

PROPOSAL FOR
ENVIRONMENTAL RECONNAISSANCE
STUDY OF MEAGER MOUNTAIN
GEOTHERMAL AREA
(EDITED)

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PETROLEUM RESOURCES
DIVISION

Prepared for

B.C. Hydro and Power Authority

1978

by

Reid, Crowther and Partners Ltd.

in association with

VTN Consolidated Inc.

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PLEASE REFER TO FILE No.

April 27, 1978

Mr. J. Stauder
Project Engineer
Generation Planning Department
B.C. Hydro and Power Authority
16th Floor - 700 West Pender Street
Vancouver, B.C. V6C 2S5

Dear Mr. Stauder:

Re: Meager Mountain Geothermal Preliminary
Environmental Study

We are pleased to submit herewith four copies of our proposal for the above study, in association with VTN Consolidated Inc.

The proposal is divided into 4 sections; Introduction, Scope of Work, Project Organization and Fee Schedule. Appendices provide company and personnel background information, and a suggested contents for the report.

We believe that the program outlined and the expertise available will provide you with a sound and useful study commensurate with your needs.

Please do not hesitate to contact me (at Reid, Crowther) or either John R. Lane or Caroline Trindle (at VTN) regarding any questions you may have concerning this proposal.

Yours truly,

G.C. Seagel

GCS/pkl
Encls.

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SECTION 1
INTRODUCTION

SECTION 1

INTRODUCTION

1.1 GENERAL

This proposal has been prepared at the request of B.C. Hydro and Power Authority (B.C. Hydro), by Reid, Crowther and Partners Ltd. in association with VTN Consolidated Inc. of Irvine, California.

The proposal addresses the Meager Mountain area of British Columbia where B.C. Hydro is exploring geothermal energy potential associated with hot water sources; and, more specifically preliminary environmental issues associated with the area and geothermal exploration and development.

As this type of development is new to B.C. Hydro and the Canadian arena, VTN has been requested to participate because of their past experience in geothermal related environmental studies (see Appendix B). Reid, Crowther is involved because VTN has not previously worked in Canada, nor for B.C. Hydro. Hence, VTN will provide their past geothermal experience as a sub-consultant to Reid, Crowther who will be responsible for ensuring that work carried out by VTN reflects British Columbian and Canadian concerns, perspectives and regulatory requirements.

As a preliminary or reconnaissance study it is recognized that the involvement of and liason with B.C. Hydro personnel is important. Hence, the study team encourages participation, input and questions by and from B.C. Hydro at all times in the study.

1.2 REID, CROWTHER AND PARTNERS LIMITED

Reid, Crowther and Partners Limited is a Canadian-owned consulting engineering and planning group created in 1965 by the merging of

the two long established consulting firms of Haddin, Davis and Brown Company Limited and Crowther, MacKay and Associates Limited.

The company employs over 300 people, of whom 95 are professional engineers and scientists, comprising the six Divisions of Environmental Analysis, Pollution Control, Transportation, Planning Oil and Gas and Municipal and Building Services. Reid, Crowther has headquarters in Calgary and 10 regional offices in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, the Yukon and the Northwest Territories.

The company's Vancouver office has been in operation for many years. The office manager Mr. R. Butler oversees all operations, which now include the permanent presence and functions of the Environmental Analysis Division which is headed by Mr. G.C. Seagel. At present this division has concluded a coordination role for the detailed environmental studies of the McGregor Diversion Project for B.C. Hydro.

The Environmental Analysis Division of Reid, Crowther maintains professional personnel in two of its other nine offices. These staff members offer expertise in the fields of ecology, hydrology, terrain analysis, climatology, water quality assessment and resource planning. In addition to performing monitoring studies and impact analyses, Reid, Crowther has assisted clients by providing coordination services (reference the McGregor Diversion Project) and identifying the applicable regulatory requirements, and in preparing data for approval applications. This service enables the client to proceed with the orderly overall progress of a project. It is in this area that Reid, Crowther will be of particular value in the conduct of the proposed Environmental Reconnaissance Report. For a more detailed discussion of tasks and areas of responsibility, see Section 2, Scope of Work.

The Planning Division has completed studies encompassing total community development, subdivision and institutional planning, traffic and annexation analyses, and building site studies.

The Transportation Division performs studies and associated engineering services, including highways, railroads and automobile bridges, and automobile and pedestrian overpasses.

