MASTER

Gilmore

ASSESSMENT OF THE FEASIBILITY OF RECOMMISSIONING THE FRENCH LANDING HYDROELECTRIC FACILITY IN VAN BUREN TOWNSHIP, MICHIGAN

FINAL REPORT

FEBRUARY 1979

AYRES, LEWIS, NORRIS & MAY, INC.
ENGINEERS - ARCHITECTS - PLANNERS
3983 RESEARCH PARK DRIVE
ANN ARBOR, MICHIGAN 48104

PREPARED FOR THE

UNITED STATES DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
ENERGY & TECHNOLOGY DIVISION
ADVANCED TECHNOLOGY BRANCH

AGREEMENT NO: EW-78-F-07-1772

DISCLAIMER

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February 21, 1979

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 Van Buren Township, Michigan, we are pleased to submit the final report on the Assessment of the Feasibility of Recommissioning the French Landing Hydroelectric Facility, summarizing the results of the engineering study performed under DOE Agreement No. EW-78-F-07-1772.

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 French Landing dam site as a hydroelectric resource. In addition, important recommendations 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

Donald W. Lystra, P. E.
Project Director

DWL/bj
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ABSTRACT

This report presents the results of a study sponsored by the United States Department of Energy into the feasibility of recommissioning a small, low-head hydroelectric facility in southeastern Michigan, owned by a public corporate authority.

The study concludes that there are several cost-effective designs for recommissioning the site, based on the use of vertical turbines and the sale of power to nearby industrial markets. In terms of the bulk sale of power to the local electric utility, no cost-effective alternatives were found to exist.

A major burden on project cost-effectiveness was found to be the relatively large costs for structural repairs to the dam and powerhouse needed to insure safe operation and an adequate service life.

From an engineering standpoint it was found that the items of equipment needed to recommission 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, without extensive new construction.

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 revenues.

A detailed environmental assessment using an "impact matrix" methodology concluded that the development of the facility for hydroelectric generation would have important positive environmental consequences related to improved impoundment and flow management techniques as well as enhanced public safety due to structural repairs to the dam.

The institutional and regulatory implications of developing the site for hydroelectric generation were found to be significant but manageable.

SECTION I
SUMMARY AND RECOMMENDED DESIGN

SUMMARY

Background

This report presents the results of study sponsored by the United States Department of Energy into the feasibility of recommissioning the French Landing hydroelectric facility, a small, low-head dam site on the Huron River in southeastern Michigan. The facility was constructed in 1925 by the Detroit Edison Company and produced power until 1962. Average available head at the dam site is 32 feet; mean annual stream flow is 518 cubic feet per second (cfs); the upstream impoundment has a surface acre of 1425 acres. At present the facility is owned and operated by a public corporate authority, Van Buren Township.

Design Alternatives Studied

A total of seven project alternatives were examined in detail. The alternatives included different production capacities, different hydraulic turbine designs, and equipment by different manufacturers.

From an engineering standpoint it was found that the items of equipment needed to recommission the site are readily available from both U.S. and foreign manufacturers. The one possible exception is low-speed vertical generators which, although still available, require special fabrication. A satisfactory alternative to the slow speed units is available, however, through the use of standard speed generators operated through speed increasers.

The project alternatives which were examined included vertical, bulb, and tubular turbine designs. It was found that each of the designs could be successfully adapted to the existing powerhouse without extensive new construction, although the cost to retrofit the vertical units was less than half the cost of either of the other approaches.

Markets

Two feasible markets for the sale of power were identified: 1) the local electric utility, Detroit Edison Company, and 2) a group of manufacturing concerns located in a nearby industrial park. A substantial difference was found to exist in the potential revenues from each market, based on the fact that the utility would only agree to purchase power based on gross energy, whereas the industrial concerns would purchase power based on both energy and demand charges. In general the projected revenues from the industrial markets for any given facility design averaged about 50 percent higher than the revenues from the utility market.

Hydrology

An analysis of site hydrology established that the storage capacity in the upstream impoundment is not sufficient to guarantee a firm demand capacity. It was possible, however, to establish a limited amount of reliable demand capacity based on natural stream flow. Figure I-1 is a conceptualization of a proposed operating strategy for the facility.

It was found that the generating capacity of the facility in relation to stream flow characteristics has an important influence on project cost-effectiveness. The benefits from increased capacity were found to deminish rapidly above a given point due to the flow-duration characteristics in the river. A detailed benefit/cost analysis was conducted to identify the optimum facility size in terms of incremental costs and revenues. It was found that the most cost-effective design contained a relatively small amount of production capacity, in relation to available water power, with a correspondingly high utilization factor. Figure I-2 illustrates the conceptual model upon which the benefit/cost analysis was based.

Financial Feasibility

An analysis of financial feasibility concluded that there are several cost-effective alternatives for recommissioning the site based on the use of vertical turbines and the sale

FIGURE I-1

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

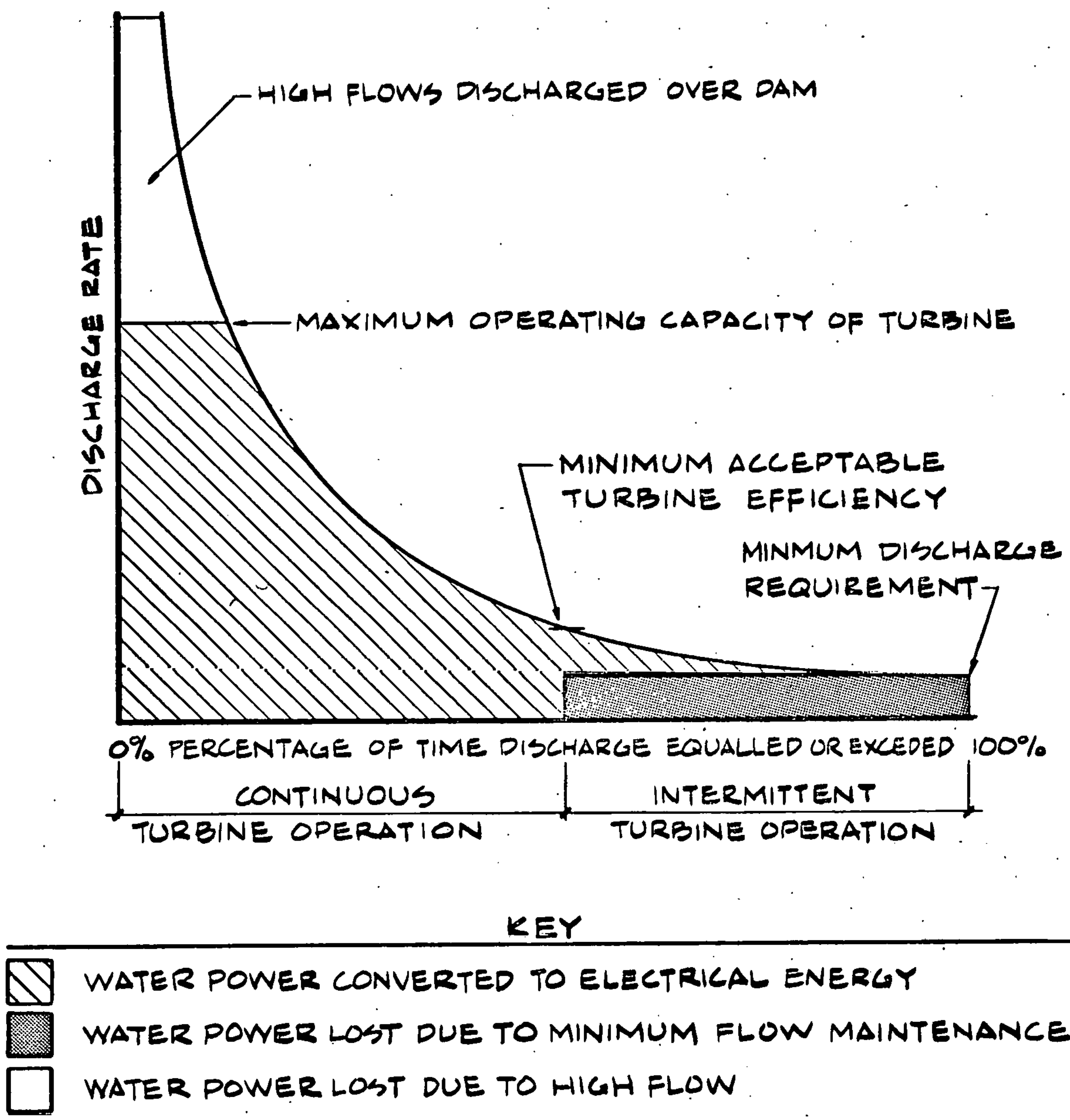
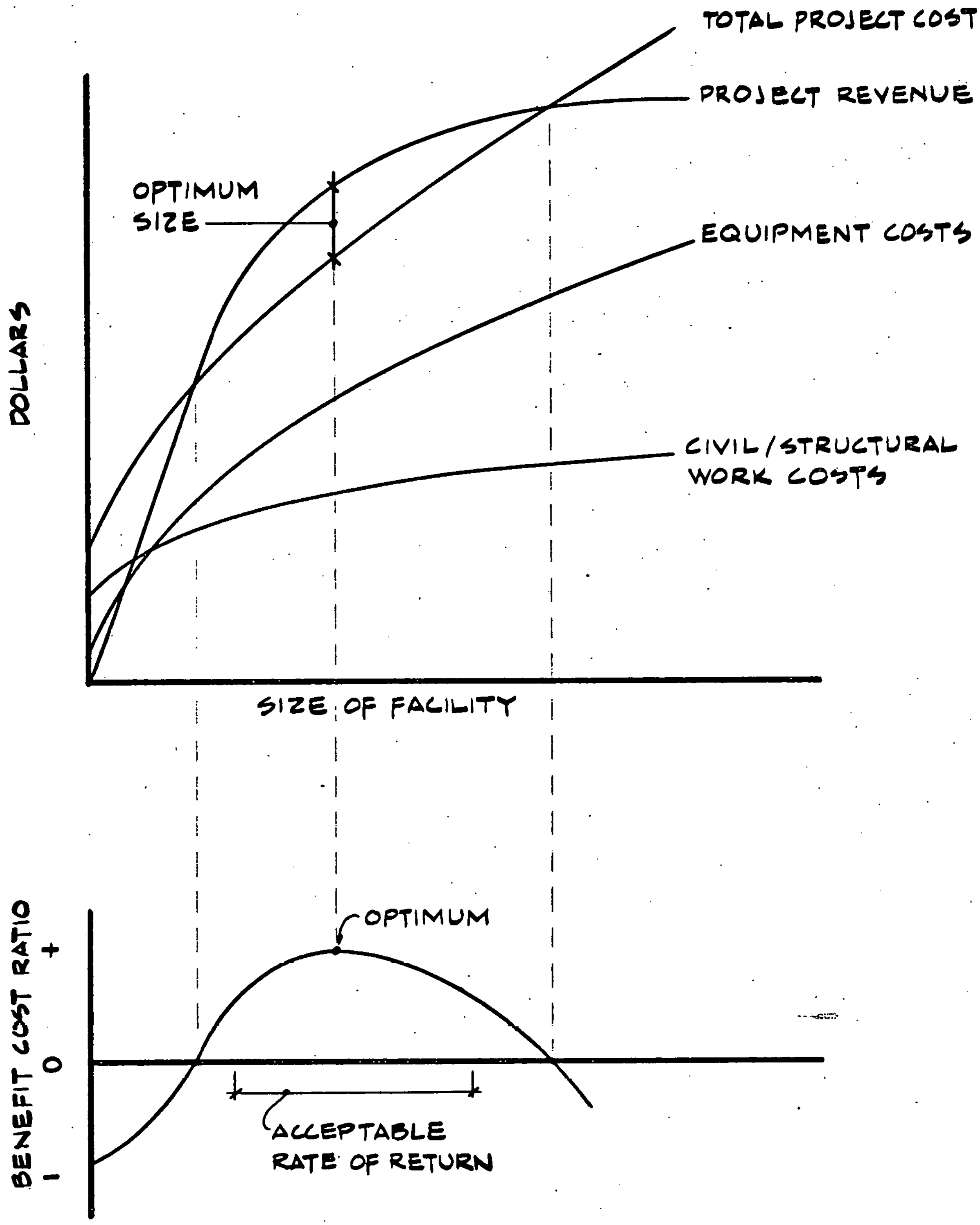


FIGURE I-2

CONCEPTUAL MODEL OF HYDROELECTRIC FACILITY ECONOMICS



of power to nearby industrial markets. Projected gross annual revenues ranged from 12 to 16 percent of estimated project costs. After accounting for expenses for operation and maintenance and debt service (including amortization of principal), the net return on investment, on a cash basis, ranged from -0.1 percent to 3.2 percent.

In terms of the bulk sale of power to the local electric utility, no cost-effective alternatives were found to exist.

A major burden on project cost-effectiveness was found to be the relatively large costs for structural repairs to the dam and powerhouse needed to insure a 25-year service life. These costs amounted to $309,000; or from 21 to 38 percent of the project costs of the alternatives studied.

Presumably, many of these costs, since they are related to matters of dam safety, would have to be incurred regardless of whether the facility is developed for hydropower.

Environmental Implications

A detailed environmental impact assessment was conducted using an impact matrix methodology of a "no-action" and a "recommended-action" alternative. The environmental assessment concluded that the development of the facility for hydroelectric generation would have important positive impacts related to improved impoundment and flow management techniques, as well as enhanced public safety due to the structural repairs to the dam.

Institutional Implications

The institutional implications of developing the site for hydroelectric generation were found to be significant but manageable. Many of the regulatory aspects of the project are based on dam ownership and operation, as opposed to hydropower development per se.

RECOMMENDED DESIGN

If the French Landing dam site is developed as a hydroelectric resource it is recommended that the design incorporate the following features:

- type of hydraulic turbines: vertical
- number of generating units: two
- size of generating units: each rated 500 to 800 kilowatt output full load, depending on manufacturer
- type of generators: synchronous
- generator speed: either low speed, or standard speed through a gear drive
- method of installation: in existing powerhouse
- market for power: nearby industrial consumers, in parallel with normal utility service

Table I-1 gives a summary of project costs and operating characteristics of the recommended design, in comparison to the other alternatives studied. The estimated project cost of $1,242,000 works out to $748 per installed kilowatt. The projected annual production of 7 million kilwatt hours represents 56 percent utilization of the total available water power at the site. The projected operating and maintenance cost of $39,500 works out to 0.56¢ per kilowatt-hour produced.

Table I-2 gives an economic summary of the recommended project for the first year of operation, in comparison to other alternatives studied. The projected annual revenue of $165,000 represents a 13.3 percent gross rate of return. After allowing for expenses related to operation and maintenance, and debt service (including amortization of principal), a net annual cash profit of $19,500 exists, representing a 1.6 percent return on invested capital.

Although Table I-2 shows Alternative No. 1 to be more cost-effective, we are persuaded to substantially discount the contribution to revenue from demand capacity of this alternative, due to the fact that the design includes but a single generating unit (see Section IX). In addition we feel that the rate of inflation of electric energy, in comparison to expense items, will in any case render Alternative No. 2 the most cost-effective in a very short time.

TABLE I-1

SUMMARY OF DESIGN ALTERNATIVES

TO RECOMMISSIONING THE FRENCH LANDING HYDROELECTRIC PLANT

	James Leffel & Co. 1-830 KW vertical	James Leffel & Co. 2-830 KW vertical (Recommended Alternative)	Bofors-Nohab, Inc. 2-500 KW vertical	Bofors-Nohab, Inc. 2-750 KW vertical	Northern Water Power Rework existing turbines	Allis Chalmers 1-750 KW tubular	Heyrpic 3 bulb turbines
Estimated Project Cost (X1000)	$ 802	$ 1,242	$ 1,294	$ 1,749	$ 1,497	$ 1,137	$ 1,875
Installed Capacity (KW)	830	1,660	1,000	1,500	2,380	750	1,362
Effective Average Capacity (KW)	595	801	703	844	913	594	760
Plant Factor	72%	48%	70%	56%	38%	79%	56%
Cost/Installed KW	$ 966	748	1,294	1,166	$ 629	$ 1,516	$ 1,377
Cost/Effective KW	$ 1,347	$ 1,551	$ 1,840	$ 2,072	$ 1,640	$ 1,914	$ 2,668
Projected Annual Production (MKWhr)	5.2	7.0	6.2	7.4	8.0	5.2	6.7
Average Demand Capacity (KW)	735	1,069	837	1,034	1,172	682	991
Projected Annual O&M Expense	$32,700	$39,500	$39,700		$43,760		
O&M Cost/KWhr produced	0.63¢	0.56¢	0.64¢		0.55¢		

TABLE I-2

ECONOMIC SUMMARY OF VERTICAL TURBINE DESIGN ALTERNATIVES BASED ON SALES OF ELECTRICITY TO PRIVATE INDUSTRIES

	ALTERNATIVES*			
	No. 1	No. 2	No. 3	No. 4
Estimated Project Cost (X1000)	$ 802	$ 1,242	$ 1,294	$ 1,497
Projected Service Life (yrs)	25	25	25	25
Projected Annual Revenue				
Energy	$ 93,600	$126,000	$111,600	$144,000
Demand	$ 51,200	$ 74,400	$ 58,300	$ 81,600
Standby Surcharge	($ 17,400)	($ 34,800)	($ 21,000)	($ 50,000)
Total	$127,400	$165,600	$148,900	$175,600
Projected Annual O&M Expense	$ 32,700	$ 39,500	$ 39,700	$ 43,760
Net Annual Revenue	$ 94,700	$126,100	$109,200	$131,840
Annual Debt Service[2]	$ 68,800	$106,600	$111,000	$128,500
Net Annual Profit (Loss)	$ 25,900	$ 19,500	($ 1,800)	$ 3,340
Return on Investment	3.2%	1.6%	(0.1%)	0.2%
		Recommended Alternative		

[1]Projected Annual Revenue is based on weighted average on-peak and off-peak energy charge (= 16 mills/KWhr)

[2]Annual Debt Service is based on 7%, 25-year financing from sale of Township revenue bonds.

*Alternative No. 1: One Leffel Co. 830 KW unit

Alternative No. 2: Two Leffel Co. 830 KW units

Alternative No. 3: Two Bofors-Nohab 500 KW units

Alternative No. 4: Overhaul of existing turbines by Northern Water Power

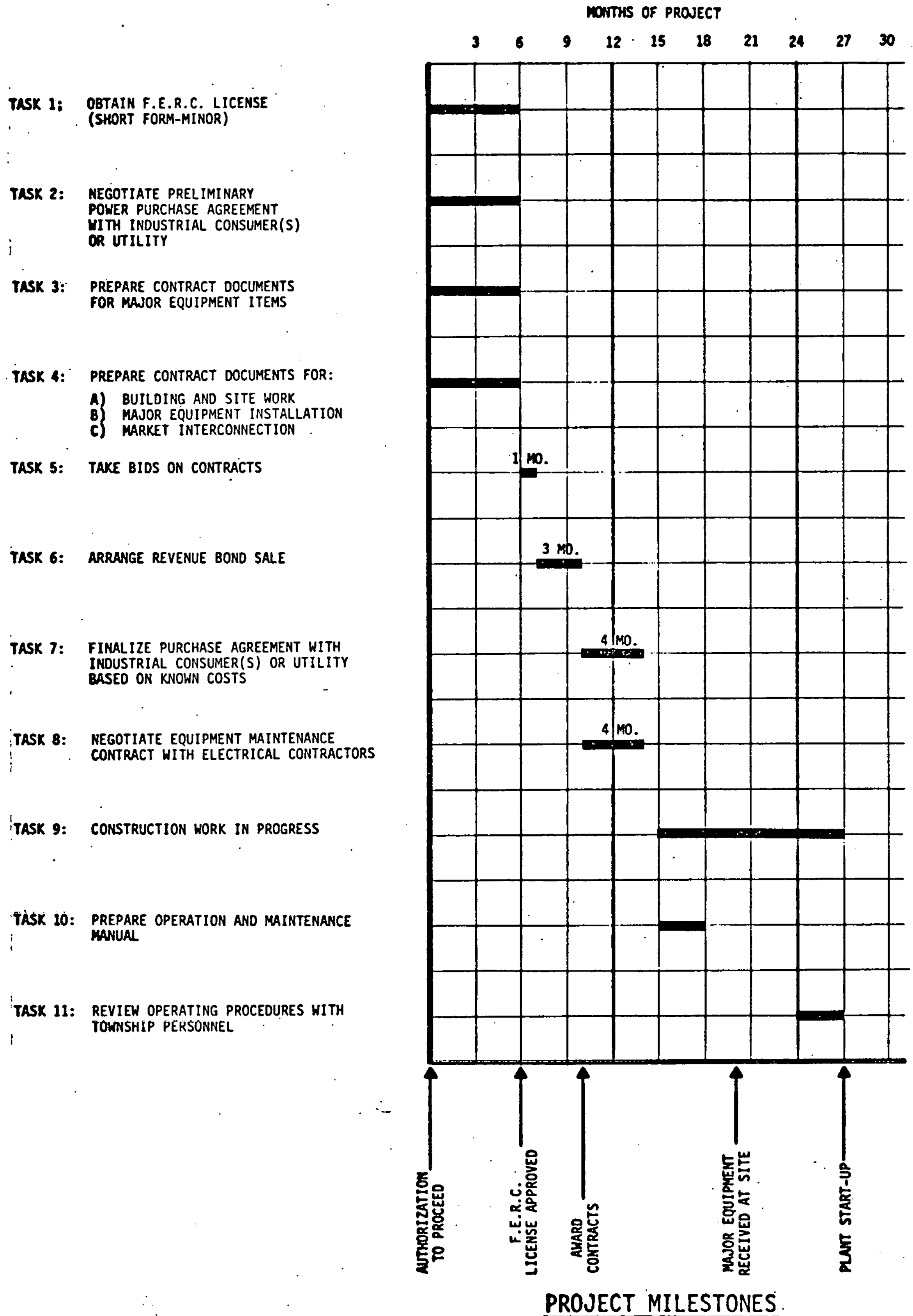
It is worth noting that Alternatives No. 3 and No. 4 in Table I, which are based on vertical turbines of different capacity and manufacture , are only slightly less cost-effective than the recommended alternative. This emphasiszes that a detailed construction design should be flexible enough to allow competitive bids by various manufacturers, based on equipment having slightly differing ratings.

Figure I-3 is a proposed schedule for development of the site as a hydroelectric facility, based on reasonable estimates of the time required for the accomplishment of eleven key tasks. The total time required from authorization to putting power on-line is projected to be twenty-seven months.

The schedule has been designed so that the owner will not incur any major financial obligations until two events which might impede development have been successfully resolved. These events are:

- receipt of FERC license
- negotiation of a satisfactory power purchase agreement with industrial consumers (or utility)

FIGURE I-3
PROPOSED PROJECT SCHEDULE
FRENCH LANDING HYDROELECTRIC FACILITY



SECTION II
BACKGROUND

LOCATION

The French Landing dam and hydroelectric plant is located on the Huron River in Van Buren Township of Wayne County, Michigan (Figure II-1). Upstream of the dam is seven-mile-long Belleville Lake, covering an area of 1425 acres (Figure II-2). Below the dam the Huron River Valley broadens out into a wide shallow floodplain which is undeveloped for several miles downstream. The area around Belleville Lake is sparsely populated, except for dense residential development along the immediate shore of the lake. The City of Belleville (1970 population: 2400) is on the south shore of the lake approximately three miles from the dam site.

The dam site includes a power house, two adjustable sector gates for release of high flows, and an 181 foot long multiple-arch section for control of the impoundment (see Figure II-3).

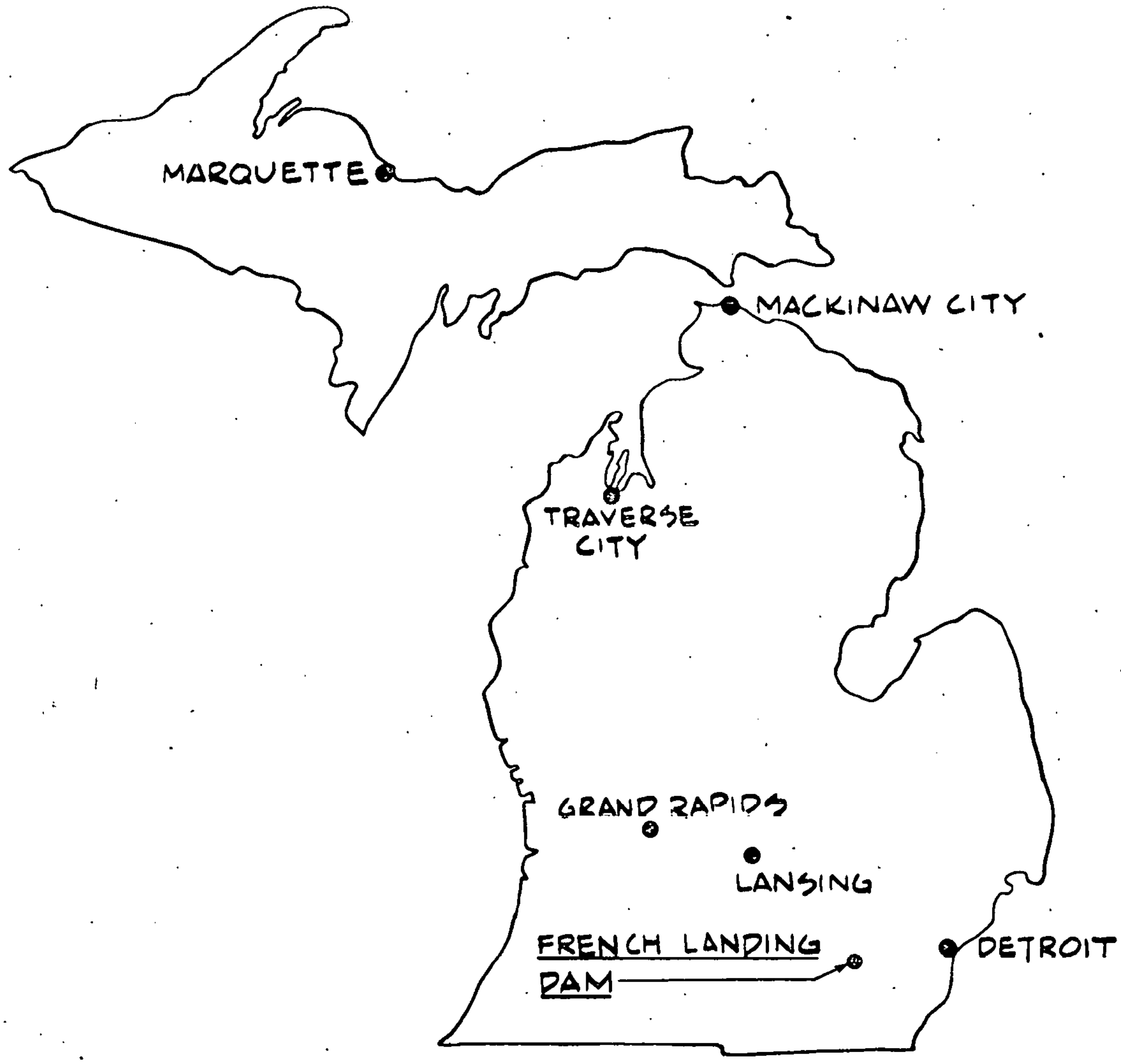
HISTORY

The French Landing dam and powerhouse were both completed in 1925, the last in a series of five Huron River dams developed for hydroelectric generation by the Detroit Edison Company. The five Huron River plants, along with two much smaller facilities on other nearby rivers, at one time constituted the entire hydroelectric system of the Detroit Edison Company, the largest electric utility operating in the State. The combined generating capacity of the entire hydro system was approximately 8.2 megawatts, about 0.5 percent of the total generating capacity of the utility in 1951. French Landing, the largest plant in the system, accounted for about 30 percent of total hydroelectric production.

The powerhouse was equipped with two vertical Francis turbines, manufactured by the Allis Chalmers Company, directly connected to 4600 volt Allis Chalmers generators, rated 1200 and 2400 KVA. Output from the hydroelectric plant was fed into the utility grid

FIGURE II-1

PROJECT LOCATION



STATE OF MICHIGAN

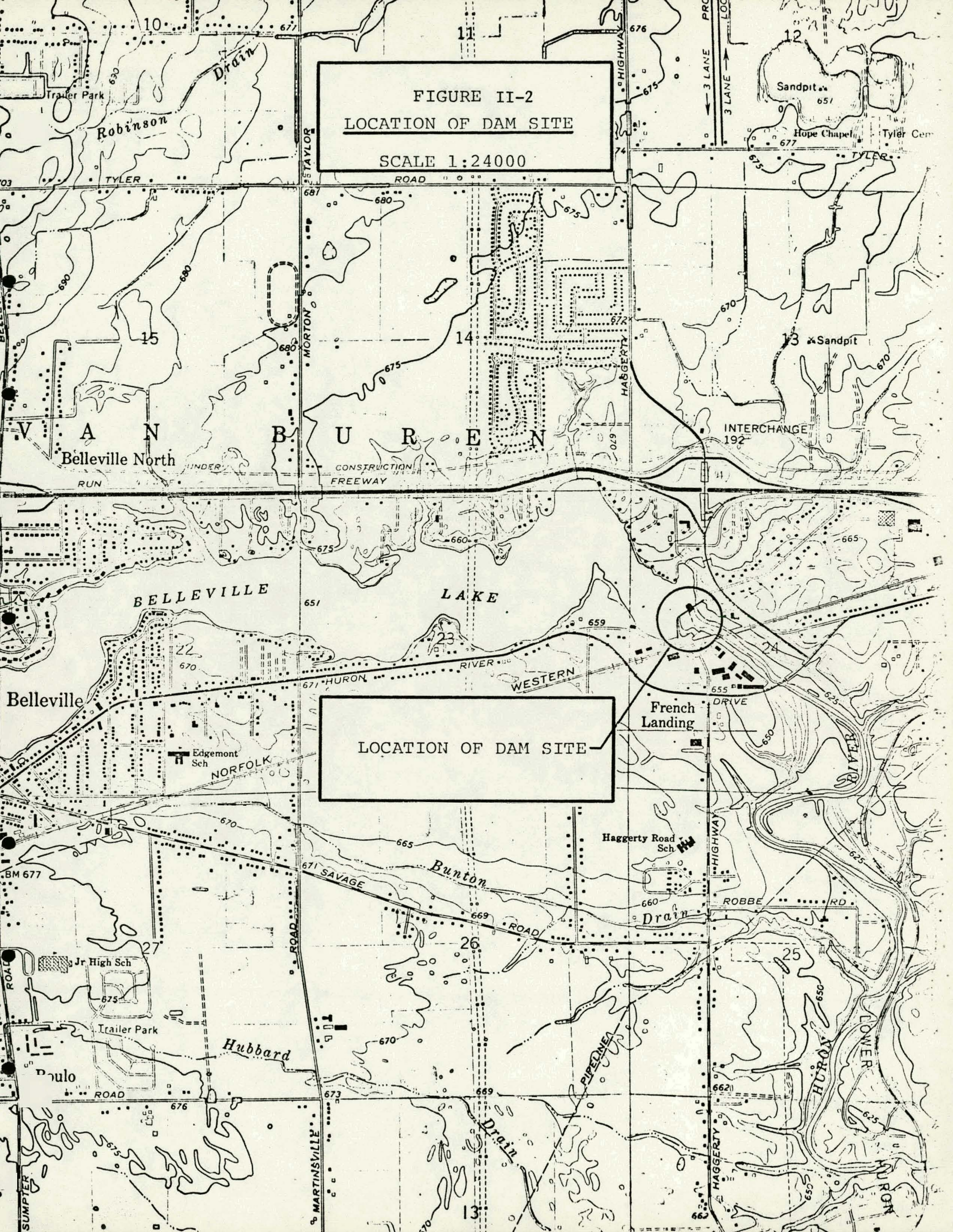
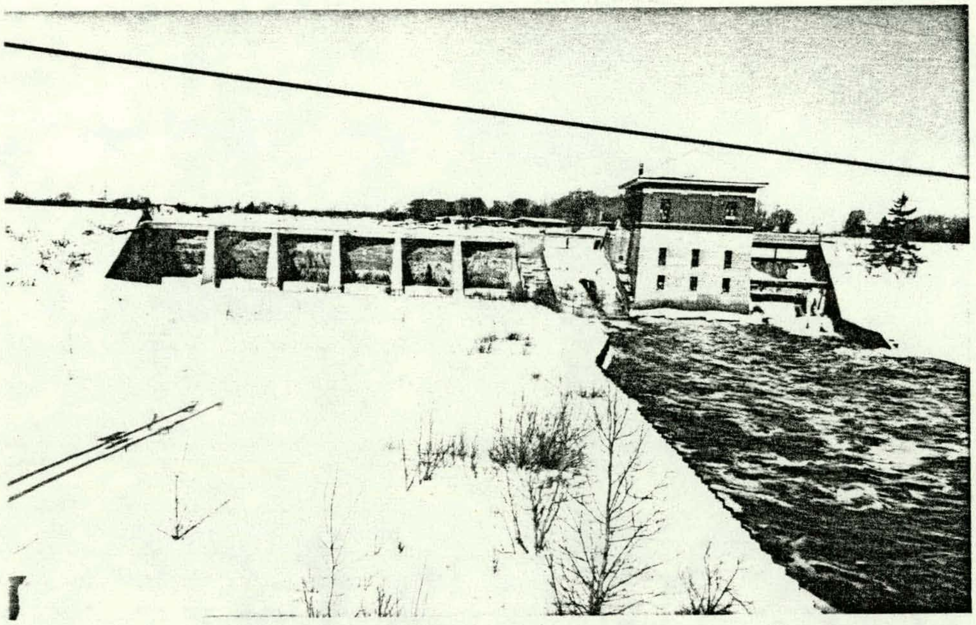


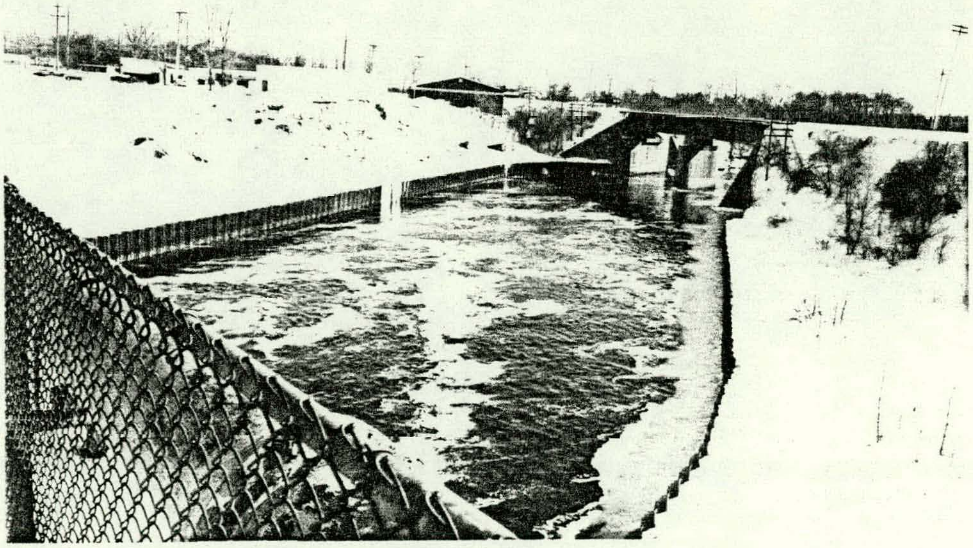
FIGURE II-2
LOCATION OF DAM SITE
SCALE 1:24000

FIGURE II-3

PHOTOGRAPHS OF FRENCH LANDING DAM

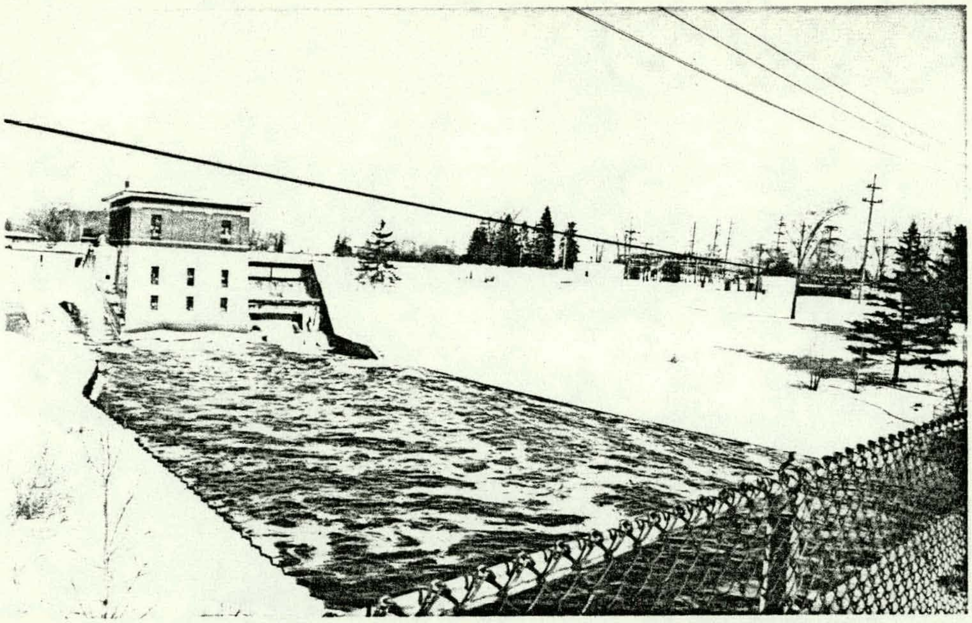


a) Upstream view of dam and powerhouse from pedestrian bridge.

