MINNESOTA ENVIRONMENTAL QUALITY BOARD

Power Plant Siting Program

TECHNICAL STUDY PROGRAM:

FISCAL YEARS 1980-1981

MAY 1980

Minnesota
Environmental Quality Board
100 Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101
Phone 612/296-2641

MEMORANDUM

FROM: Allen Jaisle, Manager
Power Plant Siting Program

SUBJECT: Technical Study Program

DATE: May 14, 1980

Attached for your information is a brief description of the 1980-81 program of technical studies being conducted by the Power Plant Siting Program. Also available for review is a report containing detailed work statements for these studies.

This information is being provided to inform you of the ongoing work of the Power Plant Siting Program and to solicit your comments and input to the studies. Your contibution to making this series of studies accurate and useful would be appreciated. The studies will constitute a significant portion of the information base that will be used to assist the Board in future decisions.

In both the design and conduct of the studies attention is being given to coordination with other study efforts. Relevant agency staff and other interested persons will be given the opportunity to attend contractor progress briefings, to review draft reports and to benefit from final study results. Please contact George Durfee, Assistant Manager for Technical Analysis, (612/296-2878) or me if you have any comments or if you wish any further information.

AJ/tj

The second area of study relates to transmission line design and operation. Specifically the 1977 report on health and safety effects of transmission lines will be updated with special emphasis on current research on the biological effects of air ions - a subject of continuing controversy along the CU dc line. A second study considers the possible use of existing rights of way and upgrading of existing lines to limit new right of way requirements. This will provide support for proposed legislation and also will allow better evaluation of transmission alternatives in southern Minnesota. Two transmission studies, undergrounding and application of the DNR heritage program are essentially supportive of the NSP King/Prairie Island project and will also provide useful general reports. Another study considers transmission line electric and magnetic fields.

The third program area involves original research in the development of a biological air quality assessment system and in the characterization of pollution which is regional in nature and that which is attributable to a point source. To complement this work an international symposium on the assessment of losses which constrain agricultural and forest crop production sponsored by the Board will be held in August 1980.

The final program area consists of studies and audio-visuals to be used in our public information programs, the inventory of power plant sites and the permit compliance program.

In summary the individual studies are responsive to issues raised by the public and in total provide the information essential for effective policy development and advance planning as well as support for specific project issues and information programs. The following section provides brief summaries of each study that has been undertaken or will be undertaken in fiscal year 1980 and 1981.

HIGH VOLTAGE TRANSMISSION LINES

Public Health and Safety Effects of High Voltage Transmission Lines.

This is an addendum and update to the earlier "Health and Safety" report prepared by the Minnesota Department of Health. This report will make use of the substantial quantity of scientific and medical information that has become available since the release of the earlier report. Particular emphasis will be placed on the biological effects of air ions.

Right of Way Compatibility Analysis.

The study will address the technical, economic, environmental and institutional issues associated with the use or paralleling of existing rights of way -transmission, highway, railroad, pipeline, communication - and upgrading existing transmission facilities in conformance with the principle of "nonproliferation."

Evaluation of Underground High Voltage Electric Transmission Systems.

The study will include a generic assessment of high voltage transmission line undergrounding practices and technology and an assessment of undergrounding options at river crossings proposed by NSP for a single circuit 345 kV overhead transmission line. This project will be funded by both the general consultant budget and the NSP-TR-2 budget.

DNR Heritage Memorandum of Agreement:

This study would review rare plant and animal occurrences and note worthy natural features and natural areas (proposed or designated) in both the general study area and within the boundaries of the NSP-TR-2 routes.

Transmission Line Electric and Magnetic Fields.

This study develops a characterization of electric and magnetic fields around power lines that will be used to establish permit conditions relating to the electric field effects of high voltage transmission lines (HVTLs). It provides both background information and a computer-based model to compute field strengths of HVTL's at various heights above ground.

ENVIRONMENTAL MONITORING

Biological Air Quality Indices.

This project will develop and evaluate a system to quantify the impact of air pollution using biological indicators of pollution stress. It will review and critically appraise existing literature to provide information necessary to the development of a valid biological air quality assessment system appropriate for use in Minnesota.

CONTRACT WORK PLANS

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VARIATION OF ELECTRICITY COST AS DETERMINED BY THE SIZE OF ELECTRIC POWER GENERATING PLANTS

CONTRACTOR: SCIENCE APPLICATIONS, INC.

ADVERTISED: 1/7/80

CLOSED:4/15/81

ATTACHMENT A

Environmental Quality Board
Power Plant Siting Program

STATEMENT OF WORK

April 4, 1980

"Variation of Electricity Cost As Determined By the Size of Electric Power Generating Plants"

I. Purpose

The purpose of this study is to enable the citizens of Minnesota to assess the effect of various alternatives in electric power generating unit and plant design on the cost of electricity. Citizens of Minnesota have expressed a desire to see electrical power generating plants built in smaller sizes, at more dispersed locations closer to the electrical load rather than in larger sizes, and located at some distance from the electrical loads.

Several studies of hypothetical utility systems have shown that, when considering the total reliability of the generating system and the uncertainty of future load growths, a program of building several smaller power plants may be more economical than building fewer but larger plants. Conversely, larger power plants may offer some definite economies of large scale production. The purpose of this project is to study the effect of the size of future power plants on the cost of electricity for some specific utility systems in Minnesota, and to allow interested citizens to evaluate how alternative decisions regarding future power plants will affect their cost of electricity.

Consideration will be limited to coal-fired electric plants rated 50 megawatts or greater. "Cost of electricity" is defined as the cost in dollars per kilowatt-hour at the high voltage bushings of the generating unit main transformer. All non site-specific costs associated with the generating system such as design, license, construction, operation and maintenance of reserve - shall be included except where otherwise specified for analytical purposes. The transmission system shall not be included. Using appropriate costs of coal, capital recovery, and operation and maintenance, as specified later in this document, show the cost of electricity.

II. Scope of the Project

This study will be divided into three parts. Part I shall consist of brief description of: major computer models currently being used to plant for future electrical generation needs and their relative advantages and disadvantages; two or three recent studies similar to this one with comments on their relative adequacy; utility operating procedures, including a discussion of how generating unit size affects those procedures. As discribed later, a report shall also be prepared for part I. Part II of the study shall consist of data collection and computer analysis of the Southern Minnesota Municipal Power Agency system and the preparation of a report. Part III shall consist of data collection and computer analysis of the Northern States Power system, and the preparation of a report.

A documented copy of computer programs used in this project shall be furnished at the completion of the project.

III. Specific Tasks of the Project

Specific Tasks of Part I of the Study

Part I of the study shall consist of the preparation of a brief report addressing the following:

a. Describe the major computer models currently being used to plan for future electrical generation needs and their relative advantages and disadvantagbes.

b. Describe two or three recently completed studies similar to this one. Comment upon their relative adequacy.

c. Describe utility operating practices, including a discussion of how generating unit size affects those practices.

The objective of this discussion is to allow citizens to comprehend, in general, how various utility decisions affect the cost of electricity and to prepare them for understanding the Part II and Part III reports. The discussion should avoid the use of complex formulas or technical language that would be unfamiliar to interested citizens. The Contractor shall assume the reader will be reasonably well-educated but lacking in formal economic or engineering training. Additional or necessary highly technical discussion shall be included appendices.

A preliminary draft of the Part I Report shall be submitted in three copies for review. Following return of the preliminary draft, the Contractor shall submit a revised draft, also in three copies, for review. Following return of the revised draft, the Contractor shall submit three copies of the final Part I Report. To minimize the changes in draft reports, personnel from the Power Plant Siting Staff will work closely with the Contractor as the work for this, and subsequent parts, progresses.

Specific Tasks of Part II of the Study

Select and document a computer model to assist in evaluation of size and reliability effects. The model should incorporate features to permit flexibility and convenience of use. Key assumptions should be accessible for modification to permit easy and extensive sensitivity analysies. Also collect data as required.

Determine the cost of electricity for generation additions for the Southern Minnesota Municipal Power Agency which is forecasting the addition of 400 megawatts of generation within the next 15 years. Assume single-unit power plants using low sulfur Western coal (0.9% S; 11.0% ash; and a higher heating value of 8300 BTU/lb). Economic parameters and costs of variously sized electrical generating units as given in the Burns and Roe Definition of Model Coal-Fired Electric Generating Stations in the 50 MW to 2400 MW Range shall be used where appropriate.

Cost of electricity shall be shown graphically and the costs of the various alternatives shall be shown on the same graph. Costs shall include capital recovery, fixed and variable operation and maintenance costs plus projected fuel costs. The objective is to allow citizens with little formal economic training to compare future costs of electricity due to the different alternatives. The determination of the effect of plant size on the cost of electricity shall be made by assuming a three percent load growth and existing system capacity; several combinations of differently sized plants might then be constructed to satisfy that projected demand.

For example, the load growth curve may suggest an additional 400 megawatts of load will exist at some future date. That load could be satisfied by a single 400 megawatt unit or by constructing a sequence of small units of 50 MW, 100 MW, 200 MW capacity.

Prior to selecting the computer model, Contractor shall determine the costs and adequacy of using the University of Minnesota computer in accordance with the PPSS letter of March 12, 1980 to SAI.

Contractor shall perform the calculations under the following sets of conditions:

1. Include the costs of maintaining adequate system reserve, but neglect costs or penalties associated with differences in reliability of differently sizes units. In addition and where appropriate, identify and quantify major cost differentiating design features such as steam conditions, condenser cooling methods, the use of precipitators or baghouse filters, and wet or dry scrubbers. Data furnished in the Burns and Roe report shall be used where appropriate. Discuss how differential lead time of the differently sized units and the accumulation of interest during construction affect the cost of electricity.

2. Repeat Task 1 except include the effects of differential lead time and differences in reliability for differently sized units. Discuss how the system reserve requirement might vary with differently sized units. Discuss system reliability as defined by a percentage reserve requirement and by a given loss-of-load-probability. Does such a different definition of reliability affect overall required capacity and cost of electricity?

3. Calculate the cost of electricity using the assumptions of Task 2 except assume multi-unit power stations. Discuss and quantify the savings that can be realized by constructing more than one generating unit at a plant.

4. Discuss how unit thermal efficiency and air pollution control equipment energy requirements and collection rates vary with unit loading, cycling versus base-load operation, and frequency of start-up and shutdown operation. Determine how loading, cycling versus baseload operation, rate of response to changes in load, and frequency of start up and shutdown might vary with unit size.

5. Determine and compare the efficiencies of various systems in differently sized units. For example, compare the efficiencies of the steam and cooling water cycles, air pollution control equipment, etc. for differently sized units using commercially available equipment. Discuss the cause of differences in efficiencies. Are those differences due to size per se or are more efficient technologies commercially available only for larger sized units? If economic considerations limit availability of more efficient technologies to larger units, might those technologies be economically feasible on smaller units if design and manufacturing procedures were more standardized or if more but smaller plants were built?

6. Perform sensitivity analysis for the major variables of the above tasks.

7. Responder may propose additional or alternate tasks if they will substantially improve the results of the project.

Written reports for Part II of the Study shall be submitted in the same manner as for Part I.

Specific Tasks of Part III of the Study

Part III of the Study shall consist of the analyses as stated for Part II of the various alternatives for the system of Northern States Power. The calculations shall be performed for three percent load growth rate. Unit sizes to be considered shall be 100 MW, 200 MW, 400 MW and 800 MW. Written reports for Part III shall be submitted in the same manner as for Part I.

IV. Department Contacts

Contractor shall address questions and all correspondence to:

Dennis Rothenmaier - Project Manager
Power Plant Siting - Environmental Quality Board
State Planning Agency
15 Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101
612/296-2169

V. Attachments

The following documents are attached and form a part of the contract.

A. 1979 Inventory of Power Plant Study Areas. This document contains maps of the state, showing broad regions (called "study areas") where variously sized plants might be located. A plant or unit is constrained by the requirements that the unit be located within the utility's service region and within an appropriate Inventory Study area.

B. 1978 Advance Forecast Report to the Minnesota Environmental Quality Board. This document includes data on current electric system capacity, forecasted load, and planned generation.

C. 1979 Update of the 1978 Advance Forecasting Report to the Minnesota Environmental Quality Board - July 1979. This document is a revision of the previously listed forecast.

D. Burns and Roe Definition of Model Coal-Fired Generating Stations in the 50 MW to 2400 MW Range. This report describes conventional, coal-fired power plants of 200, 400, and 800 megawatts. It also describes 50 MW, 200 MW and 400 MW district heating power plants. Numerous cost and technical data are given including capital, fixed, and variable costs for each size plant and for various systems of the plants. Dated June 1979 (Revised January, 1980).

IX. Schedule of Work

Activity	Weeks After Award of Contract
Preliminary draft of Part I Report due	8
PPSS returns Part I Report	14
Revised Part I Report due	20
PPSS returns revised Part I Report	26
Final Part I Report due	52
Preliminary draft of Part II Report due	16
PPSS returns Part II preliminary draft	22
Revised Part II Report due	30
PPSS returns revised Part II Report	36
Final Part II Report due	52
Preliminary draft of Part III Report due	26
PPSS returns Part III Report	32
Revised Part III Report due	40
PPSS returns revised Part III Report	46
Final Part III Report due	52

LOCAL TAXING OF ELECTRIC UTILITY PROPERTY: MATCHING BENEFITS WITH BURDENS

CONTRACTOR: WAPORA, INC.

ADVERTISED: 2/25/80

CLOSE: 9/1/80

"LOCAL TAXING OF ELECTRIC UTILITY PROPERTY: MATCHING BENEFITS WITH BURDENS

Overview

Electric utility property can provide significant tax benefits to local taxing jurisdictions such as school districts, municipalities and counties. These tax revenues can offset possible increased local expenditures made necessary by the construction and operation of these facilities and may allow local officials to lower mill rates, expand services and/or inaugurate capital improvement projects.

These tax benefits are not without cost, however. Utility property imposes a variety of burdens on localities including direct burdens for local services as well as social and environmental burdens. The latter include the social costs of absorbing locally the large numbers of temporary construction personnel, and environmental costs such as obscurred landscapes, local air and water pollution and coal transportation-related burdens.

In the case of direct local services burdens, the incidence of the burdens is fairly well matched to the location where the tax revenues are collected and a dollar figure can be placed on those additional burdens. However, the incidence of the indirect environmental and social burdens is not limited to the boundaries of local taxing districts. Futhermore, it is difficult to come up with acceptable measures that can be used to allocate such burdens. Together, these factors make it very difficult to match overall burdens with tax benefits.

ATTACHMENT A

The contractor shall provide information concerning the location specific burdens imposed by electric utility property, describe electric utility taxing concepts and evaluate how effective these concepts are in associating the burdens of the utility property with receipt of tax revenues, describe how electric utilities are taxed in Minnesota and in other states and provide the State of Minnesota with a simply written, comprehensive, illustrative report synthesizing the above efforts.

Specific Tasks

TASK 1. Describe the location-specific burdens imposed by electrical facilities.

Subtask 1a - Describe these burdens, their areal incidence, and factors that affect their areal incidence.

Subtask 1b - Discuss how well the burdens can be measured and attributed to localities where they fall.

Subtask 1c - Discuss how the level of burdens may be affected by differences in siting and size of plant.

Subtask 1d - Discuss means of mitigating burdens that can have locally attributable costs.

Subtask 1e - Prepare a draft report addressing the subjects included in Task 1.

TASK 2. Discuss utility taxing concepts and the association of burdens with tax revenues.

Subtask 2a - Conduct literature searches on taxing concepts and utility taxing policies of other states, in general.

Subtask 2b - Prepare discussions to be used as introductory matter for the Task 3 Draft Report.

TASK 3. Survey the local property taxing policies of Minnestoa and other states.

Subtask 3a - Obtain basic information on taxing policies for each of the 50 states.

i. Contact relevant agencies in each state to obtain summary descriptions of tax policies, adminstrative rules and the laws themselves.

ii. Extend the literature search in subtask 2a to include the taxing policies of other states.

Subtask 3b - Review the policies for each of the 50 states for promising states for an in-depth survey.

Subtask 3c - Establish a subset of states including Minnesota, Wisconsin, Iowa, South Dakota and North Dakota and others, for an in-depth survey.

Subtask 3d - Conduct the in-depth survey, obtaining tax laws, summary descriptions, and discussions with state, utility, and local experts.

Subtask 3e - Tabulate, organize, and assess the information obtained for presentation.

Subtask 3f - Prepare a Draft Report addressing the subjects covered in Tasks 2 and 3. Draft report will not choose among the researched taxing methods nor recommend changes in the state's utility taxing policies.

TASK 4 Prepare a Final Report based on Tasks 1 and 3 Draft Reports and comments received. Final report will not choose among the researched taxing methods nor recommend changes in the state's utility taxing policies.

Deliverables

The contractor shall provide in a timely manner:

1. Task 1 Draft Report.

2. Task 3 Draft Report.

3. All information obtained in Task 3a(i.) organized in a reasonable manner.

4. Final report based on Task 1 and 3 Draft Reports and comments received.

The Contractor shall provide the MEQB with a reproduceable master copy of the final draft and two copies within the scheduled time.

Schedule:

The contractor shall initiate work on this project upon receipt of the contract and shall complete the project according to the work schedule on p. 16 of their proposal and according to the following schedule:

Report Schedule

Task 1 Draft Report:	June 10, 1980
Task 3 Draft Report:	June 24, 1980
Final Report :	September 1, 1980

Interim Project Reports

#1 - May 1, 1980
#2 - June 1, 1980
#3 - July 1, 1980

ALTERNATIVE METHODS IN THE DESIGN OR RETROFIT OF POWER PLANTS FOR WASTE HEAT RECOVERY

CONTRACTOR: BURNS & ROE

ADVERTISED: 2/21/80

CLOSE: 11/1/80

ATTACHMENT A

ENVIRONMENTAL QUALITY BOARD
POWER PLANT SITING PROGRAM

April 3, 1980

WORK STATEMENT

Methods by which Conventional Coal-Fired Power Plants can be Constructed to Facilitate Future Conversion to District Heating Plants.

I. Purpose

The purpose of this study is to investigate the economic feasibility of several alternative methods of constructing coal-fired electric power plants such that future conversion to district heating can be readily accomplished.

Power plants constructed today will be in operation for approximately the next forty years. It seems likely that sometime during the life of the plant, the utilization of reject heat will become attractive. Our objective here is to compare the costs of alternate power plant designs that allow the option of future cogeneration or district heating development.

II. Scope of the Project

This project shall be an elaboration of a previous Burns & Roe - State of Minnesota contract: Definition of Model Plants; SPA-9036; Burns & Roe W.O. 3458-01. The final product shall be a report which can be issued as an addendum to the Definition of Model Plants final report.

III. Specific Tasks

The underlying assumption for this study is that a utility plans to construct a conventional power plant with a nominal electrical output of 50 MW, 200 MW or 400 MW. The following alternatives shall be evaluated to provide a district heating capability at a future date:

A. The initial power plant design is modified to accommodate a future district heating load. A district heating turbine is installed and space is allocated to install all other required district heating plant equipment at a later date.