The scope of the Municipal and Building Services Divisions includes structural, mechanical and electrical engineering services for a variety of industrial, commercial, cultural and recreational facilities throughout Canada. Industrial projects in which Reid, Crowther has been involved include cement manufacturing plants, nuclear facilities, electric generating facilities, Defense Department training facilities, agricultural support facilities, and hot springs developments at Fairmont and Radium.

Reid Crowther offers comprehensive services to the oil and gas industry, including reservoir analysis, production forecasts and operations, property management, and plant design services. Within this area, the Oil and Gas Division has completed studies on a wide range of topics, including prospectus assistance, investment decisions, engineering economics, demand-supply forecasts, and plant and process feasibility. Engineering services have been performed for waterflood complexes, off-plot piping and electrical distribution, and associated office buildings.

1.3 VTN CONSOLIDATED, INC.

Organized in 1950, VTN Consolidated, Inc., provides comprehensive professional services in environmental sciences, planning and management to both industry and government.

VTN provides environmental services at the majority of its 16 domestic offices and three overseas offices located in Central and South America. Offices located in Irvine, California; Metairie,

Louisiana; Denver, Colorado; Orlando, Florida; Portland, Oregon; and Cambridge, Massachusetts, possess substantial environmental staff and on-ground knowledge to serve their respective regions. When warranted, regional offices form project teams of several VTN offices and consultants to meet the needs of the project or client.

VTN has expertise in numerous environmental sciences such as air, water, socioeconomics, planning, acoustics and biological resources. VTN is particularly strong in biological, engineering and socio-economic planning applications, with staff expertise in baseline, resource and impact analysis, planning and management, and terrestrial and aquatic studies throughout the United States. All of VTN's Irvine-based Environmental Sciences staff have advanced degrees or have performed graduate work in their disciplines.

With the diversity of governmental and industry clientele and projects successfully completed, VTN's Environmental Sciences staff has experience and expertise in library science, field studies, and report preparation and documentation techniques.

VTN's total staff numbers 500 personnel, holding approximately 200 registered professional licenses in their specialties. The staff has experience in the U.S. and abroad in projects at national, state or province, regional, metropolitan, city, community and activity center levels.

The firm offers professional services in 30 categories:

- Area, Community and Site Planning
- Municipal Engineering and Public Works Management
- Water Resources Management, and System Planning and Engineering
- Wastewater Management
- Flood Plain Management and Flood Control

Solid Waste Management, Resource and Energy Recovery Systems
(Pyrolysis)

Structural Engineering and Design

Ports, Harbors and Marine Facilities Planning and Engineering

Land Development Engineering

Energy Systems

Architecture

Landscape Architecture

Environmental Analysis and Management

Economics and Market Research

Airports, Airport Systems and Air Transportation

Transportation and Traffic Systems

Urban and Regional Analysis and Planning

Aerial Photography and Photogrammetric Engineering

Land Surveying and Mapping

Recreational Site and Facilities Planning and Design

Industrial and Agricultural Pollution Control

Industrial and Process Systems

Construction Management and Services

Management Systems and Engineering

Assessment Engineering

Health Systems Analysis, Planning and Programming

Civil and Environmental Engineering

Mining and Quarrying

Heating, Ventilating and Air Conditioning

Fuel Storage, Transfer and Processing Facilities

VTN provides fully integrated services on each project, under the full control of a Project Manager, and our work philosophy emphasizes a maximum return on resources and capital allocated, in keeping with the principles of economic efficiency and productivity. This, together with adherence to the highest levels of objectivity and professionalism in all of its activities, is held in continuous view by VTN top management and professional personnel.

The VTN Environmental Sciences Division has prepared environmental assessments and studies for a wide range of projects and programs. Areas have included geothermal development, power generating plants, transmission line, railroad and highway programs, surface and sub-surface mining operations, airport studies, new community developments, solid waste programs, and water resource and public utility projects. The firm has comprehensive experience in and complete capabilities for conducting environmental reconnaissance and feasibility studies, baseline data collection programs, environmental impact analyses and reports. From 1974 to the present, VTN Environmental Sciences has performed over 100 studies for the energy industry and allied support industries within the United States. More detailed information on previous VTN projects which are relevant to the proposed B.C. Hydro project is presented in Appendix B, Relevant Experience.

