**FEASIBILITY ASSESSMENT
OF LOW - HEAD HYDROELECTRIC DEVELOPMENT
AT THE PENINSULAR PAPER COMPANY DAM
IN YPSILANTI , MICHIGAN**

**FINAL REPORT
MARCH 1979**

MASTER

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**PREPARED FOR THE
UNITED STATES DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
ENERGY & TECHNOLOGY DIVISION
ADVANCED TECHNOLOGY BRANCH**

AGREEMENT NO: EW - 78 - F - 07 - 1766

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PREPARED BY

AYRES, LEWIS, NORRIS & MAY, INC.
Engineers - Architects - Planners
3983 Research Park Drive
Ann Arbor, Michigan 48104

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April 13, 1979

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Mr. Charles E. Gilmore
Chief, Advanced Technology Branch
Energy & Technology Division
Idaho Operations Office
U.S. Department of Energy
550 Second Street
Idaho Falls, Idaho 83401

Dear Mr. Gilmore:

On behalf of Peninsular Paper Company, we are pleased to submit the final report on the Feasibility Assessment of Low-Head Hydroelectric Development at the Peninsular Paper Company Dam in Ypsilanti, Michigan, summarizing the results of the engineering study performed under DOE Agreement No. EW-78-F-07-1766.

We believe that this report represents a comprehensive examination of all aspects of hydroelectric generation at the existing low-head dam site, including engineering, environmental, economic, and institutional implications. From the information presented in the report a basis is available for making a decision on whether to develop the dam site as a hydroelectric resource. In addition, important information relating to dam safety, flood control, and impoundment management are presented.

We hope that this study will warrant your approval and we stand ready to provide any further assistance you may require.

Sincerely,

AYRES, LEWIS, NORRIS & MAY, INC.

Donald W. Lystra, P. E.
Project Director

DWL/lml
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TABLE OF CONTENTS

<u>ITEM</u>	<u>PAGE</u>
I SUMMARY	I-1
INTRODUCTION	I-1
HYDROLOGY	I-1-2
USE OF ELECTRIC POWER	I-2
DESIGN STRATEGY	I-2-3
DESIGN ALTERNATIVES STUDIED	I-3-4
PROJECT FINANCIAL ANALYSIS	I-4
ENVIRONMENTAL IMPLICATIONS	I-5
RECOMMENDED DESIGN	I-6-7
CONCLUSION	I-7
II BACKGROUND	II-1
III PRESENT STRUCTURAL CONDITION OF FACILITY	III-1
PRESENT STRUCTURAL CONDITION	III-1
Reinforced Concrete Overflow Spillway	III-1
Emergency Spillway with Radial Gate	III-1
Concrete/Brick Powerhouse	III-2
REPLACEMENT AND MAINTENANCE COSTS	III-2-3
IV ENVIRONMENTAL SETTING	IV-1
PHYSICAL RESOURCES	IV-1
Topography and Relief	IV-1
Climate	IV-1
Water Resources	IV-2
Geology and Soils	IV-2
Fish and Wildlife	IV-5
SOCIAL AND ECONOMIC RESOURCES	IV-6
Land Use	IV-6
Shoreline Use and Structures	IV-7
Population	IV-7
INSTITUTIONAL/LEGAL	IV-8
Use of Surface Water	IV-8
Protection of the River Environment	IV-9

<u>ITEM</u>		<u>PAGE</u>
V	SITE HYDROLOGY	V-1
	GENERAL	V-1
	FLOOD MAGNITUDES	V-5
	FLOOD OCCURANCES	V-6
	DAM DISCHARGE RATING	V-6
VI	THEORETICAL POWER POTENTIAL	VI-1
	GROSS ENERGY CAPACITY	VI-1
	Economic Considerations	VI-3
	PEAK DEMAND CAPACITY	VI-7
	Demand Capacity Due to Storage	VI-7
	Demand Capacity Due to Natural Stream Flow	VI-8
VII	ELECTRIC ENERGY UTILIZATION	VII-1
	TYPE OF INTERCONNECTION	VII-1
	PAPER COMPANY ELECTRIC DEMAND CHARACTERISTICS	VII-4
	Daily Demand Cycle	VII-4
	Weekly Demand Cycle	VII-4
	Seasonal Demand Cycle	VII-7
	Conclusion	VII-7
VIII	EQUIPMENT DESIGN ALTERNATIVES	VIII-1
	TYPE OF TURBINES	VIII-1
	Manufacturers/Costs	VIII-2
	Structural Modifications to Retrofit New Turbines	VIII-4
	SIZE OF TURBINES	VIII-5
	Benefit/Cost Analysis	VIII-5
	Conclusion	VIII-11
	NUMBER OF GENERATING UNITS	VIII-11
	TYPE OF GENERATORS	VIII-12
	Generator Design	VIII-12
	Generator Speed	VIII-12

<u>ITEM</u>		<u>PAGE</u>
IX	PROJECT DESIGN ALTERNATIVES	IX-1
	SUMMARY OF PROJECT DESIGN ALTERNATIVES	IX-1
	CONSTRUCTION COSTS	IX-3
	OPERATION AND MAINTENANCE COSTS	IX-3
X	PROJECT FINANCIAL FEASIBILITY	X-1
	GOVERNMENTAL TAX AND LOAN INCENTIVES	X-1
	Local Property Tax Exemption	X-1
	Sales and Use Tax Exemptions	X-3
	Federal Investment Tax Credit	X-3
	Federal Energy Tax Credits	X-4
	Federal Hydroelectric Loan Program	X-4
	FINANCIAL FEASIBILITY-OWNER'S PERSPECTIVE	X-4
	IMPLICATION OF FEDERAL LOW INTEREST LOAN PROGRAM	X-7
XI	ENVIRONMENTAL IMPACT ASSESSMENT	XI-1
	ENVIRONMENTAL IMPACT: NON-DEVELOPMENT ALTERNATIVE	XI-1
	Impact on Natural Environment	XI-1
	Impact on Cultural Environment	XI-3
	ENVIRONMENTAL IMPACT: DEVELOPMENT ALTERNATIVE	XI-3
	Impact on Natural Environment	XI-3
	Impact on Cultural Environment	XI-4
	CONCLUSIONS	XI-5
XII	INSTITUTIONAL IMPLICATIONS	XII-1
	FEDERAL ENERGY REGULATORY COMMISSION (FERC)	XII-1
	MICHIGAN PUBLIC SERVICE COMMISSION (MPSC)	XII-2

APPENDIX

Report on Above Water Inspection and Recommendations for the Peninsular Paper Dam and Powerhouse

Report on Below Water Inspection of the Peninsular Paper Company Dam and Powerhouse

Letter from Detroit Edison Company, January 11, 1979

Report of Telephone Conversation with Representative of Michigan Public Service Commission

Copies of Detroit Edison Company Rates Pertinent to the Peninsular Paper Company Project

Proposals from Hydraulic Turbine Manufacturers

- Allis Chalmers, Inc.
- Bofors Nohab, Inc.
- Dominion Engineering Works, Limited
- James Leffel and Company
- Neyrpic, Inc.
- F.W.E. Staphenhorst, Inc.
- Sulzer Bros., Inc. (Escher-Wyss)

Quotation from Ideal Electric Company for vertical, slow-speed generators

Quotations from Falk Corporation for gear drives

Letter from FERC describing licensing procedure for hydroelectric facilities

INDEX OF FIGURES

<u>FIGURE</u>	<u>PAGE</u>
II-1 PROJECT LOCATION	II-3
II-2 LOCATION OF DAM SITE	II-4
II-3 PHOTOGRAPHS OF PENINSULAR PAPER COMPANY DAM	II-5
II-4 SECTIONAL VIEW OF PENINSULAR PAPER POWERHOUSE	II-7
II-5 PLAN VIEW OF PENINSULAR PAPER POWERHOUSE	II-8
IV-1 HURON RIVER WATERSHED	IV-3
IV-2 STREAM GRADIENT OF THE HURON RIVER CHANNEL	IV-4
V-1 FLOW DURATION CURVE - HURON RIVER AT YPSILANTI	V-2
V-2 FLOW DURATION CURVE - HURON RIVER AT YPSILANTI	V-3
V-3 MASS DIAGRAM - HURON RIVER AT PENINSULAR PAPER COMPANY DAM	V-4
VI-1 OPERATING CHARACTERISTICS OF A SMALL RUN-OF-RIVER HYDRO- ELECTRIC PLANT IN RELATION TO FLOW DURATION CURVE	VI-2
VI-2 CONCEPTUAL MODEL OF HYDROELECTRIC FACILITY ECONOMICS	VI-5
VI-3 RATE OF CHANGE IN UPSTREAM LEVEL VS. DAM DISCHARGE DIFFERENTIAL	VI-6
VII-1 COMPARISON OF PAST HYDRO PLANT INTERCONNECTION WITH THAT PRESENTLY SUGGESTED BY DETROIT EDISON	VII-3
VIII-1 SUGGESTED METHOD OF ADAPTING NEW VERTICAL TURBINE TO POWERHOUSE	VIII-6
VIII-2 SUGGESTED METHOD OF ADAPTING A BULB TURBINE TO THE DAM SITE	VIII-7
VIII-3 SUGGESTED METHOD OF ADAPTING A CROSS-FLOW TURBINE TO THE DAM SITE	VIII-8
XI-1 ENVIRONMENTAL IMPACT MATRIX	XI-2

INDEX OF TABLES

<u>TABLE</u>		<u>PAGE</u>
I-1	COST SUMMARY OF DESIGN ALTERNATIVES	I-4
I-2	BENEFIT/COST SUMMARY OF VARIOUS HYDROELECTRIC PLANT DESIGNS	I-5
VI-1	AVERAGE MONTHLY DEMAND OF HYDRO PLANT BASED ON STREAM FLOW	VI-9
VII-1	TYPICAL PAPER MILL DAILY LOAD CYCLE	VII-5
VII-2	HYDRO PLANT OUTPUT EXCEEDING PAPER COMPANY DEMAND DURING PERIODS OF NON-PRODUCTION	VII-6
VII-3	PATTERN OF MONTHLY ELECTRICAL ENERGY CONSUMPTION - PENINSULAR PAPER COMPANY	VII-8
VII-4	RELATIONSHIP BETWEEN PAPER COMPANY'S 1977/78 MONTHLY ELECTRIC CONSUMPTION AND THE PROJECTED MONTHLY PRODUCTION FROM HYDRO PLANTS OF VARIOUS SIZES	VII-9
VIII-1	SUMMARY OF PROPOSALS FROM TURBINE MANUFACTURERS	VIII-3
VIII-2	INCREMENTAL BENEFIT/COST ANALYSIS OF PLANT CAPACITY ALTERNATIVES	VIII-10
IX-1	SUMMARY OF DESIGN ALTERNATIVES FOR HYDROELECTRIC DEVELOPMENT	IX-2
IX-2	PROJECT COST ESTIMATE: One (1) Leffel Co. Vertical Unit	IX-6
IX-3	PROJECT COST ESTIMATE: Two (2) Leffel Co. Vertical Units	IX-7
IX-4	PROJECT COST ESTIMATE: One (1) Bulb Unit	IX-8
IX-5	PROJECT COST ESTIMATE: Two (2) Bulb Units	IX-9
IX-6	PROJECT COST ESTIMATE: One (1) Ossburger Cross-Flow Unit	IX-10
IX-7	PROJECT COST ESTIMATE: Dual Ossburger Cross-Flow Units	IX-11
IX-8	PROJECT COST ESTIMATE: Single Tubular Unit	IX-12
X-1	BENEFIT/COST SUMMARY OF VARIOUS HYDROELECTRIC PLANT DESIGNS AT PENINSULAR PAPER COMPANY DAM	X-2

ABSTRACT

This report presents the results of a study sponsored by the United States Department of Energy into the feasibility of developing a small, low-head dam site for hydroelectric generation. The site is located in southeastern Michigan and is owned by a paper company. Average hydraulic head at the site is 13.0 feet, mean stream flow is 498 cubic feet per second (cfs).

The concept of feasibility, as used in this study, was very broad, including engineering economic, environmental and institutional factors. A project proving non-feasible in any of these areas would be considered a non-feasible project.

From an engineering standpoint it was found that the items of equipment needed to develop the site are readily available from both U.S. and foreign manufacturers. A variety of hydraulic turbine designs could be successfully adapted to the existing powerhouse or spillway, without extensive new construction.

Seven specific hypothetical designs were examined in detail, including vertical, bulb, cross-flow and tubular turbine designs. It was determined that the production capacity of the facility had an important influence on the cost-effectiveness of the project. A detailed benefit/cost analysis was conducted to identify the optimum facility size in terms of incremental costs and benefits.

From an economic standpoint, it was found that the most cost-effective design for developing the site, although profitable, would not be financially attractive to the owner compared to other investment opportunities with which the company is faced. The projected after-tax return on investment for the project, based on current costs, was projected to be from 2 to 6 percent, depending upon the depreciation basis used. The project would, however, have a favorable effect on the corporations working capital.

If financing for the project were available from a source outside the corporation, such as the federally-sponsored hydroelectric loan program, the project would be more attractive to the owner, in that it would not consume corporate funds that could otherwise be put to use in a more profitable venture.

A detailed environmental assessment using an "impact matrix" methodology concluded that the environmental issues associated with the development of the site would be relatively minor. The most important consequence would be enhanced public safety due to structural repairs to the dam and the availability of a small, independent source of electric generation that could be called on in times of power outages or natural disaster.

The institutional and regulatory implications of developing the site for hydroelectric generation were found to be significant but manageable. It was found that important tax incentives are available, at both the State and Federal level, for a project of this type.

SECTION I SUMMARY

INTRODUCTION

The Peninsular Paper Company dam is located on the Huron River in Ypsilanti, Michigan, approximately twenty-five miles east of Detroit. The facility includes an abandoned hydroelectric powerhouse, a 240-foot wide weir dam and a 12-foot wide radial gate for the release of high flows. The average hydraulic head at the site is 13.0 feet.

Power was produced at the site beginning in the nineteenth century, however the present powerhouse dates from 1918. It was originally equipped with two vertical Francis turbines directly connected to 4600-volt slow-speed generators, rated 450 and 550 kilowatts full load. Annual production from the plant average about 2.6 million kilowatt-hours, ranging from a high of 3.7 million kilowatt-hours to a low of 1.3 million kilowatt-hours.

In 1971, electrical failures in the generators prompted the paper company to retire the plant. The power purchase agreement with the utility at that time was providing only about \$13,000 annual gross revenue. In retiring the plant, the paper company removed and scrapped the generators and all related electrical equipment. In order to prevent the passage of water through the structure and to avoid a public hazard, the turbine pits were filled in with earth. It is not known at this time whether the turbines themselves were removed from the wheel pits.

HYDROLOGY

Based on extrapolated data from a U.S.G.S. permanent gaging station approximately seven miles upstream of the Peninsular Paper Company dam, hydrological parameters at the site are estimated as follows:

mean discharge	498 cfs
mean annual flood peak	2441 cfs
mean annual 30-day low flow	264 cfs

The flow-duration characteristics of the site are typical of those for sites in the midwestern United States. Average discharge during the wettest month of the year averages about five times that occurring during the driest month.

USE OF ELECTRIC POWER

The hydroelectric powerhouse is located directly across the river from the paper company's production facility. This close proximity makes a direct service connection possible, allowing the hydro plant to directly offset electric energy that would otherwise be purchased through the normal utility service.

Based on a comparison of the paper company's daily and monthly electric consumption pattern and the projected production from various sized hydroelectric facilities, it is estimated that virtually 100 percent of the hydro plant output could be consumed directly by the paper mill, for any hydro plant having an installed capacity of 700 kilowatts or less.

Presently, the paper company receives electricity under a primary rate agreement with the local utility, the Detroit Edison Company. Under the terms of this agreement energy charges (including current fuel adjustment) are 2.3¢ per kWh on-peak and 2.0¢ per kWh off-peak, monthly on-peak demand charges are \$5.80 per kW, and maximum demand charges are \$1.50 per kW per month. Customers receiving primary service from Detroit Edison Company are permitted to receive power from an alternate and independent source of energy subject to a monthly surcharge of \$1.75 per kilowatt of alternate capacity.

DESIGN STRATEGY

An analysis of site hydrology established that the storage capacity in the upstream impoundment (445 acre-feet) was not sufficient to guarantee a firm demand capacity without experiencing unacceptable variations in lake level during draught conditions. It was determined, for example, that a differential of only 100 cfs between natural runoff and dam discharge would, over 24 hours, cause a 34-inch change in headwater level. It was possible, however, to establish a limited amount of reliable monthly demand capacity based on natural stream flow.

The installed generating capacity of the facility in relation to stream flow characteristics was found to have an important influence on project cost-effectiveness. The benefits from increased capacity were found to diminish rapidly above a given point due to the flow-duration characteristics in the river. The table below shows the relationship between installed capacity and effective capacity (i.e., average utilized capacity) at the Peninsular Paper Company dam site. It can be seen that the proportional increment in effective capacity decreases with each increment in plant size.

Installed Capacity (kW)	100	300	500	700	900
Effective Capacity (kW)	96	228	287	326	351
Increment (kW)	96	132	59	39	25
Utilization	96%	66%	30%	20%	13%

DESIGN ALTERNATIVES STUDIED

A total of seven project alternatives were examined in detail. The alternatives were distinguished by the type, number and size of hydraulic turbine units employed, as follows:

<u>Turbine Type</u>	<u>Number of Units</u>	<u>Output Per Unit</u>	<u>Total Installed Capacity</u>
Vertical	1	340 kW	340 kW
Vertical	2	340 kW	680 kW
Bulb	1	126 kW	126 kW
Bulb	2	126 kW & 163 kW	289 kW
Cross-flow	1	195 kW	195 kW
Cross-flow	2	195 kW	390 kW
Tubular	1	400 kW	400 kW

The vertical turbine designs were based on the re-use of the existing powerhouse; all other designs assumed the construction of a completely new and structurally independent powerhouse. All designs, except that employing the bulb turbines, were based on units having variable gates or blades to allow the output to be matched with stream flow. The bulb turbine design, on the recommendation of the manufacturer, was based on units having fixed blades and a single operating point. All designs were based on the use of synchronous generators, connected through speed increasers to the low-speed turbines.

Table I below presents a cost summary of six of the design alternatives studied.

TABLE I-I

COST SUMMARY OF DESIGN ALTERNATIVES
FOR DEVELOPING THE PENINSULAR PAPER COMPANY
DAM SITE FOR HYDROELECTRIC GENERATION

	One 340 kW Vertical Turbine	Two 340 kW Vertical Turbines	One 126 kW and One 163 kW Bulb Turbines
Total Project Cost	\$452,000	\$708,000	\$809,000
Total Equipment Cost	205,000	380,000	396,000
Civil/Structural Cost	110,000	110,000	136,000
Project Cost/kW	1,329	1,041	3,210
Equipment Cost/kW	603	559	1,571
C/S Cost/kW	324	162	540

	One 195 kW Cross-flow Turbine	Two 195 kW Cross-flow Turbines	One 400 kW Tubular Turbine
Total Project Cost	\$493,000	\$756,000	\$795,000
Total Equipment Cost	300,000	489,000	432,000
Civil/Structural Cost	76,000	96,000	116,000
Project Cost/kW	2,528	1,938	1,988
Equipment Cost/kW	1,538	1,254	1,080
C/S Cost/kW	390	246	290

PROJECT FINANCIAL ANALYSIS

Table 2 below presents a benefit/cost summary of the seven project alternatives. After taking account of projected expenses for operation and maintenance, benefit/cost ratios were calculated ranging from 9.6% for the single vertical turbine alternative to 3.8% for the dual bulb turbine alternative.

TABLE I-2
BENEFIT/COST SUMMARY OF VARIOUS
HYDROELECTRIC PLANT DESIGNS AT
PENINSULAR PAPER COMPANY DAM

		TYPE OF TURBINE			
		Vertical (340 kW)	Bulb (126 kW & 163 kW)	Cross-flow (193 kW)	Tubular (400 kW)
One Unit Design	Project Cost	\$452,000	\$447,000	\$493,000	\$795,000
	Projected Annual Revenue	58,900	30,000	40,100	65,000
	Projected Annual O&M Expense	15,600	16,100	18,100	21,100
	Projected Net Revenue	43,300	13,900	22,000	43,900
	Benefit/Cost	9.6%	3.1%	4.5%	5.5%
Two Unit Design	Project Cost	\$708,000	\$809,000	\$756,000	
	Projected Annual Revenue	71,900	51,600	63,900	
	Projected Annual O&M Expense	19,900	20,900	22,900	
	Projected Net Revenue	52,000	30,700	41,000	
	Benefit/Cost	7.3%	3.8%	5.4%	

ENVIRONMENTAL IMPLICATIONS

A detailed environmental impact assessment was conducted using an impact matrix methodology of "non-development" and "development" alternatives. The environmental assessment concluded that the development of the facility would have very slight environmental consequences due to the small scale of the facility and the fact that a "run-of-the river" operating strategy would be followed. The main consequence which was identified was the enhancement of public safety due to the structural repairs to the dam and the projected high level of future dam maintenance. The vertical turbine design alternatives, which would involve the refurbishment of the existing powerhouse, would have additional positive consequences relating to site aesthetics, and the preservation of an historically significant structure.

RECOMMENDED DESIGN

If the Peninsular Paper Company dam site is developed as a hydroelectric resource it is recommended that the design incorporate the features of the alternative showing greatest cost-effectiveness, as follows:

- type of hydraulic turbines: vertical
- number of generating units: one
- size of generating units: approximately 340 kW output full load
- type of generators: synchronous
- generator speed: either low speed or standard speed through a gear drive
- method of installation: in existing powerhouse
- use of power: feeding owner's production facility, in parallel with normal utility service.

The following table gives a summary of project costs and operating characteristics of the recommended design.

Estimated Project Cost	\$452,000 (not including tax incentives)
Installed Capacity (kW)	340
Effective Average Capacity (kW)	234
Utilization Factor	68%
Cost/Installed kW	\$ 1,329
Projected Annual Production (MkWhr)	2.1
Average Monthly Demand Capacity (kW)	293
Projected Annual O&M Expense	\$ 15,600
O&M Cost/kWhr Produced	0.74¢

The following figures give a projected financial summary of the recommended project for the first year of operation, based on analytical method used by the owner.