B. The conventional power plant is not designed to accommodate a future district heating load. At a later date the power plant is modified to provide a district heating capability. Design options to be considered are:

1. Bypass one or more feedwater heaters to supply steam to district heating heat exchangers.

2. Tap into the turbine crossover pipe to supply steam to district heating heat exchangers.

For option A, the following information shall be supplied for 50 MW, 200 MW, and 400 MW power plants:

a. An estimate of the incremental costs incurred at the time of original plant construction, above those costs for a conventional power plant with the same net electrical output. Costs for plants supplying 15% and 100% of the maximum district heating load will be provided.

b. The cost to install all the necessary equipment to provide a district heating capability at some time in the future. Included in this estimate will be costs for extraction piping, large district heating heat exchangers, control systems, pumps and makeup water systems.

For Option B, the following information shall be supplied for 50 MW, 200 MW, and 400 MW power plants.

a. A typical plant heat balance for each size plant will be reviewed to identify the steam quantities that can be extracted for district heating by bypassing feedwater heaters or tapping into the turbine crossover pipe. The maximum district heating load, reduction in electrical output and impact on overall plant efficiency will be quantified.

b. The costs for modifying the conventional power plant to accommodate a district heating load will be identified for plants supplying 15% and 100% of the maxium district heating load.

c. The problem of physical space restrictions associated with retrofitting large district heating heat exchangers and steam piping will be described. A conceptual layout drawing will be developed for a typical turbine building.

d. A technical discussion shall be provided to identify the design problems associated with retrofitting a steam turbine to accommodate a large district heating load. Items such as turbine casing redesign, blade design and loading limitations, control systems and impact on plant performance are examples of areas that will be discussed.

SCHEDULE

The work described above shall be completed to the draft report stage by June 30, 1980, provided authorization to proceed is received no later than April 15, 1980. A final report shall be provided in reproducible form two (2) weeks after receipt of comments from the Power Plant Siting staff.

IV. Department Contracts

All correspondance with the State of Minnesota shall be addressed to:

Dennis Rothenmaier, Project Manager
Power Plant Siting Program
550 Cedar Street, Room 15
St. Paul, Minnesota 55101
612/296-2169

ATTACHMENT B

Environmental Quality Board
Power Plant Siting Program

April 3, 1980

COMPENSATION:

Compensation for the services detailed on Attachment A shall be on the basis of actual payroll cost (including the straight time portion of overtime and holiday compensation) for all personnel directly engaged in the work in accordance with generally accepted accounting procedures and Burns and Roe, Inc. established personnel practices; plus 100% of this amount to cover overheads and profits; plus out-of-pocket expenses at actual cost for payroll taxes, insurance and pension contributions, lodging, overtime premiums and allowances, communicatinos, reproductions, publications and other authorized items necessary or desirable to carry out the work. Personnel compensation, and out-of-pocket expenses shall be itemized and verified where possible by receipts, etc.

AN ASSESSMENT OF COGENERATION POTENTIAL

CONTRACTOR: SYNERGIC RESOURCES, INC.

ADVERTISED: 3/10/80

CLOSE:11/15/80

"An Assessment of Cogeneration Potential"

I. PURPOSE

The purpose of this study is to enable the citizens of Minnesota to assess the potential for cogeneration when siting future electric power generating units. The citizens of Minnesota have expressed a desire to reduce both the operating inefficiencies and the environmental effects of future generating units by productively utilizing thermal energy. An existing siting rule provides for consideration of cogeneration potential when siting generating units by specifying that "... preferred sites permit significant conservation of energy or utilization of by-products" (6 MCAR § 3.074 H.1.j.).

The citizens of Minnesota have also expressed an interest in small, localized electric power generating units that could be sited near load centers and could minimize local effects on land, air, and water. Smaller units also could be more suitable for cogeneration applications. Fewer siting constraints may enhance siting that is compatible with user, as well as utility, needs. In addition, user concentrations sufficient to economically utilize the available thermal energy from smaller cogeneration units may be easier to assemble.

Prior research studies and existing programs have demonstrated the advantages of cogeneration as a means of maximizing fuel efficiency and minimizing waste heat disposal into surface waters or into the atmosphere. Cogeneration is now viewed as a state-of-the-art technology. If viable opportunities for cogeneration can be identified, efforts can be directed toward the development of suitable applications.

II. SCOPE OF THE STUDY

This assessment of cogeneration potential will consist of three phases. Phase I will include a preliminary literature review, generic analyses of various legal, financial, and technical factors, and a general assessment of cogeneration potential in Minnesota. Phase II will focus on the identification of potential users of thermal energy in southern Minnesota. The final reports and an executive summary will be completed during Phase III.

A. STATEMENT OF WORK

Synergic Resources Corporation (SRC) shall perform the following specific tasks and subtasks.

PHASE I - GENERAL ASSESSMENT

TASK 1 - LITERATURE REVIEW

- Subtask 1.1 - Orientation Meeting

  The Project Director and Project Manager shall meet with the Minnesota Environmental Quality - Power Plant Siting Program (MEQB-PPSP) to obtain the literature and other information to be provided by MEQB-PPSP and to review the objectives and purposes of the study, outlines of the Phase I and II Reports, and the format and potential use of the final report.

- Subtask 1.2 - Compile Information

  SRC shall make use of existing information already on-hand from current project work pertaining to topping-and bottoming-cycle cogeneration and end-use thermal energy requirements; documents obtained from MEQB-PPSP and other State agencies; and information obtained by contacting manufacturers, design organizations, and representative end-users, to prepare an annotated bibliography. Emphasis will be placed on those manufacturing industries that predominate in Minnesota (i.e., grain and livestock processing, sugar, wood products, and paper production) and other enterprises and operations that utilize, or could utilize, significant amounts of energy (e.g., mining and ore beneficiation, agriculture and aquaculture, and large educational and health care facilities). In addition to the annotated bibliography, SRC shall submit a list of organizations and individuals contacted and a complete reference document set with author and organizational indexes.

TASK 2 - REGULATORY AND LEGAL ASPECTS

- Subtask 2.1 - Federal-Originated

  SRC shall contact the appropriate federal agencies (e.g., FERC) and obtain the latest information on existing and proposed regulations affecting cogeneration installations.

- Subtask 2.2 - Minnesota-Originated

  SRC shall contact the cognizant regulatory authorities in the state (e.g., Department of Public Service, Minnesota Energy Agency) to determine their current policy positions and obtain existing and proposed regulations concerning cogenera-

tion installations. SRC also shall examine the regulatory and legal aspects of rights-of-way acquisition for installation of thermal energy conveyance lines between power plant and user(s) in the event they are not on contiguous properties.

- Subtask 2.3 - Environmental Aspects

  SRC shall obtain information from federal and Minnesota authorities regarding regulations affecting discharges to land, air, and water by cogeneration facilities of the type and size contemplated, as well as by the end-use facilities. For example, diversion of water for warm-water irrigation of farmland, fish-produced wastes in aquaculture, thermal emissions from the power plant when the end-users cannot utilize this output, and discharge of condensate from the end-users (when high-grade energy is used) are environmental issues that shall be discussed.

TASK 3 - FINANCIAL INCENTIVES

- Subtask 3.1 - Federal Programs

  SRC shall investigate and obtain information related to federal tax incentives and other financial assistance suitable for cogeneration projects, such as programs sponsored by DOE and EDA.

- Subtask 3.2 - Minnesota Agency Programs

  SRC shall contact the Minnesota Department of Economic Development, the Minnesota Energy Agency, and other State Agencies to obtain information regarding cogeneration project eligibility for existing and proposed financial incentive programs (e.g., state-backed loans or grants).

TASK 4 - GENERIC FEASIBILITY

- Subtask 4.1 - Technical Feasibility

  SRC shall prepare report material describing how cogeneration systems are typically configured to provide (a) low-grade (i.e., "waste heat") and (b) high-grade (i.e., "by-product heat") thermal energy. While it is understood that this study shall emphasize the topping-cycle configuration, with a coal-using electric plant (steam/Rankine cycle) also supplying the low- or high-grade thermal energy to one of more end-users (e.g., industrial plant, hospital, greenhouse, crop drying, or ore pelletizing), potential bottoming cycle configurations also shall be described.

This discussion shall include the current status of the various technologies; examples of presently available technologies and equipment; advantages, disadvantages and limitations of each technology and configuration (including data and a discussion of environmental implications, reliability/redundancy issues, and thermal conveyance); and the cogneration implications of other future electrical generation technologies (e.g., fuel cells).

- Subtask 4.2 - Economic/Institutional Feasibility

SRC shall prepare report material describing the financial, institutional, and regulatory aspects of topping-cycle cogeneration systems. This material shall include (but shall not be limited to) the following special considerations:

- Temporal variations in demand for both products; load factors and relative phasing of one demand to the other
- Allocation of capital, fuel, and O & M costs among electric and thermal outputs
- Contractural arrangements for long-term purchase of thermal output
- Siting and rights-of-way issues
- Financing
- Interfaces
- Pricing of thermal output

SRC also shall briefly describe the financial, institutional and regulatory aspects of bottoming-cycle cogeneration systems.

TASK 5 - GENERAL STATEWIDE ASSSESSMENT

- Subtask 5.1 - Identify End-Users

SRC shall obtain information on end-users from the Minnesota Directory of Manufacturers, Census of Manufacturers data, lists of agricultural and mining enterprises, and other state-level information available form the Minnesota Department of Economic Development and other sources.

- Subtask 5.2 - Define Energy Requirements of End-Users

SRC shall analyze the energy requirements of the various end-users, defining quantities and qualities (i.e., tem-

perature level, purity, preferred form), temporal variations, present source and future availability and price of energy from this source, and other technical and economic factors such as future markets and demand for energy considering changes produced by conservation measures, technological changes, and growth in demand for the product or service produced.

- Subtask 5.3 - Establish Screening Criteria

  In collaboration with MEQB-PPSP, SRC shall develop a set of screening criteria to be applied to the inventory of all potential end-users identified in Subtask 5.1. The screening criteria will enable the potential end-users to be identified and located within specific development areas.

- Subtask 5.4 - Identify Potential End-Users

  SRC shall apply the screening criteria developed in Subtask 5.3 and shall identify the potential end-users within each of the 13 Minnesota Development Regions. This identification shall be largely by type (i.e., 4-digit SIC manufacturing industry, specific type of agricultural enterprise, or ore processing operation), but some specific organizations shall be identified in the health care and eduational fields where the identity is obvious. Maps showing the locations of the largest individual end-users, and clusters of smaller users, shall be prepared.

- Subtask 5.5 - Assess Cogeneration Potential

  SRC shall prepare an assessment of the potential for topping-cycle cogeneration in the state, considering the potential end users and their generic energy requirements and economic factors identified in Subtask 5.2, the technical and economic feasibility aspects of cogenerated thermal energy developed in Task 4, and the likely economnics of alternative technologies for providing thermal energy. SRC also shall assess bottoming-cycle potential and possible applications.

TASK 6 - DRAFT PHASE I REPORT

- Subtask 6.1 - Prepare Report

  SRC shall prepare a written report which summarizes the work performed and information obtained during Phase I of the program. This report shall be written in non-technical language to the maximum extent possible, and all technical terms will be defined. Graphical and pictorial material shall be used to illustrate the data and technical information.

- Subtask 6.2 - Presentation to MEQB-PPSP

  SRC shall meet with MEQB-PPSP representatives to make an oral presentation of the Phase I activities and results, and to amplify on the information in the report.

PHASE II - SPECIFIC ASSESSMENT

TASK 7 - COGENERATION IN SOUTHERN MINNESOTA

- Subtask 7.1 - Identify All Potential End-Users

  Based on the information developed in Task 5, SRC shall identify both organizations with existing facilities that can use thermal energy from cogeneration plants, and organizations that may construct such facilities (including "new" technologies such as "gasohol", aquaculture and enclosed-space farming) in Minnesota Development Regions 9 and 10.

- Subtask 7.2 - Develop Questionnaire

  A questionnaire shall be devleoped by SRC to identify site-specific data (primary data) relevant to the application of cogeneration-produced thermal energy, and to determine the willingness of the facility manager/operator to cooperate. The questionnaire shall be reviewed with MEQB-PPSP.

- Subtask 7.3 - Send Questionnaire

  The questionnaire shall be sent to the potential end-users identified in Subtask 7.1. It is proposed that this be accompanied by a cover letter on MEQB letterhead, and signed by the MEQB/PPSP Project Manager. Completed follow-up telephone interviews will be where questionnaire response is lacking or unsatisfactory.

- Subtask 7.4 - Preliminary Selection of Representative End-Users for Case Studies

  Based on an analysis of questionnaire responses, about 15 to 20 representative end-users shall be identified. This subtask shall be a cooperative effort between the SRC project team and MEQB-PPSP staff.

- Subtask 7.5 - Contacts with End-User Case Study Candidates

  Telephone discussions will be conducted with officials at the identified facilities to determine any additional relevant factors, degree of cooperation, degree to which certain information shall be confidential, etc. Arrangements will be made for site visits.

- Subtask 7.6 - Site Visits

  Members of the SRC project team with significant experience in site-specific energy audits and conservation studies shall visit the representative end-user sites. Specific team members shall be selected based on the type of end-use facility to be visited. Data needed to make site-specific cogeneration assessments shall be collected.

- Subtask 7.7 - Cogeneration Potential

  SRC shall analyze the data obtained from the mail questionnaires and the site visits and, from these, together with the generic information developed in Phase I, shall prepare a rational assessment of the potential for cogeneration in Soutehrn Minnesota (Development Regions 9 and 10). This assessment also shall include an estimate of the potential for new industrial facilities or technologies, (e.g., aquaculture, "gasohol"), that shall be based upon technological, feedstock, labor suply, transportation and market considerations. The maps developed in Task 5 shall be refined to identify the locations of the various types of end-use facilities, based on the infrastructure elements discussed above.

TASK 8 - PROCESS REQUIREMENTS

SRC shall summarize, in narrative, tabular and graphical formats, the thermal process energy supply requirements of each type of end-use facility. This shall include, but not be limited to, factors such as temperature and pressure levels, flow rates, purity or other quality aspects, daily weekly and seasonal temporal variations of each of the foregoing parameters, and scheduled and unscheduled downtime.

TASK 9 - VALUE ANALYSIS

- Subtask 9.1 - Systems Analysis

  Using information developed in Tasks 4, 7 and 8, SRC shall determine the most rational location, type, and size (e.g., thermal and electrical capacities) of cogeneration plants for each large end-user facility or cluster of facilties. This analysis shall, in particular, consider the environmental aspects and fuel suply and electrical interface requirements of the cogeneration plant. (Environmental aspects include waste heat rejection as well as air, water, and solid waste discharges).

- Subtask 9.2 - Economic Analysis for End-User Facilities

  SRC shall prepare an economic analysis in which the value of the thermal energy to be potentially provided by the

cogeneration plant is determined, based upon: (a) the quality, quantity, and time variations of the energy required by the processes at the facility; (b) the probable future cost of the alternate form(s) of energy or fuel that would be used (i.e., the fuel now used or the one most likely to be used in the future for inplant production of the required thermal energy); (c) the efficiency and remaining life of existing in-plant equipment used to produce the process energy (e.g., a boiler furnace or electrical resistance heater); (d) the capital cost of replacement of new in-plant equipment to produce the process energy (for facilities not yet constructed), and (e) the users expected return on investment. To the extent that plant-specific data is not obtained from the mail survey, representative values will be assumed.

TASK 10 - DRAFT PHASE II REPORT

- Subtask 10.1 - Prepare Report

  SRC shall prepare a written report that summarizes the work performed and information obtained during Phase II of the program. This report shall be written in non-technical language to the maximum extent possible, and all technical terms shall be defined. Graphical and pictorial material shall be used to illustrate the data and technical information.

- Subtask 10.2 - Presentation to MEQB-PPSP

  SRC shall meet with MEQB-PPSP representatives to make an oral presentation of the Phase II activities and results, and to amplify on the information in the report.

PHASE III - FINAL REPORT

TASK 11 - PREPARE FINAL REPORT

- Subtask 11.1 - Assemble Draft Final Report

  SRC shall carefully review all written comments submitted by MEQB-PPSP regarding the Phase I and II draft reports and shall, to the extent considered feasible, incorporate them into a draft Final Report. At the time of the Phase II presentation (or earlier), SRC shall consult with MEQB-PPSP to establish the format and structure of the Final Report and Executive Summary. SRC shall then modify the draft reports, as appropriate, and assemble the material into a single coherent document. In addition, SRC shall prepare a draft Executive Summary.

- Subtask 11.2 - Submission of the Final Report and Executive Summary

  SRC will submit the draft Final Report and Executive Summary to MEQB-PPSP for review. Any further MEQB-PPSP comments shall be addressed by SRC and camera-ready copies of the documents shall be submitted.

B. DELIVERABLES

SRC will deliver to the Minnesota Environmental Quality Board the following reports under this contract:

- Phase I Draft Report - to be delivered 8 weeks after project initiation. The report will summarize the results of work performed under Tasks 1 through 6.

- Phase II Draft Report - to be delivered 18 weeks after project initiation. The report will summarize the results of work performed under Tasks 7 through 10.

- Draft Final Report and Executive Summary - to be delivered 22 weeks after project initiation. The final report will incorporate MEQB-PPSP comments on Phase I and II. The draft Executive Summary will be a concise summary of project activities and results, written in nontechnical language for public distribution.

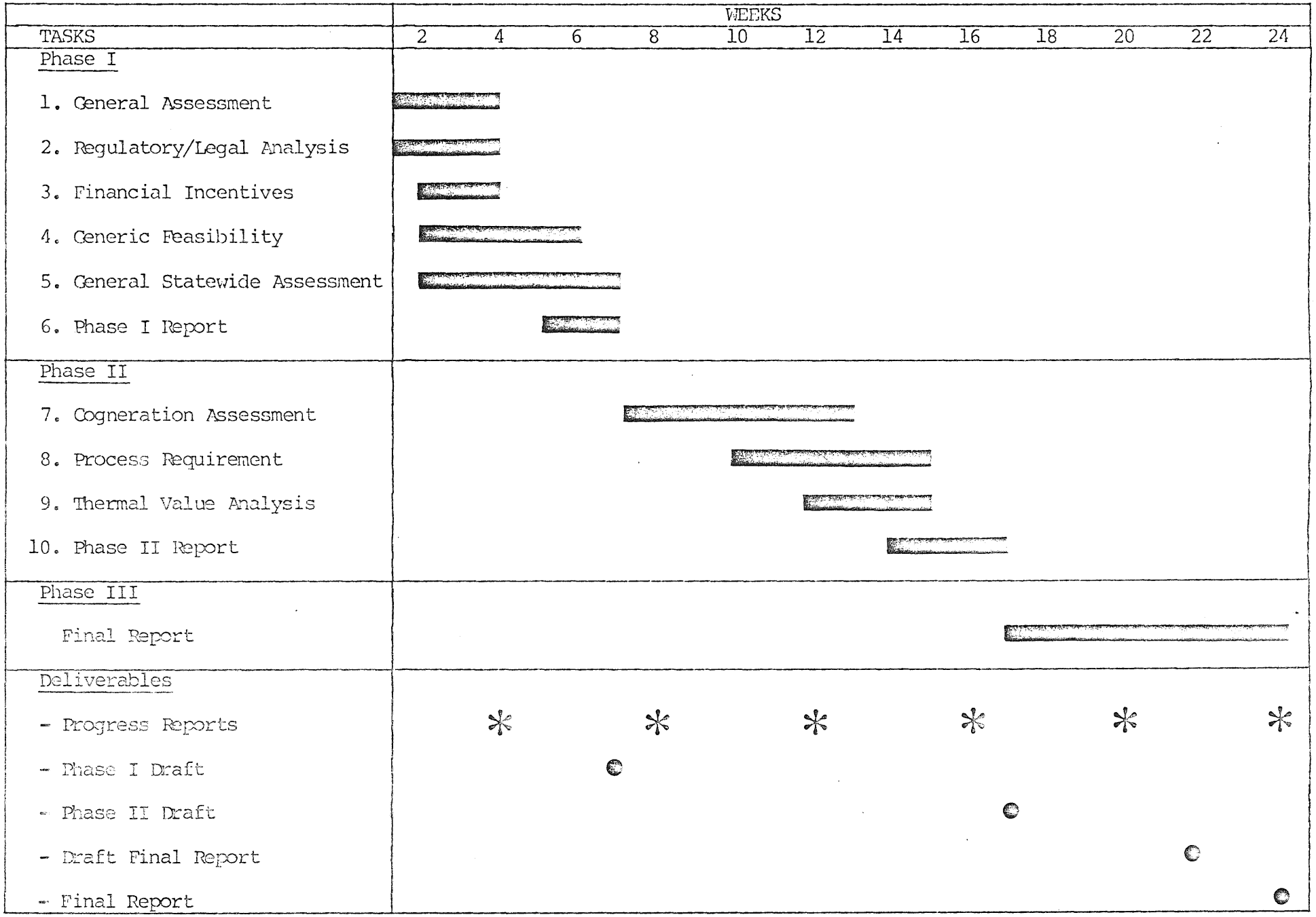
- Final Report and Executive Summary - to be delivered 2 weeks after receipt of comments on the draft Final Report and draft Executive Summary. The documents shall be camera-ready and suitable for reproduction.