SECTION 2
PROPOSED SCOPE OF WORK

SECTION 2PROPOSED SCOPE OF WORK2.1 INTRODUCTION

Preliminary geotechnical investigations sponsored by B.C. Hydro on the Meager Mountain Geothermal Project have indicated a potentially significant commercial geothermal resource. Additional exploratory drilling and underground examination, however, will be necessary to fully delineate the magnitude and characteristics of the resource. This process will begin during the summer of 1978.

Should the results of the initial exploratory drilling program be favorable and continue to indicate an exploitable resource, an expanded program may then be justified. This expanded program of reservoir verification would consist of drilling additional exploratory geothermal wells and long-term flow testing. The verification program may ultimately indicate that full development of the Meager Mountain area is warranted.

Full development will include the drilling of additional production, injection and/or disposal wells, and construction of power generation units, pipelines, electrical transmission lines, and other required ancillary facilities.

Extensive geological, hydrological, engineering, and environmental data remain to be acquired, before an adequate assessment can be made of the technical and economic feasibility of developing the Meager Mountain geothermal resource.

In view of the above and for purposes of planning, scheduling and budgeting of future exploration and other activities by B.C. Hydro in the project area, it is advisable that an effort be directed toward determining whether there are any significant environmental constraints which would materially influence, delay and/or possibly prevent future geothermal developments of the nature contemplated in the project area.

Finally, if development planning is to proceed on a logical basis, it is advisable that B.C. Hydro consider at this time the nature of the ultimate development that might occur should the Meager Mountain area prove viable, and determine the nature of the related environmental programs that may have to be conducted to gain public acceptance of the project and assure successful completion of all required agency approval and permit application processes within a reasonable time.

To appropriately respond to the above issues, it is necessary that some preliminary definitions be developed for the following: (i) the drilling and testing processes and programs that might be employed; (ii) the quantitative and qualitative nature of the surface area necessary to accommodate the project development; (iii) the nature and source of effluents, emissions and residues that could be generated by such activities; (iv) the potential project-related impacts that could result from such development; (v) the identity of those environmental parameters most sensitive to development pressures; (vi) the governmental regulations, standards and guidelines in effect or under consideration which might apply to such developments, and (vii) the nature and extent of the environmental data base that must be compiled to fully support the associated permit applications, agency approvals and license application processes that may exist within the 1980-1985 time frame.

Considering the above issues, alternatives and potential requirements, the following initial study activity is proposed and referred to hereinafter as an "Environmental Reconnaissance Report."

2.2 OBJECTIVES AND SCOPE OF REPORT

2.2.1 Initial Study Phase

Four (4) major tasks are proposed in the initial study phase. These include:

- (1) Preparation of a conceptual description of the project that might ultimately be developed, including probable drilling methods and testing programs to be employed, support facilities required and other ancillary needs. Preparation of a preliminary conceptual development schedule for bringing the project to the production stage. Geotechnical and other information which is necessary in order to complete this task will be provided by B.C. Hydro. This information will be applied to basic geothermal development procedures which have been proposed and/or utilized in the United States. Preliminary information received from B.C. Hydro indicates that actions undertaken and/or proposed by Chevron Resources Company and San Diego Gas and Electric Company in the Imperial Valley, California, may be particularly applicable to the B.C. Hydro project. This work will be performed by VTN.
- (2) Identification of current and proposed federal, provincial and local regulations and standards which apply to the project as conceptualized.
This task will be performed by Reid Crowther and utilized by VTN in the preparation of other elements of the report. The experience of B.C. Hydro involvement in coal thermal developments will be pertinent in this area.
The environmental impact assessment requirements necessary to support applications to proceed with the exploration and project development would be outlined in consultation with appropriate B.C. Hydro personnel.

- (3) Compilation of existing land use planning and environmental data currently available from public sources on the project area, and preparation of a preliminary description of the existing environmental setting; identification of existing environmental constraints or other conditions which might materially influence the engineering or economic feasibility of the project; and evaluation of the existing planning and environmental data base in terms of its adequacy to satisfy project design requirements and support permit application data needs and other associated approval processes. Based on these data, an analysis will be prepared to define those areas and parameters where existing environmental data are considered insufficient. This will be performed by VTN with the B.C. perspective provided by Reid, Crowther and B.C. Hydro's Environmental Resources Department.
- (4) Preparation of a written report providing recommendations on nature, scope, and implementation schedule (priorities) for any additional action or required pre-operational baseline data collection programs which appear necessary or desirable to satisfy permit application or approval requirements or other project needs. The report will be compiled by VTN in the technical areas, with final reviews from Reid, Crowther and B.C. Hydro.