Total Capital Cost (labor and materials):	\$362,000
Net Annual Income (or savings):	58,900
Depreciation (straight-line, 10 years):	<u>45,200</u>
Pre-tax Income (or savings):	\$ 13,700
Estimated Taxes (50%):	<u>6,850</u>
Net After-tax Income (or savings):	\$ 6,850
Add-back depreciation:	<u>45,200</u>
Increase in Working Capital:	\$ 52,050

$$\text{After-tax Return on investment} = \frac{6,850}{362,000} = 1.9\%$$

$$\text{Payback} = \frac{1}{1.9\%} = 53 \text{ years}$$

The capital cost identified above has been reduced by 20% to show the effect of the Federal investment and energy tax credits. No property tax was included based on an expected exemption under either of two applicable state statutes.

Although profitable, the recommended project would not be financially attractive to the owner compared to other investment opportunities with which they are faced.

If financing for the project were available from a source outside the corporation, such as the Federally-sponsored hydroelectric loan program, the project would be much more attractive to the owner, in that it would not consume corporate funds that could otherwise be put to use in a more profitable venture.

CONCLUSION

The development of the Peninsular Paper Company low-head dam site as a hydroelectric facility was determined by this study to be a feasible project in terms of engineering, environmental, and institutional factors. From an economic standpoint, however, it was determined to be non-cost-effective in terms of the economic factors pertinent to the owner, a private industrial concern. Conceivably, a combination of tax credits, low interest loans, and/or construction grants reducing costs and expenses by approximately 25 percent would place this project within a financially feasible range.

SECTION II BACKGROUND

The Peninsular Paper Company dam is located on the Huron River in Ypsilanti, Michigan, approximately twenty miles east of Detroit (Figure II-1). The facility includes an abandoned hydroelectric powerhouse, a 240-foot wide weir dam, and a 12-foot wide radial gate for the release of high flows (Figure II-3). The dam is located adjacent to the Peninsular Paper factory, with the powerhouse across the river from the mill buildings. Average hydraulic head at the site is 13.0 feet; mean stream flow is 498 cubic feet per second (cfs).

In spite of the sites proximity to the urbanized Ypsilanti area, the upstream and downstream areas are largely undeveloped. The upstream impoundment covers an area of approximately 72 acres and is not subject to any active use (Figure II-2).

The dam dates originally from the nineteenth century, although it was substantially rebuilt in 1920. The present powerhouse was constructed in 1918 and was equipped with two vertical Francis turbines, manufactured by the Allis-Chalmers Company. The turbines were directly connected to 4800-volt, slow-speed vertical generators, rated 450 and 550 kilowatts. Figures II-4 and II-5 show plan and sectional views of the powerhouse. Output from the plant was fed directly into the local utility grid through an overhead connection. Detroit Edison Company records indicate that the annual production from the plant averaged about 2.6 million kilowatt-hours from 1926 through 1950, ranging from a high of 3.7 million kilowatt-hours in 1943 to a low of 1.3 million kilowatt-hours in 1934.

From 1920 to 1950, the hydroelectric plant was operated and maintained by the Detroit Edison Company under a lease agreement with the paper company. The electric utility at that time owned five other hydroelectric facilities on the Huron River, both upstream and downstream of the Peninsular Paper installation. Production from the hydro plant was credited against the electricity consumed by the paper mill through their normal 4800-volt service from the utility. In August, 1950, the lease was terminated; although Detroit Edison continued to operate the facility, the maintenance responsibilities were assumed

by the paper company. The power-purchase agreement was changed at this time to a simple "dump" rate which ranged from 2 mills per kilowatt-hour in 1950 to 6 mills per kilowatt-hour in 1970, the last full year of operation.

Sometime in the late 1960's one of the generators in the hydro plant failed and in 1971, the second failed also. The exact cause of these failures is not now known, however, it is assumed that they were electrical failures precipitated by the deterioration of insulation. Paper company personnel did a brief and informal investigation of the cost required to restore the units to an operating condition, however, in terms the rate at which the utility was then purchasing the power it was deemed to be not economically justified. (In 1970, the last full year of operation of the hydroelectric facility, revenue from power sales totaled only about \$13,000.)

In decommissioning the plant, the generators and all related electrical equipment were removed. In order to prevent the passage of water through the structure and to avoid a public hazard, the head gates were closed and the turbine pits were filled in with earth. It is not known whether the turbines themselves were removed from the wheel pits prior to being filled in

FIGURE II-1
PROJECT LOCATION

STATE OF MICHIGAN

FIGURE II-3

PHOTOGRAPHS OF PENNINSULAR PAPER CO. DAM

a) Upstream view of dam and powerhouse.

b) Downstream view of Huron River below dam.

FIGURE II-3

PHOTOGRAPHS OF PENNINSULAR PAPER CO. DAM

c) View across river from paper mill side.

FIGURE II-4
SECTIONAL VIEW OF
PENNINSULAR PAPER
POWERHOUSE

HYDRO-ELECTRIC PLANT
PENNINSULAR PAPER CO.
TOSCANITA, MICH.
SECTIONAL ELEVATION
OF
POWER HOUSE
Scale 1/4" = 1'-0"

Arch. Drawing
BENJAMIN DOUGLAS COMPANY
E-33 M
J. H. H. H.

DRAWN BY F.S.T. Dec 18 1914

SECTION III

PRESENT STRUCTURAL CONDITION OF FACILITY

PRESENT STRUCTURAL CONDITION

The Peninsular Paper Company dam site consists of three major structural components:

- reinforced concrete overflow spillway
- emergency spillway with radial sector gate
- concrete/brick powerhouse

Above-water and below-water inspections were performed on the dam site in September and October, 1978, respectively, by the engineering firm of Ayres, Lewis, Norris & May, Inc. The reports which were prepared from these inspections are included in the Appendix for reference. A summary of these inspections broken down by structural components, is given below:

Reinforced Concrete Overflow Spillway

The 240-foot-wide overflow spillway was judged to be in overall good structural condition, both above and below water and in need of no immediate repair. The above-water inspection could not find any material deficiencies. The below-water inspection revealed some concrete cracks and spalling, the most significant of which was a 1/4-inch-wide crack 8 inches below the crest extending across the entire spillway face. This is judged to pose no immediate threat to the structure, however, it should probably be repaired by pressure grouting within the next several years.

Emergency Spillway with Radial Gate

Both the above and below water inspections noted large concrete losses and extensive cracking in the retaining wall between the emergency and overflow spillways. This condition allows a large amount of water to leak around the radial gate which has accelerated the deterioration and caused significant rusting of steel gate angle supports.

This is the only condition in the dam which requires immediate attention. It is estimated that repairs to the retaining wall and radial gate would cost about \$16,000.

Concrete/Brick Powerhouse

The powerhouse has been abandoned and all equipment has been removed from the upper floor. To avoid a public hazard, the turbine pits have been filled with earth. For this reason it is not known whether the original turbines are still in place.

Numerous cracks and deteriorated areas are observable in the retaining walls and piers supporting the structure, however, none of the conditions constitute a threat to dam safety. The only reason for undertaking repairs to the powerhouse would be to rehabilitate it as a hydroelectric station. The cost of the repairs and improvements required for this purpose are estimated at \$94,000.

REPLACEMENT AND MAINTENANCE COSTS

Cost estimates were made to determine the present-day replacement cost of the structural components of the Peninsular Paper Company dam and hydroelectric powerhouse, as well as projected structural maintenance costs under alternate repair programs.

The present-day replacement cost of the total facility, excluding power generating equipment, was accordingly estimated to be approximately \$1,460,000. This is the engineers best estimate of the present-day cost for materials and labor to construct a new facility identical in design to the one that is presently there. The estimate does not include cost for removal of the existing facility.

A breakdown of the replacement cost estimate is as follows:

240 foot wide spillway	\$ 725,000
retaining walls	\$ 145,000
sector and sluice gates	\$ 90,000
powerhouse	\$ 370,000
coffer dams required for construction	<u>\$ 130,000</u>
	\$1,460,000

Three alternate repair/maintenance programs were considered. The first assumed no immediate repair work and no future maintenance. The second assumed a level of repairs and maintenance required to assure a 25-year service life of the facility. The third assumed a level of repairs and maintenance required to assure a 50 year service life of the facility (i.e., a new facility).

The results of the analysis are summarized in the following table:

<u>Service Life</u>	<u>Cost of Immediate Repairs Required</u>	<u>Average Annual Maintenance Cost</u>
3-5 years	\$ 0	\$ 0
25 years	\$ 16,000	\$2,000
50 years	\$1,460,000	\$1,800

SECTION IV

ENVIRONMENTAL SETTING

The environmental setting is a statement of the existing physical, social, economic and legal institutional environment in the project area. The description of current environmental conditions serves as a baseline against which the impacts of project alternatives are assessed. For purposes of establishing an environmental setting the project area will generally be considered Paper Mill Pond and the land area immediately surrounding the pond and the Peninsular Paper Company dam. Significant environmental factors beyond this project area which could potentially be impacted by any of the project alternatives are also described.

PHYSICAL RESOURCES

Topography and Relief

The valley topography surrounding the dam is a product of glacial activity and the erosive action of the Huron River. The area south of the dam is gently sloping while the area immediately to the north is more steeply sloping with grades up to 40 percent. The greatest relief can be found downstream and north of the LeForge Road Bridge where elevations range from 700 feet above sea level at the river shoreline to 800 feet on top of adjacent hills. Beyond the immediate study area, the countryside is gently rolling or flat.

Climate

The Great Lakes have a moderating influence upon the climatic conditions and seasonal temperatures within the project area. Records collected for the past 57 years indicate an average annual daily temperature of 48.3°F.¹ Precipitation over the same 57 year period average 30.69 inches.² Mean monthly precipitation ranges from a high of 3.20 inches in April to 1.72 inches in January. The wind direction is generally from the west-southwest or southwest at speeds of around 10 mph.

Water Resources

The Peninsular Paper Company dam is located 43.8 miles upstream from the mouth of the Huron River at Lake Erie and 84.8 miles downstream from the source of the river in Oakland County. The impoundment ranges 1.09 miles upstream and encompasses approximately 72 acres before it terminates at the Superior Hydro Plant Dam. The impoundment volume of Paper Mill Pond is 362 acre feet and has a normal pond elevation of 712.5 feet above sea level.

The total drainage area of the Huron River basin (illustrated in Figure IV-1) is 892 square miles, of which 802 square miles lie upstream of the Peninsular Paper dam. The main stem of the Huron River is 128 miles long with a stream gradient elevation ranging from 1,018 feet above sea level at the headwaters, to 446 feet at the mouth (Figure IV-2). The Peninsular Paper dam lies in an area of the Huron River where stream slopes average 4.0 feet per mile.

Geology and Soils

The study area's surficial geology is generally comprised of glacial till and glacio-fluvial or outwash deposits. The site rests on the border of ancient lake beds and delta channels of southeastern Michigan and the start of the morainal uplands of central Michigan. The Defiance moraine is situated immediately to the north of the dam site while glacial outwash deposits are found on the southern edge of the study area.

The bedrock of the area is sedimentary in origin and composed of sandstone, shale and carbonate rocks of the Mississippian and Devonian age. Sunbury, Berea and Bedford formation bedrock underly the site and are found approximately 100 feet below the surface.

Four major soil types can be found surrounding the study area. These are the Blount Series, Bayer Series, Sloan Series and Fill Land. The following general descriptions of the soil types are provided.

- I. Blount Series - Somewhat poorly drained, nearly level and gently sloping soils formed in loamy textured glacial till.

FIGURE IV-1
HURON RIVER WATERSHED

SOURCE: HURON RIVER WATERSHED COUNCIL

FIGURE IV-2
STREAM GRADIENT OF THE HURON RIVER CHANNEL

SOURCE: HURON RIVER WATERSHED COUNCIL

2. Boyer Series - Well drained, nearly level to very steep soils formed in loamy and sandy deposits underlain by gravelly coarse sand.
3. Sloan Series - Very poorly drained, nearly level soils formed in stratified loamy textured alluvial deposits.
4. Fill Land - Filled areas with 3 or more feet of soil material. Slopes are less than 6 percent in most areas and soil materials range from sand to clay.

Fill lands are located along the northern side of the dam while Boyer soils are found just beyond the fill sites and on the uplands. Blount soils are found south of the dam site and Sloan soils are located downstream and in areas adjacent to the river.

Fish and Wildlife

For many years the Huron River offered poor recreational fishing due to the predominance of bottom feeding fish such as carp and suckers. In 1972 the Michigan Department of Natural Resources initiated a management program aimed at killing and removing the carp and suckers and then restocking stretches of the Huron River and Belleville Lake as a sport fishery. The Peninsular Paper dam area was included within this project and the results of this restocking effort are present today. While some carp and suckers have re-established themselves other species typically found include:

- Tiger Muskellunge
- Walleye
- Channel Catfish
- Bullhead
- Largemouth Bass
- Bluegill
- Black Crappie

The Department of Natural Resources intends to continue a management program for recreational fishing on the Huron River. Periodic restocking of sport species and

improved water quality has helped to maintain local fishing interest. These factors plus the proximity to urbanized areas have made the Peninsular Paper dam location a popular fishing area.

According to the district office of the Michigan Department of Natural Resources, the study area does not support any unique or endangered wildlife species. Lack of suitable wildlife habitat due to the presense of urban development is the primary reason why unique or endangered species are not commonly observed in the area. While an extensive sampling survey has not been done, typical species observed in the area include an assortment of songbirds, reptiles, amphibians and orustaceans. A list of mammals commonly observed in the area include:

White Tail Deer	Grey Squirrel
Woodchuck	Least Weasel
Raccoon	Cotton Tail Rabbit
Muskrat	Moles
Mink	Shrews
Deer Squirrel	Deer Mouse
Fox Squirrel	Meadow Jumping Mouse

Mallards, Blue Winged Teals and other waterfowl are also found in the vicinity of the dam. In general however, the absence of wetlands and suitable habitat restricts large populations of waterfowl or other species of wildlife.

SOCIAL AND ECONOMIC RESOURCE

Land Use

The land use surrounding the dam and its backwaters is primarily residential and is bordered by undeveloped vacant land. A multi-family housing complex is located to the north of the dam and high density student housing is located to the south on the Eastern Michigan University Campus. The University is the largest landholder within the study area and includes over 130 acres of land near the Huron River. The railroad and Huron River Drive separate the campus from industrial sites along the southern shores of the river. The Peninsular Paper Mill and parking area is the major industrial site along this portion of the Huron River.

While the industrial and high density residential uses are located near the dam site and downstream areas near the City of Ypsilanti, the upstream areas contain substantial tracts of open land. Portions of these lands are now being considered for annexation by the City of Ypsilanti and are likely to be developed for residential uses within the near future.

Shoreline Uses and Structures

The upstream system of dams on the Huron River protects the shoreline areas from destructive flooding or excessive shoreline erosion. Because of the limited force of the river and because the shoreline is sparsely developed, few man-made shoreline structures are found within the study area. Shoreline reinforcement and concrete bulkheads are found near the dam and also where the railroad bed borders the river. Most shoreline areas are in the natural state and consist of river rock and varieties of vegetative cover which tend to stabilize these shoreline areas.

Population

The populations of the City of Ypsilanti, Ypsilanti Township and Superior Township have consistently risen since 1960. The population statistics for the study area are as follows:

	1960	1970	1975-76	1960-1975/76 % Change
Ypsilanti	20,957	29,538	26,745	27.6
Ypsilanti Township	20,950	33,194	35,757	70.6
Superior Township	3,600	5,562	6,396	77.6

The dam site and surrounding lands have experienced large population influxes due to the expansion of the City of Ypsilanti and also because of the expansion by Eastern Michigan University. Current zoning and land use plans call for additional multi-family and single family residential use areas. It is therefore likely that the combined factors of urban expansion by Ypsilanti and demands for university related housing will continue to increase population within the study area.

INSTITUTIONAL/LEGAL

Use of Surface Water

Legal rights ascribed to the use of water in Michigan is derived from common law rules evolving in the courts on a case by case basis. Michigan follows the doctrine of riparian water rights used primarily in the eastern United States, although the riparian doctrine has been modified by statutory action.

The riparian doctrine stipulates that the right to the use of water in a watercourse is dependent on ownership of the land which is contiguous or riparian to the watercourse. All riparian owners have an equal right to reasonable use of the water.

The riparian doctrine tempered by the reasonable use rule entitles a riparian owner to use water for consumptive and domestic purposes on riparian land in a reasonable manner. The issue of reasonableness has always raised difficult questions which have often ultimately led to intervention by the courts.

An additional important aspect of the riparian doctrine is that there is not forfeiture of unexercised water rights. The lack of interruption of use by the riparian owner does not result in the forfeiture of the right to use the water in the future.

Public bodies owning riparian lands are entitled to the same reasonable use of the water as private riparian owners. The reasonable use doctrine has permitted public riparian owners to divert and use stream flow in reasonable amounts for beneficial public purposes. This aspect of reasonable use has been especially important for the provision of municipal water supplies. Reasonable use has also allowed the diversion of stream flow for the generation of hydroelectric power.

Modifications to the riparian doctrine have been realized through legislative intervention to protect public health, safety and welfare. These statutory modifications have largely concentrated on the protection on water quality rather than the regulation of stream flow. Although State officials realize the benefits of stream flow regulation for maintenance of fishery habitat, water withdrawal and flood prevention, legislative intervention with riparian water use and its effect on stream flow has been minimal.

While several State statutes protect the inland lakes and streams environmental quality, State authority over stream flow has been largely confined to the regulation of new structures placed in a lake or stream. Through the Inland Lakes and Streams Act of 1972, the Michigan Department of Natural Resources regulates, among other things, the placement of new structures below the ordinary high-water mark which may interfere with natural flow. New dams impounding more than five acres or with a head of five or more feet require the approval of the DNR in accordance with the Erection of Dams Act of 1963. Finally, the impoundment and utilization of surplus waters in river basin or watershed is regulated by the DNR under the Surplus Waters Act of 1964.

It is clear that the conduct of riparian activities affecting stream flow established prior to the passage of the above-named acts are not subject to scrutinization of State regulatory authorities. In other words, the management of water release from an existing impoundment is not regulated by any known State statutes.

Protection of the River Environment

As mentioned above, there are a number of statutes dealing with the protection of the river environment. These statutes would effect the hydroelectric restoration primarily during the construction phase.

The Inland Lakes and Streams Act of 1972 provides for the issuance of permits from the Michigan Department of Natural Resources for dredging, filling, construction or other activities below the ordinary high-water mark of an inland lake or stream. Dredging, filling or repair of the impoundment at the Peninsular Paper hydroelectric facility would require a permit from DNR.

Any dredging and filling activities in the vicinity of the facility would also require a permit from the U.S. Army Corps of Engineers in accordance with Section 404 of P.L. 92-500. The purpose of the '404' permit program is to maintain water quality by regulating the discharge of dredged or fill materials in inland waters.

SECTION V

SITE HYDROLOGY

GENERAL

The Huron River watershed upstream of the Peninsular Paper Company dam has a drainage area of 801 square miles. Upstream of the dam, the river passes through a series of moraines, till plains and outwash deposits in a topographic setting of rolling to rugged hills with an intermixture of relatively flat areas. This area of the water shed is well drained and consists of large numbers of natural and artificial lakes.

The watershed area consists of several dams and abandoned hydropower plants. Most of these power plants were developed and operated by the Detroit Edison Company between 1905 and 1968. The original Peninsular Paper Company dam dates from the nineteenth century, although the present structure was constructed about 1918. The nearest upstream dam is Superior dam approximately 1.5 miles upriver, having an impoundment of 625 acre-feet. The nearest downstream dam is Ford dam approximately 5.2 miles downriver, having an impoundment of 16,504 acre-feet. The impoundment upstream of the Peninsular Paper Company dam has a surface area of 72 acres and a storage volume of approximately 445 acre-feet.

Stream flow records have been collected at the Ann Arbor Gauging Station by the U.S. Geological Survey since 1904. The gauging station is located approximately seven miles upstream of the Peninsular Paper Company dam and is the closest stream gauging station to the dam. The drainage area at the gauging station is 729 square miles. On the downstream side of the dam isolated flow measurements have been made by the U.S.G.S. at New Boston.

Based on the stream flow records at the Ann Arbor Gauging Station flow-duration data has developed for the Huron River at the Peninsular Paper Company dam site. This data is shown plotted in Figure V-1 (Linear scales) and also in Figure V-2 (semi-log scales). Figure V-3 is "mass diagram" for the site, showing the accumulated water mass as a function of time.

FIGURE V-1
FLOW DURATION CURVE
HURON RIVER @ YPSILANTI (1915-1967)

FLOW DURATION CURVE HURON RIVER @ YPSILANTI (1915-1967)

KE SEMI-LOGARITHMIC
3 CYCLES X 70 DIVISIONS
MADE IN U.S.A.
46 5490
KEUFFEL & ESSER CO.

MASS DIAGRAM HURON RIVER AT PENINSULAR PAPER COMPANY DAM

Flow parameters at Ann Arbor Gauging Station are estimated by U.S.G.S. as follows:

Average Daily Discharge for Period of Records	454 cfs
Maximum Daily Discharge	5,840 cfs
Minimum Daily Discharge	4 cfs
One Year - 30 Day Low Flow	240 cfs
Ten Year - 30 Day Low Flow	50 cfs

Based on the above U.S.G.S. data, and adjusting for the additional drainage area involved, hydrological parameters at the Peninsular Paper Company dam are estimated as follows:

Average Daily Discharge	498 cfs
One Year - 30 Day Low Flow	264 cfs
Ten Year - 30 Day Low Flow	55 cfs

FLOOD MAGNITUDES

Historic flood peaks in the Huron River have been identified by the U.S. Army Corps of Engineers based on seventy-four years of data from the Ann Arbor U.S.G.S. Gauging Station. This data shows the flood of record at this station to have occurred on March 18, 1918, when discharge at the gauging station averaged 5,840 cfs over a 24-hour period.¹

The most severe flood experienced at the French Landing dam site probably occurred in June, 1968, when several days of continual rainfall caused the failure of the upstream Geddes dam (4 miles upstream). On this occasion the discharge at the French Landing dam (18 miles downstream) was estimated to have been about 13,000 cfs.² It is assumed that the loss of storage from Geddes dam contributed in a major way to this condition since records upstream of the failed dam indicate a much lower flood peak.

Flood peaks of various frequencies have been estimated by the Corps of Engineers for the Peninsular Paper Company dam. In addition, flood frequencies were estimated in a Flood Insurance Administration Study by the engineering firm of Johnson and Anderson. A summary of this information is as follows:

	C of E ³	J & A
10-year flood peak (cfs)	NA	4,324
50-year flood peak (cfs)	8,401	6,612
100-year flood peak (cfs)	9,619	7,704
50-year flood peak (cfs)	12,954	10,262

It can be observed that the Johnson and Anderson figures are slightly lower than the Corps of Engineers' figures for the 50 and 100-year peaks, and significantly lower than the Corps' figures for the 500-year peak.