- Monthly Letter Progress Reports - to be delivered on the first of each month. The reports summarize the past month's activities and review work scheduled for the subsequent month.

C. SCHEDULE

Figure 1 presents the project schedule for tasks and deliverables.

FIGURE 1
PROJECT SCHEDULE



POTENTIAL JOINT USAGE OF SOLID/SEWAGE WASTE DISPOSAL AND ELECTRIC POWER GENERATING FACILITIES

CONTRACTOR: SANDERS AND THOMAS, INC.

ADVERTISED: 3/17/80

CLOSE: 10/15/80

"POTENTIAL JOINT-USE OF WASTE DISPOSAL AND ELECTRIC POWER GENERATING FACILITIES"

I. PURPOSE

The purpose of this study is to enable the citizens of Minnesota to assess the potential for joint waste disposal and electric generating unit facilities. Both activities involve some similar or complementary processes that, when combined, may reduce operating costs and environmental effects and increase fuel efficiency.

Recent difficulties encountered in establishing new waste disposal sites and new Federal and State legislation governing landfill practices have contributed to greater public interest in resource recovery and alternative disposal practices. Although various innovative waste disposal procedures have been developed (e.g., fluff and dust refuse derived fuels, pyrolosis, etc.), incineration presently appears to be the most reliable and proven means of processing waste. In addition to reducing the volume of material that must finally be disposed of, incineration can generate useable thermal energy. However, incineration also produces air emissions and the residue or ash must still be landfilled.

The study will assess the potential for new joint-use facilities that integrate waste disposal and electric power generation. These facilities could enable the electric generating unit to utilize the incineration waste heat in the steam design cycle; enable the waste disposal unit to utilize the generating unit's exhaust stack, pollution control equipment, and ash disposal site; and confine the impacts associated with the two processes to a single location.

II. SCOPE

The study will be comprised of three phases. Phase I will focus on the technical feasibility of joint waste disposal and electric generating unit facilities. Economic and geographic considerations will be examined in Phase II, and a final report and executive summary will be completed during Phase III.

A. STATEMENT OF WORK

Sanders and Thomas, Inc., in association with Foster Wheeler Development Corporation (hereafter referred to as the 'contractor'), shall perform the following specific tasks and subtasks.

PHASE I - TECHNICAL ANALYSIS

TASK 1 - LITERATURE REVIEW

- Subtask 1.1 - Orientation Meeting

  The Project Manager for each of the contracting firms shall meet with the Minnesota Environmental Quality Board - Power Plant Siting Program (PPSP) staff to obtain literature and other pertinent information provided by the PPSP and to review the objectives and purpose of the study, outlines of the Phase I and Phase II reports, and the format and potential use of the final report.

- Subtask 1.2 - Compile Information

  The contractor shall review existing literature pertinent to the study and shall be thoroughly familiar with the current technology and operations associated with coal-fired electric generating units and waste incineration systems. Upon completion of Task 1, the contractor shall document sources that were consulted (manufacturers, designs organizations, operators, state agencies, etc.) by submitting to the PPSP a list of contacts and an annotated bibliography. In addition, the contractor shall select specific literature (printed material, slides, etc.), suitable for general reference use and/or pertinent to Minnesota, and shall deliver this literature to the PPSP with an accompanying index.

TASK 2 - DESCRIPTION OF ENERGY RECOVERY INCINERATION SYSTEMS

- Subtask 2.1 - Selection of Systems

  Utilizing the information gathered in Task 1, the contractors shall select and examine various energy recovery incineration systems that range in size, technology and configuration (e.g., modular incinerators, waterwall furnaces, rotary kilns, etc.)

- Subtask 2.2 - System Design Factors

  The contractor shall utilize both narrative and tabular format to comparatively illustrate the critical design factors for each energy recovery incineration system, including:

- Waste quantities
- Waste flows
- Front-end processing requirements
- Fossil fuel requirements for waste-drying and/or incineration
- Steam quality (temperature and pressure)
- Discharge water quality and quantity
- Residual materials (back-end) recovery capability
- Residue/ash output
- Emission characteristics and pollution control equipment
- Reliability
- Adaptability to alternative fuels
- Maintenance characteristics
- Odor/noise/detonation impacts
- Land requirements
- Other significant factors

TASK 3 - INTEGRATION OF THERMAL ENERGY

- Subtask 3.1 - Assess Integration Potential

  Utilizing the data developed in Task 2, the contractor shall assess the technical potential for integrating the thermal energy, generated by the energy recovery incineration systems, in an electric generating unit steam design cycle. The contractor shall use the information and technical data presented in the "Considerations of Electric Power Plant Siting," prepared by Burns and Roe for the PPSP. Analysis shall be limited to 50 MW, 200 MW, and 400 MW reference units. Technical factors that may affect integration (e.g., seasonal and waste load variations, reliability, back-up system requirements, etc.) shall be examined.

- Subtask 3.2 - Screen Alternatives

  In consultation with PPSP, the contractor shall select those configurations that exhibit technical merit and shall complete further analysis and development of conceptual designs.

TASK 4 - WASTE STEAM INTEGRATION

- Subtask 4.1 - Assess Integration Potential

  Based on the configurations selected in Subtask 3.2, the contractor shall assess the technical feasibility of integrating incineration waste streams with generating unit waste streams. In addition to integration of solid liquid, and gaseous waste streams, the contractor also shall examine any other opportunities for joint or complementary use (e.g., common fuel supplies, water supply etc.) that would improve operating efficiencies and/or lessen environmental impacts.

- Subtask 4.2 - Screen Alternatives

  In consultation with PPSP, the contractor shall select those configurations that exhibit technical merit and shall complete further analysis and development of conceptual designs.

TASK 5 - DRAFT PHASE I REPORT

Upon completion of Task 4, the contractor shall prepare a written report that summarizes the work performed and information obtained during Phase I. The report shall be written in clear, non-technical language, to the maximum extent possible, and all technical terms will be defined. The report shall be accompanied by graphics, wherever possible, that illustrate or supplement the written material.

PHASE II - ECONOMIC AND GEOGRAPHIC ANALYSIS

TASK 6 - ECONOMIC ANALYSIS

- Subtask 6.1 - Develop Reference Unit Capital and Operating Costs

  The contractor shall develop amortized capital costs for the three reference coal-fired generating units (50 MW, 200 MW, and 400 MW). These costs shall be based on the Burns and Roe report and shall be adjusted, as appropriate, to account for escalation, minor differences in scope or system design, or incomplete data. The contractor also shall develop annual operating costs for the reference units.

- Subtask 6.2 - Develop Integrated Facilities Capital and Operating Costs

  The contractor shall develop amortized capital costs for the selected integrated generating unit/waste incineration facilities utilizing the costs developed in Subtask 6.1, the costs associated with the model energy recovery incineration systems, and the costs for modification and alteration of the reference generating unit components and structures. The contractor also shall develop annual operating costs for the integrated facilities that include changes in fuel consumption, operating efficiency, and maintenance and staffing requirements.

- Subtask 6.3 - Calculation of Differential Costs

  The contractor shall compare the amortized capital costs and operating costs of the stand-alone reference units (Subtask 6.1) with the costs of the integrated facilities (Subtask 6.2). The differential costs shall be divided by the amount of waste incinerated to determine the waste disposal cost per ton.

- Subtask 6.4 - Calculation of Energy Balance

  The contractor shall develop an energy balance as a measure of the efficiency of the integrated facilities. The Btu difference in fossil fuel consumption between the stand-alone and integrated facilities shall be computed and compared with the Btu content of the incinerated waste.

TASK 7 - APPLICATION TO SOUTHEASTERN MINNESOTA

- Subtask 7.1 - Delineation of Service Areas

  The contractor shall utilize existing literature and documents supplied by PPSP to identify municipalities and/or large wastesheds (solid and sludge) in southeastern Minnesota (Minnesota Development Regions 9 and 10) with projected flows sufficient for the operation of integrated generating unit/waste disposal facilities.

- Subtask 7.2 - Service Area Assessment

  The contractor shall summarize persent waste disposal operations in the identified service areas (Subtask 7.1), including disposal practices, facility operating lifetimes, and projected disposal costs.

TASK 8 - APPLICATION TO TWIN CITIES METROPOLITAN AREA

The contractor shall repeat Task 7 for the Twin Cities Metropolitan Area (Minnesota Development Region 11).

TASK 9 - DRAFT PHASE II REPORT

- Subtask 9.1 - Assemble Phase II Report

  Upon completion of Task 8, the contractor shall furnish PPSP with a draft report that summarizes the work performed and information obtained during Phase II of the study. The report shall be written in clear, non-technical language, to the maximum extent possible, and all technical terms will be defined. The report shall be accompanied by graphics, wherever possible, that illustrate or supplement the written material.

- Subtask 9.2 - Establish Format for Final Report and Executive Summary

  Upon receipt of the PPSP comments on the Phase II draft report, the contractor shall consult with PPSP to establish the format and structure of the Final Report and the Executive Summary.

PHASE III - FINAL REPORT

TASK 10 - PREPARE FINAL REPORT

- Subtask 10.1 - Assemble Draft Final Report

  The contractor shall review and evaluate the written comments submitted by the PPSP on the Phase I and Phase II draft reports and, to the extent considered feasible, incorporate them into the draft Final Report. In addition, the contractor shall prepare a draft Executive Summary.

- Subtask 10.2 - Submission of the Final Report and Executive Summary

  The contractor shall submit the draft Final Report and Executive Summary to PPSP for review. Any further PPSP comments shall be addressed by the contractor and camera-ready copies of the documents shall be submitted.

B. DELIVERABLES

The contractor shall deliver to the PPSP the following reports under this contract:

- Phase I Draft Report - to be delivered 8 weeks after project initiation. The report will summarize the results of work performed under Tasks 1 through 4.

- Phase II Draft Report - to be delivered 12 weeks after project initiation. The report will summarize the results of work performed under Tasks 6 through 8.

- Draft Final Report and Executive Summary - to be delivered 16 weeks after project initiation. The draft Final Report will incorporate PPSP comments on the Phase I and Phase II reports. The draft Executive Summary will be a concise summary of project activities and results, written in non-technical language for public distribution.

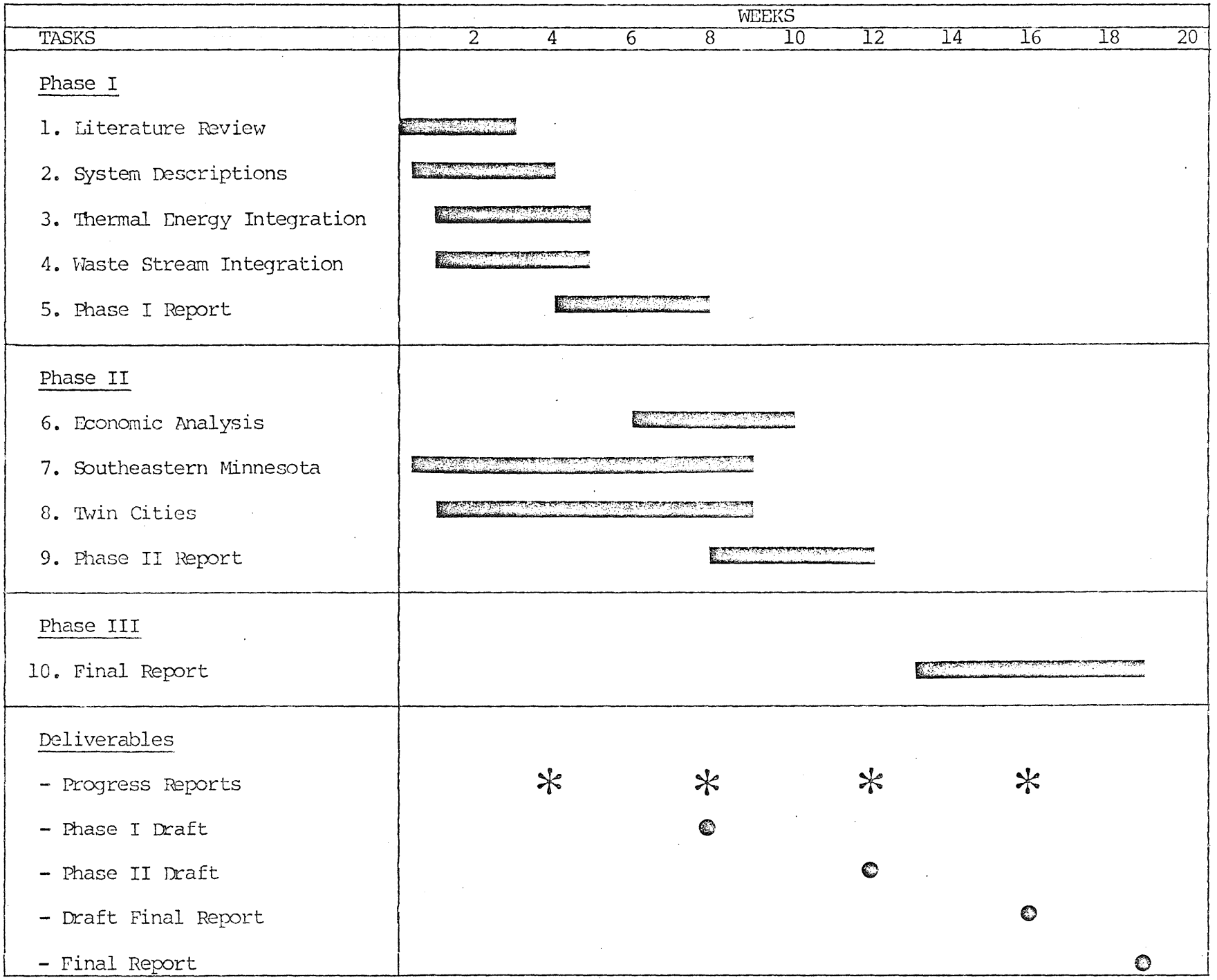
- Final Report and Executive Summary - to be delivered 2 weeks after receipt of PPSP comments on the draft Final Report and draft Executive Summary. The documents shall be camera-ready and suitable for reproduction.

- Monthly Letter Progress Reports - to be delivered on the first of each month. The reports shall summarize the past month's activities and review work scheduled for the subsequent month.

C. SCHEDULE

Figure 1 presents the project schedule for tasks and deliverables.

FIGURE 1. PROJECT SCHEDULE



PUBLIC HEALTH AND SAFETY EFFECTS OF HIGH VOLTAGE TRANSMISSION LINES

CONTRACTOR: DOW ASSOCIATES , INC.

ADVERTISED: 2/25/80

CLOSE: 6/30/80

ATTACHMENT A

The consultant shall prepare an addendum to the report "Public Health and Safety Effects of High Voltage Overhead Transmission Lines" released by the Minnesota Environmental Quality Board in October, 1977. The addendum shall include:

A. Relevant scientific and medical information that has since become available on:

   1. Ac and dc electric shock thresholds.

   2. Relationship between "worst case" and "realistic case" shock exposure.

   3. New laboratory and field research and epidemiological findings concerning biological effects of 60 Hz electrical fields.

   4. New laboratory and field research and epidemiological findings on the biological effects of dc electrostatic fields.

B. A thorough description of the biological effects of air ions with particular attention given to:

   1. Ion density, species, size, charge and characteristics of the field in which they occur.

   2. Biological effects of air ions at the organismic, cellular, and subcellular levels.

   3. Implication of air ion effects on enzymic oxidation processes.

   4. Relevance of known effects of air ions to the electrical environment associated with high voltage direct current transmission lines.

The final report shall contain a complete bibliography of all sources used, including references to personal communications about recent, as-yet-unpublished research. Copies of all significant documents used in the project shall be supplied to the MEQB.

A draft report shall be submitted to the project manager within 10 weeks of execution of contract for review and comment and a reproducible master (camera ready) of the final report by June 30, 1980.

Key personnel shall be as identified in the proposal submitted by Dow Associated dated March 17, 1980 with the addition of Dr. A.P. Krieger as consultant on air ions. Allocation of consultants time may be adjusted by Dow Associates.

RIGHT OF WAY COMPATIBILITY ANALYSIS

CONTRACTOR: POWER TECHNOLOGIES, INC.

ADVERTISED: 3/10/80

CLOSE: 2/27/81

"Right of Way Compatibility Analysis"

Overview

The Minnesota Environmental Quality Board (MEQB) has the authority under the Power Plant Siting Act Minn. Stat. 116C.51 et. seq. to designate the route for all transmission lines capable of operating at over 200 kV constructed within Minnesota. In considering transmission line routes, there has been considerable public interest in minimizing the number of new transmisison line rights of way, a view reinforced by a recent Minnesota Supreme Court ruling (PEER v. MEQB) which established the principle of "nonproliferation" by requiring that new transmission lines be placed along existing rights of way unless there are extremely strong reasons for not doing so. For these reasons it is necessary for the MEQB, when routing a new transmission line, to consider the suitability of all existing rights of way which may be available to accommodate any new line.

To specifically address the issue of right of way compatibility the Power Plant Siting (PPS) staff of the MEQB requests proposals and bids to perform a "Right of Way Compatibility Analysis." This analysis will address the technical, economic, environmental and institutional issues associated with the use or paralleling of existing rights of way (transmission, highway, railroad, pipeline, communication) and of upgrading existing transmission facilities.

Purpose

The primary objectives shall require:

1. A description of the components and the design characteristics associated with the individual, single system right of way requirements for transmission lines, roadways, railroads, pipelines and communication lines.