The Reconnaissance Report will provide basic data which will be of value to B.C. Hydro in any negotiations or coordinating efforts with federal, provincial and local agencies with influence over the project. Also, potential problem areas, if any, will be identified and future required environmental programs defined so that B.C. Hydro may provide appropriate consideration to these issues in the planning, scheduling and budgeting of succeeding phases of their overall program.

A description of these four proposed work elements follows.

2.2.2 Project Description

This first element will involve the preparation by VTN, in cooperation with B.C. Hydro, of a conceptual description of the development that might occur in the project area to provide a basis for proceeding with the other elements of the study. Elements to be defined should include:

a) Conceptual Development Program

- Definition of Project Area
- Exploration, Verification and Production Program Scheduling
- Location of Facilities

b) Geothermal Wells

- Exploratory and Confirmation Wells
- Well Configuration
- Drilling Procedures
- Casing Techniques
- Production Rate
- Well Life

c) Production and Injection Wells

- Production Process(es)
- Reinjection Process(es) (including injection and/or disposal)
- Process Requirements (MWe)
- Other

d) Resource Quantification and Reservoir Verification Program

- Rig Tests
- Completion Tests
- Long-Term Flow Tests

e) Pipeline System(s)

- Volume of Fluid to be Transported
- Chemical Characteristics of Fluid
- Fluid Transmission Problems

f) Fluid Disposal Method(s)

- Sump Configuration and Composition
- Blow-Down Disposal
- Fluid Reinjection

g) Power Plant Facilities

- Land Area Required
- Anticipated Electrical Generation (gross and net)
- Conceptual Design
- Maintenance Facilities
- Support Systems

h) Other Support Facilities

- Access and Service Roads
- Utility Systems
- Connecting Transportation Systems
- Other

i) Socioeconomic Factors

- Labour Force Requirements
- Housing
- Infrastructure (public services and facilities)
- Utility Systems

j) Sources and Characteristics of Emissions, Effluents and Waste Residues Generated by Project Activities

- Airborne Effluents
- Liquid Effluents
- Solid Wastes
- Human Wastes

k) Alternative Waste Disposal Techniques and Control Requirements

- Process Controls and Other Waste Management Techniques
- Other Disposal and/or Control Technology
- Reclamation and Abandonment

2.2.3 Regulatory Requirements

The second element of the study will include the following:

- 1) Compilation of applicable regulations and standards (federal, provincial and local) and preparation of a summary of pertinent items as they relate to the proposed well sites, power plants and ancillary facilities of the nature contemplated. New or modified environmental regulations or requirements that might emerge in the project time frame would be identified.
- 2) Determination of the probability of whether an Environmental Impact Statement(s) (EIS) would be required for any or all

elements of the project and, if so, the lead agency involved and probable time frame(s) for completion and processing. This will be performed jointly by Reid, Crowther and VTN.

2.2.4 Environmental Considerations

The VTN project team, assisted by staff from Reid Crowther, will conduct this element of the environmental study by assembling relevant environmental literature related to the region from federal, provincial and local agencies and university libraries. This information will be identified and assembled by Reid Crowther for utilization by the VTN project team. The selected staff members will represent the disciplines covering geotechnical sciences, meteorology and air resources, water resources, water quality, biological resources and socioeconomics. Appropriate representatives from Reid Crowther, and possibly VTN, will interview, as necessary, the respective federal, provincial and local agencies, other interested groups, and will visit the project site. This project team will also be responsible for compiling and writing the Environmental Reconnaissance Report.

Specific tasks to be included within this element include the following:

- 1) Bibliography of available environmental data and information.
- 2) Description of those areas and parameters where existing environmental data (or current data collection programs) are considered insufficient to satisfy future project design requirements, permit application needs, or other applicable regulatory standards, such as resource evaluation for benefit-cost guidelines and precedents.

- 3) Definition of any potential problem areas and their significance to the project (i.e., forestry considerations, salmon fisheries, recreation, extreme climatological factors, public opposition, rare or endangered species, etc.).
- 4) Analysis of political ramifications and public opinions, including the concerns of interested governmental bodies toward this project and previous actions taken by these agencies on similar projects, if any. Also, an assessment will be prepared regarding local community attitudes toward geothermal development activities in the area of interest, and the capacity of infrastructure within these communities to support a development of this nature.
- 5) Action recommended to resolve identified problems, including time requirements and alternative approaches which are considered feasible.
- 6) Preliminary description of additional required and/or recommended action programs, including public relations/information programs, environmental baseline data collection measurements and/or monitoring programs, which are necessary to satisfy permit application requirements and/or alleviate other identified environmental concerns.