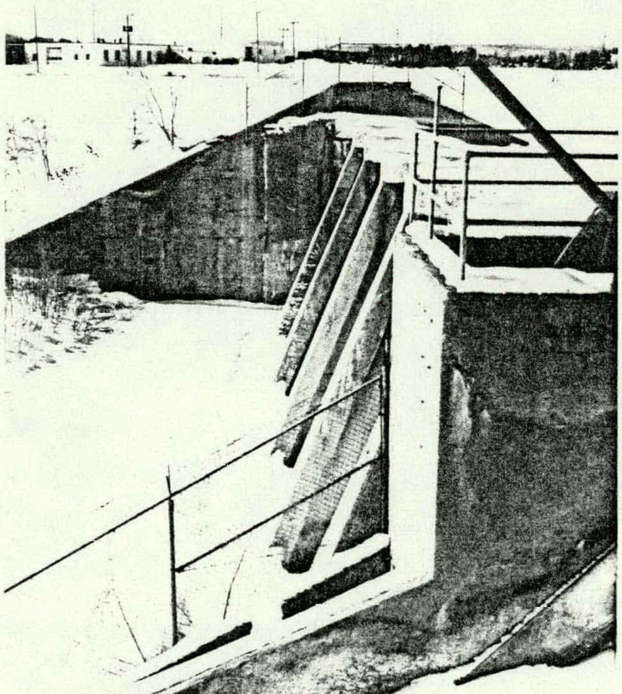


b) Downstream view of Huron River from pedestrian bridge.

FIGURE II-3



c) Upstream view of powerhouse with Detroit Edison Co. substation in background.



d) View of dam from powerhouse showing part of Industrial Park in background.

through a distribution substation located approximatley 200 feet east of the powerhouse. Detroit Edison Company records show that annual production from the plant averaged about 7.5 million kilowatt-hours from 1926 through 1950, ranging from a high of 12.7 million kilowatt-hours in 1950 to a low of 3.2 million kilowatt-hours in 1931.[1]

All of Detroit Edison's hydroelectric plants were operated remotely from a control center at the Superior plant. The Superior plant was the most central of the five Huron River facilities and was attended at all times. At the remotely controlled plants, including French Landing, no one was in regular attendance. From the Superior control center the operator could start and stop the machines at any site via a supervisory control system operating over telephone lines. In addition, information on pond levels, machine loads, and gate openings was transmitted from the remote sites to Superior for reading and recording. Local control systems at each site automatically synchronized the machines when being placed on-line, and automatically shut down the machines in the event that any of several possible malfunctions occurred. The occurrance of a malfunction would also cause an alarm to be transmitted to the control center at Superior. The Superior operator would then dispatch a so-called "mobile" operator to the plant to handle the difficulty.

DECOMMISSIONING OF HYDROELECTRIC PLANTS

In the mid 1960's, Detroit Edison decommissioned its hydroelectric plants and shortly thereafter turned them over to public authorities. The four up-river dams (Barton, Argo, Geddes and Superior) were turned over to the City of Ann Arbor. French Landing, along with adjoining properties on both sides of the river and an extensive undeveloped land parcel on the north shore of Belleville Lake, was turned over to Van Buren Township in 1973. (A copy of the transfer Agreement is included in the Appendix.)

Although we have seen no records directly pertaining to the decision to decommission the hydroelectric facilities, earlier Detroit Edison records point to a series of problems which were probably significant factors: [2]

1. Economics: Over the period of Detroit Edison's ownership of the dams, the cost of producing hydro power increased dramatically, due primarily to the increased cost of labor for operation, maintenance, and repair. At the same time, the cost of other sources of electricity actually came down during the 1930's, 40's, and 50's, reflecting improvements in the efficiency of steam generating equipment.
2. Uniqueness and Small Scale of Hydro Operations: When originally developed, the hydro plants made significant contributions to the power demands in their locales. However, over time, they came to be entirely out of scale with the size of the utility's overall operations, demanding a degree of attention that was disproportionate to their contribution.
3. Public Relations: The responsibility of owning and operating the hydro plants came to represent a public relations problem of no small size. As owner of most of the dams in the Huron River Valley, Detroit Edison was essentially responsible for management of the river. Originally this was not a very great problem, however, as development took place along the river, flow regulation came to affect more and more people. As early as 1951, the utility spoke of the "increasing public relations problems....(due to) encroachment, pollution, flood control, erosion of banks, flood damage, pumping of water from ponds, policing of our property, public use of the ponds and the shores, and criticism of Edison control or lack of control in one form or another of the lake area".[3]
4. Maintenance: It can be assumed that maintenance costs for structural parts of the plants, which would have been negligable during the early decades of operation, began to become significant expenses as the plants reached forty and fifty years of age.

PRESENT OPERATION

Since 1973, Van Buren Township has operated and maintained the dam with their own funds. A daily visit to the dam site is made by a Township Public Works employee who makes a visual check of impoundment level and adjusts the wicket gates so as to maintain the desired water surface elevations. Normal water surface elevation is 651.5 feet, half a foot below the crest of the dam. From November 1 to April 15th, the level is dropped from 3-1/2 to 5 feet. Reasons cited for this procedure are threefold:

1. To allow property owners along the lake to work on their shoreline structures, (docks, seawalls, etc.)
2. To prevent ice damage to shoreline structures.
3. To provide extra capacity in the lake to absorb spring runoff without flood danger.

* * *

Footnotes

[1] The Hydro-Electric Plants of the Detroit Edison Company, Detroit Edison Company, July, 1951.

[2] Ibid

[3] Ibid

SECTION III
PRESENT CONDITION OF FACILITY

DESCRIPTION

The French Landing dam site includes a powerhouse, two adjustable sector gates for release of high flows, and an 181 foot long multiple-arch section for control of the impoundment. Downstream from the dam are two bridges which span the river. A plan of the site is shown in Figure III-1.

The substructure of the powerhouse forms a part of the dam (Figure III-2). It is approximately 68 feet long by 50 feet wide by 50 feet high from the draft tube floor to the generator room floor. The upstream part of the substructure contains trash-racks and two open wheel pit settings with concrete elbow draft tubes (Figure III-3). The governors and turbine wicket gates have been retained and are used for release of normal stream flows. The downstream side of the substructure is divided into three floors with the outlet of the draft tubes below.

A spillway is located on both sides of the powerhouse, each with a sector type gate. The sector gates are 33 feet wide with an adjustable crest elevation of 652.0 feet to 640 feet. The east spillway gate is joined with a 100 foot long earth embankment by means of a buttressed retaining wall. The west spillway gate adjoins a fish ladder which has been plugged.

Extending west from the fish ladder is a reinforced concrete multiple-arch dam with a width of 181 feet between end walls, a maximum height from the bottom of the footings to the arch crest of 35 feet, and a base length of 61 feet. The structure consists of five reinforced concrete arch buttresses carried on reinforced concrete footings. The buttresses, with the aid of the two end walls, support six reinforced concrete arches on the upstream side carrying the water load. The arches are brought to a horizontal crest at elevation 652 by means of a reinforced concrete beam, the crest slab. The western end of the multiple arch dam is jointed with a 400 foot long earth embankment by means of a buttressed retaining wall.

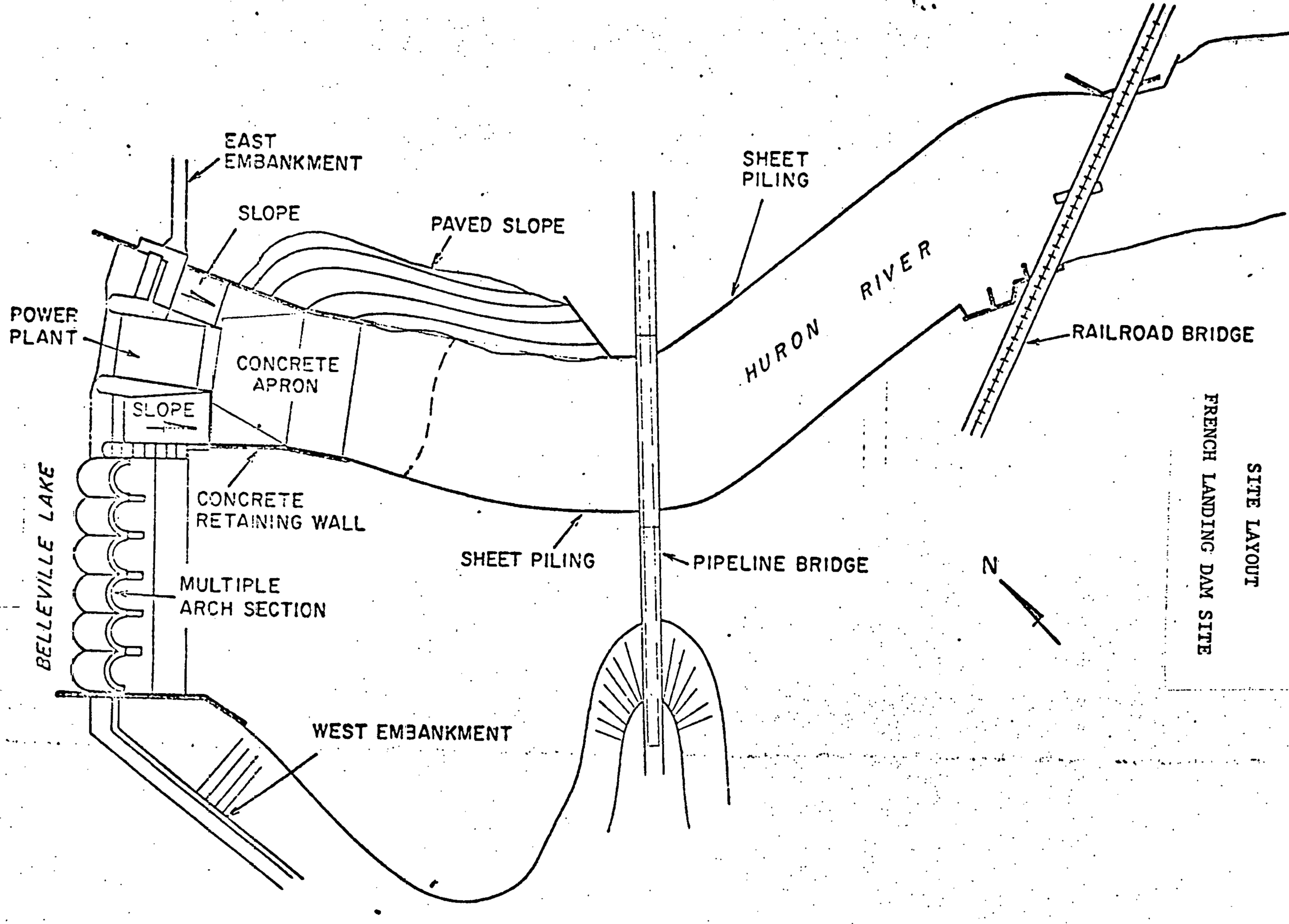


FIGURE III-1
SITE LAYOUT
FRENCH LANDING DAM SITE

SOURCE: DETROIT EDISON CO. ENGINEERING RESEARCH DEPARTMENT REPORT 69J16

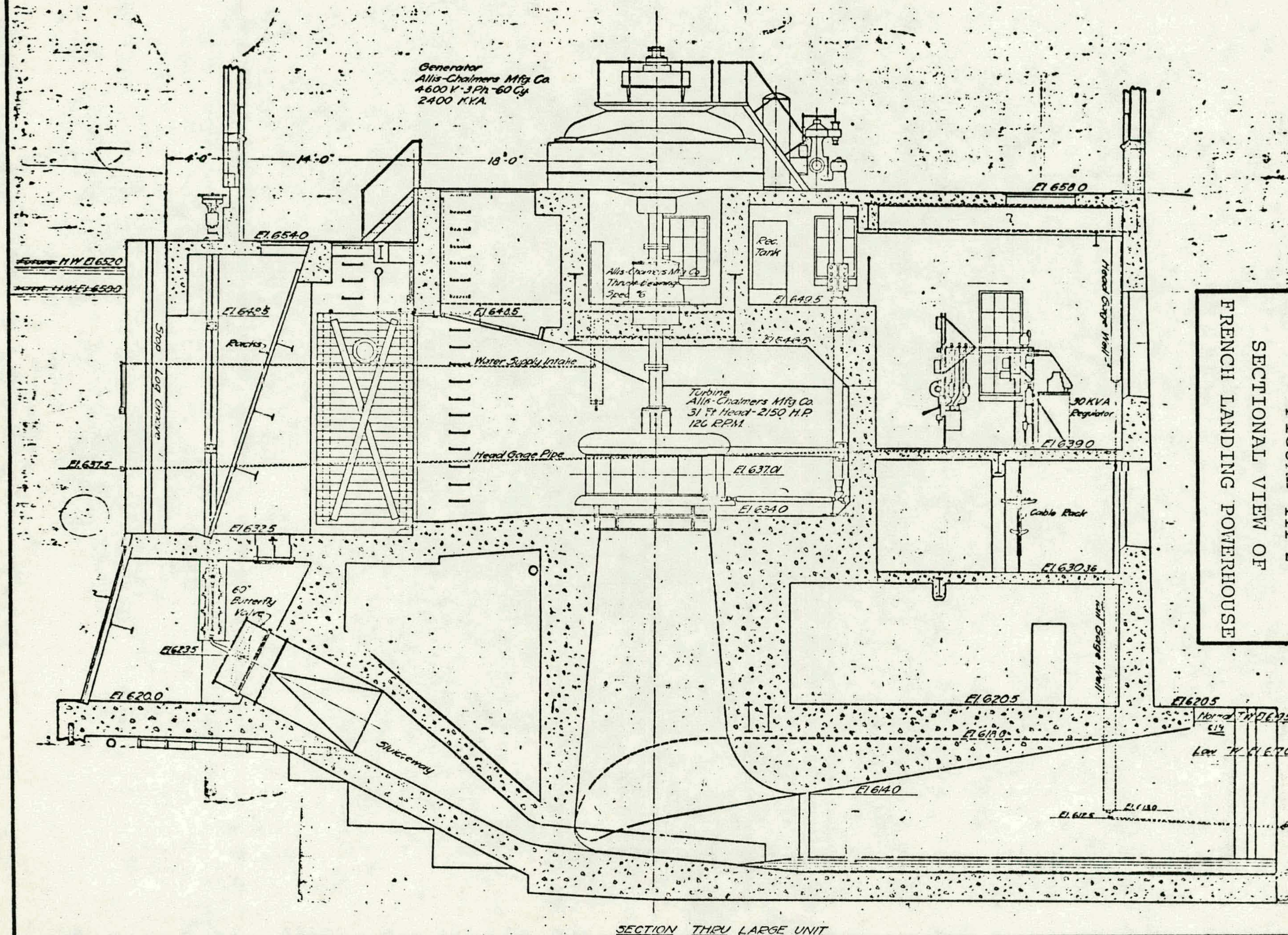


FIGURE III-2
SECTIONAL VIEW OF
FRENCH LANDING POWERHOUSE

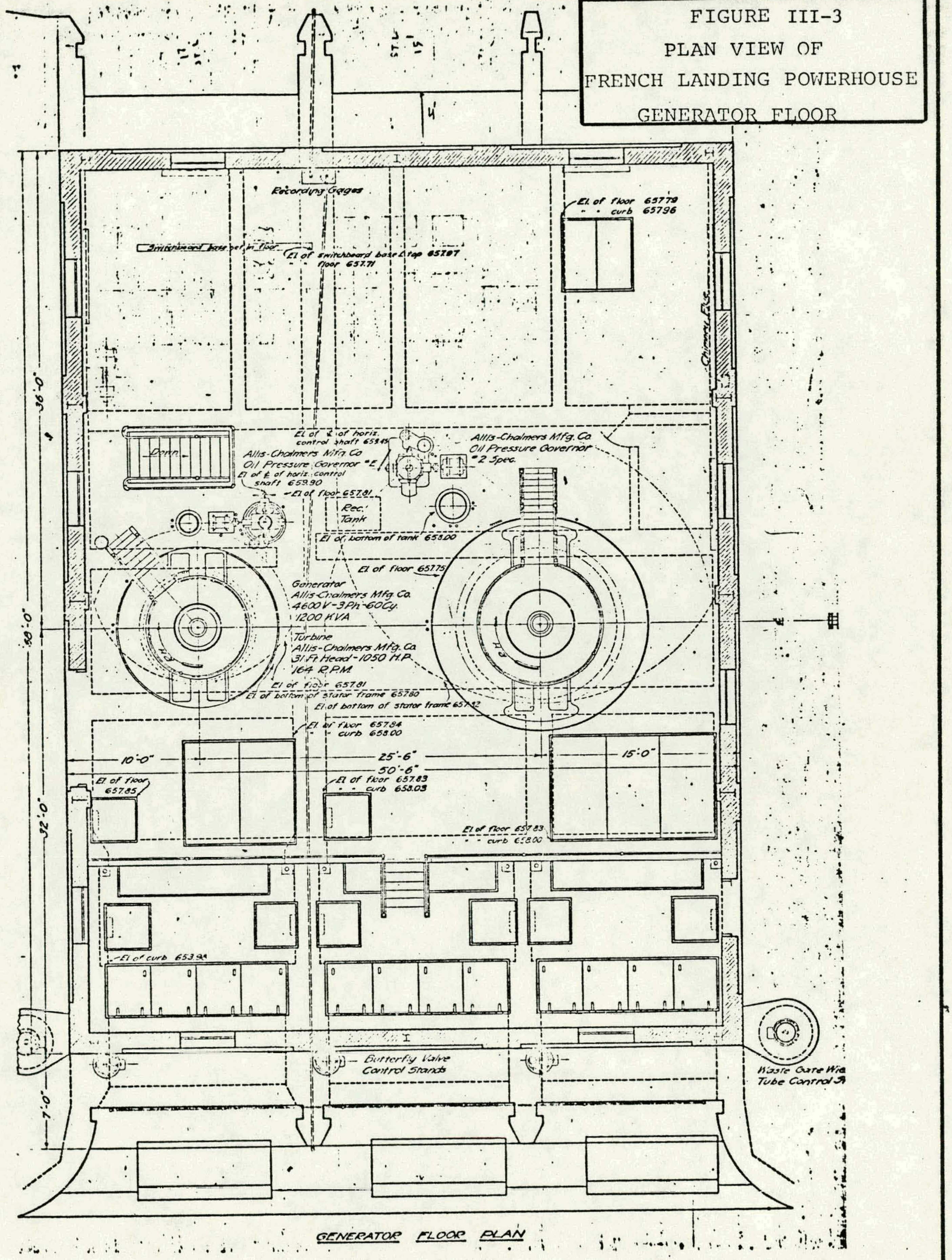


FIGURE III-3
PLAN VIEW OF
FRENCH LANDING POWERHOUSE
GENERATOR FLOOR

From the powerhouse, the tailrace is protected for a distance of about 120 feet with poured concrete retaining walls and for 100 feet with a concrete apron. From this point to the pedestrian bridge, the east bank is protected with concrete slope paving and then to the railroad bridge with sheet piling. The west bank is protected with sheet piling from the retaining wall to the railroad bridge. The river bottom is protected with precast concrete sections to approximately 70 feet beyond the end of the apron.

PRESENT CONDITION

Dam and Control Structures

A structural inspection was performed on the French Landing dam and control structures in July, 1977, by the engineering firm of Ayres, Lewis, Norris & May, Inc. A copy of the inspection report, and the Michigan Department of Natural Resources Dam Inspection Report that was prepared from it, is included in the Appendix for reference.

The inspection included the level control structures, earth dike, multiple arch spillway, and tailrace and sheet piling walls, both above and below water. In addition the draft tubes and turbine pits of the powerhouse were given a below-water inspection.

The structural inspection found these parts of the facility to be in "fair to good condition" without any need for immediate repair work. A number of recommendations for long term remedial action were suggested. These included:

1) Repair sector gate hinges and concrete of raceways.
2) Repair upstream, downstream and crest surfaces of arch spillway.
3) Install adequate drainage facilities for flat lands downstream of the arch spillway.
4) Repair seepage through earth dike south of the arch spillway.
5) Install adequate drainage facilities for runoff from Detroit Edison sub-station.
6) Sandblast and paint all exterior steel surfaces (railings, grating, plates, sector gates, gate brace assemblies, stop log guides).
7) Repair spalled exterior concrete surfaces.

8) Remove debris from tailraces under main building.

9) Replace boating cable upstream of south sector gate.

10) Obtain adequate stop logs for winter operations.

11) Repair interior wall of lower-most floor of main building.

A budgetary cost estimate for making the recommended repairs was given as between $40,000 and $60,000.

Power House Superstructure

An above-water structural inspection was made on the powerhouse superstructure in September, 1978, by the engineering firm of Ayres, Lewis, Norris & May, Inc. A copy of that inspection report is included in the Appendix.

The report concluded that the structure was in "overall good condition."

Numerous minor defects were identified such as spalled concrete, broken windows, accumulation of debris, and rusting of stairs and roof trusses. Conditions which might affect the structural integrity of the building, such as cracked and spalled concrete, were judged to be not serious. A preliminary cost estimate to repair the minor defects was set at from $5,000 to $7,000.

EQUIPMENT

Turbines

When the hydroelectric plant was decommissioned by Detroit Edison Company, the generators and all related electrical equipment were removed. The turbine shafts were disconnected below the thrust bearing chambers and the openings in the generator room floor were covered with wooden planks. The Allis Chalmer turbine units were left in place in the wheel pits (Figure III-5 and 6), however, to prevent rotation of the runners, the shafts were welded to the guide bearing housings and the runner buckets were burned off. The gate casings, guide vanes, and gate operating mechanisms were left in an operational condition so that they could be used to control the discharge of water through the structure.

FIGURE III-5

EXISTING 1050HP ALLIS-CHALMERS TURBINE

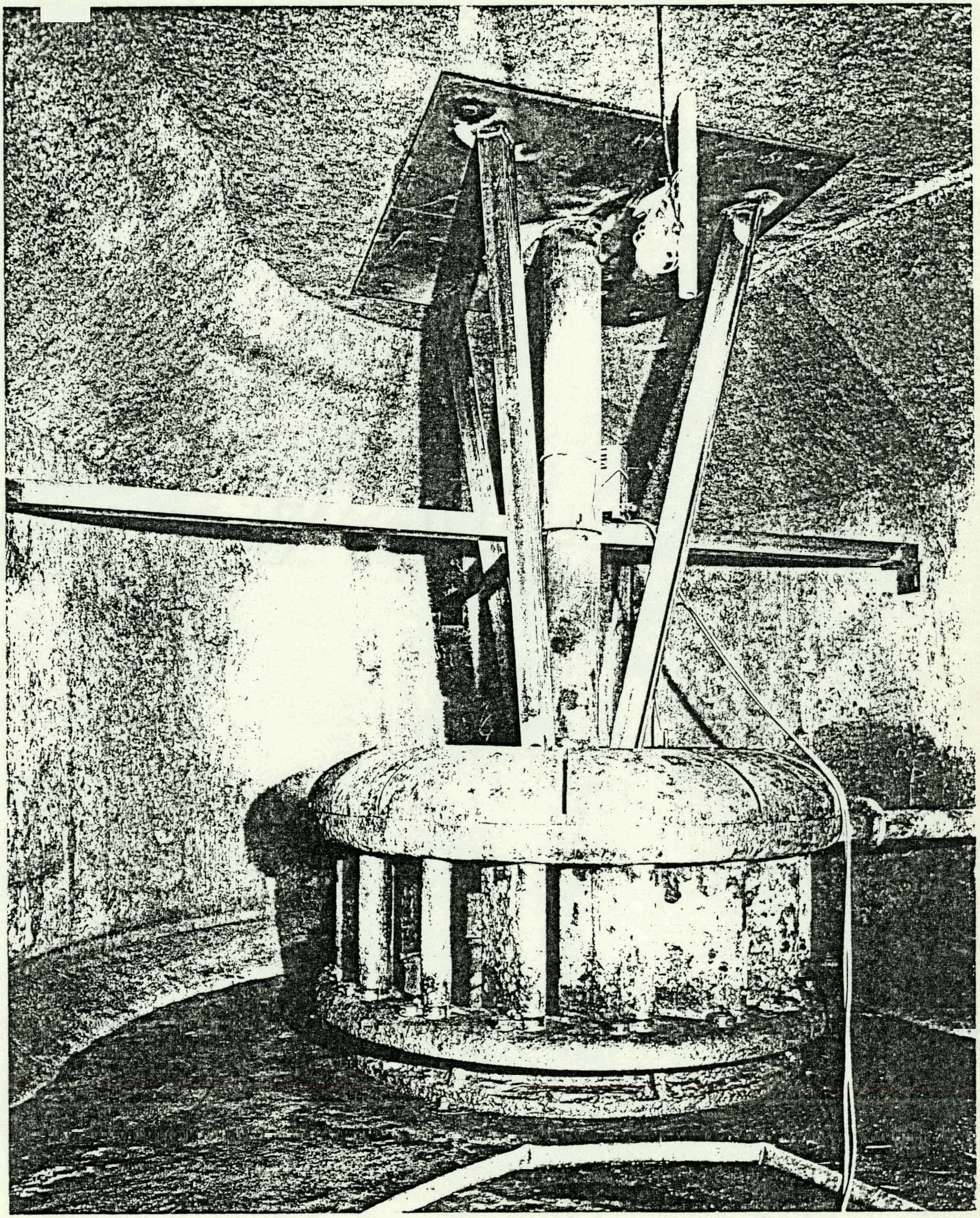
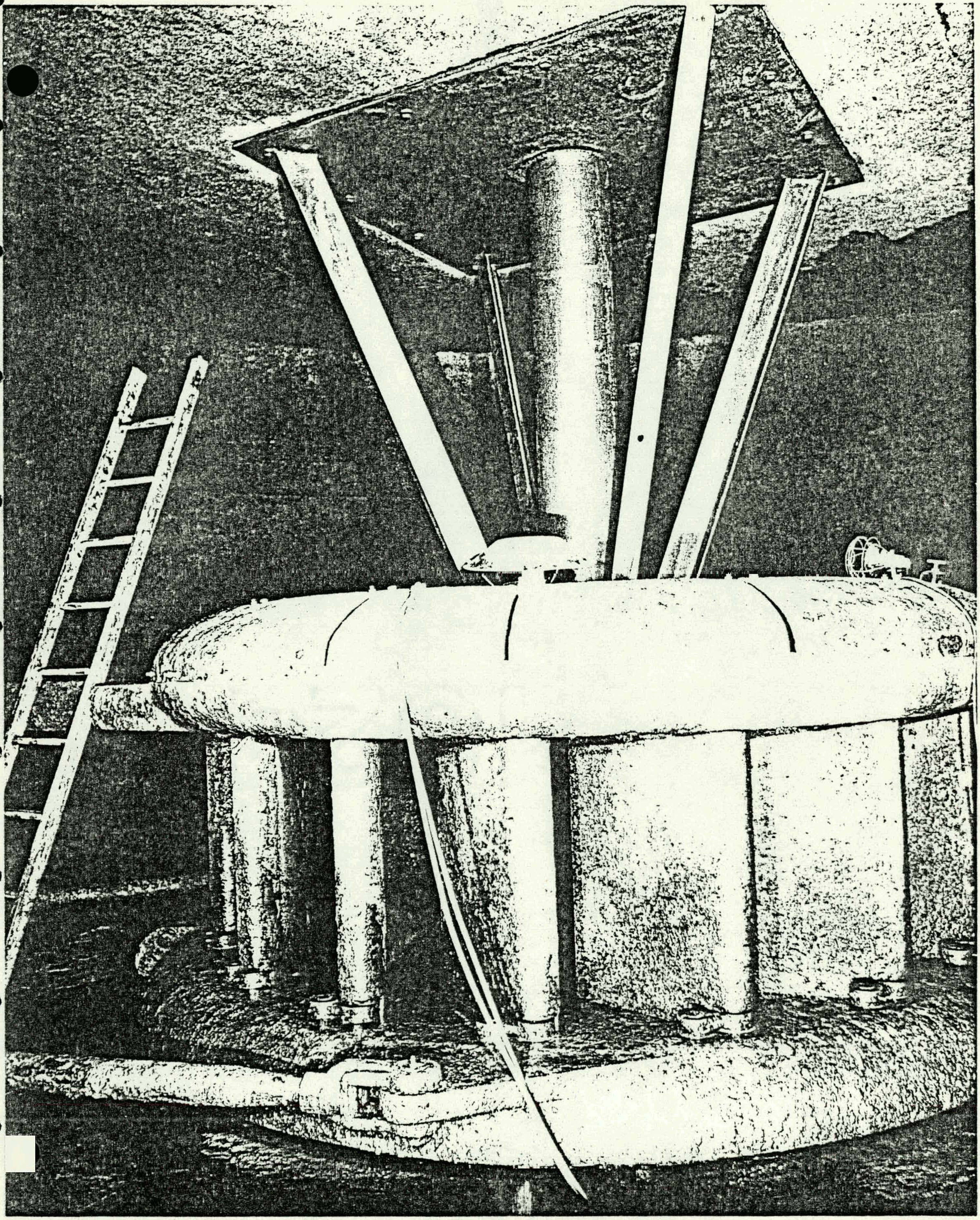


FIGURE III-6

EXISTING 2150 HP ALLIS-CHALMERS TURBINE



Overhead Crane

The overhead travelling crane system is rated at 20 tons capacity and is reported by Township personnel to be in very good condition. The crane moves in both directions by means of manually operated ropes and pulleys. The crane beam is electrically operated but presently disconnected. Township employees report that the electric motor drive on the crane boom will operate if reconnected.

Controls

A float-activated "Stevens Level Regulating Mechanism," located on the second below-grade level, is still operational, however it has been disconnected from the wicket gate control mechanism.

An electronic automatic level control system for the sector gates, although operational, is presently kept out of service in favor of manual operation of these gates.

REPLACEMENT AND MAINTENANCE COSTS

Cost estimates were made to determine the present-day replacement cost of the French Landing facility, as well as projected maintenance costs under alternate repair programs.

The present day replacement cost of the total facility, excluding power generating equipment, was estimated to be $3,105,000. A breakdown of this cost is as follows:

earth embankments	$ 75,000
multiple arch dam	650,000
fish ladder	80,000
power house	540,000
sector and sluice gates	290,000
retaining walls, steel sheet piling	980,000
miscellaneous	490,000
	$3,105,000

Three alternate repair/maintenance programs were considered. The first assumed no initial 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 presented in the following table:

Service Life	Cost of Immediate Repairs Required	Annual Maintenance Costs (Average)
5-10 years	$0	$0
25 years	$309,000	$4,400
50 years	$3,100,000	$5,000

DAM REFURBISHMENT PROGRAM

Van Buren Township officials are presently coordinating with the U.S. Department of Labor to work out the details of a program for the refurbishment of the French Landing dam and the pedestrian bridge downstream of the dam. Under the proposed program the Department of Labor would make up to $1.1 million available in fiscal 1979 for labor and administrative costs associated with repair work to the dam and bridge. The Township would be responsible for most of the material and equipment costs associated with the work. A description of the scope of work of the proposed project is included in the Appendix.

SECTION IV
ENVIRONMENTAL SETTING

The environmental setting is a statement of the existing natural, 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 (see Section XII). For purposes of establishing an environmental setting the project area will generally be considered Belleville Lake and the land area immediately surrounding the lake affected by the lake environment. Significant environmental factors beyond this project area which could potentially be impacted by any of the project alternatives are also described.