2. An analysis of how placement of transmission facilities would interact with and influence the use of other rights of way in Minnesota when paralleling immediately adjacent to or sharing. Techniques and costs for mitigating said impacts shall also be discussed.

3. An analysis of how greater use can be made of existing transmission line rights of way in Minnesota by modifying existing structures, upgrading existing transmission circuits, by adding circuits, identifying structure types and designs most suitable for and capable of expansion, and other applicable techniques.

4. A discussion of reliability.

5. Preparation of a comprehensive bibliography and recommendations for reference materials.

6. The preparation of a Report for Tasks I, II, III and IV which presents both technical and non-technical information in a form which will allow the Report to be used as an evaluation guide or manual by professional planners, technicians, citizens advisory committees and members of the public in evaluating routes that comply with the principle of nonproliferation. All technical data and analysis shall be included as Appendices to the Report. The final Report and Appendices shall be sumitted as a camera ready copy. The contractor will also prepare a series of draft brochures and slides for public information purposes. All technical terms and jargon used in report preparation shall be defined in a glossary.

May 8, 1980

ATTACHMENT A

"RIGHT OF WAY COMPATIBLITY ANALYSIS"

STATEMENT OF WORK

Task I - Linear Facility Description

PTI will provide a discussion and overview detailing the components, considerations and characteristics associated with the design, construction, operation, maintenance, safety (public and employee) and reliability factors of separate rights-of-way for the following:

A. Transmission Lines - ac

1. 69 kV
2. 115 kV
3. 138 kV
4. 161 kV
5. 230 kV
6. 345 kV
7. 500 kV

B. Transmission Lines - dc

1. ± 250 kV
2. ± 400 kV

C. Double Circuit Transmission Lines

1. 69 kV
2. 69/115 kV
3. 115 kV
4. 115/230 kV
5. 230 kV
6. 230/345 kV
7. 345 kV
8. 500 kV

D. Highways

1. Interstate
2. U.S. routes
3. Trunk or State
4. County state-aid highway
5. County roads
6. Township roads
7. Municipal roads

E. Railroads

1. U.S. Department of Transportation Classification for A and B main lines and A and B branch lines.

2. Federal Railroad Administration classification system for class 1, 2, 3 and 4 tracks.

F. Pipelines

1. Gas
2. Oil
3. Oil products

G. Communication

1. Telephone

   a. Local
   b. Long Distance

2. Railroad communications

3. Other

Items A through G in Task 1, in addition to a written discussion, will be complemented by illustrations, charts and tables as necessary where they will contribute to an understanding of the components, considerations, and characteristics associated with the individual rights-of-way. PTI will assume typical or standard designs based upon current practice in Minnesota. This task will provide a data base for the analytical portion of the study and also provide a comprehensive perspective on transmission line right-of-way use in Minnesota. This and other tasks will emphasize the efficient use of the electrical properties of the ROW. Thus, discussion of highways, railroads, pipelines, and communication systems will be limited to their interaction with electric power transmission lines. The components, design, construction, operation, maintenance, safety, and reliability of transmission lines will be described with emphasis on those factors affecting efficient use of the ROW. Because of the large number of designs, appropriate generalizations will be made. Typical characteristics of the various classes of transmission will be presented such as: audible noise, radio interference and electric field effects; loading capabilities; performance and operating characteristics.

It is assumed that MEQB staff will provide all of the input data through local contacts. This data will be defined through preliminary meetings at the start of the study. It will be institutional constraints, drawings, specifications and maps of the transmission facilities described above and presently existing in Minnesota.

Task II - Nonproliferation Techniques of Paralleling and Sharing Rights-of-way

PTI will provide a thorough and comprehensive analysis of the non-proliferation techniques of paralleling and sharing of rights-of-way and how they would interact with, and influence the rights-of-way listed in Task I. The analysis of the technical factors will be structured to interface with and address the following evaluation criteria: (1) human impacts, (2) environmental impacts, (3) efficient use of resources, (4) reliability, (5) technical constraints, (6) institutional constraints.

Factors cited in the examples above will include but not be limited to the following: RI, TVI, AN, pacemaker, ozone; ROW vs line design trade-offs; constraints on paralleling; current rules, regulations, laws and practice; insulation design; power line fault current; electromagnetic field induction, electrostatic field effects; corona, reliability, public and employee safety. Note that "efficient use of resources" includes considerations of natural and other resources as well as economic ones. PTI will also provide an analysis of mitigation techniques when existing rights-of-way are utilized or paralleled. The effect as a function of the length of parallel use will also be described. The costs associated with mitigation techniques will also be described, in addition to the trade-offs associated with true costs; i.e., minimizing transmission losses by using larger conductors. Where mitigation techniques are not applicable a presentation of data or minimum separation requirements will be provided. Illustrations, charts, matrices and tables, where appropriate will be used as a supplement to the text. PTI will submit a detailed study methodology and this task will be conducted according to the written guidance of the contractee in response to the proposed methodology.

Task III - Nonproliferation Strategies of Upgrading and Modifying Existing Transmission Facilities.

PTI will provide a thorough and comprehensive analysis of the nonproliferation strategies of upgrading and modifying existing transmission faclities. The analysis will be structured to interface with and address the following evaluation criteria:

(1) human impacts; (2) environmental impacts; (3) efficient use of resources; (4) reliability; (5) technical constraints; and (6) institutional constraints. PTI will submit a detailed study methodology and report outline at the beginning of this task. The analysis for this task will be conducted according to the written guidance of the contractee in repsonse to the proposed methodology and outline. The analysis will include but not be limited to the following:

A. Upgrading existing transmission circuits by increasing voltage or current carrying capacity. The contractor will identify the voltages and situations where the greatest potential for upgrading exists and how this relates to structure type, insulators, conductors and substation components. Particular emphasis will be placed on voltages in Minnesota between 69 kV and 200 kV that can be upgraded to 115 kV through 345 kV.

B. The addition of transmission circuits to existing structures.

C. Identification of what transmission voltages are compatible or incompatible on shared, paralleled, and double circuit rights-of-way.

D. Identification of the tower types and designs in Minnesota capable of being expanded to accommodate additional circuits and upgrading. See items A, B, C of Task 1 for range of alternatives to be considered.

E. Identification of structure types and designs in the 69 kV to 345 kV range suitable for future use in Minnesota that can provide for additional circuits and upgrading. This should include a discussion of recent design developments, i.e. prestressed concrete, fiberglass etc.

F. Provide summary matrix and tables of structures, materials and cost requirements for transmission lines in the 69 kV to 345 kV range. Contractor and contractee shall agree on the scope of this sub-task at a meeting or before initiation of the subtask.

Illustrations, charts, matrices and tables, where appropriate will be used as a supplement to the text.

Task IV - Reliability

A discusison of reliability is also necessary as a component of the analysis. The relibility discussion will be related specifically as possible to the nonproliferation strategies analyzed in Tasks II and III. The discussion will include but not be limited to the following:

A. The concept of reliability.
B. Power system reliability.
C. Reliability of transmission system components.
D. Transmission system reliability.
E. Bulk power system reliability
F. Area supply system reliability.
G. Interconnected system reliability.
H Distribution system reliability.

Reliability should also be discussed in terms of the standards used by the Mid-Continent Area Power Pool and Mid-Continent Area Reliability Council. The consequences and significance of reduced reliablity should also be discussed in general terms.

Task V - Bibliography and Reference Material

A. Prepare or recommend an existing, comprehensive bibliography for Tasks I, II, III and IV.

B. Determine what literature is appropriate to place in a MEQB special subject reference collection; collect same and deliver with shelf list and author index to the PPS staff.

C. Recommend methods and resources for annual updates.

Task VI - Final Report

The preparation of a technical report which presents both technical and nontechnical information in a form which will allow the report to be used as an evaluation guide or manual for informed parties such as professional planners, technicians, citizens advisory committees and members of the public in evaluating routes that comply with the principle of nonproliferation. PTI will also provide a series of slides which can be used for public and citizen committee meetings to facilitieate the understanding of Tasks I, II, III and IV. Drafts of each task report will be submitted upon completion for review purposes.

EVALUATION OF UNDERGROUND HIGH VOLTAGE ELECTRIC TRANSMISSION SYSTEMS

CONTRACTOR: DAMES & MOORE

ADVERTISED: 3/10/80

CLOSE11/1/80

"Evaluation Of Underground High Voltage
Electric Transmission Systems"

The Power Plant Siting staff of the Minnesota Environmental Quality Board requests proposals and bids to perform a study of underground electric transmission applications and environmental compatibility in Minnesota. Results of the study will be used to respond to the interests of the general public and state and federal agencies in considering the placement of high voltage transmission and extra high voltage transmission underground as an alternative to overhead design.

The primary objectives of the study are:

1. Preparation of a site specific analysis of the underground alternative for river crossings proposed by Northern States Power as potential crossings for a single-circuit 345,000 volt overhead transmission line between Minnesota and Wisconsin; and

2. Development of an independent, generic summary of underground electric transmission technology, cost, extent of present and near future use, and environmental impacts.

The contract performance period will be six months. Unless specific target dates are noted in the following task descriptions, delivery dates for completed work will be determined in final contract agreements.

Proposals should be in response to the following phase and task sequence and description:

ATTACHMENT A

3.0 SCOPE OF WORK

3.1 PHASE I

"Assessment of Undergrounding Options at River Crossings Proposed by Northern States Power Company for a Single Circuit 345 kV Overhead Transmission Line"

3.1.1 Task 1

"The contractor shall prepare and present a comprehensive overview of underground transmission lines to the Citizens Route Evaluation Committee at one of its April or May 1980 meetings."

Task 1 will be executed in such a way as to set the tone for the entire study. That is, areas of public concern and information required for decisionmaking will be emphasized, and these will be the areas of focus for the site-specific and generic assessments to follow.

Information to be presented at the meeting will be selected from existing reports of the U.S. Department of Energy (DOE), the Electric Power Research Institute (EPRI), manufacturers of underground cables, and from Dames & Moore project files. We will also be able to make use of information currently being prepared by Dames & Moore for a DOE project still in progress.

An outline of the presentation will be prepared with exhibits to be shown by slide projector. The meeting will be held soon after the project commences on a date to be arranged with MEQB. Both the presentation outline and the input for the slides will be provided to MEQB in advance of the meeting so that a preview of the scope of presentation (and the focus of subsequent studies) can be carried out in St. Paul. (We understand the urgency of the citizens' need for information, and if time does not permit a preview, Dames & Moore will prepare the slide exhibits directly.)

At the meeting, the following information will be presented:

- Motivation for going underground, and the present extent of underground installations (qualitative only)
- Types of cable technologies, and sketches of what they look like
- Methods of installation in various underground, underwater, and at-grade situations

- Suitable cable installation combinations for typical scenarios (land use or physical settings)
- Construction procedures, with sketches of unfamiliar activities
- Operation and maintenance procedures, including routine maintenance and repairs
- Cost factors and trends
- Environmental impacts and other public issues.

The general approach at the meeting will be similar to that of a technology assessment. We will not make decisions or advocate any particular technology or direction, as this would ultimately prove counterproductive. Instead we will attempt to present and focus on the relevant information, answer questions, and identify the important issues for the Committee.

Since this proposed work is in response to an application for an overhead crossing, we will address the pros and cons of underground and overhead, and indicate in what ways each is desirable, particularly for river crossings. However, at this meeting no specific site assessments will be made or judgements presented.

We recognize that the Citizens Committee is participating in a decisionmaking process, so the information will be presented as input to that process. The presentation will be geared so that the members will become aware of what areas they need to be concerned about, and what questions to ask. In this way, any decision will be an informed one, and any additional studies will be limited to those that are necessary and meaningful.

3.1.2 Task 2

"Conduct a preliminary engineering assessment of underground routing options, which include St. Croix River and Mississippi River crossings . . . (specified)."

Task 2 will be initiated as soon as possible after the project is authorized and will be executed simultaneously with Task 1. A visit to the King Station site (and the area south to I-94) and to the Prairie Island-Red Wing area will be made as soon as a date can be agreed upon by the attending parties. The crossings considered by NSP and MEQB and other potential crossings will be observed on site by the Dames & Moore Project Manager, a specialist knowledgeable in cable installation options; a cable construction engineer/cost specialist familiar with the North Central United States; and a member of the MEQB staff (see Section 4.0 for key personnel data).

The purpose of the site visit will be to select appropriate 345 kV cable types and methods of installation for various crossing locations. A determination of the most appropriate cable, installation, and location can best be made if a range of experience and judgement is brought to bear. Potential combinations with obvious shortcomings or disqualifying factors will be noted, so that the options can be narrowed to realistic alternatives. We will at least consider the buried HPOF option cited by NSP and the sharing of the I-94 bridge, even if they do not pass the "first cut," since these are illustrative of a number of underground cable issues. With MEQB concurrence, the crossing options identified as realistic will then be costed in a general way.

Cost categories for planning and design, material and equipment, right-of-way acquisition, and construction will be developed in order to make comparisons between crossings. In addition, to the extent possible, cost of annual operation and maintenance, cost of losses per load factor and certain types of accident repair events will be figured. In these cases, comparison in the same sense as before will be less meaningful. The units do not lend themselves to a "common denominator." The factors may vary considerably from year to year and from site to site; the factors may depend on the network or be unpredictable in other ways. Nevertheless, estimates have been made based on certain assumptions and averages, and the same approach will be used for this study.

Material and equipment will include cable components and accessories as required by the different systems (trifurcations, terminations, reactors, monitoring devices, pressurizing equipment, and perhaps pumps and heat exchangers). Information on material and equipment procurement times will be provided if the times are so long as to be a factor in selecting a transmission line option. Land area and equipment housing, if required, will be included. Also, where applicable, the expected life of the equipment will be incorporated.

Construction costs will include survey and stakeout, clearing and grading, excavation, cable installation, corrosion protection, backfill, station support accessories, cable fluid charge, and system testing.

A report will be submitted with text and tables. The process of selecting the crossing options will be documented and the rationale will be explained clearly. The sources of the cost data will also be documented. In this way, MEQB can make maximum use of the methodology in the future, as input data changes or public concerns shift. The results of the cost studies will be presented in tabular form and key summaries will be put into matrices for comparing the crossing options.

3.1.3 Task 3

"Based on the preliminary engineering assessment developed in Task 2, the contractor shall conduct an environmental impact assessment of each underground crossing."

The environmental impacts of the cable crossings identified above will be assessed. In the event that a particular option involves some cost factor of disqualifying proportion, we will recommend to MEQB that that option be eliminated from the environmental assessment.

The assessment will include impacts from construction, operation and maintenance, cable failure, and repair procedures. We will define those system components and events that are sources of impact, and the elements of the environment that are affected. The impacts will be described in terms of magnitude, duration, and extent. The relative probability of different types of failures will be determined for each particular installation and site. In addition, typical repair times will be given for various failure modes.

The impact assessment will be oriented toward specific issues of concern--cable system emissions of noise, heat, and chemicals. Particular attention will be paid to the land use, aesthetics, and water quality. We emphasize that no site-specific biological field studies or water quality field data collection will be undertaken in this project. Available data and site visits will be used for evaluation of alternatives.

Calculations of the electric and magnetic effects of the subject crossings are not included in the proposed assessment. Nevertheless, we recognize that the subject of electric and magnetic effects (E/M) is a public issue. Since MEQB is involved with the issue and is knowledgeable of the magnitude of fields for 345 kV overhead cables, we assume that MEQB (but not necessarily the Citizens Committee) realize that underground cables are either coaxial or shielded and grounded by design. Since this design significantly reduces external effects during normal operating conditions, and since the effects depend on the details of each system's operation, specific calculations for the crossing options are not proposed. If this is requested as the work progresses, we will provide upper limits (based on planning level data) of the electric field, magnetic field, step potential, interference effects, and other hazards. The proposed assessment will include a qualitative discussion and explanation of the low levels of E/M effects. This discussion will also be developed in the generic assessment to be conducted during Phase II of the project, when underground and overhead lines are compared.

A report will be prepared summarizing the impacts of the crossing options. This will be a discussion of critical issues. There will be a graphic presentation of the crossing options, i.e., sketches to illustrate key aspects of the system on site. The impacts outlined will be specific to the crossings studied, to the resident populations, species and land use, and will describe what will happen at these sites. A more comprehensive matrix exhibiting all areas of impact, including those of less significance or not considered critical to decisionmaking, will be given in the generic assessment in Phase II.

3.2 PHASE II

"Generic Assessment of High Voltage Transmission Line Undergrounding Practices and Technology"

3.2.1 Task 1

"Tabulate and summarize existing installations of 115/138 kV and larger underground transmission in the United States."

Available data on existing underground cable will be compiled for the general categories of installation and performance. The cable installation data are to include summary totals of installed length for cable type, voltage level and location (region, state or service area, if readily available). For voltage levels of 230 kV and above, data will be more specific: utility name, line location, scenario or environmental setting. The cable performance data are to include the type of service, length of time in service, record of faults, and any data of environmental or cost significance that are available.

The primary data sources will be the National Electric Reliability Council (NERC), the Federal Energy Regulatory Commission (FERC), and the Economic Regulatory Administration (ERA) of DOE. All of the FERC-regulated utilities (and this includes most utilities) report transmission line data regularly on "383's" or similar forms. Moreover, since NERC has access to FERC and ERA data, the systems are rather well defined with respect to the above data, and most of the data are consolidated.

Secondary data sources that will be consulted are EPRI, the cable manufacturers, and the utilities with the most experience using underground lines. EPRI maintains an active program in underground transmission R&D. Some of the cable manufacturers make lists available of all installations sold; the lists give the utility location, voltage, and use. Selected utilities will be contacted for information on lengths installed underground, underwater and at-grade; scenarios; costs; and history of faults.

Fault data should also be available from the results of a NERC study soon to be completed. Several reliability studies have recently been conducted for EPRI, and some data have been reported prior to publication. The emphasis of the EPRI studies is on the sources of faults, although the statistics behind them are available.

Since this task could in principle continue indefinitely, as greater definition is sought and data in forms or categories that are inconvenient or complicated must be extracted and analyzed, the proposed search effort will be limited to 80 hours. We anticipate this will be adequate to provide a very good perspective on the current situation. Following compilation, an indication will be given to MEQB of what kind of meaningful information might reasonably be expected to result from further work.

Note that the causes of faults can be grouped in different ways, e.g., by components, by function, etc. Although the categorization cannot be determined until the data are gathered, one method is to group according to electric supply modes, mechanical modes, and line modes. If this method can be followed, it will lend itself readily to a comparison with overhead lines. The line modes for underground cables are both internal and external. Internal causes of cable failure are a result of the cable type or design. This is both technology- and voltage-dependent; it is rapidly changing and cannot be extrapolated. Causes of cable failure in all other categories can be extrapolated. We will also compare reliability results with European and Japanese experience. Some information on this is available in different forms, and the totals are interesting.

The study results will be presented in tabular form. The text will be limited to explanation and qualification of the tables. Data sources will be referred to in footnotes.

3.2.2 Task 2

"Review and summarize underground transmission state of the art."

Task 2 will comprise literature identification and a report on the status of underground cable technology. The work will be conducted in four parts, not necessarily in sequence.

3.2.2.1 Bibliography. A comprehensive bibliography will be prepared, drawn from the following sources available to Dames & Moore:

- Books
- DOE and EPRI reports
- Other government agency publications, both Federal and state
- Journal articles
- IEEE publications and proceedings
- Sales material from cable manufacturers.