2.2.5 Documentation of Findings, Conclusions and Recommendations

A Draft Environmental Reconnaissance Report will be produced within this final element. This report will assemble, evaluate and document the results and recommendations generated by the preceding activities. A sample report format and schedule for conducting the Reconnaissance Report is presented in Appendix C.

2.2.6 Client Liaison

It is recognized that the Meager Mountain Geothermal Project represents a new area of enquiry for B.C. Hydro. Hence, the project team will maintain liaison with the B.C. Hydro Project Engineer and Environmental Resources Department; through the project team manager (Reid, Crowther); and as VTN personnel are available in Vancouver. This is an important aspect of Reid, Crowther's work and has been budgeted accordingly. This liaison will include time to review the report with the B.C. Hydro Project Engineer and Environmental Resources Department personnel.

2.2.7 Work Schedule

The timing and schedule of events within the study is shown in Figure 1.

It has been assumed that work would commence May 1, 1978; and require three months to completion of a first "Draft" report. These dates and times recognize commitments of the project team personnel to other jobs and responsibilities. Any delay of the start of work should be reviewed prior to a full commitment to the work in order to safeguard work quality, and time availability.

2.3 SUMMARY

Completion of the Environmental Reconnaissance Report will provide B.C. Hydro with a documented outline of the environmental factors relevant to the potential development, including the following:

- i) An identification of any areas of environmental concern which, if not resolved or mitigated, might influence the planning, or possibly preclude implementation, of the project.

- ii) An identification of the agencies (federal, provincial and regional) that may be involved in the project approval process.
- iii) An outline of other existing regulations and standards which may be applicable to the proposed project.
- iv) The identification of other proposed or impending regulations which, if enacted, might materially affect the proposed development.
- v) A preliminary description of those elements where the existing data base is not considered to be sufficient to satisfy the approval processes, or support design activities. Definition will be provided of those other recommended investigations or study activities that may be desirable to enhance public acceptance of the project and/or minimize future legal risks.
- vi) An outline of the scope of the additional required and/or recommended investigations, studies or analyses identified above.