NATURAL ENVIRONMENT

Topography and Relief

The area surrounding Belleville Lake is nearly level to gently sloping with the exception of the immediate shoreline areas. The majority of the shoreline can be considered escarpment with steep slopes plunging to the water's edge. The greatest relief can be found at the portion of the lake west of the Belleville Road Bridge where slopes up to 25 percent rise from the shoreline. Shoreline elevations range from 685' above sea level where the Huron River enters the Lake to 665' near the dam site.

Climate

The project area is located in a climatic region largely influenced by the Great Lakes which have a moderating influence on seasonal temperatures. 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 averaged 30.69". Mean monthly precipitation ranges from a high of 3.20" in April to 1.72" in January. The wind direction is generally from the west-southwest or southwest at speeds of around 10 mph.

Water Resources

The Belleville Lake French Landing Dam is located 29.4 miles upstream from the mouth of the Huron River at Lake Erie and 99.4 miles downstream from the source of the river in Oakland County.[2] One of ten impoundments on the Huron River, Belleville Lake is the second impoundment upstream from the mouth of the river. It is seven miles long with an approximate surface area of 1425 acres. The impoundment volume is 22,600 acre-ft at normal levels and 24,200 acre-ft at maximum levels.

The total drainage area of the Huron River Basin, illustrated in Figure IV-1, is 892 square miles, of which 833 square miles lie upstream of the French Landing 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, as illustrated in Figure IV-2. Belleville Lake lies in an area of the Huron River where stream slopes average 4.0 feet per mile.

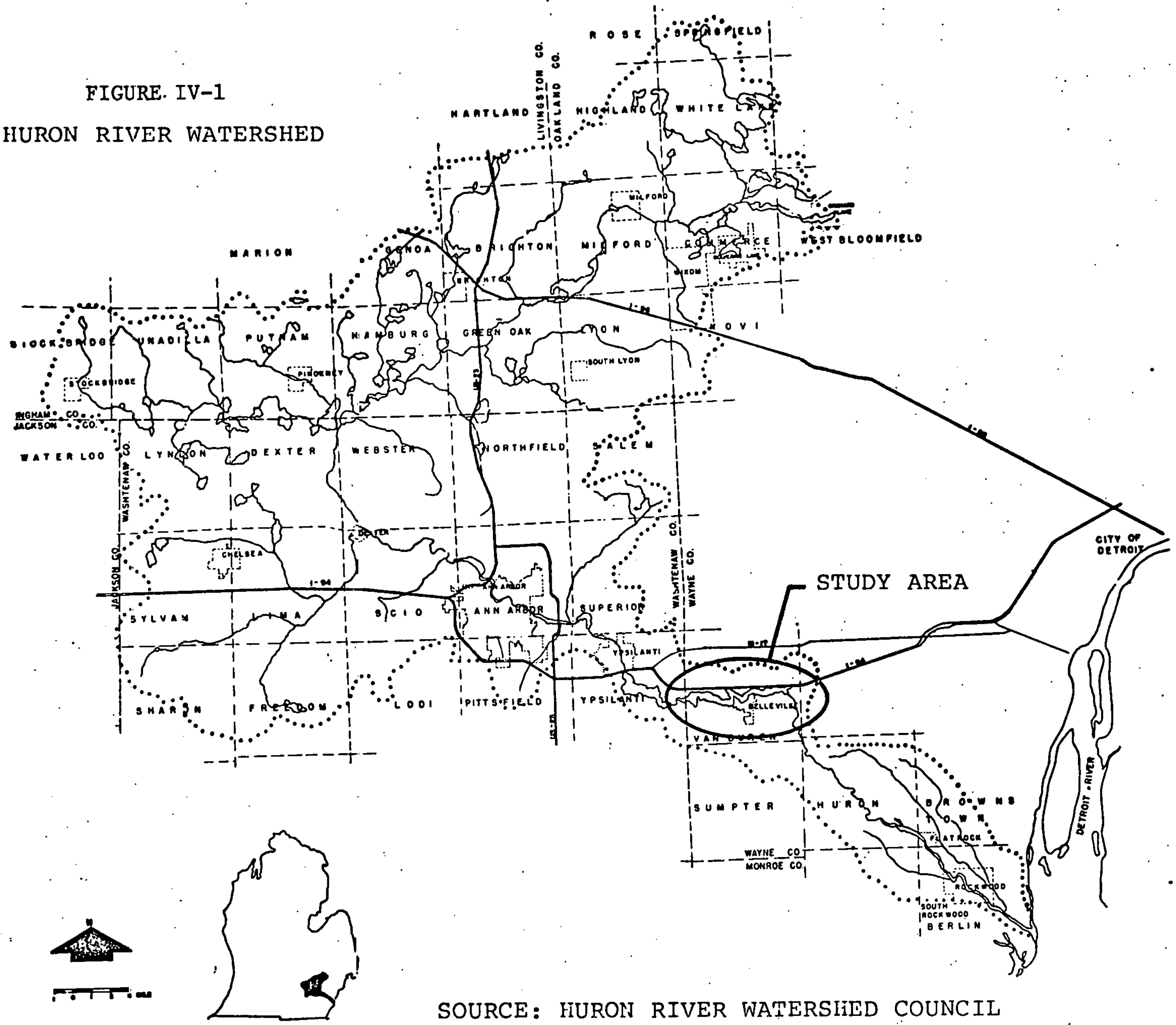
Water Quality

The water quality in Belleville Lake has been observed by J. A. Borchardt in a one-year survey made in 1956-57 and reported in 1958, in another 1957 survey covering a one-year period reported by Black and Veach (1960), and by the Michigan Water Resources Commission in the year 1966, reported in 1972. This information was updated in a 1974 summary at Rawsonville by the U.S. Geological Survey. During 1976-77, Southeast Michigan Council of Governments (SEMCOG) performed six water quality surveys for Belleville Lake.

The water quality constituents reported in the various surveys are temperature, pH, DO, BOD_5, coliform bacteria, fecal coliforms, nitrate, ammonia, phosphate, sulfate, chloride, bicarbonate, and iron. The SEMCOG survey also included water quality analyses for silica, chlorophyll, turbidity and conductivity.

FIGURE IV-1

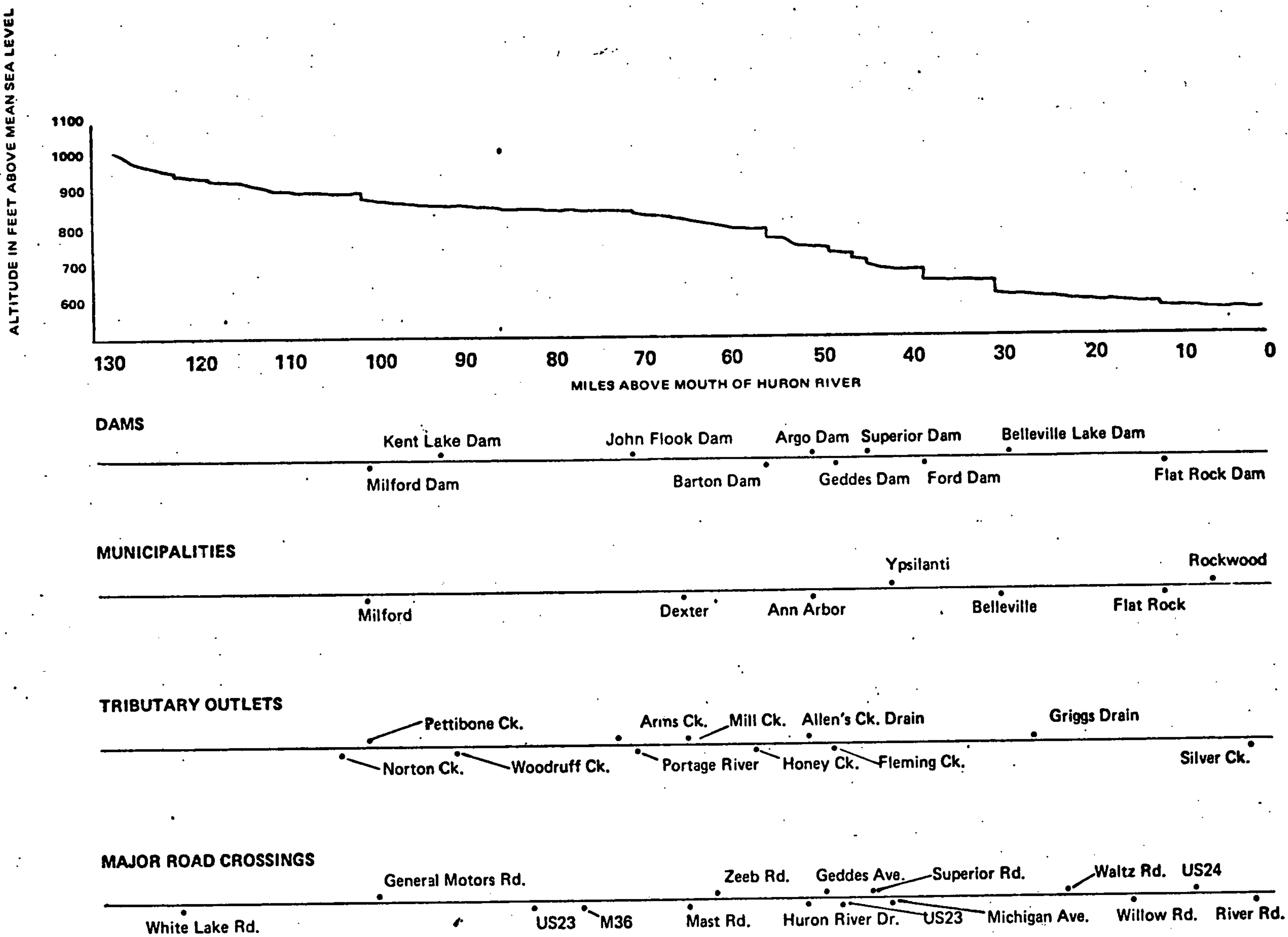
HURON RIVER WATERSHED



SOURCE: HURON RIVER WATERSHED COUNCIL

STREAM GRADIENT OF THE HURON RIVER CHANNEL

FIGURE IV-2



SOURCE: HURON RIVER WATERSHED COUNCIL

Water temperature in the lake varies with seasons. Extremes of temperature were not encountered. The lake waters are slightly alkaline as indicated by pH measurements. Dissolved oxygen (DO) levels vary with depth, ambient conditions, and along the lake. A few times during the year DO levels as low as 3.9 ppm have been observed in the surface water samples. Water samples near the bottom of the lake have shown DO levels as low as 1.1 ppm. It appears that most of the time during the year, DO levels are adequate for propagating fish life. There is also an indication that the DO concentration decreases with the passage of waters through the lake.

The highest observed value of BOD_5 is 10.0 mg/l during the SEMCOG survey. Of the various observations of fecal coliforms, some of the earlier surveys indicated high concentrations of fecal coliforms (400/100 ml). However, the most recent surveys by SEMCOG have indicated less than 20/100 ml.

Nutrient concentrations in the lake water samples have usually been an order of magnitude lower than concentrations found in the influent waters. SEMCOG surveys indicated total PO_4 in the range of 0.1 mg/l to 0.4 mg/l and NO_3 concentrations in the range of 0.01 to 0.4 mg/l. Comparison of these values with the earlier survey results indicate that nutrient concentrations have gone down over the years. This is probably due to improved wastewater treatment upstream. However, downstream of the French Landing Dam, SEMCOG survey found very high concentrations of nutrients indicating eutrophic conditions.

Chlorophyl A measurements in the lake samples showed variations from 1.5 to 4.0 mg/litre. Chloride concentration in the lake was measured at around 60-65 mg/l. Chloride in the lake water have increased from 14 in 1958 to about 65 in 1977. This increase is probably due to the upstream wastewater plant discharges over the years.

The SEMCOG survey also found lead concentrations higher than 30 mg/l recommended by the State Water Quality standards for public water supply. According to the survey the water quality downstream of the dam is not safe for public supply.

Geology and Soils

The surficial geology of the study area is characterized as flat lakebed glacial plain formed by glacial lakes. The composition of the unconsolidated materials are predominantly sand in the western portion of the lake and clay in the eastern portion. Sand deposits can be found up to 100 feet in thickness, while clay is found up to 45 feet.

The bedrock of the area is sedimentary in origin and predominantly sandstone, shale and carbonate rocks of the Mississippian and Devonian age. The bedrock formations underlying the study area are Antrim shale in the western portion of Belleville Lake and traverse group in the eastern portion. The Antrim shale formation is composed of dark brown to black bituminous shale with a thickness up to 145 feet. The contour of Antrim shale is 550-600 feet above sea level. The traverse group formation is a composition of limestones, dolomites and shales with a thickness up to 273 feet. The contour of the Traverse Group is 550-600 feet. [3]

A soil association is a group of soils geographically associated in repeating patterns and characteristics, consisting of one or more major soils and at least one minor soil. Three major soil associations can be found surrounding the study area: Wasepi-Gilford-Boyer Association; Pewamo-Blount-Metamova Association; and, Thetford-Granby-Tedrow Association. Soil associations are composed of a more specific soil series which is a group of soils having horizon similar in differentiating characteristics and management in the soil profile. The following are general descriptions of the three soil associations in the study area.[4]

1) Wasepi-Gilford-Boyer Association: Nearly level to sloping, very poorly drained, somewhat poorly drained, and well drained soils that have a coarse texture or moderately coarse texture subsoil.

2) Pewamo-Blount-Metamova Association: Nearly level to gently sloping, very poorly drained to somewhat poorly drained soils that have a fine texture to moderately coarse texture subsoil.

3) Thetford-Granby-Tedrow Assocation: Nearly level, very poorly drained to somewhat poorly drained soils that have a coarse texture subsoil.

Fish and Wildlife

For many years, the Huron River through Washtenaw and Wayne Counties served as a poor fishery due to the predominance of trash fish, i.e., carp and suckers. An extensive fisheries management program was initiated in 1972 by the Department of Natural Resources with a particular concentration of effort in Belleville Lake.

The fishery management program for Belleville Lake involved the chemical treatment of the Lake to kill and remove the trash fish followed immediately by an agressive restocking program. Table IV-1 illustrates the numbers and species of fish involved in the restocking program conducted from 1973 to 1976. The success of the restocking program as sown in Table IV-2 illustrates that fish growth in Belleville Lake has exceeded statewide averages. Table IV-3 presents the results of the creel census conducted in 1975 and 1976, which indicates a sizable population of crappie, bluegill, walleye and bass, among other species.

The DNR District Fisheries Biologist, Ronald J. Spitler, indicates that Belleville Lake is among the five most heavily fished inland lakes in Michigan and recent surveys continue to show excellent growth and reproduction with walleye, bass, crappie, catfish and other species. The Lake has also been stocked with tiger muskellunge over the past two years thereby further enhancing the fishery.

CULTURAL RESOURCES

Land Use[5]

The predominant land use around Belleville Lake is for single family residences located either individually or in subdivisions. The shore-related land use in the City of Belleville is primarily single family residential. Located west of Belleville along the south shore are the Lakepoint, Husted, Maliszewski, and Edgewater Heights Subdivisions. Along the north shore west of Belleville Road are the Lakeside and Robelle Acres Subdivision and east of Belleville Road are the Belle Harbor Estates, Lake Crest Estates, McMullan Brothers and Huron Hills Subdivision.

TABLE IV-1

FISH STOCKING

BELLEVILLE LAKE, WAYNE COUNTY, MICHIGAN

1973 through 1976

SPECIES	NUMBER	SIZE
Rainbow Trout	722	Adults
Rainbow Trout	127759	Yearlings
Largemouth Bass	166680	Fingerlings
Smallmouth Bass	5779	Fingerlings
Northern Pike	3,300,359	Fry
Tiger Muskellunge	24	Fingerlings
Walleye	16568	Fingerlings
Walleye	4,350,000	Fry
Bluegill	321	Adults
Bluegill	80323	Fingerlings
Hybrid Sunfish	1750	Fingerlings
Black Crappie	1643	Adults
Black Crappie	1500	Fingerlings
Channel Catfish	138	Adults
Channel Catfish	100,000	Fingerlings
Pumpkinseed Sunfish	300	Fingerlings
White Bass	146	Adults
Fathead Minnows	52,000	Adults
TOTAL	8,206,012	

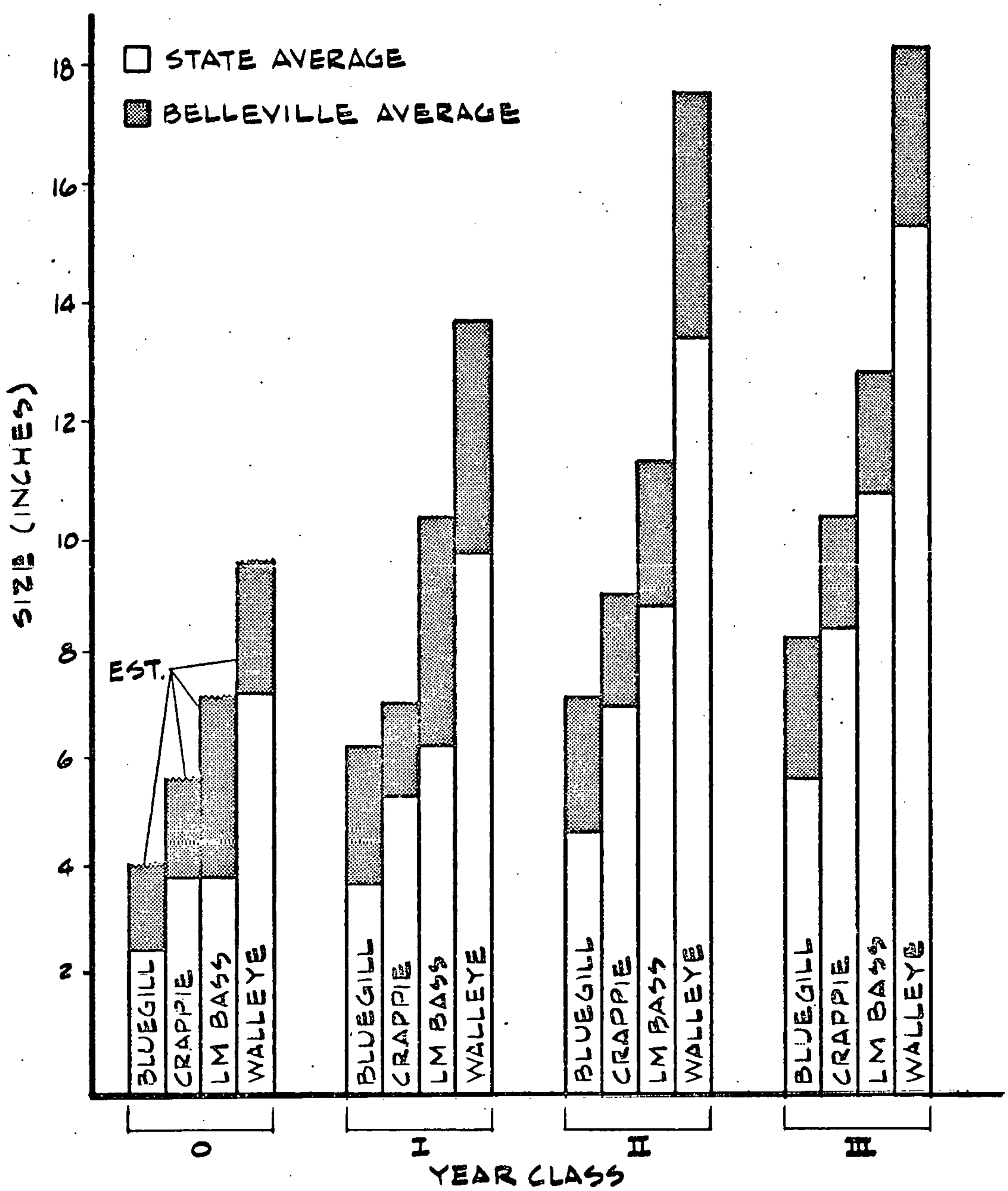
Source: Michigan Department of Natural Resources

TABLE IV-2

FISH GROWTH

BELLEVILLE LAKE, WAYNE COUNTY, MICHIGAN

1974 THROUGH 1976



SOURCE: MICHIGAN DEPARTMENT OF NATURAL RESOURCES

TABLE IV-3

CREEL CENSUS RESULTS

BELLEVILLE LAKE, WAYNE COUNTY, MICHIGAN

June 1 to November 5, 1975
April 1 to October 31, 1976

SPECIES	1975	%	1976	%
Crappie	92511	61.8	50658	63.2
Bluegill	18608	12.4	11307	14.1
Walleye	16436	10.9	1550	1.9
Largemouth Bass	6537	4.4	1700	2.1
Sunfish	4800	3.2	3357	4.2
Bullhead	3864	2.6	4848	6.0
Smallmouth Bass	2511	1.7	47	.06
Rainbow Trout	1169	.8	-	-
Catfish	1093	.7	1130	1.4
Perch	1035	.7	397	.5
Tiger Muskellunge	460	.3	-	-
Carp	248	.2	205	.3
Rock Bass	234	.2	101	.1
Northern Pike	136	.09	-	-
White Bass	-	-	3488	4.4
Sucker	-	-	1418	1.8
TOTAL CATCH	149,642		80,206	

Source: Michigan Department of Natural Resources

The largest multi-family complex in Van Buren Township is the Lemontree Apartments located west of Belleville Road between I-94 and the north shore of Belleville Lake. Located in the area adjacent to and south of the French Landing Dam is an industrial area which includes two engineering firms, two steel production plants, a food processing plant, a chemical firm, and a plastics and plating company.

Although the land surrounding Belleville Lake is highly developed, some expanses of open land can still be found. Large tracts of open land are located along the northern shore east of Belleville Road and along the southern shore west of Belleville Road. Located west of the Lemontree Apartment complex is a Township park which represents the only public recreational land use on the Lake.

Some of the more highly valued property within Van Buren Township can be found surrounding Belleville Lake. The attractiveness of lakefront property, landscaping improvements, and shoreline treatment and accessory structures are several factors which account for higher property values.

Shoreline Use and Structures

A great deal of the Belleville Lake shoreline, perhaps as much as 50%, is lined with shore protection structures intended to prevent the erosive action of fluctuating water levels and waves. The predominant materials used for shoreline protection are steel sheet piling and concrete. Other materials include wood planking and pilings and riprap.

A visual survey of the shoreline indicates that many of the steel sheet piling seawalls are suffering damage. The predominant damage eminates from a lakeward movement at the base of the seawall. While the concrete walls seem to generally be withstanding damage, many are crumbling. Where no shoreline protection measures are evident, severe erosion is taking place.

Since Belleville Lake is used for recreational purposes, there are many shoreline structures supportive of recreational boating. Most residences along the Lake have constructed some type of dock, pier, boathouse, or boat hoist. Like the seawalls, many of these structures are suffering damage.

Population

The population of Van Buren Township has shown dramatic increases since 1950 while the City of Belleville has grown much less rapidly, as illustrated below: [6]

	1950	1960	1970	1975	1950-1975 % change
Van Buren Twp.	5,105	4,509	13,162	17,400	240.8
Belleville	1,722	1,921	2,406	2,904	68.6

With the addition of the Lemontree Apartment complex along with new subdivision activity, it is apparent that much of the population growth has occurred around Belleville Lake. For the vacant or underutilized land around the lake, the Township land use plan proposes primarily low density residential (2-3 dwellings units/acre) and medium density residential (3-12 dwelling units/acre). If developed in this manner, further population pressures will be placed in the area around the lake.

INSTITUTIONAL/LEGAL SETTING

Use of Surface Water

Legal rights ascribed to the use of water in Michigan is derived from common law 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 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 led to interpretation by the courts.

An additional important aspect of the riparian doctrine is that there is no forfeiture of unexercised water rights. The lack or interruption of use by the riparian owner does not result in 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 permited 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 statuatory modifications have largely concentrated on the protection of 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 environmental quality of inland lakes and stream, 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 a river basin or watershed is regulated by the DNR under the Surplus Water 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.

The Inland Lake Level Act of 1961 provides for the determination and maintenance of legally established water levels on inland lakes for the protection of public health, safety and welfare, the conservation of natural resources and the preservation of property values. Either a county board of commissioners, acting upon petition by lake riparians or through their own action, or the Michigan Natural Resources Commission may petition the circuit court for the establishment of a legal lake level or levels (winter and summer levels). Upon establishment of a legal lake level, the expense of determining and maintaining the level, including construction and operation of a control structure, may be levied against a special assessment district composed of benefiting property owners.

Protection of the Lake Environment

As mentioned above, there are a number of statutes dealing with the protection of the lake 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 dam at the French Landing hydroelectric facility would require a permit from DNR.

Any dredging and filling activities in the vicinity of the facilities 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.

In the course of restoring the hydroelectric facility, it may be necessary or desirable to landscape the entrance and grounds near the facility. Earth changes disturbing one or more acres of land or within five hundred feet of a lake or stream require compliance with the Soil Erosion and Sedimentation Control Act of 1972. A permit would have to be obtained from the local enforcing agent.

FOOTNOTES

[1] The Huron River and Its Watershed, E. Wayne Say, Owen Janssen, Huron River Watershed Council, page 6.

[2] Ibid

[3] Draft Facilities Plans and Environmental Assessments for Wastewater Management in the Huron River Valley Portions of Washtenaw, Wayne and Oakland Counties, Washtenaw County Department of Public Works and Wayne County Road Commission, 1976.

[4] Soil Survey of Wayne County Area, Michigan, U.S. Department of Agriculture, Soil Conservation Service, 1977.

[5] Land Use Information provided by Parkins, Rogers & Associates, Inc., Planning Consultants for Van Buren Township

[6] U.S. Bureau of Census

SECTION V
SITE HYDROLOGY

GENERAL

The Huron River watershed upstream of the French Landing dam has a drainage area of 833 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 watershed is well drained and consists of large numbers of natural and artificial lakes. Watershed downstream of the French Landing dam is a narrow strip of land approximately 5 miles wide and 30 miles long.

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. French Landing dam and impoundment (Belleville Lake) was created by the Detroit Edison Company in 1925. Belleville Lake with 1425 acres of surface area is the largest impoundment in the watershed.

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 twenty-two (22) miles upstream of the French Landing 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 French Landing 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 French Landing 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 a "mass diagram" for the site, showing the accumulated water mass as a function of time. Other flow parameters at Ann Arbor gauging station are estimated by U.S.G.S. as follows:

FIGURE V-1

FLOW DURATION CURVE

HURON RIVER @ FRENCH LANDING

(1915-1967)

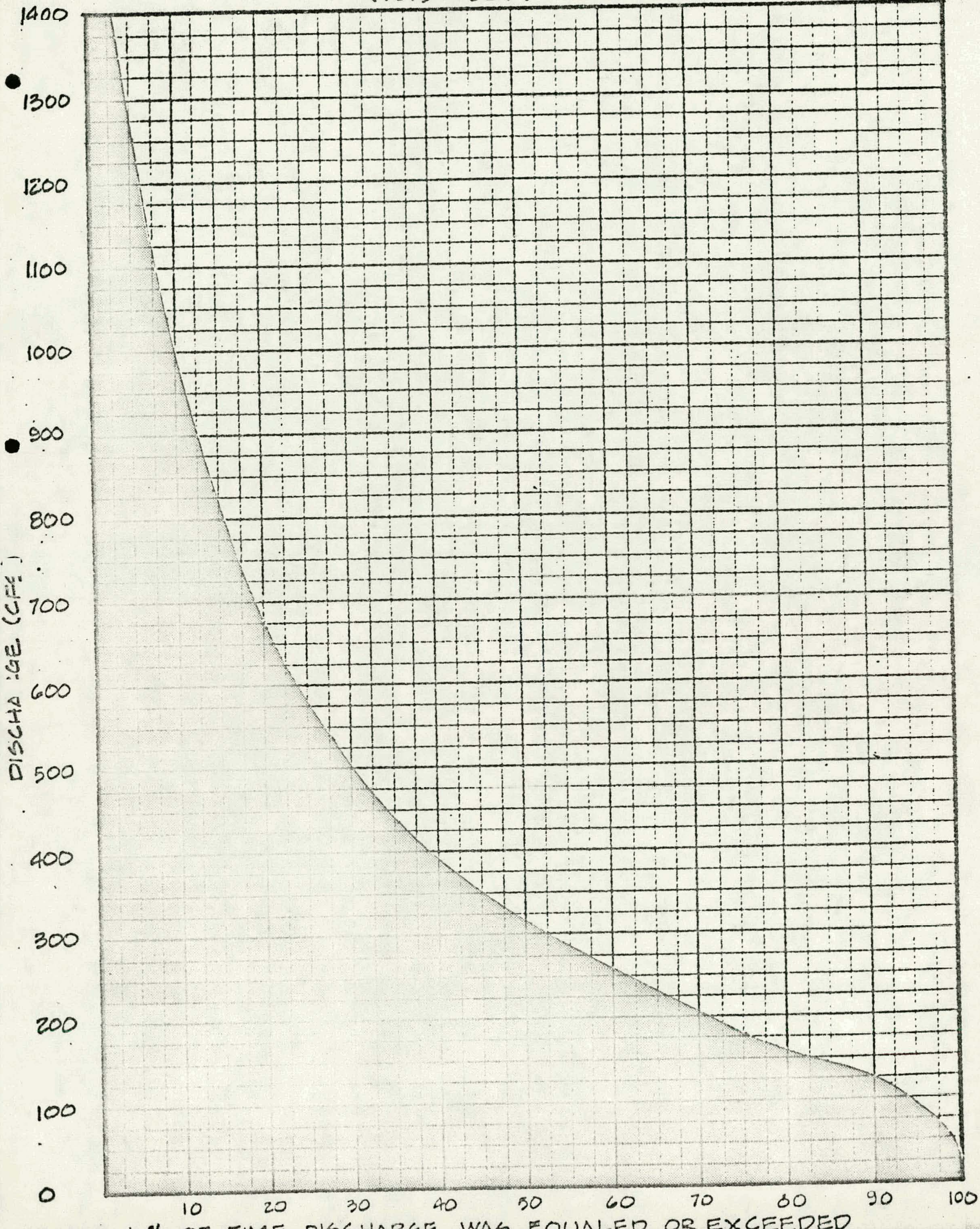


FIGURE V-2
FLOW DURATION CURVE
HURON RIVER @ FRENCH LANDING (1915-1967)

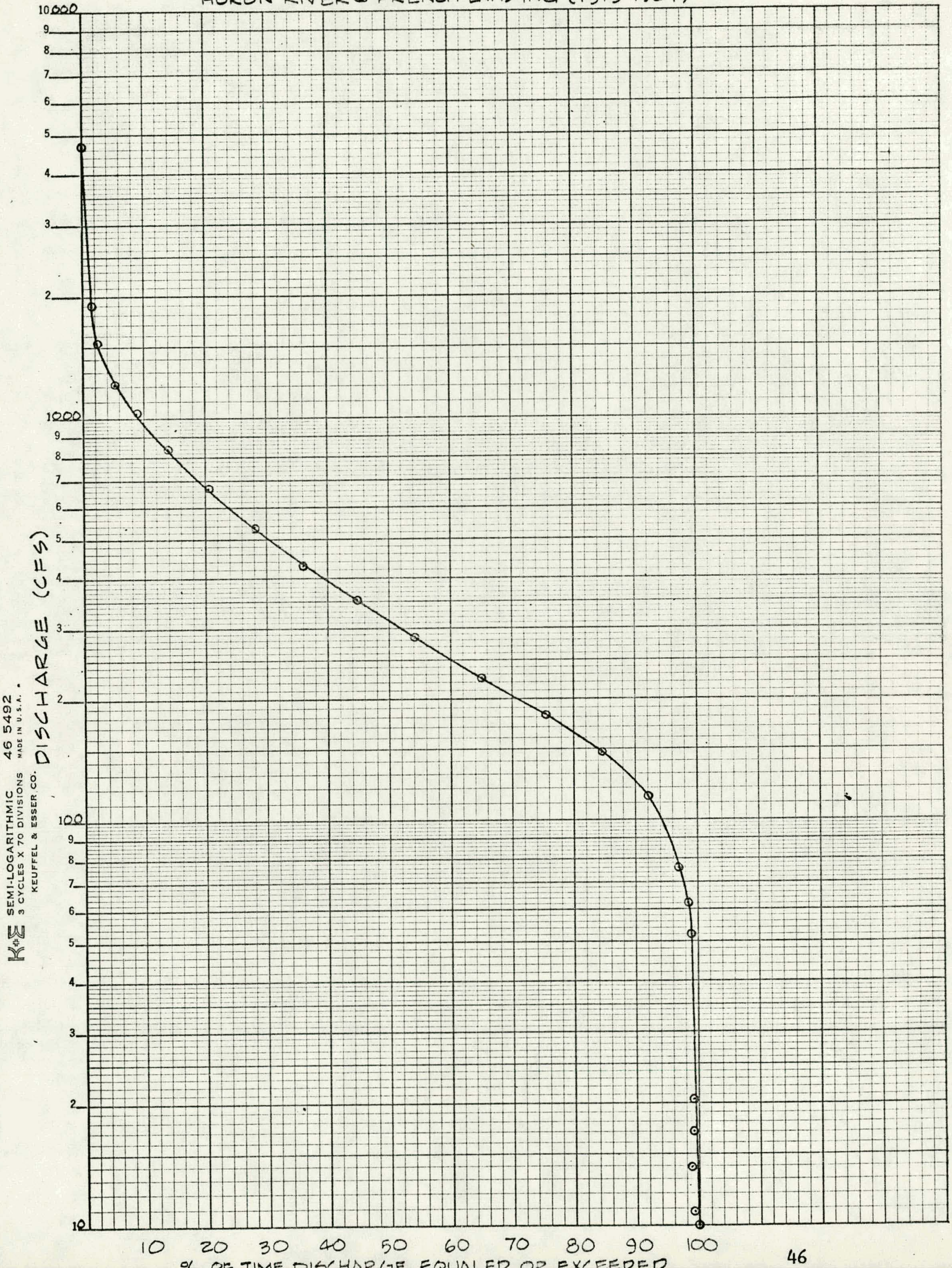
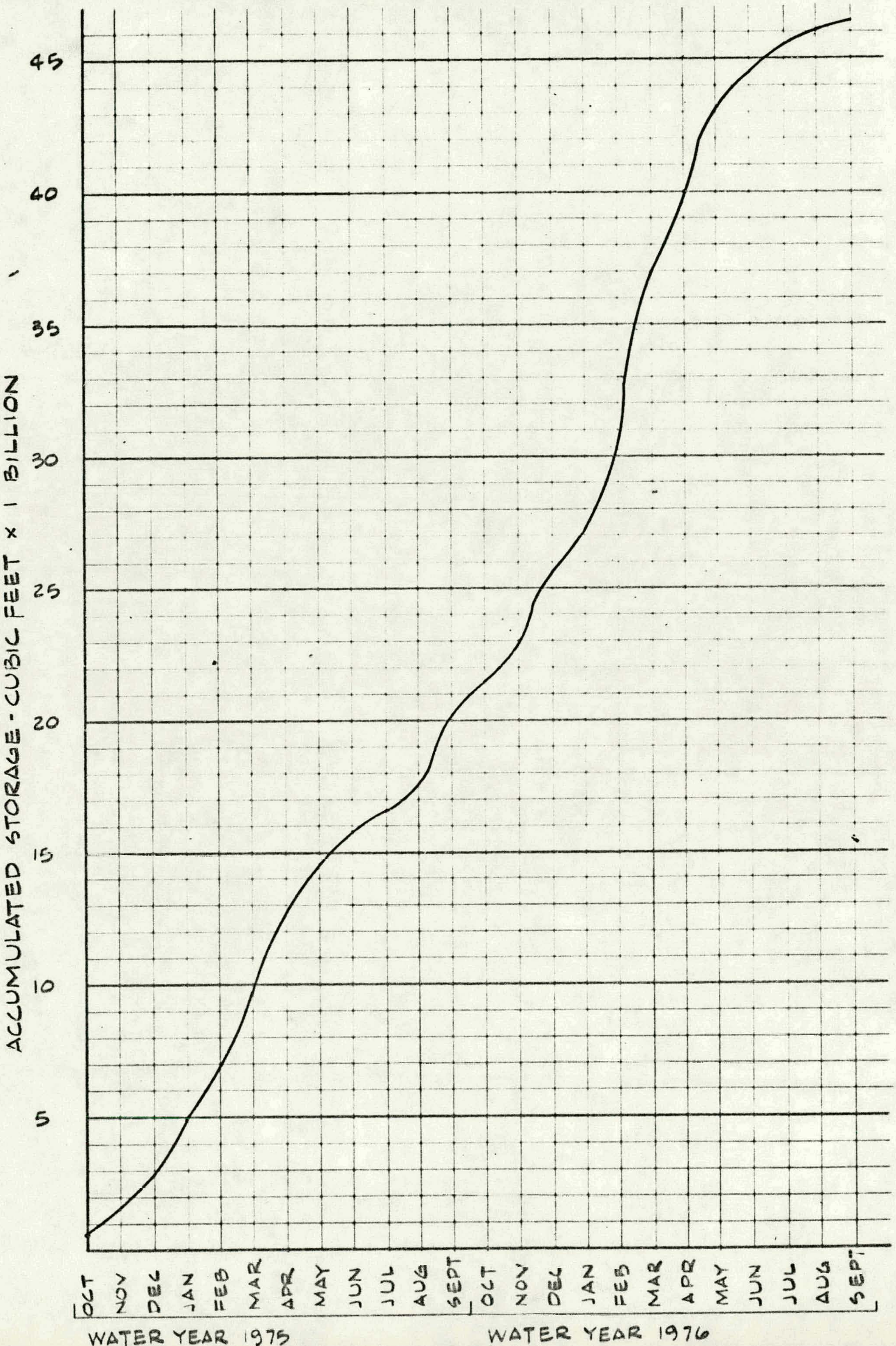


FIGURE V-3
MASS DIAGRAM
HURON RIVER AT FRENCH LANDING DAM



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 French Landing dam are estimated as follows:

Average Daily Discharge	518 cfs
One Year - 30 Day Low Flow	275 cfs
Ten Year - 30 Day Low Flow	57 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 5840 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. On this occasion headwaters rose approximately 0.6 feet above the crest of the multiple-arch section with all gates fully open. Based on a 1975 hydraulic model study of the French Landing structure, Detroit Edison Company has estimated the discharge at this time 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 as far downstream as the entrance to Ford Lake (approximately 12 miles above French Landing). In addition, flood frequencies were estiamted 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	6,255
50-year flood peak (cfs)	8,597	8,755
100-year flood peak (cfs)	9,844	9,550
500-year flood peak (cfs)	13,256	11,258

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 flood 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.

