones - Anchorage. The Anchorage office will require a new system to be installed and leased from the local telephone utility. WATS lines will be placed in the system to accommodate

traffic to to outside the State of Alaska with tie lines utilized to the job site and Bellevue.

Automated Design System. The Joint Venture has utilized two Intergraph systems supporting several workstations. The ability to transmit drawings on line to other locations with compatible equipment exists with the supplier. The Joint Venture will evaluate the use of this system to pass drawings from Anchorage to Bellevue or other locations via telephone lines.

EMDRAC System. The Ebasco Manufacturer's Drawings Records and Control (EMDRAC) System provides a more efficient administration, processing and operational flexibility for recording and keeping track of vendor-submitted drawings relative to project contracted services. The use of the EMDRAC System allows for the control of time by the responsible engineers and designers for review and return of manufacturers' drawings. The EMDRAC System is used to control vendors' drawings, instruction manuals, spare parts list and vendor/manufacturer procedures on all Ebasco engineered projects.

The EMDRAC System is an on-line interactive system with remote data terminals connected by communications lines to the Burroughs B-7700 computer located at the New York Office. The data gathered is stored in a centrally accessible data base which can be accessed and updated immediately and simultaneously by any number of users.

The EMDRAC System provides improvement in:

- Control and accuracy of vendor documents and status
- Entry time of vendor documents into the documents tracking system
- Document review time
- Document return time to vendor
- Daily response times for records
- Data terminal input and retrieval of vendor documents information
- Overall process time

The EMDRAC System has been used successfully on other major Ebasco projects. It will be used by the Joint Venture to provide document control on this project.

Data Processing

The Joint Venture offices will have access to the in-house Burroughs (B7700) mainframe computer located in the main New York office. The computer is accessed by means of a CRT (HP2624B) terminal and tele-communications modem. The telephone lines are capable of high speed (1200 baud - 120 characters per second) and low speed (300 baud - 30 characters per second) communications. In addition, this office has a Remote Job Entry (RJE) site. This site (Harris 1600 system) contains a 600 cards per minute card reader and two 600 lines per minute lineprinters. This system communicates with the mainframe over a high speed (4800 baud - 480 characters per second) tele-communications modem.

This equipment is used to access programs located on the Burroughs. Additionally, this equipment can be used to access software systems developed and located on major timesharing services. The major companies now in use are: Boeing Computer Services (BCS), McDonnell-Douglas Automation (MacAuto) and General Electric (GESICO).

More CRT terminals and modems can be located around the office as workload increases on this project. The addition of these terminals will not affect the workload of the mainframe Burroughs.

Also available in the Bellevue office are Apple II micro-computer systems for use by the professional staff. The systems consists of an Apple II processor with 48k of main memory, two diskette drives, a dot matrix printer and suitable software to allow engineers to perform analysis programming. Additional micro-computer systems can be added on a timely basis using in place vendor supply contracts.

Also located in the Bellevue office is a Tektronix 4052 micro-computer graphics system for use by the engineering staff. This system consists of a Tektronix processor with 64k of main memory, one casette tape drive, one diskette drive, and eight pen plotter and graphics software needed to produce document quality plots. Additional disk drives and a digitizer tablet are planned to be added in 1983.

Word Processing

The Joint Venture will have access to a WANG Office Information System (OIS-130A) word processing computer. There are three work staions, two printers and one tele-communications device currently installed. The tele-communications device is capable of transmitting and receiving information to and from

any similarly equipped WANG system. In addition, one of the work stations is capable of transmitting and receiving information in several different communications protocols (TTY, IBM 2741). This is accessed at 300 baud (30 characters per second). This work station will also allow communications with the mainframe Burroughs computer in the New York office.

There are also five Exxon QWYX electronic typewriters located in Bellevue office. Each contains from five to 300 pages of memory and a tele-communications device compatible with the WANG OIS. They transmit and receive at 300 baud. This function allows the secretaries to store and retrieve information on the WANG OIS and to transmit and receive between each other. Currently there are eight ports not in use on the WANG OIS. These are available for new work stations and printers which could be located anywhere within the Joint Venture office space. Wang equipment will also be used in Alaska and the home offices to assure rapid communication of project written documents.

Reprographics

The Joint Venture has access to a reprographics center. The center has photocopy capability (Kodak 150 copier) and blue line print equipment. All binding equipment is on premise to provide full document production.

The center has a full coordinator on site. A photocopy clerk mans the Kodak for all copy work in the center, eliminating professional staff having to spend time at the machine. Walk-up copy capabilities are provided by satellite photocopy machines. All equipment is controlled by card access to monitor accurate accountability of usage.

Project Records

The Joint Venture Project Management office will establish and maintain a project records system. The project record system contains the following elements:

Project Filing System. It will be used for maintaining technical documents, either developed or received by the Joint Venture, excluding drawings. This includes both originals and copies of documents that are to be retained by the Joint Venture for archival purposes. Project file personnel will have the responsibility for the security, integrity and organization of a controlled file and the implementation of project filing procedures. Project documents provide evidence of the quality of items and of activities affecting quality. This includes procedures, reports, specifications, instruction manuals, design

criteria and calculations and correspondence of a technical nature.