Maximum use will be made of items already familiar to us and used in connection with our work for DOE. To complete this work, a computer search of the National Technical Information Service (NTIS) files will be made.

3.2.2.2 Literature File. Working in conjunction with MEQB, we will select literature for a file appropriate to MEQB needs. The list agreed to will be collected by writing to DOE, EPRI, and the utilities; by sending a messenger to NTIS near Washington, D.C.; and by telephoning the cable manufacturers. The Dames & Moore librarian will index the collection by subject, title, and author; if requested, the Dewey Decimal System can be used. A catalog will be prepared on a sheet or on cards, as desired. The publications and catalog will be delivered by United Parcel Service, unless requested otherwise.

3.2.2.3 Information Location File. In order that MEQB can maintain awareness of the rapidly-developing field of underground transmission, we will identify for MEQB journal subscriptions, research report reference documents, and mailing lists, if any, for press releases, advertisements, and meeting announcements. We will also include personnel to contact--a kind of "who's who" in the field. Obviously this cannot be complete but will serve to start an information location file for MEQB, i.e., where to look for information on specific subjects. The file will indicate utility engineers, DOE and EPRI program managers, university groups, and industrial research groups.

3.2.2.4 State-of-the-Art Report. A report will be prepared to apprise MEQB of the present state of underground technology, and trends in the United States and foreign countries toward technical improvement. The state of present technology will be explained in light of the rationale behind the development of the different cable types. The rationale includes the relative technical advantages and disadvantages of the different cable types vis-a-vis the power needs of and perceived impacts on society.

Starting with the information presented at the Citizens Committee meeting, the report will indicate what technical innovation can be expected and will track

the different cables through RD&D to commercialization. We will identify what problems still require research for each system. We will discuss the future of various technologies as reviewed in the United States and in foreign countries, and the reasons. The trends toward high voltage and dc will be presented, and the problems associated with these trends of which the decisionmaker should be aware. No forecasts on market penetration will be given; this depends on utility demand-response strategy as well as commercial availability, and is not considered part of the scope of work.

3.2.3 Task 3

"Analyze various factors of underground transmission systems . . .

a. a generic, comparative analysis of underground and overhead costs . . .

b. a generic, comparative analysis of underground . . . technical and environmental factors."

3.2.3.1 Costs. Costs of underground and overhead transmission will be developed which represent averages of "typical" cable installations in a range of scenarios. The cost breakdown will be in categories similar to those used for the site-specific estimates in Phase I, i.e., planning and design, material and equipment, right-of-way, construction, operation and maintenance, and repair. Since the studies in this case will be generic, more freedom will be exercised in combining cost data from sources with varying applicability or purpose. "Typical" cost studies for various limited scenarios have been developed by DOE and by cable manufacturers. One considers a 100-km link between a rural energy park and an inner-city substation. Another considers urban applications. The results of these "typical" or "scenario" studies must be taken as only approximate if one is to generalize from them.

The units of this cost study (e.g., $/MVA-mile) will be selected in concurrence with MEQB, since they involve significant assumptions about installation parameters, load factor, etc. Anticipated changes in cost may be available from projections of on-going EPRI studies. Where quantitative data are unavailable, areas of cost improvement will be identified, as will indicators to monitor the improvement. Reports contained in the literature file delivered to MEQB which address transmission line costs will be cited. Where possible, cost differences for different scenarios will be approximated.

A report on transmission costs will be presented in textual form, with tables to show comparisons of cable types and, where meaningful results are possible, of scenarios or methods of installation.

3.2.3.2 Technical and Environmental Factors. The technical and environmental factors associated with underground cables will be analyzed to provide a generic comparison of the different cable types. Since decisionmaking is complicated by the many planes on which the factors interact, a series of matrices will be presented to clarify the most suitable environmental applications for each cable technology. The matrices will include:

- Cable type vs. transmission length
- Cable type vs. scenario
- Cable type vs. method of installation
- Method of installation vs. scenario.

The scenarios, or environmental settings, are:

- Urban
  - Inner-city
  - Residential/built-up
- Agricultural
  - Cultivated
  - Open and pasture
- Forests/woodlots
- Wetlands
- Water crossings
  - Riverine - level to moderate terrain
  - Riverine - steep terrain
  - Open water - lakes.

The general methods of installation are:

- Underground
  - Direct burial
  - Tunnel
  - Duct bank
- Aboveground
  - At-grade
  - Bridges and viaducts
- Underwater
  - Cut and cover
  - Tunnel
  - Uncovered.

Information in the matrices will have been introduced at the Citizens Committee meeting in Phase I. Much of the material to be presented here will be derived from unpublished work performed for DOE, which with DOE's approval, can be provided MEQB with minimal additional work.

The concept of utility sharing will be addressed to indicate what the points of interaction or mutual impact would be, rather than to recommend whether to share. A study of the concept of consolidated corridors can easily lead beyond the scope of this study, and we do not intend to pre-empt the decision process. We recognize that MEQB is currently in the process of procuring a "Right-of-Way Compatibility Analysis." We will discuss why the concept is attractive to some but not to everyone. An indication of the institutional and other barriers may serve as an input to the decisionmaker on whether or how to go about encouraging sharing. Our discussion will be limited to a brief identification of the issues and the opposing interests.

3.2.4 Task 4

"Develop a matrix or other relatively simple means of comparing underground and overhead transmission line environmental impacts."

Matrices will be developed to exhibit the environmental impacts of underground lines and a comparison with overhead lines. The matrices will be more comprehensive than the site-specific study, and the analysis will not be quantitative. We will briefly discuss the present and future cable types and the technical factors which have environmental implications. The sources of impact will be juxtaposed with the environmental factors in a matrix format for both underground and overhead systems.

Since the impacts of overhead lines have been studied many times, both generically and for specific installations (voltage ratings and scenarios), the explanation accompanying the matrices will concentrate on the differences between overhead and underground, and with emphasis on long-term rather than temporary impacts. To a degree, these differences may be scenario-dependent since the very choice of underground vs. overhead is often made on the basis of scenario without regard to other environmental factors. Furthermore, some of the scenarios are of regulatory significance (e.g., ambient noise, navigable waters, etc.).

The presentation will be consistent with the issue identification made at the Citizens Committee meeting. We will identify the generic issues and state which are "critical."

One area of public concern is that of electric and magnetic effects, which differ greatly between overhead and underground systems. Although little is known, much is said. We will put this issue into perspective and show why and how underground cable effects are controlled. We will indicate qualitatively what the trade-offs are for control of overhead effects regardless of the magnitude of the impact. As mentioned in Phase I, quantitative calculations of electric and magnetic effects will be performed (as additional work) if MEQB determines a need.

We will also cover the topics of system security and system reliability, although these factors will not fit into a matrix. We will discuss which cable design parameters can and cannot be altered to accommodate the environment, and which planning strategies can and cannot offset environmental impacts.

The report will include considerable textual qualification and expansion of the matrices. As with other tasks, we expect that much of the information to be presented here may be previewed earlier if there is a vigorous pursuit of the issues at the Citizens Committee meeting.

3.2.5 Task 5

"Develop a draft brochure/handout describing underground transmission, which can be distributed to the general public by MEQB."

A brochure will be prepared to promulgate the information presented at the Citizens Committee meeting. The rationale for undergrounding will be presented. Sketches of the cables and installations will be shown with a brief description. A discussion will cover typical cost multipliers for underground systems vs. overhead lines, and the environmental/social advantages and disadvantages of most concern to Minnesotans will be outlined.

The size and format will be determined in conjunction with MEQB. (This is not a significant cost factor. If MEQB chooses, for convenience of distribution, arrangements can be made locally in St. Paul for the graphic and printing work.)

If requested, we can incorporate citizen or NSP input on the customers' needs for and uses of information.

3.2.6 Task 6

"Prepare a set of slides with brief text depicting the summary results of Task 3 above."

Slides will be selected from the presentation used at the Citizens Committee meeting, from sketches used in the brochure and from tables and matrices prepared under Tasks 3 and 4. At the suggestion of the Dames & Moore and MEQB staff, additional topics can be incorporated into visual displays and prepared as slides. The selection will be made in conjunction with MEQB.

A brief text or outline will be prepared to explain the slides and qualify the use of tables and matrices. The latter is important because when data are taken out of context, comparisons or inferences are often made by the audience which are either unintended or incorrect. This is particularly true in the case of cost data.

The input for the slides and accompanying text will be submitted to MEQB for review. As before, arrangements for audio-visual material can be made locally in St. Paul.

3.3 ADDITIONAL SUPPORT SERVICES

Dames & Moore is prepared to present the findings of the Phase I studies (or any of the other studies) at public hearings. We will provide testimony, work with the staff of MEQB or NSP to prepare testimony or provide other support services on an as-needed basis. These services may involve:

- Research on special topics
- Performance of detailed calculations of environmental emissions under specific conditions
- Cost of specific options
- Sensitivity studies
- Models
- Regulatory information/analysis.

4.0 PROJECT ORGANIZATION

4.1 PROJECT MANAGEMENT STRUCTURE

The Dames & Moore project organization for the proposed study is shown in Figure 4-1. This illustrates the structure of the project organization, its relationship to MEQB, and the composition of the key personnel within the task team. As can be seen, the Dames & Moore Principal-in-Charge (PIC) is the focal point for all activities on the project. The project organization proposed for this project is consistent with that typically used. That is, a small management team brings together a technical staff specifically organized for the project.

The Dames & Moore PIC has immediate access to the Managing Partner of the Washington office and to the Executive Partner of the firm. He has contracting authority for the firm, assuring MEQB the support of Dames & Moore's management and the availability of the firm's total resources for the successful completion of the proposed tasks.

Day-to-day responsibility for the project is delegated to the Project Manager, who coordinates the technical and financial activities of each task. Technical responsibility for each task will be executed by key technical specialists.

4.2 KEY PERSONNEL

In anticipation of the work requirements for the proposed project, Dames & Moore has identified key personnel whose area of specialty and experience are best suited for the tasks involved. These key personnel and their functions are described below.

Principal-in-Charge--Richard C. Tucker, M.S., Civil Engineering.

Richard Tucker will have overall responsibility for this project. Mr. Tucker has approximately 15 years experience in the environmental/engineering/utility field and in natural resources matters. He has served in government with the U.S. Army Corps of Engineers and as the Staff Water Resources Engineer for the National Water Commission. He is presently serving as President of American Water Resources Association. Mr. Tucker has directed and is currently directing the preparation of environmental impact statements for government agencies; he has recently been involved in transmission line and powerplant site selection and site studies. He is familiar with policy, planning, and technical studies and has strong experience with management of interdisciplinary and technical projects. He is currently the Principal-in-Charge of a study for DOE entitled "Environmental Assessment of Underground Electric Power Transmission Systems."

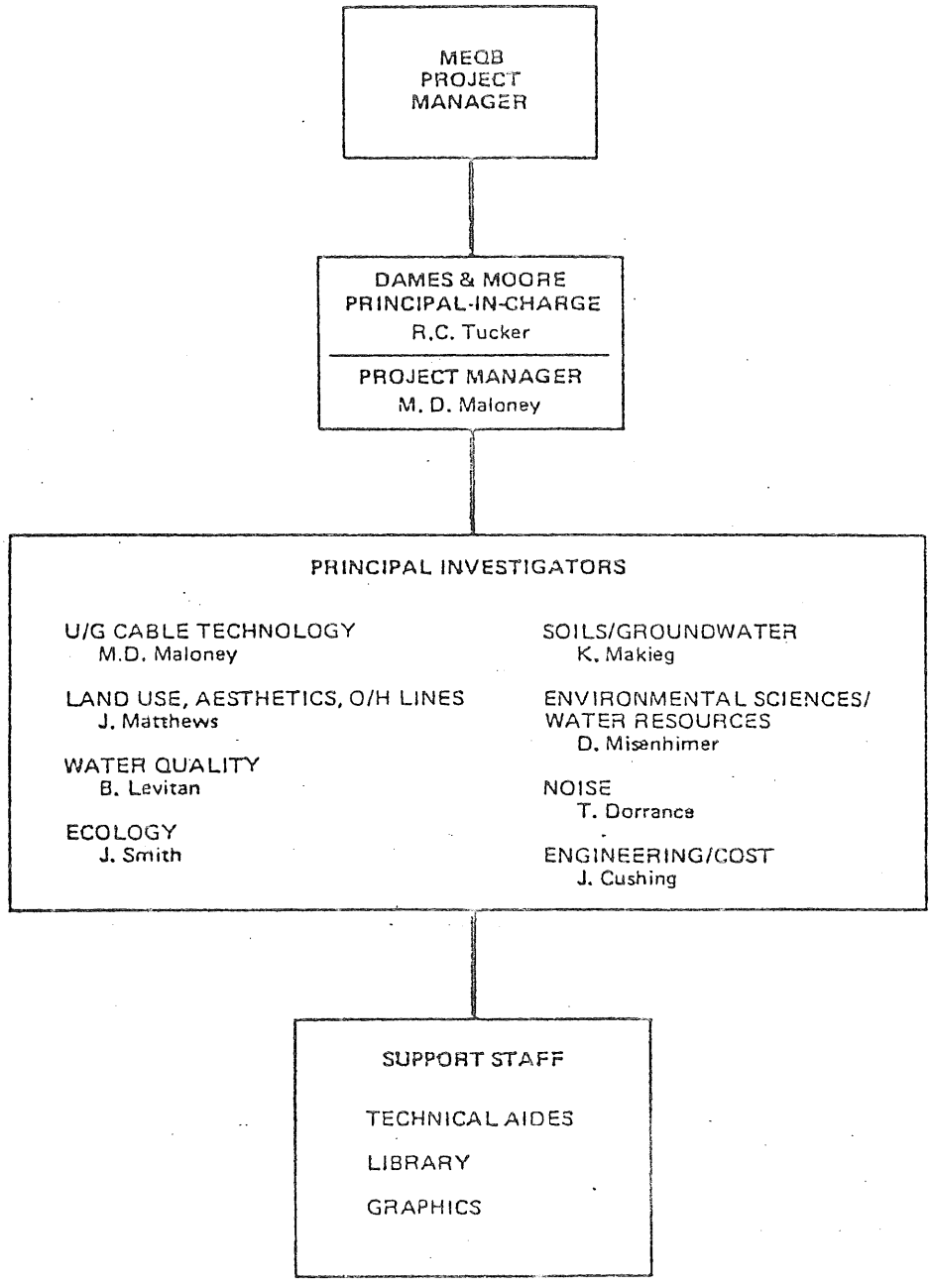


FIGURE 4-1
PROJECT ORGANIZATION

Project Manager--M. David Maloney, Ph.D., Physics.

Dr. Maloney will be responsible for managing the execution of the proposed tasks, and for the performance of the technical investigations. Dr. Maloney has considerable experience in project management for a variety of projects, including an underground transmission technology assessment, water resources studies, mathematical modeling, and environmental assessments. Dr. Maloney has experience with the cable technologies to be investigated in this study, is familiar with the critical environmental issues, and has a strong technical background in diverse fields of application. He has a working knowledge of the literature in power transmission and in all disciplines that will be brought to bear in providing the proposed services to MEQB. For three years Dr. Maloney served the Federal Insurance Administration, as technical advisor in the formulation of policy, and as a coordinator of FIA's flood program at the State and local levels. He is experienced at community participation and has served as technical representative of FIA at many community meetings throughout the United States.

Principal Investigators

Dr. Maloney will also serve as one of the principal investigators on this project. He will be responsible for technical aspects of the cable systems and for the identification of critical issues.

Jack Matthews has worked with numerous utilities across North America, has been involved as a project manager and principal investigator on numerous transmission line investigations, and has been similarly involved in environmental impact assessments. He recently has contributed his skills as a planner to conduct a service-wide optimization for Montana Power of coal plant locations, vis-a-vis power transmission to load centers, fuel transportation, land use, air quality, and other environmental and socioeconomic factors. He has developed software packages capable of sophisticated planning functions. Mr. Matthews will be responsible for land use, environmental factors, and other technical aspects. He is involved as an environmental and planning coordinator for an assessment of underground transmission technologies.

Bill Levitan is an aquatic biologist and toxicologist with considerable experience as a member of multidisciplinary teams. He has performed the aquatic ecology and water quality aspects of environmental assessments, and is involved in Dames & Moore's current project studying underground transmission line interactions with water resources. Mr. Levitan will be responsible for water quality studies.

Joel Smith is a terrestrial biologist with similar experience. He is involved in assessing the animal and plant responses to underground transmission line construction and operation procedures and effects.

Kathryn Makeig is a hydrologist who has performed analyses of soil characteristics and responses associated with the installation and operation of advanced underground power systems. Ms. Makeig has performed numerous field and analytic groundwater contamination studies in Minnesota and is familiar with the NSP study area. She will be responsible for soils and groundwater.

Tom Dorrance is an acoustics engineer with experience in the field of community noise. He has identified noise sources, calculated population exposure levels; he has developed mitigative measures for various technologies, including underground power transmission systems components.

David Misenheimer is a water resources/environmental sciences specialist with a range of experience. He will be responsible for various water resources and environmental tasks and overall report production.

Jerry Cushing is a consultant with extensive experience in contract cost estimating. In particular, he has developed cost estimates of cable and pipeline crossings of rivers and lakes by various methods of installation and cost estimates of utility tunnels and overhead transmission lines. This work was performed as a contractor for major utilities with long histories of underground systems. As a consultant to Dames & Moore for almost 15 years, Mr. Cushing has performed a number of comparative cost estimates of water crossings (underground vs. overhead).

Resumes of the key personnel are included in Section 5.0.

4.3 WORK SCHEDULE

An estimated schedule of work to be completed for the proposed project is shown in Figure 4-2. The schedule conforms to the requirements of the RFP. The Citizens Committee meeting presentation may be made on a date arranged with MEQB about 4 weeks after project initiation. The site visit, selection of crossing alternatives, and cost/impact studies will be conducted simultaneously with Task I, so that a final report on the crossings can be submitted by mid-June. The Phase II studies involve several deliverables. While these studies are not by nature sequential, the schedule indicates this manner of execution because the same investigators will be performing the work for all tasks. We propose to complete the project within 6 months after initiation.