FOOTNOTES

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

[2]Engineering Research Department Report 69J16, The Detroit Edison Company, 1970.

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

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

SECTION VI
DAM HYDRAULICS

The hydraulic characteristics of the French Landing dam were extensively studied by the Engineering Research Department of the Detroit Edison Company in 1970. The purpose of the study was to determine suitable methods for reducing downstream turbulence and subsequent erosion of the river bed due to poor energy dissipation at the base of the sector gate spillways.

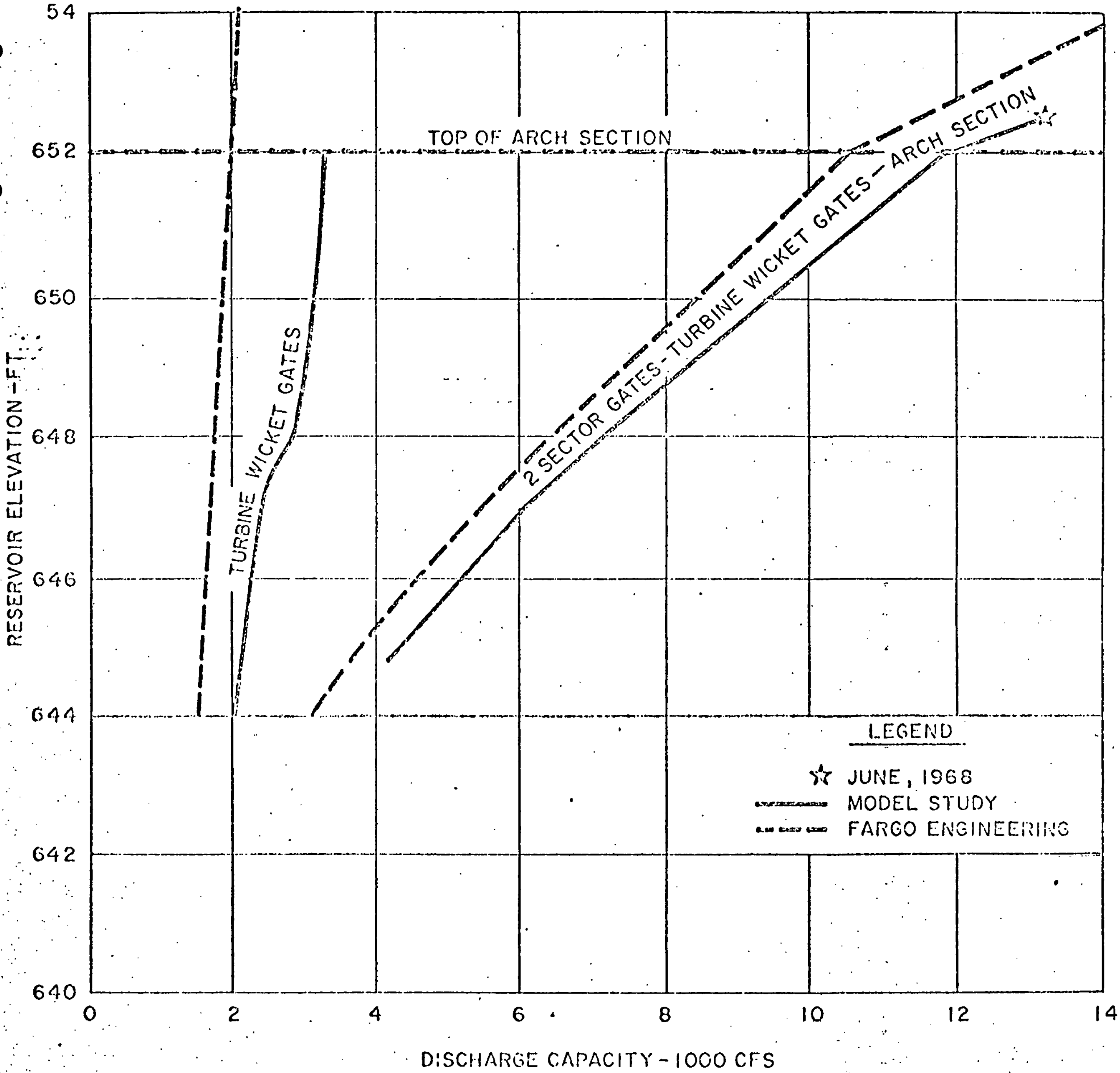
The study involved the development of an hydraulic model of the site and the performance of a series of model tests. Discharge rating and tailwater elevation curves were developed for the structure and are reproduced in Figures VI-1,2,3 and 4. The accuracy of these curves has been substantiated by independent calculations by Ayres, Lewis, Norris & May, Inc., in November, 1978, and by a 1969 study by the Fargo Engineering Company of Jackson, Michigan.

DISCHARGE RATING

The discharge rating curves show that flow through the dam is composed of three components, having the maximum capacities indicated below:

- -wicket gates: 3000 cfs
- -sector gates: 2 @ 4000 cfs
- -multiple-arch section: virtually unlimited (if restored)

The wicket gates are used to control normal streamflow. Their combined capacity of 3000 cfs can accomodate the natural discharge at French Landing over 99% of the time. The two sector gates are used to pass flood peaks. The combined capacity of the two wicket gates and two sector gates (11,000 cfs) is approximately equal to the projected 100-year flood peak (Section V). There are, however, good reasons for discounting the contribution of the wicket gates under flood conditions due to a decrease in capacity caused by debrise accumulation in the trash racks.

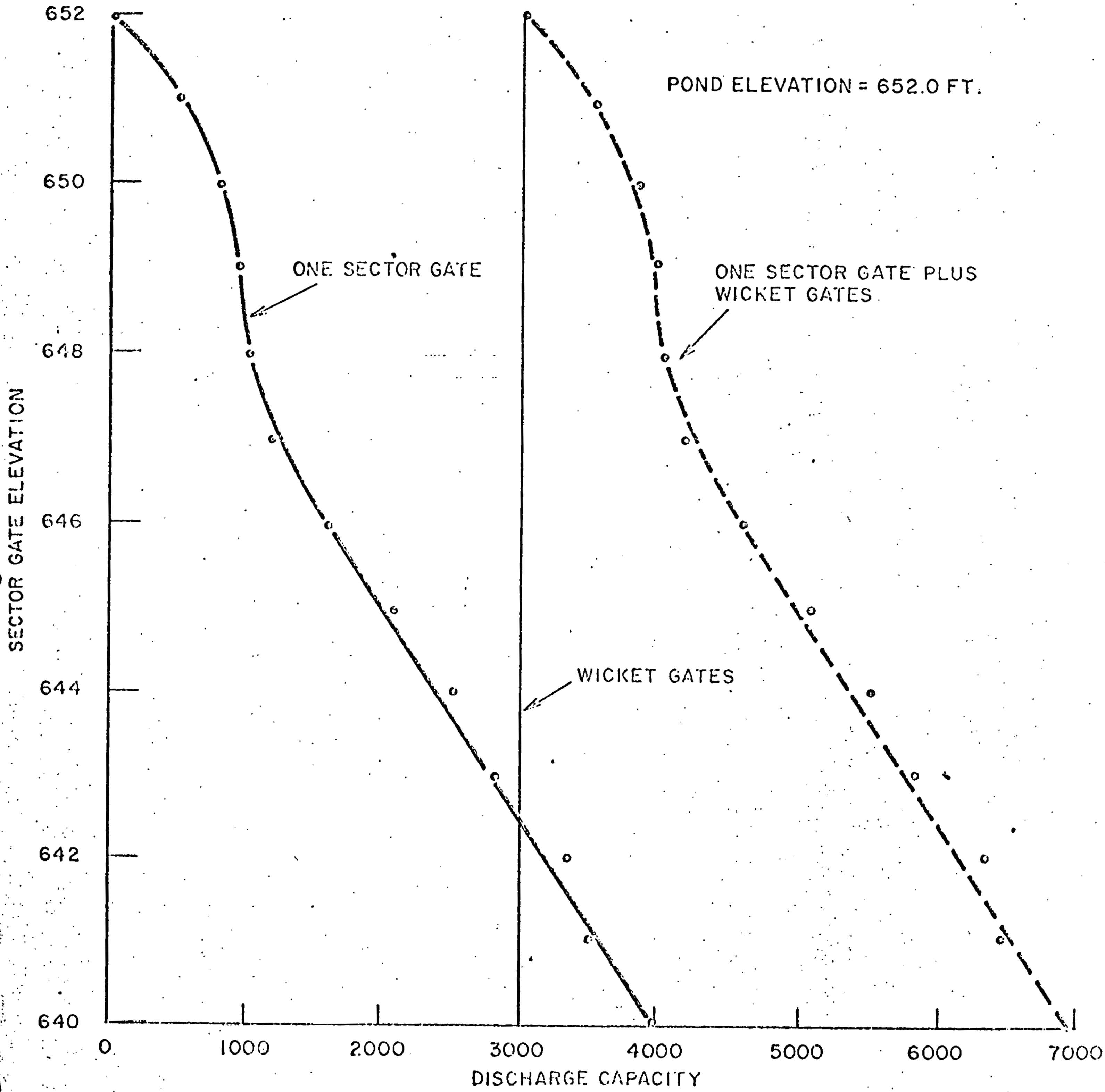


NOTE: SECTOR GATE ELEVATION = 640.0 FT.

DISCHARGE RATING CURVES FOR FRENCH LANDING DAM

FIGURE VI-1

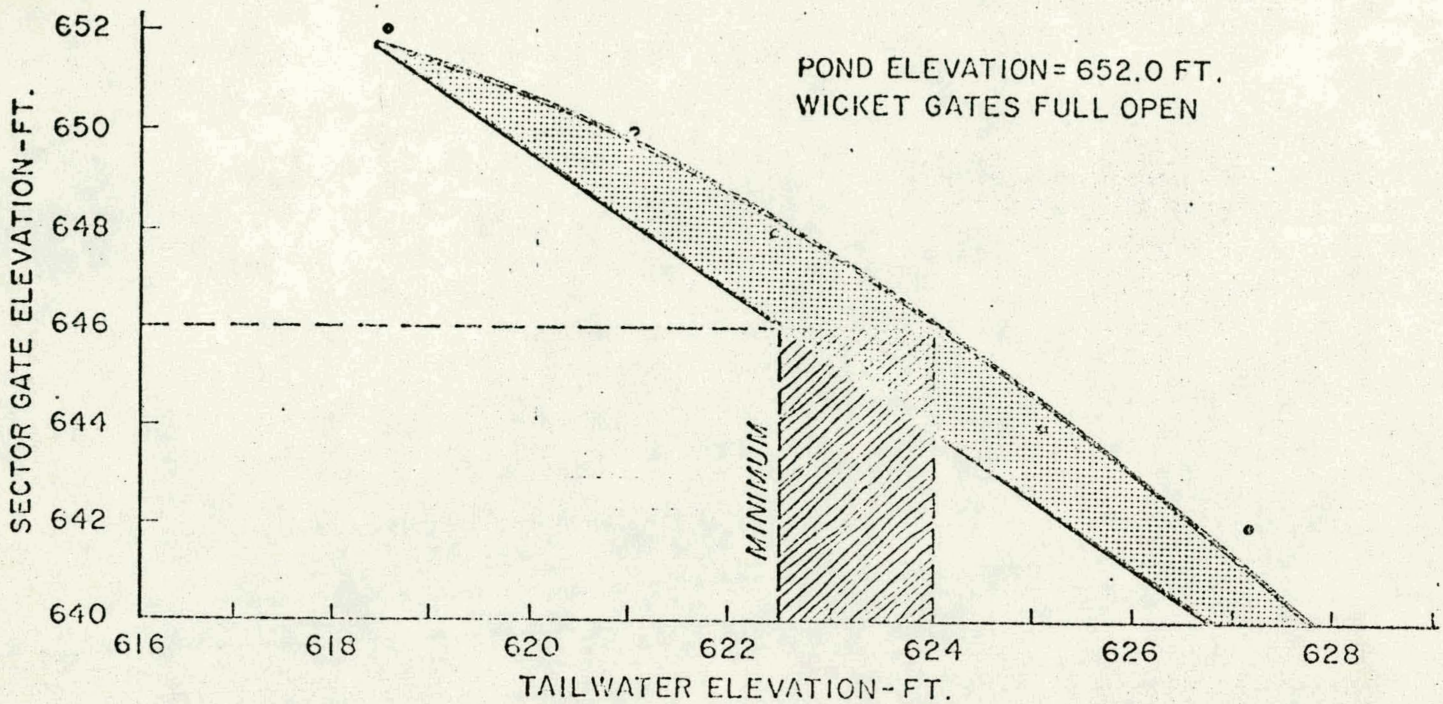
SOURCE: DETROIT EDISON CO. ENGINEERING RESEARCH DEPT. REPORT 69J16



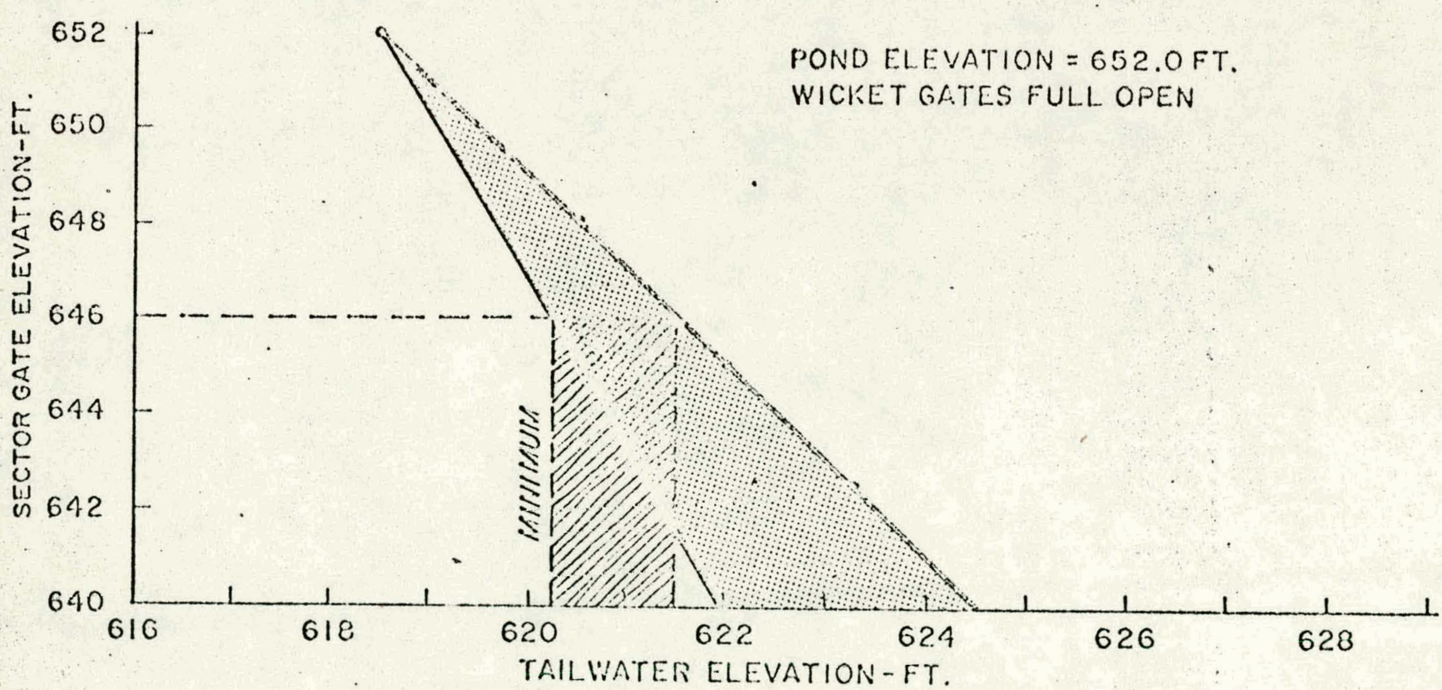
DISCHARGE CAPACITY OF EACH SECTOR GATE AT FRENCH LANDING DAM

FIGURE VI-2

SOURCE: DETROIT EDISON CO. ENGINEERING RESEARCH DEPARTMENT REPORT 69J16



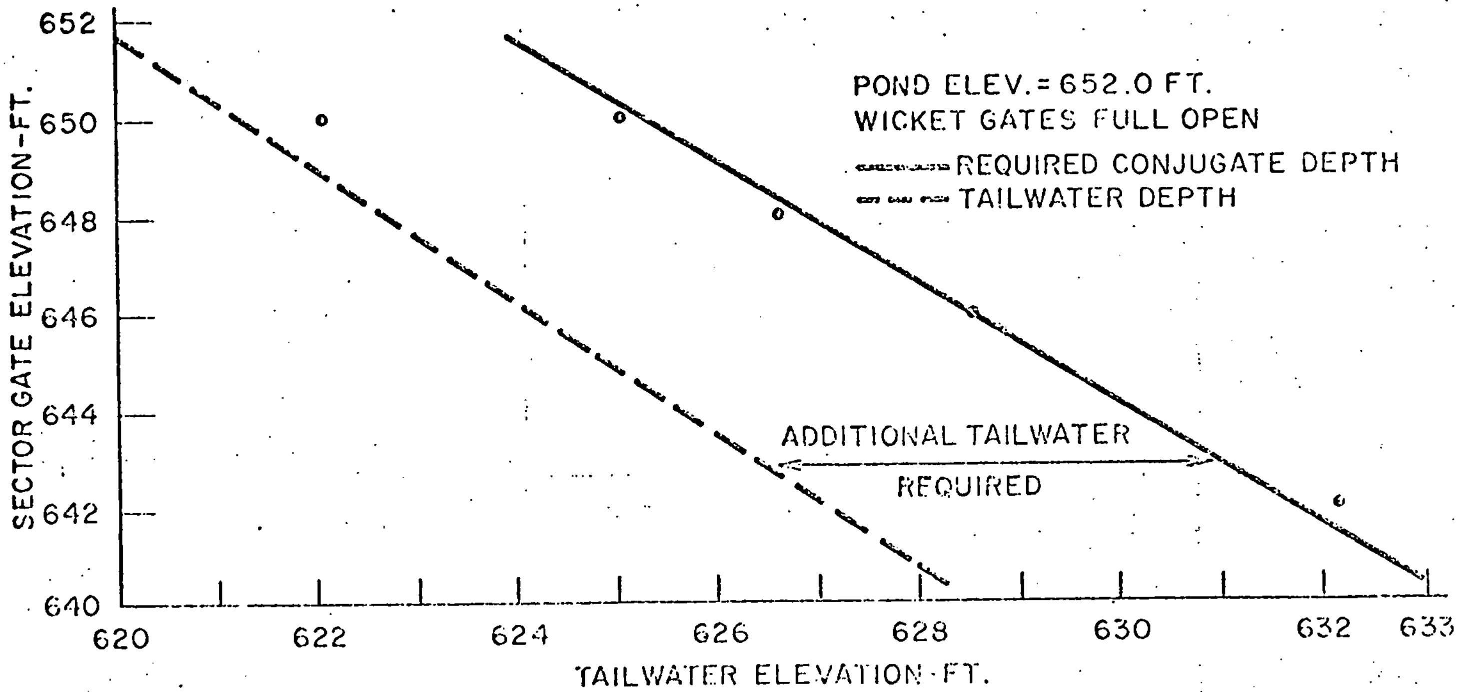
STABILIZED TAILWATER ELEVATIONS FOR OPERATION OF TWO SECTOR GATES



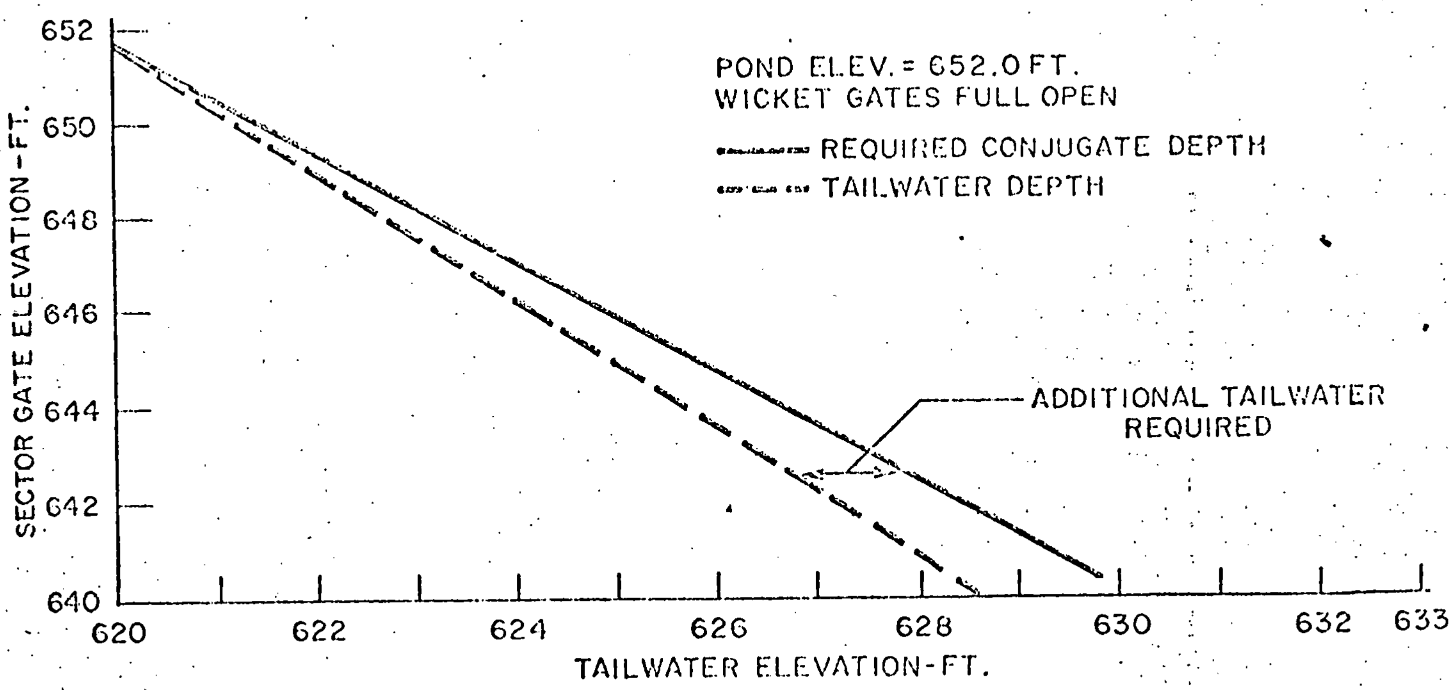
STABILIZED TAILWATER ELEVATIONS FOR OPERATION OF ONE SECTOR GATE

FIGURE VI-3

SOURCE; DETROIT EDISON COMPANY ENGINEERING RESEARCH DEPARTMENT REPORT 69J16



TAILWATER AND CONJUGATE DEPTHS ON EAST SPILLWAY
WITH BOTH SECTOR GATES OPERATING



TAILWATER AND CONJUGATE DEPTHS ON WEST SPILLWAY
WITH BOTH SECTOR GATES OPERATING

FIGURE VI-4

SOURCE: DETROIT EDISON COMPANY ENGINEERING RESEARCH DEPARTMENT REPORT 69J16

If flood peaks exceed the combined capacity of the wicket and sector gates, the upstream waters will rise and eventually overtop the crest of the multiple-arch section (elevation 652.0). The original design of the dam anticipated this contingency, as evidenced (in the original plans) by a concrete apron with energy dissipators at the foot of the arch section, and a channel to direct discharges back into the main stream of the river.

TAILWATER LEVELS

Figures VI-3 and 4 show that the tailwater level does not rise above the normal level of 619.5 feet until discharge through the dam reaches a magnitude requiring operation of the sector gates. With the sector gates closed and wicket gates fully open (3000 cfs), tailwater elevation is only 0.5 foot above normal. Buildup of tailwater level with increasing discharge is quite gradual. With both wicket gates and both sector gates fully open (11,000 cfs), tailwater elevation rises about nine feet to elevation 628.5.

MODIFICATIONS TO MULTIPLE-ARCH SECTION

The six-span arch dam spanning southerly from the powerhouse to the earth dike is an integral component of the French Landing Dam. The arch dam originally was designed to act as a 181 foot long broad crested overflow weir to pass river flows for water surfaces above elevation 652.0 feet. The overflow water would fall onto deflector slabs then into a stilling basin on the downstream side. Discharge from the stilling basin was into a wide, flat, stone-rubble covered channel which joined the Huron River about 300 feet downstream of the power house; i.e., just north of the road bridge abutments. A steel sheet piling wall provided a divider wall between the arch dam discharge and the power house discharge until the arch dam channel joined the Huron River.

In the 1950's or 1960's significant changes were made to revise the operations of the arch dam. Investigations have not been able to pinpoint the date of the changes or their reasoning. The two major components of the changes are as follows:

1. The sheet piling wall was extended downstream past the abutments of the road bridge, effectively cutting off the arch dam channel from the Huron River.

2. The deflector slabs under the overflow edge of the six arches were partially removed, probably in lieu of repairs.

The results of these changes was to eliminate the use of the arch dam as a viable discharge component of French Landing dam. Discharge over the arch dam would fall onto exposed foundations which would lead to significant undercutting and to eventual destruction of the arch dam. Also, the discharge would flood the broad channel and not be able to flow back into the Huron River except by over-topping the sheet piling wall or seepage through the wall. The channel flooding will lead to erosion of downstream earth banks and road bridge supports.

Therefore, controlled river flows are presently constrained to passage through the two sector gates adjacent to the powerhouse and the two wicket gates within the powerhouse. Discharge over the arch dam should not be allowed.

If utilization of the arch dam is once more desired, the function of discharge channel and deflector slabs should be restored.

OPERATION OF DAM DURING FLOOD CONDITIONS

General

The determination of the correct mode of operation of the French Landing dam during periods of flood hazard has been and continues to be a matter of great concern. The problem has been compounded by apparent uncertainty regarding:

- the actual flood magnitudes to which the site is subject
- the ability of the dam to safely pass flood discharges, particularly over the multiple-arch section
- the downstream consequences of various flood discharges through the dam
- the influence of upstream dams on flood discharges into Belleville Lake
- the potential adverse consequences caused by lowering Belleville Lake during winter months
- the ability of the sector gates to function reliably as components in an automatic flow control strategy

Background

When Detroit Edison Company operated the dam a flood control strategy was followed which involved a substantial lowering of the level of Belleville Lake during the period of greatest flood hazard. From about November 1st to April 15th, the lake level was lowered from three-and-a-half to five feet. The stubstantial volume of unused storage capacity that was thus created made it possible to absorb part of the flood crests as they came down the river, thereby moderating the flood discharge downstream of the dam. In addition, the extra storage capacity created a safety factor which permitted a slower response to changes in stream discharge.

In a memorandum written in 1960,[1] the utility stated that the flood control strategy was aimed at limiting flows downstream of the dam to under 3000 cfs. With five feet of storage volume, the utility estimated that a 6000 cfs storm could be controlled for about two-and-a-half days. After that period they estimated that Belleville Lake would have risen to its maximum elevation, and it would then become necessary to pass all of the flood discharge immediately through the dam.

The basis of the 3000 cfs limitaton is not known, however, the overall flood control strategy was based on avoiding any property damage downstream of French Landing due to high water resulting from large flood discharge.

Since taking over the operation of the dam in 1973, Van Buren Township has continued to follow the Detroit Edison practice of lowering the lake level by three-and-a-half to five feet during the winter and early spring.

Analysis

In terms of optimum hydroelectric plant operation, it is desirable to hold headwater levels as high as safely possible. Any decrease in level reduces the available operating head on the turbines, thereby diminishing output.

In view of this, the feasibility of maintaining a higher winter level in Belleville Lake than has been the previous practice was investigated. The following facts, which were established during the investigation, are pertinent to the conclusions reached:

1. Although most floods occur in the Huron River in late winter and early spring, there is a significant threat of floods at other times of the year, particularly early to mid-summer (see Section V). Based on U.S.G.S. stream flow records, approximately 25 percent of the maximum flood peaks in the Huron River occur after April 15th. The practice of raising the lake level in mid-April has no effect in reducing the exposure to these later floods.
2. The average yearly flood peak experienced at the French Landing dam is approximately 3000 cfs (see Section V). The Detroit Edison strategy of limiting dam discharge to less than 3000 cfs was thus only intended to accommodate storms having less than a once-a-year occurrence rate.
3. The practice of substantially lowering the level of Belleville Lake during winter and early spring has created some significant adverse environmental consequences relating to soil erosion, siltation of the lake, and property damage to shoreline structures (see Section IV).
4. The potential for flood damage downstream of French Landing does not appear to constitute a significant threat to public safety or property. A check with city personnel in the four communities between French Landing and Lake Erie (New Boston, Flat Rock, Rockwood, and South Rockwood) indicates that no significant property damage from high waters has been experienced for at least the last decade. This includes the period in June, 1968, when a severe storm plus the failure of an upstream dam caused a discharge through the French Landing dam of approximately 13,000 cfs, equivalent to a 500-year flood peak.
5. The multiple-arch section of the French Landing dam was originally designed to discharge water over its crest, if necessary. Modifications made subsequent to the original construction have eliminated this function. However, if restored as described previously in this Section, the multiple-arch section can again be relied upon to operate safely as a discharge component of the facility.
6. The discharge capacity of the nearest upstream dam (Ford dam) is not precisely known at this time, however, based on overall hydraulic dimensions it is known that the capacity is less than that of the French Landing dam, with the arch section restored.
7. The two sector gates, which are the main flood control components of the French Landing dam, have been reported to have operational instabilities which make any attempt at automatic control difficult. Because these gates operate on the principal of buoyancy they are succeptible to problems due to leakage of water into or out of

the buoyancy chambers. In addition, they apparently have varying response characteristics at different headwater levels. A 1971 Detroit Edison Company engineering report concluded that the response of the gates to changes in the level in the buoyancy chambers changed markedly with variations in headwater levels.[2] Also, a significant "deadband", or response lag, existed when going from a raising to a lowering status, or vice versa.

