SUSITNA HYDROELECTRIC PROJECT

PLAN OF STUDY

PART C: VOL I
SUPPLEMENTAL INFORMATION

SEPTEM

ACRES

ACRES AMERICAN INCORPORATED

In Association with:

COOK INLET REGION INC./ HOLMES & NARVER INC.
R&M CONSULTANTS INC.
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DCNO 3336

ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

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PART C - VOLUME I - SUPPLEMENTAL INFORMATION

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SECTION C1: PLAN FOR FINANCING THE SUSITNA PROJECT

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I. INTRODUCTION

This memorandum is submitted in response to a request from Acres American Incorporated ("Acres"). We understand that Acres and two other engineering firms have been selected to make presentations to the Alaska Power Authority ("APA") regarding the proposed Susitna Hydroelectric Project. We further understand that Mr. Eric Yould, General Manager of APA, specifically requested that Acres include in their presentation some views regarding certain issues which may affect the financing of the Susitna Project. Salomon Brothers has been asked by Acres to prepare a discussion of such issues for inclusion in their presentation.

Before addressing these questions, we would like to express thanks to Acres for giving us this opportunity to offer our analysis of the financing considerations for the Susitna Project and our sincere hope that the Board of Directors and Staff of APA find this information helpful in developing the plan of financing for this Project.

Familiarity with the Susitna Project

We have been involved and have kept abreast of the Susitna Project since 1976. Our first involvement came at the request of former Commerce Commissioner Langhorne A. Motley in the Fall of 1976.

At that time, we met with the U.S. Army Corps of Engineers in Anchorage for a briefing on the Project, and reviewed the feasibility report prepared by the Corps. Later that month, we met with U.S. Senator Mike Gravel, Commissioner Motley, Mr. Eric Wohlforth of Wohlforth & Flint, and Corps representatives in Washington, D.C. to discuss the Project and the financing alternatives. That meeting resulted in several proposed amendments to the federal Alaska Hydroelectric Power Development Act, based on suggestions made by Mr. Wohlforth and ourselves. Subsequently, we held telephone conversations with Mr. Wohlforth to discuss the amendments as he had drafted them.

Early in December 1976, Salomon Brothers prepared a memorandum to APA on the Project, which has been attached as Exhibit 1 for your reference. It outlines certain problems involved in financing the Project, based on some type of federal involvement.

Scope of the Report

This memorandum addresses the key issues that APA will face if it undertakes the Susitna Project on an independent basis. In that case, it is likely that the funds borrowed to finance the Project would ultimately be repaid from revenues generated by it, an approach known as a project financing.

Whether APA securities issued to finance this Project will be tax-exempt will have a significant influence on the planning for it. For this reason, we have addressed in Section II the factors determining tax-exemption: namely, Section 103 of the Internal Revenue Code and the taxability if the bonds are industrial development bonds. Section III discusses the elements of a successful project financing, and notes that many considerations will be relevant whether the Project is done on a taxable or tax-exempt basis. After the financing plan has been developed and security agreements are in place, APA securities can be issued. Section IV offers a brief overview of the general types of securities that may be used to enter the financial markets. As an appendix, we have included a discussion of Salomon Brothers and our experience in public power area.

It should be noted that this memorandum has not proposed alternatives dependent on either state or federal governments involvement. Such possibilities have received considerable attention in the past, and involve complicated political issues, but as yet no commitments beyond the study stage have been made. Naturally, if state or federal government support is forthcoming, certain avenues not discussed will be possible. In our role as financial consultants for the Acres report, however, we have focused on the present situation and addressed the issues facing APA if it undertakes the Susitna project on an independent basis.

II. TAX-EXEMPT FINANCING FOR THE SUSITNA PROJECT

A fundamental question is whether or not the interest paid on bonds issued to finance the Project would be tax-exempt income to the holders of the bonds. This point will affect the overall cost of the Project power and the type of financing plan which is developed. Hence, at the outset of this memorandum an examination of the factors determining the tax-exemption question would be helpful.

A. INTERNAL REVENUE CODE - SECTION 103

Section 103 of the Internal Revenue Code exempts from federal income tax interest on obligations issued by states and their political subdivisions, including state public authorities. The exemption does not apply, however, to interest on "industrial development bonds" unless the bonds are used to provide one of the types of exempt facilities. Such include port facilities, sports facilities, pollution control facilities airports and facilities for the local furnishing of electrical power, but not public power projects with a broad service area.

APA bonds issued to finance the Susitna Project would be industrial development bonds, and therefore taxable, if (i) more than 25 percent of their proceeds are used in a trade or business carried on by a "nonexempt person" (the "trade or business test"), and (ii) the payment of more than 25 percent of the principal or interest on the

bonds is secured by property used in a trade or business, or payments in respect of such property (the "security interest test"). Both the trade or business test and the security interest test must be satisfied in order for obligations to be industrial development bonds. An exempt person is a state or local governmental unit or an organization exempt from tax under sections 501(a) and 501(c)(3) of the Internal Revenue Code (relating to nonprofit, charitable organizations). Non-public, profitmaking enterprises, as well as the federal government and its agencies and instrumentalities, are thus nonexempt persons.

Since public power projects with broad service areas are not exempt facilities, the foregoing provisions of section 103 would permit the issuance of tax-exempt bonds to finance the Susitna Project, only if the Susitna bonds are not industrial development bonds.

Section B, which follows below, describes the special rules for the trade or business test and security interest test in more detail, and suggests several strategies that may prevent Susitna bonds from being classified as industrial development bonds. Section C discusses how other sources of security may be used to prevent the security interest test from being satisfied if this cannot be accomplished where Susitna Project revenues are used as security for the bonds. Section D describes the tax exemption for interest on industrial development bonds used to provide "facilities for the local furnishing of electric energy".

B. USE OF SUSITNA PROJECT REVENUES AS SECURITY

1. Special Rules for Trade or Business and Security Interest Tests

Treasury regulations under section 103 provide special rules for applying the trade or business test and security interest test to bonds issued to finance an electric generating facility owned and operated by an exempt person (such as a state, municipality or public power authority). These rules take the approach that the benefits of ownership of such a facility, and the burden of paying debt service on bonds used to finance it, will be transferred to nonexempt persons under power purchase contracts meeting certain conditions, with the result that such bonds would be industrial development bonds and, therefore, taxable. The trade or business test is satisfied with respect to bonds issued to finance a power project if either (i) one nonexempt person contracts to take, or to take or pay for, more than 25 percent of the output of the project over the period beginning on the date that output is first taken by a nonexempt person and ending on the last maturity date of the bonds ("project output"), or (ii) two or more nonexempt persons, each paying annually a guaranteed minimum payment exceeding 3 percent of the average annual debt service on the bonds, contract in the aggregate to take, or to take or pay for, more than 25 percent of the project output.

The security interest test is satisfied if all of the payments to be made with respect to the contract or contracts taken into account in applying the trade or business test exceed 25 percent of the total debt service on the bonds.

2. Special Rules Applied to Susitna Project

The special rules described above may be applied in steps to the Susitna Project to determine whether the Susitna bonds may be industrial development bonds:

a. Classify the anticipated purchasers of power from the Susitna project into exempt and nonexempt persons. For example, municipalities such as Anchorage and Fairbanks will be exempt persons, whereas private electrical co-ops will be nonexempt.

b. Determine whether any one nonexempt person will contract to take, or take or pay for, more than 25 percent of the project output of the Susitna project. If there is such a person, then the trade or business test is met.

c. If there is no such person, identify the nonexempt persons who will each pay annual guaranteed minimum payments exceeding 3 percent of the average debt service on the Susitna bonds. The trade or business test is satisfied if the aggregate amount of power which these persons contract to take, or take or pay for, exceeds 25 percent of the project output of the Susitna project.

d. If the trade or business test is met, total the payments that will be both pledged or used to pay debt service on the Susitna bonds and made pursuant to the contracts referred to in either paragraph 2 or 3 above. The security interest test is met if this aggregate amount exceeds 25 percent of the total debt service on the Susitna bonds.

3. Possible Alternatives Under the IRS Code

If it appears that the Susitna bonds may be industrial development bonds because of the commitments by nonexempt persons to purchase power, consideration may be given to altering the makeup of the group of purchasers to avoid the trade or business test or security interest test.

a. Trade or Business Test

One approach could be implemented by channeling power from existing plants to nonexempt users and using a correspondingly greater portion of the power from the Susitna Project to supply municipalities and other exempt persons. Alternatively, consideration should be given to using existing power authorities, or newly formed authorities, qualifying as exempt persons, to buy power from the Susitna project and supply nonexempt persons. Any such authority would have to be more than a conduit (i.e., it would have to enter into contracts to purchase power from

the Susitna Project that were not matched term for term by contracts with its customers) in order for it (and not the customers) to be treated as the purchaser of power from the Susitna project.

b. Security Interest Test

Another approach could be used if the Susitna bonds are industrial development bonds because of the number of nonexempt persons that both are committed to make annual guaranteed payments exceeding 3 percent of average annual debt service and purchase power on behalf of others (through a cooperative arrangement or otherwise). In this situation, it may be possible to avoid the 3 percent test (and thereby reduce the number of nonexempt persons whose purchases of power would be counted toward the 25 percent limits) by bypassing the intermediary and selling directly to the ultimate customer. The intermediate purchaser could still be used to service accounts and transmit power for a fee, but it would not be obligated to purchase power from the Susitna Project.

C. ALTERNATIVE SOURCES OF SECURITY

On the other hand, if the use of Susitna Project revenues to secure the Susitna bonds would cause the bonds to be industrial development bonds, consideration should be given to the availability for this purpose of alternative funds that are independent

of the Susitna project and not otherwise derived from a trade or business carried on by a nonexempt person, such as general revenues of the State of Alaska or an allocation of funds from the Alaska Permanent Fund.

It would not be necessary to substitute different security for all of the Susitna Project revenues, but only for an amount sufficient to avoid the security interest test.

It should be noted that the existence of a full faith and credit guarantee of payment of the Susitna bonds by the State of Alaska would not avoid the security interest test if the bonds were still secured by, or were expected to be repaid with, Susitna Project revenues meeting the requirements of the security interest test.

D. LOCAL FURNISHING EXEMPTION

If the Susitna bonds are industrial development bonds, then they will be taxable unless the bonds are used to provide an exempt facility. The only exemption that could possibly apply to the Susitna Project is that for "facilities for the local furnishing of electric energy". While it is unlikely that this exemption will apply, it is considered here for the sake of completeness.

Facilities entitled to the exemption are those used to produce, collect, generate, store, distribute, or convey electric energy that are part of a system providing service to the general populace of one or more communities or municipalities in not more than two contiguous counties (or a policital equivalent) or a city and one contiguous county. For this purpose, a city that is not within, or does not consist of, one or more counties (or a political equivalent) is treated as a county (or a political equivalent). An otherwise qualifying facility is not disqualified because it is connected to a system for interconnection with other public utility systems for the emergency transfer of electric energy. The facilities need not be located in the area served by them.

In addition to the foregoing tests, facilities for the local furnishing of electric power must be available for use by the general public. This test is met if the owner or operator of a facility is obligated by law to furnish electric energy to all persons who desire it and are within the service area of such owner or operator, and it is reasonably expected that such facility will serve or be available to a large segment of the general public in such service area.

This discussion has addressed the regulations that will determine whether or not Susitna bonds would qualify for tax exemption. Considerably more attention will have to be focused on these rules, and various alternatives explored, so that the financing plan ultimately developed will be the best possible for APA.

III. ELEMENTS OF A SUCCESSFUL PROJECT FINANCING

Assuming that the federal or state governments do not offer unlimited funding or guaranties for the project, it is likely that the funds for the it will be raised by a project financing. This means that the funds borrowed to finance the construction of the Project will ultimately be repaid from revenues generated by it.

Naturally, it would be desirable if the tax-exemption questions raised in the preceding section are resolved in APA's favor; but, whether done on a taxable or tax-exempt basis the basic elements of a successful project financing are essentially the same. Hence, the concepts developed in this section will be relevant regardless of the outcome of the tax-exemption questions.

The most important characteristic of any project financing is its economic viability. Prospective lenders will support a project of this magnitude only after they are convinced that it will become self-supporting from an economic standpoint. (Our present understanding is that the Project will produce a total of 1,601 MW from two sites, with an estimated cost of $2.5 billion.) Thus, a thorough assessment of projected power supply and demand within the potential service area is needed to support the economic viability of the Project.

A. DETERMINING THE MARKET

APA must obtain informed judgments on two critical matters: that a market will exist for the power which the Susitna Project has the potential to produce, and that the Project offers the best means, from an overall cost standpoint, to meet that future market. APA must define this market and specify the conditions under which it can reasonably expect to maintain the projected customer load. Additionally, APA should establish the extent to which the market will result from displacement, growth, or a combination of the two. Furthermore, it should be determined whether such growth or displacement will come from new or existing customers and when these various elements of market demand will materialize. It should be noted that the ability to forecast energy demand is important not only in determining the aggregate construction and financing requirements but also in demonstrating the quantitative ability to interpret market requirements accurately.

Identifying the market should also involve an assessment of the costs and benefits to each potential project participant. A directed effort then can be made to evaluate each of those parties, their priorities and creditworthiness in order to combine effectively into one project approach the interests of those most vitally concerned.

B. PROJECT RISKS

In addition to the satisfactory evaluation of the market for the power and the type of project to serve that market, there are certain risks inherent in any project financing, which must be defined, isolated and overcome before the financing can be assured. The basic project financing risks which must be addressed include:

1. Cost Overruns Prior to Completion.

With most extended construction periods, there is a reasonable probability that cost overruns will result from delays, changes in Project design, and inflation. APA must be able to price its power sufficiently to cover cost overruns, including the cost of additional capital, while still remaining competitive with other energy sources.

2. Late Completion and Non-Completion.

Delays due to technological or other reasons, in addition to causing cost overruns, may affect the timely completion of the Project. Under extreme circumstances, a project may be abandoned prior to completion or so substantially altered as not to meet anticipated output. Investors looking to the future revenue streams will demand assurance that such revenue streams materalize.

3. Partial or Total Post-Completion Outages

Once the Project is complete, there exists the risk that the Project's operation will be suspended for a period of time, either partially or totally, and therefore not generate revenues sufficient to service outstanding debt. Although this risk is remote, consideration must be given to its possible occurrence. Since the Project will consist of generation, transmission and inter-tie facilities, some part of the Project may suffer an outage which would compromise the entire operation.

4. Customer Failure to Provide Anticipated Cash Flows.

The Project customers may provide less than anticipated cash flows notwithstanding timely completion and full operability of the Project. This can result from demand shortages, competitive power supply pressures or regulatory factors. To provide comfort to investors with regard to this risk, APA must be able to demonstrate its ability to service Project debt while operating at less than anticipated levels or by selling power at lower than anticipated prices.

5. Regulatory Risk.

Regulatory risks generally exist both before and after the Project is completed. Fundamentally, any action which may be taken by a governmental or quasi-governmental agency which may adversely affect the Project's revenues or its ability to effect power interchanges with other bodies constitutes a regulatory risk. To the extent possible, the ability of any regulatory body to affect these two areas should be determined beforehand and coordinated with the development of the Project financing plan.

6. Technological Risk.

Traditionally, lenders to project financings have been reluctant to extend credit to projects which embrace unproven technology. Because of the many financial and operating risks associated with projects, the addition of a technology risk with its attendant uncertainties may prove unacceptable. To the extent that the construction techniques or generation, transmission, or distribution facilities consist of new or unproven technology, the Project will be more difficult to finance.

The above risks have been confronted and overcome in all successful projects in a variety of ways.

C. IDENTIFYING THE PARTIES-IN-INTEREST

On a preliminary basis, APA and its investment bankers must identify the entities which are potential candidates to share some of the risks, either directly or indirectly, associated with the development of the Susitna Project. In some cases, one or more of these various parties-in-interest would be direct participants in the Project, while in others they would provide direct or indirect credit support through guaranties or other contractual undertakings. These parties might include municipal electric systems, rural electric cooperatives, investor-owned utilities, and the state and federal governments.

Having identified the parties-in-interest, APA and its investment bankers would develop a financing structure which would address the basic requirement for investors in a project financing: creditor protection.

D. CREDITOR PROTECTION: REVENUE ASSURANCE

The basic credit risk against which investors attempt to protect themselves is the risk of default. The risk of default lies in the borrower's inability to meet interest and principal payments on his debt obligations in a timely fashion. Adequate revenue assurance protects the investor against this risk.

For large energy projects, the necessary revenue assurance may be derived from a demonstration of demand for the project output and adequate customer and regulatory support of the price for the power.

1. Power Sales Contracts

The demand for Project output may be formalized with power sales contracts between APA and the immediate customers for the Project's power. Such contracts may be with municipalities, cooperatives, industrial corporations and federal government installations and would serve as a source of credit support for the Project.

The types of commitments under such contracts vary considerably among different issuers. Such types of provisions which APA may wish to consider are:

a. Take-or-pay Obligations - These require users of project output to commit a defined payment for the life of the contract, regardless of the level of project output or a user's need for power. It effectively obligates the users to provide funds that can be used for debt service.

b. Take-and-pay Obligations - This requires users to pay only for the project output which is available to them. It does not insure that funds would be available for debt service if the project suffers an extended outage.

c. Minimum Payment Obligations - The user is contractually obligated to make only a minimum payment in the event it is unable or unwilling to receive all of the contractedfor output. The minimum payment obligation provides for debt service in the event of project outage, while reducing the burden of project credit support on the various obligors to an amount less than that which would be payable with the project fully operable. The unconditional nature of the minimum payment obligation, combined with the credit strength of project customers, comprise the ultimate source for project creditworthiness in the eyes of lenders.

d. Step-up Provisions - Most projects having sponsoring customers whose creditworthiness is somewhat disparate include some measure of protection against the risk of individual customer default in their power sales contracts. This protection takes the form of a specified percentage step-up for the non-defaulting customers. In such cases, upon the failure of any customer to make any payment, the share of all other customers not in default under the contractual support agreement is subject to an automatic increase.

Since the Project output at some point may become subject to price regulation or other regulatory constraints, it is incumbent upon APA to include in discussions all governmental and regulatory agencies which can possibly affect the price of the Project output. Revenue assurance would be achieved through APA's ability to set rates at levels sufficient to discharge its debt obligations without regulatory interference.

2. Guaranties or Other Sources of Payment - Guaranties by a credit worthy party, such as the State, would provide further assurance to investors that monies needed to meet debt service will be paid from power sales contracts or the guarantor. As previously mentioned in Section II, such a guaranty of the bonds will not necessarily solve the tax-exemption question, since it

would be contemplated that the bonds would be paid from the power sales contracts. However, if another source of payment, such as monies from the Alaska Permanent Fund, were used to pay all or a portion of the bonds, it may enable the bonds to qualify for tax-exemption.

3. Funds

In such projects, additional protection for meeting annual debt service requirements is supplied through the use of "Funds" of various types. The purpose of these funds is to provide protection against any unexpected shortfalls in revenues, and provide for unanticipated expenses. The Funds are established at the outset of the project financing and are subsequently maintained by a primary allocation of project revenues on a gross or net basis. The funds are labeled to describe either their source, use, or the type of risk they are intended to cover. "Revenue Fund", Construction Fund", "Reserve and Contingency Fund", "Operating Fund", "Bond Fund" and "Bond Reserve Fund" are some common examples.

Typically, the Funds are interlocking and spill-over into one another. Thus, a Revenue Fund would be sourced from all of the revenues of the project and spill-over into the Operating Fund which would be used to pay all operating expenses. The Bond Fund, the second level spill-over from the Revenue Fund, would receive payments necessary to meet all project interest, principal and bond retirements. The Bond Reserve

Fund would be used to make up any deficiency in the Bond Fund in order to keep payments of interest and principal current if project cash flows were temporarily insufficient. The Reserve and Contingency Fund would be available to meet any deficiencies in paying operating and maintenance expenses and would also be available to replenish the Bond Reserve Fund or Bond Fund.

To establish the creditworthiness of the Project at the start of construction, the various Funds may be established through borrowing or sponsors' contributions and subsequently maintained by mandatory allocations of Project revenues. While this would increase APA's financing requirements, it would provide a form of quasi-equity which enhances Project creditworthiness during the lengthy construction period.

We have examined the key elements of a successful project financing: namely, defining the market for the power, ascertaining the Project's suitability to serve that market, addressing the project's risks, and providing adequate repayment security to the investors. Each will provide challenges for APA on the Susitna Project but, with creative approaches and experienced professional advisors, a successful outcome will be achieved.

IV. ACCESS TO THE FINANCIAL MARKETS

After the tax-exemption questions have been resolved and the financing plan and security provisions structured, it will be possible to raise funds for the Project through the issuance of securities. This section will address the investment banker's role in this process, and the types of securities which might eventually be issued.

A. INVESTMENT BANKER'S SERVICES

In financing a new project, the role of the investment banker is far more difficult and far more important than in the financing of an established, market-tested credit. The essence of the investment banker's role in such a financing is to establish the creditworthiness of an entity where none has previously existed and to introduce this new borrowing entity to the marketplace.

The services provided by APA's investment banker should correspond with the various stages of the Project development plan. We envision these stages as follows: (1) the preliminary study phase; (2) the consulting and negotiating phase; and (3) the execution phase.

Much of the work which will occur during the first two steps has been discussed in the preceding sections of this report.

In particular, APA's investment banker will work closely with APA and its other professional advisors to determine the optimal structure for undertaking the Project. After the Project structure, participants and various contractual agreements have been determined, the investment banker's attention will focus on financing strategies, for both the short and long term financial needs of the Project.

Before the actual funding of the Project could be undertaken, the investment banker would assist in the preparation of a presentation to the potential investors and rating agencies and the description of the Project to be included in the official statement. Because of the generally complex nature of public power financings, the investor and rating agency presentations and disclosure material are especially important. The necessity of explaining the intricacies of the Project in a sufficiently comprehensive manner so as to obtain the optimum credit rating and develop investor acceptance requires an investment banker well versed in public power financing.

B. TYPES OF SECURITIES

The final stage of the Project, the execution phase, would involve the actual funding of the Project through the sale of APA securities. Several types of securities could be offered, some examples of which are described below:

1. Interim Financing - Prior to the construction phase APA will incur a number of expenses, so that at some point access to funds would be desirable. In general, such funds would be provided from a short-term loan which would eventually be repaid from the proceeds of a long term bond financing. The most common sources for such funds are bank loans, the sale of notes, private placements and in the very early stages, advances from the State.

2. Tax-Exempt Commercial Paper - Another possible source of short-term funds presently being developed is tax-exempt commercial paper. Presently there is no such market, but it is possible that some of the large well-established public power credits may soon start issuing these securities.

3. Long-Term Bond Financing - The actual construction of the Project will be financed from the sale of long-term bonds. As was discussed in the earlier sections, these would be repaid over a number of years from revenues generated by the project and

secured by various contractual agreements. Assuming the tax considerations already discussed can be satisfactorily addressed, the interest on these bonds would be tax-exempt.

Considering the large capital needs of the Susitna Project, and the economical energy it is expected to produce, it is likely that the various APA securities would be attractive to major institutional investors. An aggressive marketing program by APA's investment banker can develop that interest; with such support, APA's securities will enjoy an active market and be well received by investors in the years to come.

December 16, 1976

Financing Considerations
Alaska Power Authority

The Alaska Power Authority (the "Authority") proposes to finance the cost of construction of the Susitna River Project consisting of two dams, Devil Canyon and Watana, and the transmission facilities necessary to deliver the output to the Fairbanks and Anchorage area (the "Project"). The Project will be constructed by the U.S. Army Corps of Engineers (the "Corps") under a "turnkey" arrangement with the Authority wherein the Corps will complete the Project or reimburse the Authority for all costs incurred by the Authority. The output of the Project will be used to meet the projected power needs of the Fairbanks - Anchorage area and sold to certain Power Purchasers (i.e., municipal electric utilities, industry, and federal government installations) pursuant to long-term power supply contracts.

The business risks associated with the proposed financing can be separated into: (1) those risks associated with the failure of the Project to provide electric power and energy at reasonable cost, and; (2) those risks associated with the ability of the Power Purchasers to fully utilize and pay for the power supplied.

PROJECT RISKS

The risks associated with the failure of the Project to provide power and energy at the initial projected costs may be divided into:

A. Prior to Commercial Operation

(1) Non-completion due to any reason

(2) Construction cost overrun due to

(a) Inadequate initial design

(b) General inflation and/or cost escalation and/or cost increases do to required Project additions.

B. After Commercial Operation

(1) Long Project outage due to design

(2) Long Project outage due to physical damage

(3) Low water operation

Prior to Commercial Operation

Non-completion. The risks associated with non-completion of the Project are assumed by the Corps under the turnkey contract wherein the Corps would guarantee commercial operation of the Project. Commercial operation would be established by certain objective tests or by certain performance guarantees (e.g., one year of full power operation). Non-completion, the failure to meet the objective tests for commercial operation, would require the Corps to reimburse the Authority,

through a Federal funding process, for all costs, including interest charges incurred. This reimbursement procedure would be operative prior to the commencement of the Authority's financing program and be established such that the bonds issued by the Authority could be called or paid as they mature, at the option of the bondholder. Essentially, if the Project is not completed, the bondholder will be paid by the Federal government.

Construction Cost Overruns. If, in order to complete the Project, funds in addition to those originally planned are needed, then, if the cause of the cost overrun is due to design, the Corps would have responsibility to provide the funds necessary to bring the Project to commercial operation as provided for in the turnkey arrangement. To the extent the overrun is due to general cost increases, the Authority would assume the responsibility of supplying the additional funds. The overall responsibility of the Authority would be limited to a dollar amount established prior to the commencement of the Authority's financing program. This amount ("Feasible Project Costs") would be determined through negotiation with the Corps and be above the initial estimated Project cost but below the cost which would make the Project not economically feasible.

In order to insure the completion of the Project another source (e.g., the Corps or the State) would be obligated to

provide funds needed above this amount.

After Commercial Operation

Long Project Outage Due to Design. The costs associated with the failure of operation due to design would be assumed by the Corps wherein the Corps would provide funds necessary to restore the Project to operation and meet the Authority's costs not provided for out of various reserve funds.

Project Outage due to Physical Damage. The costs associated with returning the Project to commercial operation would be assumed by the Authority to the extent the funds needed do not exceed Feasible Project Cost. Costs above that amount would be provided by another source (i.e., the Corps, the State, insurance). This arrangment would be established prior to the Authority's first financing.

Low Water Operation. The higher cost associated with low water would be assumed by the Authority.

Power Purchaser Risks

The risks associated with the ability of power purchasers to utilize and to pay for the power supplied are:

(1) That the growth in demand for power and energy, as projected by an independent consulting engineer, does not develop.

(2) That the rates necessary to pay the costs associated with the Project are excessive, for reasons other than inadequate demand growth, when compared with the income levels of the population being served or when compared with power available from other power supply resources.

Both of these risks relate to the cost of power and are assumed by the Power Purchasers under the power supply contracts which will provide that payments will be made by the Power Purchasers sufficient to cover all the Authority's costs incurred in the operation and maintenance of the Project.

Further Considerations

The risk that the Power Purchasers will not be able to make payments as required by the Power Supply Contracts usually has been addressed in an independent consulting engineer's financial feasibility report which, among other things, concludes that:

(a) The Project is technically and economically feasible and the estimated cost of construction is reasonable.

(b) At the estimated date of commercial operation the power purchasers will have the need and the ability to pay for the output from the Project.

(c) Of the Projected available power resources, the Project, when integrated into existing resources, will best fulfill the future power supply requirements of the power purchasers.

(d) The revenues derived from the sale of power will

be sufficient to meet the power purchasers' obligations.

In the proposed Alaska Power Authority financing, however, two differences exist. First is that there usually a projected general market demand for Project power besides the demand from those Power Purchasers who have specifically contracted to receive such power. The power from the Project has a limited market area and no such assurances as to the general market demand will be available. The second is that the Project is in Alaska which involves investor concern over environmental difficulties, natural catastrophes (e.g., earthquakes) and other problems. Because of these differences additional security may be needed to assure investors as to the strength and adequacy of the revenue flow.

To determine Project feasibility the Authority would issue short-term bonds the proceeds of which would be used by the Corps for feasibility studies. The ultimate determination of Project feasibility would be the initial issuance of a significant amount of Bonds by the Authority (e.g., $100 million) a portion of the proceeds of which would be used to pay the maturing short-term bonds. If the Project is not feasible, the Corps would reimburse the Authority for all costs incurred, including interest expense.

SECTION C2: DRAFT CONTRACT

ACRES

DRAFT FOR DISCUSSION
September 1979

ALASKA POWER AUTHORITY
383 West 4th Avenue
Suite 31
Anchorage, Alaska

Contract No. _____

SUSITNA HYDROELECTRIC PROJECT

Engineering and Technical Services
for
Feasibility Studies Leading to
License Application

ACRES AMERICAN INCORPORATED
900 Liberty Bank Building
Main at Court Streets
Buffalo, New York 14202

Date: _____

This AGREEMENT, entered into as of the _____ day of _____, between the Alaska Power Authority (APA), a State of Alaska Authority, authorized to do business in the State of Alaska, and Acres American Incorporated (ACRES), a New York State Corporation,

WITNESSETH:

WHEREAS, APA wishes to enter into a contract with ACRES for the performance of engineering, management and technical services for a feasibility study of the Susitna Hydroelectric Project leading to license application, and

WHEREAS ACRES has represented that it is qualified and able to provide such services, and desires to do so;

NOW THEREFORE, the parties agree as follows:

SCHEDULE OF ARTICLES

Article I - Scope

The work to be performed by ACRES shall be in accordance with:

(i) the APA Request for Proposals issued _____ as amended by _____ dated _____, and

(ii) the ACRES proposal to APA dated _____.

Article II - Communications

All communications between APA and ACRES about this contract should be addressed to the following personnel at APA and ACRES respectively, until amended by either party in writing:

APA:

_____ - Contracting Officer

(Others)

ACRES:

J. Gavin Warnock - Vice President and Manager, Power Group
Acres American Incorporated
Columbia, Maryland 21044

(Others)

Article III - Cost and Fixed Fee

1. Reimbursement to ACRES for undertaking the Scope of Work set out in Article I of this AGREEMENT shall be the sum of actual costs, both direct and indirect, and a fixed fee.

2. ACRES agrees to use in all instances its best efforts not to exceed the total estimated price for the work described in Article I of this CONTRACT of $_____ including fixed fee.

3. The total firm fixed fee for this contract is $_____. This fee may only be adjusted should the Scope of Work be modified in accordance with the procedures set forth in Article XII of this AGREEMENT. The fee shall be adjusted by __ percent of the mutually agreed estimated costs of the change in Scope of Work. No fee adjustments shall be made for revisions within the defined Scope of Work.

Article IV - Payment and Submission of Invoices

1. ACRES shall submit monthly invoices to APA within 15 working days of each month end. The invoices shall be assembled in accordance with APA's Billing Instructions (Form APA/_____*) and shall clearly set out the breakdown of direct and indirect costs for ACRES and its subcontractors. All invoices shall be addressed to APA's _____.

2. ACRES shall invoice and be paid the firm fixed fee of _____ in accordance with the following procedure:

   Invoices shall include an item for "fee" which shall be ___ percent of the reimbursable costs on each invoice. ACRES shall be paid this amount until 85 percent of the fee ($_____) has been paid. The remaining 15 percent ($_____) shall be held in retention by APA until completion** of this contract.

3. APA will pay ACRES invoices within 15 working days of their receipt. Should any invoiced item require substantiation or adjustment, payment for this item will be deferred to the next invoice.

(*Or by attachment)

(** "completion" to be defined as receipt of final document, or other)

Article V - Completion of Work; Excusable Delays

1. ACRES shall perform all work set out in Article I of this AGREEMENT in a timely fashion, and agrees to make best efforts to complete all work under this contract within _____months of the date of this CONTRACT.

2. Except with respect to defaults of subcontractors, ACRES shall not be in default by reason of any failure in performance of this contract in accordance with its terms (including any failure by ACRES to make progress in the prosecution of the work hereunder which endangers such performance) if such failure arises out of causes beyond the control and without the fault or negligence of ACRES. Such causes may include, but are not restricted to, acts of God or of the public enemy, acts of any government agency thereof, in either its sovereign or contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and unusually severe weather, but in every case the failure to perform must be beyond the control and without the fault or negligence of ACRES. If the failure to perform is caused by the failure of a subcontractor to perform or make progress, and if such failure arises out of causes beyond the control of both ACRES and subcontractor and without the fault or negligence of either of them, ACRES shall not be deemed to be in default, unless (a) the supplies or services to be furnished by the subcontractor were obtainable from other sources, and (b) APA shall have ordered ACRES, in writing, to procure such supplies or services from such other sources, and (c) ACRES shall have failed to comply reasonably with such order. Upon request of ACRES, APA shall ascertain the facts and extent of such failure and, if APA shall determine that any failure to perform was occasioned by any one or more of the said causes, the delivery schedule shall be revised accordingly, subject to the rights of APA under the clause hereof entitled Termination.

Article VI - Key Personnel

The following ACRES and ACRES subcontractor personnel are considered to be essential to be work to be performed under this contract: ACRES shall give reasonable advance notice of any substitutions, and shall submit justification in sufficient detail to permit evaluation of the impact of any substitutions on the program. No substitutions shall be made without the written consent of the APA Contract Administrator.

Company	Function	Name
ACRES	Project Manager	

Article VII - Project Files

APA is to have full and free access to all project engineering files in ACRES' possession or in the possession of ACRES' subtier contractors including data, drawings, calculations, notes, technical correspondence and materials. Such files will be available to APA for at least five (5) years after completion of the APA/ACRES contract. Copies of any file items will be provided to APA upon request providing APA pays the cost of reproduction. In the event of termination of the APA/ACRES contract prior to completion, ACRES will provide a full copy of all such materials to APA within two (2) weeks of termination, with the "costs" of reproduction included in ACRES' termination charges.

Article VIII - Assignment

This contract is not assignable without prior written authorization from APA, nor is any subcontract issued by ACRES for work to be performed under this contract assignable without prior written authorization from APA.

Article IX - Insurance & Indemnification

Prior to execution of this contract, ACRES shall provide APA with certification of compliance with the requirements of Attachment 3. ACRES further agrees to transmit certification of compliance with these requirements for all subcontractors prior to ACRES/subcontractor contract execution. ACRES further agrees to name APA as additional parties insured under any insurance coverage to be provided pursuant to this contract and to require subcontractors to do likewise.

Article X - Confidentiality of Information

ACRES shall not disclose any confidential information obtained in the performance of this contract until such date, if any, that the APA shall release ACRES from this provision. Any presentation of any statistical or analytical material or reports based on information obtained from the studies covered by this contract will be subject to review by the APA's Project Manager before publication or dissemination in order to determine whether safeguards and privacy have been observed.

Article XI - Disputes

Except as otherwise provided in this CONTRACT, any controversy or claim arising out of or relating to this CONTRACT shall, upon written request of either party to the other within six months after the controversy or claim has arisen, be settled by arbitration. Controversies or claims not presented within such six-month period will be deemed to have been waived.

The parties shall select a single arbitrator by mutual agreement. If they cannot agree upon a single arbitrator, each will choose three (3) names from a list of five (5) provided by the American Arbitration Association. From these choices, a single arbitrator will be chosen by agreement of the parties. If such agreement is not accomplished, either party may request the American Arbitration Association to appoint an arbitrator in accordance with its Commercial Arbitration Rules, which rules shall govern the conduct of the arbitration in the absence of contrary agreement by the parties.

The parties shall then submit to the arbitrator a written statement setting forth the matters in dispute. If the facts are not agreed upon, the arbitrator shall promptly hold hearings in Anchorage, Alaska and thereafter shall promptly reach an appropriate decision of each matter in dispute. The decision of the arbitrator on all matters in dispute, which have been submitted to him, shall be issued in writing and shall state his reasons for such decision and separately list his finding of fact and conclusions of law, and shall be signed by the arbitrator within thirty (30) calendar days after receipt of such statement or conclusion of such hearings. The arbitrator shall not have the power to amend or add to this AGREEMENT. Subject to such limitations, the decision of the arbitrator shall be final and binding upon the parties.

Cost of such arbitration will be shared equally by the parties, unless the arbitrator determines that the claim made by one of the parties is without merit, in which event the arbitrator may award costs to the other party.

Article XII - Changes

1. APA may, at any time, by a written order, make changes within the general scope of this contract.

2. If any such change causes an increase or decrease in the estimated cost of, or time required for, the performance of any part of the work under this contract, whether changed or not by any such order, or if such change otherwise affects any other provisions of this contract, an equitable adjustment shall be made by APA:

   (a) in the estimated cost or completion schedule, or both
   (b) in the amount of fixed fee to be paid and
   (c) in such other provisions of the contract as may be affected, and the contract shall be modified in writing accordingly.

   Any claim by ACRES for adjustment under this clause must be asserted within twenty (20) days from the date of receipt by ACRES of the notification of change; provided, however, that APA's Contracting Officer, after deciding that the facts justify such action, may receive and act upon any such claim asserted at any time prior to final payment under this contract. Failure to agree to any adjustment shall be a dispute concerning a question of fact within the meaning of the Article of this contract entitled "Disputes".

Article XIII - Examination of Costs

The Contracting Officer for APA shall have the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to reflect properly all direct and indirect costs of whatever nature claimed to have been incurred and anticipated to be incurred for the performance of this contract. Such right of examination shall include inspection at all reasonable times of ACRES offices, plants, or such parts thereof, as may be engaged in the performance of this contract.

The materials described above shall be made available at the office of ACRES, at all reasonable times, for inspection, audit or reproduction, until the expiration of 3 years from the date of final payment under this contract and for such longer period, if any, as is required by applicable statute, or by other clauses of this contract, or by (1) and (2) below:

(1) If this contract is completely or partially terminated, the records related to the work terminated shall be made available for a period of 3 years from the date of any resulting final settlement.

(2) Records which relate to appeals under the "Disputes" Article of this contract, or litigation or the settlement of claims arising out of the performance of this contract, shall be made available until such appeals, litigation or claims have been disposed of.

Article XIV - Termination

The performance of work under this contract may be terminated by APA in whole, or from time-to-time in part:

(a) Whenever ACRES shall default in performance of this contract (including in the term "default" any such failure by ACRES to make progress in the prosecution of the work hereunder as endangers such performance), and shall fail to cure such default within a period of ten days (or such longer period as the APA may allow) after receipt from APA of a notice specifying the default; or

(b) Whenever for any reason APA shall terminate for its convenience.

Any such termination shall be effected by delivery to ACRES of a Notice of Termination specifying whether termination is for the default of ACRES or for the convenience of the APA, the extent to which performance of work under the contract is terminated, and the date upon which such termination becomes effective. If, after Notice of Termination of this contract for default under (a) above, it is determined for any reason that ACRES was not in default or that ACRES failure to perform or to make progress in performance is due to causes beyond the control and without the fault or negligence of ACRES pursuant to the provisions of the clause of this contract relating to excusable delays, the Notice of Termination shall be deemed to have been issued under (b) above, as appropriate, and the rights and obligations of the parties hereto shall in such event be governed accordingly.

Notwithstanding any different result which might follow from application of the provisions of this clause set forth below on payment of fees and charges, APA shall not withhold from ACRES any termination payments for work to which ACRES is entitled under this Contract.

Article XV - Equal Opportunity

Article XVI - Alaska Preference

Article XVII - Subcontracts

ACRES shall incorporate the substance of this CONTRACT in any subcontracts hereunder.

This CONTRACT consists of identification page 1, and Article I through Article XVII, and the following attachments:

Attachment 1. APA Request for Proposal
Attachment 2. ACRES Proposal
Attachment 3. APA Insurance Requirements

This CONTRACT shall be governed by the laws of the State of Alaska.

IN WITNESS WHEREOF, the parties have caused this CONTRACT to be signed by their respective officers thereunto duly authorized as of this ____ day of _____, 19__.

ACRES AMERICAN INCORPORATED

BY: _____

TITLE: _____

ALASKA POWER AUTHORITY

BY: _____

TITLE: _____

INSURANCE REQUIREMENTS - ATTACHMENT 3

Minimum Insurance and Indemnity Requirements

Before commencing the work, ACRES shall procure, and maintain at its own expense until final completion and acceptance of the entire project, the following minimum insurance in forms and with insurance companies acceptable to APA.

A. Workmen's Compensation Insurance for statutory obligations imposed by Workmen's Compensation or Occupational Disease Laws, including, where applicable, the United States Longshoremen and Harbor Workers Act, the Federal Employees Act and the Jones Act. Employer's Liability Insurance shall be provided with a minimum limit of $100,000 per accident.

B. Comprehensive Automobile Liability Insurance with the following minimum limits of liability:

   - $1,000,000.00 Combined Single Limit Per Occurrence.

   This insurance is to apply to all owned, non-owned, and hired vehicles used by the Contractor in the performance of the work.

C. General Liability, Contractual Liability and Products/Completed Operations Liability Insurance covering all operations required to complete the project with the following minimum limits of liability:

   - $1,000,000.00 Combined Single Limit Per Occurrence.

   The Products/Completed Operations Liability Insurance shall be provided for a period of at least one year after completion of the project.

   The Contractual Liability Insurance Coverage shall insure the performance of the contractual obligations assumed by the Contractor by acceptance of this order, including specifically, but without limitation thereto, the hereinafter mentioned indemnity agreement.

Contractor shall likewise require its Subcontractors, if any to carry at least the minimum insurances described above.

Before any of the work is started under any resulting order, unless a current certificate of insurance has previously been furnished to and approved by ACRES, Contractor shall file with the Project Engineer certificates of insurance containing the following information in respect to all insurance carried:

A. Name of insurance company; policy number and expiration date.
B. Limits of insurance.
C. Named insureds.
D. A statement indicating that APA's Contracting Officer will receive at least thirty (30) days' notice of the cancellation of any of the policies or any modification in the insurance that may affect its interests.

Protection Against Injuries and Damages (Indemnity Agreement)

ACRES and its subcontractors shall take all safety precautions, and furnish and install all safety devices, necessary or reasonably advisable for the prevention of injuries and damages, and shall comply with all applicable safety laws, ordinances and regulations, including the Occupational Health and Safety Act and the Safety and Health Regulations for Construction.

In addition, ACRES and its subcontractors shall comply with all safety procedures from time to time prescribed by APA.

APA and ACRES agree that any contract resulting from acceptance of this purchase order is not intended to be one of hiring under the provisions of any Workmen's Compensation Law, and shall not be so construed and the Contractor in performing the work hereunder will be acting as an independent contractor.

ACRES shall indemnity and save harmless APA from and against all claims, demands and causes of action on account of personal injuries or death or on account of properly damages arising out of any act or omission of ACRES, its agents or employees in the execution of the work to be performed by ACRES hereunder. ACRES agrees to defend at its expense and suit or action brought against one or both of them, based on any alleged injuries or damages, losses or expenses in connection therewith or resulting therefrom.

SECTION C3: MANAGEMENT AND COST CONTROL SYSTEM

ACRES

PROJECT/2

A SYSTEM FOR NETWORK BASED
PROJECT SCHEDULING AND CONTROL

PROJECT SOFTWARE & DEVELOPMENT, INC.

What is PROJECT/2®...

PROJECT/2 is a proven software package for network based project scheduling and control Through simple English-language commands, the project planner can easily adjust the network whenever conditions change. He can produce an instant picture of any new situation. Over 40 tabular and graphic reports can be produced to provide the specific information needed by each level of management within an organization or project.

PROJECT/2 is a comprehensive scheduling tool which offers Network Plotting, CPM Scheduling, Progress Control, Cost Processing, Resource Allocation and Constraining, and Multiproject features. PROJECT/2 can process Activity-on-Arrow and Activity-on Node networks using sophisticated scheduling algorithms.

PROJECT/2 is currently being used by hundreds of organizations around the world.

Why use PROJECT/2®...

You want to get started quickly. PROJECT/2 is easy to install on your computer and is readily available at major data centers in the United States, Canada, and Europe, where skilled technical support staff familiar with PROJECT/2 are ready to assist you. PROJECT/2 eliminates the need for a knowledge of programming or computers. The Command Language uses project control terminology and can be learned in a few hours. No valuable time is lost in extensive training.

You want better communication. PROJECT/2 was designed specifically for project planners and schedulers. The objectionable features of most other software systems — rigid input formats, complex computer languages, limited reporting capabilities — have been replaced by an English-language command structure and a flexibility in output that permits clear and specific communication to all levels of project management.

You can start simply and grow into advanced applications. Very few commands are necessary to generate meaningful schedules. New features can be added as you need them. Introductory and advanced PROJECT/2 schools are available to broaden your knowledge of the system.

You want a single source. PROJECT/2 is an integrated system offering sophisticated scheduling, cost resource analysis, and plotter-produced network diagrams, all in one proven package.

PROJECT/2 is continually being improved. PSDI carries on a constant dialogue with users to provide for tomorrow's needs. Since 1969, new ideas have been actively solicited from users and many new features and reports have been developed as a result of this interaction.

The PSDI staff is available to provide technical support. PROJECT/2 specialists are always on call to discuss general applications and system problems. PSDI also performs remote job entry to all North American data centers where PROJECT/2 is used.

Input to PROJECT/2®

The Command Language

One of the most attractive features of PROJECT/2 is its unique Command Language, which enables you to communicate efficiently with the computer. The English-like Command Language is totally oriented to the problem of network based scheduling and control. Each input or output request, consisting of Command Words and associated data elements, is keypunched into a card. You need write only the first three letters of any Command Word.

There are no rigid input forms to which you must conform. The only requirement is that you separate each word and group of numbers by one or more blank spaces. If you need input forms, you can design your own or we can provide forms specifically designed for your application.

The Command Language is very easy to master. Look at the sample commands illusted at the right (in capital letters) to see if you can understand them; then check your interpretations by reading the explanations (in fine print).

Input Errors

Once the Command cards have been keypunched, they may be assembled into an input deck in any logical order. In operation, PROJECT/2 will read each command, print it out, and then process it from left to right. If syntax errors are detected, an Error Message will be printed directly beneath the printed command so you can spot your errors immediately. The PROJECT/2 user has the option of automatically terminating a run, depending upon the severity of the errors encountered. Use of this and other sophisticated error detection features results in substantial savings in computer time.

Job Control

Execution of PROJECT/2 requires very simple, single step JCL (job control). Most users have one JCL card deck which they use for all PROJECT/2 computer runs.

```
ASSIGN START ACTIVITY 3540 3550 NOT LATER THAN AUG 15, 77
```

This command tells the system that activity 3540 3550 is to start no later than August 15, 1974.

```
REPORT PROGRESS AS OF SEPT 17, 77
   ACTIVITY 29 START SEPT 2, 77 PC 75
   ACTIVITY 30 FINISH 10 SEPT 77
LAST
```

This four-card command establishes (1) that the Data Date is September 17, 1974; (2) that since the last progress was reported, activity 29 started on September 2, 1974 and is now 75% complete; and (3) that activity 30 finished on September 10, 1974.

```
PLOT WORKING SCHEDULE BETWEEN APR 1, 77 AND JUN 30, 77 -
SELECT ACTIVITIES WITH TF LT 5 SORT BY ES
```

This command is asking PROJECT/2 to produce a bar chart beginning on April 1, 1974 and ending on June 30, 1974. Only those activities with Total Float (TF) less than 5 days are to be plotted. The activities are to be plotted from top to bottom, sorted by Early Start (ES). The "–" at the end of the first line of the command indicates a continuation of the command onto the next card.

```
PRINT RESOURCE ALLOCATION BY RESOURCES FOR -
RESOURCES 10.3 11.3 12.4 LAST
```

This command requests a printout of Resource Allocation for resources 10.3, 11.3, and 12.4. The printout is to be arranged by resources.

```
ASSIGN COSTS BY RESOURCE PRICES ESCALATE
```

This command will use the escalated resource unit costs to compute activity budget estimates.

Report Generation

Specification Statements

The powerful PROJECT/2 Command Language really pays off when you are ready to generate output reports. The Command Language enables you to specify easily the exact content and arrangement of the information that is to appear on any of the more than 40 pre-programmed standard PROJECT/2 reports. Many of the reports are illustrated on the following pages in which the eight Processors are reviewed. Options are available to enable you to change the layouts of many of the reports.

You can control the content and arrangement of data on a report by means of six Specification Statements:

1. *Selection* allows you to control which activities or which resources are to be output.

   PLOT SCH SELECT TF EQ 0

2. *Sorting* provides the means for you to specify the sequence in which activities appear on a report.

   PRI WOR SCH SORT BY ES

3. *Page Breaking (ejection)* allows you to subdivide a report into two or more subreports, each on its own page, with its own 36-character page heading.

   EJECT ON CODE 1

4. *Summarizing* permits you to develop composite summary groups of activities.

   PLOT TARGET SUMMARIZE BY CODES 34

5. *Time Ranging* allows you to specify the beginning and end cutoff dates for all bar charts, cost and resource histograms, and cumulative S-curves.

   PRI SCH BETWEEN 6 1 76 AND 9 1 76

6. *Interval Control* allows you to specify the horizontal scale for histograms, S-curves, and bar charts. Daily, weekly, and monthly intervals are most commonly used, but any time scale is possible.

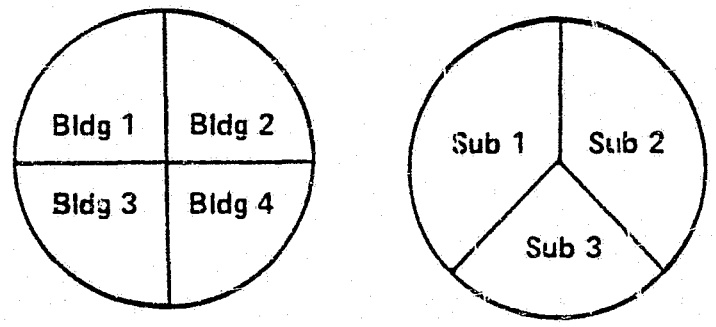
   PRI RES USAGE EVERY WEEK

Coding System

The coding structure in PROJECT/2 gives the user great flexibility. You may assign up to 27 code digits to each activity, then use any combination or grouping of up to 9 of those code digits to summarize, select, or page break reports. The PROJECT/2 code structure is used widely for work breakdown structuring, exception reporting, and other segmentation of complex networks.

To understand the potential of the coding system, consider a project that is being performed by three subcontractors and includes the construction of four buildings. Assume you have chosen code digit 3 to represent subcontractors and code digit 7 to represent buildings.

Two Breakdowns of the Project Activities



Using this code structure, you can generate a report organized either by subcontractors or by buildings. Going one step further, you can generate subreports for each subcontractor's work in each building. This would be accomplished by issuing the following simple command:

EJECT ON CODE 37

This command would arrange the work breakdown by building within each subcontractor. If it were more appropriate to order by subcontractor within building, the command would be changed to:

EJECT ON CODE 73

From these brief examples it should be clear that PROJECT/2 coding capabilities can be of immense value to the project manager. The combination of a well designed code structure and the PROJECT/2 output facilities enables you to generate reports to meet the specific requirements of all management levels within your organization.

PROJECT/2® Processors

Basic Network Processor

The Basic Network Processor takes the basic network data and establishes the network logic. This Processor handles the project calendar specifications, the expanded activity descriptions, and the code assignments. Using the Multicalendar option, as many as 100 different calendars can be accommodated and scheduled within a single network. Modifications to network logic are handled by this Processor. The output produced enables you to validate your network for logical consistency.