FLOOD OCCURRENCES

Generally, floods in the Huron River occur in greatest frequency from late winter to early spring when heavy rains and melting snow combine with the impervious frozen ground. During this period a consistently high discharge rate is experienced in the Huron River. At other seasons flooding has resulted when high intensity storms are experienced over a previously saturated basin. In that connection, it is worthwhile to note that the U.S. Environmental Protection Agency has shown that 24-hour precipitation from summer rainfall (June-September) is consistently higher than the combined effect of winter rainfall plus snow melt (October-May).⁴ In other words, although the greatest sustained flooding occurs in late winter to early spring, the floods of greatest instantaneous magnitude occur as a result of summer rainstorms.

DAM DISCHARGE RATING

Due to the 240-foot wide fixed crest weir section, the capacity of the dam to pass flood peaks is virtually unlimited.

FOOTNOTES

¹Special Flood Hazard Information Report - Huron River, Corps of Engineers, U.S. Army, Detroit District, 1976.

²Engineering Research Department Report - Huron 69J16, The Detroit Edison Company, 1970.

³Special Flood Hazard Information Report - Huron River, Corps of Engineers, U.S. Army, Detroit District, 1976.

⁴Rainfall-Runoff Relations on Urban and Rural Areas, U.S. Environmental Protection Agency, Cincinnati, Ohio, 1975.

SECTION VI

THEORETICAL POWER POTENTIAL

The value of electricity from a generating station is a combination of gross energy capacity and reliable peak demand capacity. The gross energy capacity represents the total power potential of the site, without regard to the time of production. The reliable demand capacity represents the capability of a given generating station to meet short-term peak demands.

Each of these sources of revenue will be discussed separately below:

GROSS ENERGY CAPACITY

The theoretical hydroelectric power potential at a given dam site is determined entirely by the available water power, or stream discharge. Stream discharge is of course a natural event which is constantly varying, however the variation is in accordance with a highly predictable pattern. When stream discharge is plotted as a probability density or frequency distribution it will characteristically have the appearance of a negatively skewed bell shaped curve, with flood discharges at one extreme and draught discharges at the other extreme. The greater quantitative impact of flood discharges (which theoretically have no upper limit) compared to draught discharges (which are bounded by zero) create the positive skewness and cause the mean discharge to fall well above the median.

For purposes of hydropower analysis, the impact of stream discharge characteristics can be most clearly visualized on a flow-duration curve, which is the cumulative distribution function of the frequency distribution. Stream discharge rate on a vertical axis is plotted against the exceedence percentage along the horizontal axis (that is, the percent of time a given discharge is equalled or exceeded).

The importance of the flow-duration curve for hydropower studies lies in the fact that the area under the curve, or any portion thereof, represents the theoretical water power available at different plant capacities. Figure VI-1 shows this principal more clearly. It illustrates the operating characteristics of a hypothetical run-of-the-river hydropower facility containing a single turbine rated to pass 500 cfs at full load. The area under the

FIGURE VI-1

OPERATING CHARACTERISTICS OF A SMALL
RUN-OF-RIVER HYDROELECTRIC PLANT IN
RELATION TO FLOW DURATION CURVE

KEY

- WATER POWER CONVERTED TO ELECTRICAL ENERGY
- WATER POWER LOST DUE TO MINIMUM FLOW MAINTENANCE
- WATER POWER LOST DUE TO HIGH FLOW

flow-duration curve which lies above the 500 cfs limit represents water which cannot be put through the turbine and therefore must be discharged over the spillway (unless it is possible to store the excess for utilization during subsequent low discharge periods). The area under the 500 cfs line represents water which can be passed through the turbine and therefore converted to electric energy. If the turbine has adjustable gates or runner blades to control output, it can be throttled down as stream flow decreases and essentially follow the curve. At some point, however, turbine efficiency falls to an unacceptably low level and it becomes better to operate the turbine intermittently, letting storage build up until it can be passed at an efficient rate, than to operate continuously at a very low flow. If the impoundment is too small to tolerate this intermittent storage and depletion, the low flows would have to be passed immediately and that potential power would be lost.

On most waterways, there is a necessity to maintain a minimum discharge downstream of the dam, and so a certain amount of water will have to be spilled whenever the turbine is shut down. In Figure VI-1 this is shown as the shaded area below the 100 cfs line.

Economic Considerations

A short study of the flow-duration curve reveals that the rate of increase of usable water power decreases with the installed generating capacity of the facility. Above draught flows (i.e., 100 percent exceedence), each unit of production which is added to the facility is able to be utilized for a smaller proportion of time (ignoring the effect of storage).

The table below illustrates this by showing the effective (i.e., average utilized) capacity of different sized plants at the Peninsular Paper Company dam site. It can be observed that the incremental effective capacity decreases with each increment in plant size. The first 100 kW of production capacity will be utilized 96% of the time, whereas the last 200 kW increment (i.e., between 700 and 900 kW) will be utilized only 12.5% of the time.

Installed Capacity (kW)	100	300	500	700	900
Avg. Utilized Capacity (kW)	96	228	287	326	351
Increment (kW)	96	132	59	39	25
Utilization of Increment	96%	66%	30%	20%	12.5%

The consequence of this phenomenon on the economics of a small run-of-the-river hydroelectric plant cannot be overemphasized. Since project costs increase with plant capacity, and the proportion of effective power decreases with capacity, the benefit/cost ratio is strongly affected by facility size.

Above a given point the benefits from increased capacity decrease drastically due to the rapid drop in flow-exceedence values. Of course project costs do not increase linearly with capacity. If this were the case the benefit/cost ratio would constantly decrease and the optimum plant would be sized for the 100 percent exceedence discharge. Hydropower facilities, even at existing dam sites, have large civil and structural costs which must be borne regardless of the size of the generating equipment. Consequently, the optimum plant capacity becomes that which generates sufficient revenue to optimally amortize the initial civil and structural costs, plus the variable costs associated with equipment capacity.

Figure VI-2 illustrates this principal by means of a conceptual model of hydroelectric facility economics. This graph represents the theoretical relationship of projects costs, revenues, and benefit/cost ratios, as a function of plant size (i.e., installed capacity). The curve representing civil and structural works cost starts at a fairly high initial level; however small the production capacity, there are certain necessary expenses related to dam refurbishment and powerhouse construction. As the size of the facility increases the marginal cost of civil and structural expenses becomes smaller and the curve flattens out.

The equipment cost curve starts at a low initial level and rises as the size of the facility increases, at a rate slightly less than proportional. The project revenue curve starts at zero, increases sharply as the lower stream flows are utilized, and then becomes quite flat as the water power potential at the site begins to be fully utilized.

For the project to be cost-effective, the revenue curve must at some point be higher than the project cost curve. The point at which there is the greatest positive differential between the project revenue and cost curves represents the optimum facility size.

It is worth noting, as shown on the benefit/cost curve on Figure VI-2, that there may be a range extending above and below the optimum which still will yield an acceptable return from an investment standpoint.

FIGURE VI-2

CONCEPTUAL MODEL OF HYDROELECTRIC
FACILITY ECONOMICS

FIGURE VI-5
RATE OF CHANGE IN UPSTREAM LEVEL VS DAM DISCHARGE DIFFERENTIAL
PENNINSULAR PAPER CO.

PEAK DEMAND CAPACITY

The potential value of a hydropower facility is a function of demand or peaking capacity as well as aggregate energy production. If a given plant can be operated so as to reliably offset peak demands from more costly energy sources the potential value of the plants contribution to the grid will be far greater than an equivalent amount of energy generated erratically.

This situation is reflected in many utility rate agreements by the inclusion of demand capacity charges. Demand capacity charges to electric consumers under Detroit Edison's Primary Supply Rate Agreement, for example, include two components:

1. a charge of \$5.80 per kW per month for the "monthly on-peak billing demand", defined as the average of the four weekly highest 30-minute demands during on-peak hours.
2. a charge of \$1.50 per kW per month for the "maximum demand", defined as the highest 30-minute demand created during the previous 12 months.

Reliable demand capacity at a given dam site is a function of 1) the capacity of the impoundment reservoir, and 2) stream discharge characteristics. The capacity of the impoundment reservoir establishes how much deviation is permissible between natural hydrological runoff and hydroplant discharge. Depending on the size of the reservoir it may be possible to modify hydroplant discharge on daily, weekly, or seasonal bases, by controlled storage and depletion. The limiting factor is the permissible amount and rate of change of headwater levels between storage and depletion cycles.

The second source of demand capacity is natural stream discharge. Even in the absence of any significant upstream impoundment, the stream discharge characteristic itself may be high enough to be relied upon for demand capacity. Each of these two sources of demand capacity is discussed separately below.

Demand Capacity Due to Storage

Figure VI-3 shows the effect on the upstream impoundment level due to varying dam

discharge differentials (i.e., the difference between natural hydrological runoff and the rate of discharge through the dam) at the Peninsular Paper Company dam site. It can be seen that the 72-acre impoundment is very sensitive to changes in discharge differentials.

As an example, we can calculate the effect on impoundment level due to the maintenance of a 200 kW firm capacity for eight hours each day, during a 10-year, 30-day low flow. Natural runoff during such a period is estimated to be only 50 cfs (Section V). Discharge required to generate 200 kW at the site is approximately 222 cfs. A mass balance equation for this situation over a 24-hour period will be as follows:

$$\begin{aligned} & 50 \text{ cfs over 24 hours minus 222 cfs over 8 hours} \\ & = 4.3 \text{ M cubic feet} - 6.4 \text{ M cubic feet} \\ & = 2.1 \text{ M cubic feet} \\ & = 47.6 \text{ acre-ft} \end{aligned}$$

A 47.6 acre-ft depletion from a 72-acre storage will cause a drop in impoundment level of approximately 8 inches. Obviously, this is an unacceptable variation for a 24-hour period.

As a result of this analysis we conclude that the volume of storage above the Peninsular Paper Company dam is not sufficient to be relied upon for firm peaking capacity.

Demand Capacity Due To Natural Stream Flow

Table VI-1 illustrates the development of projected monthly peak demand capacities at the Peninsular Paper Company dam site, based on records of average monthly stream discharge, for plants having installed capacities of 100, 300, 500 and 700 kW. These are, of course, average values; during some months or years the estimates might not be reached and during others months or years they might be exceeded, but over the long term they should hold true.

It can be noted that the average demand capacity is a function of the installed capacity of the hydro plant; as the rating of the equipment is increased a greater proportion of available stream flow can be utilized for electric generation during high flow months. The table below summarizes this situation.

TABLE VI-I
AVERAGE MONTHLY DEMAND CAPACITY
OF HYDRO PLANT BASED ON STREAM FLOW

	Average Stream Flow (cfs)	Equivalent Generating Potential (kW)*	Average Demand Capacity With Alternative Installed Capacities			
			100 kW	300 kW	500 kW	700 kW
January	514	463	100	300	463	463
February	602	542	100	300	500	542
March	923	831	100	300	500	700
April	936	842	100	300	500	700
May	649	584	100	300	500	584
June	370	333	100	300	333	333
July	241	217	100	217	217	217
August	178	160	100	160	160	160
September	196	176	100	176	176	176
October	273	246	100	246	246	246
November	389	350	100	300	350	350
December	<u>462</u>	<u>416</u>	<u>100</u>	<u>300</u>	<u>416</u>	<u>416</u>
Average	478	430	100	267	363	407
Minimum (Annual Demand)	178	160	100	160	160	160

VI-9

*Equivalent generating potential is based on units having 80% average operating efficiency.

Installed Capacity (kW)	100	300	500	700	900
Average Monthly Demand Capacity	100	267	363	407	430
Increment	100	167	96	44	23
Utilization of Increment	100%	84%	48%	22%	11.5%

Just as was the case with gross energy production, the proportional increase in demand capacity decreases with each increment in plant size. The first 100 kW of production capacity will theoretically develop 100 kW average demand capacity, whereas the last 200 kW increment (between 700 and 900 kW) will develop only 11.5% monthly demand capacity.

The last row of numbers on Table VI-1 is the minimum projected monthly demand during a 12-month period. It is basically the smallest number in the column of numbers representing projected month-by-month demand capacity and corresponds to the annual peak demand capacity.

SECTION VII ELECTRIC ENERGY UTILIZATION

TYPE OF INTERCONNECTION

The close proximity of the paper company to the hydroelectric plant makes it possible for the paper company to be served directly from the hydroelectric facility. Such an arrangement would permit the paper company to realize the greatest possible revenue from the facility since production from the hydro plant would directly offset electric power that would otherwise be purchased from the local utility, the Detroit Edison Company, at a premium retail rate.

At the present time the paper company purchases electric power from Detroit Edison under a primary supply rate. The monthly charge, based on schedules put into effect in September, 1978, is computed as follows:

Service Charge:

\$175.00 per month

Demand Charge:

\$5.80 per kW for on-peak billing demand (for previous month)

\$1.50 per kW of maximum demand (for previous year)

Energy Charge:

2.0¢ per kWh for all on-peak energy

1.7¢ per kWh for all off-peak energy

On-peak hours for purposes of this rate are between 1100 and 1900 hours each Monday through Friday, excluding holidays.

The energy charge is subject to a fuel and purchased power adjustment which in March, 1978, was 0.301¢ per kWh.

Customers receiving power from Edison under the primary rate agreement are permitted to receive power from an alternate and independent source of energy under Edison's

"Standard Contract Rider No. 3". Under the provisions of this rider, a primary customer receiving partial service from an independent generating source is subject to a service charge of \$1.75 per month per kilowatt capacity of the alternate source, in addition to the charges for electric service taken under the primary rate schedule. Essentially, this surcharge is intended to recompense the utility for capital costs for providing standby capacity in the event the alternate source of power becomes unavailable.

(Note: Copies of the relevant Detroit Edison rate sheets are included in the Appendix.)

In a letter dated January 11, 1979, Detroit Edison Company, through their Major Industrial Accounts Department, confirmed that parallel services from the hydroelectric plant and their system would be acceptable under the provisions of rider No. 3. They noted that the paper company is presently serviced at 4800 volts, three phase, through a utility-owned main oil circuit breaker feeding the customers 4800 volt bus. It was suggested that the hydroelectric plant be directly connected to the 4800 volt bus through a new customer-owned circuit breaker and that the existing Edison breaker be replaced with a new customer-owned breaker. Relaying would be required in each breaker to provide coordinated protection with downstream interrupting devices and also to prevent a fault in one source from affecting the alternate system. (A copy of the Detroit Edison letter is included in the Appendix.)

It is worth noting that this suggested method of interconnection is far more elaborate and costly than that which was used prior to the decommissioning of the hydroelectric plant in 1971. At that time the output from the hydro plant was fed directly into Detroit Edison's 4800 volt distribution system through a simple overhead connection on a utility pole adjacent to the powerhouse (see Figure VII-1). Electricity fed into the Edison system from the hydro plant was metered and credited against power consumed by the paper company through their service connection on the other side of the river. By this arrangement the utility was essentially permitting the paper company to use their distribution system as a sink for power, rather than requiring the installation of a redundant 4800 volt circuit from the hydro plant to the paper company main bus. Such an interconnection was only a fraction of the cost of the system currently suggested by the utility and in addition had some real benefits with respect to voltage drop, frequency regulation, and breaker coordination. If hydroelectric development is pursued at the Peninsular Paper Company

FIGURE VII-1
COMPARISON OF PAST HYDRO-PLANT INTERCONNECTION
WITH THAT PRESENTLY SUGGESTED BY DETROIT EDISON

INTERCONNECTION PRIOR
TO 1971 DECOMMISSIONING

SUGGESTED FUTURE
INTER-CONNECTION

site we would recommend that the method of interconnection be considered more fully and an attempt be made to persuade the utility to allow the type of connection which was used previously.

In the Edison Company letter referred to above the utility stated that any excess of hydroelectric generation over paper company demand would be allowed to flow back into the Edison distribution system and would be credited at a flat rate of 1.0¢ per kWh.

PAPER COMPANY ELECTRIC DEMAND CHARACTERISTICS

Daily Demand Cycle: Typically the paper company operates for three shifts per day, with the exception of Sundays and holidays. Table VII-1 presents estimates of the average electric demand in the paper mill during each of the three 8-hour production shifts, based on the items of equipment which are actually in use. The average demand of 1173 kilowatts is well above the average electric generating potential at the dam site, which is about 416 kilowatts. It can be observed that there is a great deal of stability in the demand during a 24-hour production period. The total variation between the highest and lowest shift demand is only 217 kilowatts, or about 18 percent of average demand.

Weekly Demand Cycle: The last column in Table VII-1 gives the average electric demand in the paper mill on Sundays and holidays, 170 kilowatts. Although this demand cannot be directly attributed to specific pieces of equipment, it has been periodically monitored and is a reliable figure. It is apparent that any hydro plant design having more than 170 kilowatts installed capacity will generate more electricity on Sundays and holidays than the paper mill can consume. Table VII-2 develops estimates of the annual amount of hydroelectric plant output which would exceed the paper company's demand requirements on Sundays and holidays, for various size plants. It can be noted that the amount of "excess" generation increases with an increase in installed capacity, both in terms of total energy and on a percentage basis. A 700 kilowatt plant, for example, would be expected to generate about 225,000 kilowatt-hours each year that could not be consumed by the paper mill, due to Sunday and holiday shut down. This represents energy which would be fed back into the Edison system at a credit of 1.0¢ per kilowatt-hour. Obviously, since this rate is much lower than the average retail value of energy to the paper company, it is desirable to minimize excess generation by keeping installed capacity no larger than necessary.

TABLE VII-I
TYPICAL PAPER MILL DAILY LOAD CYCLE

Equipment	Average Electrical Demand (kW)			
	1st Shift	2nd Shift	3rd Shift	Sunday/Holidays
No. 1 Paper Machine and Beater Room	542	542	542	
Broke System	367	367	367	
No. 2 Pulper and Pump	54	54	54	
Starch System	1	1	1	
Water and Sewage	51	51	51	
Boiler	44	44	44	
Lighting	37	37	37	
Finishing	16	16	0	
Processing	120	0	0	
Miscellaneous	<u>81</u>	<u>0</u>	<u>0</u>	
TOTAL	1,313	1,112	1,096	170

TABLE VII-2

HYDRO PLANT OUTPUT EXCEEDING PAPER COMPANY DEMAND DURING PERIODS OF NON-PRODUCTION
(SUNDAYS & HOLIDAYS FOR VARIOUS SIZE PLANTS)

Hydro Plant Installed Capacity (kW)	100	300	500	700	900
Average Utilized Capacity (kW)	96	228	287	326	351
Average Non-Production Demand (kW)	170	170	170	170	170
Differential (kW)	-74	+58	+111	+156	+181
Annual Excess (kWh)	0	84,000	160,000	225,000	261,000
Total Annual Output (MkWh)	0.8	2.0	2.5	2.9	3.1
% Excess	0	4.2	6.4	7.7	8.4

NOTE: Annual excess production based on 60 non-production days per year.

Seasonal Demand Cycle: Figure VII-3 shows the pattern of monthly electric consumption by the paper company during a recent 12-month period, based on data from utility invoices. It can be observed that there is a great deal of regularity in both on-peak and off-peak energy consumption, as well as monthly peak demand capacity.

Figure VII-4 illustrates the relationship between the paper company's total monthly energy consumption and the projected monthly production from hydroelectric plants of 100, 300, 500 and 700 kilowatt installed capacities. It can be noted that, the projected output from all plants up to 700 kilowatts will be less than the paper company's consumption.

Conclusion: There is a great deal of stability in the paper company's electric consumption pattern, on daily, weekly and seasonal bases. Average consumption and demand are well above the expected output from the hydroelectric plant. The only times during which the hydroelectric plant would be expected to generate more electricity than could be consumed by the paper mill are Sundays and holidays, when production in the paper mill is shut down. The total excess generation on these days is dependent upon the installed generating capacity of the hydro plant, but would probably average only about 5 percent. This excess represents energy that would be fed into the Detroit Edison system at the unfavorable rate of 1.0¢ per kilowatthour.

PATTERN OF MONTHLY ELECTRICAL ENERGY CONSUMPTION
PENNSULAR PAPER COMPANY

FIGURE VII-3

FIGURE VII-4

RELATIONSHIP BETWEEN PAPER COMPANY'S 1977/78 MONTHLY ELECTRIC CONSUMPTION AND THE PROJECTED MONTHLY PRODUCTION FROM HYDROELECTRIC PLANTS OF 100KW, 300KW, 500KW AND 700KW SIZES.

SECTION VIII

EQUIPMENT DESIGN ALTERNATIVES

Four key elements were identified as forming the basis of a conceptual design for the development of the Peninsular Paper Company hydroelectric plant. In their order of importance, these elements are as follows:

1. Type of hydraulic turbine(s)
2. Size of turbine(s)
3. Number of generating units
4. Type of generator(s)

These elements were systematically investigated as described below, and ultimately formed the basis for the seven project alternatives analyzed in Sections IX and X, Project Design Alternatives and Project Financial Feasibility.

TYPE OF TURBINES

In order to make the scope of the feasibility study as comprehensive as possible it was decided to investigate four hydraulic turbine design alternatives:

- vertical
- bulb
- tubular
- cross-flow (Ossburger)

Although it might appear that vertical turbines would prove to be the most cost effective, since this was the type of unit for which the facility was originally designed, we were interested in determining not only the best design, but the relative merits of competing designs. Conceivably, differences in equipment costs or operating efficiencies (either now or in the future) might overcome the extra structural cost burden that non-vertical turbine designs would have to carry.

Manufacturers/Costs

Proposals were solicited from eleven U.S., Canadian, European and Japanese hydraulic turbine manufacturers for equipment to develop the Peninsular Paper Company site. Each solicitation asked for a proposal based on one of the four types of turbines identified above. It was suggested that the proposals be based on two (2), 300 kW units having adjustable gates or blades to permit the variation of output with stream flow, however, it was requested that an alternative size or type be proposed if the manufacturer felt it would be more cost-effective based on his interpretation of site characteristics. A "fact sheet" was included with each solicitation which provided a summary of site hydrology and cross-sectional and plan views of the existing powerhouse. (A copy of a typical solicitation is included in the Appendix.)

Table VIII-1 summarizes the responses to the solicitations. Of the eleven solicitations that were made, a total of five proposals were actually received. Of the six manufacturers who did not submit a proposal, two stated that the site was too small to suit their equipment.