Conclusions and Recommendations

In view of the above facts we feel that the French Landing dam can be operated safely without the extreme winter lake level decrease that is currently being practiced, if some modifications are made. Our reasons for this are twofold:

1. We feel that the potential for flood damage downstream of the dam is not signficant enough to justify the adverse environmental impacts caused by the extreme lowering of the lake level.
2. We feel that the practice of creating excess storage capacity in Belleville Lake is at best a partial flood control measure, since: 1) it does nothing to alleviate the flood peaks experienced after April 15th; 2) it is intended only for floods having a less than once-a-year occurrence rate, (i.e., greater than 3000 cfs); and 3) it is not completely effective for floods of long duration.

In lieu of the current practice we recommend that a normal water surface elevation of 651.5 feet be maintained from April 15th (or ice break-up, whichever occurs first) to November 1. From November 1 to April 15th, the level should be lowered 8 to 12 inches. This is a common impoundment management technique for lakes in Michigan because it tends to lessen ice damage to shoreline structures.

In order to operate safely in this manner, it will be necessary to restore the discharge function of the multiple-arch section and to develop a satisfactory automatic control mechanism for the sector gates. We are of the opinion that a satisfactory control strategy would involve the supplementation of the buoyancy control system with an adjustable mechanical stop system. Moreover, the sector gate settings should be made in discrete steps rather than over a continuous range. Although this control strategy is more elaborate than the system devised by Edison, it is well within the capabilities of commonly available equipment and technology.

FOOTNOTES

[1]Proposed Flood Control on the Huron River, Detroit Edison Company Memorandum, 2/25/60.

[2]Investigation to Determine the Cause of Operational Instability of Spillway Gates at French Landing Dam, Detroit Edison Company Engineering Department Report 69J95, January 11, 1971.

SECTION VII
THEORETICAL POWER POTENTIAL

ENERGY

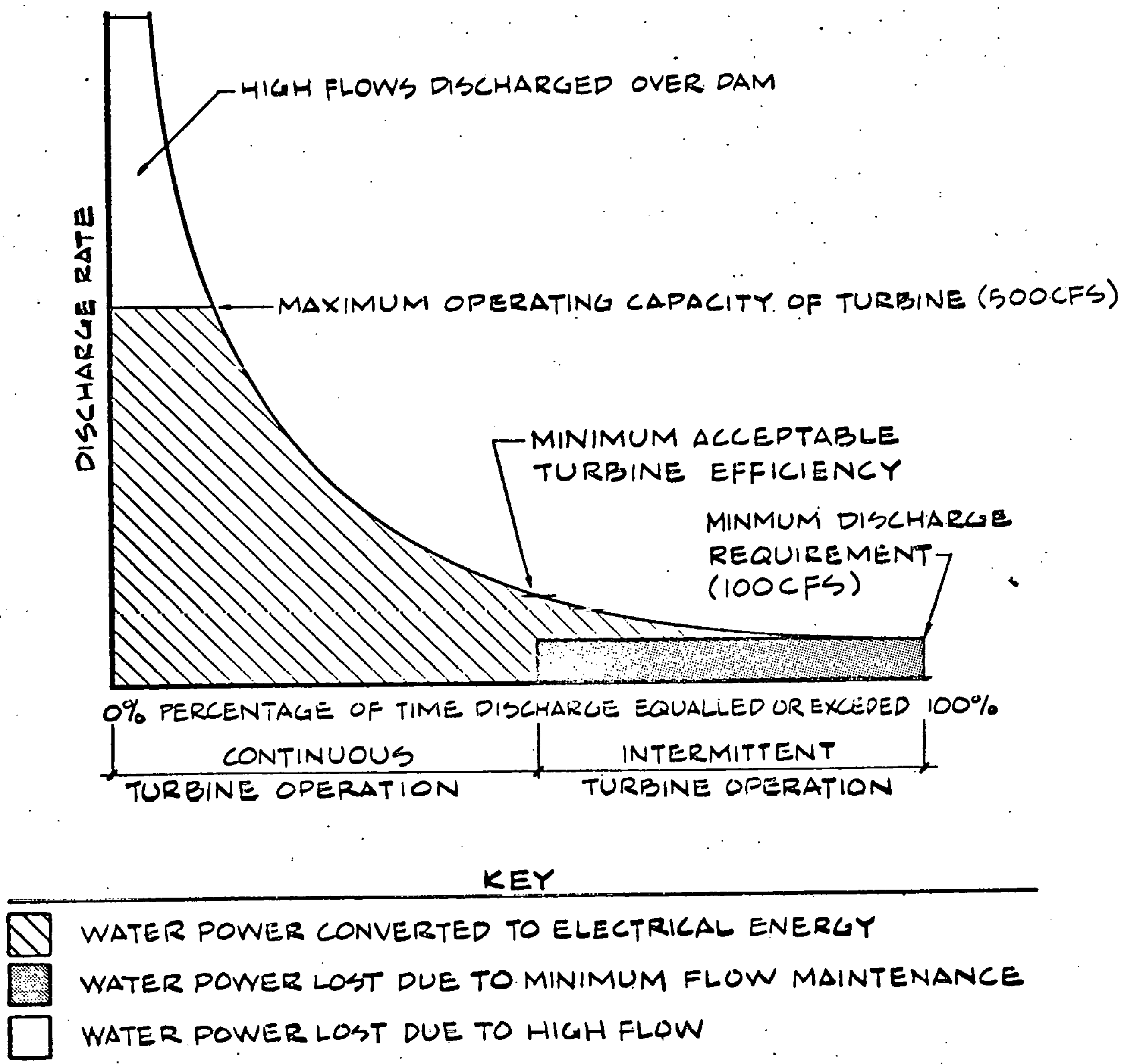
The theoretical water power potential at a given dam site is a function of stream flow characteristics and storage capacity. Stream discharge is of course a natural event which is constantly varying, however the variation is according to a highly predictible pattern. When stream discharge is plotted 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 flow 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 excedence 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 VII-1 shows this principal more clearly. It illustrates the operating characteristics of a run-of-the-river hydropower facility containing a single turbine rated to pass 500 cfs at full load. The area under the 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 subseqeunt low discharge periods). The area under the 500 cfs line represents water which can be passed through the turbine and therfore 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

FIGURE VII-1

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



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 shutdown. In Figure VII-1 this is shown as the shaded area below the 100 cfs line.

Economic Considerations

A short study of the flow-duration curve reveals an important fact about run-of-theriver hydro plant design: namely, 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 excedence), 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 shows the effective capacity of different sized plants at the French Landing dam site. It can be observed that the incremental effective capacity decreases with each increment in plant size. The first 500 kW of production capacity will be utilized 90% of the time, whereas the last 500 kW of capacity will be utilized only 28% of the time.

Installed Capacity (kW)	500	750	1000	1500
Effective Capacity (kW)	448	596	703	844
Increment (kW)	448	148	107	141
Utilization	90%	59%	43%	28%

The consequence of this phenomenon on 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. 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 excedence 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 VII-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 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 VII-2, that there may be a range extending above and below the optimum which still will yeild an acceptable return from an investment standpoint.

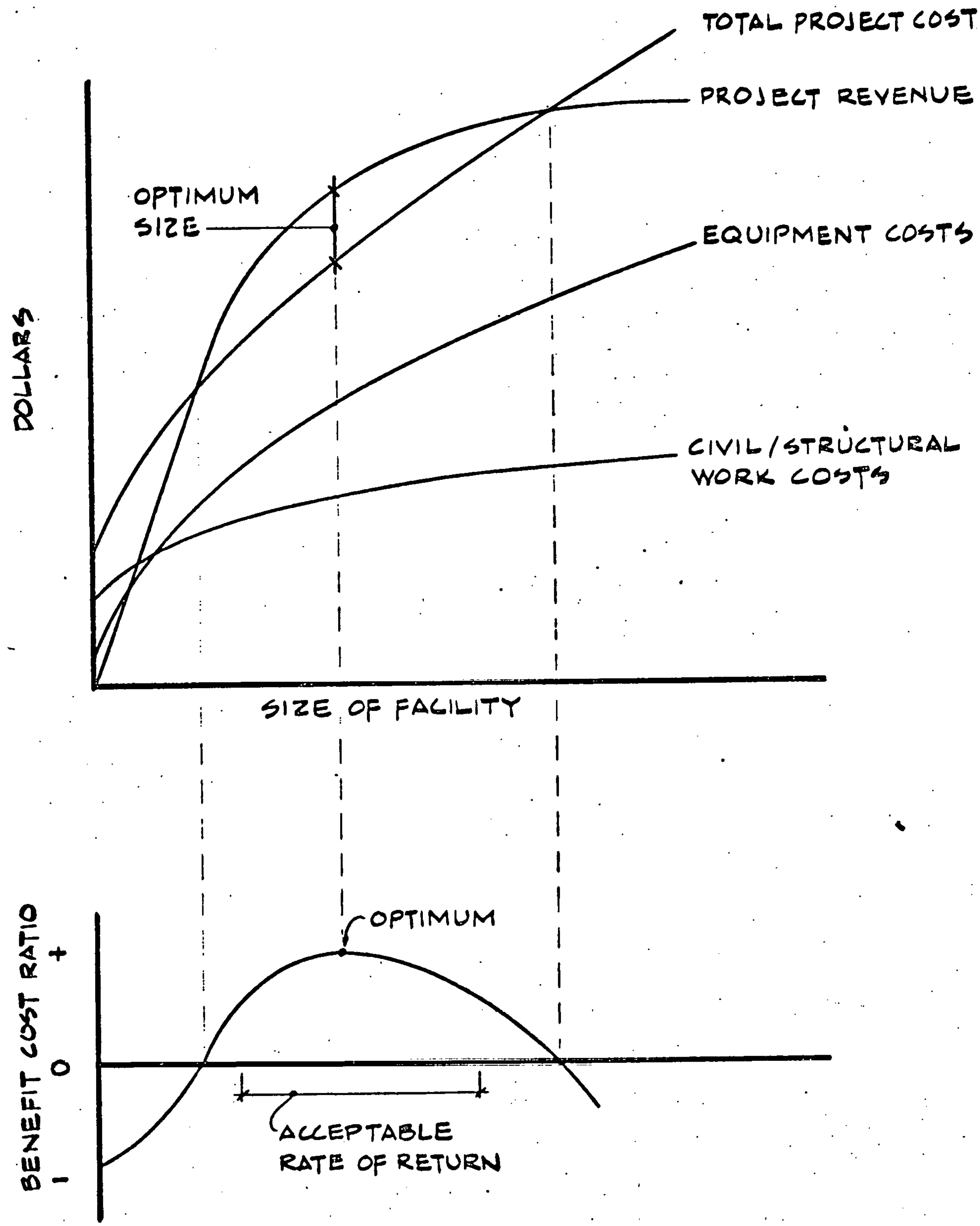
DEMAND

Demand Capacity Due to Storage

Of course 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 energy demands from more costly energy sources the potential value of its contribution to the grid will be far greater than the gross energy might indicate.

FIGURE VII-2

CONCEPTUAL MODEL OF HYDROELECTRIC FACILITY ECONOMICS



The demand capacity of a given dam site is a function of both impoundment and stream flow characteristics. Even a site with no significant impoundment will have some value as demand capacity if the normal draught streamflow is sufficiently high to guarantee some base level of production.

In the case of the French Landing dam site it is, in fact, the normal stream flow which must be relied upon for demand capacity. Figure VII-3 shows the effect on the upstream impoundment level due to varying dam discharge differentials (i.e., the difference between natural stream flow and the rate of discharge through the dam). It can be seen that the impoundment level 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 500 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 57 cfs (Section V). Discharge required to generate 500 kW at the site is approximately 240 cfs. During the eight hours of production we would experience a discharge differential of 183 cfs, equivalent to 61 cfs on a daily basis. From Figure VII-3 we can see that a 61 cfs differential would cause a drop in upstream level of approximately one inch per day. Over the 30-day draught the headwater level would drop by a total of 30 inches. This is far in excess of an acceptable limit.

As a result of this anlaysis we can conclude that the volume of storage in Belleville Lake is not sufficient to guarantee a firm peaking capacity.

<u>Demand Capacity Due To Natural Stream Flow</u>

Demand capacity charges to electric consumers under Detroit Edison's Primary Supply Rate Agreement include a significant charge for monthly on-peak billing demand (defined as the average of the 4 weekly highest 30-minute demands during on-peak hours although not less than 65% of the highest on-peak demand during the preceding eleven months). When serving primary rate consumers in parallel with a Detroit Edison service the ability of the hydroelectric plant to offset the monthly on-peak demand has a significant influence on the value of the energy contribution.

FIGURE VII-3
RATE OF CHANGE IN LAKE LEVEL VS DAM DISCHARGE DIFFERENTIAL
FRENCH LANDING

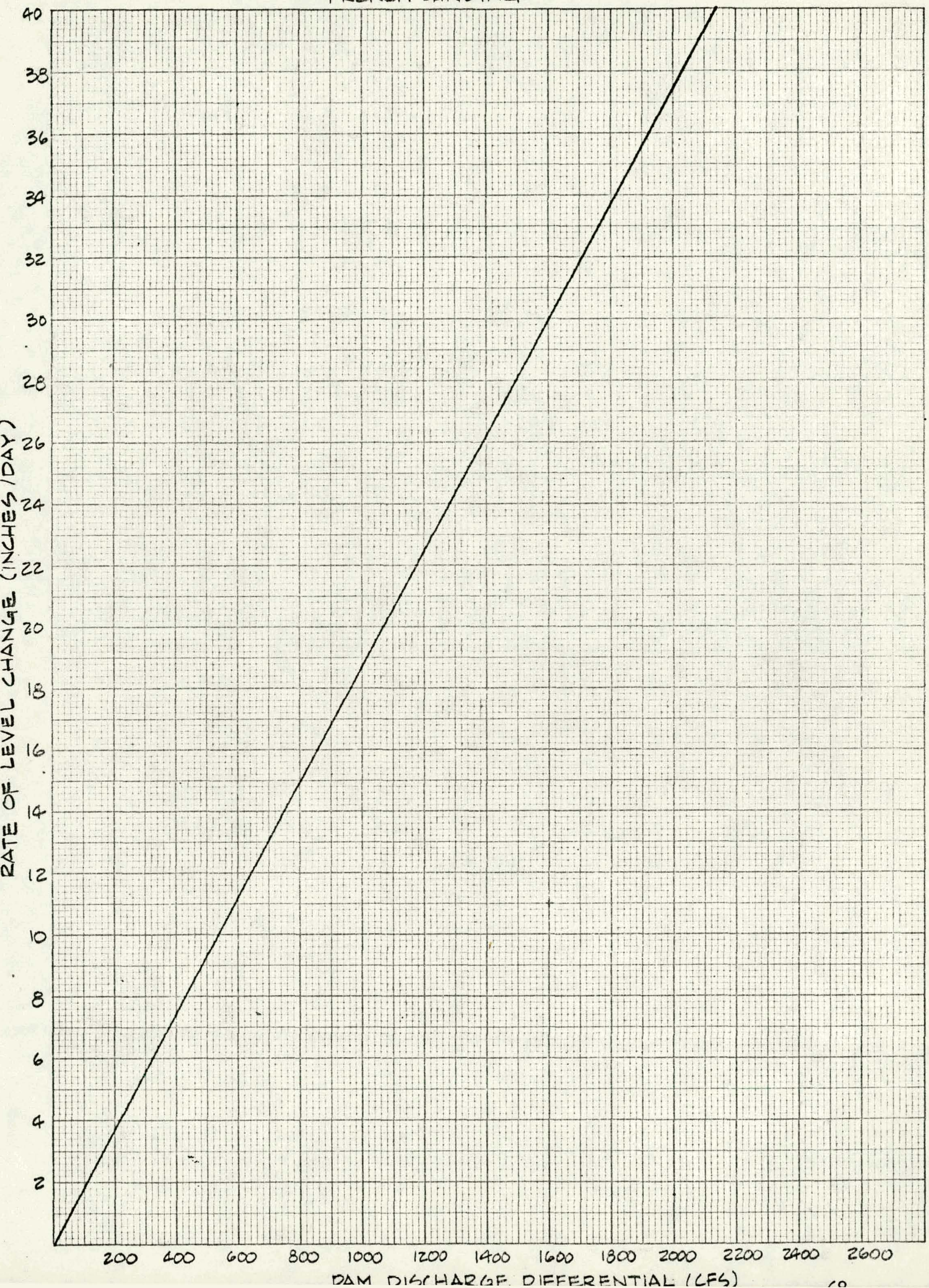


Table VII-1 shows the mean monthly demand which can be offset by the French Landing hydroelectric plant, based on average stream flow. The demand capacity is of course a function of the installed capacity of the plant; during some months the generating potential due to stream flow may be greater than can be utilized by the power producing equipment. To show this effect we have calculated the demand capacity for four different sized plants: 500 kW, 750 kW, 1000 kW, and 1500 kW. It can be seen that the addition of each increment of production capacity makes a smaller marginal contribution to the mean annual demand capacity, although the effect for individual months can be significant.

TABLE VII-1
MEAN MONTHLY DEMAND WHICH CAN BE OFFSET BY HYDRO PLANT

	Average Streamflow (CFS)	Equivalent Generating Potential (KW)	Mean Demand Offset With Alt. Installed Capacities			
			500 KW	750 KW	1000 KW	1500 KW
January	534	1,260	500	750	1,000	1,260
February	625	1,475	500	750	1,000	1,475
March	960	2,266	500	750	1,000	1,500
April	973	2,296	500	750	1,000	1,500
May	675	1,593	500	750	1,000	1,500
June	385	909	500	750	909	909
July	251	592	500	592	592	592
August	185	437	437	437	437	437
September	204	481	481	481	481	481
October	284	670	500	670	670	670
November	405	956	500	750	956	956
December	480	1,133	500	750	1,000	1,133
Mean	496	1,172	493	682	837	1,034

NOTE: Equivalent generating potential is based on units by Bofors-Nohab with mean output of 2.36 KW/CFS.

SECTION VIII
POTENTIAL ELECTRIC MARKETS

Two potential markets for electric power produced at the recommissioned French Landing hydroelectric plant were investigated:

1) bulk sale to the local electric utility, Detroit Edison Company
2) direct sale to nearby industrial consumers

BULK SALE TO ELECTRIC UTILITY

The first alternative would involve connection of the output of the plant into the sub-transmission or distribution grid of the Detroit Edison Company. This arrangement would be facilitated by the presence of a Detroit Edison substation located approximately 100 yards east of French Landing powerhouse. This substation was, in fact, the point of connection of the hydro plant into the Edison system when it was operated by the utility.

Through the Bulk Power Transactions Department of Detroit Edison it was learned that small bulk power purchase agreements between the utility and other generating entities are not uncommon. Industrial concerns, educational institutions, and other activities which operate power generating facilities occasionally enter into agreements for the sale of energy from waste heat or surplus power. Almost by definition, this energy is available only during off-peak periods, and usually on an unscheduled basis. The utility absorbs the energy into its system when and if it is available, and in whatever amounts it is available. Consequently, there is no incentive for the utility to place a very high value on contributions from these sources. A typical power purchase agreement between the utility and a small bulk energy supplier, it was learned, would be based on the average of:

– the production cost of the selling utility
– the operating and fuel cost of a typical utility-owned thermal generating plant, on an hour-by-hour basis.

By averaging these costs, any benefit from the power purchase agreement is shared equally between the selling entity and the utility. As of August, 1978, the incremental operating and fuel costs for Detroit Edison came to approximately 10-11 mills per kWh off-peak and 25 mills per kWh on-peak.

With regard to demand capacity, it was learned that the utility would place a value on any guaranteed firm production capacity and that this value would probably be based on the current capacity charge for interchange agreements between Edison and other utilities. As of August, 1978, this ranged between 45 and 60 cents per kW per week, although the higher figure was becoming more common.

In a letter dated January 11, 1979, Detroit Edison, through its Major Accounts Operations Department, formally stated its willingness to purchase power from the recommissioned hydro plant, "in any amount at any time" at an estimated purchase price of:

20 mills/kWh on-peak: (0800-2200, Monday thru Saturday)
12 mills/kWh off-peak: (all other hours)

The letter stated that Edison would not be willing to pay a demand charge since the energy contributed by the hydroelectric plant could not be scheduled by them. Finally, the letter stated that connection of the hydro plant to the Edison system would be accomplished through the 40,000 volt bus in the distribution substation, and that the Township would be responsible for providing the electrical circuitry and equipment required to make the connection.

In conversation, the Edison representative stated that the purchase rates quoted in the proposal were estimates of the highest incremental operating and fuel cost of alternate sources of energy, based on averages for 1978. In actual practice, the interchange agreement between Van Buren Township and Edison would be based on the actual hour-by-hour incremental operating and fuel cost which would range above and below these estimates. The production costs of the hydroelectric plant would not be a factor in establishing rates, contrary to the preliminary indication from the Bulk Power Transactions Department.

The Edison representative also stated that by making this purchase proposal Edison was indicating its willingness to waive the provision in their 1973 agreement with the Township which prohibited use of the dam site for "the generation of electric power for resale at any time." Reasons for waiving this provision, it was explained, had to do with the energy situation which had developed since the property was transferred to the Township in 1973.

When questioned, the Edison representative indicated that the connection of the hydro plant to the substation could perhaps be made on the secondary (low voltage) side of the substation. It was pointed out that a connection to the secondary side would be much less costly and would actually unload the transformers in the substation, since the power would all be consumed locally. The Edison representative agreed to check into this possibility, however a final decision was not available in time for this report.

DIRECT SALE TO INDUSTRIAL CONSUMERS

The presence of industrial park located approximately one-quarter of a mile from the dam on the south downstream side of the river presented an opportunity for the direct sale of energy to consumers, as an adjunct supply to normal utility service. Although this alternative would require the ownership of delivery and metering equipment by the Township, the potential revenue from such sales would be substantially greater than from sales to a utility, due to the higher value of energy to a private consumer than to a utility.

Five occupants of the industrial park were contacted and all expressed an interest in purchasing energy from the recommissioned hydro plant, providing it would be accomplished in such a way as to guarantee a high reliability of electric service and providing there was a reasonable economic incentive. Information concerning the electric demand characteristics of the industrial park occupants were obtained and are summarized in Table VIII-1.

As shown in the Table the total average monthly electric consumption of the park occupants is about 889,000 kWh, about ten percent greater than the mean generating potential of the hydroelectric plant, if developed for maximum capacity. Most of the park occupants operate for two shifts a day, so there is a significant reduction in demand during the nighttime period.

TABLE VIII-1
SUMMARY OF PRIVATE ELECTRICAL CONSUMERS IN CLOSE PROXIMITY TO FRENCH LANDING HYDROELECTRIC PLANT

	MONTHLY ENERGY CONSUMPTION (KWhr)				
Name	Mean	Max	Min	Mean Monthly Demand (KW)	D.E.Co. Service Rate
Huron Valley Steel	480,000			1400	Primary
Mastercraft Engineering	170,000	220,000	140,000		Primary
Webb Forging	130,000	180,000	85,000	900	General
Horst Mfgr.	100,000	165,000	70,000		General
Willow Run Rubber	9,000	12,000	5,000		General
TOTAL	889,000				

The two largest electric consumers in the industrial park, accounting for 73% of total energy use, presently purchase electricity from Detroit Edison on a primary supply rate. Under this arrangement electricity is received at 4800 volts, three phase. 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 at the present time is not significant.

The other three occupants of the industrial park purchase electricity under a "General Service Rate." Under this rate, electricity is received at low voltage, either three phase or single phase. The rate per month, based on schedules put into effect in September, 1978, is computed as follows:

Service Charge: $5.45 per month
Energy Charge: 5.05¢ for all kWh

This rate is subject to a fuel and purchased power adjustment to account for short term cost fluctuations.

INTERCONNECTION TO INDUSTRIAL CONSUMERS

In order to insure industrial consumers of a reliable source of electricity in the event of droughts or equipment breakdown, any arrangement to serve them from the hydro plant would have to allow for an alternate supply from an independent source. This would probably mean that the interconnection from the hydro plant would either be:

1) in parallel with the normal utility source, or
2) non-parallel and isolated from the normal utility source with an interlocked throwover provision

Under the first alternative, each customer would be served jointly by the hydro plant and the utility. A failure or reduction in capacity of either source would be automatically compensated by an increase in the demand from the other source. Under the second alternative each industrial customer (or some isolated part of his electric system) would either be wholly connected to the hydro plant or to the utility. Failure of the connected source would result in a momentary interruption of service, followed by either an automatic or manual throwover to the alternate source.

Under either of these alternatives the service entrance equipment required at each customer's facility would be more elaborate than that ordinarily provided. Two main circuit breakers, one for the utility service and one for the hydroplant service, would be required. In addition, protective relaying would be needed to prevent a fault in one system from affecting the alternate system.

In the same letter in which Detroit Edison made the power purchase proposal described above, the utility stated its willingness to have the French Landing hydro plant serve industrial customers by either of the above alternatives. Although Edison has a franchise to operate in Van Buren Township, the franchise would not prohibit a public authority, such as the Township, from selling power in the area.

Either alternative would be subject to Edison's "Standard Contract Rider No. 3" for standby service. Under the provisions of this rider, a 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 regular 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.

Any arrangement to service customers in parallel with the regular utility would require that the Township own and operate a distribution system. The close proximity of the industrial park to the hydroelectric plant would minimize the expense for the necessary circuits, although difficulties might be encountered for obtaining the necessary right-of-ways.

SECTION IX
EQUIPMENT DESIGN ALTERNATIVES

Four key elements were identified as the basis of a conceptual design for the refurbishment of the French Landing 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 X and XI, 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 three hydraulic turbine design alternatives:

- vertical
- bulb
- tubular

Although it might seem self-evident that vertical turbines would prove to be the most cost effective, since this was the type 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 the bulb and tubular turbine projects would have to carry.

Manufacturers/Costs

Proposals were solicited from twelve U.S., Canadian, European and Japanese hydraulic turbine manufacturers for equipment to refurbish the French Landing site. Each solicitation asked for a proposal based on one of the three types of turbines identified above. It was suggested that the proposals be based on two (2), 750 kW units having adjustable gates or blades to permit the variation of output with streamflow, however, it was requested that an alternative size or type be proposed if the manufacturer felt it would be more cost-effective. 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 IX-1 summarizes the responses to the solicitations. Of the twelve solicitations that were made, a total of six proposals were actually received. (Note: A follow-up proposal was requested from one manufacturer, Bofors-Nohab, Inc. based on smaller units.) Of the six manufacturers who did not submit a proposal, two stated that their equipment did not suit the site characteristics.

The six turbine proposals that were received included three based on vertical units, two based on bulb units, and one based on tubular units. Four of the proposals were based on the dual 750 kW units suggested in the solicitation; one was based on three smaller units; and one was based on refurbishing the two existing turbines still in the powerhouse. Although the solicitations asked that the proposals be restricted to turbines only, two of the manufacturers gave "package" proposals which included generators.

After making adjustments to account for the different items of equipment included in each proposal all of the proposals for new 750 kW turbines, with one significant exception, proved to be remarkably close in cost; about $600,000 to $700,000 for two units, including generators and governor, or about $430 per kW. This proved true whether the design was vertical, tubular, or bulb.

The one exception to this was the proposal fom the James E. Leffel Company of Springfield Ohio, which was by far the lowest in cost (approximately half). This manufacturer has been in business for over 100 years and utilizes cast iron turbine designs

TABLE IX-1

NAME & LOCATION OF MANUFACTURER	NUMBER/SIZE/TYPE REQUESTED	NUMBER/SIZE/TYPE PROPOSED	ESTIMATED COST	COMMENTS
Allis Chalmers York, Pennsylvania	2/750kW/tubular	2/750kW/tubular	$644,000	including generators, governors controls
Ateliers Des Charmilles Geneva, Switzerland	2/750kW/bulb	no proposal	- - -	- - -
Bofors-Nohab, Inc. Trollhattan, Sweden	2/750kW/vertical	2/750kW/vertical	$508,000	w/o governor, generators, F.O.B. factory
Bofors-Nohab, Inc. Trollhatton, Sweden	2/500kW/vertical	2/500kW/vertical	$297,000	w/o governors, generators, F.O.B. factory
Dominion Engineering Works, Ltd. Montreal, Canada	2/750kW/vertical	no proposal	- - -	site too small to suit mfgr's equipment
Escher Wyss, Inc. Zurich, Switzerland	2/750kW/bulb	2/750kW/bulb	$690,000	including generators, governors, F.O.B. site
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	2/750kW/vertical	2/750kW/vertical	$216,000	w/o governors, generators, F.O.B. Factory
KMW Kristinehamn, Sweden	2/750kW/tubular	no proposal	- - -	mail delayed
Neyrpic Groupe Hydraulic Grenoble, France	2/750kW/bulb	1-315-kW, 1-442kW, 1-605kW/bulb	$517,000	fixed blade-not including generators
Northern Water Power, Inc. Harrisville, N. H.	2/750kW/tubular	1-780kW, 1-1600Kw/ vertical	$470,000	refurbishment of existing turbines
Stapenhorst, Inc. Pointe Claire, Canada	Ossburger (radial, cross-flow)	no proposal	- - -	site too large for mfgr's equipment

SUMMARY OF PROPOSALS
FROM TURBINE MANUFACTURERS
FOR REFURBISHMENT OF THE FRENCH LANDING
HYDROELECTRIC PLANT

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 comparible 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.

The proposal for 500 kW vertical units by Bofors-Nohab was for some reason significantly less expensive per kW than the Bofors proposal for 750 kW units.

The proposals for the three fixed-blade bulb units by Nyerpic and for refurbishing the existing turbines by Northern Water Power carried a low cost per kW, but were difficult to compare to the other proposals due to the uniqueness of the designs.

Structural Modifications to Retrofit New Turbines

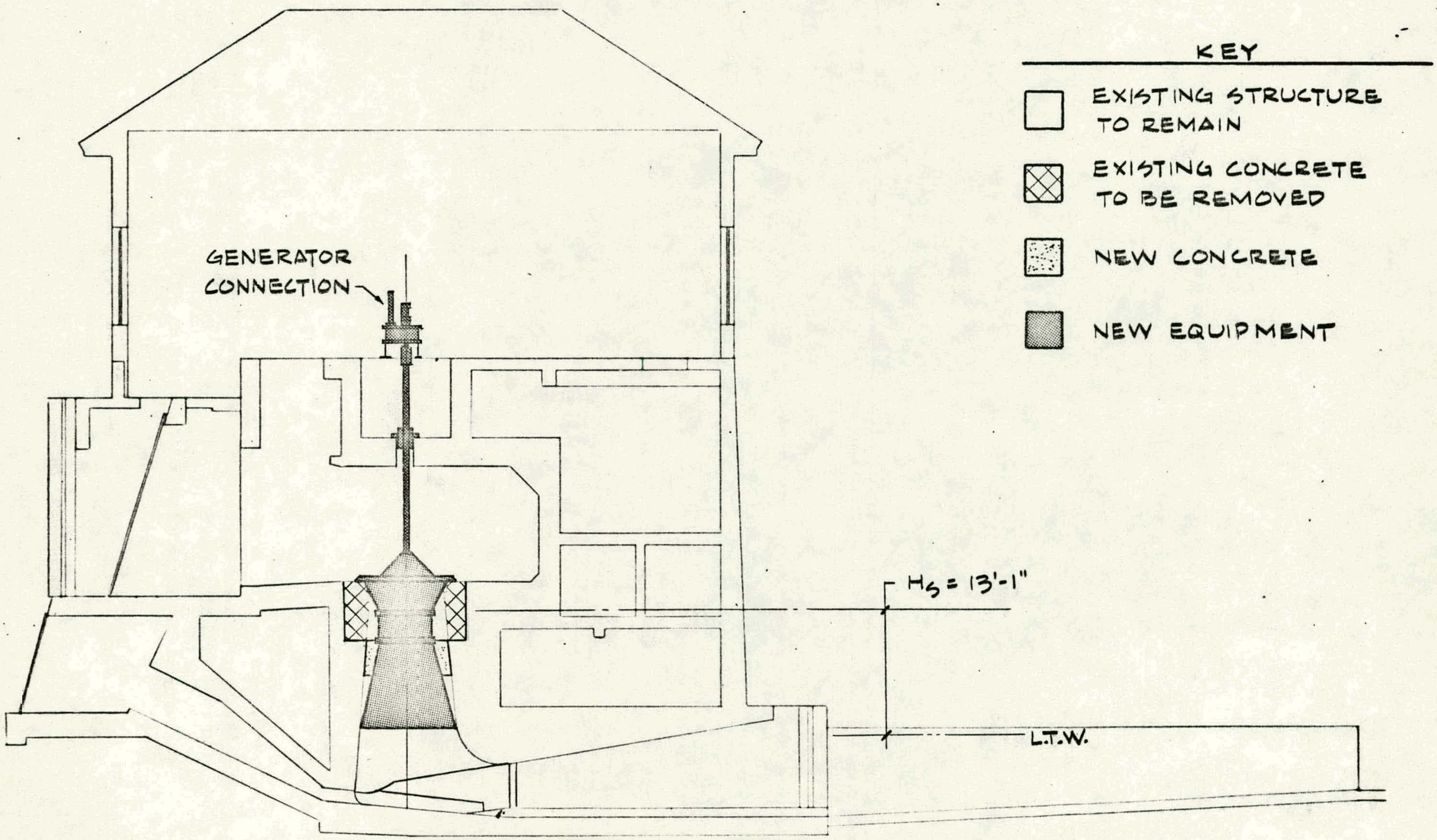
A structural analysis was conducted to determine the optimum method, and associated cost, of adapting each of the three turbine designs (vertical, bulb, tubular) to the existing dam site. The critical parameter proved in each case to be the maximum allowable draft head that was required for proper submergence (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 2.0 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

Figures IX-1, 2 and 3 illustrate the suggested methods of adapting the three types of turbines to the site within the draft head requirements cited above. It can be seen that it was possible in each case to identify a method which involved an adaptation to the water channels in the existing powerhouse, rather than the construction of an entirely new structure. Significant cost savings were thereby realized.