CPM Schedule Processor

This Processor calculates and displays both the Basic Schedule, a critical path schedule based upon network logic, and the Current Schedule, a critical path schedule that considers actual progress to date as well as the network logic. This Processor also produces input forms for updating, lists activities that must have action between specified dates, and produces many types of schedules and bar chart reports. A Multicalendar option is available.

Target Processor

After a Current Schedule has been calculated, it may be compared to a variety of other benchmark or Target Schedules. Up to 50 user-defined Target Schedules may be retained and compared to the Current Schedule, either by activity or by summary group. Target Schedules may be produced in tabular or bar chart formats. The Target Processor also produces a list of activities targeted for action as of a specified date, and is especially useful for "what if" analyses of potential future situations.

Resource Allocation Processor

This Processor assigns resources to activities and distributes resources over schedules. An activity can have any number of resources assigned to it, and a resource may be assigned to any number of activities. Resource allocation reports may be generated project-wide, by activity, or by resource. Distributed resource usage (cumulative or time interval) is output in tabular and/or graphic format. Activity budget estimates can be developed by automatically pricing resources, based on their escalated costs.

Cost Processor

This Processor handles all data related to the input, calculation, and output of project costs. It generates cashflow histograms and cumulative S-curves over the project schedules based upon estimated and actual cost. It can compare the Latest Revised cost to the project Budget in detailed or summarized forms. The Cost Processor can also produce Earned Value reports based upon progress and a payments schedule.

Resource Constraining Processor

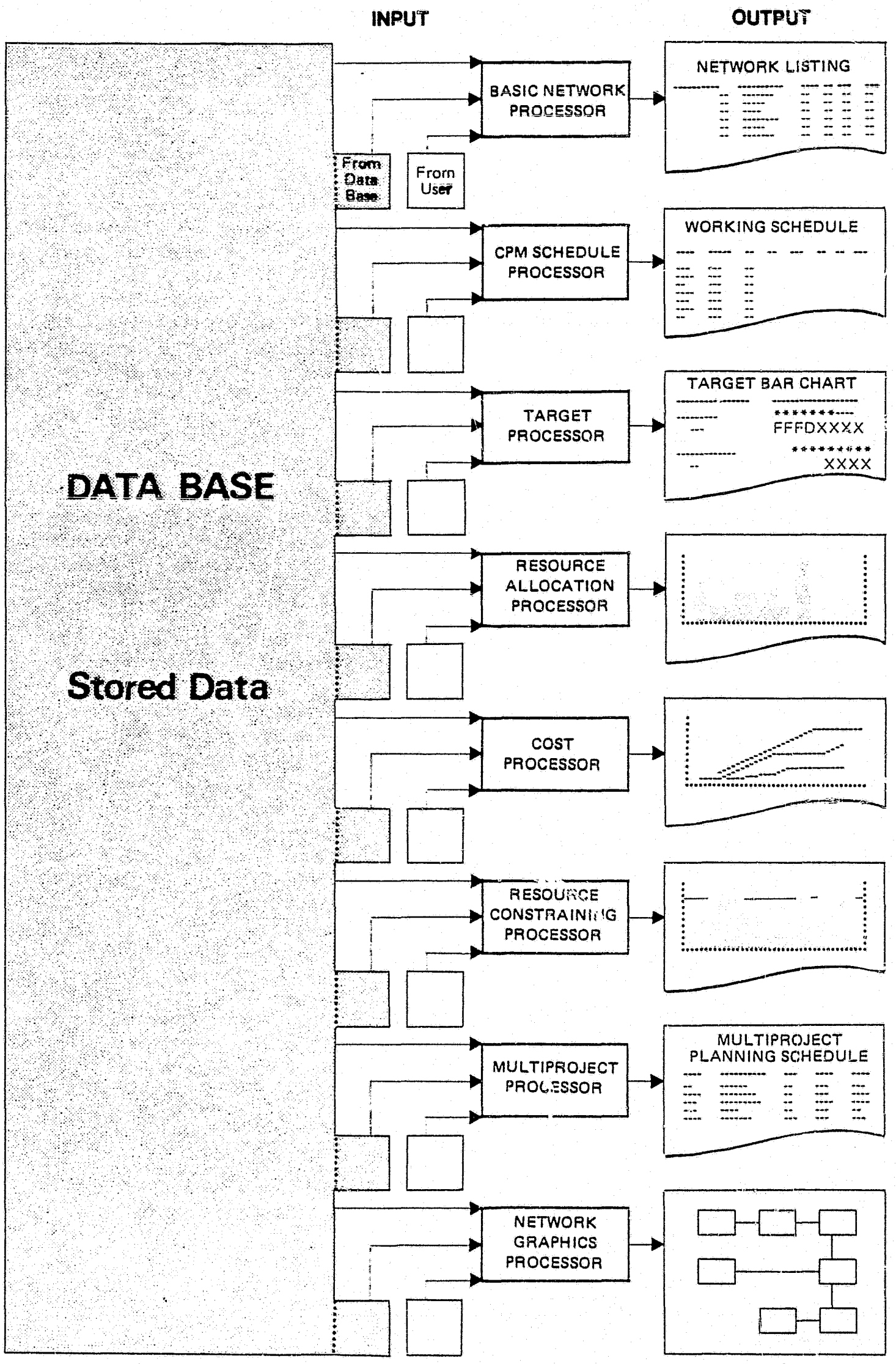
This Processor computes and saves up to 50 schedules based upon resource limitations, time constraints, and activity resource allocations. The scheduling is performed via a dynamic user-controlled procedure resulting in a most economical use of computer time. Optionally, a special report illustrates the procedure and desisions used. Resource Schedules can be displayed on most reports or saved as Target Schedules.

Multiproject Processor

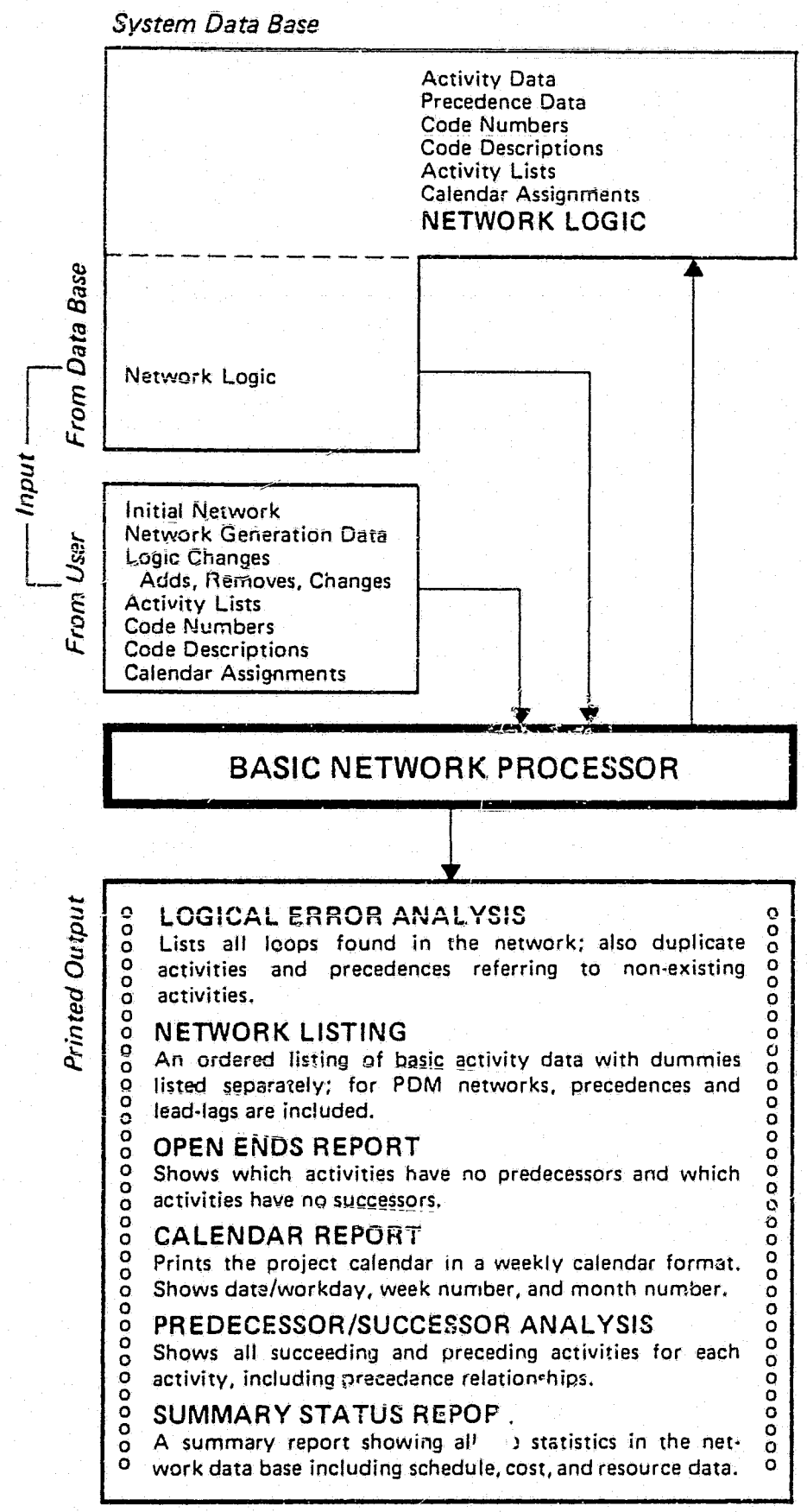
This Processor combines the Data Bases of two or more separate projects into a Multiproject Data Base. The Multiproject Processor can produce all of the standard PROJECT/2 reports for the combined Multiproject and balance resources over all your company's projects. In addition, it can transfer Multiproject Resource Constrained schedules back into the Data Bases of the individual member projects.

Network Graphics Processor

PROJECT/2's Network Graphics Processor produces high quality plotter-drawn network diagrams. Only three simple commands are necessary to output your stored data as a plotted network. Many options are available, including activity selection, paging by codes, time scaling, and control of sheet size and relative location of activities on the plotted pages via zoning. Milestones are indicated by special notations, and critical paths can be highlighted in red or with double lines.


INPUT
OUTPUT
DATA BASE
Stored Data
From Data Base
From User
BASIC NETWORK PROCESSOR
NETWORK LISTING
CPM SCHEDULE PROCESSOR
WORKING SCHEDULE
TARGET PROCESSOR
TARGET BAR CHART
FFFDXXXX
XXXX
RESOURCE ALLOCATION PROCESSOR
COST PROCESSOR
RESOURCE CONSTRAINING PROCESSOR
MULTIPROJECT PROCESSOR
MULTIPROJECT PLANNING SCHEDULE
NETWORK GRAPHICS PROCESSOR

Basic Network Processor



PROJECT/2 can process input from both activity-on-arrow (I-J) and activity-on-node (PDM) networks with lead-lags. Before a network is scheduled by PROJECT/2, the Basic Network Processor analyzes and stores network data. This Processor handles all activity data (number, description, codes, duration), precedence relationships, and calendar specifications such as the start date, workweeks, nonworking days, calendar assignments, and workday subdivisions. The Basic Network Processor thoroughly checks all input for errors, including normal keypunching mistakes, numbering and logical inconsistencies, duplication, and invalid dates. A loop detector prints a list of *all* loops.

Throughout PROJECT/2, codes are used to provide extremely flexible and powerful output control. You may assign up to 27 code digits to each activity. These code numbers allow you to select, sort, subdivide and label, and to summarize reports to meet the specific needs of each project.

When repetitive networks must be developed, the Network Generator facility saves you great amounts of input coding and keypunching. Basic subnet data is reproduced internally. The activity number, description, and duration vary according to your instructions. The Network Generator is ideally suited to multiple unit or high-rise construction projects and to transmission/distribution projects in the utilities industry.

A Multicalendar feature enables you to schedule activities in the same network on different calendars. You can define up to 100 calendars, each with its own start date, workweek, and holidays. And you can operate with variable calendars in which the workweeks change with time, reflecting seasonal variations as might be encountered in remote regions of the world.

CAPACITIES

- 32,767 activities maximum per network
- 9-digit nodes for PDM, 8-digit maximum for I-J
- three 9-digit code numbers
- 48-character activity descriptions
- 4 types of PDM lead-lags: SS, SF, FF, and FS, + and —
- unlimited expanded activity descriptions
- 100 different calendars

```
                                            ....  PROJECT/2  ....          ENGINEERING & CONSTRUCTION CO.
RUN DATE 28JUN74 1726HRS                    N E T W O R K   A N A L Y S I S          PROJECT START  2MAY74
PROJECT  WW SYS   WASTE WATER SYSTEM                                                  COMPLETION 24JUL74
                                            SORT  E START DURATN                 DATA DATE 14JUN74 PAGE  1
             ES=  11                                                              EF=   34  TF=   3
-------------------(    25         PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR        DUR=  24  )----------------

   55       ***    PRECEDING ACTIVITIES                      DIR FLOAT  F. FLOAT   REM DUR   PC COMP    LAG  ***
                   PREP SPECS UNDERGROUND TANKS                 -14         0         0        100

                                                   *** SUCCEEDING ACTIVITIES              ES    LAG  **
                                  30        COMPLETE STRUCT DWGS & RLS FOR CONSTR         25
             ES=  12                                                              EF=   34  TF=   4
-------------------(    56         PERFORM PWOC CYCLE UNDERGROUND TANKS           DUR=  23  )----------------

   55       ***    PRECEDING ACTIVITIES                      DIR FLOAT  F. FLOAT   REM DUR   PC COMP    LAG  ***
                   PREP SPECS UNDERGROUND TANKS                 -13         0         0        100
```

Three titles (examples shaded here) may be specified by the user for each report in PROJECT/2.

Each activity being analyzed appears in a box. Its predecessors appear directly beneath at the far left. The accompanying information indicates the relative degree of control exerted by each predecessor. The successors of each "boxed" activity are listed below and to the right.

NETWORK LISTING

```
ACTIVITY           D E S C R I P T I O N              DURA-      A         B         C       EST'D
NUMBER(S)                                             TION      CODE      CODE      CODE     COST ($)

          10 PREPARE LAYOUT & GENERAL ARRANGEMENT       3       3000       10         0          0
          20 PREPARE EXCAVATION DETAILS                 4       3000       10         0          0
          25 PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR    7       3000       10         0          0
          30 COMPLETE STRUCT DWGS & RLS FOR CONSTR      8       3000       10         0          0
          40 PREPARE FLOW DIAGRAM & PIPING LAYOUT       4       3000       20         0          0
          45 PREPARE SCHEMATICS-CONTROL SYSTEM          5       3000       30         0          0
          46 REVIEW & APPRV MFR DWGS PREP FNL W/O       5       3000       30         0          0
          50 FINALIZE PIPING DWGS & RLS FOR CONSTR      5
```

The basic activity data, including the three code fields and the budget for each activity, are listed in ascending order on this simple report.

CALENDAR REPORT

```
       MONTH  WEEK      MONDAY       TUESDAY      WEDNESDAY     THURSDAY      FRIDAY
         1      1       29APR74      30APR74       1MAY74        2MAY74       3MAY74
                                                                   1             2
         1      2        6MAY74       7MAY74       8MAY74        9MAY74      10MAY74
                           3            4            5              6            7
         1      3       13MAY74      14MAY74      15MAY74       16MAY74      17MAY74
                           8            9           10             11           12
         1      4       20MAY74      21MAY74      22MAY74       23MAY74      24MAY74
```

The calendar with the equivalent job workday printed directly beneath each date enables the user to estimate future dates.

AUTOMATIC NETWORK GENERATION

```
   THERE ARE      24 ACTIVITIES OF WHICH      24 NEW ONES ARE LISTED BELOW

     1101 'HEATING AND VENTILATION               GRNDLEVL'     15      1014       0       0
     2101 'HEATING AND VENTILATION               2ND FLR'      10      1014       0       0
     3101 'HEATING AND VENTILATION               3RD FLR'      10      1014       0       0
     4101 'HEATING AND VENTILATION               4TH FLR'      10      1014       0       0
     1102 'INSTALL LIGHTING                      GRNDLEVL'     10      1025     324       0
     2102 'INSTALL LIGHTING                      2ND FLR'       8      1025     324       0
     3102 'INSTALL LIGHTING                      3RD FLR'       8      1025     324       0
     4102 'INSTALL LIGHTING                      4TH FLR'       8      1025     324       0
```

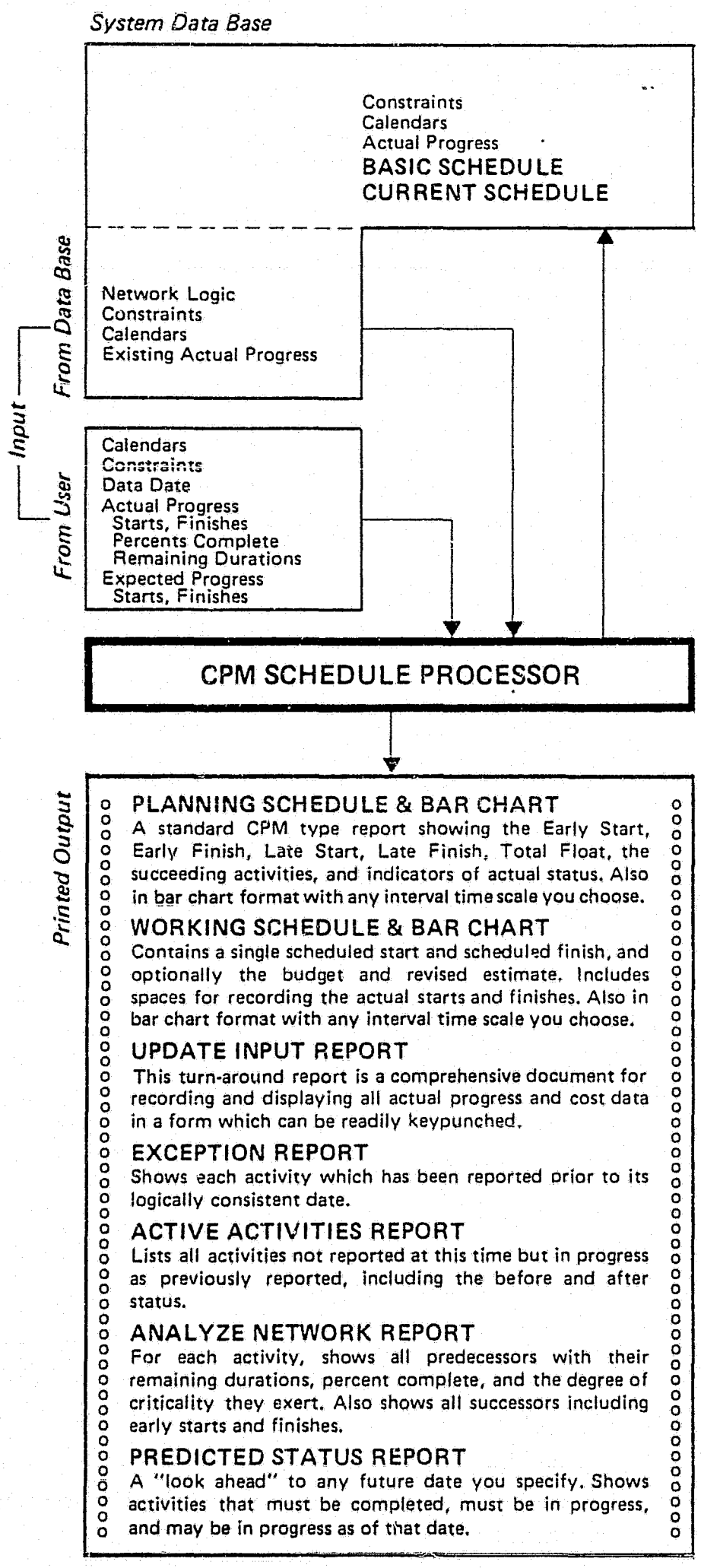
With their obvious pattern of repetitiveness, the first four activities were computer generated from a single basic activity. The left-most digit of the activity numbers and the last 8 characters of the descriptions (printed at the left of the second quotation mark) were generated automatically.

SUMMARY STATUS REPORT

```
GENERAL INFORMATION.
  TITLES
      PROJECT 'WASTE WATER SYSTEM
      SYSTEM  '      ....  PROJECT/2  ....        '
      COMPANY '      ENGINEERING & CONSTRUCTION CO.'
  NETWORK TYPE = A/N
  NO. ACTIVITIES =   29   NO. EVENTS =     3   NO. PREC =    48
   CODE NUMBERS = YES             MAX NO. DIGITS =   4
  BCODE NUMBERS = YES             MAX NO. DIGITS =   2
  CCODE NUMBERS = NO
  MODES = ORIGINAL     FULL  ES        PRECEDENCES = ON
  CONTRAINTS DATA                           WORKWEEK =   5     PROJ HOL= NO
      INDIVIDUAL CONSTRAINTS     0
  START =   2MAY74         FINISH  = 19JUL74      PROJECT DURATION =   57 WORKDAYS
  DESCRIPTION FOR CODES
      CODE              1
      CODE            234
      BCODE            12
      CODE              1      RCODE            1                         COMBINATION    6
REPORTED PROGRESS INFORMATION.
     DATA DATE = 14JUN74      ACT. START =   6MAY74     CURR. FINISH = 24JUL74      PC OF TIME USED = 50.0
                    32                          3                        60
     NO. ACT COMPLETED          7          PC     21.9
     NO. ACT IN PROGRESS        6          PC     18.8
     NO. ACT NOT STARTED       19          PC     59.4
```

The illustrated portion of the Status Report contains the basic network size statistics, the code number data, and the Basic Schedule data.

CPM Schedule Processor



Once the network logic has been successfully entered or any changes to the network content completed, the CPM Schedule Processor performs the basic early start, late start calculations and enables you to output your schedules in many formats, including bar charts.

PROJECT/2 enables you to maintain the current status of a project network easily and accurately. In order to generate meaningful schedules, you must be able to inject current information into your model. With the CPM Schedule Processor, you can report actual progress on each activity at regular intervals. The actual progress may be in the form of actual starts, actual finishes, percent completes, and remaining durations. In addition, you may also report known future starts and finishes.

Any of the above parameters not reported for an activity are calculated in a prescribed manner. If activities are reported out of sequence, they are flagged in the Exception Report. Any activities in progress but not reported by you will be highlighted and treated according to prevailing default settings. The before and after status of each reported activity is displayed as the actual data is processed.

Immediately following the input of any actual progress or movement of the Data Date, a Current Schedule is automatically calculated. The Current Schedule shows revised early and late starts, finishes and floats, and incorporates all the latest progress data. The Current Schedule represents what will happen to the project between now and the finish date and can be output on any report. Completed activities can easily be excluded from any report.

In the Multicalendar mode, each activity can be assigned to one of up to 100 different user-defined calendars. The CPM Schedule Processor schedules each activity according to its assigned calendar. Output reports indicate workdays according to the activities' calendars or a Standard Calendar you choose.

CAPACITIES

- 7 different types of constraints
- 32,767 work periods maximum project duration

PLANNING SCHEDULE

SORT E START TOT FLT

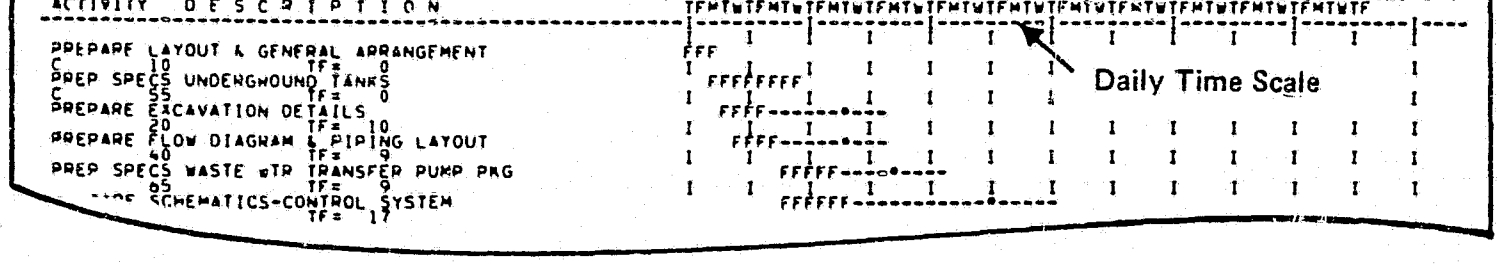
ACTIVITY		DESCRIPTION	CODE	DURATION	START EARLY	START LATE	FINISH EARLY	FINISH LATE	FF	TF
C	10	PREPARE LAYOUT & GENERAL ARRANGEMENT PRECEDES 20 40 55	3000	3	2MAY74 1	2MAY74 1	6MAY74 3	6MAY74 3	0	0
C	55	PREP SPECS UNDERGROUND TANKS PRECEDES 25 56 RELEASE INQUIRY OBTAIN BIDS EVALUATE BIDS OWNER REVIEW & APPROVAL AWARD	3000	8	6MAY74 3	6MAY74 3	15MAY74 10	15MAY74 10	0	0

The sort is given at the beginning of each report.

This is a standard CPM schedule showing either the succeeding or preceding activities.

At the user's option, expanded activity descriptions are listed beneath an activity.

PLANNING SCHEDULE BAR CHART



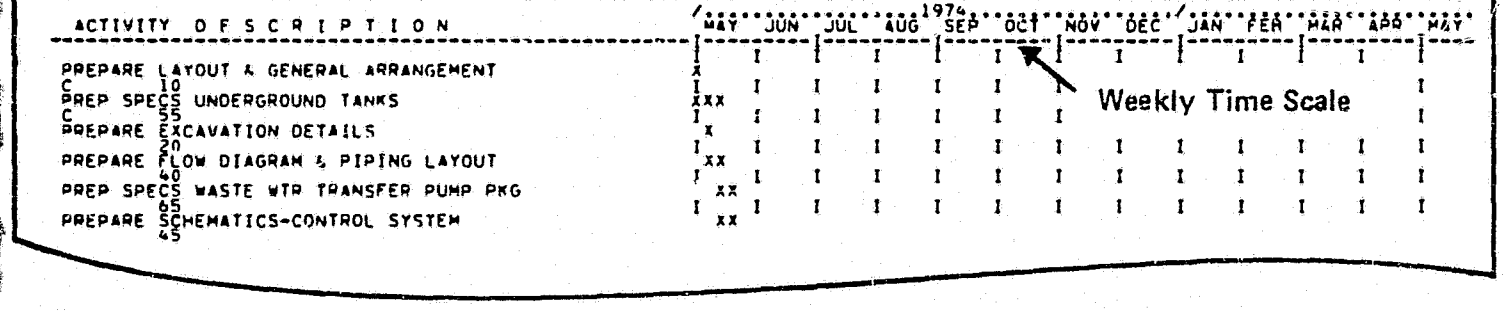
The Planning Schedule Bar Chart shows the early start (first "F"), early finish (last "F"), total float (——) and late start (•) of each activity.

WORKING SCHEDULE

ACTIVITY	DESCRIPTION	CODE	DUR	START SCH'D	START REP'D	FINISH SCH'D	FINISH REP'D
C 10	PREPARE LAYOUT & GENERAL ARRANGEMENT	3000	3	2MAY74 1	6MAY74	6MAY74 3	
C 55	PREP SPECS UNDERGROUND TANKS	3000	8	6MAY74 3		15MAY74 10	
	RELEASE INQUIRY OBTAIN BIDS EVALUATE BIDS OWNER REVIEW & APPROVAL AWARD						

The easy to read Working Schedule contains the scheduled start and finish of each activity. Reported starts/finishes can be handwritten in "Reported" columns. Once reported, these dates are thereafter printed.

WORKING SCHEDULE BAR CHART



Total float and late start are not shown on the Working Schedule Bar Chart.

The illustration is a compressed or weekly time scale which plots 6" per year. Lengthy projects can be plotted on small amounts of paper.

UPDATE INPUT REPORT

CODE 20 AL STEIN-MECH PROJ MGR DATA DATE 14JUN74

ACTIVITY NUMBER		START	PERCEN COMPL.	REM DUR.	FINISH	REMARKS					
56		PERFORM PROC CYCLE UNDERGROUND TANKS				DUR = 11	COD = 7000	BC = 20	CC = 0		
56	....REPORTED	STA A 17*MAY*74 PC *35 RD ***2 FIN F 18*JUN*74			24 JUN 74						
65		PREP SPECS WASTE WTR TRANSFER PUMP PKG				DUR = 5	COD = 3000	BC = 45	CC = 0		
65	....REPORTED	STA A 20*MAY*74 PC 75 RD ***1 FIN 25*JUN*74									
50		FINALIZE PIPING DWGS & WLS FOR CONSTR				DUR = 5	COD = 3000	BC = 20	CC = 0		
50	REPORTED	STA A 31*MAY*74 PC *78 RD ***3 FIN F 19*JUN*74									

This turn-around report is shown segmented by codes. Appropriate titles are automatically generated for each subreport.

Update Input Report allows for the reporting of progress and provides space for modification of codes, duration, and description.

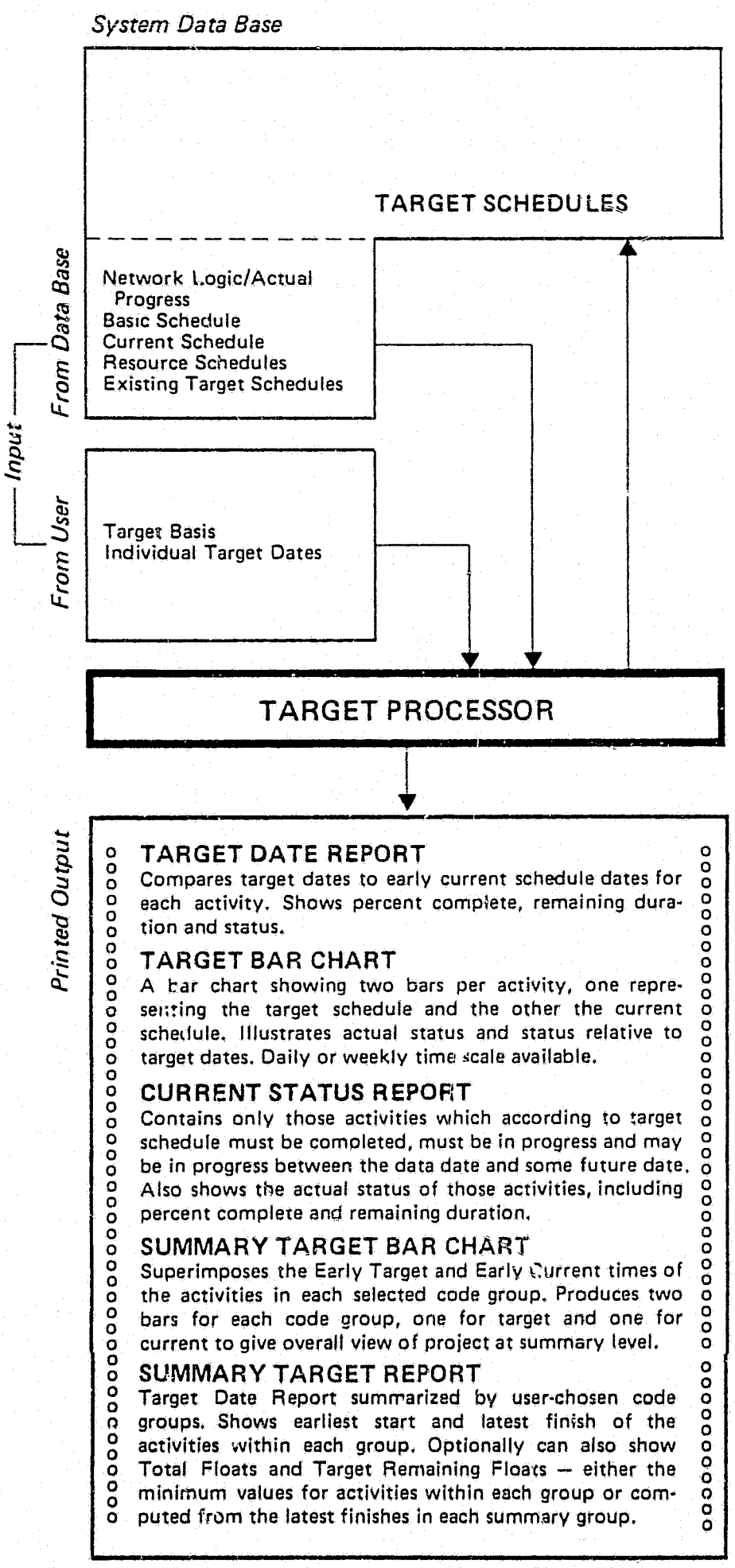
PREDICTED STATUS REPORT

THE FOLLOWING ACTIVITIES MUST BE COMPLETED BETWEEN 2MAY74 AND 30MAY74

ACTIVITY	DESCRIPTION	EST DUR	FINISH EARLY	FINISH LATE
10	PREPARE LAYOUT & GENERAL ARRANGEMENT	3	6MAY74	6MAY74
55	PREP SPECS UNDERGROUND TANKS	8	15MAY74	15MAY74
20	PREPARE EXCAVATION DETAILS	4	10MAY74	24MAY74
25	PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR	7	24MAY74	24MAY74
40	PREPARE FLOW DIAGRAM & PIPING LAYOUT	4	13MAY74	24MAY74

The Predicted Status Report looks ahead to any user-defined period and lists activities that MUST BE COMPLETED in the period listed. Separate pages (not illustrated here) list activities that MUST BE IN PROGRESS and MAY BE IN PROGRESS in that period.

Target Processor



Introduced into PROJECT/2 in 1969, the Target Date concept has developed into a major feature of the system. We have continued to refine and expand Target capabilities, incorporating specific needs of our users. Target Scheduling is now a proven project control technique.

The PROJECT/2 Target Processor enables you to create and freeze Target Schedules for comparison against the Current Schedule. The comparison is either by activity or by summary group. For each activity, the Target Dates and the Current Dates are output side by side. Accompanying these dates is an indication of the current status of the activity, i.e., either behind or complete, or critical with respect to its latest allowable Target Dates. The Target reports can be in tabular or bar chart format. In bar chart format, the differences between the Target Dates and the Current Dates for each activity are clearly visible, as are the actual percent complete and remaining duration.

A look ahead report, labelled the Current Status Report, shows the actual status of the activities targeted to finish or start as of a future date you supply. The percent complete, remaining duration, days ahead or behind target, and reported dates in the future are illustrated.

The Target Processor allows you to base a Target Schedule on any existing schedule in the Data Base. You can maintain up to 50 separate Target Schedules in the Data Base and use any one at any time. The Target Dates for any specific activity may be altered, but will never change unless you modify them. Logic changes and reported progress will not affect any of the saved Target Schedules. You may also use Target Scheduling to compare, activity by activity, any two schedules (including two Target Schedules) in the Data Base. This is very useful when displaying resource levelled schedules.

The PROJECT/2 Target Processor can also be used for "what if" analyses of potential future problems. Delays or other project changes can be simulated in the Target Schedule. Slippages resulting from such changes can then be isolated and made clearly apparent when the Target Schedule is compared with the Current Schedule.

TARGET DATE REPORT

TARGET DATA DATE 2MAY74 — TARGET COMPL 19JUL74 — CURRENT COMPL 24JUL74
CODE 10 — DATA DATE 14JUN74

	ACTIVITY	DESCRIPTION	PCT COM	REMDUR	START E.TARG	START CURRENT	FINISH E.TARG	FINISH CURRENT	TRF	STATUS
	10	PREPARE LAYOUT & GENERAL ARRANGEMENT	100	0	2MAY74 A	6MAY74	6MAY74 A	8MAY74	-2	COMPLETE
	20	PREPARE EXCAVATION DETAILS	100	0	7MAY74 A	16MAY74	10MAY74 A	24MAY74	0	COMPLETE
	25	PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR →	85	2	16MAY74 A	16MAY74	24MAY74 E	18JUN74	-17	BEHIND
	30	COMPLETE STRUCT DWGS & RLS FOR CONSTR	100	0	27MAY74 A	5JUN74	5JUN74 A	5JUN74	0	COMPLETE
	105	EXCAVATE FOR PIPING TRENCH	100	0	6JUN74 A	10JUN74	12JUN74 A	14JUN74	-2	COMPLETE
C	115	EXCAVATE FOR U/G TANKS	0	10	6JUN74	17JUN74	19JUN74	28JUN74	-1	BEHIND

Two starts and two finishes are given for each activity so they can be compared. Activity 25 is 85% complete, was started on 16 May, and will finish on 18 June. This is 17 days behind the Target Finish of 24 May.

TARGET SUMMARY REPORT

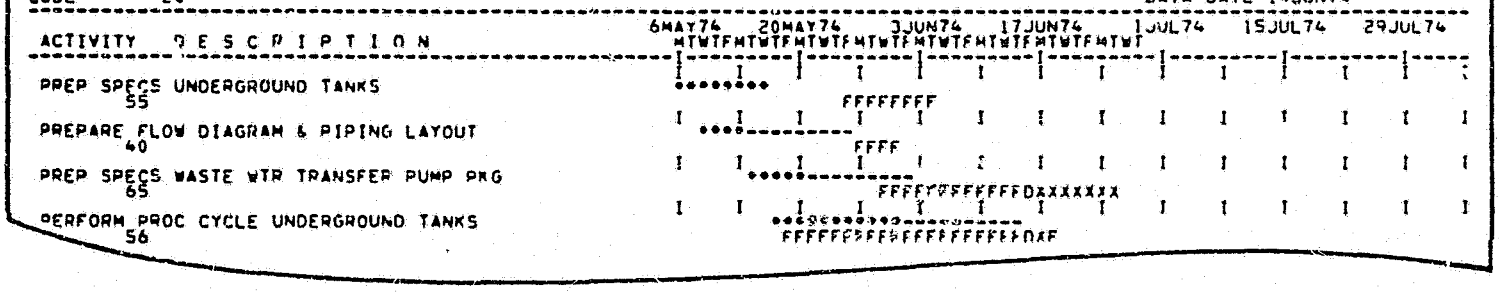
TARGET 1 COMPL 23OCT75 — CURRENT COMPL 20OCT75
SORT CODES 34 — DATA DATE 15SEP75 — PAGE 1

CODE NUMBER	DESCRIPTION MODE=T/FF	NO. ACTS	START E.TARG	START CURRENT	MINIMUM TTF	MINIMUM CTF	FINISH L.TARG	FINISH CURRENT	MINIMUM TRE	MINIMUM TRL	MINIMUM TRF
1	PRELIMINARY OPERATIONS	4	1AUG75 1	1AUG75 1	0	0	19SEP75 35	12SEP75 30	-10	0	0
2	CONCRETE WORK	4	29AUG75 21	29AUG75 21	0	0	7OCT75 47	2OCT75 44	0	3	3
10	MAJOR MILESTONES	1	30SEP75 42	25SEP75 39	0	0	29SEP75 41	24SEP75 38	3	3	3
11	SUPERSTRUCTURE	3	30SEP75 42	25SEP75 39	0	0	23OCT75 58	8OCT75 48	3	3	3
12	ELECTRICAL	1	15OCT75 52	9OCT75 49	0	0	23OCT75 58	20OCT75 55	3	3	3

The Target Schedule data is summarized for groups of activities having the same code numbers. The user chose the option of displaying the minumum float values for each summary group.

TARGET BAR CHART

TARGET COMPL 19JUL74 — CURRENT COMPL 24JUL74
CODE 20 — DATA DATE 14JUN74



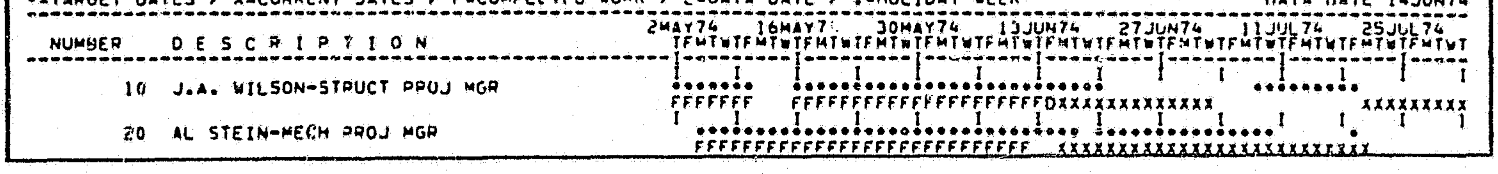
The Target Bar Chart permits a visual comparison of the Target dates (upper bars) with the Current dates (lower bars). All activities in the illustration are behind schedule (lower bars end after the Target bars).

The Target bar shows the Target Schedule (***) and float (———).

The Current bar show completed work (F), the Data Date (D), work scheduled in the future (X), and reported starts or finishes in the future (E).

SUMMARY TARGET BAR CHART

TARGET COMPL 19JUL74 — SCH 1 COMPL 5AUG74
*=TARGET DATES / X=CURRENT DATES / F=COMPLETED WORK / D=DATA DATE / .=HOLIDAY WEEK — DATA DATE 14JUN74



On the Summary Target Bar Chart all activities have been summarized (collapsed) into major groups to display the overall status of the project.

CURRENT STATUS REPORT I

TARGET DATA DATE 2MAY74 — TARGET COMPL 19JUL74 — CURRENT COMPL 24JUL74
THE FOLLOWING ACTIVITIES MUST BE COMPLETED BETWEEN 14JUN74 AND 28JUN74
DATA DATE 14JUN74

ACTIVITY	DESCRIPTION	DAYS REM	EARLY FINISH TARGET	EARLY FINISH CURRENT	PER CENT COMPLETE	DAYS AHEAD	DAYS BEHIND	EXPECTED START
65	PREP SPECS WASTE WTR TRANSFER PUMP PKG	7	20MAY74	25JUN74	50		17	
66	PERFORM PROC CYCLE WW XFER PUMP PKG	0	24MAY74	14JUN74 A	100		6	
56	PERFORM PROC CYCLE UNDERGROUND TANKS	2	30MAY74	18JUN74 E	95		3	
50	FINALIZE PIPING DWGS & RLS FOR CONSTR	3	3JUN74	19JUN74 E	78		2	
57	FABRICATE & SHIP U/G TANKS	4	7JUN74	20JUN74 F	60	1		
58	TANKS ON SITE	0	10JUN74	21JUN74	0	1		21JUN74

This report looks ahead two weeks beyond the 14 June Data Date.

The first subreport displays the current status of all activities targeted to finish in the two week period, regardless of whether the activity is 100% complete as of the 14th or not yet started. Activities scheduled to be finished before the 14th but not yet finished are included also.

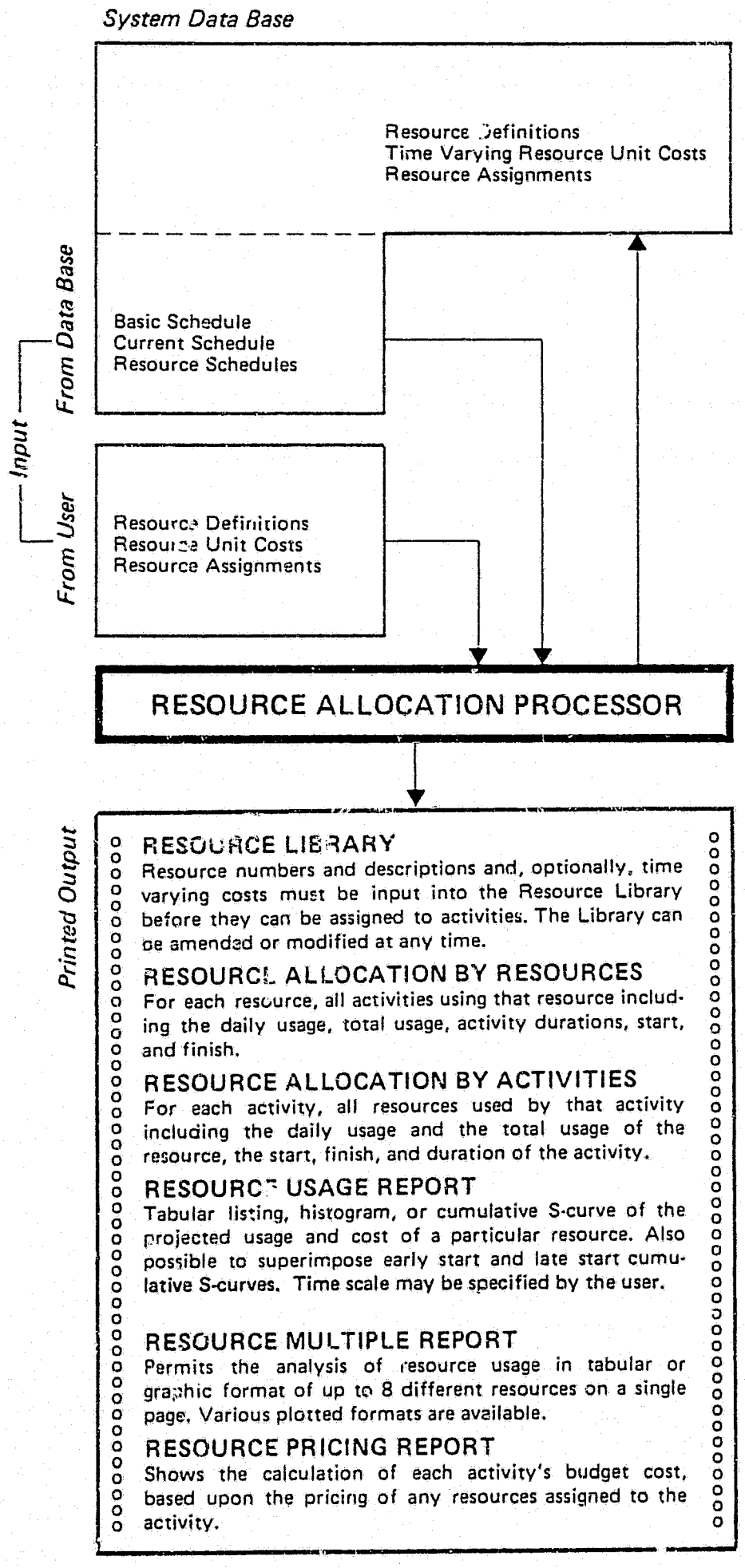
CURRENT STATUS REPORT II

THE FOLLOWING ACTIVITIES MUST BE IN PROGRESS BETWEEN 14JUN74 AND 28JUN74

ACTIVITY	DESCRIPTION	DAYS REM	EARLY FINISH TARGET	EARLY FINISH CURRENT	PER CENT COMPLETE	DAYS AHEAD	DAYS BEHIND	EXPECTED START
135	INSTALL PUMPS	2	18JUN74	26JUN74	0	3		25JUN74
130	SET TANKS & INSTALL SOIL ANCHORS	5	26JUN74	5JUL74	0		3	1JUL74
110	INSTALL PIPING IN TRENCH	8	2JUL74	4JUL74	0		2	25JUN74

In the second subreport, the activities are targeted to start within the two week range.

Resource Allocation Processor



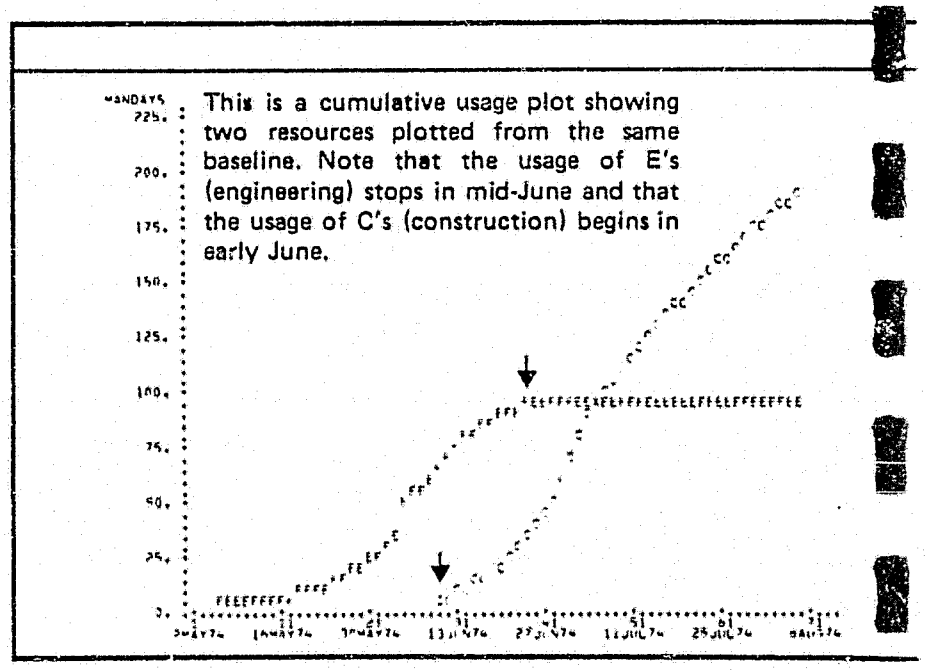
Today's resource-scarce world requires careful analysis of manpower, material, and equipment needs for each project.

The Resource Allocation Processor allows you to enter any number of resources (number, description, type, unit of measure, time varying cost) into a Resource Library table. You can assign any number of resources to any or all activities on a per day or lump sum basis. Assigned resources can also be combined into summary resources.

Once you assign resources, the Resource Pricing feature will compute activity budget estimates. Pricing by resources is completely selective. For example, you can compute the costs for labor, and exclude costs of material, equipment, and subcontracts.

PROJECT/2 can produce tabular listings, histograms, and cumulative S-curves of projected resource usage and resource cost over any schedule. The vertical scales of all plots are chosen automatically, based upon the maximum ordinate values. With the Multiple Resource Report you can analyze the projected demand of up to eight different resources on the same report. The analysis is usage versus time and can be printed in the form of a combined histogram or a set of cumulative S-curves on one plot page.

Presently in the preliminary planning phase is a feature which will report and compare actual resource usage, on an activity or summary level, to estimated usage in much the same manner as is presently available in the Cost Processor (see page 14).



This is a cumulative usage plot showing two resources plotted from the same baseline. Note that the usage of E's (engineering) stops in mid-June and that the usage of C's (construction) begins in early June.

RESOURCE LIBRARY

STRUCTURAL DESIGNERS	11.06	LABOR	MANDAYS COSTS		
				$	112.00
ELECTRICAL ENGINEERS	12.05	LABOR	MANDAYS COSTS		
			THROUGH 31MAY 1974	$	160.00
			THROUGH 30JUN 1974	$	180.00
				$	200.00

The unit cost for Resource 11.06 is a constant. The unit cost of Resource 12.05 changes from $160 to $180 on 1 June and from $180 to $200 on 1 July.

RESOURCE ALLOCATION BY RESOURCES

ACTIVITY	RESOURCE DESCRIPTION	DAILY USAGE	TOTAL USAGE	DUR	START	FINISH
*********	10.05 MECHANICAL ENGINEERS		MANDAYS			
55	PREP SPECS UNDERGROUND TANKS	1.0	8.0	8	6MAY74	15MAY74
40	PREPARE FLOW DIAGRAM & PIPING LAYOUT	0.5	2.0	4	8MAY74	13MAY74
65	PREP SPECS WASTE WTR TRANSFER PUMP PKG	1.0	5.0	5	14MAY74	20MAY74
50	FINALIZE PIPING DWGS & RLS FOR CONSTR	1.0	5.0	5	28MAY74	3JUN74
	AVERAGE	1.0	20.0	21	6MAY74	3JUN74

Each activity using a resource is listed, arranged by start date. Daily and total quantities are printed. Selection of activities is available.