The five turbine proposals that were received included two based on vertical units, one based on bulb units, one based on tubular units and one based on cross-flow (Ossburger) units.

It proved to be quite difficult to make direct cost comparisons between the various proposed units. Not only did the rating of the units vary, but the proposals varied greatly in terms of the amount of auxiliary equipment included with the turbines. One of the proposals was for turbines only, two were for turbines and drive systems (i.e., shafts, thrust bearings and gear drives), and two were for complete "packages" including turbines, drive systems, generators and electrical equipment. After making estimated adjustments to bring the systems to a common basis composed of turbines and drive systems, the costs appear as follows:

TABLE VIII-I

NAME & LOCATION OF MANUFACTURER	NUMBER/SIZE/TYPE REQUESTED	NUMBER/SIZE/TYPE PROPOSED	ESTIMATED COST	COMMENTS
Allis Chalmers York, Pennsylvania	2/300kW/tubular	2/400kW/tubular	\$864,000	including generators, governors, controls (complete package)
Ateliers Des Charmilles Geneva, Switzerland	2/300kW/bulb	no proposal	---	---
Bofors-Nohab, Inc. Trollhattan, Sweden	2/300kW/vertical	2/300kW/vertical	\$367,000	w/o governor, generators, F.O.B. factory
Dominion Engineering Works, Ltd. Montreal, Canada	2/400kW/vertical	no proposal	---	site too small to suit mfr's equipment
Escher Wyss, Inc. Zurich, Switzerland	2/400kW/bulb	no proposal	---	site too small to suit mfr's equipment
Fuji Industries Corporation New York, N. Y.	2/750kW/bulb	no proposal	---	---
Hitachi America, Ltd. Chicago, Illinois	2/750kW/vertical	no proposal	---	---
James Leffel & Company Springfield, Ohio	2/300kW/vertical	2/340kW/vertical	\$184,000	w/o governors, generators, F.O.B. factory
KMW Kristinehamn, Sweden	2/750kW/tubular	no proposal	---	mail delayed
Neyrpic Groupe Hydraulic Grenoble, France	2/300kW/bulb	1-126-kW, 1-163kW, 1-232kW/bulb	160,000 160,000 196,000 516,000	fixed blade-not including generators
Stapenhorst, Inc. Pointe Claire, Canada	Ossburger (radial, cross-flow)	2/192kW/radial	\$489,000	2 turbines/1 gen. (complete package)

SUMMARY OF PROPOSALS
FROM TURBINE MANUFACTURERS
FOR REFURBISHMENT OF THE PENNINSULAR PAPER
HYDROELECTRIC PLANT

<u>Manufacturer</u>	<u>No/Type Turbines</u>	<u>Total Capacity</u>	<u>Total Cost</u>	<u>Cost/kW</u>
Allis-Chalmers	2 tubular	800 kW	\$684,000	\$ 855
Bofors-Nohab	2/vertical	600 kW	\$367,000	\$ 612
Leffel	2/vertical	680 kW	\$240,000	\$ 375
Neyrpic	3/bulb	521 kW	\$516,000	\$ 990
Stepenhorst	2/cross-flow	385 kW	\$400,000	\$1,039

It can be observed that there is great variation both in terms of total cost and cost/kW, although the degree of variation is greatly reduced if the Leffel unit is excepted. The Leffel Company proposal is by far the lowest in cost. This manufacturer has been in business for over 100 years and utilizes cast iron turbine designs which date back in some cases to the early 1900's. The effect of these older designs shows up in the efficiency ratings. Although the peak efficiency of the Leffel machines is comparable to that of new units (about 90%), the efficiency falls off much more rapidly with decreasing flows. At 50% rated flow, for example, the Leffel turbines will be operating at about 70% efficiency whereas newer machines will be operating at about 85% efficiency. This is not to suggest, of course, that the Leffel machines might not yet be optimum at a given site, including this one.

Structural Modifications to Retrofit New Turbines

A structural analysis was conducted to determine the optimum method, and associated cost, of adapting each of the three turbine designs (vertical, bulb, tubular) to the existing dam site. The critical parameter proved in each case to be the maximum allowable draft head that was required for proper submergence (i.e., the maximum setting of the runner centerline in relation to tail water elevation). This information was readily available from manufacturers. Typical figures for each type of turbine are as follows:

- vertical (Bofors-Nohab): maximum 4.0 meters above low tail water
- bulb (Neyrpic): minimum 0.5 meters below low tail water
- tubular (Allis Chalmers): maximum 1.0 meter above low tail water
- cross-flow (Stepenhorst): maximum 4.0 meters above low tail water

Figures VIII-1, 2 and 3 illustrate the suggested methods of adapting the vertical, bulb and cross-flow turbines to the site within the draft head requirements cited above. The vertical turbine design was based upon placement in the existing powerhouse, following repairs and refurbishment. The bulb and cross-flow designs were based upon new powerhouses, structurally adapted to the existing concrete spillway.

The estimated cost for making the structural modifications identified in figures VIII-1, 2 and 3 are as follows:

Vertical (2 units)	\$ 94,000
Bulb (2 units)	\$120,000
Cross-flow (2 units)	\$ 80,000

These estimates include all work required to place the new turbine(s) in the settings shown, but not mechanical assembly of the units themselves.

SIZE OF TURBINES

Benefit/Cost Analysis

In Section VI we discussed the relationship between the installed capacity of a "run-of-the-river" hydroelectric plant and total energy production. It was stated that due to stream flow characteristics, as defined by the flow-duration curve, each increment of plant capacity returns a smaller marginal amount of total energy. This is due to the fact that the higher magnitudes of stream flow which would utilize the additional generating capacity are available an ever-decreasing proportion of time.

Presumably, if project costs and the flow duration curve could be defined in precise mathematical expressions, it would be possible to determine the optimum plant capacity at any given site, or even to define a range of acceptable capacities based upon different investment criteria. The flow-duration curve, however, because it is based on a succession of natural events which do not fit a known statistical distribution, does not lend

FIGURE VIII-2
SUGGESTED METHOD OF ADAPTING A BULB TURBINE
TO THE EXISTING PENINSULAR PAPER COMPANY DAM SITE

SECTION

FIGURE VIII-3
SUGGESTED METHOD OF ADAPTING A CROSS-FLOW TURBINE
TO THE PENINSULAR PAPER COMPANY DAM SITE

itself to a precise mathematical expression. As a consequence an approximation technique must be used. The approximation technique which we have chosen involves the calculation of incremental benefit/cost ratios for specific alternate plant capacities. By noting the effect of plant size on the incremental benefit/cost ratio it is possible to identify the range of greatest cost-effectiveness and thereby be able to define a project which will have the best chance of being able to pay for itself.

(Note: It should be observed that the optimum plant capacity may not necessarily be the preferred design capacity. Depending upon the economic factors present in each particular case, a facility which is larger or smaller than the optimum may yet render an acceptable rate of return from an investment standpoint, though not the optimum.)

Table VIII-2 summarizes the results of such an analysis based on two capacity alternatives using James Leffel Company vertical turbines.

It can be seen that as the size of the facility is increased the effective capacity (which corresponds to the area under the flow-duration curve) becomes a smaller fraction of the installed capacity. Moreover, the increment in effective capacity, as a fraction of the increment in installed capacity, falls off even more dramatically. For example, the first 340 kilowatts of generating capacity added to the site creates an effective capacity of 234 kilowatts (69% utilization), whereas the next 340 kilowatts contributes only 69 kilowatts of effective capacity (20% utilization).

The average monthly and annual demand capacity of each facility, which is based upon firm generating capacity as determined from seasonal stream flow variations, also exhibits a falling off with each increment in installed capacity.

The figures for projected annual revenues are based on energy and demand valuation as defined in Detroit Edison's primary rate agreement.

Project cost increments are based upon figures presented in Section IX. It can be observed that project cost increments start out very high and then drop precipitously. This is due to the fact that the relatively fixed civil and structural works costs are borne most heavily by the initial increment in capacity (see Section Vi).

TABLE VIII-2
INCREMENTAL BENEFIT/COST ANALYSIS OF PLANT CAPACITY ALTERNATIVES
BASED ON LEFFEL COMPANY VERTICAL TURBINES

	1 Unit	2 Units
Installed Capacity (kW)	340	680
Average Utilized Capacity (kW)	234	303
Projected Annual Production (MkWh)	2.1	2.7
Average Peak Monthly Capacity (kW)	293	404
Average Annual Capacity (kW)	178	178
Projected Annual Revenue		
Energy	42,400	54,900
Monthly Capacity	20,400	28,100
Annual Capacity	3,200	3,200
Standby Surcharge	<u>(7,140)</u>	<u>(14,300)</u>
Total	58,900	71,900
Estimated Project Cost	452,000	708,000
Revenue Increment	58,900	13,000
Project Cost Increment	452,000	256,000
Benefit/Cost Ratio	0.13	0.05

Conclusion

The last line of figures in Table VIII-2 gives the incremented benefit/cost ratio for each capacity alternative, defined as the revenue increment (benefit) divided by the project cost increment (cost). It can be seen that the benefit/cost ratio drops precipitously in going from the 340 kW design to the 680 kW design.

NUMBER OF GENERATING UNITS

The number of turbine/generating units installed at a given site has an effect on the reliability, efficiency and operating range of the facility.

Reliability: The impact on reliability is obvious and straightforward. As more units are added to a site, the firm generating capacity increases. At small sites this is especially significant since a two-unit facility may not be preferable to a one-unit facility for other reasons. We did, in fact, find that the most cost-effective alternative at the Peninsular Paper Company site, without taking reliability into account, was the one-turbine alternative.

If a facility is going to be an adjunct supplier to a utility grid, and produce revenue based strictly on gross energy output, then there is little point in placing a high premium on reliability and a one-unit design may be entirely adequate.

Efficiency: If a given run-of-the-river hydroelectric plant contains a single large generating unit then it follows that the unit will be required to operate over a broad stream flow range. Since turbine efficiency drops off with decreasing flow, the unit will tend to be operated at the lower overall efficiency, as compared to a site having multiple units with smaller ratings which could be placed on and off stream in stages.

Rangeability: As a turbine is throttled down to keep pace with declining stream flow, a point will eventually be reached where it becomes more sensible to take the unit off stream than to tolerate excessively low efficiency. Obviously, this point will be reached much sooner for a single large turbine than for two smaller turbines.

TYPE OF GENERATORS

Alternatives concerning generator selection included:

1. whether to utilize synchronous or asynchronous (induction) machines
2. whether to utilize specially fabricated low speed machines, directly connected to the turbine shafts, or standard speed machines driven through speed increasers.

Generator Design

Concerning the first point, it was recognized that if the output from the plant was to be connected to a sizable utility grid, the capacity or "stiffness" of the grid could be relied upon for speed regulation. The generators could be essentially operated as overdriven induction motors. Such machines would not require external excitation or the elaborate and costly speed controls that would be needed on a synchronous machine.

At the Peninsular Paper Company site the hydroelectric plant would serve the paper company in parallel with the normal utility service. Although this arrangement would not theoretically prohibit the use of induction generators it would create two major problems:

- the hydroelectric plant would be dependent on the utility system (i.e., it could not be operated without utility power)
- the excitation energy required by the induction machines would be contributed by the utility system (in the form of an adverse power factor), which would be objectionable.

In view of these problems it was decided to base the design for the Peninsular Paper Company hydroelectric plant on the use of synchronous generators.

Generator Speed

An investigation was made to determine the relative cost of using specially fabricated low speed generators, directly connected to turbine shafts, or standard speed generators driven through speed increasers. Equipment cost estimates were obtained from

manufacturers of generators, speed increasers, and thrust bearings. Copies of these estimates can be found in the Appendix. Cost comparisons showed that the alternative of using speed increasers with the higher speed generators is slightly less costly than using low speed machines. Although the higher speed generators are substantially less expensive than the specially fabricated low speed units, the cost of separate thrust bearings and speed increasers virtually cancel the differential. Moreover, the speed increasers would create about a 2 percent power loss, and add to the maintenance burdens.

In view of the above we are inclined to favor the use of a low speed directly-driven vertical generator, although the economics of the project would not be significantly affected either way.

SECTION IX

PROJECT DESIGN ALTERNATIVES

Based on the analysis of the key design elements presented in the proceeding section, seven specific project alternatives were selected for detailed evaluation. In order to make the analysis as comprehensive as possible a set of alternatives were defined which included equipment by different manufacturers, different types of turbine design, and different plant capacities. It was hoped that such a comprehensive approach would make it possible not only to identify the best overall design, but to be able to see how sensitive project performance and economic factors would be to changes in these design parameters.

SUMMARY OF PROJECT DESIGN ALTERNATIVES

Table IX-1 presents an overall summary of costs and operating characteristics for seven design alternatives for recommissioning the Peninsular Paper Company hydroelectric plant.

An explanation of terms used in the Table is given below:

- "Project Cost," as used here, is defined as the total non-discounted sum of money (based on 1978 prices) required to take the French Landing dam site from its present condition to an operational hydroelectric plant, plus a contingency fund for reasonable unanticipated expenses. No effort was made to identify construction costs in terms of discounted cash flow, although it can be assumed that for a construction project of this duration (i.e., approximately two years) the discounted construction cost would be approximately 15% less than the totals shown.
- "Installed Capacity" is the maximum generating potential of the plant with all units operating at full rated load.
- "Effective Average Capacity" is the projected average production capacity of each alternative, taking account of the stream flow characteristics in the Huron River at the Peninsular Paper Company dam site.

TABLE IX-1
SUMMARY OF DESIGN ALTERNATIVES
FOR HYDROELECTRIC DEVELOPMENT AT
THE PENINSULAR PAPER COMPANY DAM SITE

	James Leffel & Co. 1-340 kW Vertical	James Leffel & Co. 2-340 kW Vertical	Neyrpic, Inc. 1-126 kW Bulb	Neyrpic, Inc. 1-126 kW & 1-163 kW Bulb	Stapenhorst, Inc. 1-193 kW Cross-flow	Stapenhorst, Inc. 2-193 kW Cross-flow	Allis-Chalmers 1-400 kW Tubular
Estimated Project Cost (X1000)	\$ 452	\$ 708	\$ 447	\$ 809	\$ 493	\$ 756	\$ 795
Installed Capacity (kW)	340	680	126	289	193	386	400
Effective Average Capacity (kW)	234	303	119	219	164	258	262
Utilization Factor	69%	45%	94%	76%	85%	67%	66%
Cost/Installed kW	\$ 1,330	\$ 1,040	\$ 3,550	\$ 2,800	\$ 2,554	\$ 1,960	\$ 1,990
Cost/Effective kW	\$ 1,930	\$ 2,340	\$ 3,760	\$ 3,690	\$ 3,006	\$ 2,930	\$ 3,030
Projected Annual Production (MkWhr)	2.1	2.7	1.0	1.9	1.4	2.3	2.3
Average Monthly Demand Capacity (kW)	293	404	126	240	164	316	324
Average Annual Demand Capacity (kW)	178	178	126	178	164	178	178
Projected Annual O&M Expense	\$15,600	\$19,900	\$16,100	\$20,900	\$18,100	\$22,900	\$21,100
O&M Cost/kWhr Produced	0.74¢	0.74¢	1.61¢	1.10¢	1.29¢	1.00¢	0.92¢

- The "Utilization Factor" is the ratio of the effective average capacity to the installed capacity and expresses the utilization of generating equipment. It can be seen that the alternatives which have higher installed capacities have lower plant factors.
- "Cost/Installed kW" and "Cost/Effective kW" are self explanatory.
- "Projected Annual Production" is the gross annual energy production of each alternative, based on the effective average capacity.
- "Average Monthly Demand Capacity" is the monthly electric demand (as defined in Detroit Edison's primary rate agreement) which can be offset by the hydroelectric plant, based on average monthly stream flow (see Section VI).
- "Average Annual Demand Capacity" is the annual demand (as defined in Detroit Edison's primary rate agreement) that can be offset by the hydroelectric plant (see Section VI).
- "Projected Annual O&M Expense" is the estimated annual cost of operating and maintaining the facility (including structural components) and is based upon the figures presented in at the conclusion of this section.
- "O&M Cost/kWh Produced" is self explanatory. The figures are relatively high, due to the small scale of the Peninsular Paper Company hydro facility compared to other hydroelectric plants.

CONSTRUCTION COSTS

The construction cost estimates for the seven project design alternatives are presented in an Itemized fashion in Tables X-2 through X-8.

OPERATION AND MAINTENANCE COSTS

The operation and maintenance costs appearing in Table IX-1 are based upon the following assumptions:

1. 365 hours per year operating labor expense (assumes automatic and/or remote supervisory control of the plant with a daily visit by a "mobile" operator)
2. 80 hours labor per generating unit per year for equipment maintenance
3. 2% of equipment cost per year for maintenance parts and materials (based on a comparison with maintenance costs for water and wastewater treatment facilities)
4. Dam and building structural maintenance costs based on engineer's estimates presented in Section III.
5. Annual insurance expenses of \$2000.

Labor expense for operation and maintenance was calculated at \$20 per hour.

NOTES TO PROJECT COST ESTIMATES
(Tables IX-2 thru IX-8)

- 1) Turbine and generator prices are based upon quotations from manufacturers (see copies in Appendix).
- 2) Other equipment prices are based upon manufacturers quotations or published list prices.
- 3) Estimate of labor for installation of power producing equipment is based upon 20% of equipment costs, which is typical for heavy equipment items.
- 4) Equipment shipping charges are figured at 5% of equipment costs for U.S. manufactured items, and 10% of equipment cost for non-U.S. manufactured items.
- 5) Import duty is figured at 7% of equipment cost for all non-U.S. manufactured items.
- 6) Consultant fees are estimates based on similar services on comparable projects. Engineering services are assumed to extend through construction and startup.

TABLE IX-2
PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE

ALTERNATIVE NO. 1: One (1) Leffel Company vertical unit in Existing Powerhouse

POWER PRODUCING EQUIPMENT

Turbine(s) (vertical, propeller type, 340 KW, with gates)	\$ 92,000
Drive System(s) (gear drives, thrust bearings)	28,000
Governor(s)	20,000
Generator(s)/Exciter(s)	35,000
Electrical Switchgear/Controls	<u>30,000</u>
	\$ 205,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT 10,000

INSTALLATION OF POWER PRODUCING EQUIPMENT 41,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 94,000
Radial gate/dam repairs	<u>16,000</u>
	\$ 110,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 0
Electrical interconnection to Paper Company	<u>17,000</u>
	\$ 17,000

ENGINEERING \$ 31,000

CONGINGENCIES \$ 38,000

TOTAL ESTIMATED PROJECT COST \$ 452,000

TABLE IX-3

PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE

ALTERNATIVE NO. 2: Two (2) Leffel Company Vertical Units in Existing Powerhouse

POWER PRODUCING EQUIPMENT

Turbine(s): (vertical, propeller type, 340 KW, with gates)	\$ 184,000	
Drive System(s) (gear drives, thrust bearings)	56,000	
Governor(s)	40,000	
Generator(s)/Exciter(s)	70,000	
Electrical Switchgear/Controls	<u>30,000</u>	\$ 380,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT 17,000

INSTALLATION OF POWER PRODUCING EQUIPMENT 76,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 94,000	
Radial gate/dam repairs	<u>16,000</u>	\$ 110,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 0	
Electrical interconnection to Paper Company	<u>17,000</u>	\$ 17,000

ENGINEERING 48,000

CONGINGENCIES 60,000

TOTAL ESTIMATED PROJECT COST \$ 708,000

TABLE IX-4

PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE

ALTERNATIVE NO. 3: One (1) Bulb Unit by Nyerpic, Inc.

POWER PRODUCING EQUIPMENT

Turbine(s): (one fixed blade unit rated 126 KW)	\$ 160,000	
Drive System(s) (gear drives, thrust bearings)	incl.	
Governor(s)	N.A.	
Generator(s)/Exciter(s)	23,000	
Electrical Switchgear/Controls	<u>15,000</u>	
		\$ 198,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT

28,000

INSTALLATION OF POWER PRODUCING EQUIPMENT

40,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 0	
Radial gate/dam repairs	<u>16,000</u>	
		\$ 16,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 80,000	
Electrical interconnection to Paper Company	<u>17,000</u>	
		\$ 97,000

ENGINEERING

30,000

CONGINGENCIES

38,000

TOTAL ESTIMATED PROJECT COST

\$ 447,000

TABLE IX-5
PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE
ALTERNATIVE NO. 4: Two (2) Bulb Units by Nyerpic, Inc.

POWER PRODUCING EQUIPMENT

Turbine(s): (two fixed blade units, one rated 126KW, one rated 163KW)	\$ 320,000	
Drive System(s) (gear drives, thrust bearings)	incl.	
Governor(s)	N.A.	
Generator(s)/Exciter(s)	46,000	
Electrical Switchgear/Controls	<u>30,000</u>	
		\$ 396,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT 57,000

INSTALLATION OF POWER PRODUCING EQUIPMENT 79,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 0	
Radial gate/dam repairs	<u>16,000</u>	
		\$ 16,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 120,000	
Electrical interconnection to Paper Company	<u>17,000</u>	
		\$ 137,000

ENGINEERING 55,000

CONGINGENCIES 69,000

TOTAL ESTIMATED PROJECT COST \$ 809,000

TABLE IX-6
PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE

ALTERNATIVE NO. 5: One (1) Ossburger Cross-Flow Unit by Stappenhorst, Inc.

POWER PRODUCING EQUIPMENT

Turbine(s): (hydroelectric equipment package including one 275 HP turbine, speed increaser, 200 KW sync, generator, gates, flow controls, elec. equip. Drive System(s) (gear drives, thrust bearings)	\$ 300,000 incl.
Governor(s)	incl.
Generator(s)/Exciter(s)	incl.
Electrical Switchgear/Controls	<u>incl.</u>
	\$ 300,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT 15,000

INSTALLATION OF POWER PRODUCING EQUIPMENT 10,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 0
Radial gate/dam repairs	<u>16,000</u>
	\$ 16,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 60,000
Electrical interconnection to Paper Company	<u>17,000</u>
	\$ 77,000

ENGINEERING 33,000

CONGINGENCIES 42,000

TOTAL ESTIMATED PROJECT COST \$ 493,000

TABLE IX-7

PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE

ALTERNATIVE NO. 6: Dual Ossburger Cross-Flow units by Stappenhorst, Inc.