FIGURE IX-1

SUGGESTED METHOD OF ADAPTING NEW VERTICAL TURBINE TO THE FRENCH LANDING POWERHOUSE

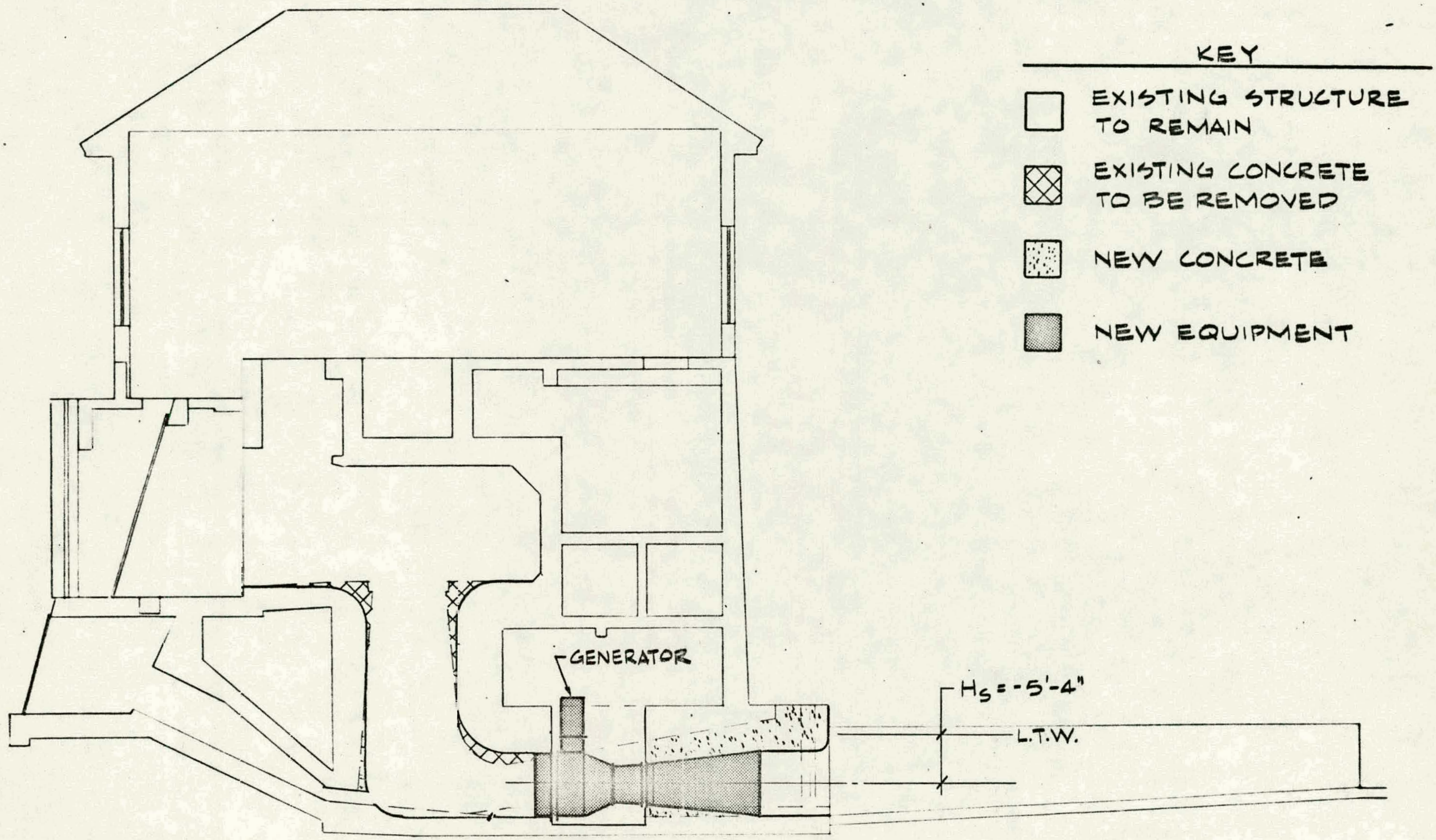


SECTION THRU DRAFT TUBE No 1

SCALE: 1/16" = 1'-0"

FIGURE IX-2

SUGGESTED METHOD OF ADAPTING NEW BULB TURBINE TO THE FRENCH LANDING POWERHOUSE

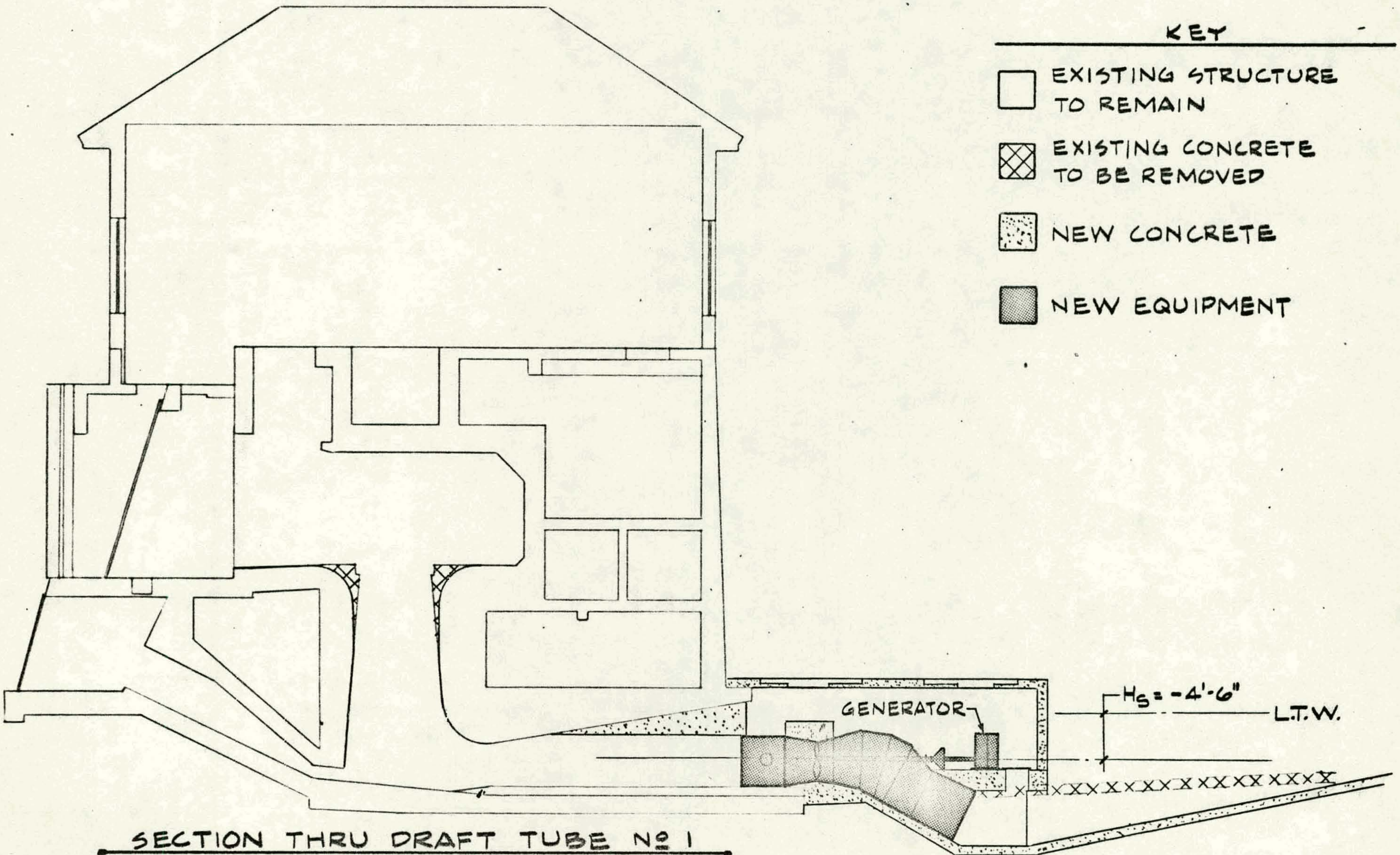


SECTION THRU DRAFT TUBE No 1

SCALE: 1/16" = 1'-0"

FIGURE IX-3

SUGGESTED METHOD OF ADAPTING TUBULAR TURBINE TO THE FRENCH LANDING POWERHOUSE



SECTION THRU DRAFT TUBE No. 1

SCALE: 1/16" = 1'-0"

Vertical Turbines:	It was only necessary to construct a recess in the floor of the existing turbine pits. This was necessary because the draft head requirement for the new turbines was less than for the larger original units.
Bulb Turbines:	The three fixed blade units were located in the vertical sections of the existing draft tubes. Concrete work was required to streamline the upstream water channels to reduce hydraulic losses, and to provide access to the generators through a hole in the floor of the existing powerhouse basement.
Turbular Turbines:	This alternative required the most extensive structural modification. A new chamber was designed by adding onto the downstream side of the existing powerhouse.

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

Vertical (2 units)	$ 45,000
Bulb (3 units)	$ 95,000
Turbular (1 unit)	$100,000

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

- removal of existing turbines
- demolition and removal of unnecessary concrete
- addition of new concrete
- placement of new turbine units
- coffer dams, stop logs, etc., required for dewatering

SIZE OF TURBINES

Benefit/Cost Analysis

In Section VII 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 streamflow 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 streamflow 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 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 IX-2 summarizes the results of such an analysis based on four capacity alternatives using Bofors-Nohab vertical turbines (i.e., installed capacities of 500, 750, 1000, and 1500 kilowatts.

TABLE IX-2

BENEFIT/COST SUMMARY OF PLANT CAPACITY ALTERNATIVES BASED ON BOFORS-NOHAB VERTICAL TURBINE

	No. 1	No. 2	No. 3	No. 4
Installed Capacity (KW)	500	750	1,000	1,500
Average Effective Capacity (KW)	448	596	703	844
Projected Annual Production (MKWhr)	3.9	5.2	6.2	7.4
Average Demand Capacity (KW)	493	682	837	1,034
Projected Annual Revenue				
Sales to Private Industry				
Energy	$70,200	$ 93,600	$111,600	$133,200
Demand	$34,300	$ 47,500	$ 58,300	$ 72,000
Standby Surcharge	($10,500)	($ 15,800)	($ 21,000)	($ 31,600)
Total	$94,000	$125,300	$148,900	$173,600
Energy Sales to D.E.Co.	$62,400	$ 83,200	$ 99,200	$118,400
Estimated Project Cost (X1000)	$ 835	$ 1,063	$ 1,294	$ 1,749
Revenue Increment				
Sales to Private Industry	$94,000	$ 31,300	$ 23,600	$ 24,700
Sales to D.E.Co.	$62,400	$ 20,800	$ 16,000	$ 19,200
Project Cost Increment (X1000)	$ 835	$ 228	$ 231	$ 455
Benefit/Cost Ratio				
Sales to Private Industry	0.11	0.14	0.10	0.05
Sales to D.E.Co.	0.07	0.09	0.07	0.04

TABLE IX-3

BENEFIT/COST SUMMARY OF PLANT CAPACITY ALTERNATIVES
BASED ON LEFFEL CO. VERTICAL TURBINES

	No. 1	No. 2
Installed Capacity (KW)	830	1,660
Average Effective Capacity (KW)	595	801
Projected Annual Production (MKWhr)	5.2	7.0
Average Demand Capacity (KW)	735	1,069
Projected Annual Revenue		
Sales to Private Industry		
Energy	$ 93,600	$126,000
Demand	$ 51,200	$ 74,400
Standby Surcharge	($ 17,400)	($ 34,800)
Total	$127,400	$165,600
Energy Sales to D.E.Co.	$ 83,200	$112,000
Estimated Project Cost (x1000)	$ 802	$ 1,242
Revenue Increment		
Sales to Private Industry	$127,400	$ 38,200
Sales to D.F.Co.	$ 83,200	$ 28,800
Project Cost Increment (X1000)	$ 802	$ 440
Benefit/Cost Ratio		
Sales to Private Industry	0.16	0.09
Sales to D.E.Co.	0.10	0.07

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 500 kilowatts of generating capacity added to the site creates an effective capacity of 448 kilowatts (90% utilization), whereas the 500 kilowatts needed to increase generating capacity from 1000 to 1500 kilowatts contributes only 141 kilowatts of effective capacity (28% utilization).

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

The figures for projected annual revenues are based on each of the two available markets: Detroit Edison Company and private industrial consumers. Since one market would place a value on both demand and energy capacity, whereas the other would value only energy, it was thought that separate calculations should be made.

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

Conclusion

The last line of figures in Table IX-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 rises to a maximum value under Alternative No. 2 (750 kW) and then drops off at Alternative No. 3 (1000 kW) and again at Alternative No. 4 (1500 kW). This is true for both markets.

Based upon this analysis we can say that the most cost effective plant capacity at the French Landing dam site is somewhere between 500 and 1000 kW, since this is the range in which the benefit/cost ratio goes through a peak value.

Table IX-3 gives figures for a similar benefit/cost analysis based upon Leffel Company vertical turbines. Two capacity alternatives are presented: No. 1 utilizing one 830 kilowatt turbine; No. 2 utilizing two 830 kW turbines. The results of this analysis are similar to those from the preceeding analysis. The most cost-effective alternative is found to be the single turbine alternative in the 500 to 1000 kilowatt range.

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 any other reasons. We did, in fact, find that the most cost-effective alternative at the French Landing site, without taking reliability into account, was the one-turbine alternative. If firm capacity is defined as the production capacity of a facility with one unit out of service, then a one-unit facility, by definition, has no firm capacity. This means that any revenue which is based on demand capacity should be discounted; perhaps not discounted entirely, but at least substantially reduced.

On the other hand, 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 streamflow 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 placed on and offstream in stages.

Rangeability: As a turbine is throttled down to keep pace with declining streamflow, a point will eventually be reached where it becomes more sensible to take the unit offstream 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.

One of the power markets available at the French Landing site is, in fact, a large utility, the Detroit Edison Company (see Section VIII). The second and far more lucrative market, however, is a group of nearby industrial consumers. Although the service connection under the second alternative would be in parallel with the utility service, we could not rely on the utility system for speed regulation, nor could we expect the utility to willingly contribute the excitation energy needed by a induction machine, without protest.

We were thus faced with two power markets, one of which would permit us to use induction machines and the other of which would require more costly synchronous machines. In order to avoid having to develop separate project cost estimates for each case it was decided to develop cost estimates based on the more desireable of the two markets, namely, private industrial customers. This had the effect of overstating project costs (as presented in Section X) in terms of the utility market alternative. A rough estimate of the amount of overstatement would be 10-15 percent of power equipment costs, or about 5-8 percent of total project costs.

If the market alternative of selling to the utility is pursued, it will of course become desireable to restate the project cost estimates based on the use of induction machines.

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 X
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 permit us 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 manufacturers, turbine design, and plant capacity.

Five of the project alternatives involved the use of vertical turbines, one involved the use of a tubular turbine, and one involved the use of three small bulb turbines.

Of the five vertical turbine alternatives, two were based on turbines manufactured by the James Leffel Company of Springfield, Ohio; two were based on turbines by Bofors-Nohab, Inc., a Swedish manufacturer, and one was based on an overhaul of the old Allis-Chalmers turbines by Northern Water Power, Inc. of Harrisville, New Hampshire.

The tubular turbine alternative was based on a single 750 kilowatt unit by AllisChalmers of York, Pennsylvania. The bulb turbine alternative was based on three fixed blade units by Neyrpic, Inc., of Grenoble, France.

SUMMARY OF PROJECT DESIGN ALTERNATIVES

Table X-1 presents an overall summary of costs and operating characteristics for seven design alternatives for recommissioning the French Landing hydroelectric plant.

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

- "Estimated Project Costs" are based upon the project cost estimates presented at the end of this seciton, and range from a low of $802,000 for the single-turbine (Leffel) alternative, to a high of $1,875,000 for the bulb turbine alternative.

TABLE X-I

SUMMARY OF DESIGN ALTERNATIVES

TO RECOMMISSIONING THE FRENCH LANDING HYDROELECTRIC PLANT

	James Leffel & Co. 1-830 KW vertical	James Leffel & Co. 2-830 KW vertical	Bofors-Nohab, Inc. 2-500 KW vertical	Bofors-Nohab, Inc. 2-750 KW vertical	Northern Water Power Rework existing turbines	Allis Chalmers 1-750 KW tubular	Heyrpic 3 bulb turbines
Estimated Project Cost (X1000)	$ 802	$ 1,242	$ 1,294	$ 1,749	$ 1,497	$ 1,137	$ 1,875
Installed Capacity (KW)	830	1,660	1,000	1,500	2,380	750	1,362
Effective Average Capacity (KW)	595	801	703	844	913	594	760
Plant Factor	72%	48%	70%	56%	38%	79%	56%
Cost/Installed KW	$ 966	748	1,294	1,166	$ 629	$ 1,516	$ 1,377
Cost/Effective KW	$ 1,347	$ 1,551	$ 1,840	$ 2,072	$ 1,640	$ 1,914	$ 2,668
Projected Annual Production (MKWhr)	5.2	7.0	6.2	7.4	8.0	5.2	6.7
Average Demand Capacity (KW)	735	1,069	837	1,034	1,172	682	991
Projected Annual O&M Expense	$32,700	$39,500	$39,700		$43,760		
O&M Cost/KWhr produced	0.63¢	0.56¢	0.64¢		0.55¢		

–"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 hydroelectric facility from its present condition to an operational status, 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 and varies from 750 kW for the tubular turbine alternative to 2380 kW for the alternative of rebuilding the existing turbines.

–"Effective Average Capacity" is the projected average production capacity of each alternative, taking account of the streamflow characteristics in the Huron River at the French Landing dam site.

–The "Plant 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. It can be seen that the two figures can make a dramatic difference in the assessment of a given alternative. The alternative having the lowest Cost/Installed kW (rebuilding the two existing turbines) has a relatively high Cost/Effective kW; in fact, over 2-1/2 times as high. This is because this alternative includes a high level of production capacity, some of which will see little use.

–"Projected Annual Production" is the gross annual energy production of each alternative, based on the effective average capacity.

–"Average Demand Capacity" is the electric demand which can be offset by the hydroelectric plant, based on average monthly streamflow. This is an important consideration for the marketing alternative involving sales to private industries. An explanation of this concept was given in Section VII, Potential Markets.

—"Projected Annual O&M Expense" 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 French Landing 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.

It should be noted that the cost estimates are based on the assumption that the hydroelectric plant will serve as an adjunct supplier of electricity to industrial consumers. As a result, generator costs are based on synchronous machines, with independent exciters, and turbine costs include an allowance for governers. As was described in the preceeding section, this assumption has the effect of overstating project costs by five to eight percent, in terms of a utility market interconnection.

OPERATION AND MAINTENANCE COSTS

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

1) 730 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.
6) Annual administrative expenses of $4000.

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

NOTES TO PROJECT COST ESTIMATES
(Tables X-2 thru X-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.

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. manufacturered 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 X-2

PROJECT COST ESTIMATE

ALTERNATIVE No 1 - JAMES LEFFEL Co. - ONE VERTICAL UNIT @ 830 KW

MATERIALS:	Power Producing Equipment		
	Turbine(s)	$ 108,000	$
	Thrust Bearing(s)	27,000	
	Gear Drive(s)	24,000	
	Generator(s)/Exciter(s)	63,000	
	Generator(s)/Exciter(s) Controls	38,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	305,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	6,000	136,000
LABOR:			
	Installation of power producing equipment	61,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	17,000	201,000
SHIPPING:	Power Producing Equipment		15,000
DUTY:			-
ENGINEERING:			79,000
LEGAL, ADMINISTRATION & CONTINGENCIES			66,000
TOTAL PROJECT COST			802,000

TABLE X-3

PROJECT COST ESTIMATE

ALTERNATIVE No 2 - JAMES LEFFEL CO. - TWO VERTICAL UNITS @ 830KW

MATERIALS:	Power Producing Equipment		
	Turbine(s)	$ 216,000	$
	Thrust Bearing(s)	54,000	
	Gear Drive(s)	48,000	
	Generator(s)/Exciter(s)	126,000	
	Generator(s)/Exciter(s) Controls	76,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	
			565,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	12,000	142,000
LABOR:			
	Installation of power producing equipment	113,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	34,000	283,000
SHIPPING:	Power Producing Equipment		28,000
DUTY:			–
ENGINEERING:			122,000
LEGAL, ADMINISTRATION & CONTINGENCIES			102,000
TOTAL PROJECT COST			1,242,000

TABLE X-4

PROJECT COST ESTIMATE

ALTERNATIVE No 3 - BOFORS-NOHAB - TWO VERTICAL UNITS @ 500 KW

MATERIALS:	Power Producing Equipment		
	Turbine(s)	$ 358,000	$
	Thrust Bearing(s)	INCL.	
	Gear Drive(s)	INCL.	
	Generator(s)/Exciter(s)	96,000	
	Generator(s)/Exciter(s) Controls	76,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	575,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	12,000	142,000
LABOR:			
	Installation of power producing equipment	115,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	34,000	272,000
SHIPPING:	Power Producing Equipment		47,000
DUTY:			25,000
ENGINEERING:			127,000
LEGAL, ADMINISTRATION & CONTINGENCIES			106,000
TOTAL PROJECT COST			1,294,000

TABLE X-5

PROJECT COST ESTIMATE

ALTERNATIVE No 4 - BOFORS-NOHAB - TWO VERTICAL UNITS @ 750 KW

MATERIALS:	Power Producing Equipment		
	Turbine(s)	$ 612,000	$
	Thrust Bearing(s)	INCL.	
	Gear Drive(s)	INCL.	
	Generator(s)/Exciter(s)	116,000	
	Generator(s)/Exciter(s) Controls	76,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	849,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	12,000	142,000
LABOR:			
	Installation of power producing equipment	170,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	34,000	327,000
SHIPPING:	Power Producing Equipment		73,000
DUTY:			43,000
ENGINEERING:			172,000
LEGAL, ADMINISTRATION & CONTINGENCIES			143,000
TOTAL PROJECT COST			1,749,000

TABLE X-6

PROJECT COST ESTIMATE

ALTERNATIVE No 5 - OVERHAUL OF EXISTING VERTICAL TURBINES BY NORTHERN WATERPOWER, INC

MATERIALS:	Power Producing Equipment		
	Turbine(s)	$ 367,000	$
	Thrust Bearing(s)	72,000	
	Gear Drive(s)	64,000	
	Generator(s)/Exciter(s)	154,000	
	Generator(s)/Exciter(s) Controls	76,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	778,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	-	130,000
LABOR:			
	Installation of power producing equipment	156,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	-	279,000
SHIPPING:	Power Producing Equipment		39,000
DUTY:			-
ENGINEERING:			148,000
LEGAL, ADMINISTRATION & CONTINGENCIES			123,000
TOTAL PROJECT COST			1,497,000

TABLE X-7

PROJECT COST ESTIMATE

ALTERNATIVE Nº 6 - ALLIS-CHALMERS - ONE TUBULAR UNIT @ 750 KW

MATERIALS:	Power Producing Equipment		
	Turbine(s)	$ 322,000	$
	Thrust Bearing(s)	N.A.	
	Gear Drive(s)	INCL.	
	Generator(s)/Exciter(s)	58,000	
	Generator(s)/Exciter(s) Controls	38,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	
			463,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	50,000	180,000
LABOR:			
	Installation of power producing equipment	93,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	50,000	266,000
SHIPPING:	Power Producing Equipment		23,000
DUTY:			—
ENGINEERING:			112,000
LEGAL, ADMINISTRATION & CONTINGENCIES			93,000
TOTAL PROJECT COST			1137,000

TABLE X-8

PROJECT COST ESTIMATE

ALTERNATIVE No 7 - NEYRPIC - THREE BULB TURBINES

MATERIALS:	Power Producing Equipment		
	Turbine(s) (315KW, 442KW, 605KW FIXED BLADE)	$ 592,000	$
	Thrust Bearing(s)	N.A.	
	Gear Drive(s)	INCL.	
	Generator(s)/Exciter(s)	124,000	
	Generator(s)/Exciter(s) Controls	114,000	
	Automatic Synchronizer	10,000	
	Automatic/Supervisory Controls	20,000	
	Utility Interconnection	15,000	875,000
MATERIALS:	Non-Power		
	Dam Renovation	100,000	
	Building/Site Renovation	30,000	
	Structural Modification (to retrofit new turbines)	24,000	154,000
LABOR:			
	Installation of power producing equipment	175,000	
	Dam Renovation	103,000	
	Building/Site Renovation	20,000	
	Structural Modifications (to retrofit new turbines)	70,000	368,000
SHIPPING:	Power Producing Equipment		73,000
DUTY:			67,000
ENGINEERING:			184,000
LEGAL, ADMINISTRATION & CONTINGENCIES			154,000
TOTAL PROJECT COST			1,875,000

SECTION XI
PROJECT FINANCIAL FEASIBILITY

REVIEW

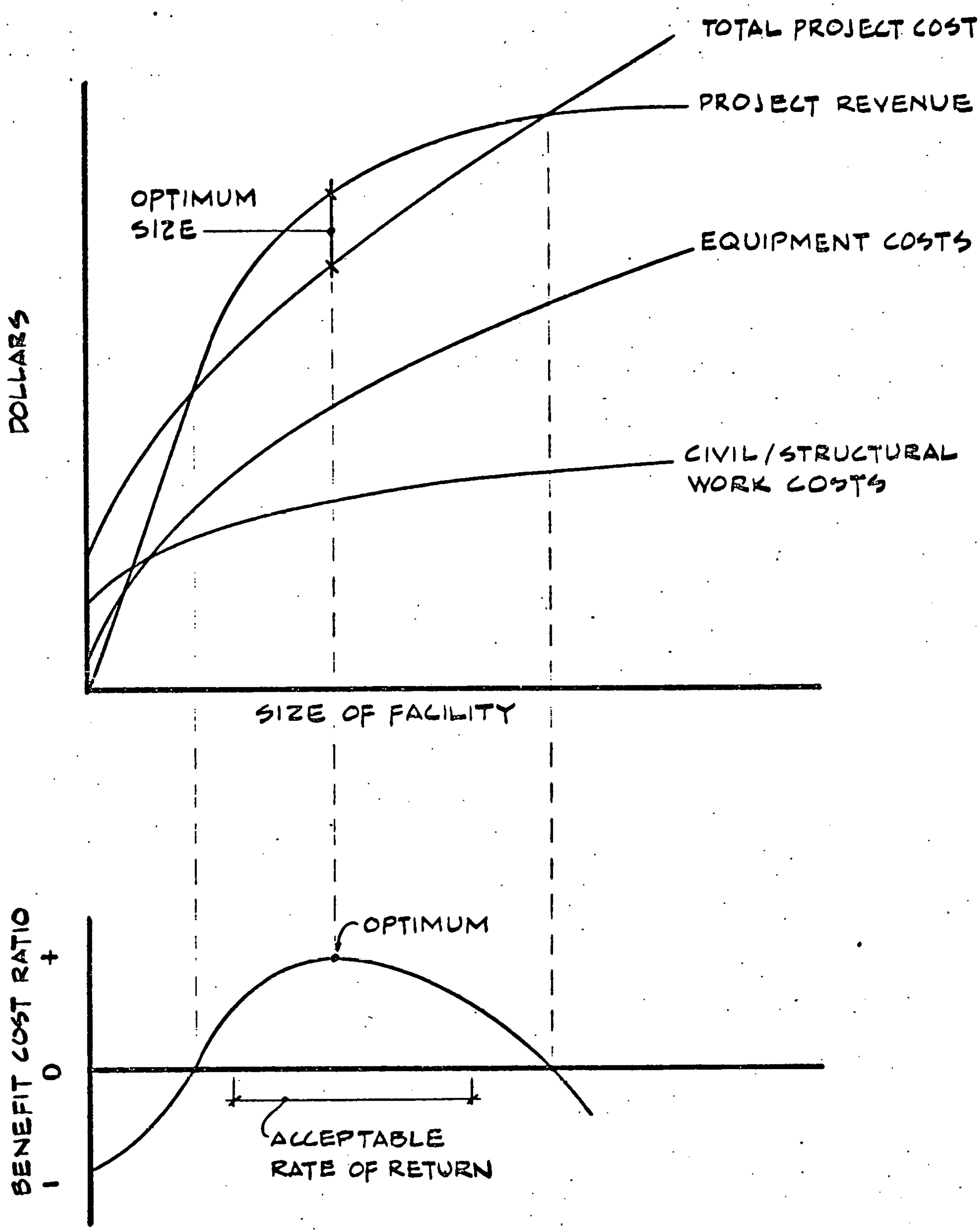
In Section VII, Theoretical Power Potential, we discussed the interrelationships for a small run-of-the-river hydroelectric facility of project costs, stream flow characteristics, and generating capacity. It was noted that the incrementally usable water power (and hence revenue) decreases with plant capacity due to the flow-duration characteristics of the river and that as a result the cost/benefit ratio changes dramatically with plant size. The optimum plant size, in economic terms, was stated to be that which generates sufficient revenue to optimally amortize the relatively fixed civil and structural costs, plus the variable costs associated with equipment capacity. Figure VI-3, which showed this concept in graphical form, is reproduced on the following page for reference.

In Section IX, Equipment Design Alternatives, we discussed the four key design areas for a small, low-head hydroelectric plant. Figures were presented which showed that vertical turbines, with one significant exception, were about equal in cost to tubular or bulb turbine designs, but that the cost of structural modifications to retrofit vertical turbines in the French Landing powerhouse was less than half that for installing either of the other two designs.

Concerning the optimum equipment size, a detailed analysis was presented in Section IX which identified the incremental benefit/cost ratios for four capacity alternatives using Bofors-Nohab vertical turbines, and two capacity alternatives using Leffel vertical turbines. It was shown that the most cost-effective design for the French Landing site was that incorporating a single turbine rated to generate between 500 and 1000 kilowatts. It was pointed out, however, that there were important adverse consequences in using a one-turbine design, compared to a multiple-turbine design.

FIGURE XI-1

CONCEPTUAL MODEL OF HYDROELECTRIC FACILITY ECONOMICS



In Section X, Project Design Alternatives, we presented detailed operational and cost data for seven specific project alternatives; five utilizing various types and sizes of vertical turbines, one utilizing a tubular turbine, and one utilizing bulb turbines. It was shown that the most meaningfull figure to use to compare alternate designs was the cost per effective kilowatt, "effective kilowatts" being the average projected production taking account of stream flow characteristics at the dam site.

In this section we are finally ready to draw all of this information together and to take a detailed look at the financial feasibility of various specific project alternatives.

SUMMARY

A detailed financial feasiblity analysis was performed on the four project design alternatives which had the lowest cost per effective kW (see Table X-1). These design alternatives are as follows:

		Cost/Installed kW	Cost/Effective kW
1)	One 830 kW vertical turbine unit by James Leffel & Co.	$ 966	$1,347
2)	Two 830 kW vertical turbine units by James Leffel & Co.	$ 748	$1,551
3)	Two 500 kW vertical turbine units by Bofors-Nohab, Inc.	$1,294	$1,840
4)	Overhaul of two existing vertical turbines by Northern Water Power, Inc.	$ 629	$1,640

Tables XI-1 and XI-2 present an economic summary for the first year of operation for each of these four project alternatives. In view of the fact that no formal agreement yet exists for the sale of power from the plant, it was thought prudent to present economic summaries based on both marketing alternatives. Accordingly, Table XI-1 is based on the sale of power to private industrial consumers, offsetting energy and demand charges under Detroit Edison's Primary Supply Rate. Table XI-2 is based on the sale of power to the Detroit Edison Company at an average rate of 16 mills per kWh (i.e., the weighted average of the on-peak and off-peak rates identified in Section VI).

TABLE XI-1

ECONOMIC SUMMARY OF VERTICAL TURBINE DESIGN ALTERNATIVES BASED ON SALES OF ELECTRICITY TO PRIVATE INDUSTRIES

	ALTERNATIVES*			
	No. 1	No. 2	No. 3	No. 4
Estimated Project Cost (X1000)	$ 802	$ 1,242	$ 1,294	$ 1,497
Projected Service Life (yrs)	25	25	25	25
Projected Annual Revenue				
Energy	$ 93,600	$126,000	$111,600	$144,000
Demand	$ 51,200	$ 74,400	$ 58,300	$ 81,600
Standby Surcharge	($ 17,400)	($ 34,800)	($ 21,000)	($ 50,000)
Total	$127,400	$165,600	$148,900	$175,600
Projected Annual O&M Expense	$ 32,700	$ 39,500	$ 39,700	$ 43,760
Net Annual Revenue	$ 94,700	$126,100	$109,200	$131,840
Annual Debt Service[2]	$ 68,800	$106,600	$111,000	$128,500
Net Annual Profit (Loss)	$ 25,900	$ 19,500	($ 1,800)	$ 3,340
Return on Investment	3.2%	1.6%	(0.1%)	0.2%

[1]Projected Annual Revenue is based on weighted average on-peak and off-peak energy charge (= 16 mills/KWhr)

[2]Annual Debt Service is based on 7%, 25-year financing

*Alternative No. 1: One Leffel Co. 830 KW unit
Alternative No. 2: Two Leffel Co. 830 KW units
Alternative No. 3: Two Bofors-Nohab 500 KW units
Alternative No. 4: Overhaul of existing turbines by Northern Water Power

TABLE XI-2

ECONOMIC SUMMARY OF VERTICAL TURBINE DESIGN ALTERNATIVES BASED ON ENERGY SALES TO DETROIT EDISON CO.

	ALTERNATIVES*			
	No. 1	No. 2	No. 3	No. 4
Estimated Project Cost (X1000)	$ 762	$ 1,180	$ 1,229	$ 1,422
Projected Service Life (yrs)	25	25	25	25
Projected Annual Revenue[1]				
Energy	$83,200	$112,000	$ 99,200	$128,000
Demand	$ 0	$ 0	$ 0	$ 0
Total	$83,200	$112,000	$ 99,200	$128,000
Projected Annual O&M Expense	$ 32,700	$ 39,500	$ 39,700	$ 43,760
Net Annual Revenue	$ 50,500	$ 72,500	$ 59,500	$ 84,200
Annual Debt Service[2]	$ 65,400	$101,300	$105,500	$122,000
Net Annual Profit (Loss)	($ 14,887)	($ 28,800)	($ 46,000)	($ 37,800)

[1]Projected Annual Revenue is based on weighted average on-peak and off-peak energy charge (=16 mills/KWhr)

[2]Annual Debt Service is based on 7%, 25-year financing

*Alternative No. 1: One Leffel Co. 830 KW units
Alternative No. 2: Two Leffel Co. 830 KW units
Alternative No. 3: Two Bofors-Nohab 500 KW units
Alternative No. 4: Overhaul of existing turbines by Northern Water Power

Project costs under the utility market alternative have been reduced by 5 percent below the industrial market alternative in order to reflect the less-costly asynchronous generators and lack of turbine governors that would be appropriate to this approach (see Sections VIII and IX).

Energy and demand revenues are based upon operating characteristics for each alternative as presented in Table X-1.