RESOURCE ALLOCATION BY ACTIVITIES

ACTIVITY	RESOURCE	DESCRIPTION	DAILY USAGE	TOTAL USAGE		DUR	START	FINISH
10		PREPARE LAYOUT & GENERAL ARRANGEMENT				3	2MAY74	6MAY74
	11.05	STRUCTURAL ENGINEERS	1.0	3.0	MANDAYS			
	11.06	STRUCTURAL DESIGNERS	1.0	3.0	MANDAYS			
	199.00	TOTAL ENGRG	2.0	6.0	MANDAYS			
20		PREPARE EXCAVATION DETAILS				4	7MAY74	10MAY74
	11.06	STRUCTURAL DESIGNERS	1.0	4.0	MANDAYS			
	199.00	TOTAL ENGRG	1.0	4.0	MANDAYS			
25		PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR				7	16MAY74	24MAY74
	11.06	STRUCTURAL DESIGNERS	1.0	7.0	MANDAYS			
	199.00	TOTAL ENGRG	1.0	7.0	MANDAYS			

Each resource being used by an activity is shown, including daily and total usage. You can sort the activities and select the resources to be listed.

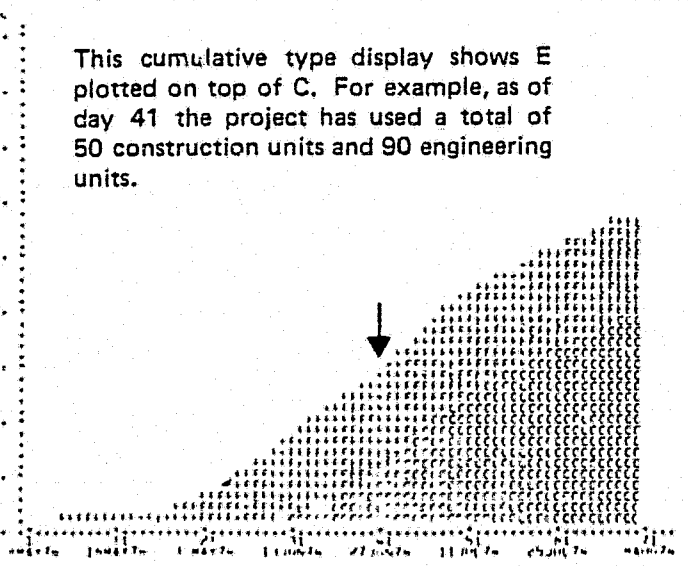
RESOURCE PRICING REPORT

ACTIVITY	10	PREPARE LAYOUT & GENERAL ARRANGEMENT			
RESOURCE NUMBER	11.05	STRUCTURAL ENGINEERS	3.0 UNITS AT $	160.00/UNIT = $	480.
RESOURCE NUMBER	11.06	STRUCTURAL DESIGNERS	3.0 UNITS AT $	112.00/UNIT = $	336.
			TOTAL COST THIS ACTIVITY= $		816.
ACTIVITY	20	PREPARE EXCAVATION DETAILS			
RESOURCE NUMBER	11.06	STRUCTURAL DESIGNERS	4.0 UNITS AT $	112.00/UNIT = $	448.
			TOTAL COST THIS ACTIVITY= $		448.

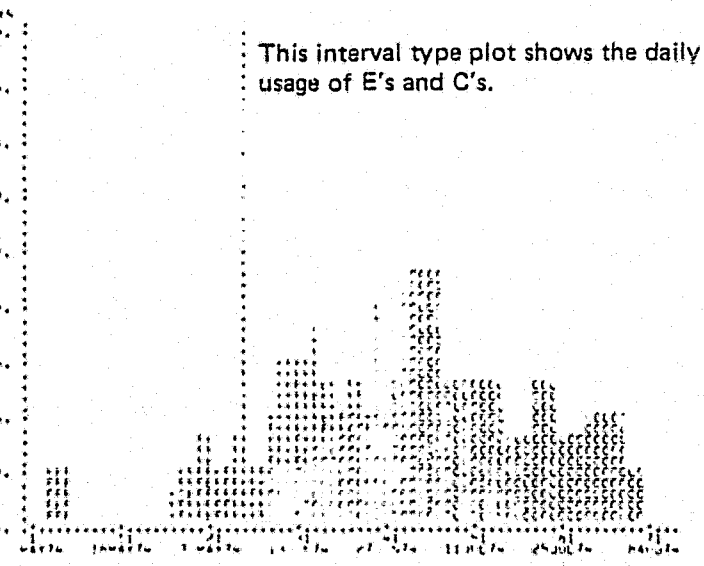
This report displays the resource pricing process for each selected activity.

MULTIPLE RESOURCE GRAPHS

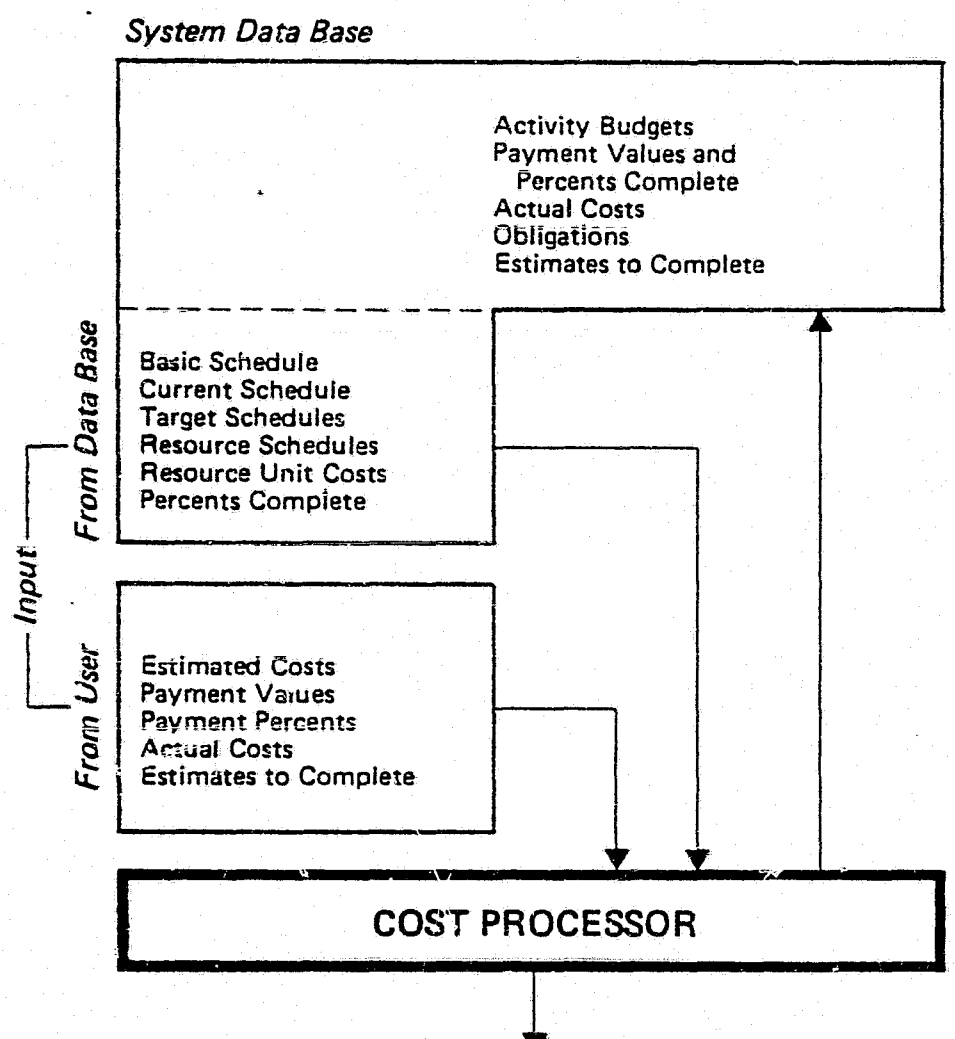
This cumulative type display shows E plotted on top of C. For example, as of day 41 the project has used a total of 50 construction units and 90 engineering units.



This interval type plot shows the daily usage of E's and C's.



Cost Processor



The PROJECT/2 Cost Processor will assist you in integrating your work schedule with your cost control. First you estimate lump sum activity budgets. (Or you may prepare your budgets by pricing resources.) PROJECT/2 will distribute your costs over your schedule, producing a projected Cashflow Report, which is printed in three forms: a listing, a histogram of dollars versus time, and a cumulative S-curve. An option enables you to request superimposed early start and late start cumulative S-curves of cashflow. On all cashflow reports, the time interval can be a day, a week, a month, or a multiple thereof.

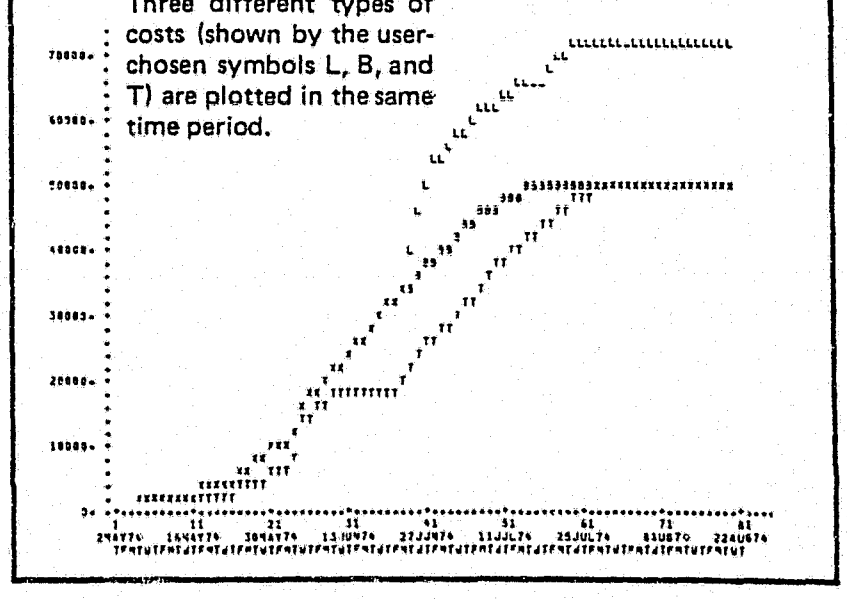
You report revised costs in the form of actual expenditures, obligations, and estimates to complete. PROJECT/2 can compute the estimates to complete for you. Comparisons of revised costs to estimated costs and percent complete costwise to percent complete timewise are available via the Actual Cost and Progress Report on either a detailed or summary basis. Actual and projected cashflow can be compared to targeted cashflow via the Multiple Cost Curves feature.

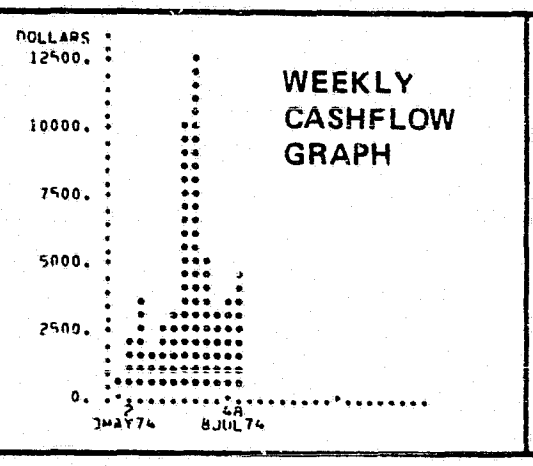
In addition to estimating project cost and allowing you to control actual expenditures, the Cost Processor produces requisition reports based upon the value of work performed. These Payments Reports (available on either a detailed or summarized basis) show the earned value to date and the cumulative percent complete, as well as the earned value and percent complete for the latest period. From the data supplied on the Payments Reports, it is possible to prepare partial payment invoices for work completed.

Presently under development is a feature that will fully integrate item-by-item cost accounts with the schedule. This feature, unique to PROJECT/2 will provide to the Project Manager an unprecented degree of control over his project.

MULTIPLE COST CURVES

Three different types of costs (shown by the user-chosen symbols L, B, and T) are plotted in the same time period.





WEEKLY CASHFLOW GRAPH

WEEKLY CASHFLOW REPORT

	DATE	DAY	INTERVAL COSTS	CUMULATIVE COSTS AT END OF INTERVAL
	3 MAY 74	2	$ 544.	$ 544.
	10 MAY 74	7	$ 2096.	$ 2640.
→	17 MAY 74	12	$ 3712.	$ 6352.
	24 MAY 74	17	$ 1648.	$ 8000.
	31 MAY 74	22	$ 2448.	$ 10448.
	7 JUN 74	27	$ 2812.	$ 13260.
	14 JUN 74	32	$ 10182.	$ 23442.
	21 JUN 74	37	$ 12259.	$ 35701.
	28 JUN 74	42	$ 5101.	$ 40802.
	5 JUL 74	47	$ 2798.	$ 43600.
	12 JUL 74	52	$ 3396.	$ 46996.
	19 JUL 74	57	$ 4500.	$ 51496.

For the week ending 17 May, $3712 is to be spent; from the project start through 17 May, $6352 is to be spent.

ACTUAL COST & PROGRESS REPORT

ACTIVITY	DESCRIPTION	START	FINISH	REM DUR	REM PC	BUDGET ($)	ACTUAL COST ($)	ADD OBLIG ($)	EST. TO COMP. ($)	REV EST ($)	PC COST	PC TIME	OVER (UNDER) ($)	PC O/U
10	PREPARE LAYOUT & GENERAL ARRANGEMENT	A 6MAY74	A 8MAY74		COMPLETE	816	2510	0	0	2510	100	100	1694	207
20	PREPARE EXCAVATION DETAILS	A 16MAY74	A 24MAY74		COMPLETE	448	560	400	0	960	100	100	512	114
25	PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR	A 16MAY74	F 18JUN74	2	15	784	0	3250	0	3250	100	85	2466	314

Revised estimate is the sum of the reported actual cost, additional obligation, and estimate to complete. Overage and percent overage represent a comparison between budget and revised estimate.

SUMMARY COST & PROGRESS REPORT

CODE	DESCRIPTION	BUDGET ($)	ACTUAL COST ($)	ADD OBLIG ($)	EST. TO COMP. ($)	REV EST ($)	PC COST	PC TIME	OVER (UNDER) ($)	PC O/U
10	J.A. WILSON-STRUCT PROJ MGR	15254	6034	3650	10530	20214	47	54	4960	32
20	AL STEIN-MECH PROJ MGR	27338	9046	950	28251	38247	26	61	10909	39
30	M. SHAH-ELECT PROJ MGR	8904	7409	0	5459	12868	57	44	3964	44
	GRAND TOTALS	51496	22489	4600	44240	71329	37	56	19833	38

The percent complete cost is the sum of actual plus obligations over revised estimate; percent complete time is based upon a measure of days worked. Totals are also shown.

PAYMENTS ESTIMATE REPORT

CODE 0 IN-HOUSE ENGINEERING

DESCRIPTION	PAYMENT VALUE	PERCENT COMPLETE PAST	PERCENT COMPLETE PER	PERCENT COMPLETE TOT	AMOUNT EARNED PAST	AMOUNT EARNED PERIOD	AMOUNT EARNED TOTAL
10 PREPARE LAYOUT & GENERAL ARRANGEMENT	816.	0.0	100.	100.	0.0	816.	816.
20 PREPARE EXCAVATION DETAILS	448.	0.0	100.	100.	0.0	448.	448.
25 PREP STRUCT DWGS-PPG TRENCH,SLAB&ANCHOR	→ 784.	0.0	78.	78.	0.0	612.	612.

The example is ejected by codes; subreport shown is for In-House Engineering.

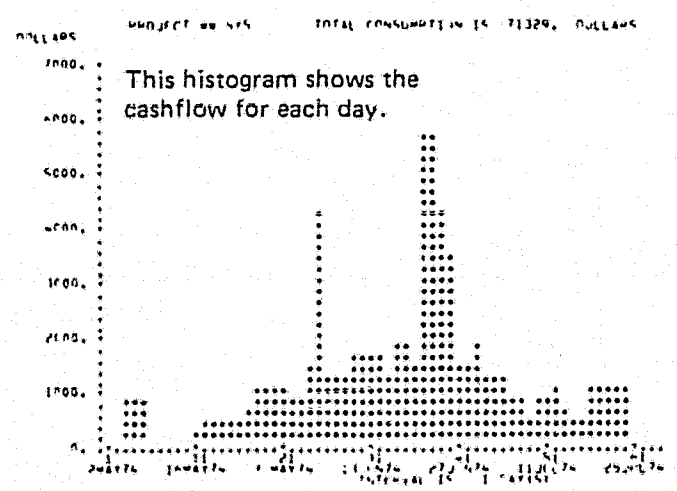
Activity 25 with a value of $784 is 78% complete this period. The amount earned this period is thus $612.

SUMMARY PAYMENTS STATUS REPORT

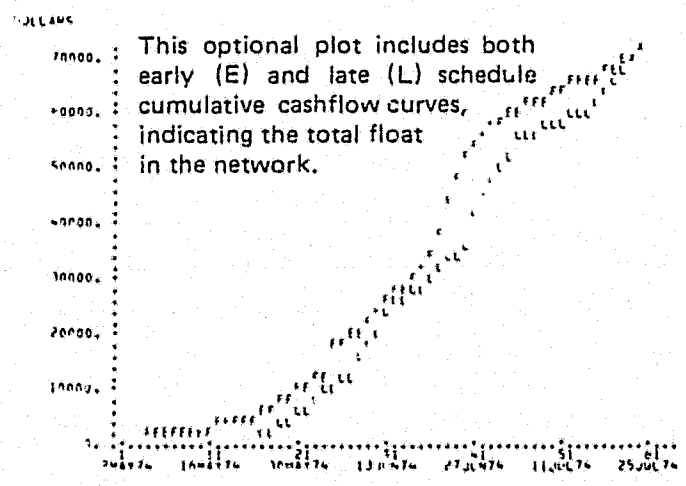
CATEGORY	DESCRIPTION	TOTAL AMOUNT	PCT/ TOTAL	PERCENT COMPLT PERIOD	PERCENT COMPLT TOTAL	AMOUNT EARNED PERIOD	AMOUNT EARNED TOTAL	PCT/TOT EARNED	AMOUNT RETAINED
0	IN-HOUSE ENGINEERING	12736.	24.73	39.68	39.68	5053.	5053.	100.00	0.0
350	EXCAVATION WORK ORDER	3710.	7.20	0.0	0.0	0.0	0.0	0.0	0.0
427	PIPING WORK ORDER	22330.	43.36	0.0	0.0	0.0	0.0	0.0	0.0
485	CONCRETE WORK ORDER	7320.	14.21	0.0	0.0	0.0	0.0	0.0	0.0
774	ELECTRICAL WORK ORDER	5400.	10.49	0.0	0.0	0.0	0.0	0.0	0.0
	GRAND TOTAL	51496.	100.	9.81	9.81	5052.	5053.	100.	0.0

The Summary Payments Status Report displays the relative value of each code group to all included code groups. Provision is made for amounts retained.

DAILY CASHFLOW GRAPHS

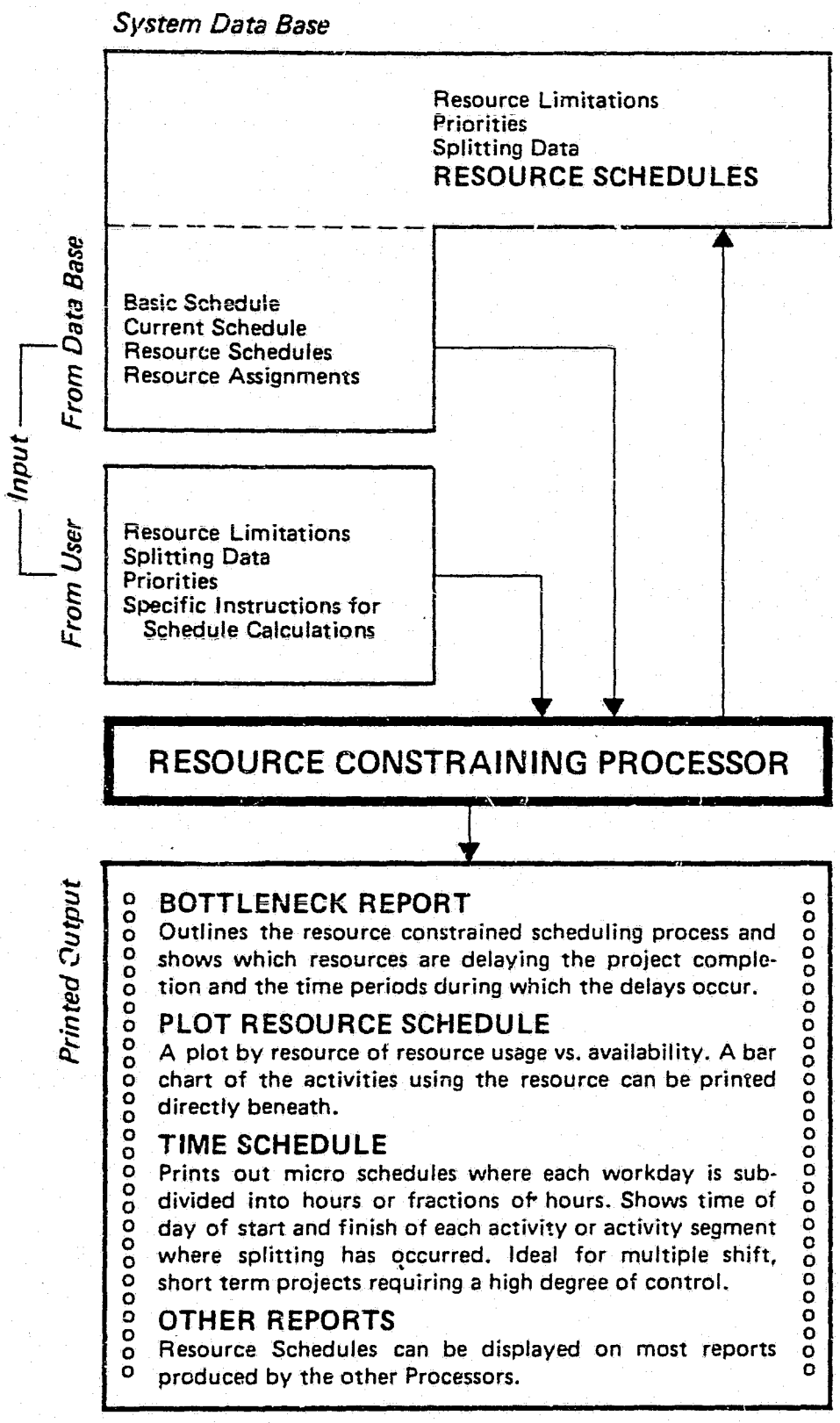


This histogram shows the cashflow for each day.



This optional plot includes both early (E) and late (L) schedule cumulative cashflow curves, indicating the total float in the network.

Resource Constraining Processor



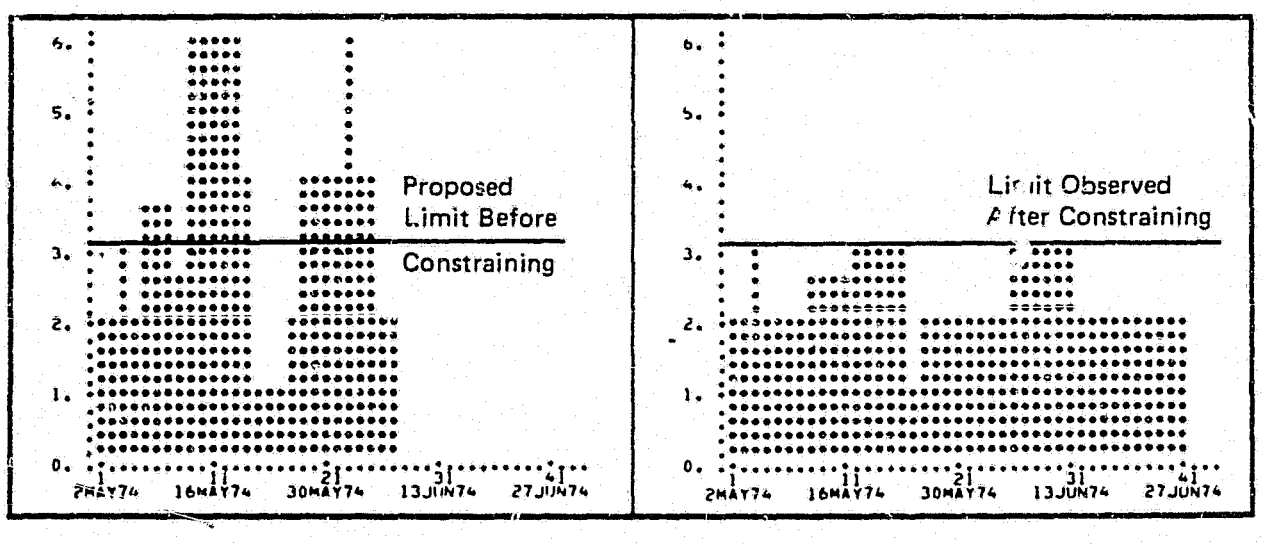
In the real world, resources are usually limited and the resource requirements of a project must be "smoothed" over time. For complex networks involving a wide variety of resources with limited availabilities, PROJECT/2 provides an exceptional facility for creating resource constrained schedules. A dynamic, user-controlled algorithm produces feasible schedules at an economical price.

The PROJECT/2 approach to resource constraining is relatively simple. First you define availabilities for the constraining resources and establish priorities for the activities. A single command will create a Resource Schedule with one start and one finish for each activity. You can constrain any number of resources assigned to a project and select the set of activities for which you want to produce resource constrained schedules. Options allow you to request a time-limited resource constrained schedule and to create resource schedules with *float*.

Fifty different Resource Schedules can be filed in the Data Base. You may activate any Resource Schedule by means of a single reference and display it on a selection of reports produced by any of the other processors. Once developed, Resource Schedules may be saved as Target Schedules and displayed on Target Reports.

The Bottleneck Report enables you to review the resource constrained scheduling process to determine which resources may delay the project. You can also request a Plot Resource Schedule report: a projected "smoothed" usage and availability histogram followed by a bar chart of the activities using the resource.

The Resource Constraining Processor also allows you to create schedules that segment activities into two or more sections. Segmentation, combined with micro scheduling (in time periods smaller than a day), can be very powerful in scheduling short-term projects such as nuclear power plant outages or refinery turnarounds which involve scheduling on a multiple shift basis.



Before Constraining (left)
Sample resource usage output histogram from the Resource Allocation Processor before levelling. It is desired to limit usage to 3 mandays per day in order to smooth the peaks and fill the valleys of the graph.

After Constraining (right)
The Resource Allocation Processor produces this output based on the Resource Schedule. Resource usage is at or below 3 mandays per day but usage time has stretched from 27 to 41 days.

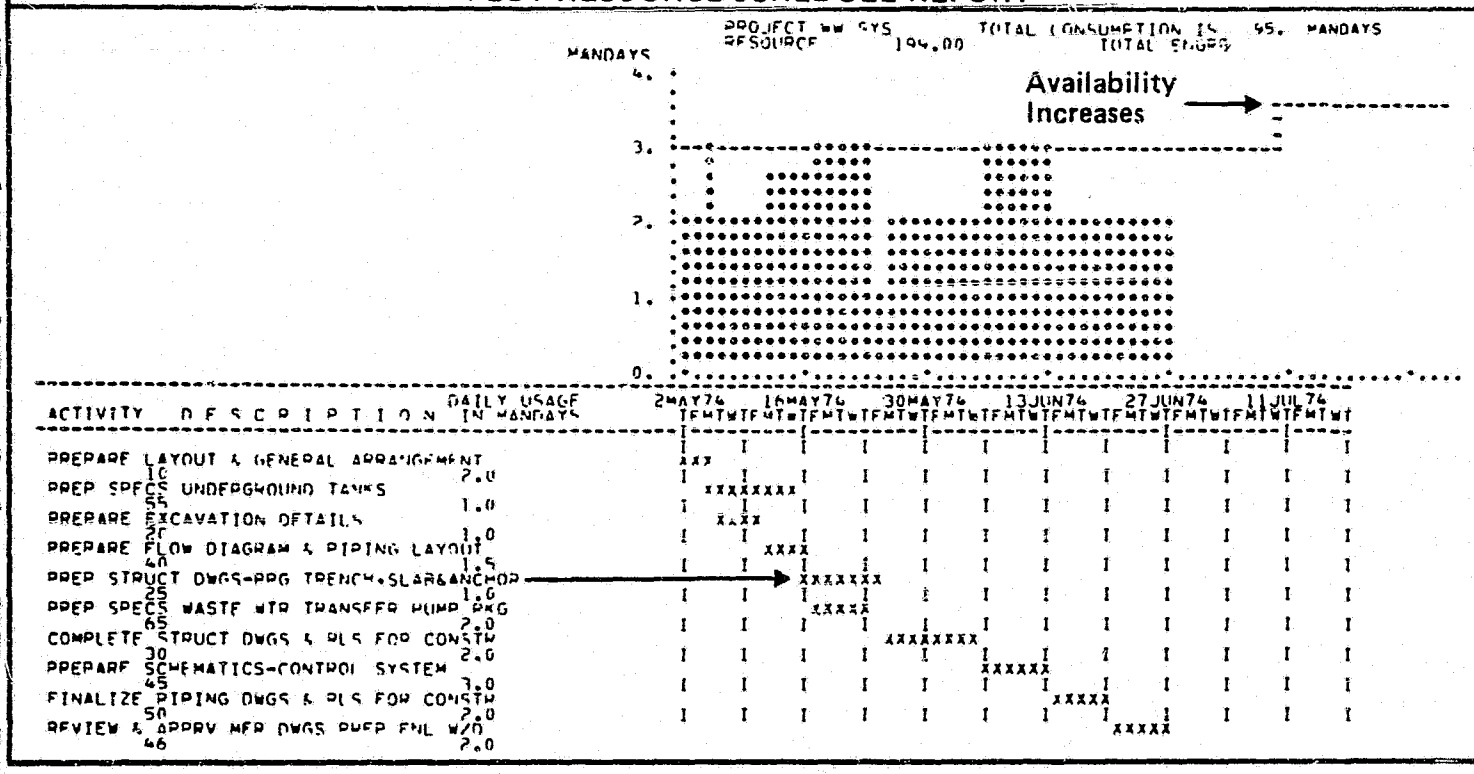
BOTTLENECK REPORT

CLOCK TIME	ACTIVITY NUMBER	PRIO-RITY	RANK (LS)	ACTION	CRIT. INDX	SCHED START	SCHED FINISH	SEG NO.	X	BOTNK RES	QUANT REQ	NORML AVAIL	SECONDARY AVAIL	DISP	AMOUNT SHORT	BOTNK TIME
T= 1	10	0	1	SCHED	0	1	3									
T= 3	55	0	3	SCHED	0	3	10									
T= 4	20	0	14	SCHED	10	4	7									
T= 5	40	0	14		9					199.00	1.5	1.0	0.0		0.5	T= 0
		0	14		4					199.00	1.5	1.0	0.0		0.5	T= 0

This report displays the actual scheduling process through a network.

In this example, activities 10, 55, and 20 were scheduled when eligible but activity 40 was delayed 3 days, (from day 5 to day 8) due to a shortage of 0.5 units of resource 199.

PLOT RESOURCE SCHEDULE REPORT



The total quantity of the resource scheduled to be used is 95 man-days represented by the * * *'s.

The ——'s represent the availability of the resource. Note the change in availability and that in this example the maximum used is never greater than the maximum availability.

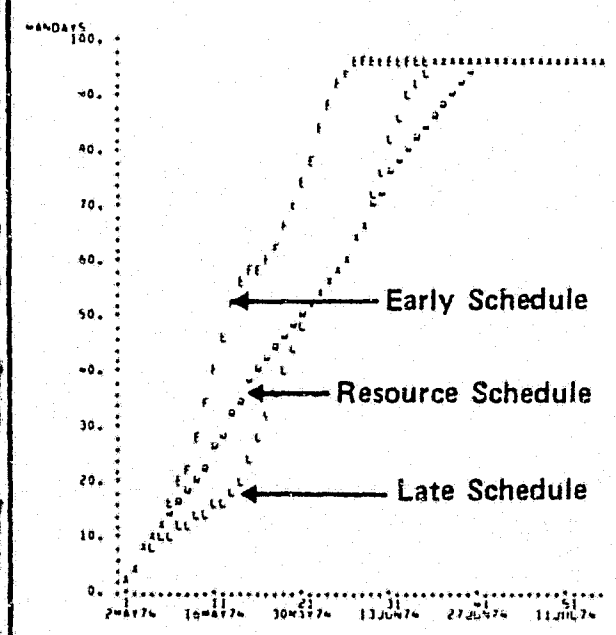
Each activity using the resource is plotted below the histogram. Activity 25 using 1 manday per day for 7 days is scheduled to begin on 16 May. The daily usage is printed beneath the description.

TIME SCHEDULE

ACTIVITY NUMBER	D E S C R I P T I O N	ACT TYPE	SEGMT NO.	DURATION ORIG	DURATION TTL	START DATE	INFORMATION WKPRD	INFORMATION TIME	FINISH DATE	INFORMATION WKPRD	INFORMATION TIME
1	GET ORGANIZED			2	2	1MAY74	1	800M	1MAY74	2	1200M
2	ALL WORK 2			3	3	1MAY74	3	1200M	1MAY74	5	1800M
3	ALL THINK			5	17	1MAY74	3	1200M	3MAY74	14	1400M
			1	2		1MAY74	3	1200M	1MAY74	4	1600M
			2	3		3MAY74	17	800M	3MAY74	14	1400M
4	MIX 4			3	3	2MAY74	9	800M	2MAY74	11	1400M

The start and finish times of day are given for each activity and activity segment. Splitting occurs as expanses of time (typically overnight) are skipped in a multiple shift project.

CUMULATIVE RESOURCE USAGE



When plotting cumulative combined Early Schedule/Late Schedule cost or resource distribution, it is also possible to overplot the same quantity distributed over a third schedule, a Resource Schedule.

Network Graphics Processor

The network diagrams on the following pages were generated by the PROJECT/2 Network Graphics Processor and drawn on a Calcomp plotter. Fast and flexible, the Network Graphics Processor enables you to produce network diagrams quickly, easily, and — using the PROJECT/2 Interval, Range, Select, and Eject features — in a format tailored to the particular needs of your project.

Because it's fast . . .

You are able to produce an updated diagram of your network when you need it, not one or two weeks later. Plus, you are able to see at a glance the effects of progress, logic changes, and delays.

Because it's flexible . . .

You can isolate just those activities which are of interest; you can format, size, and shape the plots to fit your specific needs; and you can plot on virtually any pen or electrostatic plotter.

Among the options available with the Network Graphics Processor are:

Horizontal Layout

You can choose from four available formats for spacing activities across a page:

1. DISCRETE time scale, where a new column of activities is generated for each different activity start or finish.
2. LINEAR time scale, where the individual columns as generated by the DISCRETE option are spaced linearly across the page.
3. COMPRESSED time scale, where each column represents a span of time.
4. LOGICAL (fully compressed), where activity placement is based on network logic rather than schedule dates.

Vertical Layout

You can control the vertical placement of activities by assigning "zones" to activities. The network shown on page 20 was zoned based on responsibility codes. You can also zone activities by Total Float or by assigning selected groupings of activities to specific zones.

Lettering Size and Scale

For each printed page you can choose one of ten reductions from 1/10 to full size. The sample plot on the facing page was produced at SCALE 4, which is 40% of full size. Optionally, you can eliminate the activity descriptions. If you choose to print activity numbers only, they will be blown up to fill the node boxes.

Plot Pages and Sheets

Each DRAW command will produce one or more pages of plotted output. Pages may be divided into sheets, the size of which you can specify. If no sheet size is specified, each page will be one continuous sheet, long enough to show all activities. If the format doesn't fit your plotter or purpose, you can choose to rotate the plot 90 degrees.

Off-Page Activities

Normally, all off-page activities (activities that directly precede or succeed activities on the page, but are not plotted on the same page) will be referenced in hexagonal blocks. You may choose to completely eliminate off-page activities from the plot or to limit them. Connectors are always generated between activities that are on different sheets of the same page.

Schedule Dates

The dates shown for each activity are PROJECT/2 Working Schedule dates. Thus, you can choose Early Start, Late Start, Full Range, or Resource Constrained Schedules.

Title Block

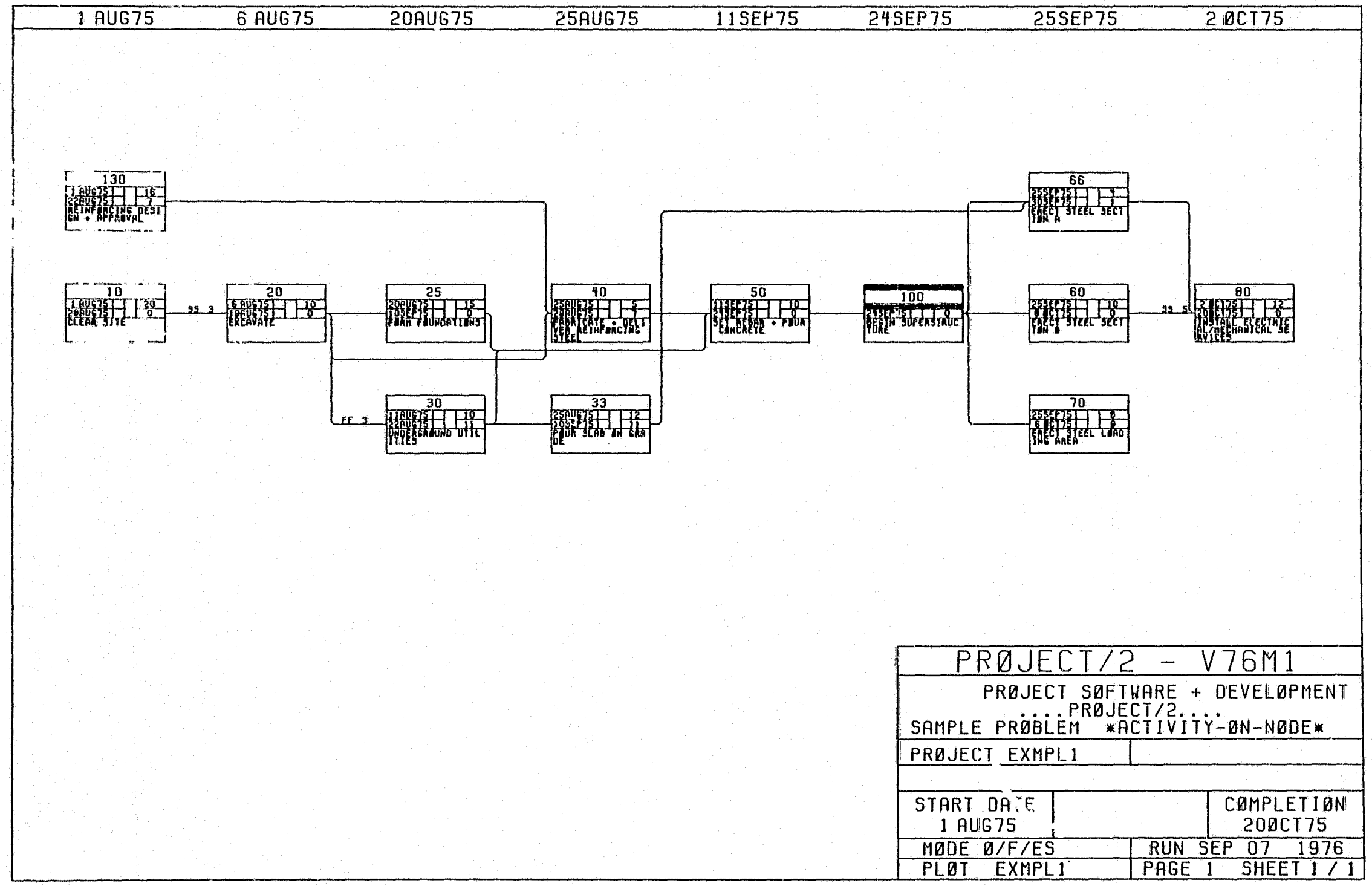
Each page may have a title block at the bottom showing the page and sheet number, project title, project start and completion dates, Data Date and, if ejecting, eject code and description.

Critical Paths

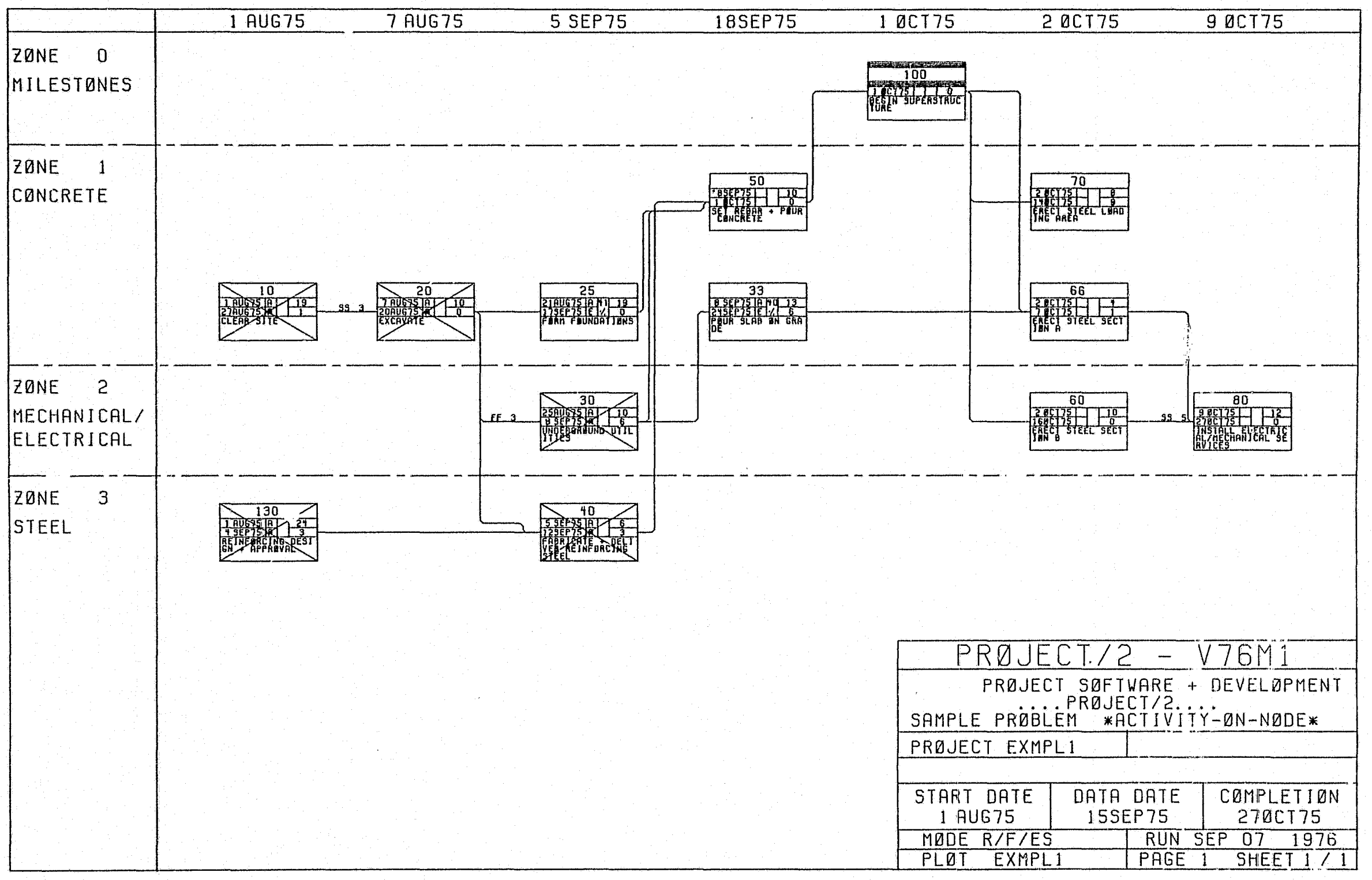
Critical paths can be highlighted in red or with double lines to permit easy tracing of this path through the network.

Milestones

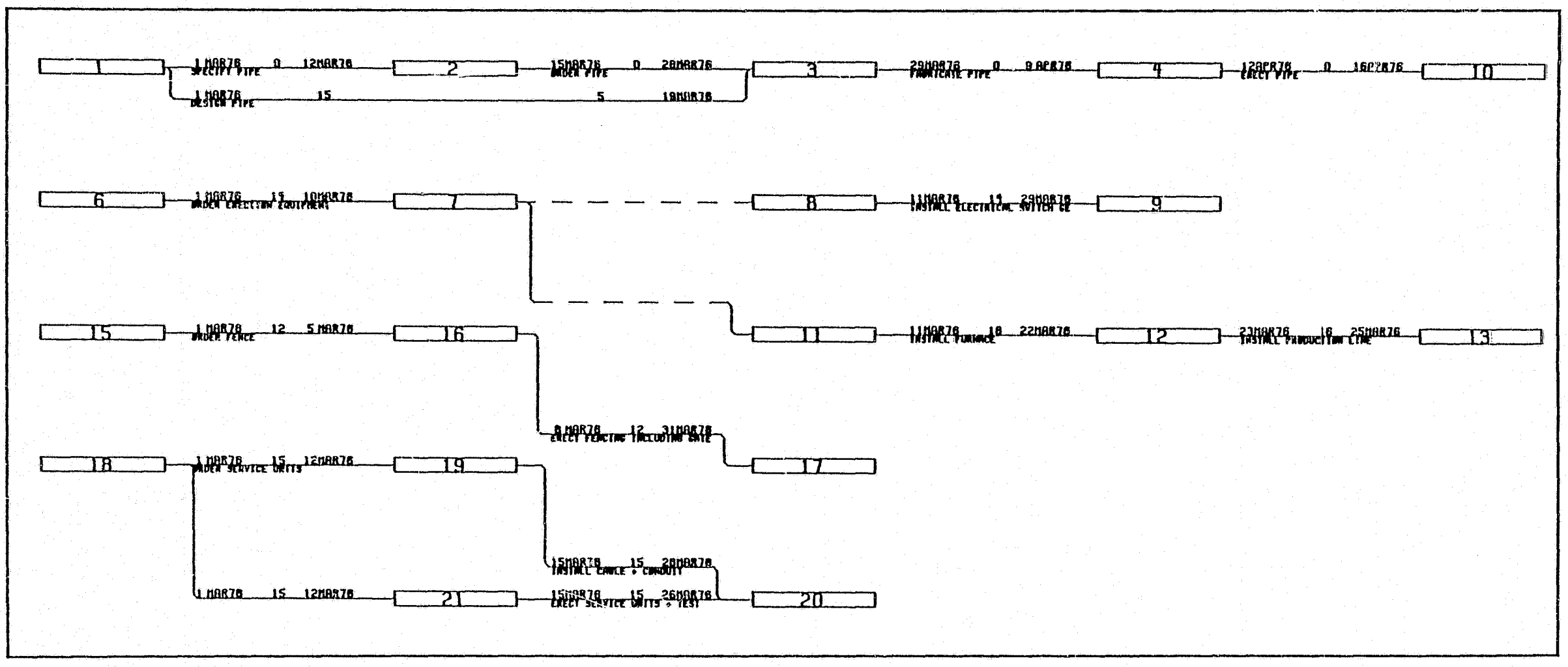
Milestones are clearly indicated in the network with special notations. In addition, "all milestone" networks can be produced simply and economically.



Example of COMPRESSED A/N Network with no Progress Reported



Zoned COMPRESSED A/N Network Diagram showing Reported Progress



Example of A/A Network Drawn by PROJECT/2

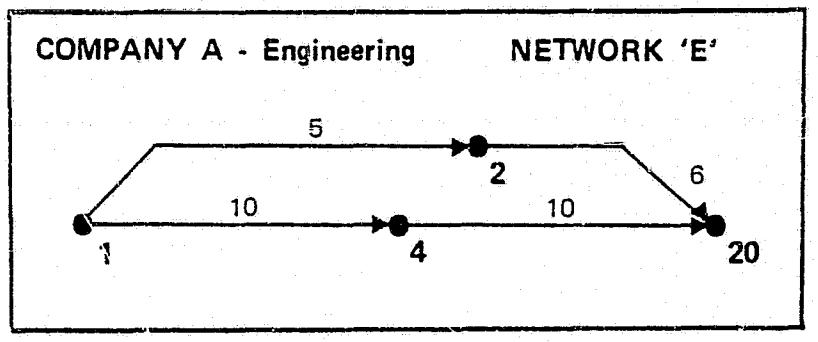
(Note: The Title Block Has Been Suppressed in This Example)

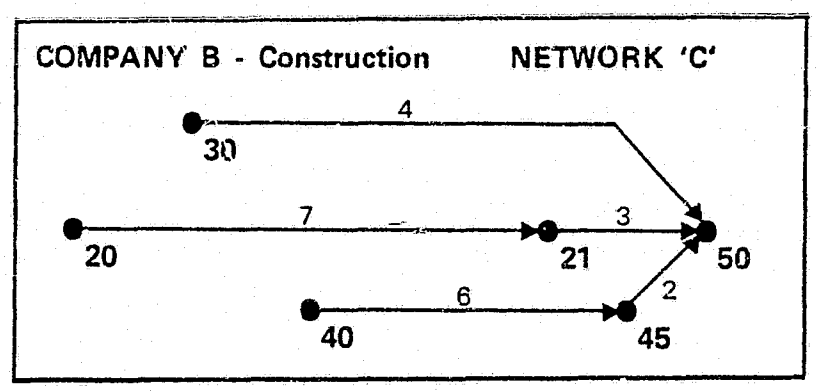
Multiproject Processor

One of the most important requirements of a project control system is the ability to simultaneously process data from two or more projects. The PROJECT/2 Multiproject capability allows you to use one single command to combine two or more separate member project Data Bases into a Multiproject Data Base and to produce reports for the entire Multiproject. Multiproject enables you to produce organization-wide functional breakdowns and to summarize an entire project on one line of a report. More importantly, you can constrain resources simultaneously across all projects in a Multiproject. Once a Multiproject Resource Schedule has been created to satisfy your overall resource considerations, you may transfer that schedule back into the Data Bases of the member projects for future use as a Target Schedule.