POWER PRODUCING EQUIPMENT

Turbine(s) : (hydroelectric equipment package including two 275 HP turbines, one 385 KW sync generator, gates, flow controls, elec. equip.	\$ 489,000	
Drive System(s) (gear drives, thrust bearings)	incl.	
Governor(s)	incl.	
Generator(s)/Exciter(s)	incl.	
Electrical Switchgear/Controls	<u>incl.</u>	
		\$ 489,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT

24,000

INSTALLATION OF POWER PRODUCING EQUIPMENT

15,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 0	
Radial gate/dam repairs	<u>16,000</u>	
		\$ 16,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 80,000	
Electrical interconnection to Paper Company	<u>17,000</u>	
		\$ 97,000

ENGINEERING

51,000

CONGINGENCIES

64,000

TOTAL ESTIMATED PROJECT COST

\$ 756,000

TABLE IX-8

PROJECT COST ESTIMATE
FOR HYDROPOWER DEVELOPMENT
AT PENINSULAR PAPER COMPANY DAM SITE

ALTERNATIVE NO. 7: Single Tubular Unit by Allis-Chalmers, Inc.

POWER PRODUCING EQUIPMENT

Turbine(s): (hydroelectric equipment package 1 400 KW unit with turbine, generator, gear drive, flow control, elec equip.	\$ 432,000	
Drive System(s) (gear drives, thrust bearings)	incl.	
Governor(s)	incl.	
Generator(s)/Exciter(s)	incl.	
Electrical Switchgear/Controls	<u>incl.</u>	
		\$ 432,000

SHIPPING/DUTY ON POWER PRODUCING EQUIPMENT

23,000

INSTALLATION OF POWER PRODUCING EQUIPMENT

86,000

SITE RENOVATION

Renovation of Existing Powerhouse	\$ 0	
Radial gate/dam repairs	<u>16,000</u>	
		\$ 16,000

NEW CONSTRUCTION (material & labor)

New Powerhouse setting	\$ 100,000	
Electrical interconnection to Paper Company	<u>17,000</u>	
		\$ 117,000

ENGINEERING

54,000

CONGINGENCIES

67,000

TOTAL ESTIMATED PROJECT COST

\$ 795,000

SECTION X

PROJECT FINANCIAL FEASIBILITY

Table X-1 on the following page presents a benefit/cost summary of the seven project alternatives identified in the proceeding section. After taking account of projected expenses for operation and maintenance, benefit/cost ratios were calculated ranging from 9.6% for the single vertical turbine alternative to 3.8% for the dual bulb turbine alternative.

In this section, we will examine the financial feasibility of that project alternative showing the highest benefit/cost ratio and hence the greatest likelihood of being cost-effective; namely, the alternative of using a single 340 kW Leffel turbine located in the existing powerhouse.

GOVERNMENTAL TAX AND LOAN INCENTIVES

Prior to presenting a detailed financial analysis, we will identify a variety of financial incentives available to private industry which have potentially major impacts on the cost-effectiveness of a hydroelectric development project. These are:

- the local property tax exemption
- State sales and use tax exemption
- the Federal investment tax credit
- the Federal energy tax credit
- the Federal hydroelectric loan program

Local Property Tax Exemption

I. The Michigan Industrial Redevelopment Act of 1974 (P.A. 198) provides for a property tax exemption on qualifying investments by Michigan industries. The act is aimed at encouraging the rehabilitation of existing industrial facilities and equipment, which would result in the creation or maintenance of employment. To qualify, the act requires the approval of the local government unit, following public hearings, and subsequent State approval.

TABLE X-I
BENEFIT/COST SUMMARY OF VARIOUS
HYDROELECTRIC PLANT DESIGNS AT
PENINSULAR PAPER COMPANY DAM

		Type of Turbine			
		Vertical (340 kW)	Bulb (126 kW & 163 kW)	Cross-Flow (193 kW)	Tubular (400 kW)
One Unit Design	Project Cost	\$452,000	\$447,000	\$493,000	\$795,000
	Projected Annual Revenue	58,900	30,000	40,100	65,000
	Projected Annual O&M Expense	15,600	16,100	18,100	21,100
	Projected Net Revenue	43,300	13,900	22,000	43,900
	Benefit/Cost	9.6%	3.1%	4.5%	5.5%
Two Unit Design	Project Cost	\$708,000	\$809,000	\$756,000	
	Projected Annual Revenue	71,900	51,600	63,900	
	Projected Annual O&M Expense	19,900	20,900	22,900	
	Projected Net Revenue	52,000	30,700	41,000	
	Benefit/Cost	7.3%	3.8%	5.4%	

Although it is not possible to know with certainty at this time whether the Peninsular Paper Company hydroelectric facility would qualify for this exemption, informal discussions with the State Office of Economic Development and the Ypsilanti Assessor's office indicate a high probability of success based on the public benefit inherent in such a project and the fact that it involves the rehabilitation of a presently defunct industrial facility. The qualification of this project under P.A. 198 would have a significant effect on project cost-effectiveness by eliminating the property tax expense (currently 74.01 mils based on State equalized valuation).

2. Property tax exemption is also provided in Michigan for solar, wind or water conversion devices under Michigan Public Act 135, P.A. 1976.

Sales and Use Tax Exemptions

Solar, wind or water conversion devices are exempt from State sales tax under Michigan Act 132, P.A. 1976, and from State use tax under Michigan Act 133, P.A. 1976.

Federal Investment Tax Credit

Current Federal income tax law permits a business to claim an income tax credit equal to ten percent of a qualified investment in the year of purchase. To be qualified, the investment must be for either:

- tangible, nonreal property for which a depreciation deduction is authorized
- tangible, real property other than buildings and building components

If the estimated useful life of the property is seven years or longer, all of the cost constitutes a qualified investment.

Since the hydroelectric facility would be composed of both categories of qualified property (real and nonreal), and since the estimated useful life would be greater than seven years, the entire project cost should constitute a qualified investment. The net result of the investment tax credit would be to reduce the initial cost of the facility by ten percent.

Federal Energy Tax Credits

The Energy Tax Act of 1978, one of five bills making up the National Energy Act passed by Congress in October, 1978, provides an additional ten percent investment tax credit to businesses making investments in energy-saving devices and equipment after September 30, 1978 through 1982.

Federal Hydroelectric Loan Program

Under the Public Utility Regulatory Policies Act of 1978, one of the five bills making up the National Energy Act of 1978, a low interest loan program for small hydroelectric power projects was authorized for two years. Loans under this program would cover up to 75 percent of the cost of the project. The maximum term of the loan would be 30 years; interest rate would be based on the rate in effect for water resource planning projects under Section 80 of the Water Resources Development Act of 1974, currently 6-7/8 percent.

FINANCIAL FEASIBILITY - OWNER'S PERSPECTIVE

Since 1974, the Peninsular Paper Company of Ypsilanti, Michigan has been owned by the James River Corporation, a publicly held producer of specialty papers with plants located in Virginia, Massachusetts, Michigan and Delaware. In their 1977 fiscal year, the James River Corporation had gross sales of \$102 million and a net income of \$3.4 million, representing a return on investment (total assets) of about 5.5 percent. Income taxes in that year amounted to approximately 50 percent of the company's net pre-tax income.

Since 1970, the growth of the James River Corporation has been substantial. Gross sales in 1977 were almost 20 times as large as those in 1970. Much of this growth has resulted from the acquisition of older paper companies which have been marginally profitable. By introducing new management and accounting techniques, the parent company has been able to make substantial improvements in financial performance.

Because the corporation is growth oriented any investment in capital equipment, such as a hydroelectric facility, would have to yield a very good rate of return to be attractive in relation to other investment opportunities. In order to help their subsidiary companies in evaluating proposed expenditures for capital improvements, the corporate staff has promulgated an accounting method which results in a rough estimate of the rate of return and payback period. The method takes account of expenses for depreciation and income taxes, but not expenses operational/maintenance expenses or interest. Although it is only an approximation technique, it results in a figure which can be readily interpreted by corporate management.

Application of this method to the most cost-effective of the hydroelectric plants examined yields the following numbers:

Total Capital Cost (labor and materials):	\$362,000
Net Annual Income (or savings):	58,900
Depreciation (straight-line, 10 years):	<u>45,200</u>
Pre-tax Income (or savings):	\$ 13,700
Estimated Taxes (50%):	<u>6,850</u>
Net After-tax Income (or savings):	\$ 6,850
Add-back Depreciation	<u>45,200</u>
Increase in Working Capital	\$ 52,050

$$\text{After-tax Return on Investment} = \frac{6,850}{362,000} = 1.9\%$$

$$\text{Payback} = \frac{1}{1.9\%} = 53 \text{ years}$$

It should be pointed out that the total capital cost includes the effect of the 10% investment tax credit and 10% energy tax credit described earlier (in other words, the estimated project cost has been reduced by 20%). To have shown the influence of these credits as a tax item in the first year of operation would have distorted the situation by showing an actual tax refund for the project.

Obviously, the 1.9% estimated return on invested capital for the hydroelectric project compares unfavorably with the 1977 corporate return on investment of 5.5%. In fact, the comparison is actually worse than it seems, in that the 5.5% figure takes account of interest expenses on corporate indebtedness whereas the 1.9% figure does not.

The effect on working capital is much more favorable, however. The projected increase of \$52,050 is equivalent to 14.4 percent of the total capital cost of the project.

An examination of the figures in the financial analysis shows the major impact caused by the depreciation expense item. This expense is fully three-fourths of the projected annual income from the project. The 10-year depreciation basis, although recommended by corporate management, is actually not reflective of the service life of a hydroelectric facility. A more realistic figure would be twenty-five years.

If the financial analysis is made based on twenty-five year service life, the numbers change as follows:

Total Capital Cost (labor and material):	\$362,000
Net Annual Income (or savings):	58,900
Depreciation (straight-line, 25 years):	<u>18,080</u>
Pre-tax Income (on savings):	\$ 40,820
Estimated Taxes (50%):	<u>20,410</u>
Net After-tax Income (on savings):	\$ 20,410
Add-back Depreciation	<u>\$ 18,080</u>
Increase in Working Capital	\$ 38,490

$$\text{After-tax Return on Investment} = \frac{20,410}{362,000} = 5.6\%$$

$$\text{Payback} = \frac{1}{5.6\%} = 18 \text{ years}$$

FINANCIAL FEASIBILITY BASED ON FEDERAL LOW INTEREST LOAN PROGRAM

The preceding analysis assumes that the financing of the hydroelectric project would come from working capital sources within the James River Corporation, and that the economic performance of the project could therefore be judged in comparison to other investment opportunities which the company might be faced with. It also assumes that the interest rate for project financing would be based on corporate indebtedness, probably in excess of ten percent.

The Federally-sponsored low interest loan program for small hydroelectric projects, described earlier in this section, would present a different set of circumstances to the owner. First, the interest rate on the loan would be substantially less than that obtainable from commercial banks. Secondly, the source of financing would not be the corporations working capital, and therefore the project would not be judged in comparison to other investment opportunities.

Financing obtained through the small hydro loan programs would be earmarked for the hydroelectric project alone; if not used for that purpose it would not be available for other purposes. The rate of return on invested capital could conceivably be much less than normally acceptable. In fact, any return at all would constitute a net benefit to the corporation; since the capital would otherwise not be available.

The overall influence of the low-interest loan program, then, would be to increase the profitability of the project (by means of lower interest rates) and to decrease the acceptable return on investment (by providing financing that would otherwise have to come from corporate working capital).

In view of the above, an economic summary of the project is presented below based on 7%, 30 year financing from the Federal low interest loan program.

Net Annual Income (or savings):	\$58,900
Debt Service (including amortization of principal):	\$29,200
Operation and Maintenance	<u>\$15,600</u>
	<u>\$44,800</u>
Net Before-tax Income (or savings):	\$14,100

$$\text{Rate of Return: } \frac{14,100}{362,000} = 3.9\%$$

SECTION XI

ENVIRONMENTAL IMPACT ASSESSMENT

The environmental impact of two alternative actions for the Peninsular Paper dam were evaluated using the environmental baseline data presented in Section IV. The first alternative, called a non-development alternative, assumes that nothing will be done to restore the facility and current flow management policies will continue. The second alternative, the development alternative, assumes that the facility will be developed as a hydroelectric generating station.

The environmental impact assessment of the development alternative involved a two-step procedure. The first step was comprehensive identification of the proposed actions on the natural and cultural environment using an environmental impact matrix (Figure XI-1). The matrix charted proposed actions on the vertical axis and natural and cultural factors on the horizontal axis. Potential interactions between proposed actions and the environment were identified as either significant or limited impacts. Where no impacts were anticipated, the pertinent matrix square was left blank.

The second step in the environmental impact assessment procedure involved a detailed analysis of the impacts identified by the environmental impact matrix. Upon completion of this analysis, conclusions were drawn concerning the potential impacts associated with the non-development and development alternatives.

ENVIRONMENTAL IMPACT: NON-DEVELOPMENT ALTERNATIVE

Impact on Natural Environment

- I. The Peninsular Paper dam is a fixed crest weir dam which requires no management to manipulate impoundment levels. The functioning of the impoundment is dependent solely upon the flow of the Huron River. There is little evidence of adverse environmental impacts as a result of the dam and impoundment.

- SIGNIFICANT IMPACT
LIMITED IMPACT
INSIGNIFICANT OR NO IMPACT

SIGNIFICANT IMPACT LIMITED IMPACT INSIGNIFICANT OR NO IMPACT			NATURAL FACTORS										CULTURAL FACTORS																																
			TERRESTRIAL		HYDROLOGICAL		BIOLOGICAL		ATMOSPHERIC		SOCIAL					LOCAL ECONOMY					LAND USE - LAND VALUE			INFRASTRUCTURE			RECREATION																		
			SOILS	LAND FORM	SURFACE WATER LEVELS	SURFACE WATER QUALITY	UNDERGROUND WATER QUALITY	WELL WATER SUPPLY	VEGETATION	FISH AND AQUATIC WILDLIFE	BIRDS	TERRESTRIAL WILDLIFE	AIR QUALITY	SCENIC VIEWS AND VISTAS	OPEN SPACE QUALITIES	ARCHAEOLOGICAL SITES	RARE AND UNIQUE SPECIES	HEALTH AND SAFETY	AMBIENT NOISE LEVEL	RESIDENTIAL INTEGRITY	EMPLOYMENT (SHORT TERM)	EMPLOYMENT (LONG TERM)	HOUSING (SHORT TERM)	HOUSING (LONG TERM)	FISCAL EFFECTS	LOCAL GOV'T.	BUSINESS ACTIVITY	AGRICULTURAL	RESIDENTIAL	COMMERCIAL	INDUSTRIAL	OPEN SPACE	TRANSPORTATION	UTILITIES	WASTE DISPOSAL	GOV'T. SERVICES	HUNTING	FISHING	BOATING	SWIMMING	PICKICKING	HIKING-BIKING			
CONSTRUCTION	EARTHWORK CLEARING/GRADING/EXCAV.																																												
	DEMOLITION/DISPOSAL																																												
	INTERIM FLOW CONTROL																																												
	COFFER DAM/DEWATERING																																												
	HEAVY EQUIPMENT USE																																												
	MATERIAL TRANSF./STORAGE																																												
	TEMPORARY STRUCTURES AND FACILITIES																																												
	WORKER & EQUIP. ACCESS																																												
	WORKER INFLUX																																												
PROPOSED ACTIONS	PERMANENT STRUCTURES & FACILITIES																																												
	ELECTRIC DISTRIB.-CIRCUITS																																												
	ELECTRIC GENERATION																																												
	FLOW CONTROL																																												
	IMPOUND. MANAGEMENT																																												
	WORKER & EQUIP. ACCESS																																												
	SECURITY & SAFETY																																												

FIGURE XI-1
 ENVIRONMENTAL IMPACT MATRIX
 PENNINSULAR PAPER COMPANY

2. If the dam were permitted to deteriorate and fail, there would be a loss of fishery habitat within the impoundment and a temporary modification of the channel downstream.

Impact on Cultural Environment

1. Under the non-development alternative, the gradual deterioration in the condition of the dam may pose a potential threat to health and safety. A failure in the dam would cause the rapid release of water potentially inflicting damage on downstream property and structures. Further, the prolonged lowering of the impoundment would diminish the load-bearing capability of the lake bottom and immediate shoreline. The resulting settlement might inflict significant damage on shoreline structures.
2. Restoration of the hydroelectric facility are projected to generate two to three million kilowatt-hours of electric energy annually having a value of \$30,000 to \$70,000. The no-action alternative would result in the loss of the energy as well as revenues.

ENVIRONMENTAL IMPACT: DEVELOPMENT ALTERNATIVE

Impact on Natural Environment

1. An analysis of the proposed actions which would affect natural environmental factors reveals few impacts associated with the project.
2. Some limited impacts will be associated with construction activities. Earthwork and coffer dam construction may contribute to soil erosion and siltation thereby causing minor temporary impairment of water quality. There may also be some disruption of fishery habitat. However, all work will be done in accordance with the appropriate environmental protection statutes.

3. Upon completion of construction, the impacts associated with the physical plant and its operation are insignificant. The operation of the facility will be "run-of-the-river" and the alteration of current stream flow characteristics will be minimal. The diversion of impoundment flow through the hydroelectric facility may disrupt the fishery.

Impact on Cultural Environmental

1. There are no significant cultural impacts expected during the construction phase. Identified impacts are all classified as limited because of the minimal level of construction activity.
2. Heavy equipment use and material transportation may impose some short term nuisances and concerns on local neighborhoods. Construction activity can pose potential health and safety hazards and also cause some increase in the ambient noise level. Material transportation and traffic may also cause temporary disruption of local roads. However, since the work force is estimated to not exceed thirty workers and the extent of new construction is limited, neighborhood disruption and safety will not be seriously affected. The local economy may benefit slightly from the temporary influx of workers and increase in business activity.
3. Noise and disruption during construction may adversely affect fishing immediately downstream of the facility.
4. Upon completion of construction, physical plant operation will present only limited impacts to the immediate area. Greater security will be needed in the immediate vicinity of the facility to minimize additional health and safety problems resulting from the project.
5. The design alternatives involving refurbishment of the existing powerhouse would have positive impacts related to the preservation of an historically significant structure and the improvement of scenic views and vistas. The powerhouse is old and architecturally significant and is highly visible from nearby roadways.

6. The availability of a small, localized source of electric energy, which would be independent of the utility's transmission and sub-transmission systems, might constitute a positive impact related to public health and safety. Presumably, the hydroelectric plant could serve as a source of electricity for the maintenance of critical services such as health care, water supply and wastewater treatment, during periods of power outages or natural disaster.

CONCLUSIONS

The environmental issues associated with the Peninsular Paper dam are relatively minor. The most serious implications of the non-development alternative concern dam safety. Without repair, the dam could pose a threat to downstream riparians as well as fishery management in the impoundment.

The development alternative would involve dam repair and reconstruction of the hydroelectric facilities should mitigate threats to health and safety. By and large, the environmental impact of the recommended alternative is minimal due to the small scale of the project.

SECTION XII

INSTITUTIONAL IMPLICATIONS

Institutional and legal implications of the French Landing project which involved regulation by the Michigan Department of Natural Resources and the U.S. Army Corps of Engineers were discussed in Section IV, Environmental Setting. Institutional implications related to Federal and State tax policy were discussed in the preceeding Section, Project Financial Feasibility. Other significant institutional implications are discussed below:

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

The authority of the Federal government to regulate certian aspects of hydroelectric development is contained in the Federal Power Act.

Hydroelectric projects by non-Federal entities must be licensed by FERC if they either: (1) occupy Federal lands; (2) are situated on a navigable waterway of the United States; (3) effect interstate or foreign commerce; or (4) utilize surplus water or water power from a government dam.

Conditions (1), (3) and (4) are not applicable to the Peninsular Paper Company facility, however, condition (2) would most definitely apply. The concept of a "navigable water" has a definite legal interpretation which extends to bodies of water such as the Huron River.

In September, 1978, FERC issued Order No. 11, "Simplified Procedures for Certain Water Power Licenses", which amended the General Rules and Regulations under the Federal Power Act to establish a short-form water power license (minor) and a new application form and accompanying instructions. Prior to these amendements, the process of acquiring a license was complicated and took about 18 months. The amended rules were aimed at simplifying the application procedure and accelerating the review process for projects having less than 2000 horsepower generating capacity. Under the amended rules, it is projected by FERC officials that the time required to obtain a license will be reduced to three to six months.

MICHIGAN PUBLIC SERVICE COMMISSION (MPSC)

The Michigan Public Service Commission has the authority to regulate the rates of all privately owned electric utilities in Michigan which sell power to public consumers according to published rate schedules. The Commission is not involved with:

- electric utilities owned by public authorities
- privately owned facilities utilizing their own power
- power transactions between utilities

Since the Peninsular Paper Company hydroelectric facility would be a privately owned facility utilizing its own power, we foresee no need for MPSC involvement.

APPENDIX

April 11, 1979

MEMORANDUM

SUBJECT: Above Water Inspection and Recommendations
for the Peninsular Paper Dam and Powerhouse

PROJECT: 69201-Peninsular Paper Hydroelectric Study

INSPECTION DATE: 9/19/78

INSPECTORS: Robert St. Claire, P. E.
Mike Kalaitjis, P. E.

STRUCTURAL COMPONENTS

The Peninsular Paper Dam consists of a reinforced concrete overflow ogee spillway about 240 ft. long, an emergency spillway with a radial sector gate about 12 ft. wide and the Concrete-brick Powerhouse at the extreme northern part of the structure. (Here the north-south direction was assumed to coincide with the dam axis).

Immediately downstream of the spillway is a concrete apron at the end of which there is a concrete block about 3 foot high. The length of the concrete apron is about 15 ft. and together with the concrete block form a stilling basin to dissipate the water energy.

Further downstream from the stilling basin are about 30 ft. of stone-blocks used for erosion protection.

Downstream of the emergency spillway the stilling basin consists of a plunge basin (reinforced concrete slab) about 20 ft. long.

Reinforced concrete retaining walls (abutments) are found at the south end of the spillway, between the spillway and emergency spillway and at the northern end of the powerhouse.

GENERAL COMMENTS

Cracking and spalling of the concrete in the retaining walls was observed and extensive areas have been patched up with mortar. The retaining wall between the spillway and emergency spillway as well as the south downstream powerhouse pier are in critical condition due to extensive spalling and cracking of the concrete.

The 240 foot long spillway and stilling basin are in good operating conditions. Above water inspection cannot reveal any material deficiencies.

The sector gate at the emergency spillway is inoperable and shows steel deterioration.

The powerhouse has been abandoned and all power producing as well as most of the electrical-mechanical equipment has been removed. The crane boom and support system are rusted away and are inoperable.