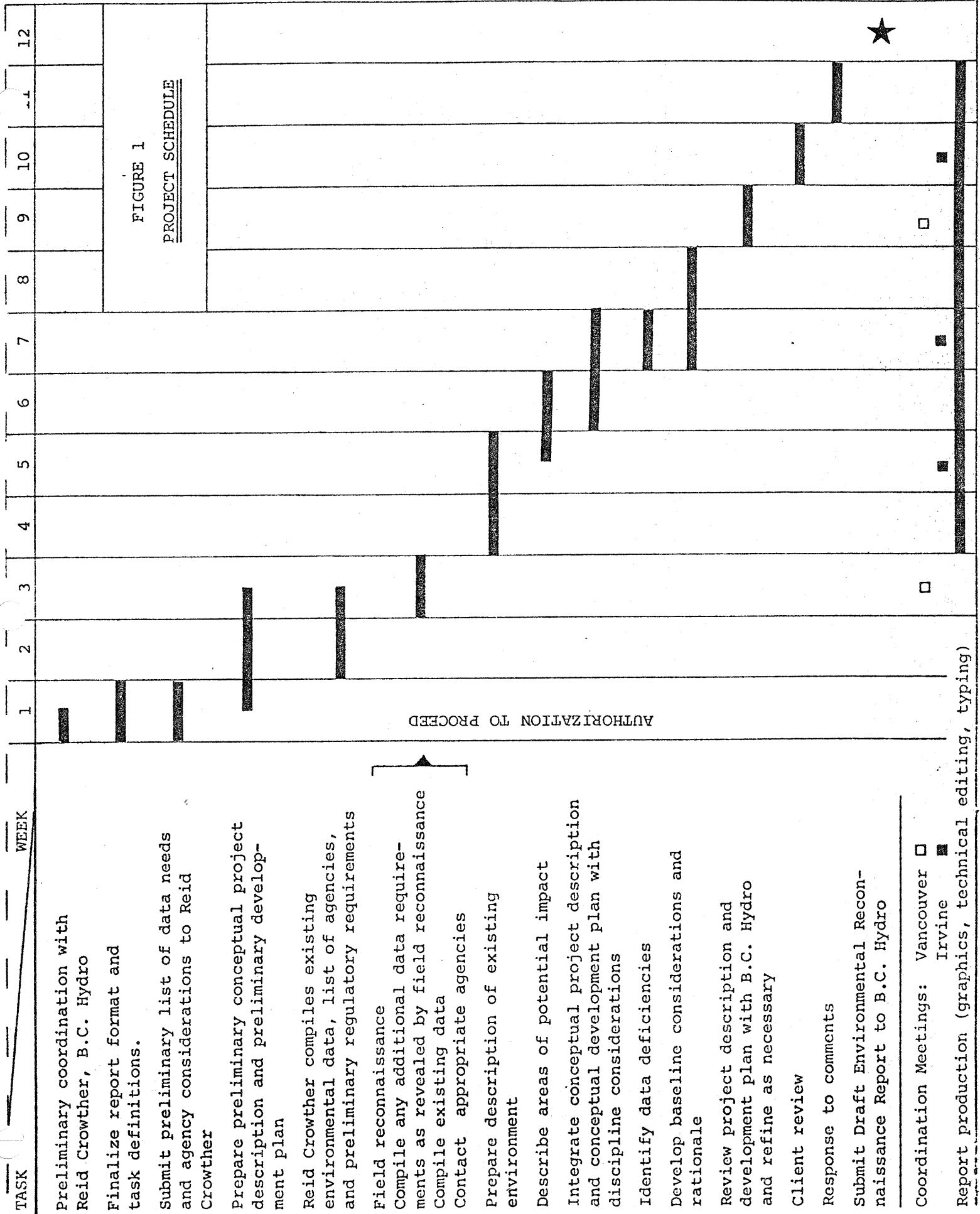


FIGURE 1
PROJECT SCHEDULE

AUTHORIZATION TO PROCEED

- Preliminary coordination with Reid Crowther, B.C. Hydro
- Finalize report format and task definitions.
- Submit preliminary list of data needs and agency considerations to Reid Crowther
- Prepare preliminary conceptual project description and preliminary development plan
- Reid Crowther compiles existing environmental data, list of agencies, and preliminary regulatory requirements
- Field reconnaissance
- Compile any additional data requirements as revealed by field reconnaissance
- Compile existing data
- Contact appropriate agencies
- Prepare description of existing environment
- Describe areas of potential impact
- Integrate conceptual project description and conceptual development plan with discipline considerations
- Identify data deficiencies
- Develop baseline considerations and rationale
- Review project description and development plan with B.C. Hydro and refine as necessary
- Client review
- Response to comments
- Submit Draft Environmental Reconnaissance Report to B.C. Hydro

Coordination Meetings: Vancouver ☐ Irvine ☒

Report production (graphics, technical editing, typing)

SECTION 3
PROJECT MANAGEMENT
AND ORGANIZATION

SECTION 3PROJECT MANAGEMENT AND ORGANIZATION3.1 INTRODUCTION

For purposes of the proposed B.C. Hydro geothermal development project, VTN Consolidated, Inc., will act as subcontractor to Reid, Crowther and Partners Limited. In this capacity, overall financial control and project management responsibilities will be retained by Reid Crowther. The responsibility for performing the environmental investigation and lending geothermal-related expertise will rest with VTN. B.C. Hydro will maintain overall project control.

In order to ensure continuity and to enable the project to proceed in the timely and cost effective manner outlined, there will be a continual three-way interaction between VTN, Reid Crowther and B.C. Hydro. The basis for this open dialogue was successfully established during pre-proposal meetings and has continued throughout the preparation of this proposal. It is the mutual belief of the two parties that the organization described herein will enable each firm to maximize its productive contribution to the proposed project. In essence, B.C. Hydro will be contributing its expertise on the project; Reid Crowther will contribute its expertise regarding knowledge of Canadian environmental concerns, available environmental data, and public agency concerns and approval prerequisites. VTN's role will be to exercise its expertise in the environmental considerations relevant to geothermal exploration and development processes, and in overall facilities siting and project design.

A more detailed explanation of VTN's and Reid Crowther's internal management philosophies is presented in Appendices A and B respectively.

3.2 PROJECT ORGANISATION

The organization and the personnel designated to the respective tasks are shown in Figures 2 and 3.