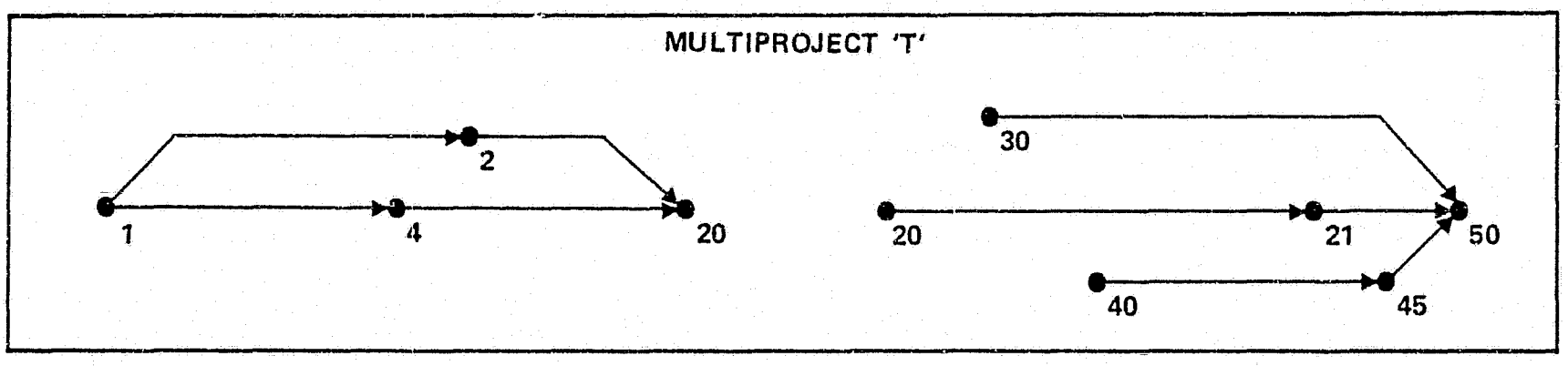
PROJECT/2 can also place logical restraints between activities in the separate member projects comprising a Multiproject. This is done by creating a Multiproject and then transforming it into a composite project, the latter having all the attributes of a single project. Such a transformation does not affect any of the individual networks that comprised the Multiproject prior to its conversion. Once a Multiproject has been transformed, restraints between individual activities in the various subnetworks can be added and all normal PROJECT/2 schedule cost and resource calculations can occur.

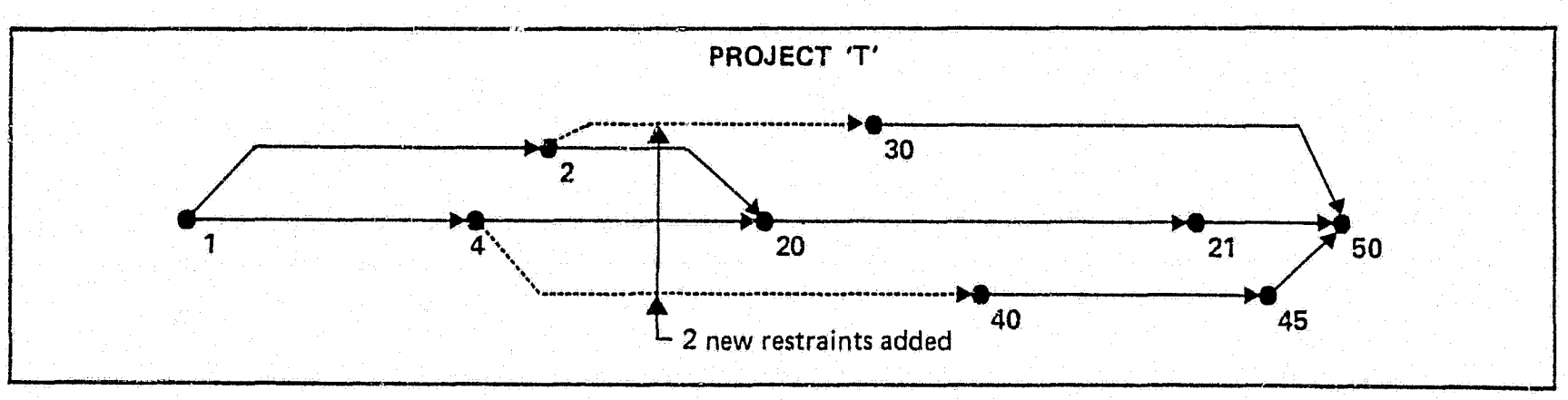
Networks "E" and "C" (at the right) illustrate a project for which Company A performs the engineering and Company B is responsible for the construction. Each develops its own individual network data and reports progress, costs, resource allocation, etc., producing separate reports for each company.





Eventually in the planning and scheduling process, Companies A and B become interdependent, thus requiring a total analysis of the entire project. The engineers' Data Base is merged with the constructors' Data Base to form a new independent project "T," which is subsequently revised and rescheduled as a normal single project. The process is illustrated below.





PSDI Customer Services

One of the features that makes PROJECT/2 unique among network scheduling systems is the heavy commitment Project Software & Development, Inc. (PSDI) has made in the area of customer support services. To assist PROJECT/2 users, PSDI provides a complete package of services including technical assistance by telephone, in-house consultation, PROJECT/2 schools, a network plotting service, and a Newsletter published three times a year. In addition, PSDI maintains a constant dialogue with all our users both to communicate information on the latest PROJECT/2 developments and applications, and to provide input for the further enhancement of the system.

Telephone Consultation

The technical staff at PSDI's Cambridge, Massachusetts headquarters office is available daily to assist users with their PROJECT/2 applications. Your call to (617) 661-1444 will connect you with a senior member of our Applications Services Department. This consultation is available to PROJECT/2 users at no charge.

In-House Consultation

A member of our Consulting/Applications staff will travel to your location to provide in-depth help with problems such as the development of coding structures, customization of management reports, the full design of a scheduling system using PROJECT/2, or any other major assistance you require to use PROJECT/2 more effectively.

PROJECT/2 Schools

Three-day introductory and advanced courses are scheduled regularly several times a year throughout the United States and Canada. The courses can also be given in-house at your location, where the material will be tailored to your individual needs. The standard courses are outlined below:

Introductory Course

Prerequisite: A working knowledge of CPM Network planning concepts. No prior experience in the use of PROJECT/2 is necessary.

Topics: The first day will introduce the basics of the Command Language, Network Input, Error Procedures, Data Base changes, output of simple reports, use of code numbers, and selecting, sorting, and summarizing schedules and bar charts. The second day will be spent on simplified Progress Reporting, the Current Schedule, Target Scheduling, and Basic Cost Processing. On the third day, Basic Resource Allocation, Resource Constrained Scheduling, Cost features, and Basic Network Graphics will be covered. Attendees will use PROJECT/2 in workshops scheduled throughout the course.

Each attendee will be provided with a Basic Network for course workshops, either Activity-on-Arrow or Activity-on-Node (Precedence), and a PROJECT/2 User's Manual.

Advanced Course

Prerequisite: The Introductory Course and/or significant experience in the actual use of PROJECT/2.

Topics: Advanced Progress Reporting, Target Scheduling, Resource Allocation, Resource Constrained Scheduling, Cost relationships, Network Generation, Multiproject, and Multicalendar. The emphasis of this course will be on solving problems in extensive workshop sessions. Topics of general interest will also be discussed.

Network Plotting Service

To assist clients who lack access to plotting equipment, PSDI will produce network plots to your specifications at our *New York* office. You use the PROJECT/2 Network Graphics commands to produce a "plot file" on magnetic tape, you mail the tape to us, and we forward the plotted networks back to you.

Newsletter

All PROJECT/2 users receive a Newsletter three times a year providing information on new features added, existing and potential applications, announcement of scheduled PROJECT/2 schools, and a Customer Service Form for school registration and documentation requests.

Documentation

The following publications are available for purchase at any of our branch offices:

PROJECT/2 User's Manual
PROJECT/2 Sample Run Books
Precedence Version
Activity-on-Arrow Version

About PSDI...

Project Software & Development, Inc. (PSDI) was founded in 1968 to develop and maintain the PROJECT/2 software package — a system for network based project scheduling and control. PSDI also furnishes documentation, specialized consulting and educational services for PROJECT/2 users. The company maintains offices in Cambridge, Massachusetts, New York City, and San Francisco. PSDI International Software, Inc., a subsidiary of PSDI, provides PROJECT/2 to users outside the United States and maintains branch sales and support in Calgary, Alberta to service Western Canada, and in London to service PROJECT/2 clients in the United Kingdom and Europe.

From its headquarters in Cambridge, PSDI maintains PROJECT/2 for its worldwide clientele, in many cases using on-line remote job entry to customer facilities throughout the United States and Canada. All development effort on the PROJECT/2 system is performed in Cambridge. The New York office contains the National Sales Office, a user training facility, and a customer data center equipped with an RJE terminal with a Calcomp 936 plotter connected by high speed lines to a large IBM 370 computer. The San Francisco office houses the Western Sales Office, and provides PROJECT/2 technical support for clients in the western United States.

PSDI documentation includes a frequently updated PROJECT/2 User's Manual, Sample Run Books, and a Newsletter published three times a year. In addition, PSDI conducts comprehensive PROJECT/2 Schools throughout the year at the New York City training center and on the West Coast.

PSDI personnel are on call during normal business hours to assist users with their PROJECT/2 applications. The staff is continually developing new system capabilities, most in response to specific user needs and requests. Among 1977-78 development projects are: overall efficiency improvements, an expanded Cost processor, Actual Resource reporting, the subdivision of activities into dicrete operations with accompanying enhancements for non-linear cost and resource allocation, enhancements to multicalendar microscheduling, and additional plotter produced output reports.

PROJECT/2 is currently in use at approximately 50 computer installations and is continuously used by hundreds of organizations including: electric utilities; engineering, construction, and management consulting firms; and industrial corporations, defense contractors, and governmental agencies. PROJECT/2 is heavily used in such fields as power plant and petrochemical engineering, procurement, and construction; pipeline construction; commercial and municipal construction; power plant maintenance and refueling; outage scheduling; environmental and safety planning; and oil platform design, construction, and hookup and commissioning.

PROJECT/2 is available for use on a surcharge basis at the commercial data centers listed on the back cover. PROJECT/2 can also be licensed for use on your own in-house IBM 370 computer, running under the OS or VS operating system.

For further information on licensing arrangements, the nearest data center, or questions about PROJECT/2 capabilities, contact the nearest PSDI office.

PROJECT SOFTWARE & DEVELOPMENT, INC.

Headquarters: 14 Story Street, Cambridge, Massachusetts 02138, (617) 661-1444, Telex: 921415

Two Penn Plaza, New York, New York 10001, (212) 564-6915

Two Embarcadero Center, San Francisco, California 94111, (415) 421-6244

PSDI INTERNATIONAL SOFTWARE, INC.

14 Story Street, Cambridge, Massachusetts 02138, (617) 661-1444 Telex: 921415

71 Duke Street, London W1M 5DH, United Kingdom, (01) 629-6909, Telex: 21478

2 Trade Square, 315 10th Ave. SE, Calgary, Alberta T2G 0W2 Canada (403) 232-1803

SECTION C4: PERSONNEL QUALIFICATIONS

ACRES

JOHN D. LAWRENCE

Education

Imperial College of Science and Technology, University of London, London, England
B.Sc. Civil Engineering, 1956
D.I.C. Hydropower Engineering, 1963
University of Birmingham, Birmingham, England
M.Sc. Water Resources Technology, 1972

Professional Associations

Registered Professional Engineers, State of New York – No. 56074
Association of Professional Engineers, Ontario – Member
Institution of Civil Engineers, U.K. – Member
Institution of Water Engineers and Scientists, U.K. – Member
American Society of Civil Engineers – Member

Experience

1974 – Acres

1974 Executive Engineer, Power and Heavy Civil Engineering Division

Management of hydroelectric projects, including

- DOE-funded feasibility studies, 15-MW Lowell hydroelectric project and 3-MW Chicopee project, Massachusetts, for Raython Service Company
- study of power system requirements and potential for hydroelectric developments in State of Maine, for Dirigo Electric Cooperative, Inc.
- hydroelectric power generation study of potential for hydro installations at existing and undeveloped sites, for Massachusetts Municipal Wholesale Electric Company.

Responsible for administration, scheduling and technical direction of water resources and power-related projects including

- comprehensive siting and engineering studies and field exploration for a proposed 1,000-MW, 4,000-ft head underground pumped hydro facility for the DOE/EPRI/Potomac Electric Power Company, Maryland
- DOE-funded feasibility study, 7-MW North Hartland hydro project, preliminary permit applications for development of hydroelectric potential at 6 existing Corps of Engineers flood control dams in Vermont and New Hampshire, and hydroelectric and pumped storage plant siting and system studies for Vermont Electric Cooperative Inc.
- feasibility study for GPU Service Corporation of 2 pumped storage projects in northeastern United States, involving earth dams, hydraulic structures, steel- and concrete-lined tunnels, and 2 underground powerhouses (825 MW and 640 MW)
- Dickey-Lincoln School Lakes hydroelectric project power alternatives and energy conservation studies for U.S. Army Corps of Engineers, New England Division
- feasibility studies, design, licensing and construction supervision for a 230-ft high fly-ash retention dam and tunnel spillway structures for the John E. Amos plant, West Virginia, for American Electric Power.

1972 – 1974 Chief Design Engineer, Public Power Corporation, Athens, Greece

Responsible for civil, mechanical and electrical design, preliminary engineering, contract documents and detail design for the 300-MW Pournari hydroelectric project in western Greece. Work involved an earth-fill dam, hydraulic structures, steel- and concrete-lined tunnels and a surface powerhouse.

1971 – 1972 University of Birmingham, Birmingham, England

Postgraduate course in Water Resources Technology.

1967 – 1971 **Project Egineer (Civil)**, Acres

Responsible for preliminary engineering, economic evaluations, contract documents, costing, scheduling and detail design for hydroelectric projects which included the 250-MW Lower Notch generating station, Ontario; 340-MW station at Alto Anchicaya, Colombia; and 1,800-MW station at Gull Island, Labrador. Work involved earth-fill and concrete-faced rock-fill dams, hydraulic structures, steel- and concrete-lined tunnels, and surface and underground powerhouses.

1961 – 1967 Binnie and Partners, London, England

1965 Senior Assistant Engineer

Responsible for preliminary engineering, economic evaluations, contract documents, costing, scheduling and detail design for hydroelectric and water supply projects including a 1,000-MW station at Mangla, West Pakistan, an 80-MW station at Bentong, Malaysia, and the Seletar water supply reservoir in Singapore. Work involved general soil mechanics, hydraulic structures, steel- and concrete-lined tunnels, surface and underground powerhouses.

1963 Resident Engineer

In charge of site supervision of preliminary contracts for construction of access roads and bridges, tunnels, underground powerhouse, and rock mechanics testing for the 150-MW Batang Padang hydroelectric station, Malaysia.

1961 Assistant Engineer

Design of hydraulic structures, steel- and concrete-lined tunnels and powerhouse, and site supervision of hydraulic model studies for the Mangla Dam project (1,000 MW), West Pakistan.

1960 – 1961 Imperial College, London, England

Postgraduate course in hydropower engineering.

1957 – 1960 **Assistant Engineer**, Binnie and Partners, London, England

Design and supervision of construction of hydraulic structures, pipelines and pumping stations for various water supply and sewage schemes, U.K.

Technical Publications

Small Hydro – Where Do We Go From Here?
Public Power Magazine, July/August 1977

Economic Exploration for Underground Energy Storage
Presented to the 18th Symposium on Rock Mechanics, Keystone, Colorado, June 1977. John D. Lawrence, Michael J. Hobson, and James D. Gill

CHARLES A. DEBELIUS

Education

United States Military Academy, West Point, New York
B.S., 1954
Columbia University, New York
Graduate work in Physics and Nuclear Engineering, 1958 – 1959
New York University, New York, New York
M.S. Physics, 1963
U.S. Army Command and General Staff College, Fort Leavenworth, Kansas
MMAS (Master of Military Arts and Science), 1968
U.S. Army War College, Carlisle Barracks, Pennsylvania
Graduate 1972
U.S. Army Logistics Management Center, Ft. Lee, Virginia
Construction Management Course, 1969

Professional Associations

Society of American Military Engineers
President, Anchorage Chapter 1974 – 1975
President, Fort Belvoir Chapter 1976 – 1977

Experience

1978 –Acres

1978 **Manager of Engineering**

Responsible for management of all technical resources for projects undertaken by the Columbia office.

1977 –1978 **Chief of Methodology, U.S. Army Study**

Responsible for direction of all operations, research and analysis for a major Army study of officer education.

1976 –1977 **Brigade Commander, U.S. Army, Fort Belvoir, Virginia**

Management and direction of activities of 4,500 soldiers in 7 battalions, including topographic and combat engineering units. Provision of engineering training for officer and enlisted students.

1973 –1976 **District Engineer, Alaska, U.S. Army**

Responsible for planning, design, environmental analysis and construction management for all military and civil works projects in the State of Alaska. Annual budget of $50 million included management of such projects as

- hydropower studies on the Susitna River, Bradley Lake, and other locations
- hydropower development at Snettisham
- major flood control works at Fairbanks
- small boat harbor development
- urban studies
- thermal power plant construction
- construction of military facilities.

1972 –1973 **Director,** Army Forces and Systems Studies, U.S. Army War College

Faculty member at Army's highest-level educational institution. Designed model for economic analysis of alternative military forces.

1969 –1971 **Cost Analyst,** Office of the Secretary of Defense (systems analysis)

Prepared economic studies of proposed new systems including major aircraft and tank procurements as well as construction of major bases.

1968 –1969 **Battalion Commander**

Directed operations of 1,000 military and 500 civilian construction workers. Responsible for design, construction, and maintenance of 100 miles of asphaltic concrete highways, as well as vertical facilities.

1965 –1967 **Project Officer,** Engineer Agency, Army Combat Developments Command

Conducted extensive studies of military engineer needs in the future.

1964 –1965 **Resident Engineer,** Kisimaio Port Project, Somali Republic, Africa

Principal U.S. Government representative on a $10 million port construction project. Contracting officer's representative, and manager of engineering staff involved in construction including

- 1,200 prestressed piles
- 1 mile of breakwater and causeway construction
- dredging
- quarry operation
- various other port-related activities.

1959 –1963 **Instructor and Assistant Professor,** U.S. Military Academy

Taught physics and supervised laboratory work for cadets.

1954 –1958 **Lieutenant,** U.S. Army Corps of Engineers

Staff, command, and management of military engineer activities in Germany.

S. SHARIF AHMAD

Education — Virginia Polytechnic Institute & University
M.Sc. Civil Engineering - Hydraulics and Water Resources, 1960

Professional Associations — American Society of Civil Engineers - Member
U. S. Committee on Large Dams - Member

Experience

1979 - Acres

1979 - Senior Project Engineer, Power and Heavy Civil Engineering Division

Management and Administration of hydroelectric projects.

- DOE-funded Northhartland Dam Project, PON application.

- Management of Susitna proposal.

1974 - 1979 - Project Engineer/Manager, Bechtel Inc.

Management and direction of hydroelectric projects studies and design.

- Hydropower and water resource feasibility study of 16 sites in northwest Colorado for Colorado River Conservation District.

- Feasibility report of Browns Canyon P.S. Project - 2000-MW with 2400 ft head.

- Detailed design of pumping stations for Setif Irrigation Project in Algeria, management and administration of 14-large size pumping station for pumping and transportation of water at 2000 ft head.

- Reviewed Rositas project in Bolivia - final design and system studies, multi-purpose project.

- Detailed studies on Tongue River Project for water supply of 1000-MW coal-fired plant, an off-river storage.

- Fish facilities for Willamet River - conceptual design and cost estimate.

- Review of desalination plant, water and waste water facilities for Jubail Project in Saudi Arabia.

- Participated in final design, construction scheduling and preparation of contract documents for lowhead (100 ft) American Falls Project in Idaho.

1969 - 1974 - Chas. T. Main Inc. - Project Engineer/
Principal Engineer

Supervised and managed hydro projects and studies

- Hydropower survey of West Java and Sulewasi Island, including feasibility study of 570-MW Tarum Project.

- Successfully prepared and presented 1620-MW Salto Grande Project proposal and later directed design of navigation lock and associated facilities including 1620-MW power plant and larger size spillway.

- Detailed design and construction documents for water supply project in Sao Paulo, Brazil.

- As Project Engineer, directed license application of Davis pumped storage project and feasibility study.

- Modified license application of Bear Swamp pumped storage project from surface power plant to an underground plant. Also, as Assistant Project Engineer, participated in final design of Bear Swamp Project.

- Reviewed design of Paute Project in Equador underground plant, tunnel and concrete gravity arch dam (600 ft high) for using ground water for initial filling and makeup water.

1968 - 1969 - Stone & Webster, Principal Hydro-Civil Engineer

- Responsible for feasibility study and license application for 1500-MW Marble Valley P.S. Project with innovative silo type design.

- Supervised hydraulic and hydrologic studies for Stoneham and North Anna nuclear power plant.

1966 - 1968 - Harza Engineering Company

- As Project Manager, prepared license application and Feasibility Study of 1000-MW Havasu pumped storage Project.

- As Section Head, modified license application of Montezuma pumped storage project.

- Coordinated and supervised as Section Head, State financed Central Arizona project - a 300-mile long aquaduct system including several pumping stations and powerhouses; estimated cost is $1.8 billion.

SHER BAHADUR

Education

University of Lucknow, Lucknow, India
B.Sc. Geology, 1959
M.Sc. Engineering Geology, 1960
South Dakota School of Mines and Technology, Rapid City, South Dakota
Ph.D. Geotechnology, 1972

Professional Associations

American Society of Civil Engineers – Member
Association of Engineering Geologists – Member
Registered Professional Engineer – States of Colorado, Illinois and New York

Experience

1977 –Acres

1977 Project Coordinating Engineer, Geotechnical

Responsible for geotechnical aspects of power and industrial projects, including

- field exploration program, foundation design and structural stability for the 10-MW Granby hydro redevelopment for Niagara Mohawk Power Corporation

- preliminary design of surface reservoir embankments and structures and underground excavations for a large underground pumped/compressed air energy storage complex in Maryland for the DOE, EPRI and Potomac Electric Power Company

- stability analysis of sheet-pile cofferdam and tie-back system for Bethlehem Steel Plant, Buffalo, New York

- design memorandum for embankments and instrumentation systems associated with tailings disposal dam for Union Carbide at Hot Springs, Arkansas

- feasibility study of small hydroelectric projects in the States of Maine, Massachusetts, and Vermont.

1975 –1977 **Principal Geotechnical Engineer,** Envirodyne Engineers, Inc., Chicago, Illinois

Responsible for coordination of geotechnical investigations and associated laboratory testing. Independent design analyses for the foundations of retaining structures, pavements, bridges, sewer tunnels, transmission towers, and industrial buildings; preparation of contracts and specifications; evaluation and selection of sites for commercial airports; and report writing.

1973 –1975 **Geotechnical Engineer,** Sargent and Lundy Engineers, Chicago, Illinois

Responsible for geotechnical exploration program. Evaluation, selection and development of sites for nuclear and fossil power plants in Illinois, Ohio and Texas. Design analyses of plant foundations and earth structures. Review of PSAR and environmental reports.

1972 –1973 **Soils Engineer,** Commercial Testing Laboratories, Denver, Colorado

Design analyses for the foundation of industrial buildings, retaining walls and pipeline routes.

Supervision of staff for geotechnical field investigations and laboratory testing.

1969 –1972 **Geotechnical Doctoral Fellow,** South Dakota School of Mines and Technology, Rapid City, South Dakota

Research in rock slope stability, experimental rock deformation, in situ rock stresses, and rock strength characteristics and their influence on seismic activity.

1961 –1969 **Assistant Professor,** University of Roorkee, India

Teaching of graduate courses in rock mechanics and engineering geology.

1960 –1961 **Teaching Assistant,** Bureau of Mines and Geology, India

Experimental rock deformation. Measurement of magnetic and gravity anamolies.

Technical Publications

Measurement of In Situ Stresses in the Black Hills, South Dakota
Ph.D. Dissertation, South Dakota School of Mines and Technology, Rapid City, 1972

JAMES D. GILL

Education — University of Manitoba, Winnipeg, Manitoba
B.Sc. Civil Engineering, 1966
M.Sc. Soil Mechanics and Foundation Engineering, 1970

Professional Associations
- American Society of Civil Engineers — Associate Member
- International Society for Soil Mechanics and Foundation Engineering — Member
- Canadian Geotechnical Society — Member
- Association of Professional Engineers, Ontario, British Columbia, and Alberta
- Registered Professional Engineer, State of New York

Experience

1966 — Acres

1977 Head, Civil and Geotechnical Departments

Responsible for administration of staff of approximately 35 in the Civil and Geotechnical departments. Special consultant for strategic oil storage conversion project, Weeks Island Mine, Louisiana, for Gulf Interstate Engineering, Houston, Texas. Visiting lecturer in soil mechanics at the State University of New York, Buffalo.

Responsible for civil and geotechnical contributions to the following projects.

- Dam inspection and small hydro developments for Dan River Inc., Nebraska Municipal Power Pool, Vermont Electric Corporation, and Niagara Mohawk Power Corporation.
- Siting studies and civil/geotechnical aspects of ERDA/EPRI energy storage study, Potomac Electric Power Company, Washington, D.C.
- Evaluation of Wabana Mine, Bell Island, Newfoundland, for strategic oil storage under the National Strategic Storage Program and geotechnical investigation of Weeks Island Mine, Department of Energy, Washington, D.C.
- Siting studies for hard rock and aquifer-based compressed air energy storage (CAES) plans and geotechnical/rock mechanics aspects of CAES plant design, California Energy Commission, Sacramento, California.
- Review of methodology and siting studies for radioactive waste disposal sites in the Middle Piedmont, for Dupont, Savannah River Laboratories.
- Trenton Falls and Granby hydro redevelopments, Niagara Mohawk Power Corporation, Syracuse, New York.
- Design of earth-fill Amos fly-ash retention dam, Winfield, West Virginia, and feasibility studies of underground pumped hydro in an abandoned mine, American Electric Power Service Corporation, New York, New York.
- Design of the raising of a major tailings embankment involving analysis for liquefaction potential during seismic loading, Union Carbide Corporation.
- Stabilization of Terrapin Point, Niagara Parks Commission, Niagara Falls, New York.

1976 Staff Engineer, Geotechnical

Responsible for design and coordination of

- retention pond dikes, Union Carbide Corporation, Ashtabula, Ohio
- mine waste runoff containment facilities, Union Carbide Corporation, Hot Springs, Arkansas
- foundation design, wastewater treatment facilities, Bethlehem Steel Corporation, Lackawanna, New York
- siting studies for underground pumped hydro/compressed air energy storage, Boston Edison Company, Boston, Massachusetts.

1974 **Lend Geotechnical Engineer**

Formulation of investigation programs, staff coordination and geotechnical related studies for

- feasibility studies of Wanita powerhouse, British Columbia
- northern staging areas for pipeline construction for Canadian Arctic Gas
- transmission line from Twin Gorges to Hay River, Northern Canada Power Commission
- Red Deer River off-stream storage study, Capital City Weir, Edmonton.

Geotechnical aspects of preliminary design and feasibility of Capital City Weir, design and construction of McMahon Stadium artificial turf, and foundations for Calgary International Airport refueling systems.

Studies into use of spray-on sealants for petroleum storage dikes in the North.

Geotechnical coordinator responsible for design of Amos fly-ash retention dam, Winfield, West Virginia, including supervision of 3-dimensional stability and finite element analyses.

1973 **Geotechnical Engineer**

Technical consultation and construction supervision including blast monitoring and geological mapping for Nilo Peçanha drainage tunnel, Brazil.

As Geotechnical Coordinator, responsible for excavation design of major railway relocation, main earth-fill dam and saddle dam design on sensitive Leda clay foundation, Arnprior generating station, Arnprior, Ontario.

As Senior Engineer, construction supervision of drainage tunnel, power tunnels, excavation, grouting and drainage works, and monitoring of dam and powerhouse instrumentation, Sirikit power project, Thailand.

Responsible for foundation design on variety of projects including field investigation and design of foundations and tailings dam for 300-ton/d ore milling plant in the Yukon Territory; work involved supervision of access road construction through mountainous and permafrost terrain.

1967 **Graduate Student**, University of Manitoba, Winnipeg, Manitoba

Course work in advanced soil mechanics, foundation engineering, hydrology, hydraulics, flood control and river morphology.

1966 **Field Engineer**

Supervision of field investigation programs for Lower Notch generating station, Ontario.

Construction supervision of dikes and flood control works, Red River Floodway, Winnipeg, Manitoba.

Technical Publications

The Bulk Modulus and Shear Modulus of a Lake Agassiz Clay, 1969
(Unpublished Master's thesis)

The Foundation of the Sirikit Powerhouse
Presented to 1976 ASCE Geotechnical Specialty Conference on Rock Foundations and Slopes, Boulder, Colorado (James D. Gill and Leib Wolofsky)

Economical Investigation for Energy Storage Projects
Presented to 18th Symposium on Rock Mechanics, Keystone, Colorado, 1977 (John D. Lawrence, Michael J. Hobson, and James D. Gill)

Water Compensated CAES Cavern Design
Presented to Asilomar Conference on Compressed Air Energy Storage, 1978 (James D. Gill and Michael J. Hobson)

National Strategic Crude Oil Storage in the Weeks Island Salt Dome Mine: I. Geotechnical Evaluation
ASME Energy Technology Conference, Houston, Texas, 1978 (A. Mahtab, D. W. Lamb, L. Van Sambeek and J. D. Gill)

THOMAS W. GWOZDEK

Education — State University of New York at Buffalo, Buffalo, New York
B.S. Civil Engineering, 1971

Professional Associations — Licensed Professional Engineer
New York State No. 53235

Experience

1971 —Acres

1974 **Project Engineer**, Civil, Acres American Incorporated

Project engineer for design of mine waste and runoff treatment facilities including retention ponds and treatment plant for Union Carbide Corporation, Hot Springs, Arkansas.

Cost and economic evaluations for hydroelectric and pumped storage developments in New England for Corps of Engineers, New England Division.

Civil coordinator responsible for all civil and structural engineering aspects for an industrial process facility for Union Carbide Corporation. Responsibilities included development of design criteria, supervision of design and drafting, and coordination with mechanical and electrical aspects of the project.

Civil project engineer for rotary forge foundation and support structures for a U.S. Army Corps of Engineers arsenal. Responsible for development of design criteria, supervision of design and drafting, and preparation of contract documents.

Participated in conceptual and preliminary design engineering and preliminary construction cost estimates for an underground oil storage facility and a pumped storage hydro development.

1973 **Structural Design Engineer**

Structural design engineer responsible for design of various foundations, buildings and structures for industrial facilities. Foundation designs included compressors, industrial equipment and buildings. Structural designs included gas ductwork, buildings, and a 6,000-foot, 16-inch diameter oxygen pipeline and supports.

Resident engineer for construction of caisson foundations for high-voltage transmission lines for Rochester Gas and Electric Corporation. Responsible for general contract management, construction inspection and supervision, cost estimates, payments and record keeping.

1972 **Engineer**

Coordinated engineering activities for wind tunnel model studies to determine stack effluent dispersion. Responsible for setting up test program, calculation of effluents from data received, report preparation, and liaison.

As construction engineer, participated in on-site field inspection, quality control assurance, general contract supervision, cost estimates, payments, scheduling, and lab testing of soils. The projects involved were installation of rock stabilization devices in a gorge face, installation of a tie-back wall system for the foundation of an industrial building, and construction of a 150-foot high, earth- and rock-fill dam.

1969 –1970 **Land Surveyor,** Engineering Department, City of Niagara Falls, New York

JOHN W. HAYDEN

Education — Carnegie-Mellon University, Pittsburgh, Pennsylvania
Ph.D. Civil Engineering (Major in Water Resources/Environmental Engineering), 1963

Professional Associations — Registered Professional Engineer, New York No. 52331, Minnesota No. 10891

Experience

1973 – Acres

1973 Manager, Special Services

Manager of the Chesapeake Bay model study for the Corps of Engineers. The model, housed in a 14-acre building is an estuarine model of the entire bay plus all significant freshwater inflows.

Technical Director for development of methodology for assessing the economic impact of modifying the cooling water discharge systems of large thermal power stations including

- Encino power generating station, four 250-MW oil-fired once-through cooling system for San Diego Power and Light Company
- Zion 2,000-MWe nuclear power generating station, Commonwealth Edison Company, Lake Michigan
- Donald C. Cook, two 1,100-MWe nuclear power generating station, American Electric Power Service Corporation.

Measurement of the impact on air quality of the emission from Niagara Mohawk Power Corporation four 100-MW coal-fired Huntley Station.

Assessment of physical impact of cooling water discharged from large power generating stations including

- Perry 2,200-MWe nuclear power generating station, Cleveland Electric Illuminating, Perry, Ohio
- Sterling 600-MW coal-fired electric power generating station, Rochester Gas and Electric Corporation
- Nine Mile Point thermal generating station (Unit 1, 610 MW and Unit 2, 1,100 MW) for Niagara Mohawk Power Corporation
- Fitzpatrick 850-MWe nuclear generating station, Power Authority of the State of New York.

1971 – 1973 Metropolitan Council, Minneapolis-St. Paul Area

Manager of the Physical and Natural Resources program of the Metropolitan Council, responsible for preparation and adoption of the Water Resources Chapter of the Metropolitan Development Guide for the Metropolitan Council seven-county planning area, including the establishment of a public participation program, liaison with local governmental units, and conducting public hearings prior to adoption of the Guide.

Directed a detailed mapping study of all storm and combined sewerage systems in the Metropolitan area.

Represented the Metropolitan Council on the Steering Committee of the U.S. Army Corps of Engineers Upper Mississippi River "Level B" study.

Represented the Metropolitan Council on the task force responsible for the adoption of QUAL II to the Mississippi, Minnesota, and St. Croix rivers system in the Metropolitan area.

Developed guidelines for acceptable types of land use relative to soil type, slope and location including wetlands, floodplains and lake frontage.

1969 – 1972 Consultant, Water Resources Engineering, Barr Engineering Company, Minneapolis, Minnesota

Participated in the development of a mathematical model for urban watershed analysis.

Participated in the development of nonstructural flood control plans for the Bassett Creek and Riley-Purgatory Creek watersheds.

Participated in water resources study of the Minnesota portion of the Lake Superior watershed.

Hydrauiic analysis of Rum River dam at Anoka, Minnesota; design and preparation of specifications for the tainter gate and stilling basin.

Model test and hydraulic design of St. Cloud Dam across the Mississippi at St. Cloud, Minnesota.

1964 – 1972 Assistant/Associate Professor, Associate Department Head, Department of Civil and Mineral Engineering, University of Minnesota

In charge of undergraduate fluid mechanics courses. Teaching and research in water resources with particular emphasis on fluid mechanics and geohydrology. Prinicpal investigator for the following studies:

- unsaturated flow through porous media
- erosion of cohesive soils
- model studies of chlorine dispersion in turbulent pipe flow
- study and hydraulic design recommendations for the intake and discharge structures for Zion nuclear power station
- seepage and stability analysis of Taconite tailings basins
- hydraulic study and development of design recommendations for the expansion of Encina power plant intake system
- study of hydraulic pressures acting on Zion nuclear power station intake structure due to wave action
- study of temperature distribution in lake near discharge structure
- model study and analysis of condensing system for D.C. Cook nuclear power plant.

1962 – 1964 First Lieutenant, U.S. Army Engineer School, Fort Belvoir, Virginia

Technical Publications

In excess of twenty-five publications.

ROBERT R. HENSCHEL

Education — State University of New York at Buffalo, New York
B.A. Geology, 1971

Professional Associations — Association of Engineering Geologists — Member
American Society of Civil Engineers — Member

Experience

1973 —Acres

1978 Geotechnical Design Engineer

Responsible for preliminary design and selection of an instrumentation system to monitor the stability of the service shaft at Weeks Island Salt Mine in Louisiana, during and following conversion of the mine for long-term storage of crude oil.

Responsible as Project Engineer for final design and preparation of contract documents for remedial works at Terrapin Point in Niagara Falls, New York, and for selection and supervision of installation of instrumentation to monitor movements in the rock mass.

Responsible for field supervision of

- shallow drilling investigation for PEPCO UPH/CAES project near Washington, D.C.
- geotechnical investigation at Terrapin Point in Niagara Falls, New York, to provide additional information for final design of remedial works
- foundation investigation for NFTA Light Rail Rapid Transit, Buffalo, New York
- additional drilling and piezometer installation at Ironton Mine, follow-up to 1976 geotechnical investigation, Federal Energy Administration
- geotechnical investigation to assess the suitability of Weeks Island Salt Mine, Weeks Island, Louisiana, for storage of crude oil, Federal Energy Administration
- construction of retention pond dikes, Union Carbide Corporation, Ashtabula, Ohio
- final certification inspection of Ironton Mine, Federal Energy Administration, Ironton, Ohio
- foundation investigation, Bethlehem Steel Co., Lackawanna, New York.

Responsible for research and development of deep drilling methods and techniques currently in use and preparation of contract documents for the drilling of a 5,000-ft deep hole for PEPCO UPH/CAES project near Washington, D.C.

Responsible for geotechnical evaluation and assessment of the Wabana Iron Ore Mine in Newfoundland as a potential site for storage of crude oil, as part of DOE strategic petroleum reserve program.

Responsible for design of raising scheme for an existing tailings dam for Union Carbide Corporation in Hot Springs, Arkansas, including internal drainage system, embankment sections, stability analysis, quantity and cost estimates, plans and final design report.

Responsible for preparation of drilling contract for geotechnical investigation of Central Rock limestone mine in Lexington, Kentucky, as part of the Federal Energy Administration oil storage program.

1976 Geotechnical Engineer

Responsible for field supervision of

- foundation investigation for an earth-fill fly-ash retention dam, Union Carbide Corporation, Marietta, Ohio
- siting study for a pumping station in an open-pit vanadium mine, Union Carbide Corporation, Hot Springs, Arkansas
- geotechnical investigation to assess the suitability of a limestone mine in Ironton, Ohio, for storage of crude oil, Federal Energy Administration
- rock-scaling operations at Prospect Point, Niagara Falls, New York.

Responsible as Project Engineer for evaluation and assessment of the short-term stability and preliminary design of remedial works at Terrapin Point, Niagara Falls, New York.

Responsible for study on conversion and development of technical requirements for geotechnical confirmation of selected mined caverns for underground crude oil storage, Federal Energy Administration.

Responsible for preparation of conceptual estimates for Yards Creek underground pumped storage power development.

1975 Geologist

Responsible as Senior Geologist/Senior Drill Inspector for the technical quality of the drilling, inspection, geologic logging, and soils testing during foundation investigation for a hydroelectric development in Gull Island, Labrador.

Responsible for field supervision of

- foundation investigation, pile load test, and foundation construction, General Dyanmics, Charleston, South Carolina
- installation of caisson foundations, Rochester Gas and Electric Company, Rochester, New York
- construction of Cardinal fly-ash retention dam for American Electric Power Service Corporation in Brilliant, Ohio, including a 240-ft high earth- and rock-fill embankment, emergency spillway, grout curtain, pressure relief and underdrainage systems.

Responsible for preparation of geotechnical data for bidders for Amos fly-ash retention dam, Winfield, West Virginia.

DAVID E. HEPBURN

Education	Stafford College of Technology, U.K. Institution of Electrical Engineers, Diploma, 1952 General Electric Company, Schenectady, New York Power Systems Engineering, Diploma, 1962
Professional Associations	Ordre des Ingénieurs du Québec — Member Association of Professional Engineers, Ontario — Member Institute of Electrical and Electronics Engineers — Associate Member Institution of Electrical Engineers, U.K. — Fellow
Languages	English, French

Experience

1965 —Acres

1978 Manager of Engineering

Responsible for administration of all technical departments in the Niagara Falls office.

1975 Divisional Chief Electrical Engineer

Technical review of electrical work and staffing levels for Company offices in Ontario and Quebec.

Quality assurance duties on balance of plant for Wolsung-1, a 600-MWe CANDU nuclear station in Korea.

Addition of four 185-MW hydroelectric generators and associated 500-kV substation, Tarbela, Pakistan.

Preparation of fully detailed purchase specification for computerized load dispatch system for 400-kV Iraq Supergrid.

Team member on power system studies in Tanzania, Iraq, Pakistan, and Indonesia.

1971 Head, Electrical Department

Design of manganese oxide recovery project for Union Carbide, including manipulation of ladle car carrying 75 tons of molten metal at 3,500 deg F.

Administration of department and supervision of projects including 300-MVA urban core substation and estimates on a ± 450-kV dc transmission scheme in North Dakota. Studies and cost estimates for underground pumped storage schemes, conventional hydro plants and various industrial projects.

Responsible for production of all electrical construction drawings, schematics and cable schedules for Churchill Falls hydro project.

Conceptual design for a 2,000-MW uranium enrichment plant for BRINCO.

1969 **System Planning Engineer,** Dacca, Bangladesh, General Consultancy to East Pakistan (Bangladesh) Water and Power Development Agency

Advisor on technical, financial and administrative matters relating to the planning and financial policy of the power system, and assistance in negotiations with international agencies for loans in excess of $25,000,000.

1966 **Head, Electrical Department**

Administration of the department and electrical engineering responsibility for hydroelectric generation, construction, utility transmission and distribution, thermal power generation, inorganic, chemical, petrochemical and food industry projects including

- a 25-MVA construction power system and technical specifications for 500-MVA, 15—240-kV, 3-phase power transformer and 240-kV cables and auxiliary equipment for 5,225-MW Churchill Falls power project

- an electrolytic plant for production of sodium chlorate, incorporating aluminum bus work rated at 25,000 A, 900 V dc

- long-range planning studies for electric power systems in eastern Canada, involving cost analyses of generation and transmission at 230 kV, 345 kV and 500 kV

- underground electric power supply systems, indoor substation and electric steam generator installations for industrial plants.

1965 **Engineer**

Responsible for electrical engineering designs, specifications, review of manufacturer's work, coordination of generating units, and auxiliary systems, Manicouagan 1 hydroelectric development, Quebec.

1959 —1965 Shawinigan Water and Power Company, Montreal, Quebec

1963 **Supervising Engineer, Projects Division**

Supervision of design engineering for 132-, 230- and 345-kV stations on Company system.

1962 **Project Engineer, Systems Engineering Department**

Coordination of the conversion of hydroelectric power stations to remote supervisory control and investigation of equipment failures.

1961 — 1962 Advanced Studies, Power Systems Engineering Course, General Electric Company, Schenectady, U.S.A.

1959 **Engineer, System Planning Department, Analytical Division**

Load flow studies, fault calculations and stability studies using computers and network analyses, including planning studies for 345-kV line Ile Maligne at Quebec City, and preparation of specifications for circuit breakers and transformers.

IAN P. G. HUTCHISON

Education

University of Cape Town, Cape Town, South Africa
B.Sc. Civil Engineering, 1967
University of the Witwatersrand, Johannesburg, South Africa
Graduate Diploma in Civil Engineering, 1974
(Hydraulic Engineering and Soil Mechanics)
Ph.D. Hydrology and Hydraulic Engineering, 1976

Professional Associations

Association of Professional Engineers, Ontario – Member
Canadian Water Resources Association – Member
American Society of Civil Engineers – Associate Member
South African Institution of Civil Engineers – Member
South African Council for Professional Engineers – Registered Professional Engineer

Experience

1976 – Acres

1976 Project Engineer, Water Resources

Responsible for all hydrologic and hydraulic aspects for the feasibility design of an 80-MW hydro plant on the Upper Salmon River, Newfoundland, and a reconnaissance level planning study involving 18 potential hydro schemes in 5 basins along the eastern shore of Lake Superior.

Hydraulic Coordinator – responsible for fluvial hydraulic input to the design of three ports on the upper Amazon, Peru. Planning and arranging training courses and study tours for Peruvian Nationals in Canada. Planning and supervision of implementation of a permanent potamological data gathering unit on the Ucayali River. Planning and design of a 54-MW hydropower plant on the St. Marys River at Sault Ste. Marie, Ontario. Preliminary design of a hydroelectric scheme on the Spanish River, Ontario.

Project Engineer – for a hydraulic and environmental study of Porcupine Lake near Timmins, Ontario. Conceptual design of a combined highway bridge and dam structure on the Bartholomew River, New Brunswick. Flood forecasting study, Rideau River basin, Ontario.

Hydrologic Consultant – for development and application of a mathematical water balance model to the Oldman River system in southern Alberta. Evaluation of hydropower potential in Tanzania. Flood damage reduction study for the Red Deer River and Sundre, Alberta. Flood damage reduction study for the Jock River at Richmond, Ontario.

Principal Investigator – regional flood frequency analysis for the Province of New Brunswick.

Design Engineer – hydraulic design of effluent treatment ponds for industrial plant in Ashtabula, Ohio. Hydraulic design of treatment facilities for contaminated runoff and of floodwater drainage facilities for open-pit mining operations in Hot Springs, Arkansas.

Business Development – engaged in writing proposals for large international hydroelectric, irrigation and rural development projects.

1970 – 1976 Research Officer, Hydrological Research Unit, University of the Witwatersrand, Johannesburg, South Africa

Development and application of mathematical models for managing surface water systems such as swamps, lakes, rivers and estuaries. Two major projects involved the modeling of the hydrology, the effects of irrigation on the lake's water supply, and the water level and salinity regime of St. Lucia Lake in Natal, South Africa, for the Natal Provincial Administration and the modeling of the flow regime of a swamp system in Botswana to aid the development of the water supply for Anglo American Corporation diamond mine.

Supervised much of the field data collection required for the St. Lucia Lake project.

Consulting work — hydrologic studies for water supplies to industrial and mining developments in Lesotho and the Transvaal, South Africa.

Lectured to graduate and undergraduate students in the fields of hydrology, mathematical modeling, and water resources project economics.

Supervised M.Sc. theses involving mathematical modeling of the water and salt circulation in a coastal lagoon and the sediment movement in a proposed nuclear power plant cooling-water intake facility on the coast.

Alternate member of a government committee set up to establish means of improving irrigation practices and efficiencies in sugarcane farming.
Undertook two study tours.

- 1976 6 weeks in the United States and Canada visiting consultants engaged in water quality modeling in urban and rural catchments, rivers, lakes and bays.
- 1973 6 weeks visiting hydrological and hydraulic institutions in Portugal, England, Finland, Denmark and the Netherlands.

1969 — 1970 **Engineer**, Technical Computing Company, Johannesburg, South Africa

Engaged in the development and application of computer programs covering various aspects of structural analysis, reinforced and prestressed concrete design and hydraulics.

1968 — **Graduate Student**, University of the Witwatersrand, Johannesburg, South Africa

Attended graduate courses in hydraulics, hydrology, irrigation engineering, soil mechanics, foundation engineering, industrial economics and accounting.

Technical Publications

A Mathematical Model to Aid Management of Outflow from the Okavango Swamp, Botswana
Journal of Hydrology, Vol. 19, No. 2, June 1973

The Okavango Delta — Ways of Evaluating the Economic and Environmental Impact of Mass Transport of Water
Presented at the 5th Quinquennial Convention of the South African Institute of Civil Engineers, "Transportation and the Environment", Johannesburg, South Africa. August 1973

A Mathematical Sediment Model for a Sea Water Intake Basin
Presented at the Conference on Marine and Fresh Water Research in Southern Africa. Port Elizabeth, South Africa. July 1976 (coauthor)

Lake St. Lucia — Mathematical Modelling and Evaluation of Ameliorative Measures
The Civil Engineer in South Africa, Transactions of the South African Institution of Civil Engineers, South Africa, Vol 19, No. 4. April 1977

Lake St. Lucia — The Computer Points the Way
African Wildlife, Vol 31, No. 2. April/May 1977

Mathematical Modelling of Water Level and Salinity Regions in Some South African Lake and Estuary Systems
Presented at the Seventeenth Congress of the International Association for Hydraulic Research (IAHR), Baden-Baden, Federal Republic of Germany. August 1977

Regional Flood Frequency Analysis for New Brunswick
Presented at the Canadian Hydrology Symposium: 77-Floods, in Edmonton, Alberta, Canada. August 1977

A Systematic Approach to Flood Risk Mapping
Presented at the International Symposium on Risk and Reliability in Water Resources, in Waterloo, Ontario, Canada, June 1978

Modelling the Water and Salt Balance in a Shallow Lake
Ecological Modelling 4 (1978) 211 — 235

D. WILLIAM LAMB

Education — Imperial College of Science and Technology, University of London, London, England
B.Sc. (Honours) Civil Engineering, 1953

Professional Associations — Institution of Civil Engineers, U.K. – Member
International Society for Soil Mechanics and Foundation Engineering – Member
Council of Engineering Institutions, U.K. – Chartered Engineer

Experience

1969 – Acres

1977 **Executive Engineer,** Power and Heavy Civil Division

Responsible for pavement design for Tribhuvan Airport, Kathmandu, Nepal, pavement and airport lighting projects for Niagara Falls, New York Airport.

Proposal preparation; management and supervision of civil engineering projects including earth-fill dams; studies for reuse of dredged material disposal areas, transportation center, remedial works at Niagara Falls gorge, fly-ash utilization, and for feasibility of using fly ash in water-retaining structures. In-house civil engineering and foundations consultant.

Chief engineer for master plan study for new international airport, Jakarta, Indonesia, responsible for all civil engineering works, site investigations, aircraft pavements and lighting, site development, and drainage.

1973 **Manager of Engineering**

Administration and job assignments for the engineering and technical personnel of the company and quality control of engineering and drafting work.

1969 **Senior Soil Mechanics and Foundation Engineer**

Supervision of construction of a 200-ft high earth dam for fly-ash retention at Brilliant, Ohio.

Foundation and structural design for electrical substations, facilities and pollution control equipment at thermal power stations, a multistory rotating hotel in New York State, and various industrial installations and transmission line towers.

Planning, supervision and assessment of geotechnical investigations; preliminary designs involving excavation slopes, dewatering, piling, backfilling and groundwater control for marine facilities in South Korea, Newfoundland, Taiwan and Puerto Rico.

Design, contract documents and construction supervision for extensions/improvements to the taxiways and terminal apron evaluation using dynamic testing techniques of the main instrument runway, and installation of runway lighting at Niagara Falls International Airport, New York.

Site investigations and geotechnical design of compacted earth-fill conservation dams for an extension to a float glass plant and for a lakeshore site evaluation for a major industrial development involving land and marine works.

1955 – 1969 Scott, Wilson. Kirkpatrick and Partners, London, England

1968 **Project Engineer,** London, England

Engineering report on site development, including field investigations of deep soft deltaic and floodplain deposits, preliminary foundation design, flood control facilities, service systems, Asian Institute of Technology, Bangkok, Thailand.

Water supply scheme, including a 35-mile long pipeline, pumping station and reservoirs, Muscat, Arabian Gulf.

1963 Project Engineer, Hong Kong

Report on future raising of the main dam, Plover Cove Water Scheme, Hong Kong. Technical and economic feasibility studies of seaward extensions of the existing reclamation and runway and taxiway pavements, including site investigations, borrow area evaluations, preliminary seawall design in 40 ft of water exposed to typhoons, drainage systems; concrete and asphalt pavements, Hong Kong International Airport.

Participation of first Southeast Asian conference of Soil Mechanics and Foundation Engineering, Bangkok, Thailand, April 1967.

Directed a land reclamation and development project, including excavation of 7 million yd^3 of rock and soft material, dredging of 1 million yd^3 of seabed mud, construction of a large, pile reinforced concrete highway storm culvert, 2 miles of seawall and a typhoon shelter breakwater, and a 4-lane highway on reclaimed land in Hong-Kong.

Supervised engineering design and specifications for a casting basin of cellular cofferdams for immersed-tube tunnel elements; land and marine site investigations for tunnel approaches, Cross Harbour Tunnel, Hong Kong.