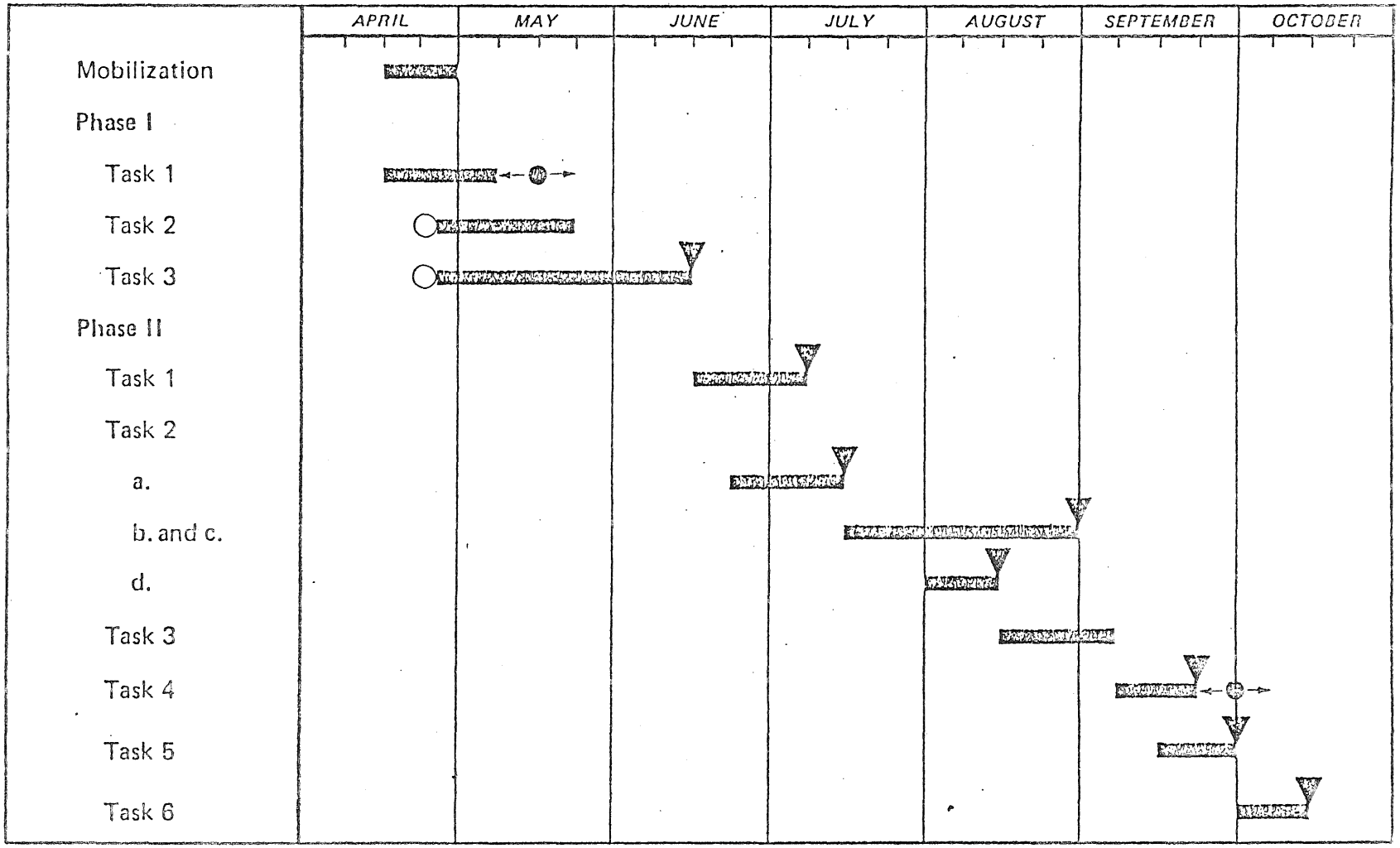


FIGURE 4-2
PROJECT SCHEDULE

DNR HERITAGE MEMORANDUM OF AGREEMENT

CONTRACTOR: NATURE CONSERVANCY

ADVERTISED: 4/1/80

CLOSE: 6/1/80

WORK PROGRAM FOR PROJECT #NSP-TR-2

Minnesota Natural Heritage Program

RESEARCH

1. Staff scientists will search computer, map and manual files within the boundaries of the ten designated USGS topographic maps for:

   a. rare plant and animal occurrences

   b. noteworthy natural features (e.g. unique geologic features)

   c. proposed or designated natural areas.

2. Staff scientists will search more specifically the same information sources for occurrences of rare species or unique natural features that are located within the boundaries of the 1.25-mile designated corridors.

FINAL REPORT

1. The final report will include a status sheet on each rare species or natural feature known to occur within the boundaries of the ten designated USGS topographic maps. The status sheet will include:

   a. a discussion on why the species or unique feature is considered rare in Minnesota

   b. species habitat preference/biological requirements

   c. status of species in neighboring states and on a national basis

   d. distribution map.

2. The final report will also include a summary of the findings described and defined by the Natural Heritage Program review of the project area.

TRANSMISSION LINE ELECTRICAL AND MAGNETIC FIELDS

CONTRACTOR: STANLEY CONSULTANTS

ADVERTISED: 3/26/79

CLOSED: 12/79

1. STATEMENT OF WORK

1.1. General:

Concern over the public health and safety effects of the overhead high-voltage transmission line electrical environment has heightened with the concurrent industry trends toward extra-high-voltage (EHV) alternating current and high-voltage direct current (HVDC) transmission lines. In Minnesota, the major concern has been with a recent + 400 kV DC line and, to a lesser extent, with 500 kV and 345 kV alternating current lines. Over half of the planned expansion of Minnesota's power transmission system over the next 15 years is made up of EHV transmission lines; as a result, the State must analyze these concerns for a regulatory perspective.

The Minnesota Environmental Quality Board (Board) has the authority to regulate the electrical environment of new high voltage transmission lines (HVTLs) through the construction permits it issues. To adequately regulate the electrical environment, and to be able to consider the concerns raised by the public, the Board needs both additional information about the electrical environment of HVTLs and the capability to predict the fields associated with proposed EHV and HVDC transmission lines.

The purpose of this contract is to provide background information concerning the coupling mechanisms of EHV and HVDC lines, and to provide the Board a computer-based model to compute the various field strengths associated with HVTLs at various heights above the ground, both during normal operations and during switching surges and faults.

AMENDED ATTACHMENT A

The contractor shall provide background information concerning the coupling mechanisms of EHV and HVDC lines, provide the Board a computer-based model to compute the magnetic field strengths associated with HVTLs at various heights above the ground, and provide estimated electric and magnetic field strengths for selected transmission lines.

Specific Tasks

Task 1. Provide two papers explaining the coupling mechanisms in action between an HVTL and conductive objects, including persons, within the fields of the HVTL. Special emphasis should be given to the difference between the mechanisms in play with EHV AC and HVDC lines. The papers shall also discuss the changes in the field strengths caused by conductive objects within the field.

a. One paper shall be written to provide the technical background necessary to establish permit conditions relating to electric field effects of HVTLs (The physical mechanisms, not the possible health effects caused by the physical mechanisms.) Assume that the readers of this paper will have a technical background although not necessarily a background in physics or engineering. This paper shall include:

(1) A discussion of Basic Electric and Magnetic Field Theory;
(2) A discussion of Time Varying Fields, specific to A.C. transmission lines;
(3) A discussion of Fields occuring with D.C. transmission lines;
(4) A discussion of the calculations used to predict A.C. electric and magnetic fields;
(5) A discussion of the calculations used to predict D.C. electric and magnetic fields;
(6) A comparison of A.C. and D.C. magnetic and electric fields.

b. A second paper shall be written assuming a readership without a technical background but with interest in the subject (e.g. citizens interested in the overall effects of transmission lines, legislators).

c. A search of the liturature shall be part of this project and an annotated bibliography shall be included as part of Task 1 (a).

Task 2. Using existing theoretical models to develop a computer program that will compute the magnetostatic field caused by high voltage transmission lines. The program shall be useable with alternating current transmission lines of voltage between 115 kV and 765 kV and direct current transmission lines of voltages between ± 200 kV and ± 600 kV. The program shall be capable of determining fields at any point in space. Analysis shall be possible for the following: Single and double circuit lines; Single conductors and conductor bundels; Normal operating conditions and faults and switching surges.

a. Using the computer program developed in task 2, and the G.E. Mark III TRENDS package, the contractor shall determine the maximum total electric field at one meter and three meters above ground for the following lines:*

   1. Minnesota Power and Light's ± 250 kV DC line from Square Butte to Duluth.

   2. The CPA/UPA ± 400 kV DC line from North Dakota to Dickenson, Minnesota assuming (1) ± 400 kV voltage, 300 kV, and 250 kV with Bipolar operation and (ii) 400 kV, 300 kV and 250 kV earth return monopolar operation.

   3. The CPA/UPA 345 kV AC line from Dickinson to Mankato; at a single circuit location and a double circuit location.

   4. The NSP/MP&L 500 kV line from Winnipeg to Chisago County.

b. The contractor shall develop and provide to the EQB two copies of a user's manual for the above program, including at least two complete examples of using the program.

c. The program shall be useable on the G.E. Mark III-Foreground System. The program shall be forwarded to the EQB on magnetic tape.

* Engineering data for these lines will be provided by the EQB.

WORK AND REPORTING SCHEDULE

The contractor shall provide a schedule of the work to be done to the project manager no later than 14 days after the contract has been negotiated.

The contractor shall provide the project manager a written status report on the project which addresses the entire scope of the project 21 days after contract execution.

The final drafts of task 1 and task 2(b) shall be submitted to the project manager in preliminary form for review and comment within 10 weeks after the date of contract execution. The contractor will provide the Board with the reproduceable master of the final reports within three weeks of receiving the MEQB's comments on the preliminary draft.

The final drafts of task 2(a) will be submitted to the project manager in preliminary form for review and comment within 10 weeks after the date of contract execution. The contractor will provide the Board with a reproduceable master of the final report within three weeks of receiving the MEQB's comments on the preliminary draft.

BIOLOGICAL AIR QUALITY INDICES

CONTRACTOR: BOYCE THOMPSON INSTITUTE

ADVERTISED: 2/11/80

CLOSED: 6/30/81

BIOLOGICAL AIR QUALITY INDICES

JUSTIFICATION

There is a need to more explicitly define air pollution occurance and impact as it relates to power plant siting decisions in Minnesota. This type of assessment presently requires an equipment intensive effort. Additionally, much of the equipment associated with air pollution monitoring is expensive in terms of both new product cost and required maintenance. Consequently, it is often necessary to determine the number of air pollution monitoring sites on the basis of available funding rather than by the number which would be most appropriate to best assess the problem. A possible alternative to instrumentation intensive monitoring is the coordinated use of a few instrument based monitoring sites in conjunction with several sites designed to bioassay pollution stress. Pollution monitoring networks such as this have been successfully developed and used in the Netherlands.

I. Description of Project

Air quality impacts of proposed power generation faclities are currently assessed using predictive air quality dispersion models. The validity of the predictive modeling effort depends upon the selected application of an appropriate air quality model to a specific site. The actual impact of a facility in a particular ecosystem is seldom measured because the means for doing so has not been quanitified. Since the predicted impact and observed impact of a pollution source may differ, there is a need to develop a routine means for measuring the amount of pollution which is actually deposited and accumulated in the affected environment.

This project is intended to develop the information necessary to evaluate the feasibility of a biological air quality assessment program to aid power plant siting decisions in Minnesota.

II. Objectives

The objectives of this project are twofold:

1. To review and critically appraise existing information pertinent to this work.

2. To conduct original research investigations designed to provide new information necessary to the development of a valid biological air quality assessment system appropriate for use in Minnesota.

CONTRACTUAL SERVICES

Dr. J.A. Laurence
Boyce Thompson Institute for Plant Research
Development of a Biological Air Quality Indexing Systen

ATTACHMENT A: CONTRACTOR'S DUTIES

1. Review the scientific literature pertaining to this subject and submit three copies (including one camera ready copy) of a report summarizing this literature by June 30, 1980.

2. Select appropriate native and cultivated plant species for future study based on findings of literature search.

3. Collect native and cultivated plant species in Minnesota for cultivation and study at Boyce Thompson Institute.

4. Conduct laboratory studies to define chronic and acute responses of selected species to air pollution stress.

5. Conduct field studies using zonal air pollutant dispensing system to define response of selected species to stress from atmospheric sulfur pollution.

6. Compare laboratory and field data to determine dose/response relationships and pollutant deposition characteristics.

7. Conduct laboratory studies using predicted ambient pollutant concentrations and define responses of indicator species.

8. Prepare a final report summarizing the findings of this research including experimental observation and discussion, and recommendations for future research.

9. Provide an interpretation of this research as it relates to the actual deployment of a bioindicator system in Minnesota. Include a statistical consideration of required statewide indicato density and location as it would affect the validity and application of the bioindicator system.

10. Submit three copies of the final report, including a camera ready copy, by June 30, 1981.

SYMPOSIUM: ASSESSMENT OF LOSSES WHICH CONSTRAIN PRODUCTION AND CROP IMPROVEMENT IN AGRICULTURE AND FORESTRY

CONTRACTOR: UNIVERSITY OF MINNESOTA

ADVERTISED:12/4/79

CLOSE: 12/31/80

E. C. STAKMAN COMMEMORATIVE SYMPOSIUM

ASSESSMENT OF LOSSES WHICH CONSTRAIN PRODUCTION AND CROP IMPROVEMENT IN AGRICULTURE AND FORESTRY

PURPOSE: This is an international symposium which will review the status of theory and methodology, identify problems in practical quantification, and develop strategies for future research on abiotic and biotic factors causing crop loss.

DATES: August 20–23, 1980 *(The Annual Meeting of the American Phytopathological Society is scheduled for August 24–28, 1980, in Minneapolis, Minnesota.)*

SPONSORED BY: Minnesota Environmental Quality Board Power Plant Siting Program

ORGANIZED BY: Department of Plant Pathology, Office of Special Programs, and College of Agriculture, University of Minnesota, St. Paul, Minnesota

SYMPOSIUM PROGRAM

August 20, 1980

- Economic, social, and political implications of crop losses - a holistic framework for loss assessment in agricultural systems
- Concepts and measurement of yield and loss
- Measuring the intensity of abiotic and biotic factors
- Experimental design for quantifying factor-effects on crop yield

August 21, 1980

- Developing realistic crop loss models
- Role of yield physiology in crop loss research
- Estimating regional crop losses by sample surveys
- Quantifying crop losses in the total production system

August 22, 1980

- Role of crop loss assessment in Integrated Crop Pest Management
- Economic analyses of crop losses
- Assessing losses in forestry
- Assessing losses due to insects and weeds

August 23, 1980

- Assessing losses due to biotic disease constraints
- Assessing post-harvest losses
- Assessing losses due to abiotic disease constraints
- Plenary session and closing of symposium

Invited speakers include: W. C. James, Canada; J. C. Zadoks, Netherlands; J. Fulkerson, United States; B. Hau, Federal Republic of Germany; J. E. King, England; M. J. Richardson, Scotland; R. E. Gaunt, New Zealand; B. A. Stynes, Australia; D. de Paddua, Phillipines; M. V. Wiese, United States; D. Mackenzie, United States; R. D. Berger, United States; D. McCunne, United States; F. Hawksworth, United States; and J. Jaksch, United States.

Please return this slip for second announcement and registration materials.

Name _____

Mailing address _____

Accommodation preferred: hotel or dormitory *(circle one)* Number of nights _____

Mail to: Office of Special Programs, 405 Coffey Hall, 1420 Eckles Avenue, University of Minnesota, St. Paul, MN 55108

I. Description of Project

The objective of this project is to develop current and authoritative information on assessment of agricultural losses. This objective will be most efficiently achieved by sponsoring a symposium on the topic, and inviting distinguished individuals to speak on their subject area of expertise. Subsequent to formal presentations by keynote speakers, specific questions may be considered in a general discussion session.

The project organizers recognize that crop losses caused by one factor cannot be viewed in isolation from the effects of other factors, since agricultural production is the result of a multifactorial equation. It is further recognized that much of the concepts and methodology that has been developed since the Food and Agriculture Organization, United Nations, International Symposium on Crop Losses held in Rome, 1967, has been for assessing losses due to biotic factors. This project will therefore endeavour to stimulate an interdisciplinary review of all constraints acting on the total production system. Concurrently, the project will identify methodology which can be directed at assessing crop losses caused by specific abiotic and biotic constraints.

The proceedings of the symposium will be subject to scientific review and published. The information will be available as a public document sponsored by the Power Plant Siting Program of the Minnesota Environmental Quality Board. The University of Minnesota, Department of Plant Pathology, will work in cooperation with power plant siting staff to develop the symposium program. The terms of cooperation will include the following:

1. The Minnesota Environmental Quality Board, Power Plant Siting Program, will be the recognized sponsor of the symposium. The Department of Plant Pathology, College of Agriculture, University of Minnesota will be recognized as the organizer of the symposium.

2. At least 50 percent of the program subjects will address issues related to the assessment of agricultural losses from abiotic factors.
3. The grant recipient will prepare and submit three copies and one camera ready copy of the symposium proceedings within four months from the date of the symposium.
4. The grant recipient may propose additional tasks or activities if they will substantially improve the results of the project.

II. Project Justification

Agricultural products form a principal basis of the economy in Minnesota, yielding nearly 5 billion dollars in crop and livestock receipts in 1977. Consequently, it is important that decisions regarding power plant sites in agricultural areas consider the potential impacts of the planned facility on the agricultural economy.

Pollution from power generation facilities may contribute to declines in both quality and quantity of agricultural products and thereby effect economic losses. At the present time, the means to assess this loss and segregate it from other loss factors is not well understood. It is our intent via this project to gather and assemble authoritative information on this subject to promote further understanding and thereby benefit power plant siting decisions.

The Power Plant Siting Program of the Minnesota Environmental Quality Board recognizes the need to consider the impact of power plants which may be located in agricultural areas of Minnesota. Locating electric power generation facilties near or in the area which they service may help mitigate the need for additional high voltage transmission lines to carry electricity from remote power generation stations. However, siting power plants in these areas may affect their agricultural productivity. Specific methodology is needed to assess the impact of pollutants from power plants on agriculture.

In a wider context, both economic and political reasons have been advanced in the United States and internationally, for quantifying crop losses as a major constraint to increased agricultural production. The major one of these is that in the United States, crop loss due to biotic factors alone is estimated at more than 30 percent of total production; the estimated value of this being $30 billion annually. As a result, scientists involved in crop loss research do not now have to justify their acitivities, but rather, are on the defensive as to why, in spite of so much concern, methodology for quantifying crop losses is still undeveloped relative to other disciplines in plant protection.

The Food and Agriculture Organization, United Nations, convened a Symposium on Crop Losses in Italy in 1967 to examine the state of the science, and the major finding of that symposium was that crop loss methodology was inadequate and had no cohesive objective. Progress achieved since 1967 has been reviewed in scientific papers by James (1974) and more recently, James and Teng (1979). While a review paper is adequate for updating and assessing developments, it is a poor tool for deriving general consensus on the problems of methodology and approach, and for providing guidelines for future work. With increased interest by government agencies and universities in the United States in all factors causing crop losses, there is now a urgent need for a symposium that will gather together those actively participating in crop loss programs.

The College of Agriculture, University of Minnesota, is well suited to organizing and hosting this important symposium. Its Department of Plant Pathology has recognized expertise in the areas of crop loss assessment and abiotic diseases, a factor which will ensure the high quality of speakers attracted to the symposium.

III. Specific Objectives of the Symposium Program

The symposium program topics will include, but not be limited to, a

consideration of the following:

1. A review and critique of agricultural loss assessment theory, with a specific consideration of the approach proposed by Eureka Laboratories, paper number 79-54.4, 72nd Annual Meeting of the Air Pollution Control Association, Cincinnati, Ohio, June, 1979.
2. A review of practical methods now employed to assess agricultural losses.

IV. Project Timetable

The project will be completed within 12 months from the date of project authorization. Project duration is tentatively set between Jnauary 1, 1980 to December 31, 1980. Quarterly reports, each consisting of a brief description of work progress, will be presented for the duration of the project.