It should be noted that VTN is providing the bulk of the technical input to the study; commensurate with their past experience in the area of geothermal projects. Reid, Crowther on the other hand are to provide a Canadian perspective and to ensure that B.C. Hydro personnel achieve the maximum benefit from the experience of VTN.

It is believed that no other Canadian organization has experience related to the planning of a geothermal project. Hence, this proposal will permit B.C. Hydro and Reid, Crowther to benefit from the experience of VTN.

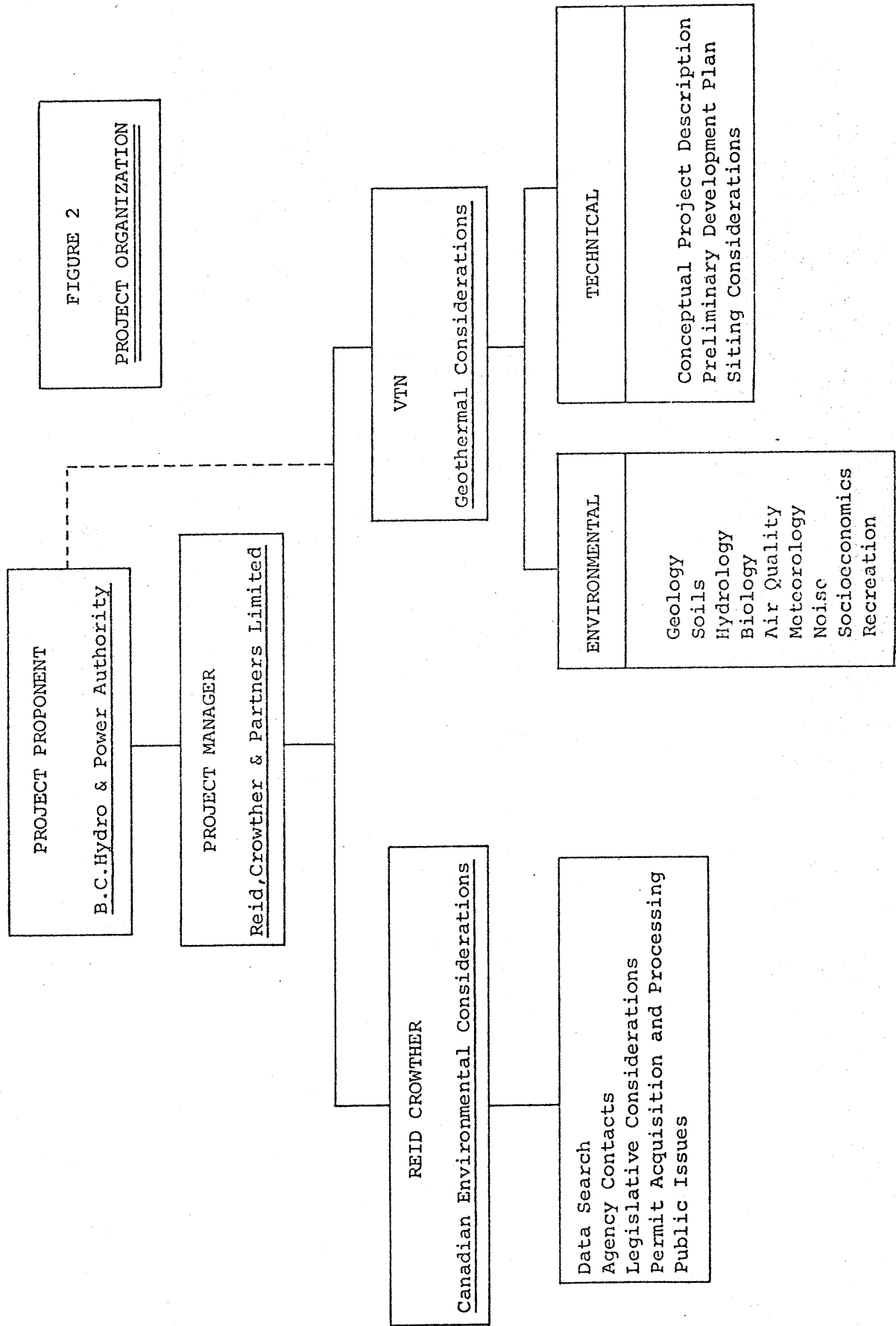


FIGURE 2
PROJECT ORGANIZATION