1960 Senior Assistant Engineer, Hong Kong

Evaluations of soil borrow areas; supervision of marine boring investigations; design and construction supervision of a large-scale "test mound" to study placement techniques and behavior characteristics of soil when deposited through water; design, manufacture and installation of piezometers and settlement gauges, Plover Cove Water Scheme, Hong Kong.

Supervision of the soil mechanics testing laboratory.

Technical Publications

Decomposed Granite as Fill Material with Particular Reference to Earth Dam Construction
Hong Kong Joint Group of the ICE, IEE, and IME Symposium on Hong Kong Soils, 1962

Ash Disposal in Dams, Mounds, Structural Fills and Retaining Walls
Third International Ash Utilization Symposium, Pittsburgh, Pa., U.S.A., 1973

DONALD H. MacDONALD

Education

University of Toronto, Toronto, Ontario
B.A.Sc. Civil Engineering, 1945
Cornell University, Ithaca, New York
M.R.P. Regional Planning, 1947
Imperial College of Science and Technology
D.I.C. Civil Engineering, 1955
University of London, London, England
Ph.D. Soil Mechanics and Foundation Engineering, 1955

Professional Associations

Association of Professional Engineers, Ontario and Newfoundland – Member
Association of Professional Engineers, British Columbia – Associate Member
Engineering Institute of Canada – Fellow
American Society of Civil Engineers – Fellow
Institution of Civil Engineers, U.K. – Fellow
Geological Society of America – Member
American Concrete Institute – Member
American Railway Engineering Association – Member

Experience

1955 –Acres

1976	Director, Acres 1975 Limited
1971	Director, Vice-President and Senior Consultant, Acres Consulting Services
1964 – 1971	Director, Acres Limited
1964 – 1969	Director and President, H.G. Acres & Company Limited
1962 – 1964	Director and Vice-President
1955 – 1962	Head, Geotechnical Department

In his association with Acres, Dr. MacDonald has been involved in the following projects in technical, administrative or policymaking capacities.

Canada – Churchill Falls power project; Gull Island power project; Mica project; Kettle Rapids generating station; Long Spruce generating station; Limestone generating station; Lower Notch generating station; Arnprior generating station; Mactaquac development; Manicouagan 2 development; Grand Rapids generating station; Bersimis No. 2 project; Lake Ste. Anne Dam; Chute-des-Passes project; Beauharnois No. 3 project; McCormick Dam projects, No. 2 and No. 3; Kelsey generating station; Laurie River No. 2 generating station; Strathcona development; Ladore Falls development; Ash River development; Portage diversion structure; Churchill River diversion; Red River floodway, Inlet and Outlet Works; Westerly Water Purification plant, Toronto; Thorold tunnel; Townline and Road/Rail tunnel, Welland, Ontario; Conestogo Dam; Finch Dam; Saint John thermal station; Atikokan thermal generating station; Mackenzie Valley pipeline studies; Arctic Ocean offshore drilling studies; Downie slide investigations

U.S.A. – Amos Dam, Cardinal Dam

Pakistan – Warsak project; Shadiwal

Colombia – Alto Anchicaya development

Ghana — Kpong hydroelectric project.

Technical involvement in these and other projects has been largely in the heavy civil engineering and geotechnical fields, and it has included all phases such as explorations, studies, laboratory investigations, preliminary and final designs, and field supervision. Particular fields of technical involvement have been with excavations, foundations, cofferdams, dams and dikes (earth fill, rock fill and concrete), tunnels, shafts and underground openings, channels, unwatering and seepage problems, groundwater studies, and river regulation works.

Numerous other projects have involved contract and project management, staffing, claims settlement and arbitrations.

1951 –1955 **Postgraduate Student,** Imperial College of Science and Technology, University of London, London, England

Research in the fields of soil mechanics and foundation engineering, with particular reference to the settlements of structures on soil.

1947 –1951 **Engineer,** Toronto Transportation Commission, Toronto, Ontario

Foundation investigations, structural designs, and material testing for the Yonge Street subway.

Committees

National Research Council of Canada
Member, Associate Committee on Geotechnical Research, 1970 – 1976.

International Society for Soil Mechanics and Foundation Engineering
Vice-President (North America), 1969 – 1973
Chairman, Conference Procedures Committee, 1969 – 1971

UNESCO
Member, Working Group on Seismic Phenomena Associated with Large Reservoirs (Representing ISSMFE), 1970 – 1975

Science Council of Canada
Member, Earth Science Committee, 1968 – 1970

International Commission on Large Dams
Canadian National Committee
Member, Executive Committee, 1968 – 1976

Consulting Engineers of Ontario
Member, Board of Directors, 1976 – date
President, 1978/79

Technical Publications

Dr. MacDonald is the author of a number of technical papers on dam and cofferdam construction, building settlements, and other technical subjects.

SONGTHARA OMKAR

Education	Colorado State University, Fort Collins, Colorado B.S.C.E. 1965, M.S.C.E. 1967
Professional Associations	American Society of Civil Engineers Association of Energy Economists Midwestern Society of Engineers International Commission on Irrigation and Drainage (U.S. Committee on Irrigation, Drainage, and Flood Control)

Experience

1979 - Present	Hydroelectric Planner, Acres American, Incorporated Responsible for directing hydroelectric planning and feasibility studies. Directs and prepares system studies for utility clients.
1975 - 1979	Engineer, Harza Engineering Company, Chicago, Illinois Conducted economic, market, and hydraulic studies for water resource projects. Group leader for the project investigating "The Magnitude and Regional Distribution of Needs for Hydropower", as a part of the Corps of Engineers' National Hydropower Study. Involved in not less than twelve other studies concerned with water resources, hydroelectric power, irrigation and energy storage projects in North, Central and South America and the Middle East.
1972 - 1975	Planning Engineer, United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, Thailand Conducted economic and technical analyses of water resources projects in the Lower Mekong River Basin in Cambodia, Laos, Thailand, and Vietnam. Developed an inventory of hydroelectric power potential for Cambodia, Laos, Thailand, and Vietnam, including preliminary designs of dams and powerplants and project costs. Developed methodology for making economic analysis of hydroelectric projects in the Lower Mekong Basin. Studied and identified projects for early development to meet irrigation requirements in the Lower Mekong Region.
1969 - 1972	Engineer-in-Charge, United Nations Development Program, Area Office for Coordination of Investigation of the Lower Mekong Basin, Phnom Penh, Cambodia. Organized field investigations to provide Cambodian Government with advisory services concerned with water resources. Made cost estimates and monitored construction of a small hydroelectric/irrigation project.

ACRES

PARIMAL C. PAL

Education — Calcutta University, Calcutta, India
B.E. (Civil), 1959
University of Michigan, Ann Arbor, Michigan, U.S.A.
M.Sc. (Civil Engineering), 1964

Professional Associations — Order des Ingénieurs du Québec — Member

Languages — English, Hindi, Bengali

Experience

1978 —Acres

1978 Project Engineer

Participation in EPRI/ERDA research development project for Potomac Electric Power Company involving a 1,000-MW·h underground pumped hydro scheme. Responsible for coordination, design and optimization of all civil and structural related works including upper and lower reservoirs, shafts and penstocks etc.

1974 —1978 Senior Structural Engineer, Asselin, Benoit, Boucher, Ducharme, Lapointe Inc. (Tecsult International Limited) Montreal, Quebec.

Responsibilities included

- structural design of steel surge tank and central concrete pier of spillway, Outardes 2 project, Quebec
- supervision of civil structural design of grain and cold-storage facilities at Port Santos, Rio de Janiero, Brazil
- design of concrete spillway, service bridge and diversion tunnel concrete structure, LG-2 hydroelectric project, Quebec
- supervision of design for low-head powerhouse, including structural steel, LG-1 project, James Bay, Quebec

1969 —1973 Senior Engineer and Group Leader, U.S.S. Consultants of Canada Ltd., Montreal, Quebec

Responsible for design of crusher building structural steel, concrete crushed ore storage, conveyor galleries, steam plant and concentrate handling facility, including concrete load-out silo and steel A-frame structure for support of stockpiling conveyor, Mt. Wright project, Quebec Cartier Minings.

1965 —1969 Senior Engineer, C. D. Howe Company Ltd., Montreal, Quebec

Structural design for various projects including

- grain handling and storage facility, Louis Dreyfus Corporation, at Port Cartier, Quebec

- concrete crib dock, including superstructure, shipping gallery and transfer tower for new ore loading dock at Seven Islands, Iron Ore Company

- structural steel and foundation for dry grinding mill building for pelletizing plant, Wabush Mine

- analysis of structural steel for Taiwan research reactor building, including cost estimates and specifications.

1965 — Design Engineer, H. J. Kaiser Company Canada Ltd., Montreal, Quebec

Design and analysis of structural steel and foundation for heavy industrial structure, conveyor gallery, and concrete tower for cement plant.

1964 —1965 Structural Designer, Foster Wheeler Corporation, Livingston, New Jersey

Structural design and analysis of open steel frameworks for large steam generators.

1961 —1963 Instructor, School of Engineering, Tuskegee Institute, Tuskegee, Alabama

Teaching of theory of structure, strength of material, and engineering drawing.

1959 —1961 Assistant Engineer, Housing Directorate, Government of West Bengal, India

Analysis and design of reinforced concrete structures and supervision of construction.

PETER RODRIGUE

Education — **University of Manitoba, Winnipeg, Manitoba**
B. Sc. Mechanical Engineering, 1971

Professional Associations — **Association of Professional Engineers, Manitoba — Member**

Experience

1976 — Acres

1971 — 1976 Crippen Acres Engineering

1978 **Senior Mechanical Engineer,** Acres American Incorporated

Preliminary mechanical design for redevelopment of the Mechanicville Hydroelectric facility for Niagara Mohawk Power Corporation.

1974 **Mechanical Coordinator,** Acres/Crippen Acres Engineering

Coordinator of preliminary mechanical engineering and initial phases of detail engineering for the 1100 MW Limestone Generating Station, Manitoba Hydro. Work included turbine selection and specification, gate selection, preparation of design criteria and arrangement for mechanical equipment and systems.

Coordination of a study to evaluate the cost of installing a 650-kW hydroelectric generating unit at the existing Little Falls station in Minnesota.

Preliminary mechanical design, for tender purposes, of gates and associated hoist and crane equipment, for Wreck Cove Power Project, Nova Scotia, Canron Ltd.

Coordination of mechanical design for two control structures associated with the diversion of the Churchill River into the Nelson River. Work included design approval and contract administration for spillway gate equipment and a 300-kW hydraulic turbine house unit; design of associated mechanical services; preparation of commissioning procedures and instruction manuals; and assistance in site testing of the spillway gate equipment and the house unit.

1971 **Mechanical Engineer,** Crippen Acres Engineering

Participation in mechanical design, including preliminary studies, for design of gate equipment, turbines, governors and compressed air systems; preparation of design criteria, conceptual design, preparation of specifications, tender analysis and design checking for major equipment related to power generation; and capital cost estimating for the 1000 MW Long Spruce generating station, Manitoba Hydro.

Analysis of turbine performance, capital cost estimating and miscellaneous mechanical studies at the completion of the Kettle generating station project, Manitoba Hydro.

ACRES

EDWARD N. SHADEED

Education — McGill University, Montreal, Quebec
B. Eng. Electrical Engineering, 1950

Professional Associations — Association of Professional Engineers, Ontario – Member
Engineering Institute of Canada – Member
Institute of Electrical and Electronics Engineers – Senior Member

Experience

1967 – Acres

1974 **Executive Engineer,** Acres Consulting Services

Supervising the engineering of the Iraq National Despatch Centre. Supervision and design of automating a hydro plant for Peterborough Utilities Commission. Consultant on Warsak Hydro Development and Larona project in Indonesia.

1973 **Engineering Specialist**

Feasibility and electrical preliminary engineering proposals for underground pumped storage plants. Electrical engineering estimate for 1,620-Mw Salto Grande Development, Uruguay, Argentina. Consultant for various projects, including Long Spruce, Manitoba, Sirikit, Thailand and Arnprior hydroelectric generating station, Ontario. Feasibility study for increasing Nam Ngum project capacity in Laos.

Management and direction of engineering for Rochester Gas and Electric Substation 23, an urban type enclosed substation.

1971 **Commissioning Coordinator** at the Lower Notch generating station

1970 **Senior Project Engineer**

Various feasibility studies and proposals for international projects.

1969 **Project Engineer,** H. G. Acres Limited

Direction and supervision of a project group on modifications of Ontario Hydro generating stations controls to provide automatic and remote operation.

1968 Coordination of preliminary engineering including electrical equipment layout for the underground 340-Mw Alto Anchicaya hydroelectric project, Colombia.

1967 **Senior Electrical Engineer**

Coordinator for electrical engineering aspects, including design, equipment specifications, assessment of tenders, review of manufacturer's drawings for the 228-Mw Lower Notch hydroelectric generating station, Ontario.

1967 – Chief Electrical Engineer, Brown and Root Limited, Montreal, Quebec

Responsible for electrical engineering aspects of petrochemical projects, including recommendations on field construction.

1966 – Senior Engineer, Geo. Demers, Consulting Engineer, Montreal, Quebec

Electrical engineering responsibility for the 600-Mw Outardes 4 hydroelectric development, Quebec.

1964 – 1966 Manager, Electrical Construction, Construction Division, Inspiration Limited, Montreal, Quebec

Management of the department, including budgets; cost estimates, proposals, schedules and construction plants; negotiation of contracts with suppliers, subcontractors, labor unions and bid/performance bonders; staff supervision and allocation; coordination and liaison.

1951 – 1963 The Shawinigan Engineering Company Limited, Montreal, Quebec

1963 Liaison Engineer

Liaison between the engineering office, the construction group and the client for twenty substation projects.

1959 Design Engineer

Resident electrical engineer for construction of a thermal electric generating station (two 150-Mw units, oil fired), Tracy, Quebec, including preparation of electrical engineering designs.

Design of the electrical control, metering and relaying systems for 120-Mw Twin Falls hydroelectric development, Labrador, Newfoundland.

Feasibility studies, cost estimates and schedules for electric power and industrial projects.

1958 Resident Electrical Engineer, Buckingham, Quebec

Liaison between site and engineering office; supervision, scheduling and inspection of the work of major equipment suppliers; commissioning and initial commercial operation of the 30-Mw Dufferin Falls hydroelectric development, Quebec.

1951 Electrical Engineer, Montreal, Quebec

Design of the electrical control, metering and relaying systems for the 75-Mw Beechwood development and switching station; Grand Lake and Moncton terminal stations, New Brunswick; various substations including La Tuque and Trenche Developments, Quebec.

Design, testing and commissioning of the autosynchronizing system for six existing units at the La Tuque Development, Quebec.

1950 – 1951 Chief Electrical Inspector, Montreal Locomotive Works Limited, Montreal, Quebec

Quality control and initial operation testing of diesel-electric locomotives.

ROBERT SHIELDS

Education — University of Texas, Arlington, Texas
B.S. Economics, 1975
M.S. Civil Engineering, 1977

Professional Associations — American Water Resources Association — Member
American Society of Civil Engineering — Member

Experience

1978 —Acres

1978 **Project Engineer**

Supervision of feasibility study and preliminary engineering of hydroelectric development for Tygart Lake Dam.

1971 —1978 **Project/Hydraulic Engineer**, Dallas Power & Light, Dallas, Texas

Design and supervision of construction of dams, intake structures, channels, spillways, and other hydraulic structures required for the operation of steam electric stations.

Preparation and evaluation of hydrological studies on company watersheds, including evaporation, siltation, yields, and flood control.

Responsible for the construction of facilities required for the generation, transmission, and distribution of electrical energy.

1964 —1970 **Project Engineer**, Long Island Lighting Co., Hicksville, New York

Design and construction of facilities required for natural gas and high-voltage electrical transmission.

Responsible for the operation and maintenance of all water requirements for steam electric plants.

Economic analysis for equipment replacement for steam electric plants.

Technical Publications

On Line Prediction of Runoff From a Mixed Rural-Suburban Watershed (Unpublished thesis)

JAMES P. SINCLAIR

Education — University of Toronto, Ontario
B.A.Sc. Mechanical Engineering, 1951

Professional Associations — Association of Professional Engineers, Manitoba, Ontario, British Columbia – Member
American Society of Mechanical Engineers – Member
International Electrotechnical Commission, Technical Committee No. 4, Hydraulic Turbines – Member
New York State Society of Professional Engineers – Member

Experience

1976 – Acres

1977 **Executive Engineer**, Acres American Incorporated

Coordination of all aspects of design of powerhouse, intake and tailrace, including mechanical and electrical systems, for 10-MW Granby hydroelectric redevelopment on the Oswego River, New York.

Direction and coordination of all mechanical engineering aspects of study to determine technical, environmental and economic feasibility of an underground pumped hydro scheme in Montgomery County, Maryland.

1969 – 1976 Head, Mechanical Department, Crippen Acres Engineering

Managed and directed the operations of the Mechanical Department for various projects undertaken by the Company.

Responsible for mechanical engineering designs involving feasibility studies, plant layout, equipment selection, specifications, drawings, contract administration (engineering phase), site commissioning documents, equipment and mechanical services estimates and schedules for

- hydroelectric projects in Manitoba including Kettle (1,224 MW), Long Spruce (1,000 MW) and Limestone (1,070 MW) generating stations. Responsible for design of turbines, governors, cranes, intake gates, spillway gates, elevators, sewage treatment system, compressed air, water and oil service systems, heating and ventilating systems and other mechanical services and systems
- river control structures in Manitoba for the Churchill River diversion project. Responsible for spillway gates, hydraulic turbine-generator house unit and all mechanical service systems
- merchant section and bar steel rolling mill in Manitoba. Responsible for mechanical service systems
- extension of boiler house and modifications to central steam heating system for Brandon University. Responsible for installation of new oil-fired boiler and control systems
- domestic water, fire protection water and sewerage systems for various construction camps accommodating 300 to 2,600 personnel.

1961 – 1969 CBA Engineering Limited, Consulting Engineers, Vancouver, British Columbia

1968 Resident Engineer

Directed the operations of resident staff of field engineers, inspectors and office staff during the final phase of construction of the Hugh Keenleyside (Arrow) Dam and navigation lock on the Columbia River in British Columbia. Responsible for engineering inspection, cost control, contract administration and site testing of concrete structures, earth dam, and mechanical and electrical equipment and services.

1967 Site Mechanical Engineer

Responsible for activities of mechanical Field Inspection Department during the installation of control gates, cranes, elevators and mechanical service systems for the control structures and navigation lock at the Hugh Keenleyside (Arrow) project.

1961 Chief Mechanical Engineer

Managed and supervised the activities of the Mechanical Department. Responsible for mechanical engineering designs, feasibility studies, equipment selection, specifications, drawings, contract administration, estimates and schedules for

- river control structure and navigation lock at the Hugh Keenleyside (Arrow) project involving low-level port gates, spillway gates, cranes, elevators and mechanical service systems

- mill water supply for Kraft and pulp mill complex associated with Hugh Keenleyside (Arrow) Dam and designed for capacity of 72 million U.S. gal/day

- log handling facilities for construction of Hugh Keenleyside (Arrow) Damconsisting of two 70-ton overhead cranes and runways

- renewal of crane runway and new mechanical and electrical services for a graving dock at Esquimalt, British Columbia.

1956 – 1961 British Columbia Hydro and Power Authority, Victoria, British Columbia

Served in capacity of project engineer for a major gas turbine generating station on Vancouver Island involving installation of four 25,000-hp turbines and generators with associated fuel storage and treatment facilities and mechanical and electrical service systems. Responsible for the administration of contracts, scheduling, estimating, coordinating, purchasing and reporting of all phases of the project. Also acted as project engineer on construction of other small hydro and diesel electric generating stations.

Supervised the activities of the hydraulic power section of the Mechanical Department. Responsible for review of mechanical equipment and services for a number of projects being undertaken by the Authority.

1951 – 1956 Ontario Hydro-Electric Power Commission

1952 Mechanical Design Engineer

Responsible for layout, design, specifications, drawings, and contracts for major mechanical equipment, including turbines, intake gates, spillway gates, cranes, elevators, large valves and similar equipment for the following projects undertaken by the Commission

- Sir Adam Beck No. 2
- Robert Saunders (St. Lawrence)
- Pine Portage (extension)
- Manitou Falls
- Whitedog Falls
- Caribou Falls.

1951 – Junior Engineer, Mechanical Maintenance, North Bay, Ontario

Worked in maintenance engineering on hydroelectric generating stations in northeastern Ontario, involving overhaul and repair of hydraulic turbines, gates and related equipment. Acted as mechanical inspector on field installation of turbines and generators during construction of Otto Holden (LaCave) generating station.

Technical Publications

Trend to Zero Cavitation in Hydraulic Turbine Operation
Canadian Electrical Association, March 1976, Water Power, January 1978, coauthor W. Pawlikewich, P.E.

Kettle Generating Station, Mechanical Equipment
Canadian Electrical Association, March 1970, coauthor E. L. Flook, P.E.

Design and Operating Features of the Navigation Lock at Arrow Dam
Canadian Electrical Association, 1968

River Closure at Arrow Dam
Canadian Electrical Association, 1968, coauthor L. S. McLure

Requirements of Vertical Hydraulic Turbine and Generator Alignment for Equipment Specification
Canadian Electrical Association, 1966

D. C. Power Commissions, Georgia Generating Station
Engineering Institute of Canada, September 1958

RICHARD C. STUTCHBURY

Education — University of Southampton, Southampton, England
B.Sc. Civil Engineering, 1955
Postgraduate Studies in Highway Bridge Design and Engineering Law, 1956

Professional Associations — Association of Professional Engineers, Ontario — Member
Order des Ingénieurs du Québec — Member
Institution of Civil Engineers, U.K. — Member

Experience

1965 —Acres

1973 Executive Engineer

As Manager of transmission line section, responsible for overseeing of all transmission oriented projects within the Electrical Services Division, including management of projects, preparation of proposals, and business development. Projects include 161-kV Ocean Falls line (120 miles), single circuit, Ocean Falls to Kemano; 132-kV and 66-kV lines (1,000 km), single circuit, planning study in Ethiopia; Assistant and Deputy to Project Manager, Acres Shawinigan Ltd. for 400-kV Iraq Supergrid project consisting of about 1,000 km of lines and 4 major 400/132-kV substations.

Responsible Manager for contracts, purchasing, inspection, expediting, scheduling and planning, estimating, budgeting, forecasting and cost control for Gull Island hydroelectric project, Lower Churchill Consultants, an 1,800-MW development in Labrador. Organization and direction of a division as part of project management team to carry out the above functions.

Responsible for direction of planning, engineering, contract preparation, material procurement and construction for an 80-mile, 138-kV transmission line from Aishihik power project to Whitehorse, Yukon Territories and for a 100-mile long, 315-kV transmission line from Montagnais to Normand switchyards in northeastern Quebec.

Responsible for engineering, planning and coordination of construction management for 360 miles of single-circuit 735-kV line from Churchill Falls power project to Quebec border and 50 miles of single-circuit 230-kV line from Churchill Falls to Twin Falls power project.

Planning and control of engineering cost and work progress, including special reports resulting from changes in approved scope of work.

Preplanning responsibility for final design, procurement and construction of a 9-mile long proposed causeway-bridge-tunnel, New Brunswick — Prince Edward Island. Estimating, cost forecasting, budget control, scheduling and performance monitoring.

Coordination of engineering studies on the economics of alternative designs for the crossing, including studies of geotechnical and structural design factors and wave and ice action on proposed structures.

1961 –1965 **Resident Engineer (1963 – 1965) and Assistant Estimating Engineer,** Geo Demers, Consulting Engineer, Montreal, Quebec

Supervision of construction of 21 piers (concrete on pile foundation, 4,000-yd^3 maximum single underwater concrete pour), site geotechnical investigations (including 7,000 ft of shore), and overwater drilling and field laboratory analyses for Three Rivers bridge, St. Lawrence River, Quebec.

Economic analyses of alternative schemes and optimization for development of hydroelectric power sites for Outardes River, Quebec.

1958 –1961 **Engineer,** C. D. Howe Company Limited

Supervision of scheduling, expediting of owner-purchased materials, claims evaluation, progress schedules and inspection aspects of contracts, including assistance with contract management, for a complete ore handling facility, Quebec Cartier Mining Company, Port Cartier, Quebec.

Assistance with supervision of the setting out, quantity control, soundings and construction of access roads and service systems for a grain handling and wharf facility, Baie Comeau, Quebec.

1957 –1958 **Field Engineer,** Canadian British Aluminum Company Limited, Baie Comeau, Quebec

Supervision of construction of smelter facilities, wharf, townsite and municipal service systems.

1955 –1957 **Graduate Engineer under Agreement,** Richard Costain Limited, Civil Engineering Contractors

Assistance with preliminary designs, schedules, and quantity and cost estimates for heavy construction tenders, investigation of construction problems, and design of precast and prestressed concrete structures.

STEWART N. THOMPSON

Education — Franklin & Marshall College, Lancaster, Pennsylvania
B.S. Geology, 1968
University of Maine, Orono, Maine
M.S. Geological Sciences, 1973

Professional Associations — Geological Society of America — Member
Association of Engineering Geologists — Member

Languages — English, German

Experience

1977 —Acres

1978 Senior Geologist

Responsible as Project Engineer for

- Department of Energy Strategic Oil Storage Project, Weeks Island Mine — Geotechnical Investigations, Louisiana
- feasibility of hydrofracture and injection, West Valley, New York
- site selection and exploration for the DOE/EPRI Energy Storage Study, for Potomac Electric Company
- radioactive waste repository siting study, Southern Piedmont for Savannah River Laboratories.

Participation in geologic studies and inspection of hydro facilities at Little Falls, New York, Trenton Falls, New York, and Tygart Lake, West Virginia.

1973 —1977 Lead Geotechnical Engineer, Stone & Webster Engineering Corporation, Boston, Massachusetts

Responsible for all aspects of geotechnical studies and licensing for the Greene County nuclear plant, Power Authority of the State of New York, (PASNY) and for several fossil-fueled plants.

For the PASNY fossil and nuclear MTA applications, involvement in

- supervision and coordination of geotechnical aspects of 6 Public Service Commission (PSC) license applicants for State of New York, including 4 fossil-fueled and 2 nuclear sites
- supervision of geotechnical field operations for above sites, including geologic mapping, surveys, and test borings
- coordination of specifications.

Supervision and coordination of written preparation and field activities for the Preliminary Safety Analysis Report for Greene County nuclear power project.

Assistance in interpretation of geologic problems for potential power plant sites, Niagara Mohawk Power Corporation.

1971 –1973 Graduate Student and Teaching Assistant, Department of Geologic Sciences, University of Maine, Orono, Maine

1972 (Summer) Thesis research along Maine coast to determine rates of sea-level rise during last 3,000 years.

1968 –1971 United States Army

Served 2-1/2 years in Germany with U.S. Army Intelligence.

1967 –(Summer), Conducted surficial geologic mapping along the Yellowstone River, Montana, on a National Science Foundation undergraduate research grant, Franklin & Marshall College.

Technical Publications

Faulting and Seismicity in the Anna, Ohio, Region
Abst., Geol. Soc. of Am., 1976 Annual Meeting

J. GRAY S. THOMSON

Education — University of Glasgow, Scotland
B.Sc. Civil Engineering, 1950

Professional Associations — Ordre des Ingénieurs du Québec — Member
Association of Professional Engineers, Ontario — Member
Association of Professional Engineers, Newfoundland — Licensed
Institution of Civil Engineers, U.K. — Fellow

Experience

1953 —Acres

1978 **Vice-President,** Acres International Limited and **Assistant Project Director,** Karun II and III Development Projects, Iran

Elected Ontario representative on CANCOLD Executive Committee (1977). Canadian representative on ICOLD Committee for Bibliography and Documentation (1978).

1973 **Vice-President and Regional Manager,** Niagara Falls and Toronto, Acres Consulting Services Limited

1972 **Vice-President and Manager** (Montreal)

Member, Policy Committee, Cochin pipeline project, Calgary, Alberta (1971).

Responsible for the March 1971 formative report on James Bay development (5 rivers).

1965 **President,** Acres Quebec Limited

1964, 1966 — 1970 **Manager of Engineering,** Acres Canadian Bechtel of Churchill Falls

Responsible for all engineering design, including permanent and temporary site facilities and transmission lines, for the 5,225-MW Churchill Falls power development, Labrador, Newfoundland.

Member, Engineering Board, Northumberland Strait Crossing project (1965).

Responsible for the Man and Resources exhibit, Expo '67.

1961 **Head,** Civil Department, H. G. Acres & Company Limited

Administration of the department and civil engineering responsibility for all projects, including

- Grand Rapids hydroelectric development, Manitoba, 340 MW
- Los Esclavos hydroelectric development, Guatemala, 14 MW
- Manicouagan 2 hydroelectric development, Quebec, 1,010 MW

- feasibility studies, Mactaquac hydroelectric development, 630 MW
- Westerly water purification plant, Ontario, 150 million gal/d
- mine caisson and headframe substructure, Manitoba, 55-ft diameter
- steel mill foundations, Hamilton, Ontario.

1956 **Project Engineer**

Coordination of all engineering for Bersimis 2 hydroelectric project (640 MW), Manicouagan and Outardes rivers economic development studies, Quebec, planning studies for electric power development, and rehabilitation of a flood-damaged power development in Brazil.

1953 **Engineer**

Economic studies, preliminary explorations and designs, appraisal of geological conditions, flow and silt records, aggregate resources and specifications for all hydraulic gates, Shadiwal and Warsak hydroelectric developments, West Pakistan.

Design and testing of a hydraulic model of the 16,000-cfs tunnel intake, and designs for the intake approach channel, Bersimis 1 hydroelectric development, Quebec.

Site supervision of exploratory drilling for a 39,995-ft long power tunnel.

1950 –1953 **Engineer**, A.P.I. Cotterell & Sons, London, England

Site supervision of road construction in U.K., and of a water resources survey and exploratory drilling program in Cyrenaica, North Africa.

Technical Publications

Economic Development of Hydro-Quebec Power Resources – System Studies Utilizing an IBM 704 Computer
The Engineering Journal, October 1961 (coauthor)

Concreting at Warsak
American Concrete Institute, Fall Meeting, Toronto, Ontario, November 1963 (coauthor)

Churchill Falls Power Facilities
Proceedings, American Society of Civil Engineers, March 1971 (coauthor)

PETER H. TUCKER

Education — Clarkson College, Potsdam, New York
B.S. Civil Engineering, 1966

Professional Associations — Licensed Professional Engineer — New York State

Experience

1978 —Acres

1978 **Project Engineer**

Project Coordinator for two engineering feasibility studies of hydroelectric power sites in Massachusetts on the Merrimack River at Lowell and the Chicopee River at Chicopee. Responsibilities include coordination of engineering activities, project reporting, development of design alternatives, review of design data and drawings, preparation of design documents and client liaison. The projects involve the evaluation of power potentials and conceptual designs for installation of a hydroelectric power development at each of the two existing dams. The project sizes are approximately 15 MW and 3 MW respectively.

1968 —1978 **Hydro Engineer**, Niagara Mohawk Power Corporation, Syracuse, New York

Staff and project engineering functions in hydroelectric plant design and study jobs, environmental reports, regulatory reporting and licensing. Responsibilities included acting as Project Engineer on a 10-MW new hydro facility through its preliminary design and licensing stage; undertaking a statewide review of hydro development potentials which resulted in a 15-plant hydro expansion program; studies involving hydro purchases, rehabilitation or other capacity related matters; liaison, review and correspondence with agencies and groups associated with water resources in upstate New York, including preparation and presentation of testimony; and other staff functions incorporating impacts on corporate hydro facilities or involving licenses or permit applications.

1966 —1968 **Design and Maintenance Engineer**, PPG Industries, New Martinsville, West Virginia

Design of modifications or replacements of piping systems, storage tanks, conveyors and other miscellaneous plant equipment and building components. Performed machinery and facility testing and inspections, acted as temporary crew foreman and worked on various preventive maintenance and procurement tasks.

MALCOLM R. VANDERBURGH

Education — Queen's University, Kingston, Ontario
B.Sc. Civil Engineering, 1957

Professional Associations — Society of American Military Engineers — Member
International Society for Soil Mechanics and Foundation Engineers — Member
Association of Professional Engineers, Ontario — Member

Experience

1957 —Acres

1976 Executive Engineer

Project Manager responsible for design of powerhouse, intakes, penstocks and pipeline, including mechanical and electric systems, for Trenton Falls 28-MW hydroelectric redevelopment, West Canada Creek, New York.

Direction of engineering for structural evaluation of 100-ft high Sturgeon Pool concrete gravity dam on Wallkill River, New York.

Direction of engineering and economic feasibility study for liquefied natural gas terminals at two alternative locations in Maine and Rhode Island, capable of delivering 1,300 million ft^3/d of vaporized gas, with gas pipelines to New York and Pennsylvania.

Responsible as Project Manager for all aspects of design of powerhouse, intake and tailrace, including mechanical and electrical systems for 10-MW Granby hydroelectric redevelopment on the Oswego River, New York.

Direction of feasibility studies for compressed air energy storage as peak shaving scheme for California, and underground hydro pumped storage project utilizing existing mine in Ohio.

Direction of siting study for underground pumped hydro or compressed air storage schemes in the greater Boston area.

Responsible as Project Manager for all aspects of design for Long Spruce generating station.

1973 Project Engineer

Coordination of design for gravity structures, earth-fill dams, sand-fill dikes, powerhouse and spillway (including mechanical and electrical systems) for the 1,000-MW Long Spruce generating station on the Nelson River, Manitoba.

Coordination of all aspects of engineering for a 200-ft high earth-fill dam constructed to retain fly ash for the Cardinal plant, Brilliant, Ohio. The work also included a multiple-pipe slurry pipeline from the plant to the retention area.

Coordination of all aspects of engineering for a 180-ft high earth- and rock-fill dam constructed to retain fly-ash slurry, for the John E. Amos thermal plant, New Haven, West Virginia.

Coordination of all aspects of engineering for a 65-ft high earth-fill dam, a concrete chute spillway and a low-level outlet control works for flood control and recreational purposes, G. Ross Lord Dam, Toronto, Ontario.

1965 Civil Engineer

Direction and coordination of civil engineering for the canal, spillway, intake, concrete gravity structures and powerhouse for the 228-MW Lower Notch generating station.

Preparation of a program of erosion control and channel improvement measures for the West Branch of the Don River, Toronto, Ontario.

Engineering responsibility for flood protection measures, water supply and sewer services, and access roads for the site of the Ontario Science Centre, Toronto.

1960 Engineer

Studies for the development plan for Niagara District Airport, St. Catharines, Ontario.

Feasibility report on a water supply dam for Antigua, West Indies.

Report on power requirements for a citrus fruit processing plant in British Honduras.

Soils investigations and foundation design for Stamford-Niagara pollution control plant, Niagara Falls, Ontario.

Studies, designs and specifications for earth- and rock-fill structures of hydroelectric power developments, including Grand Rapids generating station, Manitoba.

Supervision of pumping tests for groundwater hydrology studies and soils explorations for various projects.

1957 Field Soils Engineer

Engineering supervision of construction for earth- and rock-fill structures for hydroelectric power projects, including a 120-ft high rock-fill dam, forebay dikes and two sand-fill dikes on permafrost, Kelsey generating station, Manitoba, and a 2,100-ft long rock-fill forebay dike, Beauharnois No. 3, Quebec.

ALEXIS C. VIRCOL

Education	Master of Engineering in Hydroelectrical Engineering 1958, Polytechnical Institute of Bucharest, Rumania
	Graduate Courses in Applied Fluid Mechanics, 1977-1979 Northwestern University, Evanston, Illinois
Professional Associations	Professional Engineer - Illinois and Rumania American Society of Civil Engineers International Water Resources Association
Experience	
1979 - Present	Hydroelectric Planning Specialist, Acres American, Inc.
	Responsible for directing hydroelectric planning, feasibility and design studies. Directs and prepares hydraulic, hydrologic and economic studies for water resource development studies.
1976 - 1979	Planning Engineer, Harza Engineering Company, Chicago, Illinois
	Design and cost estimate of a diffuser structure at D. H. Mitchell Station in Indiana; water supply analyses for the Guri Dam Project, Venezuela; design of spillway and outlet works for the multi-purpose (irrigation, water supply, flood control) Kajakai Project in Afghanistan; determination of water supply available for irrigation and estimated drainage design discharges for the Black River Upper Morass Project, Jamaica; determination of hydraulic elements (water surface long-profiles and dike elevations) for the flood control scheme on the agricultural lands in Jamaica, Upper Morass Project; water availability studies, PMP and PMF analyses, and irrigation requirements for the Yarmouk River Project, Jordan; participation in determination of spillway and interconnection-system design flood for the multi-purpose (irrigation supply, power, flood control) project at Tavera-Bao, Dominican Republic; hydraulic and economic analyses for the surface water-control plan in the North Rawhide-Caballo surface coal mine areas, Carter Mining Company Porject, Wyoming; hydraulic analyses for relocation requirements at the multi-purpose Kootenai Dam, Montana; economic evaluations of additional developments at various existing multi-purpose dams in the Kanawha River Basin, West Virginia (both normalized cost and life-cycle cost analyses); and design and cost estimates of spillways and lower level outlets for new damsites in Virginia.
1963 - 1976	Design Engineer, Soil Reclamatic, and Water Resources Planning and Design Institute, Bucharest, Rumania
	Directed study teams in evaluation of regional water resources studies; urban and industrial water supply, low

	flow augmentation; evaluation of drainage and flood control requirements; cost estimations of projects; river basin irrigation and drainage.
1959 - 1963	Research Engineer, Research Hydrotechnical Institute, Bucharest, Rumania Performed hydrologic analysis of flood control and drought frequencies, stochastic hydrology, reservoir sedimentation, spillway design floods and open-channel and reservoir flood routing.
1958 - 1959	Junior Engineer, Hydro-Industrial Enterprise Company, Bucharest, Rumania Assignments during construction, erection-phase and start-up of various water works such as earth-fill dams, pumpage stations, irrigation and drainage channels, spillways.
Technical Publications	"Hydrological Studies on the Mures River Basin," I.S.C.H. Publications, Hydrological Series, Bucharest, Rumania,1963. "Analysis of Flood Marks for Estimating the Flood Peaks," I.S.C.H. Publications, Hydrological Series, Bucharest, Rumania, 1962. "Application of the Risk-Uncertainty Theory in the Design of the Flood-Control System in the Crisul-Alb River Basin," Rev. Hidrologia, Meterologia and Gospodarirea Apelor, 1969 (no. 2,), Bucharest, Rumania. "Use of Linear and Dynamic Programmation in Determining the Optimal Staged Development of Water Supply Works for Urban and Industrial Area of Brasov City," Rev. Hidrologia, Meteorologia and Gospodarirea Apelor, 1970 (no. 4), Bucharest, Rumania. "General Equations for Drought-Curves of the Mures River at Arad Station and a Method of Estimating the Ground-Water Reservoir," Rev. Hidrologia, Meteorologia and Gospodarirea Apelor, 1965 (No. 1), Bucharest, Rumania. "Hydrotechnical Structures" (Handbook for technical high schools), coauthor, Ed. Didactica & Pedagogica, 1965, Bucharest, Rumania.

J. GAVIN WARNOCK

Education

University of Glasgow, Glasgow, Scotland
B.Sc. (Honors), Mechanical Engineering, 1945
Imperial College of Science and Technology
University of London, London, England
D.I.C. Hydropower, 1947

Professional Associations

American Underground–Space Association — President
National Society of Professional Engineers — Member
Canadian Nuclear Association — Director
American Nuclear Society — Member
International Water Resources Association — Board Member
Association of Professional Engineers, Ontario — Member
Engineering Institute of Canada — Member
Institute of Directors, London, U.K. — Member

Experience

1964 –Acres

1977 **Vice-President, Director and General Manager,** Power and Heavy Civil Engineering Group, Acres American Incorporated

Overall direction of group activities covering hydroelectric and heavy civil, electrical services, transportation, environmental, and special services.

1971 **Vice-President, Director and Manager,** Marketing Power and Heavy Civil Engineering Group, Acres Consulting Services Limited

1970 **Vice-President, Director,** Acres American Incorporated

Special projects, business development and corporate external relations.

1964 **Vice-President,** Acres Consulting Services Limited

Business development, public relations, and special projects including direction of the task force preparing supporting documents for the Bond Offering Memorandum for Churchill Falls Power Project.

1947 –1964 The English Electric Company Limited

1960 **Manager, Hydroelectric Division,** Liverpool, England

Overall responsibility for design, development and production of hydroelectric equipment for the world market.

1952 **Manager, Hydraulic Department,** John Inglis Company Limited, Canada — A division of The English Electric Company Limited

1947 **Design Engineer,** Hydraulic Design Section, The English Electric Company Limited, Rugby, England

Technical Publications

Application of Welded Design to Hydraulic Turbine and Valve Manufacture
The Engineering Journal, October 1956

Economics of Variable Pitch Runners for Water Turbine Pumps
World Power Conference, Canadian Sectional Meeting, Montreal, 1958, Proceedings (coauthor)

Reversible Pump-Turbines for Sir Adam Beck–Niagara Pumping–Generating Station
American Society of Mechanical Engineers, Transaction, Journal of Basic Engineering, 1959 (coauthor)

Supporting Documents for Bond Offering Memorandum
Churchill Falls Power Project, 1967 – 1968 (editor in charge)

Giant-Sized Hydraulic Turbines, Review and Forecasts
American Power Conference, Illinois Institute of Technology, April 1968 (coauthor)

The Total Contribution of Tidal Energy to the System
International Conference on the Utilization of Tidal Power, Halifax, Nova Scotia, May 1970 (coauthor)

Tidal Power
The Relentless, Clean and Predictable Energy Sources
68th National Meeting American Institute of Chemical Engineers, February – March 1971 (coauthor)

Pumped Storage Development and its Environmental Effects
University of Wisconsin-Milwaukee and American Water Resources Association, International Conference on Pumped Storage Development and its Environmental Effects, September 1971

Pumped Storage Underground
Symposium on Hydroelectric Pumped Storage Schemes, Athens, Greece, November 1972 (joint author)

Review of Trends of Large Hydroelectric Generating Equipment
Proceedings, IEE, October 1976 (coauthor)

Design Risk and Engineering Management
Jumbo Projects Conference, London, July 6, 1977

A Giant Project Accomplished
Successful Accomplishment of Giant Projects Conference, London, England, May 1978

DAVID C. WILLETT

Education — Imperial College of Science and Technology, University of London, London, England
B.Sc. Civil Engineering, 1955

Professional Associations — Association of Professional Engineers, Ontario – Member
Institution of Civil Engineers, U.K. – Member
American Society of Civil Engineers – Member

Experience

1962 – Acres

1974 **Vice-President,** Acres American Incorporated

Manager for

- Strategic Petroleum Storage Study for FEA
- Underground pumped hydro and compressed air energy siting studies
- Technical, economic and environmental assessments of underground pumped storage
- Fly-ash retention dams.

1973 **Manager,** Power Division

- Studies of hydro redevelopment on the Oswego River
- Environmental assessments of river basins
- Thermal hydraulic model tests
- Fly-ash studies
- Rock-fill dam design and construction.

1970 **Manager of Projects**

Responsible for the general administrative and technical direction of all projects.

1968 **Head, Civil Department,** H. G. Acres Limited, Niagara Falls

Responsible for the general technical direction of the Civil Engineering Department.

1967 **Executive Engineer**

Administrative and technical responsibility for all the engineering for the powerhouse complex, 5,225-Mw Churchill Falls power project, Labrador, Newfoundland.

1962 **Project Engineer**

Coordinated engineering for the study, design and construction of the 630-Mw Mactaquac hydroelectric development, New Brunswick.

Studies of the optimum location of the underground powerhouse, 2,000-Mw Mica hydroelectric development, British Columbia.

Studies for a national power network in Canada, and for a proposed interconnection of the New Brunswick and Nova Scotia electric power systems.

Feasibility studies of potential power sites on the Lower Churchill River, Labrador.

1960 – 1962 **Engineer**, Shawinigan Engineering Company Limited, Montreal, Quebec

Designs for Carillon hydroelectric development and Navigation Lock, Quebec; studies of diversion, outlet and spillway works for Mica hydroelectric development, B.C.; designs, specifications and contract documents for a small sewage treatment plant.

1957 – 1960 **Engineer/Field Engineer**, Freeman, Fox and Partners, London, England and Ffestiniog, Wales

Coordination of civil engineering and liaison with electrical and mechanical consultants for 300-Mw Ffestiniog pumped storage hydroelectric development, Wales.

1955 – 1957 **Engineer**, Sir William Halcrow and Partners, London, England

Designs for small hydroelectric power developments in Scotland.

Technical Publications

Design and Construction of the Mactaquac Hydro-Electric Development
Engineering Institute of Canada, Annual Meeting, Vancouver, British Columbia, September 1969 (coauthor)

Seismic Refraction Surveying on the Hamilton River Survey
Institution of Civil Engineers Library, Miller Prize for Graduate Papers, 1956

The Churchill Falls Power Development
Water Power, November/December 1971

Pumped Storage Underground
Economic Commission for Europe, Athens, Greece, November 6 – 8, 1972 (coauthor)

Underground Reservoirs for Pumped Storage
Association of Engineering Geologists Annual Meeting, Kansas City, Missouri, 1973 (coauthor)

Rock Caverns for Underground Nuclear Power Plant Siting
American Nuclear Society, June 1974 (coauthor)

Underground Pumped Storage Possibilities
Engineering Foundation Conference, Rindge, New Hampshire, August, 1974

Pumped Storage Underground, Preliminary Site Selection Procedures
International Symposium on Multipurpose Storage Pumping Schemes, Madrid, Spain, November, 1974

Environmental Impact of Underground Pumped Storage
Engineering Foundation Conference, Rindge, New Hampshire, August 1975 (coauthor)

Underground Pumped Storage – Technical and Economic Feasibility
American Society of Mechanical Engineers, Winter Meeting, New York, December 1976.

JIM McCASLIN BROWN, Ph.D. SENIOR ENGINEERING GEOLOGIST

Current Responsibilities

Senior Engineering Geologist, specializing in projects requiring expertise in rock mechanics, structural geology, groundwater monitoring and control, bedrock mapping, and airphoto interpretation.

Alaskan Task Assignments

R&M Consultants, Inc.:

Operations Coordinator for the Northwest Alaskan Pipeline Company centerline soils investigation along the Alaska Highway from Delta Junction to the Canadian Border. This investigation performed in the spring of 1979 for Fluor-Northwest Inc., utilized 5 drillrigs, thermistor installations, and geophysical methods to obtain geotechnical data required for the Federal Energy Regulatory Commission permitting processes, and for design and financing purposes. The operations coordinator was responsible for sample storage and shipping; scheduling of the downhole permafrost density and moisture content determination by gamma-gamma response and neutron-thermal-neutron response techniques; thermistor installation; resistivity surveys employing Geonics EM 31 resistivity units to locate anomalies prior to drilling; scheduling of special drilling techniques for large sample recovery for frost heave studies; and final environmental inspection of drill sites.

Field Supervisor for resistivity survey of selected sites along the Northwest Alaskan Pipeline Company gas line route from Eielson Air Force Base to Livengood. The geophysical traverses totaled about 20 miles in length and were performed for Fluor-Northwest Inc. by a five man party utilizing the Geonics EM 31 and EM 34 survey units to measure ground resistivity, and to allow subsequent interpretation of subsurface conditions such as soil type and unfrozen versus frozen thermal state.

Project Geologist, Preliminary Site Investigations for 16 proposed high school sites at villages within the Lower Kuskokwim School District. Through the use of available well log data combined with airphoto and topographic map interpretation described the soils, permafrost, and seasonal frost conditions likely to prevail at the proposed school sites. Also responsible for a discussion of the regional geology, permafrost, and seismic conditions.

Senior Engineering Geologist, responsible for the preparation of terrain unit maps based upon published soils data and air photo interpretation as a part of a number of projects in southcentral and western Alaska. These terrain unit maps

and non-plastic soil cements; and developing structures and methods to control erosion, stream siltation and surface runoff.

Project Geologist, responsible for the 1977 Terrain and Geotechnics Investigation of the South Willow Capital Site. This surficial geology and subsurface soils investigation, using the terrain unit method of terrain analysis, provided geologic data and engineering evaluation of the geotechnical conditions at the designated development area. This information was required for the initial physical planning and design tasks of the State of Alaska Capital Site Planning Commission.

Project Geologist, responsible for the 1978 Geotechnical Studies - Geologic Materials and Hazards Analysis of the new State Capital Site at South Willow, Alaska. This investigation, applying the techniques of terrain unit analysis to a 100 square mile area, was performed as part of the Environmental Assessment Program - Phase 1. These techniques allowed the collection of considerable geotechnical data to be used for an environmental assessment of the Capital Site.

Project Manager, rock slope stability consultant to the Alaska Department of Highways on the Keystone Tunnel Bypass Project. Services provided included construction inspection of bedrock conditions, blasting, and slope stability. Performed a stability analysis of the partially excavated rock slope west of the Lowe River. Participated in a Value Engineering Study of alternative plans for continuation of the project.

Project Geologist, responsible for the geologic reconnaissance, terrain unit mapping, and soils investigation portions of the Goose Bay - Point MacKenzie Highway Corridor Route Reconnaissance. This study performed for the Matanuska - Susitna Borough defined possible highway route corridors, evaluated geologic and soil conditions along each corridor, and estimated construction costs for roads within each corridor.

Project Geologist, responsible for the field investigation and site analyses of the Quarry Site Selection Study, for the University of Alaska Seward Marine Shore Station.

Senior Engineering Geologist, participated in a mile-by-mile frost heave potential assessment of the Northwest Alaska Pipeline Company gas line route from Prudhoe Bay to the Alaska Border.

Project Manager, provided geologic documentation of the cathodic protection borings at the Alyeska Pipeline Terminal in Valdez.

U. S. Geological Survey:

Geologist, investigated the structure and stratigraphy of the southern part of Kodiak Island, the Trinity Islands, and Chirikof Island, Alaska.

BOB A. DORTCH, L.S. CHIEF OF SURVEYS

Current Responsibilities

Chief of Surveys and Survey Coordinator, Anchorage Office, R&M Consultants, Inc.

Alaskan Task Assignments

R&M Consultants, Inc.:

Project Manager, Alaska Divisions of Lands Cadastral Survey at Glennallen, Alaska. Boundary survey involving 14 Sections of land including aerial topography and tentative subdivision of State ownership parcels. Final subdivision platting of approximately four square miles into parcels of appropriate size.

Chief of Surveys, responsible for the field surveying, computing and mapping of 16 remote village high school sites within the Lower Kuskokwim School District. Conducted public hearings in 8 remote villages assisting in the public selection of school sites in the L.K.S.D. Prepared real estate transfer procedure and resolution documents for execution by Village Councils, Village Corporations and Regional Corporations for the villages within the L.K.S.D.

Project Supervisor in the research and surveying of various lease tracts in the Prudhoe Bay area for the North Slope Borough.

Project Manager, Southwest Region Schools Boundary surveys at Togiak, Koliganek, Portage Creek, Ekwok and Alegnagik. Complete boundary and topographic surveys and mapping.

Project Manager, single family residence subdivision portion of Turpin Road Planned Unit Development consisting of approximately 35 fully improved lots.

Performance of various boundary and lot surveys in and around Anchorage, Eagle River and Mat-Su Valley areas.

Supervising Surveyor of Matanuska Glacier Park, a planned unit development.