V. Project Personnel

a) Organization

Paul S. Teng, Assistant Professor (Principal applicant, vita attached)

J. S. Baumer, Assistant Professor

J. V. Groth, Associate Professor

S. V. Krupa, Associate Professor

R. A. Meronuck, Associate Professor

Department of Plant Pathology
University of Minnesota
304 Stakman Hall
1519 Gortner Avenue
St. Paul, Minnesota 55108

(612) 373-0852

The Department of Plant Pathology, through its department head, Dr. D. W. French, has agreed to actively support and promote this project.

b) Consultants to Project

Dr. W. Clive James, Canadian International Development Agency, 200 rue Principale, Hull, Quebec, CANADA K1A 0G4 (Crop Loss Expert)

Dr. J. F. Tammen, Dean of Agriculture, College of Agriculture, University of Minnesota, St. Paul, Minnesota 55108

Dr. J. C. Zadoks, Laboratory of Phytopathology, Agricultural University, Binnenhaven 9, 6709 PD Wageningen, The Netherlands. (Chairman, Committee on Crop Losses and Production Constraints, International Society of Plant Pathology).

Dr. H. C. Chiang, Department of Entomology, Wildlife and Fisheries, University of Minnesota, St. Paul. (Consultant to the Food and Agriculture Organization, U.N., International Collaborative Program on Crop Losses).

VI. Project Budget

Total sum requested is $17,650.

(See attached Budget Sheet for details).

VII. Symposium Program

The symposium delibrations will take place over four days, August 20-23, 1980. Each scientific session of 90 minutes will address a key issue in crop loss assessment, with a keynote speaker presenting a 30 minute review. This will be followed by three 10 minute addresses from representatives of disciplines different from that of the keynote speech. There will then be 30 minutes of discussion.

Topics in the program have been arranged to follow the logical sequence of issues that confront scientists embarking on a crop loss program. The last day of the symposium has been assigned for critically examining special factors causing crop loss, based on presentations of the previous three days. (See attached outline of Proposed Program for details.)

Of the fifteen technical sessions, at least eleven (73%) will have direct bearing on the concerns of the Minnesota Environmental Quality Board. These are Scientific Sessions : 1 to 8, 10 and 14 to 16.

BUDGET SHEET, EXPECTED ATTENDANCE OF 100

1) Invited Speakers

Air Travel for Seven Overseas Experts	$ 6,600.00
Air Travel for Ten U.S. Experts	3,000.00
Subsistence for 5 days @ $50.00/day for 16 Experts	4,000.00
	$13,600.00

2) Symposium Organization

Travel Expenses	$ 400.00
Audio-visuals & materials	300.00
Postage, U.S. & Overseas	150.00
Promotion: Program set up & printing	200.00
Telephone & cablegrams	400.00
Presymposium instructional material	500.00
Room rental & set up	200.00
Registration material	350.00
Refreshment breaks	250.00
Administration & clerical (office & Special Programs)	500.00
Miscellaneous	100.00
Honoraria for program consultants	500.00
	$ 3,850.00

3) Preparation of Symposium Report

Secretarial and graphic services	$ 300.00
TOTAL EXPENSES	$17,750.00

PROPOSED PROGRAM

ASSESSMENT OF LOSSES WHICH CONSTRAIN PRODUCTION AND CROP IMPROVEMENT IN AGRICULTURE AND FORESTRY

AN INTERNATIONAL SYMPOSIUM

(A) Program Outline

August 19, Tuesday

		Arrival
		Evening Social/Mix

August 20, Wednesday

0800-0900		Registration
0900-0915		Welcome by Dean, College of Agriculture, Univerisity of Minnesota
0915-0945		Opening speech by Governor, State of Minnesota or alternate
0945-1030	*SS1	A Holistic framework for loss assessment in agricultural systems
1030-1100		Break
1100-1200	SS2	Concepts and measurement of yield and loss
1200-1330		Break
1330-1500	SS3	Measuring the intensity of abiotic and biotic factors
1500-1530		Break
1530-1700	SS4	Experimental design for quantifying factor-effects on crop yield

August 21, Thursday

0830-1000	SS5	Developing realistic crop loss models
1000-1030		Break
1030-1200	SS6	Role of yield physiology in crop loss research
1200-1330		Break
1330-1500	SS7	Estimating regional crop losses by sample surveys

*SS - Scientific Session

1500-1530		Break
1530-1700	SS8	Quantifying crop losses in the total production system

August 22, Friday

0830-1000	SS9	Role of crop loss assessment in Integrated Crop Pest Management
1000-1030		Break
1030-1200	SS 10	Economic analyses of crop losses
1200-1330		Break
1330-1500	SS 11	Assessing losses in forestry
1500-1530		Break
1530-1700	SS 12	Assessing losses due to insects and weeds

August 23, Saturday

0830-1000	SS 13	Assessing losses due to biotic disease constraints
1000-1030		Break
1030-1200	SS 14	Assessing post-harvest losses
1200-1330		Break
1330-1500	SS 15	Assessing losses due to abiotic disease constraints
1500-1530		Break
1530-1700	SS 16	Plenary session and closing of symposium
1900-		Social/Mix

(B) Proposed Invited Speakers

Session 1: A holistic framework for loss assessment in agricultural systems

Dr. W. Clive James, Canadian International Development Agency, Ottawa, Canada.
(Dr. James has been a key figure in the crop loss assessment area for many years)

Session 2: Concepts and Measurement of Yield and Loss

Dr. J. C. Zadoks, Laboratory of Phytopathology, Agricultural University,

Wageningen, The Netherlands.
(Chairman of the International Society of Plant Pathology, Committee on Disease Losses and Production Constraints, and author of many papers on methodology for measuring crop loss)

Dr. R. Schein, Department of Plant Pathology, Pennsylvania State University, U.S.A.

Session 3: Measuring the intensity of abiotic and biotic factors.

Dr. W. W. Heck, Dr. R. I. Larsen and Dr. A. A. Heagle, Department of Botany, North Carolina State University, U.S.A.
(These three gentlemen are recognized authorities on measuring dose-responses of plants to pollutants)

Dr. R. D. Berger, Dept. of Plant Pathology, University of Florida, U.S.A.
(Dr. Berger is an epidemiologist with vast experiences in disease assessment)

Dr. L. Apple, Associate Director of Research, School of Agriculture & Life Sciences, North Carolina State University, U.S.A.

Session 4: Experimental design for quantifying factor-effects on crop yield

Dr. R. J. Oshima, Research Scientist, University of California.
(Dr. Oshima is known for his innovative experimental approach to quantifying pollutant effects)

Dr. J. Jenkyn, Division of Plant Pathology, Rothamsted Experimental Station, Herts, United Kingdom
(Dr. Jenkyn has served as a F.A.O. consultant on many occasions in this area)

Dr. W. Fry, Dept. of Plant Pathology, Cornell University, Ithaca, NY, U.S.A.

Session 5: Developing realistic crop loss models

Dr. P. S. Teng, Dept of Plant Pathology, University of Minnesota, U.S.A.

Dr. J. Kercher, Lawrence Livermore Laboratories, California, U.S.A.
(For abiotic diseases)

Session 6: Role of yield physiology in crop loss research

Dr. R. E. Gaunt, Dept. of Agricultural Microbiology, Lincoln College, New Zealand.
(Dr. Gaunt is well-known for his investigations on the physiological basis for crop loss in cereals)

Dr. Julian Thorne, Rothamsted Experimental Station, United Kingdom
(Dr. Thorne is author of many papers onyield physiology)

Session 7: Estimating regional crop losses by sample surveys

Dr. O. C. Taylor & Dr. A. Millikan, California Statewide Air Resources Board, Sacramento, CA, U.S.A.
(Dr. Millikan has considerable experience with large-scale monitoring of abiotics)

Dr. C. E. Main, Dept. of Plant Pathology, North Carolina State University, U.S.A.
(Dr. Main has developed an optimal sampling procedure for estimating quality and quantity losses of tobacco)

Dr. J. E. King, Ministry of Agriculture and Fisheries, Harpenden, U.K.
(Dr. King is in charge of a cereal survey program in England and Wales which is now in its tenth year of operation)

Session 8: Quantifying crop losses in the total production system

Dr. John Jaksch, U.S.E.P.A., California, U.S.A.

Dr. B. A. Stynes, Department of Agriculture, Perth, Australia.
(Dr. Stynes has developed a method for quantifying two-factor interactions on crop loss)

Dr. M. J. Richardson, Ministry of Agriculture & Fisheries, Scotland.
(Dr. Richardson has an ongoing program which partitions crop losses as they occur sequentially in crop growth)

Session 9: Role of crop losses in IPM

Dr. D. McKenzie, Dept of Plant Pathology, Pennsylvania State University, U.S.A.
(Dr. McKenzie has an active IPM program making use of disease-loss models)

Dr. L. Brader, Division of Plant Production and Protection. Food and Agriculture Organization, Rome, Italy.

Dr. R. F. Smith, University of California, Berkeley, U.S.A.

Dr. D. Thurston, Dept. of Plant Pathology, Cornell University, U.S.A.

Session 10: Economic analyses of crop losses

Dr. R. Adams, Division of Agricultural Economics, University of Wyoming, U.S.A.
(Dr. Adams has been concerned with economic impact of pollutants on crops)

Dr. G. Carlson, Dept. of Agricultural Economics, North Carolina State University, U.S.A.
(Dr. Carlson has researched the economics of crop loss caused by biotic factors)

Dr. A. Barker, Dept of Agric. Economics, Michigan State University, U.S.A.

Dr. L. G. Holm, Dept of Agronomy, University of Wisconsin, U.S.A.

Session 11: Aesthetic, economic and recreational impact of abiotic and biotic factors on natural ecosystems.

Dr. F. Hawksworth, USDA-Forest Service, Rocky Mountain Forest and Range Expt. Station, Colorado, U.S.A.
(Dr. Hawksworth and his team have developed a workable model for predicting forest losses due to mistletoe)

Dr. K. Russell, Dept. of Natural Resources, Division of Forest Land Management, Olympia, Washington, U.S.A.

Session 12: Assessing losses due to insects and weeds

Dr. H. C. Chiang, Dept of Entomology, Wildlife and Fisheries, University of Minneosta, U.S.A.
(Dr. Chiang is known for his research on insect losses)

Dr. W. C. Ruesink, University of Illinois, U.S.A.

Session 13: Assessing losses due to biotic disease constraints

Dr. L. Chiarappa, Senior Plant Pathologist, Food and Agriculture Organization, U.N., Rome Italy.
(Dr. Chiarappa has been involved in international programs on crop losses, in particular those caused by diseases)

Prof. J. Kranz, Dept of Phytomedicine, Tropeninstitut, Giessen, West Germany
(Prof. Kranz is author of several books which concern the practical management of disease-losses)

Dr. J. A. Browning, Dept of Botany & Plant Pathology, Iowa State University, Iowa, U.S.A.

Dr. M. V. Wiese, Dept. of Plant & Soil Sciences, University of Idaho, Moscow, U.S.A.

Session 14: Assessing post-harvest losses

Dr. Don Russell, Agriculture Canada, Charlottetown, Canada

Dr. Dante de Paddua, Los Banos, Phillipines.
(Both gentlemen are recognized for their expertise in post-harvest loss technology)

Dr. H. H. Kauffman, Grain Research Laboratory, Cargille, Inc., Minneapolis, U.S.A.
(Dr. Kauffman is directly concerned with the commercial significance of post-harvest losses)

Session 15: Assessing losses due to abiotic disease constraints

Dr. D. McCunne, Boyce Thompson Institute for Plant Research, Cornell Univesity, Ithaca, New York, U.S.A.

Dr. R. Guderian, Angew Biologie, Essen-GHS, West Germany.

Session 16: Plenary and closing

Dr. John Fulkerson, Principal Scientist, USDA/SEA, Washington, D.C. U.S.A.

Dr. R. Herrett, Research Director, I.C.I. (representing the view of industry on crop losses)

AIR POLLUTION ASSESSMENT

CONTRACTOR: STANLEY CONSULTANTS

ADVERTISED: 2/25/80

CLOSE 6/30/81

AIR POLLUTION ASSESSMENT

The Power Plant Siting Program of the Minnesota Environmental Quality Board has a need to develop specialized information regarding ambient air quality which affects power plant siting decisions. Specific information is needed on the occurrence of atmospheric sulfur compounds with ozone. Additionally, there is a need to characterize the sources of these and other pollutants which may result from fossil fuel combustion.

I. Description of Project

Long range transport considerations suggest that a significant portion of the air pollution which occurs in Minnesota does not originate in Minnesota. It is our intent to gather information on air pollutant character and origin so that siting decisions can be made which will minimize the contribution of new sources of pollution to air quality degradation. Observations of pollutant deposition and effects will be used to validate predictive air quality models used to define air quality impacts from coal fired electric power generating facilities.

II. Objectives

The research efforts requested here will address two basic issues: The characterization of pollution which is regional in nature and 2) the characterization of pollution which can be attributed to point sources. Regional pollutant occurrence will be assessed by determining air mass trajectories from synoptic weather data. Pollutant episodes will be analyzed based upon history of the air mass and pollutant composition to define pollutant origins.

Pollution attributable to point sources will be investigated by examining pollutant dispersion in relation to existing pollutant gradients and associated environmental impacts.

These research efforts are intended to address specific objectives. However, functional and innovative methods which will accomplish these objectives in a manner which is different from that outlined here are invited as alternative proposals.

ATTACHMENT A: CONTRACTOR'S DUTIES

OVERVIEW OF CONTRACTOR'S RESPONSIBILITIES

The contractor shall address two major objectives under this contract. First, the contractor shall examine the occurrence and deposition of atmospheric sulfur (in the form of SO_2 and SO_4) with ozone in Minnesota and to determine the trajectory of the air masses responsible for pollution episodes. Second, the contractor shall conduct a detailed examination of pollutant occurrence and deposition in the vicinity of two large coal-fired power generation facilities in Minnesota.

SPECIFIC TASKS:

1. The contractor shall work cooperatively with representatives of the Power Plant Siting Program and the Minnesota Pollution Control Agency to develop the most effective means of collecting and analyzing the data pertaining to this research.
2. Studies to be conducted for the purpose of characterizing the occurrence and sources of regional pollutants shall include the following:

    a. an evaluation of the occurrence of atmospheric sulfur and its relationship to ozone episodes;
    b. a determination of the relative amounts of atmospheric sulfur which occur as sulfur dioxide and particulate sulfate; (Sulfur dioxide and ozone data are to be supplied by the State of Minnesota.)
    c. operation of six sulfate monitoring stations for a period of at least four months during the summer months of 1980;
    d. a comparison of the deposition of atmospheric sulfur and trace elements as measured with wet and dry fall collectors to that observed to accumulate on synthetic substrates (such as dried moss) and crops grown in the immediate vicinity of the monitoring stations;
    e. a determination of the history of air masses which coincide with oxidant pollution episodes in Minnesota during the months of June, July, August and September of 1980.

3. Studies to be conducted for the purposes of characterizing pollution gradients near coal-fired power generation facilities shall include the following:

    a. the design and implementation of a program to compare the predicted occurrence and deposition of pollution from the source (using "best available" air quality modeling methods) with that observed to be deposited by appropriate collection and analysis of snow, soil and plant tissue;

b. the observation of the following pollutants in soluble and insoluble form as indicated by sample type: S, $SO_4^=$, NO_3^-, Cl^-, NH_4^+, K^+, H^+, Na^+, Mg^{++}, Ca^{++}, Al, V, Fe, Ni, Zn, As, Se, Be;
c. an examination of vegetation growth as a function of defined pollution gradients about the source;

4. All sampling and analytical procedures shall be designed to ascertain the errors associated with observations and to segregate that source of variation, in spatial and temporal terms, from variation attributable to pollutant occurrence.
5. All samples shall be collected, handled and analyzed in an appropriate manner so as to assure the quality of the resulting data.
6. All samples which are not analyzed destructively shall be appropriately stored after analysis so as to serve for the purpose of future reference.
7. The personnel responsible for this project shall be the same as described in the contractor's proposal. No changes in the personnel are allowed except as approved by the project manager.
8. Resources originally proposed to study sulfur isotopes shall be redirected to provide a more detailed examination of ions and elements described in Task 3b.
9. All remaining conditions of this contract are as described in contractor's proposal dated March 17, 1980 and contractor's amended proposal submitted April 21, 1980.

LOW HEAD HYDRO-ELECTRIC POWER STUDIES

CONTRACTOR: CH2 M HILL

ADVERTISED: 3/26/79

CLOSED: 12/79

ATTACHMENT A

The consultant shall provide the Minnesota Environmental Quality Board with data useful in evaluating the environmental and other tradeoffs involved in significant development of hydropower. The work should address low-head (head less than 50 feet) hydro-electric plants with generating capacity of five megawatts or less.

Specific Tasks

A. Small low-head hydro-electric plants

1. Provide backgorund information on state-of-the-art run-of-river plants and plants using storage. Explain operational differences between baseload and peaking hydro plants. The information should explain how the plants operate; indicate reliability, transmission needs for 1, 2 and 5 MW output, and capital and operating costs for 1, 2 and 5 MW output; and compare environmental, economic and engineering advantages and disadvantages. At a minimum, the environmental parameters considered should be disolved oxygen, temperature, sediment load, scouring, aesthetics, and maintenance of water levels. Figures showing typical site layouts and operational features shall be provided.

2. Compare major turbine types - bulb, Kaplan and any other major type in current use.

3. Compare major financing methods available to private and public builders of hydro plants.

4. Indicate what a "good" hydro plant site needs other than sufficient water and head: soil type, slope, access to roads or railroad, etc.

5. Indicate major management techniques or additional equipment that can be used to minimize environmental effects identified in task A.1. Specify capital and operating maintenance costs.

B. Multiple plants on rivers.

1. Evaluate the increased power yield from siting a series of plants on the same river stretch. Indicate how far apart the plants would be to maximize power yield. Specify advantages and disadvantages.

C. Estimation of hydropower yield

1. Present method of rapid rule-of-thumb estimation of potential hydropower from run-of-river plant, given figures for monthly or daily stream flow and head; present similar method for plant using reservoir storage. Discuss major factors that would increase or decrease actual yield; quantify increase or decrease.

D. Feasibility of proposed technological innovations.

1. Review and comment on the feasibility of certain technological innovations to extract more energy from hydropower. The evaluation will consider current use of the innovation (if any), major technological advances that must be made, a rough estimate of when such technological advances will be made, a rough comparison of capital and operating costs with existing costs (if possible), major environmental/economic/engineering advantages and disadvantages, and the amount of increased power realisitcally possible. Brief descriptions and illustrations of the innovations will be included.

   Please note that very detailed review is unnecessary.

   The innovations include:

   a. Use of hydraulic/air compressor (HAC) with a gas turbine generator, for a combined cycle hydroplant. (See Electric World; May 1, 1978; "Exploiting Our 'Dam' Potential"; Gordon D. Friedlander; pp. 72-73.)

   b. Heat engines to store thermal energy from plant reservoirs - vapor liquid Rankin cycle heat engine and Nitinol heat engine.

   c. Use of thermal energy from thermoclines in plant reservoirs. (See Science; January 12, 1979; "Thermoclines: A Solar Thermal Energy Resource for Enhanced Hydroelectric Power Production; J.L. McNichols and W.G. Ginell; pp. 167-168.) Also consider actual efficiency of heat engines at temperature differentials typical of Minnesota waters, amount of water needed, and how long during the year Minnesota waters would exhibit the needed stratified thermocline configuration. (See also Science; October , 1977; "Ocean Thermal Energy: The Biggest Gamble in Solar Power"; William D. Metz; pp. 178-180.)

   d. Any other innovations under serious study that would significantly (above 50%) increase extraction of power or significantly (10% or more) decrease capital costs.