Table XI-1 includes a reduction from revenues for the stand-by surcharge ($1.75 per kW per month) which would be imposed by Edison. In each instance the standby surcharge has been based on total installed capacity.

Annual debt service is based upon 7%, 25-year financing and includes the amortization of principal as well as interest. It is assumed that construction financing would be obtained from the sale of Township revenue bonds.

No depreciation expenses are included based on the fact that debt service expense includes the amortization of principal.

No taxes are included based on ownership of the facility by a tax-exempt government entity.

The bottom figures in each table give the projected net annual profit or loss for each project alternative during the first year of operation. It can be seen that three of the four alternatives show a profitable status based on the sale of electricity to private industries, whereas none of the alternatives shows a profitable status based on sale of electricity to Detroit Edison Company. The most cost-effective alternative, showing a return on invested capital of 3.2%, is the installation of a single 830 kW Leffel turbine. This is also the alternative showing the largest annual gross profit, $25,900.

IMPLICATION OF DEPARTMENT OF LABOR DAM REFURBISHMENT PROGRAM

It was pointed out in Section III that the U.S. Department of Labor has recently contacted Van Buren Township officials with regard to a program for the refurbishment of the French Landing dam and a pedestrian bridge downstream of the dam. Under the proposed program the Department of Labor would make up to $1.1 million available in fiscal 1979, and possibly subsequent years, for labor and administrative costs associated with repair work to the dam and bridge.

At the present time a $505,000 program is being considered for funding in fiscal year 1979. Although the grant is not yet confirmed, it appears that it will be forthcoming within the next few months. The implication of this program on the cost-effectiveness of the hydroelectric project would be substantial. Approximately $309,000 of the $505,000 refurbishment program would cover items that are included in the hydroelectric development project.

If this amount is subtracted from the project costs presented in Tables XI-1 and XI-2, the economic summary of the hydroelectric development project changes as shown in Tables XI-3 and XI-4. The profitability of all alternatives improves dramatically, due to the much smaller debt burden. All four alternatives are now profitable under the industrial market alternative, and one of the alternatives is profitable under the utility market alternative. The most cost-effective alternative continues to be the one-turbine Leffel design, showing a net annual profit of $52,400 and a return on investment of 10.6%.

TABLE XI-3

ECONOMIC SUMMARY OF VERTICAL TURBINE DESIGN ALTERNATIVES BASED ON SALES OF ELECTRICITY TO PRIVATE INDUSTRIES

(Assuming Dam Repairs Accomplished Under a Separate Project)

	ALTERNATIVES*			
	No. 1	No. 2	No. 3	No. 4
Estimated Project Cost (X1000)	$ 493	$ 933	$ 985	$ 1,188
Projected Service Life (yrs)	25	25	25	25
Projected Annual Revenue				
Energy	$ 93,600	$126,000	$111,600	$144,000
Demand	$ 51,200	$ 74,400	$ 58,300	$ 81,600
Standby Surcharge	($ 17,400)	($ 34,800)	($ 21,000)	($ 50,000)
Total	$127,400	$165,600	$148,900	$175,600
Projected Annual O&M Expense	$ 32,700	$ 39,500	$ 39,700	$ 43,760
Net Annual Revenue	$ 94,700	$126,100	$109,200	$131,840
Annual Debt Service[2]	$ 42,300	$ 80,000	$ 84,500	$102,000
Net Annual Profit (Loss)	$ 52,400	$ 46,100	$ 24,700	$ 29,840
Return on Investment	10.6%	4.9%	2.5%	2.5%

[1]Projected Annual Revenue is based on weighted average on-peak and off-peak energy charge (= 16 mills/KWhr)

[2]Annual Debt Service is based on 7%, 25-year financing

*Alternative No. 1: One Leffel Co. 830 KW unit
Alternative No. 2: Two Leffel Co. 830 KW units
Alternative No. 3: Two Bofors-Nohab 500 KW units
Alternative No. 4: Overhaul of existing turbines by Northern Water Power

TABLE XI-4

ECONOMIC SUMMARY OF VERTICAL TURBINE DESIGN ALTERNATIVES BASED ON ENERGY SALES TO DETROIT EDISON CO.

(Assuming Dam Repairs Accomplished Under a Separate Project)

	ALTERNATIVES* No. 1	No. 2	No. 3	No. 4
Estimated Project Cost (X1000)	$ 453	$ 871	$ 920	$ 1,113
Projected Service Life (yrs)	25	25	25	25
Projected Annual Revenue[1]				
Energy	$83,200	$112,000	$ 99,200	$128,000
Demand	$ 0	$ 0	$ 0	$ 0
Total	$83,200	$112,000	$ 99,200	$128,000
Projected Annual O&M Expense	$ 32,700	$ 39,500	$ 39,700	$ 43,760
Net Annual Revenue	$ 50,500	$ 72,500	$ 59,500	$ 84,200
Annual Debt Service[2]	$ 38,900	$ 74,700	$ 79,000	$ 95,500
Net Annual Profit (Loss)	$ 11,600	($ 2,200)	($ 19,500)	($ 11,300)

[1]Projected Annual Revenue is based on weighted average on-peak and off-peak energy charge (=16 mills/KWhr)

[2]Annual Debt Service is based on 7%, 25-year financing

*Alternative No. 1: One Leffel Co. 830 KW units
Alternative No. 2: Two Leffel Co. 830 KW units
Alternative No. 3: Two Bofors-Nohab 500 KW units
Alternative No. 4: Overhaul of existing turbines by Northern Water Power

SECTION XII
ENVIRONMENTAL IMPACT ASSESSMENT

The environmental impact of two alternative actions for the French Landing dam were evaluated using the environmental baseline data presented in Section V. The first alternative, called a no-action alternative, assumes that nothing will be done to restore the facility and current impoundment management policies will continue. The second alternative, the recommended alternative, assumes that the facility will be restored and developed as recommended in Section I of this report, Conclusions and Recommendations.

The environmental impact assessment of the recommended alternative involved a two-step procedure. The first step was a comprehensive identification of the proposed actions on the natural and cultural environment using an environmental impact matrix (Figure XII-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 signficant 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 no-action and recommended alternatives.

ENVIRONMENTAL IMPACT: NO-ACTION ALTERNATIVE

Impact on Natural Environment

1. The no-action alternative would maintain the current policy of lake level management and the ensuing flow release from the French Landing dam. This management policy calls for the lowering of the lake level by three-and-a-half to five feet during the winter months beginning November 1. By April 15th the water level is raised to the normal operating elevation of approximately 651.50 feet.

2. The fluctuations of water levels practiced for Belleville Lake may be contributing to accelerated soil erosion on the existing natural shorelines. Dropping the lake level modifies the gradient of groundwater movement thorugh the soil thereby tending to cause a sloughing of the banks. The shoreline erosion, besides being unsightly, contributes to siltation of the lake.

3. The manipulation of the lake level also has a potential impact on the fish population. According to DNR fisheries biologists, large manipulations of the lake level can strand and destroy young and adult fish and their eggs.

* * *

Impact on Cultural Environment

1. The effect of current lake level management practices on erosion of natural shorelines similarly affects man-made shoreline structures. The potential for property damage at Belleville Lake is greatly increased compared to other lakes due to the large number of man-made structures which dot the shoreline. Seawall damage apparently due to lowering the lake level would continue under the no-action alternative. Continual repair and replacement of shoreline protective structures places an economic burden on the lake residents.

2. Under the no-action alternative, the gradual deterioration in the condition of the dam and lake level control mechanism may pose a potential threat to health and safety. A failure in the lake level control mechanisms or the dam structure itself would cause the rapid release of water potentially inflicting damage on downstream property and structures. Further, the prolonged lowering of the lake level would deminish the load-bearing capability of the lake bottom and immediate shoreline. The resulting settlement might inflict significant damage on shoreline structures.

3. Restoration of the hydroelectric facility are projected to generate approximately seven million kilowatt-hours of electric energy annually having a value of approximately $165,000. The no-action alternative would result in the loss of the energy as well as revenues to the Township.

* * *

ENVIRONMENTAL IMPACT: RECOMMENDED ALTERNATIVE

Impact on Natural Environment

An analysis of the proposed actions which would affect natural environmental factors reveals that all significant impacts are associated with flow and impoundment management practices affecting the level of Belleville Lake. A review of these proposed management practices is therefore in order:

Flow Management: It will be recalled that the flow management proposed for the hydroelectric facility is based on a "run-of-the-river" operation. No attempt would be made to utilize the storage capacity of Belleville Lake to optimize electricity production. The schedule of production will be based entirely on natural stream flow characteristics. For this reason, the flow management practices will have no affect on lake level.

Impoundment Management: The impoundment management proposed under the recommended alternative calls for the maintenance of the normal water surface elevation of 651.50 feet from April 15th (or ice break-up, whichever occurs first) to November 1. From November 1 to April 15th, the level would be lowered approximately 8 to 12 inches.

1. Lake level management proposed by the recommended alternative should improve conditions for fishery resources by restricting fluctuations of the lake level and providing a stable environment for fish spawning. Eight to twelve inches during the winter months should not be detrimental to fish populations.

2. Since the recommended alternative will utilize existing hydroelectric structures, significant natural factor impacts will be limited to flow controls and aquatic wildlife. Other natural resources such as soils, water quality, vegetation and terretial wildlife are not expected to be affected.

Impact on Cultural Environment

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. Recreational activities such as fishing and boating can be affected by interim flow control associated with the construction activities. Fishing and boating are popular recreational activities along Belleville Lake and the Huron River. While major fluctuations will be prevented, accidental mismangement could occur and cause temporary problems to boating, canoeing and fishing activities.

4. Upon completion of construction activities, physical plant operation will present minor impacts to the immediate area. However, because the scale of the complex is relatively small and most of the electrical equipment and concrete structure are existing, the total impact is minimal.

5. The operation of the hydroelectric facility should have a positive affect on the local economy. In addition to the annual generation of approximately 7 million kilowatt-hours of electricity the operation is projected to produce $165,000 in revenues to Van Buren Township.

6. The facility will operate with minimal water level fluctuation and will therefore not impair recreational activities on Belleville Lake. Downstream of the dam, the Huron River and the adjoining Huron-Clinton Metropolitan Park System provides popular canoeing resources which could be impaired if the dam were to restrict river flow. It is anticipated that when natural stream flow becomes less than 200 cfs, the dam will discontinue electrical generation and divert flow directly to the river. This practice should insure uninterrupted summer canoeing except during extreme drought.

7. The maintenance of a higher winter water elevation than has been the recent practice may pose an inconvenience to those property owners who are not in the practice of removing their boat docks and other partially submerged shoreline structures. The dropping of the water level by 3-1/2 to 5 feet insured that these structures would be above the water line during the winter months. By dropping the level only 8 to 12 inches these structures would be subject to damage from ice if left in place during the winter.

* * *

CONCLUSION

The significant environmental issues associated with the French Landing dam are flow control and impoundment management. Current practices identified in the no-action alternative have an impact on property values, shoreline structures, erosion, water quality and fishery resources. The impoundment management policies put forth in the recommended alternative should greatly improve environmental conditions on Belleville Lake. Further, the no-action alternative has very serious implications for the health and safety of downstream as well as lakefront property owners.

The recommended alternative calling for the repair and restoration of the hydroelectric plant, dam and related facilities should mitigate threats to health and safety.

Due to the small scale of the project, the environmental impact of the recommended alternatives is minimal. The benefits derived from restoring the facilities from the standpoint of impoundment management and anticipated revenues far outweigh potential adverse environmental impacts.

SECTION XIII
INSTITUTIONAL IMPLICATIONS

Institutional and legal implications of the French Landing project which involve regulation by the Michigan Department of Natural Resources and the U.S. Army Corps of Engineers were discussed in Section IV, Environmental Setting. Other significant institutional implications are discussed below:

FEDERAL ENERGY REGULATORY COMMISSION (FERC)

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

Hydroelectric projects by non-Federal entities must be licensed by FERC if the 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 on water power from a government dam.

Conditions (1), (3) and (4) are not applicable to the French Landing facility, however, condition (2) would most definitely apply. The concept of a "navigable waterway" 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 amendments, 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 French Landing hydroelectric facility is owned by Van Buren Township, a public corporate authority, we foresee no need for MPSC involvement with respect to rates.

Concerning the possibility of selling power to industrial consumers who are presently receiving electric service from another utility, certain legal implications related to so-called "raiding" of customers might come into the picture. Statutory prohibitions of long standing prevent rival utilities in Michigan from selectively trying to attract the most lucrative customers of another utility. If the French Landing facility is developed to serve industrial consumers it may be necessary to get approval from MPSC to waive these statutory prohibitions. However, since the Detroit Edison Company has already agreed to the possibility of a joint service with some of their existing industrial customers, we foresee the granting of this permission to be a mere formality.

DETROIT EDISON COMPANY OPERATING FRANCHISE

The Detroit Edison Company has a franchise from the State Public Service Commission to operate an electric utility in Van Buren Township. This franchise would prohibit another utility from selling electric power in the area, however it would not prevent a public authority, such as the Township, from undertaking such a venture.

CONTRACTURAL PROHIBITION TO GENERATE POWER

The 1973 agreement which transferred ownership of the French Landing dam from the Detroit Edison Company to Van Buren Township contained a provision that "the dam and related equipment shall not be used for the generation of electric power for resale at any time." Detroit Edison has stated that this provision would be waived if the Township elected to recommission the hydroelectric facility, in view of the radically changed energy situation since 1973. In fact, as described in Section VIII, the utility has made an earnest proposal to purchase power from the plant, when and if it is recommissioned.

PROJECT FINANCING

It is anticipated that if the Township elects to undertake the recommissioning of the facility the project will be financed through the sale of Township revenue bonds. The authority of the Township to issue revenue bonds for public improvements such as the proposed hydroelectric facility is contained in the Michigan Revenue Bond Act, Public Act No. 94, of 1933. The approval of a revenue bond sale would be based on a vote by the Township Board of Commissioners.

APPENDIX

AGREEMENT

THIS AGREEMENT, made this 28th day of December, 1973, by and between THE DETROIT EDISON COMPANY, a corporation organized and existing concurrently under the laws of the States of Michigan and New York, with offices at 2000 Second Avenue, Detroit, Michigan, 48226, and THE EDISON ILLUMINATING COMPANY OF DETROIT, a Michigan corporation, with offices at 2000 Second Avenue, Detroit, Michigan, 48226, hereinafter collectively referred to as "GRANTOR", and the TOWNSHIP OF VAN BUREN, a political subdivision of the State of Michigan, whose address is 46425 Tyler Road, Belleville, Michigan, 48111, hereinafter referred to as "GRANTEE".

W I T N E S S E T H :

WHEREAS, the GRANTOR is presently the owner of certain parcels of land in the Township of Van Buren, County of Wayne, State of Michigan, commonly known as Belleville Lake and those portions of the Huron River lying within the Township of Van Buren, and including French Landing Dam and its related equipment as more particularly described in the attached deeds marked Exhibit "A" which by reference are made a part hereof, and

WHEREAS, GRANTOR desires to convey said lands, dam, pond and related flowage rights subject to any existing encroachments, building and use restrictions,existing permits and easements, governing the use of said properties and subject to any and all Federal, State or local governmental laws, rules and regulations governing navigable waters, and dam with related equipment located in said premises upon the following terms and conditions:

1. No consideration is to be paid to GRANTOR.

2. Conveyance to be by Corporate Quit Claim Deeds,with reservations of certain easements for the benefit of GRANTOR as more fully set forth in Exhibit "A" attached hereto.

3. Conveyance shall be subject to the receipt by GRANTOR of a "Consent to the Donation of Real Estate" by the Board of Directors of the Edison Illuminating Company of Detroit and a resolution of the Board of Directors of The Detroit Edison Company authorizing the President or a Vice President to effectuate the disposal and conveyance of said properties.

4. Conveyance shall be subject to the receipt by the GRANTOR of a certified copy of a resolution of the Township of Van Buren authorizing the acceptance by the Township of the property.

5. Conveyance shall be subject to the lien of the Mortgage and Deed of Trust and supplemental indentures thereto running to Bankers Trust Company as Trustee, dated October 1, 1924 for those portions of said property owned by The Detroit Edison Company.

6. GRANTOR will obtain a release from said lien within a one hundred eighty (180) day period from the date of conveyance. If GRANTOR fails to obtain said release within said (180) day period, GRANTOR shall pay to GRANTEE $100.00 liquidated damages hereby declared to be reasonable for each full month in which the lien of said Mortgage remains in full force and effect.

7. GRANTOR warrants that the lien of the said Mortgage and Deed of Trust running to Bankers Trust as indicated in paragraph 5 of this Agreement constitutes the only consensual lien to which said property is subject.

8. GRANTOR shall turn over possession of said lands, ponds, flowage rights and French Landing Dam on the date and at the time of conveyance. GRANTOR agrees to provide GRANTEE with instruction in the operation of the dam gates and control mechanisms for a six (6) month period from the date of conveyance. Said instruction will be limited to the operation of the dam gates and control mechanisms to be provided at reasonable times and under reasonable conditions.

9. GRANTOR agrees to repair the number one sector gate, being that sector gate of the French Landing Dam nearer to Haggerty Road, said sector gate to be placed in good working condition by February 1st, 1974.

10. GRANTOR agrees to install an automatic control device on sector gate #2 by February 1st, 1974.

11. GRANTEE covenants and agrees that it will indemnify and hold harmless GRANTOR and all of GRANTOR'S officers, agents, and employes from any claim, loss, damage, cost, charge, or expense, whether direct or indirect, and whether to any person or property, to which GRANTOR or said parties may be subject or put by reason of GRANTEE'S failure to use proper care and caution in the operation of said dam, pond, flowage rights and associated properties, except that GRANTEE will not be liable under this clause for damages arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence of GRANTOR or GRANTOR'S officers, agents or employes as required under Public Act 165 of 1966.

12. GRANTEE agrees that the dam and related equipment shall not be used for the generation of electric power for resale at any time.

13. GRANTEE agrees to furnish its own evidence of title insurance either in the form of abstracts or owner's title insurance, if it so desires. GRANTOR will cooperate with any title insurance company selected by GRANTEE by loaning title information from its land file records.

14. Closing to be held at 2000 Second Avenue, 688 Walker Cisler Building, Detroit, Michigan, at a date to be determined by the parties.

In the Presence of:

Christopher C. Nern

T. Katherine Hayes

THE DETROIT EDISON COMPANY

BY: William G. Meese, President

BY: Frank M. Kehoe, Secretary

Christopher C. Nern

T. Katherine Hayes

THE EDISON ILLUMINATING COMPANY OF DETROIT

BY: William G. Meese, President

BY: Frank M. Kehoe, Secretary

W. PHILIPRICE

THOMAS P. GEASEN

TOWNSHIP OF VAN BUREN

BY: G.E. Gollwitzer, Supervisor
G.E. GOLLWITZER

BY: Stephanie A. Sojer, Dep. Clerk
in the absence of:
Pat Cullen, Clerk

Ayres, Lewis, Norris & May, Inc.
Engineers · Architects

3983 Research Park Drive
Ann Arbor, Michigan 48104

July 14, 1977

MEMORANDUM

SUBJECT: Inspection of French Landing Dam and Control Structure

PROJECT: 66201 Van Buren Township
French Landing Dam Inspection

I. Inspection Dates: Above Water - May 3, 1977
Below Water - May 4, 1977

II. Inspectors: Robert K. St. Claire, P. E. (ALNM)
Tom Bihlmeyer (ALNM)

III. Owner's Representatives: Mr. Steve Partridge, Superintendent of Township Water Department
Al and Rick, Township Water Department

IV. North Direction: The upstream face of the control structure and arch dike lies generally along a northeast-southwest line. To be consistant with the original plans and existing labeling of items at the site, the north direction used in this inspection report will be in a true northeasterly direction; e.g.., the north sector gate has the access road bridge over it, and the fish ladder is adjacent to the south sector gate.

V. Major Structural Elements: South earth dike, 6 - span multiple arch dam, fish ladder, south sector gate with footbridge and pier, main building with two wicket gates and operators, north sector gate with access road, downstream tailrace with steel sheet piling and concrete retaining walls, tailrace concrete apron and north earth dike with access road.

VI. Above Water Inspection:

A. Fish Ladder

1. Not in use and representatives indicated that ladder may never have been used.

2. Major concrete spalling on top of divider walls - no structural problem. Repair required only for esthetics.

3. Very small amount of water passing through due to leakage of closed upstream entrance. Some debris in bay areas.

4. New wall and slab constructed at base of fish ladder.

* 5. Railings adequate but need painting. Post has cracked concrete and needs resetting.

* 6. Some cracked and spalled areas at footbridge over south sector gate which should be repaired.

* 7. Wall between fish ladder and south sector gate raceway needs concrete cap - heavy spalling.

* 8. Grating adequate but very rusty - needs painting.

B. South Sector Gate, Pier and Footbridge

* 1. No stop logs on site, and stop logs not used. Stop log guides adequate but need painting.

* 2. Railing and attachments adequate but need painting.

* 3. Minor cracking and spalling of footbridge and its supports.

* 4. Sector gate guide and brace assembly installed in 1974. Attached to top of gate and footbridge to keep gate locked in position. Brace assembly needs painting.

5. Signs in place and legible.

6. Sector gate level control indicator operable. Automatic level control feature nonoperable.

7. Checkered plates on pier tack welded shut except for three.

8. Concrete surfaces under plates on pier have very minor spalling.

* 9. Upstream 1/4-inch diameter wire cable broken. Used to keep boats away from gate and needs to be reattached.

* 10. Grating on pier needs painting.

* 11. North sides of gate raceway have vertical cracks in the corners with some leaching and need grouting.

* 12. Manual inlet valve assembly on pier needs painting. Outlet valve assembly cover in good condition requiring minor cleaning. Automatic controls nonoperable.

13. Valves locked with chains. Electrically operated valve controlled from inside Main Building. Valve operations satisfactory.

* 14. Crack in pier floor near Main Building needs grouting.

C. Main Building - Exterior

1. South side - adjacent to south sector gate

   a. Wood of entrance door requires repair.

   b. Exposed reinforcing rod needs to be cut off and grouted.

   c. Brick work in fair condition with some minor pointing of mortar required. Mortar is hard with minor cracks.

   d. Rusting of steel frames of windows has stained brickwork. Frames should be painted.

   e. Wood eaves appear in fair condition but require painting.

   f. Some spalling and cracking around windows in concrete wall and in wall itself which require grouting.

   g. Debris at base of building wall should be cleaned up.

   * h. Pipe railing adequate but needs painting.

   * i. Major crack at southeast corner needs repair work and grouting.

2. West Side - upstream face of structure

   a. Butterfly valve stands have been removed and holes patched.

   * b. Minor cracking in concrete work requiring grouting.

   * c. Spalled concrete along walkway at north end requires repair.

   d. Wood eaves require painting.

3. Northside - adjacent to north sector gate

   a. Main entrance door requires repair

   b. Wood eaves require painting.

   c. Glass on windows broken - repair or seal up.

   d. Air intake louver grillage should be removed and/or sealed up.

   e. Brick surfaces should be cleaned and mud wasp hives removed.

   f. Cable conduit penetrations should be sealed.

g. Debris at base of wall should be removed.

h. Top northeast corner of brickwork is cracked through mortar above stoneline and moved easterly - probably due to roof expansion. Area needs repair work.

i. Concrete wall shows spalling roughly one-third up from bottom which should be repaired.

j. Wood eaves should be painted

4. East Side - downstream

a. Windows need repair and/or sealing.

* b. Crack at southeast corner needs repair.

c. Wood eaves should be repaired.

* d. Concrete spalled at waterline and should be repaired.

* e. Minor crack in horizontal surface above tailrace area should be repaired.

f. Major wall movement evident in south sector gate north wall. It has moved 1-inch downstream. Appears in stable condition and only requires monitoring in successive years.

5. Roof appears in fair - good condtion

D. Main Building - interior

1. Interior generally is in fair condition requiring normal maintenance.

2. Wicket gate operating assemblies in fair condition requiring normal maintenance. Automatic level control feature operating satisfactorily.

3. Roof and block/brick wall in fair condition showing no leaks. Bird nests and wasp nests should be removed.

4. On the floors beneath the generator floor, the paint is peeling off the walls and should be repaired.

* 5. Railings and hatch covers in good condition requiring some painting.

* 6. Concrete walls are in fair condition except for wall of bottom-most floor. This wall has water upstream against it. The wall shows water leaching through cracks in several places with water accumulating on floor next to boiler. Wall needs major repair work to improve water tightness.

E. North Sector Gate, Pier and Access Bridge

* 1. Spalled areas at stair steps and slab need repair.

* 2. Valve assemblies need cleaning. Valve operations satisfactory

* 3. Railing adequate but needs painting.

* 4. Stop log guides need painting. No stop logs in use.

* 5. Handrail at north end of bridge needs repair.

* 6. Checkered plates welded shut - needs painting.

* 7. Access bridge shows major spalling which requires repair.

* 8. Drain holes in access bridge spalled and need repair along with underside of bridge.

* 9. Similar sector gate brace system as south sector gate and also needs painting.

F. Earth Dike

1. Top and Upstream Face

* a. Foot paths show surface erosion and should be repaired.

b. No major erosion rivelets.

c. Motorcycle hill climbing trails evident.

d. Upstream surface in good condition with adequate riprap protection.

* e. Fence torn at arch spillway and should be repaired. Fence posts solidly attached.

* f. Signs illegible and should be replaced.

2. Downstream Surface and Flat lands

* a. Large stones at base of dike need to be replaced.

b. Water perched in flat lands - swampy and mushy.

* c. Evidence of seepage at base of dike in area near arch spillway. Needs major repair work.

d. Trees appear upright with no evidence of soil sliding.

* e. Major washout has occurred along old Huron River Drive about 300 feet downstream of earth dike. CMP drain pipe exposed. Surface runoff from road is draining into flat lands. Needs major repair work.

G. Arch Spillway

1. Arch No. 1 at south end next to earth dike, and Arch No. 6 at north end next to fish ladder.

2. Downstream Side

* a. Arch No. 1 shows bad spalling of concrete. One-inch diameter hole in arch about 5 feet down from crest - spurting steady stream of water. Ten wet spots show seepage. Appears a gunite plastering was used to repair surfaces. Plastering has flaked and peeled off in many areas.

* b. Arch No. 2 has peeling plaster and six wet spots.

* c. Arch No. 3 has peeling plaster and two large wet spots.

* d. Arch No. 4 has peeling plaster and one large wet spot.

* e. Arch No. 5 has peeling plaster, three wet spots and spalling at crest.

* f. Arch No. 6 has two wet spots, major leaching and spot patching which is leaking.

* g. Several buttresses show long structural cracks along with cracks in top crest of arches at center of arch crest. Areas need major repair.

h. Water draining along base of spillway to drain at fish ladder.

* i. Minor leaks where arch surface meets abutments/buttresses.

* j. South retaining wall adjacent to earth dike shows no major cracks but leaks at base. Water seeps into low areas at base of spillway. Evidence of clay leaching through leaks. Requires repair work.

* k. Downstream surfaces of arch spillway requires major repair work.

3. Top Surface and Upstream Side

* a. Arch No. 1 has hollow sound when struck at crest where top surface was patched. Patching coming loose.

* b. Arch No. 5 was not patched and requires capping.

c. Water appears to have gotten under recent repair capping and has lifted capping off of original concrete giving rise to hollow sound.

* d. Capping and crest requires major repair work.

H. Tail Race and sheet piling walls

* 1. No drain holes for surface water runoff. Water pockets and seeps through sheeting causing some erosion and sink holes. Drainage methods should be provided and be adequate to drain flat lands.

2. Sheeting in fair to good condition.

3. Much litter and debris in area.

I. North Earth Dike and Access Road

1. Road in fair condition.

2. Ground cover good.

* 3. Runoff from Detroit Edison sub-station paving causing rivelet erosion on down stream side of dike. Requires proper drainage methods.

4. Upstream riprap protection adequate.

VII. Below Water Inspection

A. North and South Sector Gates

* 1. Some rust and flaking of metal surfaces - require painting.

* 2. Some spalled concrete three to four feet below water surface.

3. No leakage through gates - good seal.

* 4. Stop log guides require painting.

* 5. Raceway of north sector gate has major spalling. Appears that new surfacing was poured, and it is being undercut. Steel hinge of sector gate is rusted (top and bottom) through. Same areas have been spot welded. Requires major repair work.

* 6. Concrete face at bottom hinge of south sector gate is missing for an area about four-feet by 1-foot wide requires replacement. Steel channel bolted to hinge is rusted badly around bolt plates and requires replacement. Vertical crack in concrete wall near bottom of sector gate needs repair.

B. Main Building - Upstream

* 1. Some minor spalling about four-feet below water.

2. Steel bar racks cluttered with debris but in satisfactory condition. No repair work required. Cleaning required.

3. North and south wicket gates in satisfactory condition. Louvers not completely shut - 1/2-inch openings.

4. Concrete under water and inside main building in good condition. No spalling or erosion evident. No major cracks.

C. Main Building - Downstream

1. All three exit raceways show evidence of surface erosion of concrete surfaces due to water action. Some debris accumulated in raceways and should be renewed. No repairs necessary.

2. No problem areas or cracks.

* 3. Surfaces of both sector gate raceways show major spalling areas and holes requiring major repair work.

4. Some erosion evident under north retaining wall at bottom of north sector gate raceway.

5. Concrete apron in good condition with no heaving of concrete.

D. Arch Spillway

* 1. Horizontal crack about 10-feet below water surface along Arch Nos. 2, 3, 4 and 5. Crack is through gunite repair (gunite thickness about 1/4-inch) and is about 1/8 - 1/4-inch width. Portion above crack is raised.

2. Bottom 15 to 20-feet in good condition. Gunite repair work was to bottom of river bed.

3. No major structural cracks in original concrete work.

* 4. Arch No. 3 has a chip about 10 feet below water surface which is 12-inches long, 4-inches wide and 3-inches deep. Chip is at a horizontal construction joint.

5. Bottom of river is silty with some sand.

6. Stones are piled where arches meet abutments.

* 7. Crack in gunite surface requires major repair work.

Robert K. St. Claire, P. E.
Robert K. St. Claire

July 14, 1977

Township of Van Buren
46425 Tyler Road
Belleville, MI 48111

Attention: Ms. Doreen J. Crawen
Township Clerk

Re: French Landing Dam Inspection
Preliminary Report

Dear Ms. Crawen:

In accordance with our proposal letter of January 19, 1977, and your authorization of February 9, 1977, we are presenting our preliminary report relative to the aforementioned inspection. Details of the inspection are included in the enclosed memorandum. In addition, we have completed the Dam Inspection Report form of the Department of Natural Resources and are enclosing five (5) copies for your use.

The lake level control structure, arch spillway and earth dike are in fair to good condition and do not require any immediate repair work. Some of the repair items mentioned in the memorandum would be part of a normal maintenance program. There are other items which require more extensive efforts. We would summarize our recommendations for this latter remedial work pertaining to the integrity of the lake level control structure, arch spillway and earth dike as follows:

1. Repair sector gate hinges and concrete of raceways.
2. Repair upstream, downstream and crest surfaces of arch spillway.
3. Install adequate drainage facilities for flat lands downstream of the arch spillway.
4. Repair seepage through earth dike south of the arch spillway.
5. Install adequate drainage facilities for runoff from Detroit Edison sub-station.
6. Sandblast and paint all exterior steel surfaces (railings, grating, plates, sector gates, gate brace assemblies, stop log guides.)
7. Repair spalled exterior concrete surfaces.

8. Remove debris from tailraces under main building.
9. Replace boating cable upstream of south sector gate.
10. Obtain adequate stop logs for winter operations.
11. Repair interior wall of lower-most floor of main building.

Specific items in the memorandum included in the above 11 items have been marked with an asterisk (*).

For a very preliminary budget cost estimate of the total project costs for the above remedial work, we would suggest a range of $40,000 to $60,000 and would suggest that the work be scheduled for the summer of 1978.

The aforementioned remedial work does not include any work on the main building superstructure (exterior and interior). The superstructure is in need of repairs and refurbishing as indicated in the memorandum. These deficiencies, however, do not impinge on the integrity of the control structure and its operations. The extent and nature of the building repairs would be dependent upon the desires of the Township relative to the functional use of the superstructure.

We would suggest that some of the remedial work can be performed by local contractors without elaborate documents and agreements. We would be pleased to meet with the Township to discuss this report and assist in the recommended remedial work. If you wish to discuss any items mentioned herein, please do not hesitate to contact us.

Very truly yours,

AYRES, LEWIS, NORRIS & MAY, INC.

Robert K. St. Claire, P. E.

RKSC/bsj
Enclosures
874/66201

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

DAM INSPECTION REPORT

(Act 146, P.A. 1961, As Amended)

NAME OF WATER	COUNTY	TOWN, RANGE, SECTION
HURON RIVER	WAYNE	T3S, R8E
DATE ELEVATION SET BY COURT	SUMMER ELEVATION	WINTER ELEVATION
N/A	650.50'	646.50'
DATE OF INSPECTION	LEVEL THIS DATE	HIGH WATER MARK ELEVATION
5/3 & 5/4, 1977	650.40'	651.50' ±

DESCRIPTION OF CONTROL STRUCTURE

TYPE	BY WHOM CONSTRUCTED	DATE
TWO SECTOR GATES (WIDTH EACH = 33')	NOT KNOWN	1925 - 1926
LENGTH OF EARTH DIKE:	LENGTH OF ARCH DAM:	HEAD ON GATES:
400'	181'	VARIABLE (0' TO 12')
VERTICAL PIPE SIZE	HORIZONTAL PIPE SIZE	FREEBOARD
N/A	N/A	2' - 0"

EARTH DIKE

CONDITION OF COVER	SETTLEMENT OF FILL (If any)
FAIR AMOUNT OF GROWTH	NONE
EROSION (SHEET)	WAVE ACTION (Beach or Bank)
SOME ALONG TOP	NONE - ADEQUATE RIPRAP IN PLACE
EROSION (RIVULETS)	VEHICLE OR FOOT TRAFFIC
NONE	HAS DEVELOPED PATHWAYS AND SOME EROSION. EVIDENCE OF MOTOR CYCLE HILL CLIMBING.
SEEPAGE AT TOE OF DAM	SEEPAGE ON SLOPE
SOME SEEPAGE AT BASE AND AT RETAINING WALL REQUIRING CORRECTIVE WORK	NONE
SEEPAGE AT DISCHARGE PIPE OR CONTROL STRUCTURE	HOLES BY ANIMALS
N/A	NONE

CONTROL STRUCTURE - ARCH DIKE, FISH LADDER, SECTOR GATES, MAIN BUILDING

STOPLOG VALVES & GATES (Open and Close to Check Condition): Check Location of Top Stop-Log in relation to top of riserpipe intake box or fixed crest, for leakage, and condition of stop-logs, valves, & gates.