Project Manager of numerous site civil surveys in and around Anchorage, Kenai and Mat-Su Valley.

Supervisory Surveyor of various fly-in subdivisions in Mat-Su Valley.

Project Supervisor, Alaska Division of Lands Cadastral Survey G.S.C.-131, Glennallen, Alaska. Approximately 35 miles of

boundary line in 14 sections and ground contour for photogrammetric contour mapping.

Supervising Surveyor, Old Seward Highway between Huffman and New Seward Highway. Pre-design survey including centerline and right-of-way establishment, profiling and location of all above and below ground features.

Task Assignments Outside Alaska

Dortch-Gresdel & Associates, Klamath Falls, Oregon:

Special Consultant to Weyerhaeuser Co., Bly, Oregon, capital improvement project including Project Manager in design and construction of 15 acre deep strength asphalt log sort yard over aggregate and lime treated base. Project Manager for design and construction of 60 single family unit housing project.

Consultant to Pacific Power and Light Co., monitoring lateral movement and subsidence of John Boyle Dam on an on-going basis for over five years.

Contract Surveyor on Roger Peak Cadastral Survey for Fremont National Forest consisting of approximately 12 sections of land along the crest of the Warner Mountains.

County Surveyor on contract to Lake County, Oregon, for five years performing all of the county road surveying, boundary dispute surveying, corner remonumentation, and served as advisor to County Commissioners.

Contract Surveyor to Fremont, Winema and Rouge River National Forests for the survey of approximately 125 miles of timber access roads and highways over a period of eleven years.

Consulting Surveyor to Bureau of Land Management for the surveying and photogrammetric mapping of Sterling Reservoir in eastern Oregon.

Project Manager of Sprague River Ranchos, a 2,000 acre planned unit development. Responsible for design and concept plan.

Project Manager for the photogrammetric contour mapping for the City of Klamath Falls, Oregon, of the northerly portion of the city.

Surveyed and mapped known geothermal resource areas being explored for hot water source for use in large scale geothermal greenhouse complex in Lakeview, Oregon.

Performed numerous geothermal wellhead position surveys for San Juan Oil Company in eastern Oregon.

Served as surveyor and consultant for Western Nuclear, locating approximately 30 uranium claims in development of mining plan.

Performed crime scene surveys for State of Oregon, Department of Justice, and for Klamath County Sheriff's Department; prepared exhibits for court display and served as expert witness in trial courts.

Surveyed microwave network route and established transmitter and reflector sizes for Pacific Northwest Bell utilizing long range microwave electronic measuring devices (tellurometers) to establish position control.

Consultant to the City of Chinoquin, Oregon, for the design and construction of 600,000 gallon per day sewage treatment plant, an E.P.A. funded project.

Project Manager for the City of Tulelake, California, in the construction of an aerated lagoon sewage treatment facility and two sewage lift stations.

Performed numerous vehicle and train related accident surveys throughout Oregon and California, prepared court exhibits and served as expert witness in related court trials on behalf of companies such as Union Pacific Railroad, Greyhound and others.

Designed, computed and staked approximately 40 subdivisions in and around southern Oregon and northern California containing a total of approximately 6,000 lots over a 10 year period from 1967 to 1977.

Selected as a Governor's special task force member created for the study of subsurface disposal of sewage effluent and promulgation of Oregon State rules governing the subsurface disposal of septic tank effluent.

Designed and supervised installation of numerous experimental subsurface sewage disposal systems under the direction of the State of Oregon, Health Division.

Performed large scale on-the-ground cadastral and highway control surveys utilizing field points digitized from aerial photogrammetry in experimental project conducted jointly by U.S. Forest service and Weyerhauser Co.; evaluated various techniques for use of this type of survey in timber resource area application.

Surveyed and mapped representative test plots for use in the evaluation of damage to pine timber stands caused by beetle

infestation. Selected test plots were used as bench mark material for the classification of beetle damage using infrared aerial photogrammetry techniques.

Education

Associate Degree in Surveying, Oregon Technical Institute, 1959.

Registration/Certifications

Professional Land Surveyor, 1964, Oregon.

Professional Land Surveyor, 1966, California.

Professional Land Surveyor, 1966, Nevada.

Professional Land Surveyor, 1976, Alaska.

Professional Affiliations

Fellow Member, American Congress on Surveying & Mapping

Charter Member, Professional Land Surveyors of Oregon

BRENT T. DRAGE, P.E. HYDROLOGIST/SENIOR ENGINEER

Current Responsibilities

Hydrologist, specializing in hydraulic design, river mechanics, ice engineering, sedimentology, riverine regime analysis, and northern hydrological evaluation and assessment.

Senior Engineer responsible for project management on hydraulic and general civil engineering projects.

Alaskan Task Assignments

R&M Consultants, Inc.

Hydrologist, conducted an extensive hydrological study of the Kuparuk River and Coastal Plain watershed on the North Slope, for Atlantic Richfield Company. Utilized the Corps of Engineers' Floodplain Hydrology (HEC-1) and Floodplain Hydraulics (HEC-2) computer programs for the analysis.

Project Engineer, responsible for design of 2 miles of reconstruction for the Old Seward Highway in Anchorage. Carried the project through the preliminary design and location study, public hearings and final design.

Project Engineer, in charge of site selection, site engineering, soils investigation, surveying and road design for housing projects at five villages in the Aleutian Islands.

Hydrologist, reviewed the bank erosion problem at the village of Noatak and provided recommendations to the State of Alaska for locating future school facilities.

Permit application specialist, have prepared several permit applications for bridges, waterway encroachments and marine facilities for clientel to be presented to the U.S. Army Corps of Engineers.

Project Manager for conducting a feasibility study for crossing the Kuparuk River with a bridge capable of supporting 1200 ton building modules and resisting severe ice and flood forces while meeting present environmental and governmental concerns. Client was ARCo Oil and Gas Company.

Project Engineer, responsible for route selection and performing the preliminary design of a submarine pipeline across the Kuparuk River. Prepared permit for submission to U.S. Army Corps of Engineers. Client was ARCO Oil and Gas Co.

Hydrologist, participated in a water availability study for a proposed fish hatchery at Upper Trail Lake on the Kenai Peninsula. Client was Alaska Department of Fish and Game.

Hydraulics Engineer, designed the spillway geometrics for Saxman Dam to adequately convey the design flood flow. Client was U.S. Public Health Service

Alyeska Pipeline Service Company

Senior River Engineer, responsible for the design, maintenance and monitoring of river and stream crossings for the Trans Alaska Pipeline System preceeding, during and following the operational start-up.

Hydraulic design and site selection for several permanent access bridges.

Woodward - Clyde Consultants

Project Engineer, developed and implemented a hydrology program for a multi-disciplinary project to determine guidelines for mining gravel from rivers and floodplains in Alaska, for the U.S. Fish & Wildlife Service.

Prepared a hydrological assessment of the National Petroleum Reserve - Alaska for an environmental impact statement on the exploratory drilling program.

Provided hydrological input on the Oil Spill Contingency Plan for the Trans Alaska Pipeline System.

Consultant, for the development of a winter water supply project for oil drilling rigs on the North Slope for BP Alaska, Inc.

Schlumberger Offshore Services

Field Engineer, in charge of performing oil well logging in the Prudhoe Bay and Cook Inlet oil fields. Interpretation of the logs to determine geological formations, location of oil and gas reserves, and the quantity of fossil fuels contained within the reserves.

Institute of Water Resources, University of Alaska

Research Assistant involved in hydrologic research projects. A major project investigated the current methods of peak flood determination in northern sparse data regions. Completed thesis research on the hydraulic characteristics of northern braided rivers.

Canadian Task Assignments

Northwest Hydraulics Consultants, Ltd.

Conducted an extensive river ice research program on the Mackenzie River to determine the effects of spring break-up on proposed wharf structures and pipeline crossings.

Hydraulic Engineer, participated in the river engineering data collection and design for the proposed Arctic Gas Pipeline.

Consultant, participated in a multi-discipline task force assigned to select the route and prepare preliminary testimony for the proposed Beaufort-Delta oil pipeline from the Mackenzie Delta to Edmonton, Alberta.

Hydraulic Engineer for the Trans Alaska Pipeline System, conducted river surveys, collected hydraulic data and prepared field data reports for the major and minor river crossings along the pipeline route. Participated in the hydraulic design of major river crossings. Computed 'Standard Project Flood' water levels, flood limits, velocities and scour depths.

Hydraulic Engineer, design of hydraulic structures and river training works, river surveys, bathymetric surveys, and preparation of proprietory reports for projects in western Canada.

Education

B.S., 1969, Civil Engineering, Utah State University

M.S., 1977, Civil Engineering, University of Alaska

Registrations/Certifications

Professional Engineer (Civil), Alaska, 1975

Professional Engineer (Civil), Alberta, Canada, 1974

Publications

Drage, B.T., and Carlson, R.F., "Hydraulic Geometry Relationships for Northern Braided Rivers." Third Canadian Hydrotechnical Conference, Laval University, Quebec, May, 1977.

Drage, B.T., "Hydraulic Engineering Investigation into the Braided Rivers of the Eastern Brooks Range, Alaska." Masters Thesis submitted to the College of Engineering, University of Alaska, Fairbanks, 1976.

Drage, B.T., and Nuttall, J., "Mackenzie River Ice Break-Up." Presented at ASCE Hydraulics Division, 23rd Annual Specialty Conference, Seattle, Washington, 1975.

MALCOLM A. MENZIES, P.E., L.S. VICE PRESIDENT

Current Responsibilities

Principal and General Manager, Juneau Office, R & M Consultants, Inc.

Alaskan Task Assignments

- R&M Consultants, Inc.

  Location Engineer; responsible for locating 55 miles of secondary road from Livengood to the Yukon River for the Trans Alaska Pipeline.

  Project Manager, supervised engineering and environmental analysis for the Juneau-Douglas waste water treatment facility.

  Project Manager, supervised site reconnaissance, evaluation, location surveys, and soils investigation for the U. S. Coast Guard's 17th District Loran 'C' Sites at Shoal Cove, Tok, and Narrow Cape, Alaska.

  Project Manager, supervised quality control and construction management services provided to the City and Borough of Juneau for repaving improvements to the Juneau International Airport and pavement construction, Wrangell Airport.

  Project Manager, currently responsible for supervising R&M's portion of a joint venture effort with Richardson Associates and TAP, Inc., to update the Juneau International Airport Master Plan for the City and Borough of Juneau.

  Project Manager, supervising feasibility studies, surveys, and preliminary designs for the sawmill and port development proposed by the Alaska-Juneau Timber Corporation.

  Project Manager, supervised special studies to evaluate natural resource sites throughout Southeast Alaska for multiple land use as construction material sources and at the same time provide environmental improvements.

  Project Manager, supervised 155 mile Native Land Selection Cadastral Engineering project at Unalakleet, Alaska for the Bureau of Land Management.

  Project Manager, currently supervising Native Land Selection Cadastral Engineering project in the Craig-Klawock area of Southeast Alaska for the Bureau of Land Management.

  Project Manager, responsible for site evaluation, complete design, and construction management for a 310 unit mobile home park at Switzer Creek near Juneau, Alaska.

Project Manager, responsible for planning, design, and construction management of several projects throughout Alaska. Projects range from land development through to solid waste management and slope stability studies.

State of Alaska, Department of Highways, Juneau District

Area Resident Construction Engineer, responsible for protecting the State's interest in highway construction maintenance and design projects.

Project Construction Engineer, responsible for making certain that highway projects were constructed in accordance with the plans and specifications.

District Location Engineer, responsible for highway location surveys throughout Southeast Alaska.

Project Survey and Design Engineer, responsible for obtaining necessary preconstruction surveys and developing designs for specific highway projects in Southeast Alaska.

Project Right-of-Way Engineer, researched and made recommendations concerning highway right-of-ways for specific projects within the district.

Southeastern Consultants; Juneau, Alaska:

Partner in a firm which specialized in land surveys and civil engineering throughout Southeast Alaska.

Education

B.S., 1963, Civil Engineering, Chicago Technical College, Chicago, Illinois.

Special Studies in Surveying, U. S. Army Engineering Center, Fort Belvoir, Virginia.

Registrations/Certifications

Professional Engineer (Civil), 1969, Alaska, Washington.

Professional Land Surveyor, 1965, Alaska.

Professional Affiliations

Member, American Society of Civil Engineers.

Past State Treasurer, Alaska Society of Professional Engineers.

Past Chairman, Alaska Section, American Congress of Surveying and Mapping.

Board of Directors - Alaska Society of Professional Land Surveyors.

Member - American Society of Photogrametry.

Member - Canadian Institute of Surveying.

Member, American Congress of Surveying and Mapping.

Member, Alaska Society of Professional Land Surveyors.

Member, City and Borough of Juneau Planning Commission.

Member, Juneau Chamber of Commerce.

RALPH R. MIGLIACCIO PRESIDENT

Current Responsibilities

President, Alaska Western, Inc., Anchorage
President, R&M Consultants, Inc.

Alaskan Task Assignments

R&M Consultants, Inc.:

Founder and President, R&M Consultants, Inc., from 1968-present.

Special Consultant to Alyeska Pipeline Service Company and other gas pipeline groups. Includes participation on unique earth science engineering geology projects.

Geologist, experienced in route soils studies, foundation investigations, site evaluation, and selection studies. In charge of geological route review and drilling studies, Trans Alaska Pipeline Project.

Engineering Geologist, with broad experience in geotechnical disciplines including soil mechanics, foundations, geology, aerial photographic interpretation and earthquake effects; work has encompassed every physiographic province of Alaska, including permafrost regions and areas possessing more normal conditions.

His experience has provided the basis for a number of technical papers, including major works on the engineering geologic effects of earthquakes, and problems associated with permafrost, frost action, and northern climate construction.

Alaska Department of Highways:

District Geologist and District Materials Engineer, Valdez, Alaska, responsible for geological investigations and materials testing for district projects.

Materials Foundation Engineering Geologist, College, Alaska. Directed many complex subsurface foundation investigations throughout the State for major bridge and embankment structures.

University of Alaska:

Research Geologist, Arctic Environmental Engineering Laboratory, College, Alaska. Directed geotechnical investigations and research studies for cold regions projects.

Task Assignments Performed Outside Alaska

Pacific Materials Laboratory, Riverside, California:

Employed as an Engineering Geologist on various projects in Southern California.

Utah Department of Highways, Salt Lake City, Utah:

Employed as Laboratory Supervisor of their soil mechanics laboratory.

U.S. Department of Agriculture, Salt Lake City, Utah:

Cartographer, participating in various aerial photo and map making projects at their Western Aerial Photo Laboratory.

U.S. Air Force, St. Louis, Missouri:

Cartographer, participating in various map making projects at their Aeronautical Chart and Information Center.

Education

B.S., 1958, Geology, Brigham Young University

Postgraduate course work in Geology, Brigham Young University

Postgraduate course work in Engineering Management, Glaciology and Soil Mechanics, University of Alaska, Fairbanks

Cartographic instruction, U.S. Air Force Cartographer School

Air traffic control instruction, U.S. Air Force

Registrations/Certifications

Registered Engineering Geologist, 1970, California

Professional Geologist, 1970, California

Certified Professional Geologist, 1970

Professional Affiliations

Member, Association of Engineering Gelogists

Member, American Institute of Professional Geologists

Member, Highway Research Board

Member, American Association for the Advancement of Science

Professional Affiliations

Affiliate Member, American Society of Civil Engineers

Special Consultant, National Academy of Science, Alaska Earthquake

Member, Civil Air Patrol

Past Mayor (Pro Tem) and City Councilman, Valdez

Director and Vice President, Greater Fairbanks Chamber of Commerce 1971-1977

Director, Alaska State Chamber of Commerce, 1974-1977

City Councilman, Fairbanks, Alaska, 1975-1977

State Committee Member, Alaska Humanities Forum, 1976-present

Awards

Outstanding Service Award, Greater Fairbanks Chamber of Commerce, 1971, 1972, 1974

Publications

Coulter, Henry W. and Migliaccio, Ralph R. "Effects of the Earthquake of March 27, 1964 at Valdez, Alaska," Geological Survey Professional Paper 542-C.

Migliaccio, R. "Earthquake Damage to Highways in the Valdez District, Alaska." Highway Research Record, No. 91, HRB Publication 1307, 1965.

Ross, G.A., Seed, H.B. and Migliaccio, R. "Bridge Foundation Behavior in the Alaska Earthquake," ASCE, SMFDIV, July, 1969.

Migliaccio, R. and Rooney, J. W. "Engineering Geologic and Subsurface Soil Investigations for the Trans Alaska Pipeline System," (abstract). Proceedings - Symposium on Cold Regions Engineering (Vol. I), University of Alaska, College, June, 1971.

JAMES W. ROONEY, P.E. PRINCIPAL/VICE PRESIDENT

Current Responsibilities

Vice President and Principal-in-Charge, Anchorage Office, R&M Consultants, Inc.

Alaskan Task Assignments

R&M Consultants, Inc.:

Special Consultant to Trans Alaska Pipeline System and gas pipeline study groups.

Consultant, for the coordination and supervision of field investigations and geotechnical studies for the Trans Alaska Pipeline System; involvement has been continuous since early 1969.

Geotechnical Engineer, assisted in the evaluation of pipeline alignment, general soil conditions, and preliminary review of slope performance of critical segments along the Trans Alaska Pipeline route.

Geotechnical Engineer, selected as special task group member by Dr. R. B. Peck for detailed review and identification of slope stability problems associated with construction programming along the Trans Alaska Pipeline route.

Project Consultant, visual impact engineering and site restoration projects for the Trans Alaska Pipeline.

Evaluation of a small dam failure in Anchorage, Alaska, and retained as a third party to review a number of geotechnical and civil design related project failures.

Expert review on legal case concerning 1) Construction claims associated with pavement materials at Barrow, Alaska, 2) a major landslide and powerhouse failure in Ketchikan, Alaska, and 3) the failure of large multi-plate highway culverts in Juneau, Alaska.

Project Geotechnical Manager for U. S. Coast Guard Loran "C" Stations at Ketchikan, Kodiak, and Tok, Alaska.

Performance of soils engineering and foundation studies in Anchorage, Wasilla, Palmer, Fairbanks, Juneau, Kenai, Cordova, Valdez, and many Alaskan locations throughout the Trans Alaska Pipeline route.

Evaluation of a construction excavation slope failure in weathered bedrock which partially undermined an existing three story structure on the University of Alaska - Fairbanks campus, included the design of a braced bulkhead retaining wall for temporary support through construction period.

Selected as Project Geotechnical Consultant for the Northwest Alaskan Natural Gas Transmission System by Fluor Engineering and Constructors. Involved in coordination of and supervision of field and office geotechnical studies for the chilled gas pipeline alignment.

State of Alaska, Department of Highways:

Project Design Engineer, responsible for a number of highway design projects in Southeast Alaska.

Design Engineer, directed a special study involving construction of a four-lane highway adjacent to the Juneau-Douglas High School. Effort included evaluation of settlement and highway embankment slope stabilization related to previous boat harbor construction and hydraulic fill placement adjacent to structure.

Valdez District Materials Engineer, responsible for project materials and soil investigations for district projects; programs included evaluation and design recommendations for cut slopes of up to 300' in height in soils and rock containing both frozen and thawed conditions.

Valdez District Materials Engineer, conducted special study and prepared remedial design for a major embankment failure involving gravel fill on thawed clay soil.

State Soils Engineer, responsible for review of soil conditions and specific geotechnical studies for general soil investigations on highway projects throughout the State.

State Soils Engineer, supervised and directed a number of special studies on soils and construction materials and assisted in the review of project construction materials and soil conditions.

State Soils Engineer, directed investigation of a major 55' high rock-fill embankment failure on disturbed frozen foundation material along a section of the Alaska Highway.

Task Assignments Performed Outside Alaska

Soil Testing Services, Iowa City, Iowa:

Senior Engineer, responsible for project operations at branch office of Soil Testing Services in Iowa City, Iowa. Projects involved major foundation investigation programs for highways, buildings, small dams, and industrial sites.

Project Soils Engineer, providing services for two major interstate highway projects involving special design considerations for deep cuts and fills in potentially unstable soils; evaluation and recommendations for staged construction, sub-drains,

instrumentation and monitoring controls for these projects. Also involved in the evaluation of bluff instability and erosion problems abcve the Burlington Railroad alignment along the Mississippi River near Ft. Madison.

Education

B.S., 1962, Civil Engineering, Wayne State University.

M.S., 1967, Civil Engineering, Wayne State University.

Registrations/Certifications

Professional Engineer (Civil), 1964, Alaska, 1967, Iowa.

Professional Land Surveyor, 1972, Alaska.

Professional Affiliations

Member, American Society of Civil Engineers.

Member, National Society of Professional Engineers.

Member, Transportation Research Board.

Past Assistant Chairman, Soil Mechanics and Foundations Committee, American Society of Civil Engineers, Iowa Section.

Former Member, Anchorage Municipality Geotechnical Commission.

Instruction

Instructor (Evening Course) - University of Alaska, School of Engineering, Department of Civil Engineering, "Pavement Design."

Workshop Topic Chairman, Transportation Corridors - Design and Construction. Joint U.S. - Canadian Northern Civil Engineering Research Workshop. Edmonton, Alberta, March, 1978.

Publications

Davison, B.E., Nottingham, D. and Rooney, J.W., "Chilled Pipeline Frost Heave Mitigation Concepts." Pipelines in Adverse Environments, Proceedings of the ASCE Pipeline Division Specialty Conference, January, 1979.

Davison, B.E., Rooney, J.W., and Bruggers, D.E., "Design Variables Influencing Piles Driven in Permafrost." A.S.C.E. Cold Regions Specialty Conference, Anchorage, Alaska, May, 1978.

Vita, C.L. and Rooney, J.W., "Seepage - Induced Erosion Along Buried Pipelines." A.S.C.E. Cold Regions Specialty Conference, Anchorage, Alaska, May, 1978.

Davison, B.E., and Rooney, J.W., "Arc Welding Applied to Arctic Foundations," Consulting Engineer, December, 1977.

Wang, Dr. W., Rooney, J.W., and Davison, B.E., "Simpson Hill Cut, Copper River Basin, Alaska - A Case History of Slope Stability in Frozen Cohesive Soil." Thirtieth Canadian Geotechnical Conference, Saskatoon, Saskatchewan, October, 1977.

Davison, B.E., and Rooney, J.W., "Use of Thermal Piles for Offshore Frozen Embankments." Fourth International Conference on Port and Ocean Engineering Under Arctic Conditions, Memorial University of Newfoundland, St. Johns, Newfoundland, Canada, 1977.

Rooney, J.W., Nottingham D., and Davison, B.E., "Driven H-Pile Foundations in Frozen Sands and Gravels." Second International Symposium on Cold Regions Engineering, University of Alaska, College, Alaska, 1976.

Rooney, J.W., and Atkins, J.T., "Servicing in Northern Communities" (abstract). Forum - Canadian Institute of Planners - Annual Conference, Winnipeg, June, 1976.

Migliaccio, R.R., and Rooney, J.W., "Engineering Geologic and Subsurface Soil Investigations for the Trans Alaska Pipeline System" (abstract). Proceedings - Symposium on Cold Regions Engineering (Vol. I), University of Alaska, College, Alaska, June 1971.

Rooney, J.W., "The Influence of Sampling and Disturbance on the Shear Strength of Saturated Cohesive Soils," Master's Essay submitted to College of Engineering, Wayne State University, June, 1967.

Klausner, Y., and Rooney, J.W., "Design and Construction of a Device for the Pure Deviatoric Loading of Soils." National Science Foundation Science Teaching Equipment Development Program Grant, Wayne State University.

Awards

1976 Lincoln Arc Award for H-Pile Foundation Design.

Awarded Membership in Chi Epsilon, National Honorary Civil Engineering Fraternity.

ROBERT L. SCHRAEDER SENIOR ENGINEERING GEOLOGIST

Current Responsibilities

Associate of R&M Consultants, Inc.

Head, Earth Science Department, R&M Consultants, Inc.

Vice President, Resource Exploration Corporation, management of field operations conducted within the State of Alaska.

Professional Experience

1965	Staff Geologist, Alaska Department of Highways, Valdez.
1965-1969	District Geologist, Alaska Department of Highways, Valdez.
1969-1970	Acting District Materials Engineer, Alaska Department of Highways, Valdez
1970-Present	Senior Geologist, R&M Consultants, Inc.

Directly Related Task Assignments

R&M Consultants, Inc.:

Supervisory Geologist, supervision of the centerline soils investigation for the Trans Alaska Pipeline. This involved establishing the procedures, standards and lines of communication necessary to direct the activities of up to 40 field geologists, and to coordinate their efforts with the needs of management and other involved groups. This project involved various levels of activity over a period of approximately seven years, and a multimillion dollar budget. Products included preparation of published borehole logs, drilling location maps and supporting information in a format suitable for presentation to government review agencies.

Supervisory Geologist, supervision of the preliminary centerline soils investigation for the proposed Northwest Alaskan Gas Pipeline between Delta Junction and the Canadian Border. Tasks were essentially the same as for the TAPS (above) except that supervision of seven double shifted drill rigs was also included. This task involved as many as 50 personnel of varying job descriptions and was further complicated by the extremely short time available for mobilization and the urgent need for the finished product.

Supervisory Geologist, supervised preparation of terrain unit maps and associated landform profiles for the TAPS project. These maps were developed by intensive use of photogeologic interpretation combined with extensive field checking and incorporation of all soils information available from the drilling program, published sources, and personal knowledge of the area.

Senior Geologist/Associate, managed and directed work of the R&M Houston office. Primary duties were: liaison with Alyeska Geotechnical Engineering and the numerous other consultants involved in the project, review of proposed design documents for compliance with design criteria and government stipulations, writing and reviewing design mode justification documents prior to submittal to the agencies, writing requests for Notices to Proceed and answers to agency questions and objections, performing duties attendant with the R&M position on the Alyeska construction mode selection committee, supervising other geotechnical personnel in the Houston office.

Supervisory Geologist, supervised preparation of preliminary Terrain Unit Maps for the proposed Northwest Alaskan Gas Pipeline. The project involved photo interpretation, a literature search and field checking.

Supervisory Geologist, assisted in the design of and data gathering for the TAPS Soil Data Bank.

Supervisory Geologist, supervised the design and implementation of resistivity surveys along selected segments of the TAPS. These surveys were used to extend the information in hand to other, less understood segments of the alignment, and to increase the confidence level of sub-soil interpretations.

Geotechnical Consultant, temporary duty in the Alyeska Houston Office. Duties included membership on the Alyeska Construction Mode Committee. This committee was responsible for the application of government stipulations and APSC design criteria to the collected geotechnical data to develop a construction mode listing for the entire pipeline route. Also included were extensive design review duties. These reviews included inspection of essentially all pertinent geotechnical parameters which might affect the integrity of the pipeline. Other duties involved monitoring of field data flow from Alaska to Houston, assisting on numerous short term task forces, and liaison between project personnel the R&M Houston Consultant Group and the Alyeska Hoston Group.

Supervisory Geologist, supervision of the day-by-day operation of the R&M Fairbanks Geotechnical Section. This included normal management duties as well as scheduling and implementation of all projects.

Geotechnical Consultant, participated in the foundation drilling program and materials source reconnaissance for two school buildings in Ketchikan Alaska. This project involved use of tripod and cat head wash boring tools which were hand carried to the drilling sites in dense vegetation.

Geotechnical Consultant, supervised the development of numerous reports such as slush flow avalanche studies, solifluction studies, slope stability studies and bedrock mapping projects.

Geologist, Member of the Site Study Task Force, North Slope Haul Road Maintenance Camp Study for the Alaska Department of Transportation and Public Facilities. Participated in the field investigation of all potential maintenance camp sites along the 360 mile road. Performed preliminary examination of all potential camp sites and described their physical parameters, including road maintenance, siting, climate, and geotechnical parameters as well as environmental, historical, and archaeological considerations.

State of Alaska, Department of Highways

District Geologist, performed route reconnaissance for various proposed routes including the Chitina to McCarthy Road, the Lake Louise Reroute and Extension, The Tasnina Pass segment of the Copper River Highway and other short realignment proposals.

District Geologist, directed and performed centerline soils investigations of the Chitina to McCarthy Road, various segments of the Glenn, Richardson and Tok Highways, the Lake Louise Road, and the Valdez to Ft. Liscum Road.

District Geologist, directed and performed borrow and quarry site investigations of the Lake Louise Road, the Chitina to McCarthy Road, the west end of the Copper River Highway, the Tasnina Pass area, and segments of the Richardson, Glenn and Tok Highways.

District Geologist, participated in setting-up and monitoring the Chitina permafrost insulation test section.

District Geologist, responsible for preparing and administering the budget and the day-by-day activities of the Geology group of the Materials Section, Valdez District.

Acting District Materials Engineer, direction of the geology, materials testing and construction materials inspection for the Alaska Department of Highways, Valdez District.

District Geologist, directed and performed seismic and resistivity surveys for bridge sites, borrow sites, cut sections and centerline investigations of segments of the Lake Louise Road, the Valdez to Ft. Liscum Road, and the Tasnina Pass section of the Copper River Highway.

Other Alaskan Experience:

Geologist, participated in stratagraphic geologic studies for Gulf Oil Corporation in the area north of the Brooks Range, Alaska.

Geologist, participated in research on Ice Island ARLIS II in the Arctic Ocean for the Office of Naval Research.

Geologist, teaching Assistant, University of Alaska, assisted in teaching the Mining Short Courses.

Research Assistant, investigations in geochemical research for the University of Alaska.

Education

M.S. Geology, University of Alaska

Registration/Certification

Registered Professional Geologist, California (1971)

GARY A. SMITH SENIOR GEOLOGIST

Current Responsibilities

Project Manager for the scheduling and coordination of multidisciplined projects.

Geologist, specializing in engineering and environmental geology.

Alaskan Task Assignments

Developed critical path method scheduling for the construction management phase of a $450,000 water system for the village of Beaver. The project resulted in a cost savings to the Alaska Department of Public Works of 15-20%.

Manager of the Alaska Branch office, Pacific Testing Laboratories, responsible for soils investigations for foundation studies, construction inspection and materials testing.

Project Manager, scheduling and coordinating multidisciplinary projects involving the phasing of work efforts for both internal departments and outside participants involved in a project.

Prepared preliminary analysis of water supply sources and evaluations of development alternatives for the Trans Alaska Pipeline Terminal at Valdez.

Instrumental in land-use feasibility and selection analysis for Cook Inlet Region, Inc., under the Alaska Native Claims Settlement Act; $140,000 project.

Major participation in a hydrology study involving analysis of small drainage basins and their affect on the Trans Alaska Pipeline route.

Involved in the development of erosion control procedures and related environmental design considerations for Alyeska Pipeline Service Company.

Involved in the design of special erosion control systems at critical sites along the Trans Alaska Pipeline.

Design of special erosion protection systems and quantity estimates of materials for several pump stations along the Trans Alaska Pipeline.

Involved in the systematic evaluation of soil erodability along proposed Trans Alaska Pipeline access roads, material and disposal sites, in order to facilitate the formulation of soil protection programs.

Land desirability and usability analysis for evaluation of potential land selection and development in Southcentral Alaska for the Knik Village Corporation.

Evaluation, with written and graphic presentations, of geotechnical constraints related to the location of short segments of the Trans Alaska Pipeline route for permit applications.

Evaluation of potential quantities of suitable materials and rough projected operating costs of a particular gravel pit development in the Anchorage area.

Geologist, routinely involved in subsurface studies for the evaluation of potential development sites, roadways, and building foundations.

Directed a complete geotechnical study for a Cattle Research Center, Kalsin Bay, Kodiak Island, involving coordination of site work, performing subsurface investigations, and preparation of a comprehensive report which included design recommendations for building foundations, roadway foundations, sewage disposal, water supply well, and special considerations for remote site development.

Conducted a literature search and prepared an evaluative report with annotated bibliography on the subject of Rapid Detection Techniques for Water Sources in Arctic Regions. Report prepared for CRREL, Army Corps of Engineers.

As part of a two-man team, prepared a water study to identify potential water sources for the City of Eagle River, Alaska. A final report for the State of Alaska, Department of Environmental Conservation was prepared following field efforts which included shallow resistivity surveys, surface water hydrology analysis, terrain unit mapping and three test wells.

As the final phase of a soils evaluation for a major Anchorge Hillside subdivision, Mr. Smtih represented the developer in a presentation to the Planning and Zoning Commission.

Prepared development and restoration plans, and made client's permit application submittal for a gravel pit in an environmentally sensitive area.

Edited and revised the Environmental Protection Manual for Alyeska Pipeline Service Company.

Project Manager, responsible for a project to drill 300 foot deep holes and install cathodic protection apparatus at the Trans Alaska Pipeline Terminal, Valdez, and four pump stations. The $255,000 project came-in 10% under budget.

Coordinates many small site investigations and their report preparation dealing with soils suitability for on site septic systems -- to assure conformation with state and local environmental regulations.

Developed terrain-unit map from aerial photographs and literature search data for 185 proposed State offered homesites at three remote areas in Alaska. Resultant maps and recommendations pro-

vided necessary soils information for approval of the sites by the Department of Environmental Conservation.

Participation in the preparation of an environmental impact assessment of various energy conservation technologies utilized in the construction and operation of Alaska's proposed new capital at Willow.

Editor-in-Chief in charge of preparation of school site investigation reports for sixteen (16) villages in the Lower Kuskokwim School District. The published reports included detailed regional and site conditions and comprehensive design determinants necessary for design and construction planning in remote areas where very little information existed previously.

Involved in office coordination of three drilling rigs dispatched to seventeen (17) remote villages in the Lower Kuskokwim region, and responsible for the preparation of geotechnical reports outlining subsurface conditions and providing recommendations for foundation selection and design at each village.

In charge of subsurface investigation for ARCO's proposed Kuparuk River Pipeline Crossing. The study involved a resistivity survey and drilling program, and resulted in the preparation of a report utilized as part of a permit application submitted to the Corps of Engineers.

Education

B.S., 1968, Geology, University of Oregon.

Registrations/Certifications

Registered Professional Geologist, 1978, Oregon

Professional Affiliations

Member, Alaska Geological Society.

Member, Alaska Ground Water Association.

Publications

R&M Consultants, Inc. 1978. Rapid Detection of Water Sources in Cold Regions. Prepared for the Cold Regions Research and Engineering Laboratory, U.S. Army Corps of Engineers. Manuscript. 75 p.

Smith, T.L. et al. 1977. Energy Conservation Technology Study--Identification of Environmental Impacts of Energy Conservation Technologies for Proposed New Capital Site at Willow, Alaska. Prepared for the Alaska Division of Energy and Power Development and the U.S. Energy Research and Development Administration. R&M Consultants, Inc., Anchorage. 59p.

Norma E. Biggar

geology

EDUCATION

University of Alaska, Fairbanks: M.S., Geology, 1974
Antioch College, Yellow Springs, Ohio: B.A., Geology, 1970

REGISTRATION

Registered Geologist: California
Certified Engineering Geologist: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Staff Geologist to Project Geologist, 1973-date
Geophysical Institute, University of Alaska, Research Assistant, 1971-1973
Wright State University, Teaching Assistant, Department of Geology, 1971
Dr. Ronald G. Schmidt, Consulting Geologist, Yellow Springs, Ohio, Draftsperson, 1971

REPRESENTATIVE EXPERIENCE

Ms. Biggar has served as the project geologist for the active fault identification study for the proposed Alcan gas pipeline in Alaska; and for the geological and seismological investigations of the New Melones Dam site in California.

She served as technical editor for the Woodward-Clyde Consultants' book, "Age Dating of Geologic Materials", in addition to researching and compiling many of the age-dating discussions presented in the book, and is presently preparing a manuscript of the book for publication. Since joining Woodward-Clyde, she has also been involved in regional geologic studies for the siting of a proposed LNG plant at Yakutat, Alaska, nuclear reactors in the Persian Gulf of Iran, Italy, and the Central Valley of California, and the detection of active faults for the Trans-Alaska pipeline project.

An overall geologic study of the Chena Hot Springs area near Fairbanks, Alaska was the topic of Ms. Biggar's Master's Thesis. This investigation included a 35-square mile mapping project of the granitic and metamorphic units in the vicinity of the thermal springs, and geochemical, geophysical and ground temperature studies in the thermal area.

AFFILIATIONS

Geological Society of America
Association of Women Geoscientists
Association of Engineering Geologists

NEB 6-78

PUBLICATIONS

"Alaska's geothermal resource potential", with R. B. Forbes, The Northern Engineer, V. 5, No. 1, 1973.

"Identification of distinguishing characteristics of late Quaternary faults in the Western Sierran foothills, California", with R. F. Harpster and C. L. Taylor, Abstracts, Earthquake Notes, V. 49, no. 1, pp. 88-89, 1978.

"Evaluation of Quaternary faulting in colluvium and buried paleosols, Western Sierran Foothills, California", with W. D. Page, F. H. Swan III, R. Harpster and L. S. Cluff, Abstracts with Programs, Cordilleran Section, Geological Society of America, V. 10, no. 3, p. 141, 1978.

NEB 6-78

George E. Brogan

engineering geology
seismic geology
structural geology
geomorphology

EDUCATION

San Diego State College: M.S., Geology, 1969
San Diego State College: B.A., Geology, 1966

REGISTRATION

Registered Geologist: California
Certified Engineering Geologist: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, Los Angeles/Orange, California, Associate, 1978-date; Deputy Director of Geology, 1976-date; Oakland, California, Staff Geologist to Senior Project Engineering Geologist, 1971-1975
Woodward-Lundgren and Associates, Oakland, California, Consultant in Geology, 1969-1971
University of Nevada, Reno, Department of Geology-Geography, Teaching Fellow, 1968-1971
Humble Oil and Refining Co., Kingsville, Texas, Production Geologist, 1967
San Diego State College, Department of Geology, Teaching Assistant, 1966-1968
U.S. Navy Electronics Laboratory, San Diego, California, Data Analyst with San Deigo State College Foundation, 1964-1968

REPRESENTATIVE EXPERIENCE

Mr. Brogan has practiced engineering geology since 1966, and has world-wide experience in engineering geology and seismic geology on projects including nuclear and conventional power plants, dams, tunnels, pipelines, airports, high-rise buildings, offshore drilling platforms, and liquefied natural gas terminals. In connection with these numerous investigations, he has completed complex projects in diverse geographic and climatic environments. He was in charge of the evaluation of active faults for the Trans-Alaska Pipeline System, the evaluation of the Boconó fault in Venezuela for the Yacumbú tunnel, the mapping and evaluation of the Wasatch fault in Utah, the evaluation of seismic activity and faults for several power plants in Italy, studies for nuclear power plant siting in Iran, evaluations of dams and dam sites in North and South America, and mapping active faults for land-use planning in Managua, Nicaragua. He has completed studies of seismic and geologic hazards in offshore areas of California, Alaska, and the Caribbean.

GEB 1-79

His experience in siting critical facilities includes studies for domestic and foreign nuclear power plants. He managed field and office studies that identified potential nuclear power plant sites along the Southern Persian Gulf and Gulf of Oman for the Atomic Energy Organization of Iran (AEOI). After the siting studies were completed, he managed field studies of 5 of the sites; these studies were used as a basis by AEOI for selecting the favored site on the Persian Gulf. In addition to managing the Iranian siting studies, Mr. Brogan has provided high-level guidance in developing the approach and philosophy to be used in nuclear power plant siting studies in California for Pacific Gas and Electric Company (PG&E), and in Washington and Oregon for Washington Public Power Supply System (WPPSS).

Mr. Brogan has managed studies for siting other critical facilities, including siting of a proposed Liquefied Natural Gas (LNG) Import Terminal Site in California. Those studies were conducted for the California Coastal Commission, a California State agency that regulates development in coastal areas. Both onshore and offshore areas were considered, and methodologies were developed to screen coastal California for acceptable areas, and to identify positive and negative attributes of individual sites. Field studies were conducted in response to the methodologies that were developed, which resulted in ranking of 10 sites and selecting a favored onshore site and a favored offshore site.

Mr. Brogan has become a recognized leader in evaluating earthquakes and fault activity. He has convened a Geological Society of America Penrose Conference on that topic, and is an adviser to the U.S. Geological Survey Earthquake Hazard Reduction Program. He has taught graduate and undergraduate courses in geology and earthquake engineering, has lectured for many universities and professional organizations, and was selected as Woodward-Clyde Consultants' Young Professional in Geotechnical Practice in 1975. In his present position, Mr. Brogan is in responsible charge of geological, seismological, and geophysical studies within the Southern California offices of Woodward-Clyde Consultants.

AFFILIATIONS

American Association for the Advancement of Science
American Association of Petroleum Geologists
American Geological Institute
American Geophysical Union
American Society of Photogrammetry
Association of Engineering Geologists
Earthquake Engineering Research Institute
Geological Society of America
International Association of Engineering Geology
Seismological Society of America
Sigma Xi

GEB 1-79

PUBLICATIONS

Mr. Brogan has authored or co-authored more than 30 professional publications that have appeared in numerous scientific and engineering journals and proceedings of conferences and symposia. These publications include studies of the effects of recent earthquakes, case histories of studies of faulting and seismicity in many localities, and philosophical discussions regarding mitigation of geological hazards. A complete list of Mr. Brogan's publications will be provided upon request.

GEB 1-79

Lloyd S. Cluff

seismicity and seismic geology
earthquake engineering
environmental geology
engineering geology

EDUCATION

University of Utah, Salt Lake City: B.S., Geology
University of Utah, Salt Lake City: Graduate studies in Engineering Geology

REGISTRATION

Geologist: California
Certified Engineering Geologist: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Principal, Chief Engineering Geologist, Vice President and Director, 1971-date; Associate and Chief Engineering Geologist, 1965-1971; Staff Geologist, 1960-1965
University of Nevada, Reno, Nevada, Visiting Associate Professor of Geology, 1968-1973
Lottridge Thomas & Associates, Salt Lake City, Utah, Geologist, 1960
El Paso Natural Gas Company, Salt Lake City, Utah, Junior Geologist, 1957-1959
University of Utah, Salt Lake City, Utah, Teaching Assistant, 1958-1960

REPRESENTATIVE EXPERIENCE

As Vice President and Chief Engineering Geologist, Mr. Cluff is responsible for all technical and administrative functions related to geologic, seismologic, and geophysical investigations, explorations, and evaluations. Types of projects under Mr. Cluff's direction include nuclear reactor siting studies, active fault and earthquake hazard and risk evaluations, geologic hazard evaluations, seismic safety studies, and land-use planning with regard to geologic and earthquake hazards. Mr. Cluff also directs geologic and earthquake studies relating to dams, bridges, tunnels, pipelines, highways, urban development, LNG facilities, industrial sites, oil field operations, offshore developments, groundwater development, and aggregate and quarry sites.

In March, 1978, Mr. Cluff was elected to the National Academy of Engineering. He served in 1976 and 1977 on the Newmark Panel, a panel of experts called to advise the U.S. Geological Survey, National Science Foundation, and the President regarding the national program for earthquake prediction and hazard mitigation. He serves on the Earthquake Programs Advisory Panel of the U.S. Geological Survey and is a consultant to the Office of Science and Technology Policy, Working Group on Earthquake Hazards Reduction. He is a member of the National Academy of Sciences' Committee on Seismology, and serves on their Subcommittee on seismologic and geologic considerations in the safe siting of critical facilities. He recently served on an International Strong Motion

Arrays Committee of the International Associations of Earthquake Engineering and of Seismology and Physics of the Earth's Interior. He has served as consultant to the U.S. Atomic Energy Commission, Oak Ridge National Laboratory, regarding active faulting and earthquake effects on nuclear reactor safety.

As a member of the State of California's Task Committee on Seismic Hazards from State-Owned/Occupied Structures, Mr. Cluff is involved in the definition of standards for the evaluation of seismic risk. He was a member of the Stanford Research Institute Oversight Committee on Earthquake Prediction, and the State of California Energy Resources Conservation and Development Commission Advisory Panel on earthquake and geologic hazards in California.

Mr. Cluff has made more than 15 post-earthquake evaluations of the geologic effects of damaging earthquakes throughout the world as a post-earthquake evaluation team member for the Earthquake Engineering Research Institute, the International Association of Engineering Geologists, the California Seismic Safety Commission, and the California Governor's Earthquake Council.

Since 1967, Mr. Cluff has served as consultant to the Venezuelan Presidential Earthquake Commission. From 1966 to 1970, he served as consultant to the State of Utah Governor's Earthquake Council and to the Utah Geological and Mineralogical Survey regarding active faulting, earthquake, and geologic hazards in Utah.

From 1968 to 1973, he served as a member of the Consulting Board of the San Francisco Bay Conservation and Development Commission, Earthquake Engineering Criteria Review Board. In 1969, he served as a member of the Special Panel of Consultants to the President and the Secretary of the Interior for the Santa Barbara oil spill, and was responsible for reviewing earthquake problems in that area.

As a member of the International Consulting Board for the International Atomic Energy Agency in Vienna, Mr. Cluff advised on geologic, seismologic, and earthquake engineering problems associated with siting nuclear power reactors in foreign countries. He has served as a consultant to the atomic energy commissions of the governments of Mexico, Chile, Italy, and Iran, regarding active faulting, earthquakes, and geologic hazards with respect to siting nuclear reactors. Since 1970, he has served as consultant to Ente Nazionale Per L'Energia Elettrica, Milan, Italy, on geologic and earthquake hazards with respect to siting fossil fuel power plants in Italy. He has also served as consultant to Ente Nazionale Per L'Energia Elettrica, Rome, Italy, regarding active faulting and earthquake problems in siting nuclear reactor power plants in Italy. He has served as consultant to Comision Federal de Electricidad, Mexico, regarding dam safety from active faulting and earthquakes.

He served as a member of the State of California Joint Committee on Seismic Safety, Advisory Group on Land Use Planning to Minimize Earthquake Risk. Since 1970, Mr. Cluff has served as a member of the UNESCO Consulting Board in Paris for "seismic phenomena associated with the filling of large reservoirs." He has served as consultant to the U.S. Corps of Engineers, Vicksburg research facility, and the U.S. Bureau of Reclamation regarding active faulting and earthquake effects on dams.

Mr. Cluff is a member of the Board of Directors of the Earthquake Engineering Research Institute. He was President of the Association of Engineering Geologists, 1968-1969. He also served as Vice President of the International Association of Engineering Geologists, 1970-1974. He is Chairman of the International Association of Engineering Geology Commission, studying worldwide seismic phenomena.

Mr. Cluff is listed in Engineers of Distinction (1970) and American Men of Science (1975).

AFFILIATIONS

National Academy of Engineering
Association of Engineering Geologists
Earthquake Engineering Research Institute
Geological Society of America
International Association of Engineering Geologists
Seismological Society of America
Structural Engineers Association of Northern California
Utah Geological Association

PUBLICATIONS

Mr. Cluff has authored and co-authored more than 50 technical papers on subjects relating to geology, seismology, and engineering. These papers have been published in national and international journals, and proceedings of conferences and international meetings.

LSC 8-78

PERSONAL DATA

NAME: Robert B. Forbes

DATE OF BIRTH: March 14, 1924

PLACE OF BIRTH: Aberdeen, Washington

EDUCATION:

University of Oregon, Eugene, Oregon, 1941-1942
1946-1948
B.S. Geology, University of Washington, Seattle, Washington
1948-1950
Graduate work, University of Washington, 1950-1951
Ph.D. Geology, University of Washington, 1957-1959

POSITIONS HELD & EXPERIENCE:

Geologist and Executive Officer, Juneau Ice Field Research Project, (spring-summer) 1949-1950.
Consultant, Mountain Environment Project, Department of Army, Washington, D.C., 1951-1953.
Chief, Field Observation Branch, OQMG, Department of Army, Washington, D. C., 1952-1953.
Department of Army Expeditions Project Supervisor, 1953-1955.
Assistant and Acting Chief, Research Branch, Office of Research Development, OQMG, Washington, D. C., 1955-1957.
Research Associate, Department of Geology, University of Washington, 1957-1959.
Assistant Professor, Geology Department, University of Alaska, 1959-1961.
Associate Professor of Geology, Geophysical Institute and Geology Dept., University of Alaska, 1961-1963.
Visiting Research Professor in Petrology, Geophysical Institute, University of Tokyo, Tokyo, Japan. (NSF Science Faculty Fellowship), 1963-1964.
Associate Professor of Geology, Geophysical Institute and Geology Department, University of Alaska, 1964-1965.
Professor and Head, Geology Department, University of Alaska Geology Dept. and Geophysical Institute, 1965-1969.
Visiting Research Geologist, Alaskan Geology Branch, U.S.G.S., Menlo Park, California, 1969-1970. (Temporary appointment; Sabbatical Leave academic year 1969-70).
Professor of Geology, Geophysical Institute and Geology Department, University of Alaska, 1970-1976.
Senior Geologic Consultant, Geophysical Institute, University of Alaska, 1976-present.

HONORS:

Department of Army Outstanding Performance Award (Special award for Antarctic research), Jan., 1957.
National Science Foundation Science Faculty Fellow in Geology (Geological Institute, Tokyo University, 1963-1964).
Vice President, Section of Volcanology, Geochemistry and Petrology, American Geophysical Union, 1970-1972.

PROFESSIONAL ORGANIZATIONS:

Fellow, Geological Society of America
Fellow, Arctic Institute of North America
Fellow, American Association for the Advancement of Science
Member, American Geophysical Union
Member, American Association of Petroleum Geologists
Member, Sigma Xi
Member, American Polar Society

PRESENT RESEARCH INTERESTS:

Petrology and geochemistry of igneous and metamorphic rocks, with current emphasis on andesitic volcanism and the petrology of blueschist and eclogite facies metamorphic rocks; volcanology, including geophysical and geochemical studies of Alaskan volcanoes; exploration and utilization of Alaskan geothermal and uranium resources.

PUBLICATIONS:

Published Papers

Forbes, R. B., Field research and expeditionary mountaineering, American Alpine Journal, 1954.

Forbes, R. B., Operation Deepfreeze I: Parts I, II, III, IV, The Quartermaster Journal, May-December, 1957.

Forbes, R. B., Ultrabasic inclusions from the basalts of the Hut Point area, Ross Island, Antarctica, Bull. Volcanologique, 26, 13-21, 1963.

Forbes, R. B. and D. W. Ester, Glaciation of Observation Hill, Hut Point Peninsula, Ross Island, Antarctica, J. Glaciol., 5, 87-92, 1964.

Forbes, R. B., The comparative chemical composition of eclogite and basalt, J. Geophys. Res., 70, 1515-1521, 1965.

Forbes, R. B. and H. Kuno, The regional petrology of peridotite inclusions and host basalts, Upper Mantle Volume; Selected papers from the Proceedings of the 22nd International Geological Congress, New Delhi, India, 161-179, 1965.

PUBLISHED PAPERS (Cont'd)

Forbes, R. B. and S. Banno, Nickel-iron content of peridotite inclusions and cognate olivine from an alkali-olivine basalt, American Mineralogist, 51, 130-140, 1966.

Foster, H. L. R. B. Forbes and D. M. Ragan, Granulite and peridotite inclusions from Prindle Volcano, Yukon-Tanana Upland, Alaska, U.S. Geological Survey Prof. Paper 550-B, B115-119, 1966.