Earth (dirt) has been dumped throughout the generator floor, probably for safety reasons. For this reason it is not known whether the original turbines are still in the wheel pits.

Bank undercutting and erosion are detected next to the upstream and downstream ends of the most northern retaining wall.

The steel fence at the north upstream end of the powerhouse is destroyed.

INSPECTION BY PARTS

1. South-end Retaining Wall:

Minor cracking but not spalling of the concrete. Areas have been patched up with mortar and the repairs are effective. The adjacent downstream channel area is adequately protected against erosion with big stone blocks.

2. Concrete Spillway:

The ogee overflow concrete spillway is in good operating condition but underwater inspection is required to determine the overall quality of the structure.

Scouring or undercutting was not detected in the downstream channel.

3. Emergency Spillway:

The radial sector gate of the emergency spillway is closed and the mechanism for the gate operation is shut.

All the angle supports of the gate are rusted and deteriorating and few of them show sectional losses.

Water is flowing through the closed gate indicating the existence of holes.

The plunge basin (concrete slab) seems in good operating condition and the concrete does not show any cracking or spalling.

4. Retaining Wall Between the two Spillways:

Water forced its way through between the radial gate and the abutment wall and have caused large concrete losses and extensive cracking that has propagated upstream and downstream on the abutment wall.

April 11, 1979

The wall is in danger of failure since more sectional losses and consequently more cracking is expected to occur.

5. Powerhouse:

a. Upstream Exterior Wall:

The brick portion of the wall is not cracked; the windows need new framing and glass.

The concrete portion has widespread hairline cracks (especially at the northern corner) and some but not major concrete spalling.

The central and south pier are badly cracked and deteriorating. The powerhouse water gates are plugged with wood.

b. Northern Exterior Wall:

The large door is missing and the windows need framing and glass. The brick portion of the wall seems to be in good condition, while the concrete portion is covered with earth and can not be inspected.

c. South Exterior Wall and Bridge:

The brick portion of the wall seems to be in good condition and no cracks were detected. The windows need new framing and glass.

The concrete portion contains some cracking especially at the downstream corner but in general is in sound condition.

The concrete bridge that spans the emergency spillway is in poor condition due to extensive cracking and spalling of the concrete.

d. Downstream Exterior Wall and Piers:

Cracking and spalling is detected at the concrete portion of the wall. The south pier is in critical condition with badly spalled and deteriorated concrete. This pier has been extended to form a retaining wall which diverts the flow away from the northern retaining wall and directs it towards the center of the downstream channel.

The brick portion of the wall is in good condition but the windows need new framing and glass.

e. Powerhouse Interior:

The generator floor has been covered with earth (dirt) and cannot be inspected.

April 11, 1979

The crane boom and crane support system is inoperable and rusting away.

The plaster at the furnace-pump rooms (second floor down) is falling off the concrete walls. Water leaking from the turbine room to the furnace room was not detected. All power-producing equipment has been removed. Mechanical and electrical equipment are either removed or not functioning.

f. Northern Retaining Wall:

Inspection revealed that the wall contained some cracking and the top surface concrete is spalling. Holes on the concrete due to water undercutting have been detected on the downstream side of the wall.

Extensive bank undercutting was observed at both the upstream and downstream end of the retaining wall.

7. RECOMMENDATIONS:

Repair immediately the retaining wall between the spillways and the southern downstream pier of the powerhouse.

Extend further downstream the southern powerhouse pier as to prevent excessive water flow toward the northern retaining wall that causes concrete and earth bank undercutting.

Place stone, masonry or concrete blocks at the bank, upstream and downstream of the northern retaining wall for more effective erosion control.

If powerhouse is to be placed in operation, clean up the interior and place new trash-racks, new crane system, doors and window framing and glass.

We recommend that the structural frame (concrete, brick exterior walls) and piers be kept and the interior space to be modified according to the requirements of the new power-producing equipment that is to be selected.

The radial sector gate needs new structural supports (steel angles) and steel-plate replacements.

Place the sector gate in operation immediately to utilize the emergency spillway at the time of emergency.

Repair the concrete at the bridge that spans the emergency spillway.

April 11, 1979

MEMORANDUM

SUBJECT: Below-Water Inspection of the Peninsular Paper Company Dam
and Powerhouse

PROJECT: 69201-Peninsular Paper Hydroelectric Study

INSPECTION DATE: 10/12/78

INSPECTORS: Robert St. Claire, P. E.
Richard Henes

OBSERVATIONS

1. Power-House:

Upstream side: The underwater concrete walls and piers appear in good condition and do not show defects that would endanger the integrity of the structure.

Downstream side: No cracking or spalling of the concrete adjacent to the draft tube exit was observed.

2. Radial Gate Opening and Retaining Wall

Extensive cracking and spalling of the concrete at the retaining wall between the radial gate and the overflow ogee spillway. The underwater inspection verified that the wall is in danger of collapse.

3. Northern Retaining Wall:

The underwater part of this reinforced concrete retaining wall does not show any continuous cracking or spalling of the concrete that would endanger the structure with failure.

Holes at the concrete due to water undercutting have been detected at the downstream side of the wall.

4. Overflow Ogee Spillway:

Upstream Side:

Heavy rip-rap was observed up to about 4 ft. below the top of the spillway crest. The rip-rap continued upstream for about 25 to 30 ft.

April 11, 1979

A concrete crack about 1/4 inch wide was observed throughout the spillway width at the upstream spillway face about 8 inches below the top of the spillway crest.

Concrete Apron Downstream from Spillway:

Concrete cracks were observed along the flow direction on the concrete apron exposing the rebars at locations. Concrete cracks and spalling were detected on the concrete block (sill) at the end of the apron at certain locations along the spillway.

5. South Retaining Wall (End of Spillway).

The upstream portion of the wall is in very good condition. The downstream portion shows cracking and spalling of the concrete especially at places where they have been patched-up before.

Cleaning of debris is required at this location also.

Detroit
Edison

2000 Second Avenue
Detroit, Michigan 48226
(313) 237-8000

January 11, 1979

Mr. D. W. Lystra
Ayres, Lewis, Norris and May, Inc.
3983 Research Park Drive
Ann Arbor, Michigan 48104

Dear Mr. Lystra:

Thank you for the opportunity to assist in the feasibility study regarding the reactivation of two hydroelectric sites on the Huron River.

I have included reviews of the Peninsular Paper Company and the French Landing sites pointing out possible methods of attachment to the Edison system, along with samples of how the Edison rate structure might influence the economic analysis. I have not included any values for the cost of capital, maintenance, labor, taxes, depreciation, etc. that are so vital in completing such an analysis. In addition, our analysis of the hydro-generation -- assuming a 100% load factor -- may be optimistic. Flood control, natural water flow variation, etc. may dictate a much more conservative output potential from the dam.

Should your feasibility studies indicate more detailed analysis would be advisable, we will be available to provide whatever additional assistance may be required.

Sincerely,

R. R. Williams
Industrial Account Engineer
Major Account Operations

936/RFW/M1/5

enclosures

PENINSULAR PAPER COMPANY
Ypsilanti, Michigan

I. Proposed Method of Electrical Connection to the Detroit Edison System

Peninsular Paper is presently serviced at 4800 volts through an Edison owned main oil circuit breaker feeding the customers 4800 volt bus. We suggest that the hydroelectric generation be connected to the Peninsular 4800 volt bus through a new 4800 volt breaker, and that the existing Edison breaker be replaced with an adequate customer owned breaker having the necessary relaying.

II. Proposed Distribution of Generation Energy

All generated kWh will be applied to the Peninsular 4800 V bus downstream from the Edison metering. When the Peninsular load exceeds the generated energy, all generated kWh will be absorbed within the Peninsular Plant. Should the Peninsular load fall below the generation level, excess generated kWh will be pumped back into the Edison system. With this plan, Edison would serve Peninsular under the terms of our Contract Rider No. 3 — Standby Service.

III. Samples of Rate Application

Five levels of generation have been reviewed to demonstrate the interface between Edison's rate structures and the Peninsular load:

- A. No Generation
- B. 1-400 kW Generation Unit
- C. 2-300 kW Generation Units
- D. 2-400 kW Generation Units
- E. 2-400 kW @ 75% load factor

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
1. <u>Generated Energy</u>					
Capacity-kW	-	400	600	800	800
Load Factor-%	-	100	100	100	75
Generated MWh/Mo. (a) -	-	288	432	576	432
To Peninsular-MWh/Mo.		288	405	494	422
To Edison-MWh/Mo.		-	27	82	10

	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>
2. <u>Purchased Energy</u>	(b)				
On-Peak Billing Demand-kW	1,038	638	438	238	638 (c)
Primary Maximum Demand-kW	1,088	688	488	288	688 (c)
On-Peak MWh/Mo.	136	67	45	20	92
Off-Peak MWh/Mo.	408	189	94	30	102
Total MWh/Mo.	544	256	139	50	194
Standby Capacity-kW	-	400	300	400	400
3. <u>Billing Calculations</u>					
Service Charge	175	175	175	175	175
On-Peak kW @ \$5.80	6,020	3,700	2,540	1,380	3,700
Max. kW @ \$1.50	1,632	1,032	732	432	1,032
On-Peak kWh @ \$0.02	2,720	1,340	900	400	1,840
Off-Peak kWh @ \$0.017	6,936	3,213	1,598	850	1,734
Fuel Adj. @ \$ 0.003	1,632	768	417	150	582
Standby kW @ \$1.75	-	700	525	700	700
	<u>\$19,115</u>	<u>\$10,928</u>	<u>\$6,887</u>	<u>\$4,087</u>	<u>\$9,763</u>
kWh to Edison @ \$0.01 Cr.	-		(270)	(820)	(100)
Net Total	<u>\$19,115</u>	<u>\$10,928</u>	<u>\$6,617</u>	<u>\$3,267</u>	<u>\$9,663</u>

NOTES:

(a) Peninsular load estimated to fall below generation levels:

A - 0%	C - 5%
B - 0%	D - 15%
	E - 15%

(b) Peninsular load based on the past twelve month's average use as shown in Plan A.

(c) The on-peak and maximum demands will reflect the reduction of generation capacity with less than 100% load factor.

FRENCH LANDING
Van Buren Township

There are two proposals to be considered. The first--with all kWh sold to the Edison Company--provides the minimum in investment, engineering, distribution, and construction problems, maintenance, operating and scheduling problems, etc. and appears to be preferred.

Proposal No. 1

The hydroelectric generators operated in parallel with Edison and all kWh sold to Edison @ 40 kV through an existing position on the Edison French Landing 40 kV Bus. Billing for kWh would be through an interchange agreement between Van Buren Township and Edison @ an estimated cost of:

On-Peak	-	20 Mills/kWh.
0800 hrs - 2200 hrs, Mon-Sat..		
Off-Peak	-	12 Mills/kWh
All other hours		

Under such an agreement Edison would not be willing to pay a demand charge of any kind since the supply of hydroelectric energy will dependent up conditions other than the requirements of Edison and will not be scheduled by Edison. Edison would accept hydroelectric energy, however, in any amount at any time.

The hydroelectric facility would be responsible for providing, installing, and owning the electrical equipment and facilities -- cable, breakers, relays, etc. -- required to connect into the Edison 40kV bus. The hydroelectric facility would also be responsible for the following additional costs required on the Edison system:

a.	Metering	\$ 20,000
b.	Telemetry	15,000
c.	Programming	<u>10,000</u>
Total		\$ 45,000

Proposal No. 2

The hydroelectric generators would feed a new distribution system--constructed and maintained by Van Buren Township--which would feed energy to several customers in the vicinity. The operating difficulties associated both with parellel operation and with non-parallel throwever operation at each customer will require considerable coordination in design and operation.

The rate application would be similar to the demonstration in the Peninsular Paper study, but based on individual customer contract capacities.

Ayres, Lewis, Norris & May, Inc.
Engineers - Architects - Planners

3983 Research Park Drive
Ann Arbor, Michigan 48104

February 6, 1979

MEMORANDUM

TO: File 66202, French Landing Hydro Feasibility Studies

FROM: Don Lystra, P. E.

DATE: August 2, 1978

RE: Report of Telephone Conversation on 8/2/78 with Mr. MacGregor,
Engineering Division, Michigan Public Service Commission

I described the hydro feasibility studies we were engaged in and asked Mr. MacGregor whether M.P.S.C. would be involved with controlling rates on power purchase agreements.

Mr. MacGregor said that MPSC is solely concerned with privately owned facilities that sell to the public.

Any a) municipally owned facility, b) private facility using power itself, or c) private facility selling to another utility, would come under F.E.R.C. regulation, at Federal level.

I described the sites we were studying and the power marketing alternatives we faced and he said that MPSC would not be involved in regulating any of them.

Donald W. Lystra, P. E.

PRIMARY SUPPLY RATE

AVAILABILITY OF SERVICE: Available to customers desiring service at primary voltage who contract for a specified capacity of not less than 50 kilowatts at a single location.

HOURS OF SERVICE: 24 hours, subject to interruption by agreement or by advance notice.

CURRENT, PHASE AND VOLTAGE: Alternating current, three-phase, nominally at 4,800, 13,200, 24,000, 41,570 or 120,000 at the option of the Company.

CONTRACT CAPACITY: Customers shall contract for a specified capacity in kilowatts sufficient to meet normal maximum requirements but not less than 50 kilowatts. The Company undertakes to provide the necessary facilities for a supply of electric power from its primary distribution system at the contract capacity. Any single reading of the demand meter in any month that exceeds the contract capacity then in effect shall become the new contract capacity.

RATE PER MONTH:

Service Charge:
\$175.00 per customer per month

Demand Charges:

\$5.80 per kW for on-peak billing demand, plus:
For primary service (less than 24 kV), \$1.50 per kW of maximum demand
For service at subtransmission voltage level (24 to 41.6 kV) \$.80 per kW of maximum demand.
For service at transmission voltage level (120 kV and above) \$.30 per kW of maximum demand.

The maximum demand shall be the highest 30-minute demand created during the previous 12 billing months, including the current month but not less than 50% of contract capacity.

Energy Charge:
2.0¢ per kWh for all on-peak kWh
1.7¢ per kWh for all off-peak kWh

FUEL ADJUSTMENT AND PURCHASED POWER ADJUSTMENT: The Energy Charge in the above rate is subject to the provisions of Schedule Designation B-4.6.

LATE PAYMENT CHARGE: See Schedule Designation B-2.10.

EMERGENCY LOAD MANAGEMENT DISCOUNT: (Available for loads of 500 kW or more)
A credit of \$.20 per kW of on-peak monthly billing demand shall be applied to any customer who contracts in writing to permit the Company to curtail his entire load during a period of short-term power emergency as a means of emergency load management.

DEFINITION OF CUSTOMER VOLTAGE LEVEL: See Schedule Designation B-4.7.

(Continued on next sheet)

PRIMARY SUPPLY RATE

MONTHLY ON-PEAK BILLING DEMAND: The monthly on-peak billing demand shall be the average of the 4 weekly highest 30-minute integrated readings of the demand meter during the on-peak hours of the billing period. In no event will the monthly on-peak billing demand be less than 65% of the highest monthly on-peak billing demand during the calendar months of June, July, August, September, and October of the preceding eleven calendar months, nor less than 50 kilowatts.

MINIMUM CHARGE: Service Charge plus the demand charges.

SCHEDULE OF ON-PEAK HOURS: See Schedule Designation B-4.4.

POWER FACTOR CLAUSE: The rates and charges under this tariff are based on the customer maintaining a power factor of not less than 85% lagging. Power factor less than 70% will not be permitted and the customer will be required to install at his own expense such corrective equipment as may be necessary to improve power factor. A penalty will be applied to the total amount of the monthly billing for electric energy for power factor below 85% lagging in accordance with the table in Power Factor Determination, Schedule Designation B-4.5.

SPECIAL TERMS AND CONDITIONS: The contract capacity however established shall not be decreased during the term of the contract and subsequent renewal periods as long as service is required unless there is a specific reduction in connected load.

Customer owned equipment must be operated so that voltage fluctuations on the primary distribution system of the Company shall not exceed permissible limits.

Customers will be permitted to transfer from this rate to a secondary commercial rate, provided they can meet the availability requirements, if the load characteristic changes sufficiently so that the customer would benefit by the change for the foreseeable future even though metering was continued at primary voltage. Frequent changes, however, from one rate to another for a period less than one full year will not be permitted in accordance with Rule B-2.4—Choice of Rates.

For example, during the period that a building is under construction primary service may be supplied and metered at primary voltage and billed on a secondary rate while the building is under the jurisdiction of the contractor.

Also, for the convenience of the utility, service to a large school complex or a high rise building where, as a matter of design, primary voltage is furnished with Company owned transformers at remote locations fed by customer owned primary cables, the account can be billed on a secondary rate though metered at one central primary voltage location at or near the termination of the utility owned cables.

CONTRACT TERM: The term is two years, extending thereafter from month to month until terminated by mutual consent or on twelve months written notice by either party, which may be given at any time after the end of the first year. Where special services are required, the term will be as specified in the applicable contract rider.

**STANDARD CONTRACT RIDER NO. 3
STANDBY OR PARTIAL SERVICE**

APPLICABLE TO:

Large General Service Rate	Schedule Designation D4
Primary Supply Rate	Schedule Designation D6
Large Primary Supply Rate	Schedule Designation D6.1
Bulk Power Supply Rate	Schedule Designation D7

Customers having another source of power for their entire load, or any part thereof, and desiring standby service must take service on one of the applicable filed rates listed above. Parallel operation of private electric generation is not permitted except by written permission of the Company.

For customers desiring partial service which will be separately metered and not served by another source of power, the service charges set forth below shall not apply and service will be supplied at any applicable filed rate.

STANDBY SERVICE—Where the customer generates all or any part of his total requirements, standby service will be provided for all or any part of the load served by the customer's generator or prime mover. Customers purchasing their entire energy requirements from the Company with generators or prime movers installed for use only in emergency will not be considered as taking standby service.

PARTIAL SERVICE—Where the customer generates a part of his total requirements, partial service will be provided for the part of the load permanently connected to the Company's service where it is not possible to connect such load to the customer's generator or prime mover.

STANDBY CAPACITY—The standby capacity in kilowatts shall be initially established by mutual agreement for electrical capacity sufficient to meet the maximum standby requirements which the Company is expected to supply. The rating in kilowatts of the largest generator or prime mover in service will be considered in establishing the amount of standby capacity required. Whenever the standby capacity so established is exceeded by the creation of a greater actual maximum demand, excluding firm load regularly supplied by the Company, then such greater demand becomes the new standby capacity.

RATE—At the primary rate, a service charge of \$1.75 per month per kilowatt of standby capacity in addition to the charges for electric service taken under the rate schedule.

At the secondary rate, a service charge of \$2.00 per month per kilowatt of standby capacity in addition to the charges for electric service taken under the rate schedule.

(Continued on next sheet)

**STANDARD CONTRACT RIDER NO. 3
STANDBY OR PARTIAL SERVICE—Continued**

LATE PAYMENT CHARGE: See Schedule Designation B-2.10.

MINIMUM CHARGE—The service charge as above in addition to the minimum charge for any electric service taken on the applicable filed rate.

CONTRACT TERM—The customer may take service at any applicable filed rate listed above but will be required to pay the service charge for standby service in addition to the charges for electric service taken under the rate schedule. This rate is made effective by a rider modifying the contract form prescribed for one of the applicable filed rates listed above. The contract terms as to service charge is for a five-year period extending thereafter from month to month until terminated by mutual consent or by thirty days written notice by either party. No customer shall be permitted to effect a reduction in the standby capacity so established by requesting a new contract for the same service unless there has been a bona fide reduction in connected load.

SPECIAL TERMS AND CONDITIONS: Whenever the Company supplies the customers' total requirements because their generation is inoperative, the billing demand for that month on the regular rate will be excluded from the calculation used to compute subsequent billing demands under the ratchet provision.

RULES AND REGULATIONS—Continued

B-4.4 SCHEDULE OF ON-PEAK HOURS:

For Large General Service Rate—D4;
Primary Supply Rate—D6;
Large Primary Supply Rate—D6.1;
Bulk Power Supply Rate—D7;
Interruptible Supply Rate—D8;
Primary Pumping Rate—E4;

On-peak hours are those hours between 1100 hours and 1900 hours each day, Monday through Friday, legal holidays excluded.

The following will be considered legal holidays for the purpose of applying this schedule: New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day, "Monday" holidays, where legally recognized, will be recognized in place of the "traditional" holidays.

For Primary Pumping Rate E-4 and Large General Service Rate D-4, the billing demand shall be the highest daily demand reckoned as follows: To the highest 30-minute integrated reading of the demand meter occurring in each day during the on-peak hours shall be added one-third of the amount by which it is exceeded by the highest single demand occurring during the off-peak hours on the same calendar day.

Schedule of on-peak hours also applies to on-peak and off-peak kWh charges.

(Continued on next sheet)

BOX 712 • YORK, PENNSYLVANIA 17405 / 717 792-3511

YORK PLANT
HYDRO-TURBINE DIVISION

October 24, 1978

Ayres, Lewis, Norris and May, Inc.
3983 Research Park Drive
Ann Arbor, Michigan 48104

ATTENTION: Mr. Donald W. Lystra, P.E.
Associate

SUBJECT: Standardized Hydroelectric Generating Units
Site No. 1 - Peninsula Paper Company
A-C Inquiry 6-33265
Site No. 2 - French Landing
A-C Inquiry 6-33266

Gentlemen:

Per your letter of September 12, 1978 to our Mr. J. Patterson, we have enclosed preliminary technical data and prices for the hydraulic generating equipment to the captioned project.

Briefly describing the equipment quoted, we propose a horizontal adjustable blade, fixed vane, standardized hydroelectric generating TUBE turbine with sizes, settings and ratings as outlined in Table I which is attached.

Coupled to the turbine shaft would be a speed increaser capable of stepping the turbine output speed to a 60 cycle synchronous speed of 900 RPM.

Connected between the high speed side of the speed increaser and the generator would be an air operated disconnect clutch. Should the turbine runaway to an overspeed in excess of 25% of rated speed, the clutch would disconnect, protecting the generator from such overspeed.

The generator proposed is a horizontal synchronous type with brushless excitation rated for a maximum output as listed in Table I, with a 900 RPM, 1,125 RPM overspeed, 3 phase, 60 Hertz, 4,160 volts. Included with each generator is a brushless excitation system, voltage regulator, lightning arrester and surge capacitor.

Mr. Lystra

-2-

October 24, 1978

The additional accessories included would be a Woodward U.G. type governor for control of the blades, oil pressure system, turbine inlet streamseal type valve, shaft couplings and electrical controls for each unit.