Project Communications. We will establish a system to define the method of preparing, formatting, processing, approving, monitoring and controling of project communications to and from the Joint Venture. Communications are all information disseminated to, or originated by, the Project Team or others associated with the project which involve personnel outside of the Joint Venture. This includes all reports and studies as well as letters, telegrams, telecopied messages and conversations. The Project Manager will have overall responsibility for communications on this project. He is responsible for seeing that the proper individuals, both inside and outside of the Company, receive and respond to relevant communications. All client and certain vendor communications will be sent to and issued by the Project Manager.

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C(E) WORKLOAD

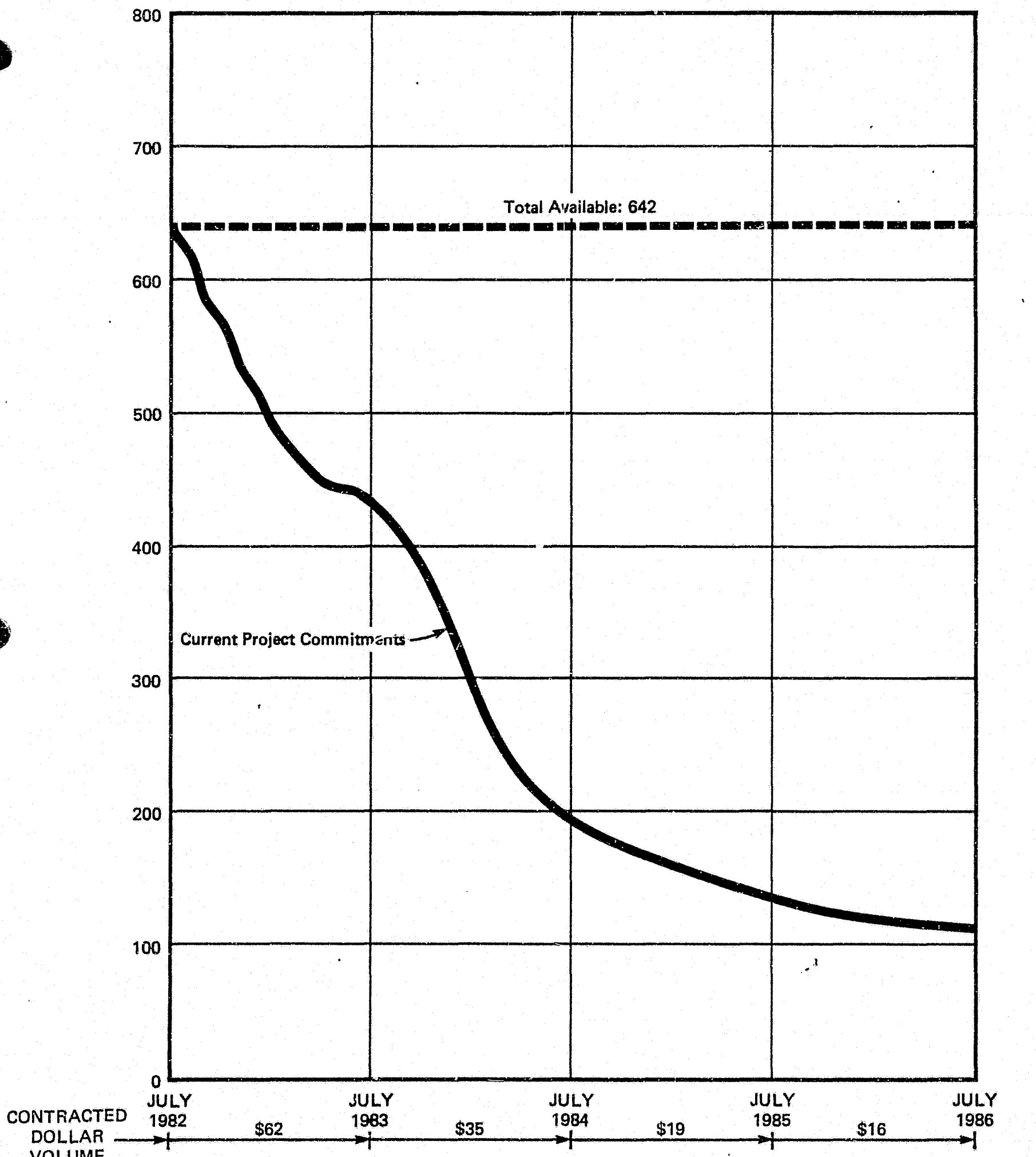
The Joint Venture firms have the ability to perform this project in relation to current and projected workload. Exhibits E-1 and E-2 provide the requested information regarding current manpower capacity and commitments.

As shown by these exhibits, the Joint Venture workload based upon current contract commitments totals 4642 project personnel (management, supervisory, and professional). The Joint Venture has a total of 5462 personnel in these categories. General and administrative personnel are excluded.