Wilson, C. R., S. Nichparenko and R. B. Forbes, Evidence of two sound channels in the polar atmosphere from infrasonic observations of the eruption of an Alaskan volcano, Nature, 211, 163-165, 1966.

Forbes, R. B. and H. Kuno, Peridotite inclusions and basaltic host rocks, Ultramafic and Related Rocks, 238-337, Ed., P. J. Wyllie, John Wiley and Sons, 1967.

Forbes, R. B., D. K. Ray, T. Katsura, H. Matsumoto, H. Haramura, and M. J. Furst, The comparative composition of continental versus island arc andesites in Alaska, International Upper Mantle Project Scientific Report #16, State of Oregon Dept. of Geology and Min. Indus. Bull., 65, 111-120, 1969.

Forbes, R. B. and R. J. Barsdate, Trace metal zonation in a native copper nugget from the McCarthy district, Alaska, Econ. Geol. 64, 445-458, 1969.

Forbes, R. B., R. C. Dugdale, T. Katsure, H. Matsumoto and H. Haramure, Dredged basalt from Giacomini Seamount, Nature, 221, 849-850, 1969.

Wilson, C. R. and R. B. Forbes, Infrasonic waves from Alaskan volcanic eruptions, J. Geophys. Res., 74, 4511-4522, 1969.

Forbes, R. B. and C. M. Hoskin, Dredged trachyte and basalt from Kodiak Seamount and the adjacent Aleutian Trench, Alaska, Science, 116, 502-504, 1969.

Forbes, R. B. and J. C. Engels, K^{40}/AR^{40} age relations of the Coast Range Batholith and related rocks of the Juneau Icefield area, Bull. Geol. Soc. Amer., 81, 579-584, 1970.

Forbes, R. B. and H. L. Foster, Hisashi Kuno (Memoriam), EOS, 51, 246-247, 1970.

PUBLISHED PAPERS (Cont'd)

Gedney, L., C. Matteson and R. B. Forbes, Seismic refraction profiles of the ash flow in the Valley of 10,000 Smokes, Katmai National Monument, Alaska, J. Geophys. Res., 75, 2619-2624, 1970.

Forbes, R. B. and J. Kienle, Mount Saint Augustine--restless volcano, Pacific Search, 6, 3-4, 1971.

Forbes, R. B., T. Hamilton, I. L. Tailleur, T. P. Miller and W. W. Patton, Tectonic implications of blueschist facies metamorphic terranes in Alaska, Nature (Physical Science), 234, 106-108, 1971.

Forbes, R. B., D. L. Turner, J. Stout and T. E. Smith, The Denali Fault offset problem, U.S. Geol. Sur. Circular 683, 46, 1973.

Forbes, R. B. and M. J. Lanphere, Tectonic significance of mineral ages of blueschists near Seldovia, Alaska, J. Geophys. Res., 75, 1383-1386, 1973.

Forbes, R. B. and N. Biggar, Alaska's geothermal resource potential, The Northern Engineer, Vol. 5, No. 1, p. 6-10, Geophysical Institute, University of Alaska, Spring 1973.

Turner, D. L., R. B. Forbes and C. W. Naeser, Radiometric ages of Kodiak Seamount and Giacomini Guyot in the Gulf of Alaska; Implications for circumpacific tectonics, Science, 182, 579-581, 1973.

Foster, H. L., F. R. Weber, R. B. Forbes and E. E. Brabb, Regional geology of the Yukon-Tanana upland, Alaska, "Arctic Geology", AAPG Memoir 19, 388-395, 1973.

Bunder, C. M., C. A. Bush and R. B. Forbes, Radioelement distribution in the Birch Creek basement complex, Eielson Deep Test Hole, Alaska, J. Res. U. S. Geol. Survey, 1, No. 6, 659-663, 1973.

Subbarao, K. V., G. S. Clark and R. B. Forbes, Strontium isotopes in some seamount basalts from the northeastern Pacific Ocean, Canadian J. Earth Sciences, 19, No. 10, 1479-1484, 1973.

Forbes, R. B. and R. Swainbank, Garnet clinopyroxenites from Red Mountain Pluton Alaska, Bull. Geol. Soc. Am., 85, 285-292, 1974.

Forbes, R. B., D. L. Turner and J. R. Carden, Age of trachyte from Ross Island, Antarctica Geology, pp 297-298, June 1974.

PUBLISHED PAPERS (Cont'd)

Forbes, R. B. and F. R. Weber, Progressive Metamorphism of Schists Recovered from a Deep Drill Hole Near Fairbanks, Alaska, J. Res. U. S. Geol. Survey, Nov.-Dec. 1975.

Swainbank, R. and R. B. Forbes, Petrology of eclogitic rocks from the Fairbanks district, Alaska, Geol. Soc. Am. Special paper 151, p. 77, 1975.

Forbes, R. B. (contributing author and editor), Exploring Katmai National Monument, Chapter 3 (History) and Chapter 4 (Geology), Alaska Travel Publications, Inc., Anchorage, Alaska, 276 pp. 1975.

Forbes, R. B., L. Leonard and D. H. Dinkel, Total energy utilization potential of Alaskan thermal springs, Selected papers from the Proc. of the United Nations Geothermal Symposium, San Francisco, California, May 1975, pp. 2209-2215, 1975.

Forbes, R. B., "The Energy Crunch...Alaska Style", Proceedings of the Public Meeting on a National Plan for Energy Research, Development and Demonstration; Transcript of the Proceedings, U.S. Energy Research and Development Administration, Washington, D. C., December 1975.

Forbes, R. B. Investigation of Alaska's Uranium Potential: Part 2, Map of the granitic rocks of Alaska; and Regional Distribution and tectonic setting of Alaskan alkaline intrusive igneous rocks. GJO-1627, State of Alaska Division of Geological and Geophysical Survey, June 1975.

Forbes, R. B. and J. Kienle, Augustine Eruption Damages University Research Facilities, Now in the North, 6(2), 6-7, April, 1976.

Pewe, Troy L., John W. Bell, Robert B. Forbes and Florence R. Weber, Geological map of the Fairbanks D-2 SW quadrangle Alaska, U.S. Geol. Surv. Miscellaneous Investigations Series Map I-829-A, 1976.

Carden, J. R. and R. B. Forbes, Discovery of blueschists on Kodiak Island, Short Notes on Alaskan Geology, Alaska State Div. of Geol. and Geophys. Surveys Geological Report 51, pp. 19-22, 1976.

Pewe, Troy L., John W. Bell, Robert B. Forbes, and Florence R. Weber, Geological map of the Fairbanks D-2 SE quadrangle, Alaska, U. S. Geological Survey, Miscellaneous Investigations Series Map I-942, 1976.

Jones, B. K. and R. B. Forbes, Investigation of Alaska's Uranium Potential: Part 2, Uranium and thorium in granitic and alkaline rocks in western Alaska. GJO-1639, State of Alaska Div. of Geol. and Geophys. Surveys, February, 1977.

Pewe, Troy L., John W. Bell, Robert B. Forbes, and Florence R. Weber, Geological map of the Fairbanks D-2 NW quadrangle, Alaska, U.S. Geol. Surv. Miscellaneous Investigations Series Map I-829-A, 1977.

I.M. Idriss

earthquake engineering
soil mechanics and foundation engineering
numerical techniques and computer applications

EDUCATION

University of California, Berkeley: Ph.D. Civil Engineering, 1966
California Institute of Technology: M.S. Civil Engineering, 1959
Rensselaer Polytechnic Institute: B.C.E., Civil Engineering, 1958

REGISTRATION

Civil Engineer: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Principal and Vice President, 1974-date
Woodward-Clyde Consultants, San Francisco, California, Director, 1975-date
Stanford University, Department of Civil Engineering, Consulting Professor, 1977-date
Woodward-Clyde Consultants, Oakland, California, Associate, 1969-1974
University of California, Berkeley, Department of Civil Engineering, Associate Research Engineer, 1966-1975
Consultant to several architect-engineers and other firms, 1966-1969
Dames & Moore, San Francisco, California, Senior Soils Engineer, 1968-1969
University of California, Berkeley, Department of Civil Engineering, Lecturer in Soil Mechanics, 1967-1968
Dames & Moore, Los Angeles, New York and San Francisco, Field Engineer to Project Manager, 1959-1966
Moran, Proctor, Meuser & Rutledge, Field Engineer, New York, New York, Summer, 1958

REPRESENTATIVE EXPERIENCE

D . Idriss has been engaged in the practice of soil mechanics and foundation engineering since 1958 and has worked on foundation investigations for land developments, industrial buildings, power plants, earth dams, offshore structures and other facilities. Since 1964, he has also been engaged in research and applications pertaining to: the seismic response of soil masses and soil structures; evaluation of the failure potential of soils; soil material properties during cyclic loading; soil-structure interaction during earthquakes; and characteristics of ground motions. As a result of this research, he has developed and co-developed several analytical and empirical procedures for the evaluation of the behavior of soil masses during earthquakes. Recent consulting assignments have included seismic investigations for earth and rockfill dams, sites for nuclear power plants, high-rise buildings, offshore platforms, and industrial facilities, and applied research studies.

IMI 3-79

Dr. Idriss is director of geotechnical earthquake engineering studies for the Western Region of Woodward-Clyde Consultants. He has conducted and directed such studies for over 25 earth and rockfill dams in California, Alabama, North Carolina, Tennessee, and in Latin America. He has also conducted and directed earthquake engineering studies (including ground-motion characterization, assessment of liquefaction potential, evaluation of soil-structure interaction, cyclic soil characterization) at over 20 nuclear plant sites in the USA, Europe and the Middle East. Other projects for which he has conducted and directed geotechnical earthquake engineering studies include offshore platforms in California, Alaska, and New Zealand, and waterfront facilities, fossil plants, land developments in California, Idaho, Alaska, New Jersey, Texas, Italy, Puerto Rico, Iran, Nicaragua, Venezuela and other locations. Among the more recent applied research and non-site specific studies he has been engaged in are the following:

Soil-structure interaction studies for GESSAR and for General Electric's Standard Plant (1973-date); assessment of behavior of marine clay sediments during earthquake loading conditions (1973-date); assessment of behavior of marine clay sediments during wave loading conditions (1976-date); behavior of soil-pile-structure systems during earthquakes (1976-date); soil-structure interaction studies and correlations with model field tests (1976-1978); probabilistic and deterministic assessment of ground motions in Southern California for small and moderate earthquakes (1976-date); and Offshore Alaska Seismic Exposure studies (1977-date).

Recent Applied Research Activities: Since early 1975, Dr. Idriss has been conducting research related to the nonlinear behavior of soils under cyclic loading conditions. The results of this research have been applied to assessing performance of soft sediments during earthquakes. Other research activities in which Dr. Idriss has been engaged relate to: significant duration of earthquakes, simplified procedures for assessment of seismic soil-structure interaction, and probabilistic review and assessment of recorded ground motions and associated spectra.

HONORS

Norman Medal, ASCE, 1977
Walter L. Huber Civil Engineering Research Prize, ASCE, 1975
Woodward Lecture, Woodward-Clyde Consultants, 1973
J. James Croes Medal, ASCE, 1972
The Thomas A. Middlebrooks Award, ASCE, 1971
Chi Epsilon (Honorary Member, Rensselaer Polytechnic Institute Chapter)
Tau Beta Pi
Sigma Xi

IMI 3-79

SPECIAL ASSIGNMENTS

1966-date: invited lecturer at various universities in the United States, Latin America, Canada, Europe, and the Middle East
1971-date: invited lecturer at specialty conferences and special courses in the United States, Latin America, and Europe
1975-date: consultant to the International Atomic Energy Agency, Vienna; participated in preparation of IAEA's Safety Guide on "Seismic Analysis and Testing of Nuclear Power Plants"
1970-1976: consultant to the Government of Italy on nuclear reactor safety related to earthquake effects
1974-1977: Member, Subcommittee on Ground Motions and Site Effects, Applied Technology Council

AFFILIATIONS

American Society of Civil Engineers
Member: Publications Committee, Geotechnical Division;
Nuclear Structures and Materials Committee, Structural Division
(Chairman, Ad Hoc Group on Soil-Structure Interaction)
Earthquake Engineering Research Institute
Seismological Society of America
Structural Engineers Association of Northern California
Member: Seismology Committee (Soil-Structure Interaction Subcommittee; Chairman 1971-1972; 1977-1979)
U. S. Committee of the International Commission on Large Dams
American Petroleum Institute

PUBLICATIONS

Dr. Idriss has authored or co-authored over 60 technical papers and research reports on subjects relating to the geotechnical aspects of earthquake engineering (seismic response of soil deposits; earth structures including slopes and earth and rockfill dams; dynamic soil material properties; liquefaction; soil-structure interaction; and probabilistic and deterministic assessment of characteristics of ground motions.) These papers have been published in the Journals of the Geotechnical Engineering Division, the Structural Engineering Division and Proceedings of Specialty Conferences of the American Society of Civil Engineers; Bulletin of the Seismological Society of America; International Journal of Earthquake Engineering and Structural Dynamics; Proceedings of World Conferences on earthquake engineering, Offshore Technology Conference, and proceedings of other international engineering meetings.

Ulrich Luscher

project management
geotechnical engineering
frozen soil engineering
performance and instrumentation engineering

EDUCATION

Massachusetts Institute of Technology, Cambridge: Sc.D., Civil Engineering, 1963
Massachusetts Institute of Technology, Cambridge: M.S., Structures, 1959
Swiss Federal Institute of Technology, Zurich, Switzerland: B.S., Civil Engineering, 1956

REGISTRATION

Registered Civil Engineer: California
Registered Professional Engineer: Massachusetts

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Principal, 1974-date; Associate and Project Engineer, 1967-1974
Massachusetts Institute of Technology, Department of Civil Engineering, Assistant Professor, Soil Mechanics, 1963-1967
Massachusetts Institute of Technology, Instructor and Research Engineer, 1959-1963
Vevey Iron Works, Switzerland, Design Engineer, 1957

REPRESENTATIVE EXPERIENCE

Dr. Luscher's professional activities over the last 22 years have covered a broad range of applied geotechnical projects with ever increasing responsibility. At present, he is in charge of a group which conducts or manages large, often interdisciplinary projects for major industrial and governmental clients. He has recently been responsible for a site evaluation for an LNG plant, a foundation investigation for a nuclear power plant, offshore site evaluations, and measurement and appraisal of building vibrations. He has also headed several recent projects related to hazardous waste storage ponds.

As the principal responsible for a field measurement group, he has overseen a number of research and development studies related to development of energy resources and including topics such as mining subsidence, mine dewatering, geothermal subsidence measurement, core recovery, and in-situ permeability measurement. He has also headed several applied field instrumentation and monitoring projects. Finally, he is responsible for the extensive WCC soil and rock mechanics laboratory in Oakland, California.

Since mid-1977, Dr. Luscher has managed several studies for the proposed chilled gas pipeline across Alaska. The work has related to trench blasting tests, a review of the existing data base for the project, seismic fault investigations, and a large laboratory test program.

UL 7-79

Ulrich Luscher

From 1970 to 1976, Dr. Luscher was involved full-time in the Trans-Alaska oil pipeline project, leading a group of Woodward-Clyde Consultants' personnel engaged in evaluating geotechnical aspects of the pipeline system. The work included the following major areas: (1) Design of the pipeline support system, including development and application of criteria to evaluate the need for above-ground construction; (2) Development of design criteria and mile-by-mile design information for vertical support members of the above-ground pipeline; this task included field tests on prototype support members; (3) Geotechnical field engineering during construction, and development of guidelines for design changes in response to field conditions different from those assumed in the design; and (4) Preparation of surveillance and monitoring manual for use during pipeline operation.

Before 1970, Dr. Luscher acquired extensive experience in many phases of geotechnical engineering including foundations, earth retaining structures, land development, earth structures and underground conduits. He also worked on several projects involving nuclear power stations and the effects of earthquakes and other dynamic loads.

Dr. Luscher has also conducted projects involving foundation instrumentation, performance monitoring, and correlation between observed and predicted foundation performance. He has done research on the interaction of soil and underground structures and the failure conditions of foundations under static and dynamic loads.

AFFILIATIONS

American Society of Civil Engineers
International Society of Soil Mechanics and Foundation Engineering
Structural Engineers Association of Northern California

PUBLICATIONS

The following is a partial list of publications. A full list will be provided on request.

"Geotechnical Issues and Answers During Construction of the Trans-Alaska Pipeline," with H.P. Thomas, Paper No. 78-Pet-66, ASME Transaction, 1979.

"Pipe-Soil Interaction, Trans-Alaska Pipeline," with H.P. Thomas and J.A. Maple, ASCE Specialty Conference on Pipelines in Adverse Environments, New Orleans, Jan. 1979.

"Geotechnical Aspects of Trans-Alaska Pipeline," with W.T. Black and K. Nair, Proceedings, ASCE, Vol. 101, No. TE4, Nov. 1975.

"Thaw Consolidation of Alaskan Silts and Granular Soils," with S.S. Afifi, Permafrost: North American Contribution to 2nd International Conference, 1973.

UL 7-79

Maurice S. Power

soil mechanics
foundation engineering
earthquake engineering

EDUCATION

University of California, Berkeley: M.S., Soil Mechanics, 1962
Stanford University, Stanford: B.S., Civil Engineering, 1961

REGISTRATION

Civil Engineer: California

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Staff Engineer to Associate, 1966-date
Naval Air Station, Grosse Ile, Michigan, Assistant Public Works Officer, 1963-1965
Harding, Lawson & Associates, San Rafael, California, Field and Laboratory Engineer and Staff Engineer, summers 1960-1962

REPRESENTATIVE EXPERIENCE

Mr. Power has been engaged in analysis, design, planning and project management for a wide range of foundation engineering and earthquake engineering studies. Since 1970, he has worked primarily in earthquake engineering applications, including liquefaction potential evaluations, characterization of soil dynamic properties, ground response analyses, earthquake ground motion studies, soil-structure interaction analyses, and seismic stability evaluations of slopes and dams.

Representative projects include:

Earth and Rockfill Dams: Upper San Leandro Dam (San Leandro, California); San Pablo Dam (San Pablo, California); Chabot Dam (near Oakland, California); five proposed earth and rockfill dams (near Raleigh, North Carolina); two proposed earth dams (near Columbia, South Carolina); two proposed earth dams (near Walnut Creek, California); and Watauga Dam (Tennessee).

Nuclear Plant Sites: Summer Plant (near Columbia, South Carolina); Shearon Harris Plant (North Carolina); South Texas Project (near Bay City, Texas); X21-X22 Nuclear Station (northeastern Tennessee); X24-X25 Nuclear Station (Tishomingo County, Mississippi); proposed Stanislaus Plant (central California); Humboldt Bay Plant (Humboldt Bay, California); San Onofre Nuclear Generating Station (Southern California).

Industrial Facilities and Building Sites: Projects include foundations and seismic investigations for many types of facilities including: assessment of liquefaction potential and design response spectra for offshore platforms Maui A and Maui B in New Zealand; foundation and seismic studies for the Port of Oakland, California Middle Harbor Terminal (wharves, dikes and fills), preliminary characterization of ground motions

and evaluations of liquefaction potential for a proposed LNG facility in Yakutat, Alaska; soil and foundation studies for the Trans Alaska Pipeline; earthquake ground motion studies for proposed offshore oil platforms in the Santa Barbara Channel, California; preliminary evaluations of geotechnical conditions and geologic hazards for offshore platforms on the Kodiak outer continental shelf, Alaska; geotechnical planning and feasibility study for offshore guyed tower platforms; applied research on the behavior of offshore soil-pile-structure systems during earthquakes.

Other representative projects include: characterization of earthquake ground motions and ground motion probability studies for the proposed Auburn Dam, California; evaluation of the causes of damage to the Joseph Jensen Water Filtration Plant (Los Angeles, California) during the 1971 San Fernando earthquake; preparation of input for the seismic safety element, City of Fremont, California; foundation studies and seismic evaluations for the Loma Linda Veterans Administration Hospital (Loma Linda, California); evaluation of liquefaction potential of gravels beneath sand and gravel pits proposed to be used for solid waste disposal (Pleasanton, California); evaluations of expansive soil effects on residential housing in California, Colorado, Texas and Alabama for the Federal Housing Administration; earthquake engineering and wave loading studies for the proposed Southwest Ocean Outfall, offshore San Francisco, California; seismic soil-structure interaction studies for General Electric's Standard Nuclear Plant.

AFFILIATIONS

American Society of Civil Engineers
Earthquake Engineering Research Institute
Seismological Society of America

PUBLICATIONS

"A Simplified Procedure for Developing Interaction Response Due to Variations in Soil Properties," paper presented at the ASCE Structural Division Specialty Conference on Methods of Structural Analysis, Madison, Wisconsin, with K. Sadigh, C-Y. Chang, and T. Udaka, August 1976.

"Soil Response Considerations in Seismic Design of Offshore Platforms," Journal of Petroleum Technology, with I.M. Idriss and R. Dobry, March 1976.

"A Study of Attentuation of Ground Motion Parameters for Moduate Magnitude Earthquakes," Sixth European Conference on Earthquake Engineering, Dubrovnik, Yugoslavia, with K. Sadigh and R.R. Youngs, September 1978.

"Peak Horizontal and Vertical Accelerations, Velocities, and Displacements on Deep Soil Sites for Moderately Strong Earthquakes," Proceedings, Second International Conference on Microzonation, San Francisco, California, with K. Sadigh and R.R. Youngs, November 1978.

MSP 4-79

William U. Savage

seismology
geophysics
seismic geology

EDUCATION

University of Nevada, Reno: Ph.D., Seismology, 1976
University of Nevada, Reno: M.S., Seismology, 1971
University of Washington: National Science Foundation Graduate Fellow, Geophysics, 1966-1968
University of Oregon: B.S., Physics, 1966

PROFESSIONAL HISTORY

Woodward-Clyde Consultants, San Francisco, California, Senior Project Seismologist, 1974-date
United States Geological Survey, Menlo Park, California, Research Associate, 1973-1974
University of Nevada, Reno, Seismological Research Assistant, 1969-1973

REPRESENTATIVE EXPERIENCE

Dr. Savage has applied his seismological research experience and training to a large number of projects at Woodward-Clyde Consultants. He has conducted historical seismicity evaluations, seismotectonic interpretations, and seismic safety analyses for high-rise buildings, thermal and nuclear power plant sites, offshore oil developments, and other critical engineering projects, both in the United States and overseas. Dr. Savage has recently completed several major investigations of microearthquake occurrence as related to the development of seismic design criteria for major projects. These projects, in the United States, the Middle East, and Latin America, involved the design and installation of both portable and permanent telemetered arrays of field microearthquake recorders, the analysis of the resulting data, and the interpretation of the results leading to seismic safety and design information. These studies have been significant in understanding earthquake hazards in complex geologic environments. Dr. Savage is leading the Woodward-Clyde Consultants program in developing additional capabilities in microearthquake instrumentation and applications.

During the past several years, Dr. Savage has participated as a key member representing the fields of seismology on several interdisciplinary project teams. These projects have involved siting studies and safety analyses for the major dams of Auburn, California, the Coca River, Ecuador, and the Chulac and Xalala projects, Guatemala, and for the nuclear power plants at Hanford, Washington, Humboldt Bay, California, and San Onofre, California, and proposed plants at Stanislaus, California, and in Southern Iran. Dr. Savage has directed field studies and data analyses for seismological aspects of the projects and has worked with other technical experts in the earth sciences and engineering to synthesize and integrate the results of the investigations performed and to mutually develop and apply the methodologies leading to specific engineering results.

William U. Savage

Dr. Savage has recently completed a study of the seismicity of the Alaskan Interior for the proposed Alcan gas pipeline. In this study, detailed analyses of the microearthquake data along and east of the Denali fault were carried out to assess the location, level of activity, and sense of movement of potentially active faults.

While with the U.S. Geological Survey's National Center for Earthquake Research as a Postdoctoral Research Fellow, Dr. Savage participated in studies of historical seismicity, microearthquake seismicity, and seismic velocities pertinent to earthquake prediction. At the University of Nevada, Dr. Savage helped supervise the installation of a statewide telemetered seismic network and studied the statistical occurrence features of earthquake activity.

AFFILIATIONS

American Association for the Advancement of Science
American Geophysical Union
Seismological Society of America
Geological Society of America
Earthquake Engineering Research Institute

PUBLICATIONS

Dr. Savage has authored numerous reports and portions of reports ranging from brief summaries of site-related observations to lengthy presentations of the technical results of major studies and to regulatory agency documentation such as Preliminary Safety Analysis Reports for the U.S. Nuclear Regulatory Commission. In addition, much of his work has received peer review within the academic and professional community through presentations at scientific meetings and the publication of technical articles in professional journals. A complete list of publications is available upon request. Dr. Savage has also presented technical seminars and public lectures both locally and abroad on topics related to earthquake hazards, current seismological research, and engineering seismology.

WUS 6-79

CLINTON EDWIN ATKINSON
Fisheries Consultant and Advisor

EDUCATION

B.S., Fisheries, University of Washington, 1937
M.Sc., Fisheries, University of Washington, 1964
Duke University (Marine Station), 1950-51

EXPERIENCE

Experience:

Business:	1932-1936	Boise Glass and Paint Co. (partner) Manufacturer of Aquaria and dealer in fish and aquaria supplies
	1974-	Fisheries Consultant and Advisor
Government:		
U.S. Bureau of Fisheries	1937	Apprentice Fish Culturist Silver Springs Trout Hatchery
International Pacific Halibut Commission	1937	Scientific Assistant
International Pacific Salmon Fisheries Commission	1938-1940	Scientific Assistant
	1940-1946	Assistant Scientist
	1946-1948	Senior Scientist
U.S. Fish and Wildlife Service (Bureau of Commercial Fisheries):	1948-1949	Chief, Middle Atlantic Fishery Investigations College Park
	1949-1952	Chief, Middle and South Atlantic Fishery Investigations Beaufort
	1952-1958	Chief, Pacific Salmon Fishery Investigations Seattle
	1958-1966	Director, Biological Laboratory Seattle
	(1965)	Acting Deputy Assistant Director for Research, Washington, D.C.
U.S. Department of State:	1966-1971	Fishery Attache, American Embassy Tokyo
	1971-1973	Regional Fishery Attache for East Asia/Pacific Islands, American Embassy Tokyo
University:		
University of Washington:	1952-1964	Lecturer, College of Fisheries
	1974-	Visiting Scholar
University of Alaska	1974-197\	Advisor to the President (Fisheries)
University of Washington	1978	Visiting Lecturer (taught an upper division/graduate course in World Fisheries

AWARDS

Phi Mu Alpha (Music)	1937	Univ. of Washington
Phi Sigma (Biology)	1937	Univ. of Washington
Sigma Xi (Science)	1944	Univ. of Washington

Unit Citation for Meritorious Service (Research on Pacific Salmon)
U.S. Fish & Wildlife Service, 1957

U.S. Fish & Wildlife Service (Bureau of Commercial Fisheries):
Outstanding Performance 1960 and 1965
Outstanding Contribution, Federal Business Assn. 1959 and 1960

Governor of Niigata (Japan)	1962	Citation (Rainbow Transplants)
Japan Salmon Resources Protection & Preservation Soc.	1969	Citation (Conservation and Propagation of Salmon Resources)
Japan Marine Products	1973	Citation (Preparation of Books)
Office of Fisheries (Korea)	1973	Citation (Development of Fisheries)

SOCIETIES and ASSOCIATIONS

Pacific Fishery Biologists	1939-66
American Society of Ichthyologists and Herpetologists	1938-41
American Fisheries Association	1939-40
American Institute of Fishery Research Biologists	1956-
Japan Society of Scientific Fisheries	1974-
Japan America Society (Seattle)	1974-

COMMITTEES

North Carolina Resource-Use Education Commission	1951-1952	Commissioner
International North Pacific Fisheries Commission	1954-1967	Expert
U.S. Corps of Army Engineers Technical Advisory Committee	1955-1966	Member
University of British Columbia Hydro and Fisheries Research Committee	1956-1957	Member
Salmon Coordinating Committee	1960-1966	Member and Chairman
International Whaling Commission	1968,1972	Advisor
International North Pacific Fur Seal Commission	1969,1973	Advisor
Inter-American Tropical Tuna Commission	1972	Expert
United Nations (UNESCO (IOC)) Kuroshio Current Study Group	1972	National Coordinator (Acting)

International Commission for the Fisheries of the Northwest Pacific Ocean (USSR-Japan)	1961,1968 1970,1972	U.S. Observer
Alaska Interagency Fisheries Committee	1974-1977	Member and Chairman

PUBLICATIONS:

26 Publications dating from 1939 to the present, of which recent representative publications include:

1976 Development and Potential Yield of Arctic Fisheries. (Chapter 24 in Assessment of the Marine Environment - Selected Topics, D. W. Hood and D. C. Burrell, editors.) Institute of Marine Science, University of Alaska Fairbanks. pp. 389-400.

1976 United States and the 200-Mile Exclusive Economic Zone. Lecture, National Fisheries University of Busan (Korea), May 26, 1976. 73 pp.

1977 Fisheries and Markets for Tanner Crab in the Northeast Asian Countries. (in The Bering Sea Tanner Crab Resource: U.S. Production Capacity and Marketing). University of Alaska, Sea Grant Report No. 77-5, May 1977. pp. 125-153.

1977 Aquaculture of China. (in World Aquaculture (approximate title), E. Evan Brown, editor). (in press)

1977 Aquaculture of the Eastern USSR. (in World Aquaculture (approximate title), E. Evan Brown, editor). (in press)

1977 The Role of the University of Alaska in the Research and Development of Alaskan Fisheries. Part III - Development of Fisheries. University of Alaska, Office of the President, June 1977. 48 pp. and appendices

1977 Northeast Asian Fisheries. Lecture, University of British Columbia, March 22, 1977. 43 pp.

1978 Statistics of the Crab Fisheries of Japan. University of Alaska Sea Grant Program. (in press)

1978 Statistics of the Tuna, Skipjack and Billfish Fisheries of Japan. Macronsian Maritime Authority. (in manuscript)

1978 The Feasibility of Establishing a Fishing Base at Ponape: An Interim Report. Marine Resources Division, Trust Territory of the Pacific Islands, Ponape, East Caroline Islands. (in manuscript)

CLINTON E. ATKINSON

Fisheries Consultant and Advisor

8000 CREST DRIVE NORTHEAST
SEATTLE, WASHINGTON 98115
TELEPHONE - (206) 524-4242
TELEX - (TWX) 910 444 2108

May 20, 1979

SUPPLEMENTAL STATEMENT

Experience in Alaskan Fisheries and Salmon Research

Alaskan Fisheries -

1. Director of Biological Research for the United States Bureau of Commercial Fisheries (now the National Marine Fisheries Service), including extensive research on salmon in all major fishing/spawning areas in Alaska from Southeast Alaska to Bristol Bay. At that time, research projects were carried out in the Cook Inlet area and the staff was involved in a cooperative study of the proposed development of the upper Susitna river for hydro-electric power. (1952-1956/57).

2. Advisor to the President of the University of Alaska with specific duties to develop a fisheries curricula for the various campuses at the University of Alaska. I have been called in by the University of Alaska to review the program for progress and accomplishment and am engaged in such a review at the present time.

   During this study, I was also directed by the President to study the the organization of the fisheries research program in the University and to make appropriate recommendations. (1974-1977, 1979)

3. Chairman of the Alaska Interagency Fisheries Committee, composed of the President of the University of Alaska, the Regional Director of the National Marine Fisheries Service, the Commissioner of the Alaska State Department of Fish and Game, the Chairman of the Alaska State Senate Committee on Natural Resources and a representative of the Governor's office. (1974-1977)

4. Member of the Board of Directors, Whitney-Fidalgo Seafoods Inc., one of the largest fishing companies operating in Alaska. (1974-1977)

Salmon Fisheries -

1. Staff of the International Pacific Salmon Fisheries Commission, in charge of escapement and other studies on the spawning grounds in the Fraser river, and other related duties. (1938-1948)

2. Director of Biological Research and Chief Pacific Salmon Investigations for the United States Bureau of Commercial Fisheries (see 1 above), but including extensive research on fish passage problems on the dams of the Columbia river (mainly financed by the US Corps of Engineers).

Salmon Fisheries (continued) -

The research program also served as the principle agency for the investigation of the distribution of Asian and North American stocks of salmon in the North Pacific and an evaluation of the numbers taken by the Japanese high-seas fisheries. (1952-1965)

3. Member of a number of technical and advisory committees on planning, coordination and negotiation of salmon programs and problems.

4. Two Citations of Recognition from the Governor of Niigata and the Salmon Resource Conservation Preservation Association (Japan) for assistance in developing the salmon propagation programs in Japan.

5. Citation of Recognition from the Republic of Korea for assistance in the survey of the salmon resources of the Republic of Korea and in establishing a salmon propagation program for that country. (1973)

6. Head of delegation of salmon experts to participate in a four-nation salmon symposium at South Sakhalin (USSR) and adjunct professor for the University of Alaska. (1978)

Clinton A. Atkinson

JEFFREY O. BARNES

Terrestrial Environmental Specialists, Inc.

Education

B.S. Zoology (Major), Botany (Minor): State University of New York College of Environmental Science and Forestry, Syracuse, New York, 1971.

Professional Experience

Environmental Scientist, Terrestrial Environmental Specialists, Inc., Phoenix, New York, 1976 - present.

Terrestrial Ecologist, Niagara Mohawk Power Corporation, Syracuse, New York, 1972-1975.

Teacher/Demonstrator, Environmental Matters, Nine Mile Point Nuclear Station Progress Center, Niagara Mohawk Power Corporation, Oswego, New York, 1971-1972.

Awards and Offices

Certificate of Completion, Short Course on Environmental Siting of Transmission Lines, from Bruce Howlett, Inc. Brewster, New York, 1973.

Certificate of Completion, Natural Resource Inventory Workshop, Atmospheric Sciences Research Center, Wilmington New York, 1975.

Secretary - Treasurer (1974-1977); Vice President (1977-1978); The Wildlife Society - New York Chapter.

Memberships

National Audubon Society
National Wildlife Federation
The Smithsonian Institution
The Wildlife Society
The Wildlife Society - New York Chapter

Consulting and Related Experience

- supervised and reviewed impact analyses of six 115 kV to 765 kV electric transmission line sitings.

- devised a Site Sensitive Avoidance Technique for transmission line corridor selection studies and utilized this technique on two 115 kV and one 765 kV study in New York State.

Consulting and Related Experience (Continued)

- prepared and presented oral and written testimony at public hearings regarding electric transmission line siting studies.

- prepared exhibits to fulfill regulations governing the licensing and relicensing of hydroelectric generating facilities.

- supervised feasibility study on technique selection for aquatic biology and water chemistry studies.

- supervised and participated in a study to assess prescribed burning as a vegetation management technique for rights-of-way.

- presented testimony at public hearings regarding proposed electric generating plant siting studies.

- supervised and reviewed impact analyses for siting of high pressure gas transmission lines.

- worked upon the preparation of an environmental update for a proposed 765 kV transmission line and the evaluation of the environmental compatibility of proposed routes.

- supervised the preparation of a critique of a proposed stream reclassification report.

CATHIE A. BAUMGARTNER
Terrestrial Environmental Specialists, Inc.

EDUCATION

B.A. Biology; Douglass College, Rutgers University, 1969
M.S. Zoology; Penn State University, 1973

EMPLOYMENT HISTORY

1976-Present: Environmental Scientist, TES, Inc., New York

1975: Assoc. Environmental Scientist (Director of Herpetological Studies), Equitable Environmental Health, Inc.

1973-1975: Asst. Environmental Scientist (Herpetologist) Environmental Analysts, Inc.

1973: Instructor, Pennsylvania State University
Assistant Curator of Herpetology, Penn State Univ. Museum

1967-1973: Graduate Teaching Assistant, Penn State (Zoology, Ecology, Ornithology

CONSULTING and RELATED EXPERIENCE

Designed and implemented or supervised herpetofaunal surveys at 4 proposed nuclear power plant sites and 2 proposed fossil fuel power plant sites and authored herpetofaunal sections of EIS for the 6 proposed power plant sites. Supervised and coordinated production of a report on major baseline terrestrial ecology study for proposed electric generating facility.

Conducted literature searches on ecological parameters of selected marine fauna in conjunction with generation facility feasibility study and on habitat requirements, distribution, and predator-prey interactions of selected vertebrates of the northeast.

Critically analyzed sections of an environmental assessment for two proposed power plant sites and collected ornithological data at 6 proposed power plant sites.

Conducted study on habitat ecology of several species of stream vertebrates. Designed and supervised studies of amphibian, reptilian, and fish resources of a 4,300 acre naval facility.

Participated in and/or supervised reports assessing impacts of the renovation of a small hydroelectric facility, the impacts of an urban redevelopment project, and an environmental assessment of a proposed sanitary landfill.

Supervised and coordinated a route selection study for a 115 kV transmission line and designed and implemented data collection for a baseline and herpetofaunal monitoring program assessing the impacts of construction of a nuclear power plant.

Participated in data collection on peregrine falcons as part of a nationwide effort; assisted in collection of baseline breeding bird data to be used to monitor impacts of power plant construction activities.

AWARDS

National Science Foundation Grant, Summer Science Program, Patterson State College, 1964, and Fairleigh Dickenson University, 1963

Phi Sigma (National Biological Honor Society) 1971-73

Sigma Delta Epsilon (Graduate Women in Science), 1972-73

MEMBERSHIPS

American Association for the Advancement of Science
American Birding Association, Inc.
American Ornithologists' Union
American Society of Ichthyologists and Herpetologists
Eastern Bird Banding Association
Ecological Society of America
Federation of New York State Bird Clubs, Inc.
Raptor Research Foundation
Society for the Study of Amphibians and Reptiles
Wilson Ornithological Society

PUBLICATIONS

Authored testimony and responses to interrogatives on the environmental assessment of a proposed electric generating facility.

Designed, implemented and authored report on study of vegetation mapping of a small impoundment.

MILO C. BELL

EDUCATION

B.S., Mechanical Engineering, University of Washington, 1930
Professional Engineer, registered in Washington and Idaho

ACADEMIC

University of Washington, College of Fisheries:
Special lecturer 1940-53
Research Associate Professor 1953-58
Associate Professor, 1958-63
Professor, 1963-75 Professor Emeritus, 1975

Conducted Seminar on Salmon Hathery Design, University of Alaska, July 1976

PROFESSIONAL SOCIETIES, HONORS, MEMBERSHIPS

(Representative Listing)

National Academy of Engineering, Member, 1968
Eugene Baker Award (Assn. of Conservation Engineers), 1969

Fellow, American Institute of Fishery Research Biologists, 1973

Conferee at International Fisheries Conventions in Canada and the U.S. (1956 and 1957)

Past member, Pacific Marine Fisheries Commission

Panel member, First Governors' Salmon Conference, Juneau, 1961
Member, Fish & Wildlife Committee, Pacific Northwest River Basins Commission, April 1969 to present

Member, Fish Advisory Board, Consolidated Edison, NY, 1974-present
Member, Fish Facility Board of Consultants, California Dept. of Water Resources, 1974-present
Member, American Society of Civil Engineers (Hydraulic Div.), Task Committee on Fish Handling Capacity of Intake Structures, 1975-present

Fishery advisor, Lower Elwha Tribal Council, Washington (1975-present)
Southern Southeast Regional Aquaculture Assn., Inc., Ketchikan, Alaska (fish cultural facilities), 1976 to present

RESEARCH ACTIVITIES

Design and installation of artificial spawning channel on Mokelumne River, California; head losses encountered in use of wire cloth for fish protective screening; development, by use of models, of a permeable dyke; model study for reconstruction of forebay for downstream migrant passage; model study of louver screen section for application at T.W. Sullivan Power Plant.

Designed and installed artificial spawning channel on Mokelumne River; siltation effects in salmon and trout spawning redds, streambed silting; isolation of physical factors necessary for measuring success of spawning of salmonoid fish.

Major effects on environment in a closed lake system heated by stream generation; developed plans for use of heated water in a hatchery proposed by Puget Sound Power & Light on Skagit River; Development/installation of equipment for testing behavior of fish under light stress conditions; effects of stress on fish passing through water use projects. Develop and install equipment for testing swimming speeds and endurance of salmonoid fish and programming for experiments on passage of fish through turbines and spillways.

PUBLICATIONS and PAPERS

Over 30 papers, reports and publications from 1943 to 1976 dealing with all aspects of fisheries.

GENERAL ACTIVITIES

1930-33; Chief Engineer, Washington Department of Fisheries. Major work included development and installation of the first rotary fish screens in the State of Washington and the development of bypasses.

1933-35: Consultant for the States of Washington and Oregon, assigned to Bonneville Dam project, Columbia River, with the status of a consultant for the Corps of Engineers. Co-holder of basic patents for the fishway systems developed for this project and subsequently used at other major Columbia River dams.-

1935-43: Chief Engineer, Washington Department of Fisheries, with responsibility for design, construction and installation of fishways and rotary fish screens in the Yakima, Wenatchee, Entiat, Methow, and White River systems. Activities related to the design and construction of the Grand Coulee salvage facilities at Rock Island Dam, Icicle, Entiat, and Methow Rivers. Designed and constructed numerous hatcheries and the Minter Creek Biological Station. With the United States Geological Survey, established a means of measurement of small streams on an area basis.

1941-43: Consultant to International Pacific Salmon Fisheries Commission. Inaugurated required field work and experimentation for the fish facilities at Hell's Gate Canyon, Fraser River, British Columbia.

1943-51: Chief Engineer and Associate Director, International Pacific Salmon Fisheries Commission. Responsible for construction of the Hell's Gate, Bridge River Rapids, and Farwell Canyon fishways and the Horsefly Lake Biological Field Station. Conducted spawning ground area and lake surveys.

1949 to present: Consultant, Corps of Engineers (North Pacific Division and District offices) on fish facilities design and research programs in the Columbia and Willamette Rivers and the Puget Sound area.

1951-57: Technical Coordinator, Washington Department of Fisheries, heading all biological and hatchery research programs and engineering and stream improvement activities for the department; Acting Director, 1957.

1968-69: Acting Director, Water Research Center, State of Washington.

Consulting activities have included assignments for the States of Pennsylvania, Washington, Oregon, Idaho, and California, Federal agencies of the United States and Canada, and public and private water developers in Washington, Oregon, California, Massachusetts, Michigan, New Mexico, and New York.

E. JAMES DIXON, JR.

EDUCATION

B.A., Anthropology, University of Alaska, 1970
M.A., Anthropology, University of Alaska, 1972
Ph.D., Anthropology, Brown University, 1979

PRESENT POSITION

Curator of Archeology, University of Alaska Museum since February 1975. Initiated curatorial program for over one million specimens including comparative collections from Western and Central U.S., Europe and Ashia. Regional focus of collections: Western North American Arctic. Institute SELGEM for the collections. Provide input into exhibits and educational Museum programs and develop program of collections and field research

RESEARCH CONTRACTS

1971 Archeological Salvage Contract, Holmes and Narver, Inc. (acting on behalf of the Atomic Energy Commission), with J.P. Cook and C.E. Holmes. Archeological salvage of site 49-RAT-32, a large prehistoric Aleut Village Site. ($37,633.00)

1975 Bureau of Land Management Research Contract, probability modeling based on ecological criteria for regions of high archeological site occurrence. ($7,360.00)

1975 Project coordinator and Principal Investigator with R.D. Guthrie, G.D. Sharma and S.W. Stoker, Bureau of Land Management Outer Continental Shelf Office, "Bering Land Bridge Cultural Resource Study". Probability modeling for archeological site occurence on outer continental shelf between Asia and North America. Inter-desciplinary study. Conducted a marine archeological survey in an effort to detect submerged aboriginal habitation sites in the Bering Sea. ($225,520.00)

1977 Project Coordinator and Principal Investigator with G.D. Sharma and S.W. Stoker, Bureau of Land Management Outer Continental Shelf Office, "Western Gulf of Alaska, Cultural Resource Study", probability modeling for archeological site occurence on the outer continental shelf in the Western Gulf of Alaska. ($52,000.00)

1977 Project Coordinator and Principal Investigator with G.D. Sharma and S.W. Stoker, Bureau of Land Management Outer Continental Shelf Office, "Beaufort Sea Cultural Resource Study", probability modeling for archeological site occurrence on the outer continental shelf in the Beaufort Sea. ($146,000.00)

1978 Project Coordinator and Principal Investigator

Research Contracts (cont.)		With G.D. Sharma and S.W. Stoker, Bureau of Land Management Outer Continental Shelf Office, "Lower Cook Inlet Cultural Resource Study", probability modeling for archeological occurrence on the outer continental shelf in Lower Cook Inlet and Northwestern Gulf of Alaska. ($116,532.00)
	1978	With G.D. Sharma and S.W. Stoker, Bureau of Land Management Outer Continental Shelf Office, "Compendium of Alaskan OCS Cultural Resource Studies". ($204,531.00)
	1978	Principal Investigator, U.S. Army Corps of Engineers, Alaska District, "Archeological Survey and Inventory of Cultural Resources Fort Wainwright, Alaska". ($116,185.00)
Relevant Field work and Professional Experience	1967	Field Assistant, Archeological salvage and erosional study, Point Hope, Alaska (August)
	1969	Field Assistant, archeological excavations at Healy Lake, Alaska (summer)
	1969-70	Limited analysis of Healy Lake material (winter)
	1970	Crew Chief, survey and salvage of right of way of proposed haul road and pipeline from Brooks Range to Prudhoe Bay, for Alyeska Pipeline Service Caompany (summer)
	1970-71	Analysis of previous summer's field work
	1971-72	Co-assistant investigator, archeological salvage site 49-PAT-32, Anchitka Island, Alaska (May-January)
	1971	Director of excavations at the Gallagher Flint Station, North Slope, Arctic Alaska (July-August)
	1972	George C. Marshall Memorial Fellow, for study in Denmark (research at the National Museum of Denmark, Copenhagen) (February-May)
	1972	Director of excavations at Old Fish Camp, middle Yukon River region, Alaska (June-July)
	1972	Assisted in geological mapping and survey upper Sagavanirktok River Valley, Alaska, with T. Hamilton (August)
	1972-73	Analysis of Old Fish Camp archeological materials (winter)
	1973	Studied archeological collections housed in Irkutsk and Nova Sibersk, USSR (May)
	1973	Director of excavations at Old Fish Camp, middle Yukon River region, Alaska (summer)
	1973-74	Continued analysis of Old Fish Camp archeological materials (winter)
	1973-74	Teaching assistant, Brown University, Providence, R.I. (winter)

1974	Alyeska Archeologist, director of excavations at the Gallagher Flint Station and other sites along the Sagavanirktok River. Directed field crew of 30 excavators and foremen (summer)
1975	National Park Service archeologist attached to Anthropology Department, University of Alaska. Helped establish (14th) program for Alaskan Native Historic sites land claim settlement (January)
1975	Reconnaissance of archeological sites reported to the University of Alaska Museum
1975	Archeological site distribution probability modeling in the State of Alaska
1975-76	Research relating to the human occupation of the Bering Land Bridge during Pleistocene and early Holocene times (winter)
1976	Executed first marine archeological survey conducted in the Bering Sea, aboard the University of Alaska's R/V ACONA (June)
1976	Director of archeological survey of St. Matthew Island, Western Bering Sea (July)
1976	Participant (Northwest regional representative in SELGEM Workshop, sponsored by the National Association of Systematics Collections and the University of Knasas, Lawrence, Kansas (1 week in August)
1978	Director of archeological survey of Porcupine River Caves, Eastern Interior Alaska.

MEMBERSHIPS

Society for American Archeology
American Anthropological Association
Alaskan Anthropological Association
National Geographic Society
Society of Professional Archeologists

GRANTS AND AWARDS

1971	Geist Fund Award
1972	George C. Marshall Fellowship, for study in Denmark
1973	Arctic Institute of North America Research Grant
1973	Haffenreffer Museum of Anthropology Collection Grant
1973	Society of Sigma xi Equipment Grant
1973	International Research and Exchange Commission Travel Grant to the Soviet Union
1974	Arctic Institute of North America Research Grant
1975	State of Alaska Division of Parks Matching Grant
1976	American Council of Learned Studies International Travel Grant to Nice, France (declined)

PUBLICATIONS

More than 20 publications, reports and research papers on archeological topics from 1971 to 1978.

ROY GERARD

Socio-Economic Consultant

Terrestrial Environmental Specialists, Inc.

EXPERIENCE

Current:

President, Economic Consultants Organization, Inc.
Buffalo and Syracuse, New York

Prospect, obtain, prepare, design, supervise collection of data and analysis, help write report, present and defend findings to client.

As President of E.C.O., Inc., prepared or assisted in preparation of studies of: housing, economic base - industrial development, population, finances, capital budget, growth management, governmental unification, economic impact of bridges, roads, colleges, management analysis of social agency. These studies covered more than 250 separate areas in New York State, Vermont, Massachusetts, Connecticut, New Jersey, Ohio and West Virginia. Clients are public agencies, private concerns, banks, other professionals (engineers, architects, planners), quasi-public agencies.

Lecturer, Niagara University

Teach sequence of Society and Economic Behavior in the Fall Term and Population Change, Society and the Economy in the Spring Term.

Lecturer, State University College at Buffalo

Teach Housing and the Community in the Fall Term; Management and Operations and Housing Management in the Spring Term.

Past:

Lecturer, Associate Professor, Chairman, Department of Economics, and Director, Bureau of Economic Research
Le Moyne College, Syracuse, New York

Taught Principles of Economics, International Trade Theory, Urban Economics, Macro-Economics, Economic Research, Government and Business. Directed economic studies of communities and areas.

EXPERIENCE - Past (Cont'd.)

Lecturer, College of Art, Architecture and Planning, Cornell University

Assisted in developing concepts and analysis for field work courses in planning. Projects covered in courses were plans for: Onondaga County, City of Auburn and Cortland County, New York.

Director of Research, Syracuse Department of City Planning, Syracuse, New York

Responsible for demographic and economic analysis of master plan; supervised parking and site selection studies.

Lecturer, Syracuse University

Part-time teaching: Principles of Economics, Financial Management, Personnel Management, Labor Market Analysis, Consumer Economics.

Labor Market Analyst, Division of Employment, New York State Department of Labor, Syracuse, New York

Responsible for monthly (public) letters and bi-monthly detailed analysis of labor market conditions (current and projected) for a seven-county area. Developed basic employment and unemployment series. Assisted in operations of Division.

Business Editor, Research Institute of America, Inc. New York City

Prepared analyses on management problems; interpreted government price control regulations for business subscribers.

Market Research Analyst, Dun & Bradstreet, Inc. New York City

Carried out studies for individual clients on: potential for entering the truck-trailer industry; prospects for house trailers; outlook for textile products and for binderies, etc.

EDUCATION

Ph.D., Economics, New School for Social Research, New York City (Minor: Sociology)

M.A., Economics, American University, Washington, D.C. (Minor: Marketing)

B.A. cum laude, Economics, Brooklyn College, Brooklyn, New York (Minor: Statistics)

PUBLICATIONS

More than 34 publications dealing, in general, with Industrial Location cost aspects, commuting and labor market areas, area analyses, management of growth, capital budgeting, improvement of government services, economic development and urban planning for such agencies as: City of Buffalo, Niagara County Industrial Development Agency, Erie and Niagara Counties Regional Planning Board, Westchester County, and Southern Tier Central Regional Planning and Development Board.