Our present day preliminary prices on Table I are for the number of units shown and include design and manufacture of the standardized hydroelectric generating sets as described above with prices FOB factory.

The overall dimensions of the proposed equipment can be obtained from Page 5 of the Standardized Hydroelectric Generating Brochure 54B10241-02, which is enclosed.

The expected performance curves for the proposed equipment would be as shown on Curve Sheet 6-33265-A for the Peninsula Paper Company Project and 6-33266-A for the French Landing Project.

We are presently anticipating a six to nine month delivery for the equipment described above.

If further information is desired concerning this equipment, please do not hesitate to call upon us.

Very truly yours,

G. M. Hickey
Sales Engineer

GMH/gps
Enclosure

cc: Mr. P. C. Riley, F. W. Riley Company, Niles, Michigan
Mr. J. Patterson, A-C York

October 24, 1978

TABLE I
FEASIBILITY STUDY
FOR
AYRES, LEWIS, NORRIS & MAY, INC.

Site No.	1	2
A-C Inquiry No.	6-33265	6-33266
Turbine Runner Size (mm)	1,750	1,250
No. of Adjustable Blades	4XA	4XA
Turbine Rating (KW)	400	750
Generator Maximum Rating (KW)	400	750
Rated Flow (cms)	12.3	12.3
Rated Net Head (M)	4.0	9.8
Unit Centerline Setting at ... M above Min. Tailwater	1.0	1.0
Estimated Price (\$)/Number of Units	432,000	322,000/1
\$/KW	1,080	429

Allis-Chalmers Corporation
Hydro-Turbine Division
York, Pennsylvania

ALLIS-CHALMERS
STANDARD

tube units

DIMENSIONS,
ARRANGEMENTS

Figure 3

BASIC DIMENSIONS

A = Runner Diameter in millimeters (inches) = 1.00

All Other Dimensions Are In Proportion From Runner Diameter

A	750 (29.5)	1000 (39.4)	1250 (49.2)	1500 (59.6)	1750 (68.9)	2000 (78.7)	2250 (88.6)	2500 (98.4)	2750 (108.3)	3000 (118.1)
B	1.43	1.37	1.34	1.32	1.31	1.30	1.29	1.28	1.27	1.22
C	8.6	7.9	7.3	7.2	6.9	6.7	6.6	6.6	6.5	6.5
D	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
E	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6
F	1.8	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.4
G	3.8	3.6	3.5	3.5	3.4	3.4	3.3	3.3	3.3	3.3
H	1.5	1.3	1.1	1.1	1.0	0.9	0.9	0.9	0.8	0.8
J	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
K	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
L	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7
M	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
N	3.0	2.7	2.6	2.5	2.4	2.4	2.3	2.3	2.3	2.2

NOTE: Dimensions are approximate and may vary for specific applications.

BOFORS
NOHAB

YOUR REF

Ayres, Lewis, Norris & May, Inc.
3983 Research Park Drive
Ann Arbor, Michigan 48104

OUR REF.

Attention: Mr. Donald W. Lystra, P.E.
Associate

TROLLHÄTTAN

New York, October 12, 1978

Re: Preliminary Cost Quotations for Hydraulic Turbines
Peninsula Paper Company - Our Reference No. 1024
French Landing - Our Reference No. 1025

Dear Mr. Lystra:

With reference to today's telephone conversation, we take pleasure in confirming the following preliminary information.

A. Peninsula Paper Company

1. Two vertical open flume propeller turbines
2. Output per unit 300 kw
3. Average head 13 feet (3.96 meters)
4. Discharge 8.87 m³/sec
5. Runner diameter 1400 mm
6. Turbine speed 230 rpm
7. Generator speed 918 rpm
8. Gearbox ratio 1:4
9. Setting 4 meters or less (runner center line elevation above tail water level)

On our drawing 5T137043-1, we have shown the runner blade center line elevation at .5 meters above tail water level in order to have sufficient water depth above distributor crest. If, however, a "vacuum flume" is provided it would be possible to raise the unit to the 4 meters above tail water level mentioned above.

10. Expected turbine peak efficiency 89%
11. Expected gearbox efficiency 98-99%
12. Price per unit F.O.B., Goteburg, Sweden, 800.000 Swedish Kroner

RECEIVED OCT 16 1978

Bofors-Nohab Inc., One World Trade Center, Suite 10225, New York, N.Y. 10048

Telex 640132

B. French Landing

1. Two vertical open flume propeller turbines
2. Output per unit 750 kw
3. Average head 32 feet (9.75 meters)
4. Discharge 9.01 m³/sec
5. Runner diameter 1700 mm
6. Turbine speed 290 rpm
7. Generator speed 918 rpm
8. Gearbox ratio 1:3.15
9. Setting 4 meters or less (runner center line elevation above tail water level)

On our drawing 5T137043-2, we have shown a draft head of 4 meters in order to reduce as far as possible removal of existing concrete.

10. Expected turbine peak efficiency 90%
11. Expected gearbox efficiency 98-99%
12. Price per unit F.O.B., Goteburg, Sweden, 1.110.000 Swedish Kroner

It is also possible to use a 1400 mm unit for this station, i.e., identical to the unit under A. above. This would, however, require removal of more existing concrete and possibly also excavation below the existing draft tube bottom.

The following data would be valid:

Output 750 kw

Turbine speed 367 rpm

Generator speed 910 rpm

Gearbox ratio 1:2.5

Setting 2 meters or less (runner center line elevation above tail water level)

The above prices include:

Vertical turbine with moveable runner blades,

Control equipment for the runner blades comprising a float arrangement on the head water level,

Draft tube conical liner,

Gearbox

BOFORS
NOHAB

3.

It should be noted that although the runner blades are moveable they are not suitable to shut off the flow completely, i.e., an intake gate or similar shut off mechanism must be provided and is not included in our quoted prices.

Please do not hesitate to contact us should there be any further information that you may desire.

Very truly yours,

BOFORS-NOHAB INC.

Arthur Meland
President

AM:oez

Enclosures: Drawings 5T137043-1
5T137043-2

Small scale hydro turbine program
including three separate dimensional
sketches
Nohab bulb turbines
Water turbines - Reference list

OPEN FLUME ARRANGEMENT

BASIC DIMENSIONS

BASIC DIMENSIONS

The tabulation shows dimensions (coefficients) in proportion from the runner diameter " D " in millimeter (inches).

D	500 (19,7)	700 (27,6)	900 (35,4)	1150 (45,3)	1400 (55,1)	1700 (66,9)	2000 (78,7)	2250 (88,6)	2500 (98,4)	2750 (108,3)	3000 (118,1)
B	2,67	2,67	2,67	2,67	2,67	2,67	2,67	2,67	2,67	2,67	2,67
C	1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33	1,33
D_1	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
E_{min}	0,5	0,43	0,33	0,26	0,21	0,18	0,2	0,18	0,16	0,16	0,15
F	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
G	0,84	0,84	0,84	0,84	0,84	0,84	0,84	0,84	0,84	0,84	0,84
L	4,44	4,44	4,44	4,44	4,44	4,44	4,44	4,44	4,44	4,44	4,44

NOTE: All dimensions are indicative only and can be changed depending on site conditions.

Dominion
Engineering
Works
Limited

P.O. Box 220, Montreal, P.Q., Canada H3C 2S5
Telephone: Area 514 634-3411
Cable Address: Domworks Montreal
Telex 05-821673

Head Office and Plant: Lachine, P.Q.
Branch Offices: Toronto and Vancouver

RECEIVED OCT 02 1978

File: 300-87

27 September 1978

Mr. Donald W. Lystra, P.E.
Ayres, Lewis, Norris & May, Inc.
Engineers, Architects, Planners
3983 Research Park Drive
Ann Arbor, Michigan 48104
USA

RE: Dept.of Energy PRDA No.ET-78-0-07-1706

Dear Sirs:

We appreciate the opportunity of reviewing your requirements.

Unfortunately the turbines required for these two applications are smaller than we manufacture, therefore we are unable to provide budget prices.

We hope that on future projects we can be of more assistance.

Yours truly,

DOMINION ENGINEERING WORKS LIMITED

Ian McKay,
Sales Engineer.
Hydraulic Turbine Section.

/mcp

— OUR 116th ANNIVERSARY YEAR —

THE JAMES LEFFEL & CO.

MANUFACTURERS OF

HYDRAULIC TURBINES

SCOTCH BOILERS-STOKERS

SPRINGFIELD, OHIO, U.S.A.
45501

CABLE ADDRESS
"LEFFEL SPRINGFIELD OHIO"

TELEPHONE 323-6431
AREA CODE 513

ALL CONTRACTS AND AGREEMENTS ARE CONTINGENT UPON STRIKES, ACCIDENTS OR OTHER CAUSES BEYOND OUR CONTROL, AND SUBJECT TO APPROVAL AT THE HOME OFFICE AT SPRINGFIELD, OHIO.
ALL QUOTATIONS F.O.B. FACTORY, SPRINGFIELD, OHIO, UNLESS OTHERWISE STATED, AND ARE FOR PROMPT ACCEPTANCE ONLY.
ALL RIGHTS RESERVED TO CORRECT ERRORS ON QUOTATIONS OR ANY OTHER MATTER HEREIN.

October 18, 1978

Ayres, Lewis, Norris & May, Inc.
Engineers - Architects - Planners
3983 Research Park Drive
Ann Arbor, Michigan 48104

Attention: Mr. Donald Lystra, PE

Subject: Leffel W78-2332

Dear Mr. Lystra:

Referring to your letter of September 12 and also referring to Mr. Groff's letter of September 19. We very much regret the delay in replying to your letter, however, this has been due to a considerable amount of work in our Engineering Department.

We note from your letter of September 12 that you are interested in two (2) 300 KW units for Site #1 and two (2) 750 KW units for Site #2.

With your letter you sent us additional information on Site #1. We note that the average head at this site is 13' and for Site #2 the average head is 32'.

We note that you are interested in vertical propeller type turbine units and we will be glad to furnish turbines that would meet with your requirements.

With the additional information that you sent to us, you also sent drawings for Site #1 and Site #2.

SITE #1

For this site, we note two units will be required each having a rating of 300 KW which means that the turbine output must be 450 HP.

We can furnish vertical propeller type turbines installed in an open flume setting similar to that shown on the drawings that you sent us.

Ayres, Lewis, Norris, & May, Inc.

-2-

W78-2332

We are, herewith, enclosing Bulletin A-45. Please refer to the page referring to vertical propeller installed in an open flume setting.

The performance of this vertical propeller turbine will be as follows when operating at a speed of 164 RPM under a net effective head of 13'.

164 RPM 13' Net Head			
% Load	Horsepower	Exp. Efficiency	Exp. CFS
1.00	450	86.0	355
95	427.5	90.0	322
90	405	89.2	308
80	360	86.0	284
70	315	81.8	261
60	270	77.2	237
50	225	71.8	212

The maximum runaway speed would be 328 RPM.

The total thrust, based on the turbine equipment, will be 26,000 pounds. This includes the weight of the turbine runner and shaft as well as the hydraulic thrust setup by the turbine runner.

The governor effort to operate the turbine gates would be approximately 5,000 FT LB.

We would furnish a Woodward governor which would be connected by means of levers and links to the turbine gate shaft.

The unit would be furnished with either a vertical conical plate steel draft or if an elbow type of a draft tube would be required, we could design the tube and this tube would be made of concrete. We would furnish a short draft tube liner and extending into the concrete elbow draft tube.

The runner would be made of semi-steel and the runner would be furnished with six blades.

The turbine would be furnished with submerged type gate mechanism and this mechanism would be connected by means of levers and links to the turbine gate shaft which would extend above the generator floor for connection to governing equipment.

For this complete turbine without generator or governing equipment, price approximately:

Price - - - - - \$92,000.00 f.o.b. factory
Springfield, Ohio
Gross shipping weight - - - - 29,000 pounds

If a Woodward governor would be furnished, the design would be of the UG type and will have ample capacity to operate this turbine unit as require. Approximate price:

Price - - - - - \$20,000.00 f.o.b. factory
Springfield, Ohio

Gross shipping weight - - - 1500 pounds (approximate)

SITE #2

We understand that two (2) units will be required for this site - each turbine driving a generator having an output of 750 KW. The horsepower required by the turbine would be approximately 1125 HP. However, we have selected a turbine that would have slightly more output than the referred to above.

This turbine would also be of the vertical propeller type design installed in an open flume or a concrete pressure flume.

The performance of this turbine will be as follows when operating at a speed of 300 RPM and under a net effective head of 32':

300 RPM		32' Net Head	
% Load	Horsepower	Exp. Efficiency	Exp. CFS
1.00	1250	85.8	402
95	1187	90.0	365
90	1125	89.2	348
80	1000	86.0	321
70	875	82.0	294
60	750	77.2	268
50	625	71.8	240

The maximum runaway speed would be 600 RPM.

The total thrust setup by the turbine would be 42,000 pounds. This includes the weight of the turbine runner and shaft as well as the hydraulic thrust setup by the turbine runner. This total thrust must be added to the generator rotating parts.

With this turbine, we can furnish governing equipment. The effort to operate the turbine gates would be 8,840 FT LB.

The turbine would be similar in design as referred to for Site #1 only somewhat smaller in physical dimensions than that referred. The size of the turbine would be smaller which is due to the difference in head conditions since this head is 32'

Ayres, Lewis, Norris & May, Inc.

-4-

W78-2332

For this turbine with wall ring and cover which would be installed in the pressure flume and these covers would be furnished with packing boxes where the shaft extends through the floor so that there will be no leakage of water on the generator floor.

For this complete turbine unit with wall ring and covers, price approximately:

Price - - - - - \$88,000.00 f.o.b. factory
Springfield, Ohio - for 1
Gross shipping weight - - - 21,000 pounds

If a governor would be required, we could furnish a UG Woodward governor, price approximately:

Price - - - - - \$20,000.00 f.o.b. factory
Springfield, Ohio - for 1
Gross shipping weight - - - 1400 pounds

We are very much interested and we hope that this will meet with your requirements and if you need further information in reference to the turbine unit we have selected, please write us.

Appreciate hearing from you further in reference to the above.

Sincerely,

THE JAMES LEFFEL & COMPANY

R. Sahle
R. Sahle
Chief Engineer

RS:sjs

Enclosure

AYRES, LEWIS, NORRIS and MAY, Inc.
3983 Research Park Drive
ANN ARBOR, MICHIGAN 48104
(U.S.A.)

N/Réf. HYD/TUR/PFS/SS
V/Réf.

GRENOBLE, le 4th December 1978

Dear Sirs,

We are writing in reply to your letter dated September 12th 1978 concerning two hydroelectric renovation projects on the HURON river, Michigan - French Landing, Van Buren Township, and Peninsular Paper Company, Ypsilanti.

Because your letter arrived at a time when we were revising our range of small bulb turbines, we are rather late in replying. However, we hope that the information included with this letter will be of interest to you.

1. INTRODUCTION

All the turbines proposed are selected from our range of standardised right-angle drive (RAD) bulb turbines which are available for heads up to 18 m (60 ft) and from 150 kW to 1500 kW unit power. These turbines are derived from the much larger units which we have developed in recent times, and use the same proportions and profiles. However, the main difference is that the generator is placed vertically above the turbine, outside the water passage. In fact, these machines are too small to allow access and maintenance to a generator placed inside the water duct, unlike the larger bulb turbines where the generator can be inspected without dewatering the unit. Furthermore, the use of a right-angle drive (a pair of spiral bevel gears) enables the runner speed to be stepped up to 900 rpm so that a standard, high-speed induction motor can be used as a generator. Of course, in this case, the machines must be connected to a more powerful network which supplies the necessary reactive power.

A drawing of a typical (new) installation is enclosed for your information. On this drawing can be seen the following :

- . Trashrack and intake stoplog,
- . Intake duct,
- . Turbine with its generator,

RECEIVED DEC 08 1978

ENCL.

- . Draft tube,
- . Roller-type tail gate,
- . Access road for installation and maintenance vehicles (above the draft tube).

Some of the other advantages are as follows :

- . Straight water duct reducing both the hydraulic losses and the civil works costs,
- . High-efficiency, high-speed bulb turbine with small runner diameter,
- . No civil works embedments for the generator,
- . Flow control either by varying the number of units in service (fixed-pitch machines) or by adjusting runner blades by remote control during shut-down (variable-pitch machines),
- . Turbines fully assembled in our works before shipping.

2. PROPOSALS FOR FRENCH LANDING, VAN BUREN TOWNSHIP

For this project, we have examined two different possibilities in order to determine the most satisfactory annual power production with respect to investment costs.

Before going into details, we would mention that we found your 2 x 750 kW figure rather high considering the annual flow duration given with your letter : here in Europe, and particularly in the case of small hydro, we tend to install a little less total power in order to ensure maximum profit returns.

2.1. VERSION 1

This corresponds to your enquiry but with a little less power : 2 identical RAD bulb turbines with variable-pitch runners. Keeping within reasonable efficiency limits, each turbine can cope with flows between 4 and 8.5 m³/s (140 to 300 cfs) and produces a maximum power of 642 kW under the given head of 9.75 m (32 ft) at 8.5 m³/s. This is the power at the turbine output shaft.

According to your annual flow duration figures, and taking into account the variation in turbine efficiency as a function of the discharge, the total annual electrical production assuming a generator efficiency of 95 % would be about 5 400 000 kWh.

2.2. VERSION 2

This consists of 3 RAD bulb turbines with fixed-pitch runners having different power :

- . 1 turbine set for 4 m³/sec (140 cfs) giving 315 kW
- . 1 turbine set for 5.5 m³/sec (194 cfs) giving 442 kW
- . 1 turbine set for 7.5 m³/sec (265 cfs) giving 605 kW

The set of 3 turbines, each of which runs at a fixed discharge, gives the following range of discharge depending on the machines in service :

4 - 5.5 - 7.5 - 9.5 - 11.5 - 13 - 17 m³/sec.

According to your flow duration figures, the total annual electrical production, assuming in each case a generator efficiency of 95 %, would be about 5 260 000 kWh.

2.3. REMARKS

As you will see in the price estimates, the two variable-pitch turbines of Version 1 cost slightly more than the three fixed-pitch machines of Version 2. However, there is little difference in the annual production (Version 1 produces about 3 % more kWh). This is explained by the fact that the turbines of Version 2 always run at maximum efficiency.

In our opinion, therefore, Version 2 is the better solution because the turbines are very much more simple and require far less maintenance than the variable-pitch turbines. Downtime and maintenance costs are thus reduced. Furthermore, having 3 different sizes of turbine should not create any difficulties for spares etc... as each machine is standardised and not purpose-built.

3. PROPOSAL FOR PENINSULAR PAPER COMPANY, YPSILANTI

For this site which has a rather low head and may be a marginal investment, we have only estimated for the fixed-pitch version, i.e. under 3.96 m (13 ft) :

- . 1 turbine set for 4 m³/sec. giving 126 kW
- . 1 turbine set for 5.5 m³/sec giving 163 kW
- . 1 turbine set for 7.5 m³/sec giving 232 kW.

These powers are at the turbine output shafts. The total annual electrical production assuming generator efficiency of 95 % would be about 2 010 000 kWh.

Here, two of the turbines are identical but set differently, and the third turbine is the next model up in the range.

4. CONCLUSION

We enclose herewith an estimate for each of these two projects, completed by brief technical specifications, possible installation drawings, and, for each runner diameter, drawings showing overall dimensions required for turbine and draft tube.

A pamphlet on this range of small turbines is being prepared and will be forwarded to you as soon as it is available. This publication will also cover a new product for adapting our fixed-pitch machines to synchronous operation (i.e. with speed governing) to enable use on isolated networks.

In the meantime, we remain at your disposal for any further information you may require. If this is the case, please contact us directly at our factory here in Grenoble.

Yours faithfully,

GROUPE HYDRAULIQUE
Le Directeur Commercial,

L. MEGNINT

PS : Please, address all correspondence to the attention of :

Mr CHADENSON

Departement Microcentrales

NEYRPIG

GRENOBLE FRANCE

TYPICAL SMALL POWER STATION
DAM WALL BASE INSTALLATION

MAIN DIMENSIONS (MM)

RUNNER DIA.	R	800	1 000	1 250	1 500	1 800
PIT LENGTH	C	2 700	2 900	3 200	3 700	3 900
DRAFT TUBE CONE	D	2 500	3 200	3 820	4 680	5 780
TULIP LENGTH	E	780	970	1 210	1 460	1 750
GATE SLOT	F	265	300	340	400	450
FLOOR DEPTH	H	1 340	1 550	1 830	2 100	2 350
INTAKE DIA.	S	1 530	1 830	2 240	2 650	3 150
TULIP DIA. AND SQUARE	T	1 440	1 800	2 200	2 650	3 200

* These dimensions are not binding and should not be used for installation purposes.

* Centreline of turbine and draft tube must not be sloped more than 15° from horizontal.

Grenoble, 4th December 1978

PENINSULAR PAPER COMPANYYPSILANTI, MICHIGANRENOVATION PROJECT FOR HYDROELECTRIC PLANTSPECIFICATION AND ESTIMATE FOR TURBINES

Average head : 3,96 m

Maximum total discharge : 17 m³/s

3 horizontal-axis RAD bulb turbines, characteristics as follows :

Turbine n°	1	2	3
Bulb type	440	440	560
Runner dia (mm)	1000	1000	1250
Runner type	4 bladed one-piece (fixed) propeller type		
Discharge (m ³ /s)	4,0	5,5	7,5
Power at above discharge on output shaft (kW)	126	163	232
Generator speed (rpm)	900	900	900
Turbine altitude	same conditions as for French Landing		
Tail gate dimensions (mm)	1800 x 1800	1800 x 1800	2200 x 2200

Total annual production : About 2 010 000 kWh at generator terminals
according to your flow duration figures, assuming a generator efficiency of 95 %.

DESCRIPTION OF TURBINES

Each turbine is composed of the following :

- Plate steel turbine case including a fixed distributor, a stainless steel runner band, upstream and downstream flanges for embedding in the concrete and the mounting flange and coupling for the generator.
- Cast steel "bulb" or gear casing containing the RAD spiral bevel gears, the runner shaft, the runner seal, rolling element bearings all dimensioned for more than 100 000 hours L10, and the vertical output shaft.
- Aluminium bronze runner, either one-piece for the fixed-pitch versions, or with blades adjustable by remote control during shut-down for the variable pitch versions.
- Lubrication and seal pressurizing system with oil tank, pump, filter, oil cooler.
- Safety devices including oil flow, pressure, level and temperature monitors and overspeed detector.