The final report will be submitted to the project manager in preliminary form for review and comment eight weeks after execution of contract and notification of contractor. The contractor will provide the Minnesota Environmental Quality Board with a reproducible (camera-ready) master of the final report by September 1, 1979. The final report will include an executive summary summarizing major points and conclusions.

RESERVOIR STUDY

CONTRACTOR: WOODWARD-CLYDE CONSULTANTS

ADVERTISED: 3/26/79

CLOSED: 12/79

Water Storage Reservoirs for Coal-Fired Electric Power Generating Plants

1. STATEMENT OF WORK

1.1 General

The Minnesota Environmental Quality Board (Board) is required to site large electric power generating plants. Reasonable access to a proven source of water must be demonstrated before a plant site can be certified. If sites away from the lower stretches of major rivers are considered, water storage reservoirs will be needed to provide a constant water supply.

The purpose of this contract is to provide the Board with state-of-the-art information on reservoir operations, management and impacts so that the Board can effectively evaluate and review the use of reservoirs. The information will also be used to identify alternate reservoir sites.

The work is to address water storage reservoirs for coal-fired plants capable of generating between 400-800 megawatts (MW) of electricity. The reservoir size can range from 5,000-50,000 acre-feet of storage. The area of the state to be considered is the southern half of the state; conditions in these areas should be addressed.

Three types of reservoirs are to be studied:

1. Instream reservoir (reservoir created by dam across stream; only upper reaches of large rivers and tributary streams are to be considered).

2. Off-stream reservoir designed to supplement stream flow (stream water pumped to impoundment located away from stream and returned to stream above plant intake pipe to augment stream flow during low flow).

3. Off-stream reservoir providing water directly to the power plant.

ATTACHMENT A

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3. Off-stream reservoir providing water directly to the power plant.

The major emphasis should be on the third reservoir type. In all tasks, most work should center on the third reservoir type.

Specific Tasks

1. Provide background information on the design, components and operations of the three reservoir types. Consider operations under normal conditions and under abnormal conditions (e.g. major rainfall that might be expected in southern Minnesota). Provide illustrative graphics, including site layout.

   Identify and compare the major types of dam/embankment materials (earthen, earthen with concrete, concrete, etc.) that would likely be used for the three reservoir types for the specific location and size.

   Present engineering advantages and disadvantages for each reservoir type and dam/embankment materials. Among these, consider reliability, construction time or need for materials difficult to obtain, ease of keeping water levels at set levels and probable mode and severity of dam/reservoir failure. Indicate major management or construction techniques that can minimize disadvantages; indicate relative costs of each. It is not necessary to include legal or institutional considerations.

2. Environmental Impacts

   Compare the severity of environmental impacts of the three reservoir types. Include considerations of nutrient levels (phosphorous, nitrogen), and associated algal blooms, increased temperature of impounded water, fish killed, leaching to ground water, silt load and scouring of receiving waters. Indicate management techniques or other ways the adverse impacts can be minimized; indicate relative costs of each.

3. Costs

Compare capital and operating costs of components of the three reservoir types, (e.g. dam/embankment, pumps at reservoir site, etc.). Consider the costs for the major types of dam/embankment materials that would be used in southern Minnesota (as identified in Task 1).

It is not necessary to consider piping costs.

4. Volume/Area Ratio

Propose a range of volume/area ratios for southern Minnesota, to minimize water loss through evaporation and seepage. Propose appropriate size for multiple use consideration.

5. Other Design Considerations

a. Seepage. Compare "normal" seepage from the three reservoir types for the major dam/embankment materials; assume a site with suitable soils. Evaluate methods of preventing seepage in areas with unsuitable soils or subsurface geology (e.g. liners); indicate impacts, advantages, disadvantages and costs of each.

b. Evaporation. Evaluate available methods of preventing evaporation (e.g. films); indicate impacts (particularly on aquatic vegetation and fish), advantages, disadvantages and costs of each.

c. Wave, ice damage. Compare "normal" damage from wave and ice action for each reservoir type and dam/embankment materials. Assume conditions in southern Minnesota. Evaluate methods of preventing such damage; indicate advantages, disadvantages and costs of each.

d. Minimum water level in reservoir. Indicate whether minimum water levels must be present to maintain structural stability of the dam/embankment or serve other purposes. Compare levels for the three reservoir types and major dam/embankment materials.

6. Site Conditions

Specify the physical conditions needed for a good reservoir site; indicate which types of soils, subsurface geology, distance to ground water, slope distance from populated areas and other major constraints are acceptable. Indicate whether unacceptable conditions can be corrected and indicate whether unacceptable conditions can be corrected and indicate costs; in particular, specify additional measures (and costs) needed to construct a reservoir in areas containing Karst features or low slope.

7. Innovations

Survey the literature and specify major innovations that will be available in the next ten years. The emphasis is on major innovations that will significantly reduce water loss due to evaporation or seepage (especially in Karst areas), adverse environmental effects or construction costs.

8. Multiple Use

Compare the multiple use possibilities for the three reservoir types. Indicate advantages, disadvantages and any associated cost increases. In particular, evaluate use of the reservoir as a wildlife management area, and evaluate severity and frequency of conflicts due to water level fluctuation, high water levels, and changing water quality.

9. Water Quality

For the three reservoir types, evaluate the impacts on cooling water requirements when impounded water is used; what is the possibility that increased levels of temperature, silt load, nutrients, algal blooms, etc., will require pretreatment? At what cost? List major management techniques that can be used to reduce need for pretreatment.

10. Safety

For the three reservoir types, specify major construction of management materials or techniques that will ensure structure safety for conditions typical of southern Minnesota. Only consider those items that will increase construction time and cost less than 100%. Indicate costs and increased construction time involved. Specify availability of dam safety insurance.

The final report will be submitted to the project manager in preliminary form for review and comment within nine weeks of execution of contract. The contractor will provide the Minnesota Environmental Quality Board with a reproducible (camera-ready) master of the final report by September 1, 1979. The final reports will include an executive summary summarizing major points and conclusions.

KEY PERSONNEL

Any change in key personnel for this project shall not be made without the prior written approval of the Board's project manager.

ATTACHMENT B

Woodward-Clyde Consultants

Environmental Systems Division

SUMMARY OF FEES AND CHARGES

The following method of compensation has been developed using as a guide Manual No. 45 of the American Society of Civil Engineers Committee on Standards of Practice, 1975.

CONSULTING SERVICES

The charge for technical services of personnel for hours charged to the project, including office, field, and travel time, will be their hourly rate times a multiplier of 2.5. The hourly rate is determined by dividing the individual's base annual compensation by 2,080 hours, plus a percentage of the rate so determined for payroll taxes, social security contributions, workmen's compensation insurance, retirement and insurance benefits, and vacation, holiday, and sick leave. No more than eight (8) hours of travel time will be charged in any day. A list of the current range of hourly personnel rates is attached.

Charges for special accounting and financial services which are beyond standard project procedures will be at the individual's hourly rate multiplied by 2.5.

Appearance as an expert witness at hearings will be charged at a rate of $1,000.00 per day, plus expenses. The full-day rate will be the minimum charge for any portion of a day. Preparation for a hearing will be charged at regular hourly rates.

DIRECT NON-SALARY COSTS

All identifiable costs incurred will be charged at cost plus 15%. Examples include: subcontractors and special consultants; boat and vehicle rentals; aerial surveys; laboratory testing; subsistence pay; fares of public carriers; communications; expendable supplies and equipment; tolls and parking; special drafting, stenographic, or printing supplies (including outside printing of photographs, photostats, blueprints, etc.); fees and insurance; permits and licenses; shipping charges; computer rentals and programming. Automobile mileage associated with a project will be charged at 17 cents per mile plus 15%. In-house copying will be charged at 10 cents per page plus 15%.

EQUIPMENT RENTAL

Field survey instruments, special equipment and Arctic clothing which are the property of Woodward-Clyde Consultants will be charged to the project at daily, weekly or monthly competitive rates. A list of rates will be supplied upon request.

PAYMENT

Invoices will be submitted monthly and will include the charges incurred during the preceding month. Payment of these invoices is due within thirty (30) days from the invoice date. A one percent (1%) discount may be taken if invoices are paid within ten (10) days after receipt. A charge of one and one-half percent (1½%) per month is made for invoices paid more than 30 days after the invoice date.

Charges are subject to an estimated average 10% increase in 1980.

1/1/79

INVENTORY OF POWER PLANT SITES /AUDIO-VISUAL

CONTRACTOR: SLIDE IMAGES

ADVERTISED: 4/2/79

CLOSED: 1/80

Inventory of Power Plant Sites/ Audio-Visual:

This audio-visual is used in a program of public information aimed at generating public understanding and involvement in the 1979-80 Inventory of Power Plant Study Areas Information Meetings.

INVENTORY OF POWER PLANT STUDY AREAS 6/25/79

EXPANDED GENERAL TREATMENT (ROUGH) FOR SOUND/SLIDE PROGRAM

CONTENT:

I. PURPOSE AND GENERAL GOAL

"No one doubts our need for power."

Power uses: industry, heat, recreation, home conveniences, business, etc.
Power facts: current useage, projected useage, limited resources, etc.

"Everyone wants to protect human health, environment, resources."

Impact of power on health, welfare, enviroment, land use, energy resources, etc.

"Everyone wants the economic costs to be as low as possible."

Begin the balancing/trade-off considerations. The costs of cleaning the matter added to the air, cooling the water, reducing size of plants, protecting certain areas, transporting fuels vs electricity via transmission lines, etc.

"Everyone's goal is to reduce these costs -- human, environmental, financial -- as far as possible while still meeting the needs as defined by the people of Minnesota."

Balancing of interests: reduce consumption vs increase output, industry/agriculture, financial burden/air & water quality/plant size/wilderness areas/distance from users/etc.

"Let's work together to find out how best to achieve these goals."

Give enough information so people can form intelligent opinions, make meaningful judgements, participate most effectively in the decision-making process.

The information flow works both ways: your elected representatives and agencies research & disseminate the results; the electorate makes its needs and priorities known. It is beyond the ability and willingness to change; it is the ability and willingness and necessity to use all public inputs in all phases of the power process.

II. PROCESS FOR PUBLIC INVOLVEMENT

Since change and the rationale/need for public involvement at all levels and phases was covered as a basic Goal in the preceeding section of this outline, all that need be covered here is the actual vehicles through which the public can make its wishes/priorities known:

Environmental Quality Board members: 7 agencies, Governor's representative, 4 citizens; State Planning Agency director as chairperson.

Citizens Advisory Committee (Power Plant Siting): its makeup, when & where it has met, when & where it will meet.

Discussion Meetings: when and where met and will meet, who may participate (everyone); valuable results so far and more expected.

Draft Inventory: now available, can be changed, need public input now.

Further Discussion Meetings: currently in process.

Final Draft of Inventory: incorporating information/opinions obtained from all of the above.

Formal Hearings: with an independent hearing examiner who submits the findings of the public hearings to the EQB.

State Agency Input: throughout the entire process; including those concerned with power plants (agencies on the EQB -- Agriculture, Energy, Health, Natural Resources, Pollution Control, Planning and Transportation -- plus any others as the situation warrents)

Changes still possible after complete process has been finished.

Public input will be necessary for specific site selection process also.

III. MAJOR CONCERNS IDENTIFIED BY PUBLIC from previous inputs

"Nuclear plant?!" No need for nuclear plants in MN projected over the next 15 years.

"We don't want the power plant in our area." Few do, but if everyone said that and got their way, no one would have power in their area either.

"Why do we need more power plants at all?" Good question. Please take that up with the Minnesota Energy Agency; we are dealing with the location of power plants when and if they become necessary, not the need for them.

"What is being done to make sure our air and water doesn't get too polluted?" State and federal standards must be followed. This is a complex question which we are all trying to answer in the best possible way. The problem(s) will be carefully considered during each of the areas we're going to cover now:

Types and Sizes

Exclusion and Avoidance Areas

Water Supply and Quality

Air Quality

Agricultural Land

Coal Transportation; Railroads

Transmission Needs

Economic Considerations

IV. ISSUES, CRITERIA AND POLICIES

A. Types and Sizes of Power Plants

Alternative Energy Sources: Advisory Committee or EQB member interview expressing on-going research, why others sources are not yet ready.

Explain briefly the size relationships, interest of the public in "smaller" size plants, economic considerations, desire to get more input.

B. Exclusion and Avoidance Areas

Brief outline/listing of areas

C. Water Supply and Quality

Water Pollution Problem: Advisory Committee or EQB member interview expressing protections and trade-offs.

Explain briefly the various waters available for use and their advantages/disadvantages. Touch upon the reason water is needed for power generation, and the possibilities for lessening this need through other technologies.

D. Air Quality

Advisory Committee or EQB citizen member interview expressing protections and trade-offs.

Health protection vis-a-vis its costs explained. The fact that other sources of air pollution than the plant's stacks must be considered: from trains hauling the coal, from industry producing/purchasing heat from elsewhere if plant is built away from industry thus removing the possibilities for co-generation or use of industry waste as fuel, etc.

E. Agricultural Land

Advisory Committee or EQB citizen member interview expressing relationship between obvious needs for good land for crops and power.

Land rating system, balance between ag, forest and mining land. Balance between ag land considerations and all others; reinforcement of trade-off basic idea.

IV. Issues, Criteria and Policies (Cont.)

F. Coal Transportation; Railroads

Size of power plant/unit train/cost relationships. Site relationship with all of the above.

Consideration of the basic question is analogous to all the cost/benefit ratios being considered and weighed: "Which do you think is the least burdensome; increased coal traffic or more power lines? Do we ship the fuel or the power?"

This question then leads into the next major area of concern...

G. Transmission Needs

Smaller plants on existing power line routes, near users if possible minimize impact.

Problems of safety, farming disturbance, right of way, aesthetic considerations, costs of putting lines underground, etc.

Advisory Committee or EQB citizen member interview expressing the many interests involved in the issue and everyone's desire to seek the answer which involves the least disruption and minimal human burden.

H. Economic Considerations

Higher costs stimulate conservation which then minimizes each of the problems above.

All costs are borne by the power consumer anyway.

Factors, other than above, being applied or researched in attempts to reduce costs.

Review each of the Issues (A - G) in relation to financial cost factors.

V. SUMMARY

Cost considerations lead into human and environmental costs, the desire to minimize them, the need for any and all citizen input.

If possible end with appropriate quote from Advisory Committee or EQB citizen member.

PERMIT COMPLIANCE PROGRAM
TRANSMISSION LINE ROUTES /AUDIO-VISUAL

CONTRACTOR: MEDIA LOFT

ADVERTISED: 4/2/79

CLOSE: 6/30/80

Permit Compliance Program - Transmission Line Routes/Audio-Visual:

This audio-visual presents and describes the events that take place from the time a transmission line route is designated until the line is completed and operational. It is designed to give the general public a basic understanding of the permit compliance program.

MINNESOTA STATE PLANNING AGENCY
REQUEST FOR PROPOSAL
Audio/Visual Production Bid Specification Data

COST

1. Subject Matter: Post Designation Program for High Voltage Transmission Lines (Title) _____

2. Medium: 16mm Film (35mm Slides) Filmstrip Video Tape
Other: _____ _____

3. (Color) & (Black & White) _____

4. Run Time 20 minutes _____

5. (Single Tray) and (Multiple Tray) 2 tray versions with up to 3 different dissolve modes. _____

6. Date Needed (Production Schedule) June 30, 1979 _____

7. Background Research or Material: staff resources, meetings, research and technical papers, location interviews, and original work _____

8. Conferences: for treatment and subsequent revisions scripting drafts, story boards and graphics photo selection, talk through of audio and visuals combined and final presentation. _____

9. Scripting Treatment & Development: up to 2 outlines _____
   a. Number of Drafts: up to 3 draft scripts
   b. Creative Time: _____
   (estimate days)

10. Editing: for all story boards and graphics, treatments, scripts, photos and audio portions as required _____

11. Photography: provided by contractor _____
   a. number: up to 220 frames
   b. type: reproduction & on site locations
   c. locations: (3 Loc) 7 Co. Metro (4 Loc) N. MN. (4 Loc) S. MN. up to 4 regional loc. out of state
   d. multiples: up to 20 builds and multiple frames
   e. other: up to 24 builds, up to 60 superimpositions with type

12. Reproduction: (2) double tray versions, plus (1) single tray version _____

13. Lab and Color Corrections: as needed for product quality and consistency _____

14. Numbering and Delivery: all slides numbered and inserted into counsel trays and packaged for shipping _____

20 additional ·ord slides

c) title & credits: up to 12

16. Story Boards: for all art work and pieces using type/to be done in full color including photos where used

17. Special Effects: registered slide sequencing up to (15) plus sound effects, live interviews and location sounds

18. Production costs: a) travel:
b) rentals:
c) recording time: music, narration, on site and other
d) audio editing: for music, interviews, narration, effects etc.
e) other:

19. Narration/Talent: professional quality as approved by agency

20. Music: up to eight needle drops or package coverage for all cleared music.

21. Impulse/Advance Frequency Rate: double tray units (with 3 dissolve modes) inaudible advance impulses; single tray unit with audible advance beep tone at 1 kc and one additional inaudible advance tape

22. Audio Mixing: combine narration music on site recordings, sound effects and impulsing (up to 5 tracks)

23. Packaging and Distribution: units to be delivered as per item 14-SPA will undertake distribution

24. Reproduction and Copy Rights: all rights held by SPA

TOTAL ESTIMATE

COMMENTS:

Submitted by:

(Company Name)

(Address)

Name of Contact Person Area/Code/Phone

Authorized Signature:

(Name)

(Title)

PLEASE RETURN TO: R.A. Woodbury
200 Capitol Square Bldg.
St. Paul, Minn. 55101

INFORMATION CALL 612/296-2289

The Contractor will be required to produce a slide-tape presentation which presents and describes the events which take place from the time the Minnesota Environmental Quality Board (EQB) designates a route for a high voltage transmission line until the line is completed and operational. The product will be used to give the general public a basic level of understanding regarding the material covered. The presentation should highlight:

1. The nature and use of the construction permit issued by the EQB with particular emphasis on the major functional sections of that document;

2. The process by which right of way easement is acquired by a utility including a description of Minnesota's eminent domain and condemnation statutes and procedures;

3. A summary of the construction process used to erect the transmission line which outlines the major phases (e.g. right of way clearing, construction, cleanup) of the construction process in chronological order;

4. Discussion of how the line will be operated and maintained and how that operation will be monitored; and

5. A discussion of the EQB/Power Plant Siting staff post designation program and how that program relates to each of the preceeding items.

The presentation should begin with the Environmental Quality Board's decision and a brief explanation of what that decision triggers. The product should be designed as an introductory module fromwhich additional material could be developed in any one of the major areas addressed (e.g. construction, post designation).

PROJECT SCHEDULES

POWER PLANT SITING TECHNICAL WORK PROGRAM: PROJECT TIMETABLE, FISCAL YEARS 1980-81.