SPEECHES

Numerous speeches to such groups as:

Association of Erie County Governments,
Southern Tier West Regional Planning and Development Board
HUD - Conference of Federal Agencies, Planning Personnel
New York State Department of Transportation

PHILIP S. GIPSON

EDUCATION:

Ph.D., Zoology, University of Arkansas, 1971
M.S., Zoology, University of Arkansas, 1967
B.S., State College of Arkansas, 1964

PRESENT POSITION

Assistant Leader of Alaska Cooperative Wildlife Research Unit, University of Alaska.

Develop and supervise research projects in wildlife ecology and and related areas, write and edit scientific publications, serve on graduate student advisory committees and participate in graduate teaching program (Wildlife and Fisheries). Presently supervising research dealing with northwestern Alaska wolves, Arctic foxes, canid interactions along a transportation and utility corridor and ecology of wolverines in interior Alaska.

PROFESSIONAL ORGANIZATIONS and ACTIVITIES

The Wildlife Society, Northwest Section of the Wildlife Society, Alaska Chapter of the Wildlife Society, American Society of Mammalogists, Ecological Society of America, SigmaXi, American Institute of Biological Sciences.

Served as reviewer for scientific articles submitted to various publications; reviewer for research grant proposals submitted to National Science Foundation; seminar presentation at Colorado and Kansas State Universities; organized carnivore workshop at University of Alaska; offerred graduate seminars (1977-78) and presented 6 guest lectures in graduate and undergraduate classes at Univ. of Alaska during 1977 and 1978.

Experience:

Extension Wildlife Specialist and Assistant Professor, joint research and extension appointment. Research projects: 1) Ecology of known damaging coyotes, 2) coyote social interactions, 3) distribution of coyote x dog hybrids in Nebraska, 4) crop damage caused by deer and pronghorn to alfalfa and corn. Graduate faculty responsibilities: Major advisor to students pursuing M.S. and/or Ph.D. degrees in wildlife ecology. Served as graduate committee member for students in wildlife ecology and related fields. Extension duties: 1) Worked with County Extension Agents and the public to control wildlife damage to livestock and crops, 2) developed programs to encourage landowners to increase wildlife habitat, and to improve landowner and sportsmen relationships, 3) interacted with professionals in the Extension Service and other agencies to influence their programs for the betterment of wildlife, 4) designed youth programs to develop an appreciation of wildlife and good sportsmanship. Department of Poultry and Wildlife Sciences (now Department of Forestry, Fisheries and Wildlife), Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln, Nebraska 68583. October, 1974 - November, 1976.

Consultant for Marks, Clare, Hopkins, and Rauth, Attorneys at Law, Omaha, Nebraska. Problems associated with managing commensal rodents in food storage facilities. March, 1976 - November, 1976.

Research Associate investigating the ecology of white-tailed deer, and relationships of dogs and deer in regions of Arkansas with high and low density deer populations (home range, activity, heart rate, and body temperature of deer monitored by radio telemetry before, during, and following repeated harrassment with dogs). State-wide survey to determine physical condition of deer caught by dogs. Zoology Department, University of Arkansas. Research sponsored by Arkansas Game and Fish Commission and University of Arkansas. September, 1971 - September, 1974.

Consultant, Arkansas Department of Planning. Endangered species of mammals in Arkansas. July, 1972 - June, 1973.

Research Assistant investigating taxonomy (multivariate analysis of cranial characters), reproductive biology; food habits, and range (radio telemetry) of wild Canis for Ph.D. dissertation. Zoology Department, University of Arkansas. Research sponsored by Arkansas Game and Fish Commission and University of Arkansas. July, 1968 - August, 1971.

Teaching Assistant in General Biology, General Zoology and Comparative Anatomy. Zoology Department, University of Arkansas. September, 1967 - June, 1968.

Seasonal Ranger. Pea Ridge National Military Park, Pea Ridge, Arkansas. July, 1966 - January, 1967.

Research Assistant investigating island vs. mainland small mammal and game animal populations for M.S. thesis. Zoology Department, University of Arkansas. Research sponsored by Arkansas Game and Fish Commission and University of Arkansas. June, 1966 - August, 1967.

Biologist Aide, herring research. Alaska Department of Fish and Game, Petersburg, Alaska. June, 1965 - August, 1965.

Science teacher, public schools. Juneau, Alaska. January, 1965 - May, 1965 and September, 1965 - May, 1966.

PUBLICATIONS: Over 50 popular and extension publications, scientific publications, and abstracts and papers presented to scientific meetings. Recent examples include:

Gipson, P.S. 1978. Prevention and control of damage caused by coyotes, wolves, dogs and foxes. In Henderson, F.R. (Editor), Wildlife damage: Prevention and control handbook. Kansas State University.

Buskirk, S.M. and P.S. Gipson. 1978. Characteristics of wolf attacks on moose in Mt. McKinley National Park, Alaska. Arctic. In Press.

February, 1979

RESUME

NAME: Alan Jubenville

TITLE: Associate Professor of Resources Management

ADDRESS: Agricultural Experiment Station
School of Agriculture and Land Resources Management
University of Alaska
Fairbanks, Alaska 99701

EDUCATION:

B.S.	Forest Management, North Carolina State University, 1962
M.S.	Forest Ecology, West Virginia University, 1964
Ph.D.	Wildland Recreation, University of Montana, 1970

WORK EXPERIENCE:

1979 to present	Assistant Professor of Resources Management, Agricultural Experiment Station, University of Alaska. FTE = 4.5 months teaching, 7.5 months research.
1971-1979	Assistant Professor, University of Wyoming. Developed outdoor recreation curriculum; FTE = 75% teaching, 20% research, and 5% University activities. Tenured in 1977.
1970-1971	Assistant Professor and State Outdoor Recreation Extension Specialist, University of Illinois. Coordinated extension education programs and participated in major state projects as a planner.
1968-1969	Instructor, University of Montana. Taught a basic biometrics course, including labs.
1967-1968	Natural Resource Planner, State of Indiana. Assisted the private landowner in the development of resource management plans.
1964-1967	Post Maintenance Officer, Ft. Wainwright, Alaska. Coordinated entire post maintenance program on the General Staff. Captain, U.S. Army, Corps of Engineers.
1962-1964	Graduate Teaching Assistant, West Virginia University. Taught silvicultural lab courses.
1961-1962	Forestry Technician. Conducted forest resource inventories, assisted in management prescriptions, headed survey crew.

PUBLICATIONS: More than 20 publications and refereed articles on pertinent topics in his field between 1962 and the present time.

SUMMARY OF
TEACHING
ACCOMPLISHMENTS

1. Coordinated and conducted extension education programs while at University of Illinois for practicing professionals and para-professionals at regional centers throughout the state.

2. Developed original outdoor recreation resource management cirriculum in 1971 and new outdoor recreation planning curriculum aimed at developing specific, scientific background of students to prepare them for real-world complex situations.

3. Developed four academic courses at University of Wyoming: Outdoor Recreation Management; Recreation Field Evaluations; National Park Policy and Graduate Seminar.

4. Developed topographic planning models laboratory as a learning lab with grant obtained through College of Arts and Sciences.

5. Developed original departmental graduate catalog at University of Wyoming and was appointed a member of Graduate School in 1974, personally handling about 5 graduate students per year and 45 undergraduate advisees.

6. In fall of 1976, developed and coordinated special non-credit graduate seminar on river recreation management identifying, enumerating, and evaluating specific problems associated with river recreation management.

7. Developed two texts: Outdoor Recreation Planning and Outdoor Recreation Management. Assisted Northwest Community College in development of their recreation majors program in December 1977.

RESEARCH GRANTS:

1. Direct Observation Study, $750.00, Basic Research Division, University of Wyoming, 1973.

2. Evaluation of Wilderness Potential of the Roadless Areas in the Medicine Bow National Forest, $150.00 E.P.A. and $300.00 Wilderness Society, 1972.

3. Snowmobiler Preferences in the Snowy Range, $300.00, Wyoming Recreation Comission, 1972.

4. Park Standards for Wyoming, $11,900.00, Wyoming Recreation Commission 1973.

5. National Park Service, $13,227.00, Snake River Corridor Study, 1974 and 1977.

6. (with Donald S. Warder) Regional Planning Office, $5,000.00, County-Wide Recreation Plan for Albany County, 1975.

7. "Decision-Making Model: How the Commercial Camper Chooses His Campground." Phase 1, summer 1978. $4,000.00, Basic Research Division, University of Wyoming.

UNIVERSITY ACTIVITIES:

University of Wyoming:

Faculty Senate, 1977-1979
University Ad Hoc Committee, Campus Sports Club, 1978
University Ad Hoc Committee, new Master's in Planning Program, 1977-1979
Governor's Land Use Planning Committee, 1976-1977
Former departmental graduate studies coordinator, 1974-1977
Former advisor to the Recreation Club (for Recreation and Park majors), 1971-1973
Departmental chairman for library acquisitions, 1976-1978
Member of the Yellowstone Environmental Research Committee, 1975-1977
Research Associate and Advisory Board Member, Center for Behavioral Studies, Institute for Policy Research, Univeristy of Wyoming, 1976-1978
Member of the Association of American Geographers (Recreation Research Division), 1977
Participated in a Humanities project entitled "A Wyoming Design Ethic." The $14,900 grant from the Wyoming Council for the Humanities was to sponsor a workshop for top level state decision-makers, 1977-1978.

RECENT RELATED PROFESSIONAL ACTIVITIES

Chairman, Albany County Park and Historic Preservation Board, 1976-1978.
Participated in a 15-hour Short Course on Citizen Participation Techniques, March 4-5, 1977, at Laramie, Wyoming.
Participated in a National Conference on River Recreation Management and Research, January 24-27, 1977, at Minneapolis, Minnesota.
Asked by the Bureau of Outdoor Recreation to participate in the evaluation of the Nationwide Plan at the National Congress in Boston, Massachusetts.
Consulting editor for recreation books, W. B. Saunders Co., Philadelphia, Pa.—have reviewed three book manuscripts for publication recommendation since 1975.
Resource person for a workshop on *Recreation and Tourism*, Wyoming Planning Association, October 17, 1977.

MEMBERSHIP IN HONOR SOCIETIES:

Gamma Sigma Delta (Agriculture)
Tau Alpha Sigma (Wildlife)
Xi Sigma Pi (Forestry)

CONSULTING:

Site Feasibility for Four Campgrounds in Illinois, 1970.

Review of Management Plan for BWCA, 1971.

(with Donald S. Warder) "Analysis of the Relocation of the Ryan Park Winter Sports Site," 1975.

(with Donald S. Warder) "County Recreation Plan," Albany County, Wyoming, 1975.

(team member) *Master Plan for South Pass Historic Mining District*, 1976.

Conducted two public hearings for the U.S. Forest Service on a proposed site development, February 8 and 9, 1977, in Douglas and Casper, Wyoming.

Composite Plan for the Continental Divide Area of the Medicine Bow National Forest, Wyoming, November, 1977.

VITAE

BRINA KESSEL

Birth:
20 November 1925, Ithaca, N.Y.

Education:

B.S.	Cornell University, Ithaca, N.Y.,	1947
M.S.	University of Wisconsin, Madison,	1949
Ph.D.	Cornell University, Ithaca, N.Y.,	1951

Employment:

Administrative Associate for Academic Programs (including Graduate Studies), Office of the Chancellor, University of Alaska, Fairbanks, 1973-current.
Director of Academic Advising, University of Alaska, Fairbanks, 1973-1979.
Curator of Terrestrial Vertebrate Collections, University Museum, University of Alaska, Fairbanks, 1972-current.
Professor of Zoology, University of Alaska, Fairbanks, 1959-current
Dean, College of Biological Sciences and Renewable Resources, University of Alaska, Fairbanks, 1961-1972.
Head, Department of Biological Sciences, University of Alaska, Fairbanks, 1957-1966.
Associate Professor of Zoology, University of Alaska, Fairbanks, 1954-1959.
Assistant Professor of Zoology, University of Alaska, Fairbanks, 1951-1954.
Instructor in Zoology, University of Alaska, Fairbanks, Summer Session, 1951.
Wisconsin Alumni Research Foundation Assistant, University of Wisconsin, 1948-1949.
Graduate Assistant in Ornithology, Cornell University, 1947-1948, 1949-1951.
G.S. 1 Biologist (Ornithology), U.S. Fish and Wildlife Service, Patuxent Research Refuge, Summer, 1946.
Teaching and Research Assistant, Cornell University, 1945-1947.

Other Experience:

Project Director, University of Alaska Ecological Investigations for AEC Project Chariot, Northwestern Alaska, 1959-1963.
Ornithological Consultant for private industry and government.
Field work undertaken throughout Alaska, but primarily in western, central, and northern Alaska--including Sheenjek River (summer 1956), Chukchi Sea coast (summer 1976), entire Seward Peninsula (summers 1966-1977), Yukon-Kuskokwim Delta (June 1963); also, North Slope (several sites), Cape Thompson, Kivalina, Selawik, Tokotna, Fairwell, Iguigig, Shemya, Cold Bay, Kenai Peninsula, Minto Lakes, entire Alaska Highway system, including Alyeska Haul Road, etc. Funding sources have included U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. National Park Service, U.S. Corps of Engineers, Office of Naval Research, National Science Foundation, Alaska Department of Fish and Game, private foundations, industry, etc.
Editorial Board member for Western Birds and The Murrelet (regional journals).
Referee of journal manuscripts for Auk, Condor, Wilson Bulletin, Syesis, Canadian Journal of Zoology (national journals).

Professional Organizations:

American Association for the Advancement of Science, Fellow since 1960 (Life).
American Ornithologists' Union, Fellow since 1973; Vice-President 1976-1977; Governing Council 1969-1972, 1973-1977, (Life).
Arctic Institute of North America. (Fellow)
Cooper Ornithological Society (Life).
Ottawa Field-Naturalists' Club.
Bird-Banding Association.
Pacific Northwest Bird and Mammal Society.
Wilson's Ornithological Society (Life).

Honorary Societies and Who's Who Listings:

Sigma Xi (Cornell University).
Phi Kappa Phi (Cornell University).
Sigma Delta Epsilon (Cornell University).
American Men of Science, since 1954.
Who's Who in America, since 1960 (also in the West, and in American Women).

Current Research (Kessel and graduate students):

Birds of Interior Alaska (continuing data collection and compilation)

Migratory movements of Sandhill Cranes in Alaska (data collection; funded by Northwest Alaskan Pipeline Co.)

Waterbirds and wetlands, Chisana-upper Tanana rivers, Alaska (baseline study for Northwest Alaskan Pipeline Co., stressing relationships between habitat and avian productivity)

Birds of Alaska (an active, on-going project of data gathering and compilation for a future book on Alaska birds)

The biology of the puffins... (PhD thesis, Duff H. S. Wehle)

Relationship between feeding ecology and nesting dispersion in Pigeon Guillemots (Cepphus columba) at Naked Island, Prince William Sound, Alaska (MS thesis, Karen L. Oakley)

Plastic pollution in Alaska's seabirds. (MS thesis, Robert H. Day)

Habitat niche relationships of four sparrows in low shrub bog, interior Alaska (MS thesis, Betty A. Anderson)

PUBLICATIONS: Over 30 publications, contract completion reports and other documents since 1950, three of the most recent being:

Ornithological Investigations, Chukchi-Imuruk Biological Survey, Seward Peninsula, with D. D. Gibson, U.S. National Park Service (In Press)

Status and distribution of Alaska birds. Studies in Avian Biology, with D. D. Gibson. 1978

Winter activity patterns of Black-capped Chickadees in Interior Alaska. Wilson Bull. 1976

MATTHEW P. KILLEEN

Terrestrial Environmental Specialists, Inc.

Education

B.S. Environmental and Resources Management (Forest Management): State University of New York College of Environmental Science and Forestry, Syracuse, New York, 1974.
M.S. Resource Management and Policy: State University of New York College of Environmental Science and Forestry, Syracuse, New York, 1978.

Professional Experience

Associate Environmental Scientist, Terrestrial Environmental Specialists, Inc., Phoenix, New York, 1979 - present.

Environmental Planner, Essex County, Elizabethtown, New York, 1978 and 1979.

Graduate Research Assistant, Applied Forest Research Institute, College of Environmental Science and Forestry, Syracuse, New York, Spring, 1977.

Graduate Teaching Assistant (Outdoor Recreation Planning and Management), State University of New York College of Environmental Science and Forestry, Syracuse, New York, 1975 - 1977.

Planning Assistant, Essex County Planning Office, Elizabethtown, New York, Summer, 1976.

Memberships

National Wildlife Federation

Consulting and Related Experience

- designed, implemented and prepared a planning report examining the economic, environmental and social impacts related to the development of a countywide system of winter recreational trails.

- prepared a management plan for the winter use of an outdoor education center and served as the director of the center.

- prepared a plan for the development of a countywide system of winter recreational trails, including layout and design of trails, and provided direction and supervision for crews constructing and/or improving more than 100 miles of trails.

Consulting and Related Experience (Continued)

- provided technical information related to the development plans of a municipal recreation area including campsite, beach, and boat-launching site.

- participated in a research project aimed at classifying the users of forest research materials.

- was responsible for the development and implementation of an outdoor educational program at a summer camp for boys.

- performed major portions of an environmental feasibility study for hydroelectric generation at a flood control dam in north central West Virginia.

- participated in a hydroelectric site selection study designed to identify significant ecological, social, economic, and cultural impacts.

VINCENT J. LUCID
Terrestrial Environmental Specialists, Inc.

EDUCATION

B.S. Zoology; University of Rhode Island, 1968
M.S. Animal Science (Wildlife Management), University of Rhode Island, 1971
Ph.D. Wildlife Biology; Virginia Polytechnic Institute and State University, Blacksburg, VA 1974

EMPLOYMENT HISTORY

1976-Present: Director of Environmental Studies, TES, Inc., Phoenix, New York

1976: Environmental Scientist (Sr. Terrestrial Ecologist/ Project Manager), Equitable Environmental Health, Inc.

1975: Associate Environmental Scientist (Terrestrial Ecologist/ Quality Assurance Coordinator), Environmental Analysts, Inc.

1971-1974: Graduate Research/Teaching Assistanships, VA Polytechnic and State University

1970-71: Graduate and Post-graduate Research Assistantships, University of Rhode Island

CONSULTING and RELATED EXPERIENCE

Design and management of comprehensive study of effects of fossil fuel effluents on agricultural crops.

Design and implementation, quantitative data analysis of terrestrial ecology studies at 2 proposed power plant sites; coordination of quality assurance programs for aquatic ecology and water quality studies at two proposed power plant sites and five existing stations; and design and management of critical analysis of environmental assessment for two proposed power plant sites.

Compiled and analyzed background information for environmental assessment of proposed theme park development. Critically reviewed and conducted computer analysis for series of terrestrial ecology monitoring studies.

Designed and conducted comprehensive analysis of bird populations and habitat in residential developments and study of bird utilization of tidal marsh.

Environmental impacts: Coordinated and participated in preparation of EIS for proposed renovation of hydroelectric generating facility; Provided technical input in comparison of environmental impact of two proposed highway routes; managed and prepared major portions of EIS for proposed urban redevelopment project

Coordinated and participated in floral and faunal surveys at a U.S. Navy installation and performed the faunal portion of a floral/faunal assessment for proposed sanitary landfill site.

Conducted major portions of environmental analysis of proposed routes for high voltage electric transmission facility; coordinated terrestrial ecology monitoring program at nuclear power plant construction site; coordinated environmental studies at 2 potential power plant sites in the midwest.

AWARDS

Phi Kappa Phi (National Honor Society) 1973
Phi Sigma (National Biological Honor Society 1973
Sigma Xi (Scientific Research Society 1974-Present

MEMBERSHIPS

American Ornithologists' Union
Int'l Oceanographic Foundation
National Wildlife Federation
Virginia Soceity of Ornithology
Wilson Ornithological Society
National Audubon Society
The Wildlife Society
The Natur Conservancy

PUBLICATIONS

Authored terrestrial ecology sections of a report on regional impact issues for electric generation development in Pacific Northwest.

Authored major sections of preliminary report on the environmental impact of XIII Olympic Winter Games

Authored responses to interrogatories concerning testimony on the environmental assessment of a proposed electric generating station.

Authored report on slash disposal following land clearing for construction purposes and sections of a report on the use of private lands for outdoor recreation.

Authored major sections of bird pest control handbook for the U. S. Air Force.

VITAE

STEPHEN O. MACDONALD

Birth:

27 June 1948, Cloquet, Minnesota

Education:

-- University of Minnesota, Deluth
B.S. University of Alaska, Fairbanks, 1975

Employment and Experience:

Museum Technician I, University of Alaska Museum, Fairbanks, 1977-current. Curatorial (mammal(s)) and research activities, including principal investigator for small mammal and bird population studies for the baseline studies for the Delta Barley Project, interior Alaska, and mammalogist for a reconnaissance of the mammals of the Skagway-Haines area of Alaska.

Game Technician II, Alaska Department of Fish and Game, Fairbanks, 1976. Logistic planning and field research censusing birds of the coastal habitats of the Chukchi Sea, northern Alaska.

Museum Assistant, University of Alaska Museum, Fairbanks, 1974-75. Curatorial activities and field research conducting a bird species habitat inventory of mainland southeastern Alaska, under a UAF contract with the U. S. Forest Service.

Field Assistant, Institute of Arctic Biology, University of Alaska, Fairbanks, Summers 1970 & 1971. Assisting in various avian field studies at Barrow, Prudhoe Bay, Eagle Summit, and College, Alaska.

Other. Twenty-four years experience in furbearing animal trapping in Minnesota and Alaska.

Professional Organizationa:

American Society of Mammalogists
Ottawa Field-Naturalists' Club (Canadian Field-Naturalist)

Publications:

1978. Checklist - Mammals of Alaska. University of Alaska Museum. 2 p.

Reports:

1975. Bird species and habitat inventory, mainland southeast Alaska, summer 1974. Univ. of Alaska Museum report to U. S. Forest Service. 73 p. (with D. D. Gibson)

1975. The birds of the Chickamin River, Alaska. Unpublished manuscript, Univ. of Alaska Museum, 157 p. (with Nena MacDonald)

Reports (cont'd):

1979. A reconnaissance of the mammals - Skagway/Haines, Alaska, region, June 1978. Univ. of Alaska Museum report to U. S. Forest Service. 16 p.

1979. Breeding birds and small mammals in the Delta Barley Project area, Alaska. Univ. of Alaska Museum report to Alaska Division of Lands. 63 p.

NAME: Jay D. McKendrick

PRESENT POSITION: Associate Professor of Agronomy
University of Alaska

ADDRESS: Agricultural Experiment Station
P. O. Box AE
Palmer, Alaska 99645

PHONE: (907) 745-3257

EDUCATION: B.S., University of Idaho, Moscow, 1963 (Soils)
M.S., University of Idaho, Moscow, 1966 (Range Management)
Ph.D., Kansas State University, Manhattan, 1971 (Range Management, Plant Ecology & Crops)

PROFESSIONAL ORGANIZATIONS:

Xi Sigma Pi
Gamma Delta Sigma
Society for Range Management
American Society of Agronomy
International Society of Biometerology

ALASKAN RESEARCH PROJECTS:

Range Research - Alaska. (1972 - present)

This is a state supported research program to assist the livestock industry's utilization and management of Alaskan rangelands.

Reclamation of Land Damaged by Oil Spills. (1972 - 1974)

This project was industry funded and involved field investigations in southcentral, interior and the North Slope regions of Alaska. Laboratory analyses of oil-affected soils and the mitigation of oil-damaged terrestrial sites as well as documenting recovery of damaged vegetation were project objectives. Low level monitoring of long-term effects is in progress.

Tundra Rehabilitation Research. (1972 - 1974)

This was an industry funded project focused on finding plant materials (primarily native Alaskan grasses) and soil treatments for rehabilitating areas disturbed by arctic oil developments.

Applying remote sensing technology for developing regulations for off-road vehicle use for a selected portion of the Alyeska Pipeline route. (1975 - 197

This project was initiated to assist the BLM in assessing and identifying sensitive areas along the access road of the Trans-Alaska Pipeline route which

might be threatened by off-road vehicle and other recreation users after the pipeline is completed. Color infrared air photos in conjunction with field visits are being used to prepare 1:250K maps and a technical report. The final report is in review. Due to changes in BLM personnel, this project was interrupted in 1976.

Compilation of cold-climate oil-spill research and technology pertaining to Alaskan shorelines. (1975 - 1977)

This EPA sponsored project was to assess the adequacy of available methods and techniques for preventing damage from oil spills to coastal and inland shorelines, and for restoring oil spill damage. The cold-climate focus involved surveying, completed and on-going research in Alaska, Canada, Northern Europe and the USSR. Data were collected from the literature and through personally visiting various researchers and their facilities. The final report is in review.

Mineral nutrient studies on arctic tundra. (1975 - 1978)

This project was part of the NSF sponsored Research on Arctic Tundra Environments (RATE). It included study of natural and artificial fertilization A M.S. thesis on effects of caribou carrion was completed by John Swanson, University of Idaho. A paper was presented at the AIBS meeting, Athens, Georgia, August 1978 and other papers are in various stages of publication.

Range types and productivities for ungulates in portions of Cook Inlet Basin. (1977 - 1979)

This is a cooperative State research project with USDA. It's objectives are to identify productivities, production, and seasonal forage qualities on various habitat types in the Cook Inlet region of Alaska. This project is in its final year of field work.

Musk Ox Range evaluation. (1978 - 1980)

This two-year project is sponsored by the National Science Foundation. Objectives are to identify dietary components of musk oxen grazing on the recently established Musk Ox Farm near Unalakleet, Alaska. That information is to be used as a basis for determining range condition and trend indicators. Seasonal changes in herbage quality are also being monitored. This project commenced in March 1978 and will terminate March 1980.

Homer Beef Production Project. (1977 - 1979)

This two-year project was funded by the Alaska legislature. Range, agronomy and animal science investigators are collaborating to define management techniques for reducing winter feeding costs and increasing summer grazing returns from ranching operations on the lower Kenai Peninsula. This project terminates September 30, 1979.

Sand dune revegetation near Northway, Alaska. (1977 - 1978)

This project is sponsored by the Northwest Alaskan Pipeline Corporation and is aimed at determining revegetation technology to stabilize sand dunes exposed during construction in the Tanana River uplands between Tetlin Junction and the Alaskan/Canadian border. The first year's report for this project was submitted in June 1978. Continuation depends upon several pending factors relative to the granting of federal and state permits and agreements on right-of-way easements.

Natural succession on placer mine spoils of Interior Alaska. (1979)

Records from past mining activities are being used to age various placer mine spoils in the Fairbanks vicinity. Dr. Bonita Neiland and a graduate student, Kay Holmes, are co-investigators on this study. The Office of Surface Mining USDI is funding this project.

Bison range study. (1979 ----)

This is a new project aimed at determining the dietary composition of forage eaten by bison in the Delta Junction area. The field work and laboratory determinations are to be part of a graduate student's thesis. Alaska Department of Fish and Game, U.S. Army and U.S. Soil Conservation Service are cooperators. The State of Alaska is the funding source.

Coal mine reclamation. (Sept 1979 - Sept 1980)

This is a Department of Energy sponsored project that includes documenting the natural species which invade coal spoils and to determine which substrate and site characteristics are most beneficial for mine spoil revegetation. Drs. Wm. W. Mitchell and G. A. Mitchell are co-investigators on this study.

PUBLICATIONS:

Twenty-four publications since 1966, some of the more recent being:

"A super bird's eye view of Alaska."Agroborealis. (1974)

"Volcanic-ash-affected soils of southcentral Alaska: some chemical and mineralogical properties. Agroborealis. with George A. Mitchell. (1975)

Agrometeorology in northern regions. Bull. Amer. Meterol. Soc. (1976)

Effects of burning crude oil spilled onto six habitat types in Alaska. With Wm. W. Mitchell. Arctic. (1978)

Mine reclamation in West Germany and the USSR relative to Alaska (accepted) Agroborealis. (1979)

JOSEPH M. MCMULLEN

Terrestrial Environmental Specialists, Inc.

Education

B.S. Biology (Major); Saint Francis College, Loretto Pennsylvania, 1971.
M.S. Biology (Botany, Ecology); West Virginia University Morgantown, West Virginia, 1974.

Professional Experience

Environmental Scientist, Terrestrial Environmental Specialists, Inc., Phoenix, New York, 1976 - present.

Associate Environmental Scientist (Director of Plant Ecology), Equitable Environmental Health, Inc., Woodbury, New York, 1975.

Assistant Environmental Scientist (Plant Ecologist), Environmental Analysts, Inc., Garden City, New York, 1975.

Graduate Teaching Assistant (General Biology, Botany), Department of Biology, West Virginia University, Morgantown, West Virginia, 1971-1974.

Awards

Grant-in-aid of research from The Society of Sigma Xi, 1972.

Memberships

American Institute of Biological Scientists
The Wildlife Society (New York Chapter)
Society of American Foresters
Southern Appalachian Botanical Club

Consulting and Related Experience

- designed, implemented, and prepared reports for botanical studies of hardwoods forests, plant succession, and threatened and endangered species.

- prepared vegetation cover type maps for 12,000 acres of mixed communities.

- assisted in the development of two FORTRAN programs for the analysis of vegetation data.

Consulting and Related Experience (Continued)

- collected data and assisted in writing the botanical portion of a study of prescribed burning as a vegetation management technique.

- prepared written testimony and interrogatory responses concerning plant communities and related impact of power plant construction.

- critically reviewed botanical portion of a baseline terrestrial ecology study for two power plant sites.

- supervised technical personnel conducting a botanical survey on a total of 8,000 acres of land.

- collected, analyzed and interpreted data for plant ecology studies on the primary and secondary sites for a proposed major electric generating station.

- provided technical information for slash disposal estimates following land-clearing operations for construction purposes.

- authored vegetation section concerning the environmental impact of a proposed beach and town rehabilitation project.

- prepared sections on soils and vegetation for an environmental report on the renovation of an existing, non-operating hydroelectric generating facility.

- prepared a report on the status of endangered plant species in the vicinity of a proposed hydroelectric facility.

- supervised the preparation and authored various sections of a comprehensive draft environmental impact statement prepared under the guidelines of the New York State Environmental Quality Review Act for a proposed county sanitary landfill.

- designed and supervised the data collection and report preparation for an intensive study of vegetation and designed a five-year monitoring program to assess the impacts of the construction of a nuclear power plant in New Jersey.

- provided input for an environmental assessment and routing analysis for a 138 kV transmission line in Pennsylvania.

- participated in an environmental assessment and routing analysis for a 115 kV transmission line in northern New York.

- prepared a vegetation cover map and flora survey for a 4,300 acre naval base in Virginia.

FRANKLIN L. ORTH

EDUCATION

University of Tennessee, Ph.D. in Economics. Dissertation: "An Empirical Analysis of the Relationship Between Diversification and Profitability in the 1,000 Largest U.S. Corporations."

University of Richmond, BA in Economics. Dr. Orth studied in the areas of industrial organization, finance and economic theory. He has lectured on each of these subjects as well as environmental economics, fisheries management and aquaculture economics. His research and pulications include topics in industry organization, banking, marketing and the financing of resource development.

EMPLOYMENT HISTORY

President: Frank Orth & Associates, Kirkland, WA 1979 - present

Sr. Economist and Vice President: Private Consulting Firm, Seattle, WA 1978 - 1979

Associate Professor: Department of Economics and Alaska Sea Grant Program, University of Alaska 1971 - 1978

Assistant Professor, Department of Economics, Colorado State University 1970- 1971

EXPERIENCE

While working in both academic institutions and in private consulting business, Dr. Orth applied his expertise in industrial organization, natural resource economics, market and financial planning and banking to a wide range of problems. He has provided numerous private and public organizations with research, planning, and policy analysis services. In the private sector, organizations assisted include commercial banks, financial investors, seafood companies and architectural-engineering firms. Public sector organizations include: National Marine Fisheries Service, Alaska Department of Commerce and Economic Development, Alaska Fisheries Council, Alaska Legislature and Alaska Power Administration.

Dr. Orth has extensive experience in project management. Management functions include the direction and coordination of large research staffs and subcontractors, integration of complex study elements into unified, purposeful documents, project budgeting and professional and support staff recruitment. In addition, he has successfully managed company operations and marketing functions and has been highly successful in motivation of independent-minded professionals with diverse areas of expertise toward common goals.

PROJECT EXPERIENCE

1979 - Project Manager and analyst on study to estimate benefits and costs of U.S. fisheries development. Developed methodology for analysis, directed and coordinated staff research and project integration. For: National Marine Fisheries Service and U.S. Department of Commerce Task Force on Fisheries Development.

1978-1979 Developed and implemented methodology to estimate capital requirements of Alaska Commercial Fisheries and Agriculture Bank, for Alaska Dept. of Commerce and Economic Development.

Conducted economic and financial feasibility/planning studies in support of Comprehensive Regional Salmon Enhancement Plan

for Prince William Sound Aquaculture Corporation, Alaska.

Estimated current and future levels of credit demand from the commercial fisheries industry of Alaska. Estimates considered replacement/upgrading capital requirements for current fishing and processing operations as well as new capital requirements. For Federal Intermediate Credit Bank, Spokane, WA.

Determined economic impact of Outer Continental Shelf Oil Development on razor clam fishery of Northern and Western Gulf of Alaska. For Univ. of Alaska Sea Grant Program and U.S. Bureau of Land Management.

1978 -Conducted analysis of Japanese marketing channels for tanner crab for use by North Pacific Fisheries Management Council. For Alaska Sea Grant Program.

Performed descriptive study of Japanese ownership in Alaska seafood processing industry for use by fisheries management agencies. For Alaska Sea Grant Program.

For U.S. Department of Commerce: Developed and implemented a methodology to determine domestic and export market potential for currently underutilized U.S. fish and shellfish species and also for analysis of financial impediments to fisheries development in the U.S. - National Marine Fisheries Service.

1977-1979 -Managed study of the market structure of the Alaska Seafood processing sector. Study included extensive primary data collection from Alaska Department of Fish and Game and from private industry. Study results have applications in private and public sector policy formulation. For University of Alaska Sea Grant program.

1977 -Managed study of U.S. production capacity and marketing for Alaska tanner crab (National Marine Fisheries Service). Developed regulations for implementing financing provisions of Alaska Salmon Enhancement Act (State of Alaska). Developed issue paper on implications of foreign investment in Alaska seafood processing industry (Senate Interim Committee on Permanent Fund, Alaska Legislative Affairs Agency). Conducted detailed analysis of problems and alternative solutions for financing Alaska fishing businesses, a study which laid the foundation for creation of Commercial Fisheries and Agriculture Bank (Senate Iterim Committee).

1976 -Market evaluations in support of bank acquistion for private clients (confidential); performed financial analysis of proposed bank acquisition for Doyon, Inc.

1975 -Conducted detailed economic and legal evaluation of the commercial potential of Alaska clam fishery for Alaska Sea Grant Program.

1973 - Analysis of economic impact of proposed civic, recreation and convention center on economy of Cordova, Alaska, for Linck-Thompson Engineers and Planners.

PUBLICATIONS

More than a dozen publications dealing in general with fisheries, economic impacts and aquaculture.

ACTIVITIES
ORGANIZATIONS

Member, Alaska Fisheries Council 1977-78
Member, Steering Committee, Bering Sea Clam Development, 1977
Member, Executive Advisory Committee, Alaska Power Survey, 1974
Faculty Fellow, Pacific Coast Banking School, Univ. of WA, 1973

EDWARD T. REED

Terrestrial Environmental Specialists, Inc.

Education

B.S. Science Education; Pennsylvania State University, University Park, Pennsylvania, 1967.
M.S. Wildlife Management, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1974.

Professional Experience

Environmental Scientist, Terrestrial Environmental Specialists, Inc., Phoenix, New York, 1976 - present.

Associate Environmental Scientist (Director of Mammalian Studies), Equitable Environmental Health, Inc., Woodbury New York, 1974-1975.

Graduate Teaching Assistant (Silviculture), Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1973.

Biology Instructor, Upper Dublin High School, Fort Washington, Pennsylvania, 1967-1972.

Awards

Gamma Sigma Delta, 1974.

Phi Kappa Phi, 1974.

Memberships

The Wildlife Society
The American Society of Mammalogists
Eastern Bird Banding Association
Editorial Board of Eastern Bird Banding Association
The Ruffed Grouse Society of North America

Consulting and Related Experience

- collected and analyzed data and prepared reports for mammalian studies on six proposed power plant sites.

- critically reviewed an environmental assessment for two proposed power plant sites.

- designed, implemented, and analyzed a technique to assess the habitat suitability of 8,000 acres for selected game species.

Consulting and Related Experience (Continued)

- monitored populations of mammalian species in respect to potential impacts of power plant sitings.
- evaluated the behavioral impact of sport hunting on white-tailed deer.
- designed, implemented and prepared the report of a study to determine species composition of bat populations on proposed power plant sites.
- provided ornithological input to an impact study for a proposed hydroelectric project.
- prepared written testimony concerning mammalian populations and related impacts of power plant construction.
- provided critical review and advice on an impact evaluation of two proposed power plant sitings.
- authored responses to interrogatories concerning baseline ecology studies and related impacts.
- prepared descriptions of the ecology of aquatic fauna and the aquatic impact assessment for a proposed lake shore construction project.
- authored major sections of a comprehensive draft environmental impact statement for a proposed county sanitary landfill.

ROBERT W. WILLIAMS

Terrestrial Environmental Specialists, Inc.

Research Associate

Education

B.S. Biology; State University of New York, Oswego, New York, 1966.
M.A. Zoology; University of Vermont, 1969.

Professional Experience

President and Owner, Aquatic Equipment Company, Minetto, New York, 1976 - present.

Assistant Adjunct Professor, Syracuse University, Syracuse, New York, 1976 - present.

Director, Oswego Laboratory, Quirk, Lawler and Matusky Laboratories, Inc., Oswego, New York, 1973-1976.

Project Biologist, Quirk, Lawler and Matusky Engineers, Nyack, New York, 1972-1973.

Technical Coordinator of Biological Programs, Quirk, Lawler and Matusky Engineers, Nyack, New York, 1972-1973.

Assistant Director of Laboratory, Quirk, Lawler and Matusky Engineers, Nyack, New York, 1971-1972.

Project Biologist, Quirk, Lawler and Matusky Engineers, Nyack, New York, 1971-1972.

Biologist, Quirk, Lawler and Matusky Engineers, Nyack, New York, 1970-1971.

Memberships

International Association of Great Lakes Research

Consulting and Related Experience

- coordinated general biological, entrainment and impingement studies at the Nine Mile Point Nuclear Station and the Oswego Steam Station.

- coordinated and supervised studies on fish behavior in thermal discharges at three sites for Ontario Hydro.

Consulting and Related Experience (Continued)

- set up and oversaw the execution and quality of field and laboratory studies at the Nine Mile Point Nuclear Station and the Oswego Steam Station.

- coordinated technical biological programs with administrative responsibilities for biological programs on the Hudson River and Lake Ontario.

- coordinated manpower, technical skills and equipment for many projects at the Bowline Generating Station, Lovett Generating Station, Danskammer Point Generating Station, and the Roseton Generating Station.

- participated in power plant siting studies on the Hudson River.

- managed physical, chemical and biological activities associated with intensive projects on lake and river systems in New York.

- managed biological programs for environmental reports on the Hudson River and Lake Ontario.

- participated in physical, chemical and biological investigations on Lake Ontario, Hudson River and Lake Champlain.

and resident engineer and project manager. As project engineer, responsible for monitoring and controlling all aspects of refinery design, including civil, structural, building, and pressure vessel design. As field engineer, responsible for all off-site work, including mechanical, electrical, civil and structural aspects, as well as for a two-mile long, 44-inch diameter submarine pipeline, special mooring, a 3,000-foot long pier, and ancillary piers. Cost of this project was $60 - $70 million.

For approximately $4 million expansion project of the same refinery, was responsible, as resident engineer, for a hard-rock dredging program in deep water, plus site development program.

1965 to 1967 — Parson, Brinckerhoff-Tudor-Bechtel
San Francisco

One of four engineers responsible for coordination of civil and structural design for the 75-mile long, billion dollar Bay Area Rapid Transit (BART) system. Formulated design criteria, expedited solutions of design problems, reviewed construction plans and specifications, and coordinated internal and external efforts on the project. Portions of the BART system responsible for included rock tunnels, subways of cut-and-cover and soft-ground tunneled construction, and aerial and at-grade structures.

1962 to 1965 — Hazelet and Erdal, Consulting Engineers
Chicago, Illinois; Manistee, Michigan;
Cleveland, Ohio

1956 to 1960 — Resident engineer for construction of rolling lift bascule bridges in Michigan and Ohio; structural engineer responsible for design, design supervision, and design checking of several bascule and fixed bridges as well as other structures.

1960 to 1962 — A. J. Boynton & Co.
Chicago, Illinois

Structural engineer responsible for design and design supervision of a variety of structures, including underpinning and rehabilitation of a major structure in Chicago, several fixed bridges for the Massachusetts Trunpike, and mill builings; also, investigation and preparation of reports for several structural failures.

SECTION C5: PROJECT EQUIPMENT AND FACILITIES

ACRES

RESUME

FRANK PATRICK MOOLIN, JR.

EDUCATION	University of Illinois, B.S.C.E., magna cum laude, 1956 Graduate: Illinois Institute of Technology, University of California,* Seton Hall University,* Farleigh Dickerson University,* University of Alaska*
SOCIETIES	American Society of Civil Engineers National Society of Professional Engineers New Jersey Society of Professional Engineers Singapore Institute of Engineers American Management Associations The Society of American Military Engineers
LICENSED	Illinois (1), Michigan, Ohio, California (2), New Jersey, South Carolina, Republic of Singapore (1) By examination; Professional and Structural (2) By examination
AWARDS	Selected as "Construction Man of the Year" by Engineering News-Record magazine, 1976

EXPERIENCE

1973 to Date	Atlantic Richfield Company, Assigned to: Alyeska Pipeline Service Company Fairbanks, Alaska Senior Project Manager, heading the Pipeline Department As Senior Project Manager, develops and administers the goals, objectives, policies, procedures, and controls required to effectively direct the planning and construction of the pipeline portion of the Trans Alaska Pipeline. As the Senior Project Manager, accountable for providing management direction and leadership to over 800 supervisory and inspection personnel in the Pipeline Department. Responsibilities

*Completed 2/3 of course requirements towards an MBA.

August 1977

the following:

- o 3.5 billion dollar budget
- o 200-plus active contracts
- o Over 10,000 workers
- o Five major execution contractors
- o Over 14,000 pieces of construction equipment
- o 19 camps spread over 800 miles of right-of-way
- o Approval authority of $10 million

1971 to 1973 — Parsons, Brinckerhoff, Quade and Douglas
New York City
Vice President, Special Projects; Asscciate of the Firm

Project Manager, DuPont Atomic Energy Commission Bedrock Waste Storage Project, responsible for a first-of-a-kind project for storing vast amounts of liquid radioactive wastes for a 1,000 year period in caverns excavated several thousand feet below the surface of the ground. Total estimated cost of the project in excess of $100,000,000. Responsibilities included all client relations, contract negotiation, organization of a multi-disciplined diversified project team, including numerous outside consultants, contract administration and control and approval of all phases of the Parsons effort. Because of the unprecedented nature of the project in terms of the material to be stored and the lifetime requirement, there is considerable interest among members of the local, scientific, and "environmental" communities, as well as in the State and Federal governments.

1967 to 1971 — Esso Research and Engineering Company
Florham Park, New Jersey
Tokyo, Japan and Singapore; Republic of Singapore
Engineering Associate, Senior Project Engineer, Project Engineer

As contract development engineer, responsible for business-oriented activities associated with major capital investments, from preparation of contracting strategy through contract negotiation and award. Major projects handled included large refinery expansion in France, grassroots refinery in the Far East, and a major new unit and an investment venture, both in the United States. The value of these four projects amounted to approximately $140 million.

For grassroots Singapore refinery, project engineer

C5 - PROJECT EQUIPMENT AND FACILITIES REQUIRED

C.5.1 - General

A complete list of individual equipment requirements associated with the conduct of all work necessary to secure a Federal Energy Regulatory Commission license to construct the Susitna Hydroelectric Project would necessarily be long and would likely be heavily loaded with relatively sophisticated items. It is these latter entities which deserve serious attention for their availability in Alaska is not generally widespread and even well-conceived plans to import them can prove costly -- both because transportation to and from the State is a traditional contributor to the higher cost of living and because the cost of delays on giant projects can wreak havoc with tight budgets. In addition, of course, certain modifications appropriate to harsh climatic conditions, delicate terrain and the like, add yet another increment to the expense column. We propose to satisfy virtually all major equipment requirements for which use or accessibility is demanded in Alaska by providing them from R&M's resources already in the State. To the extent that certain equipment needs do not have to be satisfied in Alaska (as would be the case for hydraulic modelling, for example), we propose to provide them in the main from in-house resources available to Acres American Inc. or owned by Terrestrial Evnironmental Specialists.

The relatively short period during which conditions are favorable for field investigations of the proposed dam and reservoir site and transmission line routes creates an important constraint. To minimize its negative impacts, there is simply no alternative to identifying the equipment needs well in advance and ensuring that they are fulfilled. R&M has faced this fact on numerous occasions in the past in Alaska and during the past ten years, has evolved a stable of equipment and a syustem for ensuring ready availability at the site when it is required. In short, R&M has found it prudent to become self-sufficient in terms of its total investigatory capabilty. We propose to offer this self-sufficiency as a unique characteristic of the team we have assembled for the work.

C.5.2 - Geological Investigations

For the purpose of supporting further geological investigations which may be required, we are pleased to note that the Drilling Company Inc. (TDC, an affiliate of R&M) has the capability to undertake explorations requiring core recovery, core orientation, down-hole surveys, installing thermostats, thermocouples, piezometers, and other instrumentation. TDC has configured its equipment acquisition and subsequent modifications to permit maximum mobility, even in areas which are remote, roadless, and frequently fragile or starkly rugged. TDC has accompoished a variety of drilling work using rail, truck mounts, tracked carriers, trailers, all-terrain vehicles, skids, barges, airplanes and helicopters. Some major items owned by TDC include:

- CME-55 Soils Drills (both Nodwell-mounted and heli transportable)
- CME-45c Soils Drills
- CME-550 ATV
- Failing 1500 Rotary Drills
- Mobile B-30 Auger Drills
- Mobile B-40 Auger Drills
  Mobile B-40L
- Mayhew 1000
- Longyear-38 Diamond Core Drills
- Nodwell-Mounted Units
- Truck-Mounted Units
- Heli-Transportable Units
- Portable Camp Facilities
- Waterpumps
- 15,000-ft Hose
- Core Barrels
- PVC Tubing
- Slope Indicators and Readout Device
- Thermister Strivy Readout Device
- Drilling Mud
- Sample Bags

C.5.3 - Surveys

Air surveys must be conducted when environmental conditions are favorable. Acceptable periods may be few and far between since cloud cover may interfere even when snow cover and leaf cover conditions are otherwise within allowable limits. In this regard, the fact that R&M Consultants Inc. owns its own aircraft, fully equipped for aerial survey, becomes particularly significant. Other survey needs can be satisfied as well through use of R&M's modern distance measuring and position locating state-of-the-art instruments.

C.5.4 - Access

Relative inaccessibility of proposed dam sites will not prevent the Acres team from acquiring necessary data, nor will our need to bring equipment within steep narrow canyons result in environmental damage. We are pleased to note that R&M owns a complete cableway system available for use in the field investigations of the Susitna sites. As may be seen from detailed project descriptions contained in Appendix B2, R&M designed the Thompson Pass cableway system used to advantage by Alyeska Pipeline Service Company.

C.5.5 - Material Testing

We plan to provide a system for rapid turnaround on material samples testing, for we recognize the importance of maximizing time available for investigation, preliminary analysis, and following-up leads suggested by early test results.

A cornerstone of this system is the R&M ownership of four modern materials testing laboratories in Alaska. We are prepared to absorb overload testing requirements during peak periods through round-the-clock operation of these facilities if necessary. At the same time, environmental samples will normally be analyzed in the R&M laboratories.

C.5.6 - Stream Gauging

R&M will provide stream gauging equipment in support of continuing hydrologic investigations. In addition, we are prepared to acquire and install remote sensing devices and long-term recording apparatus, for our extensive experience in arctic and subarctic environments and our own involvement in giant projects has convinced us that the collection of site-specific data during all parts of the year is an imperative. A clear example of the importance of this point can be found in the Corps of Engineers' experiences on the Snettisham transmission line south of Juneau. The erroneous assumption that wind conditions along a mountain ridge just outside of town would replicate those in Juneau proper led to collapse of a portion of the line and two year's delay in furnishing reliable power to the marketplace. Anemometers installed after the initial disaster showed that actual wind speeds had probably exceeded design speeds by more than 100 percent.

C.5.7 - Hydraulic Models

Acres has had extensive experience in hydraulic modelling. Not only do we currently operate the Chesapeake Bay Hydraulic Model for the Corps of Engineers, but we also own a well-equipped laboratory in Niagara Falls where we have modelled a variety of hydraulic structures. Our modelling experience has included extensive ice studies for extending navigation seasons on the Great Lakes as well. We will employ Acres' facilities and technical expertise for modelling certain hydraulic structures.

In addition, we have verified that the use of government laboratory facilities for private investigation is possible provided costs are fully reimbursed and capacity is available. We would expect to engage the services of the Cold Regions Research and Engineering Laboratory in Hanover, New Hampshire, when necessary. The newly dedicated Ice Engineering Laboratory affords excellent facilities for analysis of the effects of certain conditions (e.g. frazzile ice) which must be dealt with. While the bulk of such detailed study is more likely to occur during the final design stage, certain preliminary investigation will be appropriate during the feasibility study.

C.5.8 - Seismic Investigations

One of the particularly crucial problems to be resolved for the Susitna project involves the proximity to known faults. Seismic investigations and subsequent detailed analysis demand the availability of modern computer facilities. Because of the crucial nature of the work, R&M will use its

own computer facilities in the investigation. The Acres' Geotechnical Department will independently verify the results using computer systems available to us and tapping the expertise of senior in-house Acres consultants who faced and solved seismicity problems on the Churchill Falls project.

The following equipment will be used:

- geophysical seismic equipment
- geophysical resistivity equipment
- ten seismic recorders

C.5.9 - Environmental Study Equipment Requirements

- four to six snowmobiles
- canoe and outboard motor
- two Zodiac or rubber boats and motors
- 30-foot boat and motor
- radio transmitters and receivers
- dartgun and immobilizing drugs
- snaptraps and metal pitfalls
- gill, seine, fyke and trap nets
- electrophoretic laboratory equipment
- electroshocking equipment
- pH and DO meters
- binoculars
- Bausch and Lomb zoom transfer scope
- archeological excavation tools
- field cameras and lenses
- tape recorders
- University of Alaska Honeywell computer

C.5.10 - Miscellaneous

In addition to the ownership of, or access to necessary technical equipment, we are pleased to note that all members of the proposed Acres team offer modern and efficient administrative facilities and support, designed to minimize client costs and improve our respective productivities. Thus, for example, we make extensive use of word processing equipment, telex, tie-lines, company vehicles, in-house technical library support, and the like.

The following items of equipment will be for general use at the base camp:

- Bobcat backhoe
- Bell 205 helicopter
- Bell 206B helicopter (three)
- Cat D7 dozer
- six to eight vehicles