Each turbine is assembled in our workshops before shipping, and arrives on the site ready for installation.

SUPPLY LIMITS

Our quotation does not include the following :

- Electrical equipment, i.e. generators, switchgear, control gear and relaying transformers, meters, and all their wiring and cables.
- Trashracks, intake stoplogs, tail gates, intake and draft tubes, drainage equipment, handrails and ladders.
- Civil works and their drawings.

PRICES

- Price of one RAD bulb turbine, type 440, runner diameter 1000 mm, fixed-pitch runner, 126 or 163 kW at 4,0 or 5,5 m³/s respectively, under 3,96 m head :

686 000 FF

- Price of one RAD bulb turbine, type 560, runner diameter 1250 mm, fixed pitch runner, 232 kW at 7,5 m³/s under 3,96 m head :

839 000 FF

TOTAL for two type 440/Ø1000 and one type 560/Ø 1250 : 2 211 000 FF _{50%}

All these prices are estimated budget prices. They are in French Francs, uninclusive of taxes and import duties, adjustable on base September 1978, payments accompanying our expenses. Delivery is F.O.B. from a French port. Delivery time about 14 months for the first machine, followed by one machine per month thereafter.

Drawing No 451 548 gives a possible installation. A 1250 mm dia. machine is shown. Of course, you could situate the turbines anywhere else in power house as long as the conditions relating to the distance below low tail water are respected.

GROUPE HYDRAULIQUE
Le Directeur Commercial,

L. MEGNINT

F. W. E. STAPENHORST INC.

285 LABROSSE AVE., POINTE CLAIRE, QUE. H9R 1A3

TEL: (514) 695-2044

TELEX: 05-82177B

RECEIVED MAR - 5 1979

March 1, 1979

Ayers, Lewis, Morris, May
3983 Research Park Drive
Hanover, Mich. 48104
U.S.A.

Attention: Mr. Don Lystra

Dear Mr. Lystra:

Please find enclosed a sketch showing approximate space requirements for the Ypsilanti project.

The sketch is not to scale, but the relative sizes of the components are about right.

Weights indicated are also only approximate, but accurate enough for preliminary floor design.

If you have any further questions, please do not hesitate to contact me.

Yours very truly,

F.W.E. STAPENHORST INC.

F. Kanger, P. Eng.

Enclosures

CC: Mr. Joe Keating

FK/hr

3-4' to wall

(K)

79/03/01

(k)

YPSILANTI

79/03/01

View of Typical OSSBERGER Turbine Assembly

APPLICATION			REVISIONS		
NEXT ASSY.	USED ON	LTR	DESCRIPTION	DATE	APPROVED

PART NO	QTY.	CODE IDENT.	PART IDENT. NO.	DESCRIPTION	MATERIAL & SIZE
				PARTS LIST	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONAL ± ANGLES ± 3 PLACE DECIMALS ± 2 PLACE DECIMALS ± SURFACE FINISH (EXCEPT AS NOTED) ✓ RAK SHARP RNNERS 003- 015				DESIGNED DATE MAY 6 '75 DRAWN L MELANSON CHECKED APPR'D	
				F. W. E. STAPENHORST INC. 285 LABROSSE AVE., POINTE CLAIRE, QUÉ. H9R 1A3 TELEPHONE (514) 695-2044 TELEX 05-821778	
				SIZE OUR REF: 0230	DRAWING NO S-7501-A1
				SCALE —	WT. —
				SHEET 1 OF 1	

SULZER BROS. INC.

SULZER

Mailing Address:

19 Rector Street
New York, N.Y. 10006

Telephone
Area Code 212
Hanover 5-4560

Cable Address: Sulfra
Telex: 232126

Please quote our reference
in correspondence and
telephone calls

RECEIVED SEP 25 1978

Ayres, Lewis, Norris & May, Inc.
3983 Research Park Drive
Ann Arbor, Michigan 48104

Attn: Mr. Donald W. Lystra

Your Reference

Your letter of

Our reference
Mo/ur

Date

September 21, 1978

Re: French Landing Hydroelectric Projects

Gentlemen:

Thank you for your letter of September 12, 1978. We now have pleasure in submitting prices and technical data for a solution with STRAFLO Turbines:

Type:	STRAFLO with fixed runner blades and adjustable wicket gates
Number of units:	Two (2)
Head:	32 ft
Discharge:	308 cfs
Output:	750 kW
Normal speed:	400 rpm
Runner dia.:	51 in.
Submergence:	Unit centerline at min. tailwater level

Estimated price for two (2) turbines including
generators and governors, F.O.B. job site,
erection and commissioning not included

US \$ 690,000.00
=====

For your information we are enclosing a sketch giving you some main dimensions of the turbine.

./.

SULZER

Our reference
Mo/ur
To

Page
2

Date
9/21/1978

Ayres, Lewis, Norris & May, Inc., Ann Arbor

We do not have a proper unit for the Peninsula Paper Project, since the output is too small for the application of a STRAFLO Turbine. Therefore, we would like to be excused from submitting a proposal for this unit.

Should you need additional information, please do not hesitate to contact us.

Very truly yours,

SULZER BROS. INC.
by

B. E. Moser

B. E. Moser
Vice President

Encl.

as mentioned

CC: Mr. van der Schaar
Mr. Sennhauser

QUOTATION FROM

IDEAL ELECTRIC CO.

330 EAST FIRST STREET • MANSFIELD, OHIO 44903 U. S. A.

TELEPHONE (AREA CODE 419) 522-3611 • TELEX 98-7410

TO Ayers, Lewis, Norris & May

Negotiation No. GGSH 791215 DG A

Date January 19, 1979

Your Inquiry Budget Prices

RECEIVED JAN 23 1979

Gentlemen:

We are pleased to quote you on the following equipment and materials subject to conditions specified below.

Horizontal Generators to be as follows:

IDEAL Type "SAB".8 P.F., 300 RPM, 3 phase, 60 hertz, 4160 volts, 105° C rise by resistance, continuous duty above a 40° C ambient, Class "F" insulation, horizontal, open dripproof, two bearing, low speed brushless synchronous generator with damper windings. Suitable for runaway speed to 600 RPM without injury
Stator temperature detectors

IDEAL Type "FRBA", suitable KW, 300 RPM, 105° C rise, Class "F" insulation, horizontal, brushless exciter, direct connected.

Static type voltage regulator system including:

Static type voltage regulator
Voltage adjusting rheostat
Three phase sensing circuitry
Isolation power transformer

Vertical generators to be furnished with thrust bearing designed to carry a continuous external downthrust of (see table)

Voltage regulator system furnished loose for mounting and wiring by others.

Continued page 2

Terms:

F. O. B. Mansfield, Ohio

Shipment

Quotations are based on acceptance within 15 days; are subject to change without prior notice and to the approval of an executive officer of the company. Deliveries are contingent upon delays beyond our control.

Respectfully submitted,

THE IDEAL ELECTRIC & MFG. CO.

By

IDEAL ELECTRIC CO.

330 EAST FIRST STREET • MANSFIELD OHIO 44903 U. S. A.
TELEPHONE (AREA CODE 419) 522-3611 • TELEX 98-7410

TO Ayers, Lewis, Norris & May

Negotiation No. GGSH 791215 DG 4

Page 2

Horizontal Generators

Item	KVA	KW	Net Price Each
1	300	240	\$55,025.00
2	400	320	58,920.00
3	600	480	67,960.00
4	800	640	77,990.00

Vertical Generators

Item	KVA	KW	Thrust	Net Price Each
1	300	240	26,000#	79,425.00
2	400	320	26,000#	85,490.00
3	600	480	42,000#	99,590.00
4	800	640	42,000#	115,670.00

Terms and Conditions

1. The prices quoted are for estimating purposes
2. Delivery: 26 - 28 weeks after approval and release for production.
3. For the services of an Ideal Electric Field Engineer refer to General Section "0000" for rates (attached)

Terms: Net 30 days

F.O.B. Mansfield, Ohio

Shipment See above

Freight allowed to first destination within continental USA
excluding Alaska & Hawaii

Quotations are based on acceptance within 15 days; are subject to change without prior notice and to the approval of an executive officer of the company. Deliveries are contingent upon delays beyond our control.

Respectfully submitted,

IDEAL ELECTRIC CO.

cc: Detroit Office

By _____

jc

MILWAUKEE FALK CORPORATION
MILWAUKEE, WISCONSIN

SPECIAL UNIT QUOTATION

DATE: 1-23-79
SHEET 2 OF 4

TO: _____ AT _____

FROM: _____ AT _____

SUBJECT: AYRES, LEWIS, NORRIS & MCG FALK INQ. NO.: 78G852-684

UNIT NO.: _____

OR GENERATOR DRIVE, 670 HP, 300-1200 RPM, 3.95:1 RATIO, 1.25 SF,

NOTE 1- 20 x 4.8 EXVIS

PRICE 30,100⁰⁰ NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES NO

- ☐ ☒ BEDPLATE
- ☒ ☐ LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)
- ☐ ☒ SOLEPLATE (UNDER UNIT ONLY)
- ☐ ☒ MOUNTING OF CUSTOMER'S MOTOR
- ☐ ☒ MOUNT 1/2 OF CUSTOMER'S H.S. CPLG.
- ☐ ☒ MOUNT 1/2 OF CUSTOMER'S L.S. CPLG.
- ☐ ☒ SPECIAL RATIO
- ☐ ☒ SPECIAL OR MODIFIED SHAFTS
- ☐ ☒ EXPORT PREPARATION
- ☐ ☒ GREASE PURGED SEALS (1 H.S. & 1 L.S. EXT.)

YES NO

- ☐ ☒ FANS ()
- ☒ ☐ ~~MOTOR~~ BRACKET GEN.
- ☐ ☒ BACKSTOP
- ☐ ☒ H.S. CPLG. GUARD
- ☐ ☒ L.S. CPLG. GUARD
- ☐ ☒ SPECIAL PAINT
- ☐ ☒ H.S. CPLG. () SIZE
- ☐ ☒ L.S. CPLG. () SIZE
- ☐ ☒ OTHER

SPECIAL FEATURES:

YES NO

- ☐ ☒ VERTICAL CENTER
- ☐ ☒ VERTICAL L.S. SHAFT
- ☒ ☐ VERTICAL H.S. & L.S.S.
- ☐ ☒ HOLLOW L.S.S.
- ☐ ☒ DUAL PINION

YES NO

- ☐ ☒ DUAL GEAR
- ☐ ☒ 2 HI - DUAL OUTPUT
- ☐ ☒ RIGHT ANGLE INPUT (BEVEL WORM)
- ☐ ☒ IDLER
- ☒ ☐ OTHER THRUST BRG.

PRICES ARE NET F.O.B. MILWAUKEE FREIGHT NOT ALLOWED.

PRICES ARE FOR ACCEPTANCE WITHIN 90 DAYS.

THIS QUOTATION IS SUBJECT TO THE TERMS AND CONDITIONS ON POLICY #100-603.

PROGRESS PAYMENTS ~~WILL~~, WILL NOT BE REQUIRED. ~~RATE OF PAYMENT PER SALES PRIORITY LETTER #322.~~

DELIVERY 34 wks.

COMMENTS MAX RATED SPEED 2500 RPM

011

FALK CORPORATION
MILWAUKEE, WISCONSIN

SPECIAL UNIT QUOTATION

DATE: 1-23-79
SHEET 3 OF 4

_____ AT _____

FROM: _____ AT _____

SUBJECT: AYRES LEWIS NORRIS & May FALK INQ. NO.: 78G852-684

UNIT NO.: _____

OR GENERATOR DRIVE, 804 HP, 300-1200 RPM, 4:1 RATIO, 1.25 SF,

NOTE 1- 22.5 x 4 ZXVIS

PRICE 31,500⁰⁰ NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES	NO	YES	NO
☐	☒ BEDPLATE	☐	☒ FANS ()
☒	☐ LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)	☒	☐ FLANGE BRACKET <u>GEN.</u>
☐	☒ SOLEPLATE (UNDER UNIT ONLY)	☐	☒ BACKSTOP
☐	☒ MOUNTING OF CUSTOMER'S MOTOR	☐	☒ H.S. CPLG. GUARD
☐	☒ MOUNT 1/2 OF CUSTOMER'S H.S. CPLG.	☐	☒ L.S. CPLG. GUARD
☐	☒ MOUNT 1/2 OF CUSTOMER'S L.S. CPLG.	☐	☒ SPECIAL PAINT
☐	☒ SPECIAL RATIO	☐	☒ H.S. CPLG. () SIZE
☐	☒ SPECIAL OR MODIFIED SHAFTS	☐	☒ L.S. CPLG. () SIZE
☐	☒ EXPORT PREPARATION	☐	☒ OTHER
☐	☒ GREASE PURGED SEALS (1 H.S. & 1 L.S. EXT.)		

SPECIAL FEATURES:

YES	NO	YES	NO
☐	☒ VERTICAL CENTER	☐	☒ DUAL GEAR
☐	☒ VERTICAL L.S. SHAFT	☐	☒ 2 HI - DUAL OUTPUT
☒	☐ VERTICAL H.S. & L.S.S.	☐	☒ RIGHT ANGLE INPUT (BEVEL WORM)
☐	☒ HOLLOW L.S.S.	☐	☒ IDLER
☐	☒ DUAL PINION	☒	☐ OTHER <u>THRUST BRG.</u>

PRICES ARE NET F.O.B. MILWAUKEE FREIGHT NOT ALLOWED.
PRICES ARE FOR ACCEPTANCE WITHIN 90 DAYS.

THIS QUOTATION IS SUBJECT TO THE TERMS AND CONDITIONS ON POLICY #100-603.

PROGRESS PAYMENTS ~~WILL~~, WILL NOT BE REQUIRED. ~~RATE OF PAYMENT PER SALES PRIORITY LETTER #322.~~

DELIVERY 34 WKS.

COMMENTS MAX RATED SPEED 2900 Rpm

MILWAUKEE CORPORATION
MILWAUKEE, WISCONSIN

SPECIAL UNIT QUOTATION

JAN 25 1979

DATE: 1-23-79
SHEET 1 OF 4

BY J. SCHNEIDER AT DETROIT

FOR R. HESER AT MILW.

SUBJECT: HIRES, LEWIS, MORRIS & ME FALK INQ. NO.: 72G852-684

UNIT NO.: _____

OR GENERATOR DRIVE, 402 HP, 300-1200 RPM, 3.95:1 RATIO, 1.25 SF,

NOTE 1- 20 x 3.5 Z X VIS

PRICE 28,400⁰⁰ NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES NO

☐	☒	BEDPLATE
☒	☐	LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)
☐	☒	SOLEPLATE (UNDER UNIT ONLY)
☐	☒	MOUNTING OF CUSTOMER'S MOTOR
☐	☒	MOUNT 1/2 OF CUSTOMER'S H.S. CPLG.
☐	☒	MOUNT 1/2 OF CUSTOMER'S L.S. CPLG.
☐	☒	SPECIAL RATIO
☐	☒	SPECIAL OR MODIFIED SHAFTS
☐	☒	EXPORT PREPARATION
☐	☒	GREASE PURGED SEALS (1 H.S. & 1 L.S. EXT.)

YES NO

☐	☒	FANS ()
☒	☐	STATION BRACKET GEN.
☐	☒	BACKSTOP
☐	☒	H.S. CPLG. GUARD
☐	☒	L.S. CPLG. GUARD
☐	☒	SPECIAL PAINT
☐	☒	H.S. CPLG. () SIZE
☐	☒	L.S. CPLG. () SIZE
☐	☒	OTHER

SPECIAL FEATURES:

YES NO

☐	☒	VERTICAL CENTER
☐	☒	VERTICAL L.S. SHAFT
☒	☐	VERTICAL H.S. & L.S.S.
☐	☒	HOLLOW L.S.S.
☐	☒	DUAL PINION

YES NO

☐	☒	DUAL GEAR
☐	☒	2 HI - DUAL OUTPUT
☐	☒	RIGHT ANGLE INPUT (BEVEL WORM)
☐	☒	IDLER
☒	☐	OTHER <u>THRUST BRG.</u>

PRICES ARE NET F.O.B. MILWAUKEE FREIGHT NOT ALLOWED.
PRICES ARE FOR ACCEPTANCE WITHIN 90 DAYS.

THIS QUOTATION IS SUBJECT TO THE TERMS AND CONDITIONS ON POLICY #100-603.

PROGRESS PAYMENTS ~~WILL~~, WILL NOT BE REQUIRED. ~~RATE OF PAYMENT PER SALES PRIORITY LETTER #322.~~

DELIVERY 34 WKS.

UNITS MAX RATED SPEED 2500 Rpm

THE FALK CORPORATION
MILWAUKEE, WISCONSIN

SPECIAL UNIT QUOTATION

DATE: 1-23-79
SHEET 4 OF 4

TO: _____ AT _____

FROM: _____ AT _____

SUBJECT: AYRES, LEWIS, NORRIS + MAY FALK INQ. NO.: 78G852-684

UNIT NO.: _____

OR GENERATOR DRIVE, 1072 HP, 300-1200 RPM, _____ RATIO, 1.25 SF,

QUOTE 1- 22.5 x 5ZXVIS

PRICE 34,100⁰⁰ NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES NO

- ☐ ☒ BEDPLATE
- ☒ ☐ LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)
- ☐ ☒ SOLEPLATE (UNDER UNIT ONLY)
- ☐ ☒ MOUNTING OF CUSTOMER'S MOTOR
- ☐ ☒ MOUNT 1/2 OF CUSTOMER'S H.S. CPLG.
- ☐ ☒ MOUNT 1/2 OF CUSTOMER'S L.S. CPLG.
- ☐ ☒ SPECIAL RATIO
- ☐ ☒ SPECIAL OR MODIFIED SHAFTS
- ☐ ☒ EXPORT PREPARATION
- ☐ ☒ GREASE PURGED SEALS (1 H.S. & 1 L.S. EXT.)

YES NO

- ☐ ☒ FANS ()
- ☒ ☐ ~~BRACKET~~ BRACKET GEN.
- ☐ ☒ BACKSTOP
- ☐ ☒ H.S. CPLG. GUARD
- ☐ ☒ L.S. CPLG. GUARD
- ☐ ☒ SPECIAL PAINT
- ☐ ☒ H.S. CPLG. () SIZE
- ☐ ☒ L.S. CPLG. () SIZE
- ☐ ☒ OTHER

SPECIAL FEATURES:

YES NO

- ☐ ☒ VERTICAL CENTER
- ☐ ☒ VERTICAL L.S. SHAFT
- ☒ ☐ VERTICAL H.S. & L.S.S.
- ☐ ☒ HOLLOW L.S.S.
- ☐ ☒ DUAL PINION

YES NO

- ☐ ☒ DUAL GEAR
- ☐ ☒ 2 HI - DUAL OUTPUT
- ☐ ☒ RIGHT ANGLE INPUT (BEVEL WORM)
- ☐ ☒ IDLER
- ☒ ☐ OTHER THRUST BRG.

PRICES ARE NET F.O.B. MILWAUKEE FREIGHT NOT ALLOWED.
PRICES ARE FOR ACCEPTANCE WITHIN 90 DAYS.

THIS QUOTATION IS SUBJECT TO THE TERMS AND CONDITIONS ON POLICY #100-603.

PROGRESS PAYMENTS ~~WILL~~, WILL NOT BE REQUIRED. ~~RATE OF PAYMENT PER SALES PRIORITY LETTER #322.~~

DELIVERY 34 WKS.

COMMENTS: MAX RATED SPEED 2900 RPM

FEDERAL ENERGY REGULATORY COMMISSION

WASHINGTON, D.C. 20426

OEPR AUG 18 1978

RECEIVED AUG 23 1978

Mr. Donald W. Lystra, P. E.
Ayres, Lewis, Norris & May, Inc.
3983 Research Park Drive
Ann Arbor, Michigan 48104

Dear Mr. Lystra:

This is in reply to your letter of July 20, 1978, requesting information on licensing procedures for hydroelectric facilities.

Hydroelectric projects proposed by non-Federal entities must be licensed if they either: (1) occupy Federal lands; (2) are situated on a navigable waterway of the United States; (3) affect interstate or foreign commerce; or (4) utilize surplus water or water power from a government dam. The authority of the Federal government to regulate certain aspects of hydroelectric development is contained in the Federal Power Act.

The requirements for an application for a license are contained in the Regulations of the Federal Energy Regulatory Commission, as set forth in Section 18, Parts 1 to 149, of the Code of Federal Regulations. Relevant excerpts are enclosed. Copies of the Federal Power Act and of 18 CFR Parts 1 to 149 are available by mail from the U. S. Government Printing Office, Washington, D. C. 20402, at costs of \$3.15 and \$4.25, respectively.

Projects of less than 2,000 horsepower capacity receive minor licenses. The requirements for an application for such license are less stringent than those for a project having 2,000 hp or more of installed capacity. Application for minor license projects should be prepared and filed in conformance with Sections 131.6 and 4.31 of the Regulations (copies enclosed).

When an application is received by the Secretary of the Federal Energy Regulatory Commission, it is examined by the Commission staff to determine whether it contains all of the information required by the Commission's Regulations. If so, notice of the application is published in local newspapers in the project area and additional copies of the application are requested from the Applicant and transmitted to various Federal, State, and local agencies for their comments. The Applicant is then given an opportunity to respond to these comments. An environmental impact statement is prepared if the approval of the application would constitute a major Federal action significantly affecting the quality of the environment. Hearings may be held if there are issues of fact that require taking evidence.

Based on the information gathered through the above processes, the Commission staff prepares its recommendations to the five members of the Federal Energy Regulatory Commission. The Commission then reaches a decision as to whether a license should be issued, and, if so, whether any special conditions (as to minimum flow releases, recreation facilities, etc.) need be included.

If your client's plans do not call for construction in the immediate future, and if they wish to obtain priority over a project site, they may file an application for preliminary permit. A preliminary permit, if issued, would not authorize construction. A permit would give the Permittee, during the term of the permit (up to three years), the right of priority of application for license while the Permittee undertakes the necessary studies and examinations to determine the engineering and economic feasibility for the project, the market for the power, and all information necessary for inclusion in an application for license. Procedures to be followed in preparing an application for preliminary permit can be found in Section 4.42 and 4.80 through 4.86 of the Commission's Regulations (copies enclosed).

For further information and assistance in the preparation of applications for license, you may contact: Mr. Leonard Podell of our Washington, D. C. office on 202-275-4946.

Sincerely,

Ronald A. Corso
Deputy Director, Division of
Licensed Projects

Enclosure:
Excerpts from Regulation