Projected workload for the next four years is also depicted by the charts. The dollar volumes related to these contractual commitments is shown at the bottom of each chart.

As demonstrated by the manpower charts, the Joint Venture has substantial technical staff resources. Given the projected manpower requirements for this project contained in Section C. Organization (B) and the highest level corporate commitment made by the Joint Venture firms, Harza-Ebasco does not anticipate any problems providing the manpower support required to execute the Susitna Project. As further evidence of personnel resources, we have projected future potential work of Harza and Ebasco (including Susitna) on the chart to demonstrate our capabilities to provide the required manpower. Projected dollar volume for the period 1982 to 1986 is also inlcuded on Exhibit E-1 and E-2.

EXHIBIT E - 1

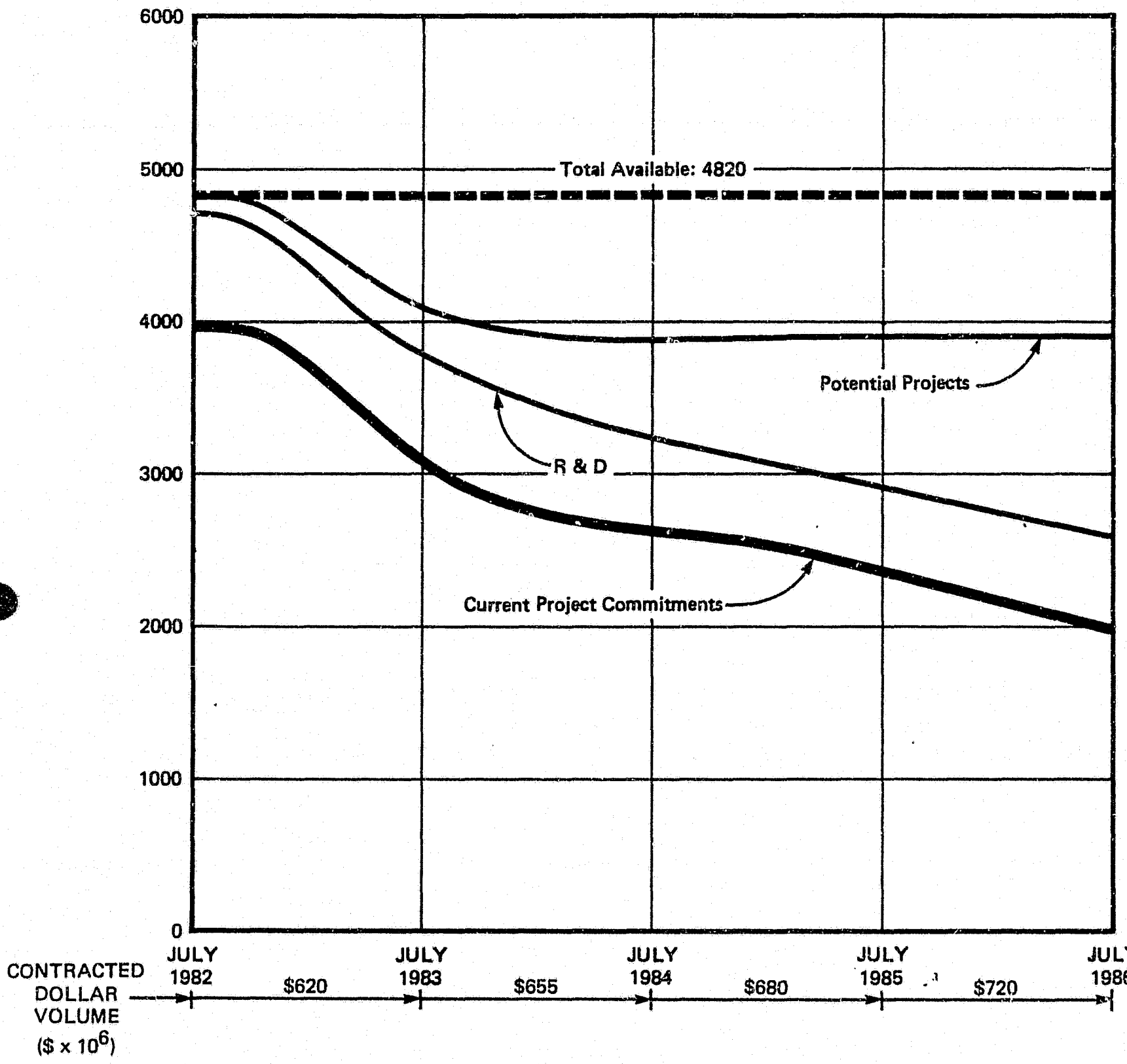


SUSITNA HYDROELECTRIC PROJECT

HARZA MANPOWER FORECAST
MANAGEMENT, PROFESSIONAL &
SUPERVISORY PERSONNEL

HARZA-EBASCO

EXHIBIT E - 2



SUSITNA HYDROELECTRIC PROJECT

EBASCO MANPOWER FORECAST
MANAGEMENT, PROFESSIONAL & SUPERVISORY PERSONNEL

HARZA-EBASCO