SECTOR GATES OPERABLE AND IN FAIR CONDITION - NEED PAINTING AND REPAIR TO HINGE AT BASE. NO STOP LOGS USED. GATE CONTROL VALVES ADEQUATE AND OPERABLE. SECTOR GATE RACEWAYS SHOW SPALLED AREAS REQUIRING REPAIR WORK.

OUTLET PIPE: Check for damage from ice, logs, vandalism; inside discharge pipe for settlement and/or joint separation; condition of pipe coating.

WICKET GATES OPERABLE AND THEIR CONTROLS IN FAIR - GOOD CONDITION. AUTOMATIC CONTROL FEATURE OPERABLE.

CONCRETE STRUCTURE: Check for erosion; location of cracking or spalling, if old or new; settlement or tipping; need for crack repairs.

ARCH SPILLWAYS SHOWS LEAKAGE - REQUIRES REPAIR. MAIN BUILDING IN FAIR CONDITION - REQUIRES NORMAL MAINTENANCE. CONCRETE UNDER MAIN BUILDING IN GOOD CONDITION - NO MAJOR CRACKS OR SETTLEMENTS.

WALKWAY & RAILING: Check if in place or removed, and condition.

WALKWAYS IN FAIR CONDITION. RAILING ADEQUATE - REQUIRES PAINTING - SOME SIGNS NEED REPLACING. HORN NOTIFYING OF LOWERING GATES IS OPERABLE.

OUTLET CHANNEL: Check for erosion; riprap; obstructions - beaver dams - brush - debris.

DOWNSTREAM APRON IN GOOD CONDITION. SHEET PILING WALL SATISFACTORY - NEEDS OUTLETS FOR SURFACE DRAINAGE.

DIKES & DITCHES : ACCESS ROAD EARTH DIKE

SETTLEMENT	NE
[E]ROSION	SOME EROSION FROM ADJACENT DETROIT EDISON SUB-STATION PAVING - NEEDS PROPER DRAINAGE HANDLING.
COVER ON SLOPES	ADEQUATE
WEED GROWTH IN DITCHES	NONE
TREE & BRUSH GROWTH IN DITCHES & ON DIKE	NONE

PUMPS (Running)

VIBRATION	N/A
EXCESSIVE NOISE	N/A
MOUNTINGS	N/A
ALIGNMENT OF BELTS & SHEAVES - EXCESSIVE WEAR	N/A
MOTOR OVERHEATING	N/A
GATES	N/A
PIPE LEAKAGE	N/A
EROSION AT DISCHARGE PIPE	N/A

RECOMMENDATIONS

List work needed, how to be done, by whom, estimated cost, source of funds, recommended completion date. If emergency, to what extent. ADDITIONAL COMMENTS.

SEE INSPECTION MEMORANDUM OF JULY 14, 1977, AND TRANSMITTAL LETTER OF JULY 14, 1977.

ROBERT K. ST. CLAIRE, P. E., (19330)
REG. ENGINEERS NAME & REG. NO.

AYRES, LEWIS, NORRIS & MAY, INC.
3983 RESEARCH PARK DRIVE
ADDRESS

ANN ARBOR, MI 48104

September, 1978

MEMORANDUM

SUBJECT: Above Water Inspection and Recommendations for the Powerhouse of the French Landing Dam

PROJECT: 66201 - Van Buren Township

INSPECTION DATE: ~~August~~ September 12, 1978

INSPECTOR: Mike Kalaitjis, P. E. - ALNM

GENERAL COMMENTS

The visual inspection of the structural units at the powerhouse revealed that the structure is in overall good condition.

Cracking of the concrete was detected in several places of the exterior of the building, but the structural integrity of the structure is not endangered.

Minor differential settlement and displacement might have caused the cracking at the corners of the building while the cracking in the vicinity of the windows might be attributed to inadequate performance of the construction joints. Cracking was also concentrated at the previously repaired areas.

The brick part of the walls is in very good condition while the tile exterior root needs minor repairs.

The interior of the building needs general cleaning and some steel units need sandblasting and painting.

The wall paint is peeling off at the 2nd and 4th level down while water leaking caused extensive leaching and some swelling of the concrete back wall at the 4th level. The interior reinforced concrete columns, beams and slabs are in good structural condition.

The roof trusses and the 20 ton capacity crane system are in good condition.

The crane system can be operated in both directions manually (ropes and pulleys) while the crane boom is electrically operated, but disconnected at the present time. Communications with an employee of the Van Buren Township revealed that the crane boom will operate well if reconnected. The water level recorder is placed at the 2nd level down and is in fine operating condition.

The remaining mechanical equipment, i.e., oil burners, circulating water heating systems, valves and c.e.t., were not inspected.

Finally, it was observed that several windows will need repairs.

INSPECTION BY PARTS

A. EXTERIOR OF THE BUILDING

1. North-eastern exterior wall:

The top brick portion of the wall is in very good condition. The interior steel frames of the three windows need painting and the glass of the middle window needs replacement.

The concrete portion of the wall shows cracking at the corners at the vicinity of the windows and at the previously repaired (patched with mortar) portions. Spalling of the concrete shows at the spillway abutment attached to this wall.

2. Northern (upstream) exterior wall:

The top brick portion is in very good condition, but the first (North-eastern) window needs partial glass replacement.

In the concrete portion of the wall spalling and cracking is detected at the right (northwestern) corner at the previously repaired portion.

The upstream concrete piers show cracking but no spalling of the concrete.

3. Northwestern exterior wall:

The brick portion of the wall is in good condition.

The concrete portion of the wall shows some cracking that is especially concentrated at the previously repaired sections and at the corners.

The concrete railing adjacent to the entrance to the building shows extensive cracking that continues down to the spillway abutment adjacent to this building wall. These cracks endanger the stability of the wall and should be repaired immediately.

4. Southern (downstream) exterior wall:

The brick portion of the wall is in good condition.

In the concrete portion of the wall concrete spalling is observed at the junction of the brick and concrete wall and extensive concrete cracking shows at the corners of the wall and at the previously repaired sections. At the southwestern corner of the wall concrete spalling has exposed the reinforcing steel.

The concrete piers and the slab on top show extensive cracking and spalling. Repairs are required.

B. BUILDING INTERIOR

1. First level:

The roof trusses show no deterioration or section losses and are assumed to be in good condition. The crane system is rated at 20 tons capacity and is considered to be in very good condition. The crane moves in both directions manually (ropes and pulleys) but the crane boom is electrically operated and disconnected at the present time.

The walls and floor slab show no cracks or spalling and are considered sound.

The three bar screens at the water entrance of the powerhouse need cleaning while the three steel plates that cover the openings to the bar screens need sandblasting and painting.

Electrical and mechanical equipment at this level were not inspected.

The steel stairs between this level and second level down show extensive rusting but no sectional losses were observed. Sandblasting and painting is recommended.

2. <u>Second level (down)</u>

The walls, slabs and columns show no cracks and are in good condition. The wall and roof need painting since present paint is peeling off.

The water level recorder is in good condition and operating. The windows in this level need glass replacement and painting of the steel frame. The steel stairs between this and the third level (down) show excessive rusting and need sandblasting and painting.

3. <u>Third level (down)</u>

The northwestern wall shows extensive cracking and needs repairing. The remaining of the walls, slabs and columns are in good condition. The steel stairs between this and the 4th floor down need sandblasting and painting.

4. Fourth level (down)

All three windows need repairs. The walls, slabs and columns are structurally sound but need painting. Water leakage through the back wall has caused extensive leaching and some swelling of the concrete at this location. Spalling of concrete shows at the right column. The resulting sectional loss is approximately 12" long by 2" wide.

RECOMMENDATIONS

The cracking and spalling of the concrete at the southern (downstream) exterior wall, the leaching-swelling of the concrete at the back wall of the fourth level and the cracking at the concrete railing and spillway abutment are items that definitely require repairs.

Repairs are recommended for the remaining defects to prevent major future problems as well as for aesthetic and functional reasons.

For a preliminary cost estimate for all the required and recommended repairs, we would suggest a range of $5,000 to $7,000.

September 1, 1978

Township of Van Buren
46425 Tyler Road
Belleville, MI 48111

Attention: Ms. Patricia Cullin, Supervisor

Re: French Landing Dam and
Pedestrial Bridge Rehabilitation

Gentlemen:

In accordance with our meeting on August 28, 1978, we have prepared and are enclosing project descriptions and preliminary cost estimates for the rehabilitation of the French Landing dam and the downstream pedestrian bridge. On August 30 we visited the site to become familiar with the pedestrian bridge and its approaches.

In preparing our estimates, we have given attention to rehabilitating the French Landing dam in as much as it relates to its hydraulic function and operations; i.e., no work has been included that relates to electric power generation. We, also, have not included any work in site development of park areas adjacent to the dam site, either upstream or downstream.

The work on the pedestrian bridge includes approximately 300 feet of road work at the southwest approach and approximately 50 feet at the northeast approach, in addition to rehabilitation of the pedestrian bridge to carrry pedestrian and bicycles. Some of the roadwork may involve the Wayne County Road Commission on private property. Beyond the above approach road work, no work has been included that ties the pedestrian bridge into any park development adjacent to the dam site. Also, the bridge inspection and evaluation included in the engineering work may reveal additional work on the bridge which is not evident at this time.

We trust that the information enclosed will assist you in your deliberations. If you wish to discuss any items mentioned herein or we can be of further assistance, please do not hesitate to contact us.

Very truly yours,

AYRES, LEWIS, NORRIS & MAY, INC.

SR

Robert K. St. Claire, P. E.

RKS/slt
Enclosures
1258/99900

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

3983 Research Park Drive
Ann Arbor, Michigan 48104

September 1, 1978

PROJECT SCOPE DESCRIPTION FOR THE REHABILITATION OF FRENCH LANDING DAM AND PEDESTRIAN BRIDGE FOR THE TOWNSHIP OF VAN BUREN, MICHIGAN

1. French Landing Dam

The major elements of the dam are the south earth dike, 6-span multiple arch dam, fish ladder, south sector gate with footbridge spillway and pier, main control building with two wicker gates and operators, north sector gate with access bridge, spillway and pier, downstream tailrace with steel sheet piling and concrete retaining walls, tailrace concrete apron and north earth dike with access road. The inspection report of the dam's inspection in May, 1977 forms a basis for the proposed rehabilitation work. The rehabilitation work to the dam may be summarized as follows:

a. Repair and paint sector gates.
b. Repair and restore fish ladder.
c. Repair concrete of sector gate spillways.
d. Repair earth dike seepage.
e. Install drainage for flat lands downstream of arch dam.
f. Repair cracks, spalled areas and leaks of arch dam.
g. Install arch dam energy dissipatators, stilling basin and channel to river.
h. Repair control building superstructure including spalled concrete, brickwork, windows, roof, doors and heating.
i. Refurbish lake drainage controls.
j. Refurbish and install lake level and sector gate automatic controls.
k. Repair handrails and cover plates.
l. Install fencing and signs.
m. Pave approach road.
n. Miscellaneous minor items to improve operation, safety and integrity of the dam.

2. Pedestrian Bridge

The major elements of the bridge are a southwest approach road, south multi-span concrete arch bridge, central steel truss bridge, north multi-span concrete arch bridge, northeast approach road, foundation sheet piling and concrete slope protection. The proposed rehabilitation work, based on a field visit in August, 1978, may be summarized as follows:

a. Remove and replace spalled concrete of arches and bridge deck.
b. Sandblast and paint steel truss bridge.
c. Remove and replace southwest approach road including storm drainage.

d. Repair northeast approach road including storm drainage.
e. Install expansion joints.
f. Install bridge deck drainage.
g. Install pedestrian fencing along bridge.
h. Provide fencing around bridge site.
i. Repair concrete slope protection.
j. Miscellaneous minor items to improve the safety and integrity of the bridge.

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

September 1, 1978

PRELIMINARY COST ESTIMATES FOR THE REHABILITATION OF FRENCH LANDING DAM AND PEDESTRIAN BRIDGE FOR THE TOWNSHIP OF VAN BUREN, MICHIGAN

ITEM	ESTIMATED COSTS		
	LABOR	MATERIAL	TOTAL
1. Construction Costs			
a. French Landing Dam	$146,500	$137,500	$284,000
b. Pedestrian Bridge	$ 61,600	$ 58,400	$120,000
Construction Cost Totals	$208,100	$195,900	$404,000
2. Engineering	$ 52,600	$ 8,000	$ 60,600
3. Legal, Administration and Contingencies	$ 20,200	$ 20,200	$ 40,400
Estimated Project Totals	$280,900	$224,100	$505,000

NOTES:

1. Engineering includes site survey, design, bridge inspection and evaluation, plan preparation, contract documents, advertising, bidding, award, construction contract administration, resident inspection, as-builts, and operation manual.

2. Legal, administration and contingencies includes legal opinions, Township administration and supervision, advertisement publishing and construction contingencies.

AYRES, LEWIS, NORRIS & MAY, INC.
engineers·architect
ANN ARBOR, MICHIGAN 48104

COST ESTIMATE

Date 9/26/78 Dept F

Project No. 66201

Client Van-Buren Township

Project Description FRENCH-LANDING COST ESTIMATE

Project Mgr. MGK FOR DON LYSTRA

No.	Div. or Item	Description	Quantity	Unit Cost	Total Cost
1	A	SOUTH EARTH EMBANKMENT	18,318 c.y	3	54,954
	B	NORTH EARTH EMBANKMEN	6,942 c.y	3	20,826
2	A	CONCRETE ARCH DAM AND RETAINING WALL	2159 c.y	300	647,700
3	A	CONCRETE OF FISH LADDER	261 c.y	300	78300
		~~SOUTH SIDE~~ (CONCRETE)			
4	A	RET WALL and Rollway South of FISHWAY (CONCRETE)	296 cu.y	300	88,800
	B	Platform and Retaining wall on South side of Power House	670 c.y	300	201,000
	C	BRIDGE AND RAIL ON SOUTH SIDE OF POWER HOUSE	9 c.y	300	2,700
	D	SPILLWAY CONCRETE (SOUTH)	39 c.y	300	11,700
		NORTH SIDE (CONCRETE)			
5	A	RET WALL AND ROLLWAL ON NORTH FISHWAY	317 c.y	300	95,100
	B	Platform and Retaining wall	717 c.y	300	215,100
	C	BRIDGE AND RAIL	10 cu.y	300	3,000
	D	SPILLWAY CONCRETE	39 c.y	300	11,700
		POWER HOUSE:			
6	A	CONCRETE OF POWER HOUSE	1500 cy	300	450,000
	B	BRICK PART (WALLS)	5688 ft²	6.5$/ft²	36,972
	C	TILE ROOF (CLAY)	4242 ft²	4$/ft²	16,968
	D	STEEL CRANE SUPPORT	16,000 lb	1$/lb	16,000
	e	STEEL SUPPORT & TRUSSES	20,000 lb	1$/lb	20,000
	f	2 Sector Gates	Lump Sum		140,000
	g	3 sluice Gates	Lump Sum		150,000
	h	CRANE BOOM	Lump Sum		20,000
	i	other (steel stairs, Racks, screens, windows)	Lump Sum		115,000

AYRES, LEWIS, NORRIS & MAY, INC.
engineers-architect
ANN ARBOR, MICHIGAN 48104

COST ESTIMATE

Project No. 66201

Date 9/26/78 Dept P

Client Van-Buren Township

Project Description FRENCH LANDING DAM COST ESTIMATE

Project Mgr. MGK For Don Lyjvq

No.	Div. or Item	Description	Quantity	Unit Cost	Total Cost
(7)	(A)	STEEL SHEET PILE [upstream shear-key	13,560 ft²	12$/ft²	162,720
	(B)	Steel sheet Pile on North BANK	8,000 ft²	12$/ft²	96,000
	(C)	Steel sheet Pile on South BANK	10,200 ft²	12$/ft²	122,400
		EROSION PROTECTION			
(8)	(A)	Protective concrete Apron			
		on channel and in ARCH DAM	596 c.y	275	163,900
	(B)	PRECAST CONCRETE BLOCKS	2388 sq.y	22.7	54,208
	(C)	HEAVY RIP-RAP	2701 sq.y	22	59,422
		COFFER DAM			
(9)	(A)	EXCAVATION	17,629 c.y	2.5	44,073
	(B)	EMBANKMENT	4,444 c.y	3	13,332
		Σ TOTAL: 3,111,875 $			3,111,875

NOTE: This cost estimate does not include any electrical or Mechanical Equipment in Power House. The coffer Dam cost estimate reflects the initial site construction condition (site as in 1924)

Total

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, Governor

DEPARTMENT OF NATURAL RESOURCES

HOWARD A. TANNER, Director

District 14 Headquarters
2455 N. Williams Lake Rd.
Pontiac, Michigan 48054

RECEIVED OCT 17 1978

October 16, 1978

Mr. Richard K. Carlisle, P.C.P.
Ayres, Lewis, Norris & May, Inc.
3983 Research Park Drive
Ann Arbor, Michigan 48104

Dear Mr. Carlisle;

Thank you for requesting my comments on the hydroelectrice proposals potential impact in Belleville Lake and the Huron River downstream.

Enclosed is my report on our fish reclamation project on Belleville Lake, yet to be finalized and published by Fisheries Division. It explains that the lake (and river below) have developed into excellent fisheries, and in fact the lake ranks among the top five heaviest fished inland lakes in Michigan. More recent surveys continue to indicate excellent walleye, bass, crappie, catfish, etc. growth and natural reproduction. We have also stocked tiger muskellunge in the past two years and expect them to add to the fishery as well.

I am not as concerned about "minor" water level fluctuation in impoundments, as for discharge levels through the dams. An occasional few inches drop or rise in water levels has little if any effect on fishes, but large manipulations (a foot or more) could strand and destroy fish adults, young, or their eggs, especially during the spawning seasons. I'm sure there are no plans for such drastic adjustments at Belleville.

Below a dam, and downriver, flow adjustments, such as at Ford Dam (Joint Ypsilanti Recreation Organization Electrical Generating Operation) can cause damage to the fishery resource. Right now our coho salmon fishing success rises and falls with such adjustments. It appears that the Ford Dam is closed (to minor flow rates) for several days while a "head" is built up, then the dam opened for maximum power generation for one to several days, and closed again. Poor salmon angling and erratic fall runs may be more attributable to that factor than anything else.

Similarly, spawning fish such as walleyes can be affected by such unnatural adjustments, where flows and temperatures can shock or destroy eggs and young, not to mention stranding them in the "dry".

I also wonder how the constant changes in river levels and flow affects fishermen and canoests, both physically and aesthetically.

If Belleville dam is operated for hydroelectric generation similarly to Ford Dam, I fear greater problems downstream. Rather I strongly urge you to recommend alternatives that will maintain a much more constant (guaranteed) flow downstream in order to mitigate the problems that now exist. Hopefully we'll be able to do the same at Ford Dam.

At any rate we need energy, and I am sure any power generated at dams such as Belleville will be in great demand. Just so the resources receive fair treatment.

Don't hesitate to contact me if you need further assistance.

Sincerely,

Ronald J. Spitler/br

Ronald J. Spitler
District Fisheries Biologist

RJS:br
cc: Weaver
    Doyle

November 20, 1978

Mr. John Schnandt, Plant Manager
Master Craft Engineering
3955 I-94 South Service Dr.
Belleville, MI 48111

Dear Mr. Schnandt:

We are contacting you regarding the possibility of purchasing inexpensive supplementary electricity from the French Landing Hydroelectric Plant.

Our firm is currently working on two projects for the U. S. Department of Energy to study the feasibility of using existing small dams to generate electricity and, thereby, to help meet the nation's energy needs. A 1977 study by the Corps of Engineers concluded that the hydropower potential at existing small dams could produce 180 billion kilowatt-hours of electricity per year, the equivalent of 60 large nuclear or thermal plants.

One of the studies on which we are engaged focuses on the French Landing Dam on the Huron River, owned by Van Buren Township. This facility was constructed in the late 1920's and produced electricity until about 1967, when it was taken out of service and turned over to the Township. What we are studying for DOE is whether the drastic increase in fuel costs in recent years, with the attendant rise in the price of electricity, cost-effective to put this hydro plant back into service.

This is why we are asking for your help. We are trying to determine what a potential customer, like yourself, would find advantageous or disadvantageous in regard to buying the electric power generated by the hydroelectric plant, as a supplement to your normal service from Detroit Edision Company. We would also like to obtain some information about your electric demand, to determine what fraction of your total needs could be met by the hydro plant.

To help us begin to answer these questions would you please take a minute to fill out the enclosed questionnaire. We have included a stamped envelope for mailing your response. If you have any thoughts or opinions on this matter which are not covered by the questionnaire, please feel free to write your comments in the margins or on a separate sheet of paper.

(continued on page 2)

Obviously, there is no commitment to you in returning this questionnaire. Although we are asking you to identify yourself. This is only because of the possible need for follow up contacts.

Incidentally, if any of the questions cannot be readily answered, feel free to skip over them.

Thanks very much for your cooperation on this matter. If you have any questions please give me a call.

Sincerely,
AYRES, LEWIS, NORRIS & MAY, INC.

Donald W. Lystra, P.E.
Project Director

DWL/skl
Enclosures
1680/66202

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

QUESTIONNAIRE

1. Type of production activity carried on at your facility: ____________________
   ____

2. Present source of your electric energy: ________________________________

3. Utility rate agreement under which your electric energy is presently purchased:
   ____

4. Present electric demand:
   a) average monthly consumption in kilowatt-hours: ____________________
   b) average monthly peak demand in kilowatts: ______________________

5. What is your estimate of the amount of variation in the rate of your electric usage over a day:
   a lot /--------/--------/--------/--------/ a little

6. How many shifts of production does your facility operate each day, typically:
   ____

7. By what fraction is your electric demand reduced during times of the day when you are not in production, compared to times of the day when producing:
   ____

8. Have you ever experienced an interruption of electric service during the last three years? ____
   If so, how long did is last? ____________

9. If it were acceptable to you in all other respects, would you be willing to enter into an agreement to purchase electricity from the French Landing Hydro Plant as a supplement to your normal electric service?

YES ________ NO ________

10. If the Hydro Plant were able to meet all of your electric service requirements, would you be willing to enter into an agreement to purchase electricity from the plant as a sole source of power? YES________ NO ________

11. What reduction in the cost of electric energy would be required to make either of the above arrangements an attractive proposition to you?__________

____

12. If it were acceptable to you in all other respects, and if it contained adequate safeguards for your protection, what is the maximum period of time that you would consider contracting for electric service from the French Landing Hydro Plant? Check one:

month-to-month________, one year ________, five years ________, ten years ________, twenty years ________

13. What is your overall reaction to the idea of recommissioning the French Landing Hydro Plant? ____

____

____

14. Name and address of organization?

____

____

____

15. Name of individual completing questionnaire?__________________________

THANK YOU FOR YOUR ASSISTANCE.

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,

Ray

R. F. 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 curcuit 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

	A	B	C	D	E
1. Generated Energy					
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

936/RFW/M1/5.1

	A	B	C	D	E
2. Purchased Energy	(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. Billing Calculations					
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
	$19,115	$10,928	$6,887	$4,087	$9,763
kWh to Edison @ $0.01 Cr.	-		(270)	(820)	(100)
Net Total	$19,115	$10,928	$6,617	$3,267	$9,663

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 hydoelectric 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	10,000
	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.

936/RFW/M1/5.3

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 Study

FROM: Don Lystra, P.E.

RE: Report of Meeting on 1/16/79 with Mr. Ray Williams, Major Accounty Operations, Detroit Edison Company

Mr. Willim s delivered a letter from him detailing the alternatives for selling power from the hydroelectric plants at French Landing and Peninsular Paper Co.

Mr. Williams explained the two alternatives for sale of power at French Landing. The first would involve a bulk sale to Edison via an interchange agreement between the Township and Edison. The purchase rate would be based on the highest incremental operating and fuel cost for alternative sources of energy, on an hour-by-hour basis. He explained that the on-peak and off-peak rates given in the letter are averages based on 1978 operating data. In actuality, the rates would range above and below these figures, depending on the incremental cost of energy at any given day and hour.

I asked him whether it might be permissible for the hydro plant to connect into the secondary side of the Edison substation rather than the primary side (as stated in the letter) since this would be much less costly and would actually unload the transformers in the substation, since the power would all be consumed locally anyway. He agreed that this might be possible and said he would check into it.

I asked him if the costs for telemetry and programming ($25,000) would really be necessary since DECo. was assuming that the power from the hydro plant could not be scheduled or controlled by them. Mr. Williams stated that perhaps they would not be necessary and could be checked further at a later date.

The second alternative for sale of power would involve service to one or more electric consumers in the vicinity of the dam, either in parallel with the Edison service, or as a non-parallel isolated operation. The contribution from the hydro plant would essentially offset whatever power would otherwise be purchased from Edison at whatever rate the customer was purchasing it subject to the stand-by surcharge (Rider 3).

Mr. Williams stated that Detroit Edison does have a franchise to operate in Van Buren Township. This franchise would prohibit another utility from selling power in the area, however, it would not prevent a public authority, such as the Township, from undertaking such a venture.

Mr. Williams stated that the 1973 agreement which transferred ownership of the dam from Detroit Edison to the Township included a provision that the Township could not use the site to generate electricity, but that Detroit Edison could waive that provision in view of the energy shortage which has developed since that time.

Donald W. Lystra, P. E.

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.

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 Study

FROM: Don Lystra

DATE: August 31, 1978

RE: Report of Telephone Conversation on 8/31/78 with Mr. D. K. Falk, Head of Bulk Power Transactions Department, Detroit Edison Company

(Note: I was directed to speak with Mr. Falk by Mr. Atkinson of the Electric Systems Department)

I informed Mr. Falk of the work we were doing on the hydro feasibility studies and our interest in determining what kind of a power purchase agreement could be worked out between the owners and Detroit Edison Company.

Mr. Falk said that he had recently given a similar quotation (on purchasing power from a small supplier) to the City of Detroit for power obtained from solid waste incineration.

He said that DECo. had several such arrangements in effect. Usually they are characterized by DECo. having no control over the delivery of power into thier system; they just absorb it when and if available, and in whatever amount available.

The University of Michigan, for example, sells waste head from turbines in their power plant on an unscheduled basis. The payment is their cost plus 10 percent or the cost of energy from a large coal burning plant, whichever is higher. Right now this comes out to about 10 to 11 mills per kwhr. Most is delivered offpeak. If it were possible to identify some as onpeak, then they could support a higher payment. DECo. would be willing to pay higher for peak power. Right now, the minimum cost is about 11 mills per hwhr; the average highest cost would be about 25 mills per kwhr; so the average cost of onpeak power would probably be somewhere between.

I inquired whether a capacity charge could be applied if it were possible to guarantee a certain amount of firm production. Mr. Falk said that the capacity charge between Consumers Power Co. and Detroit Edison Co. right now is 45¢/kw/week and between an Indiana utility and Detroit Edison is 60¢/kw/week. He said that we could assume the higher figure would apply - they were headed in that direction with Consumers anyway.

I asked Mr. Falk who we could talk to about a joint service between Detroit Edison and the hydro plant and he suggested I talk to Mr. Bill Hodeman, Marketing, telephone number 237-7770.

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.

LARGE PRIMARY SUPPLY RATE

AVAILABILITY OF SERVICE: Available to customers desiring service at sub-transmission voltage who contract for a specified capacity of not less than 10,000 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 24,000, 41,570 or 120,000 volts 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 10,000 kilowatts. The Company undertakes to provide the necessary facilities for a supply of electric power from its subtransmission 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:
$2,500.00 per customer per month

Demand Charges:
$5.55 per kW of on-peak billing demand, plus:
$.60 per kW of maximum demand for service at subtransmission levels.
$.25 per kW of maximum demand for service at transmission levels.

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

Energy Charges:
1.95¢ per kWh for all kWh used during the on-peak period.
1.65¢ per kWh for all kWh used during the off-peak period.

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

METERING ADJUSTMENT: For loads metered at less than 24,000 volts, all measured kilowatts and kilowatthours shall be increased by 1%.

LATE PAYMENT CHARGE: See Schedule Designation B-2.10.

EMERGENCY LOAD MANAGEMENT DISCOUNT: 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 menas of emergency load management.

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

(Continued on next sheet)

LARGE PRIMARY SUPPLY RATE—Continued

MONTHLY ON-PEAK BILLING DEMAND: The monthly on-peak billing demand shall be the highest hourly integrated reading 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 10,000 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 subtransmission system of the Company shall not exceed permissible limits.

The customer must own and maintain all facilities specified by the Company to receive power delivered at the Company's option from its system nominally at 24,000, 41,570 or 120,000 volts.

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.

GENERAL SERVICE RATE

AVAILABILITY OF SERVICE: Available to customers desiring service for any purpose, except that this rate is not available for service in conjunction with the Large General Service Rate, nor to installations having a demand of over 1000 kilowatts, including applicable riders, not taking service on this rate prior to August 19, 1972.

The 1000 kilowatt limitation may be waived for the following cases:

1. For temporary installations where the customer pays the "in and out" charges.
2. For Primary Supply installations during construction while the building is under jurisdiction of the contractor.

Standby service not available under this rate.

HOURS OF SERVICE: 24 hours.

CURRENT, PHASE AND VOLTAGE: Alternating current, single-phase, nominally at 120/240 volts, three-wire; or three phase four-wire, Y connected at 208Y/120 volts; or under certain conditions three phase four-wire, Y connected at 408Y/277 volts.

In certain city districts, alternating current is supplied from a Y connected secondary network from which 120/208 volt, three-wire or 208Y/120 volt, three phase four-wire service may be taken.

RATE PER MONTH:

Service Charge:
$5.45 per customer per month, plus

Energy Charge:
5.05¢ per kWh for all 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.

MINIMUM CHARGE: $5.45 per month

LAMP SUPPLY: See Schedule Designation B-5.5.

CONTRACT TERM: Open order, terminable on three days written notice by either party. Where special services are required, or where the investment to serve is out of proportion to the revenue derived therefrom, the term will be as specified in the applicable contract rider.

WATER HEATING SERVICE: Water heating service is available on an optional basis. See Schedule Designation No. D5.

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 become 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 rachet 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)

— OUR 116th ANNIVERSARY YEAR —

THE JAMES LEFFEL & CO.

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AREA CODE 513

ESTABLISHED 1862

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.

<u>SITE #1</u>

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.

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'

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

BOFORS
NOHAB

YOUR REF.

OUR REF.

TROLLHÄTTAN

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

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

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. <u>Peninsula Paper Company</u>

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 m^3/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

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 m^3/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

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,

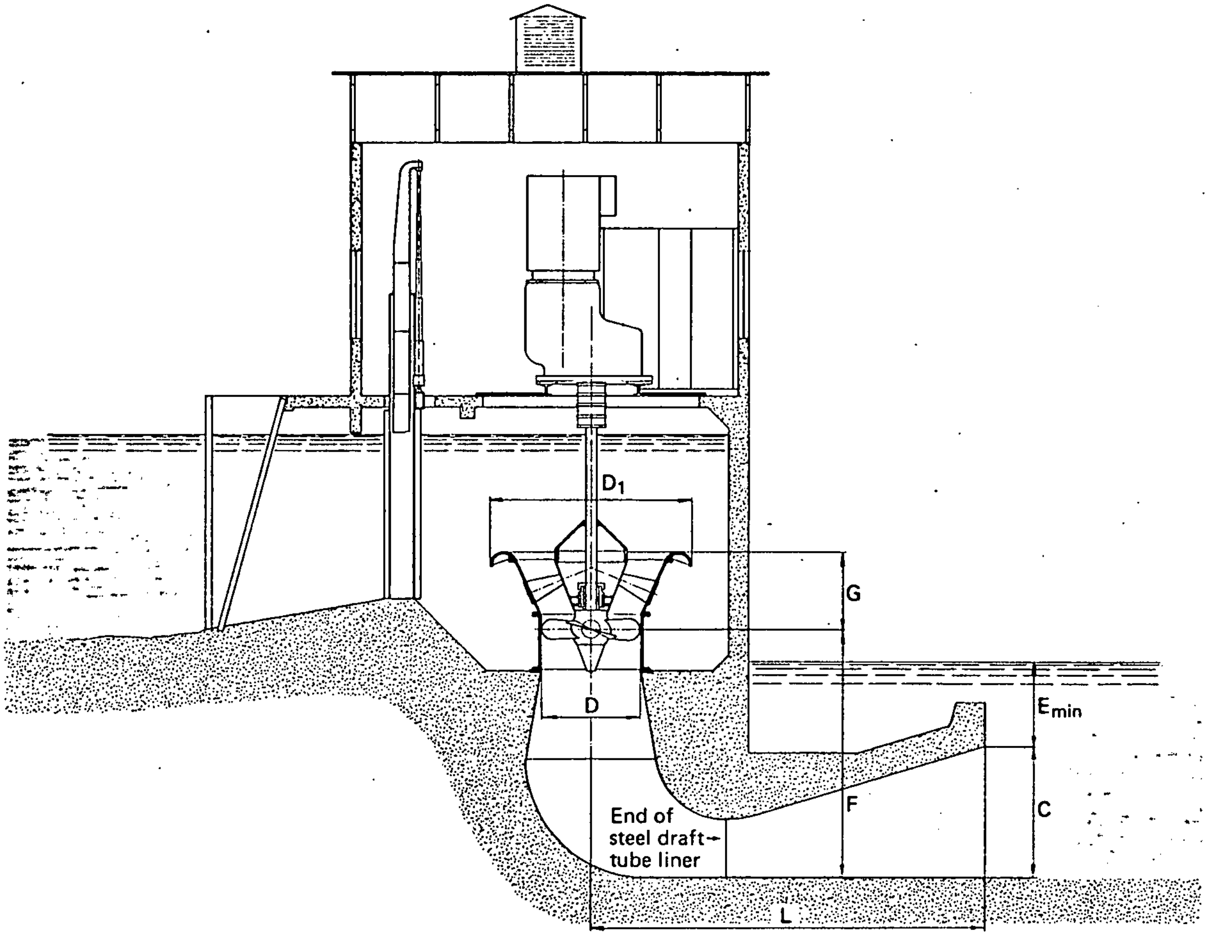
BOFORS-NOHAB INC.

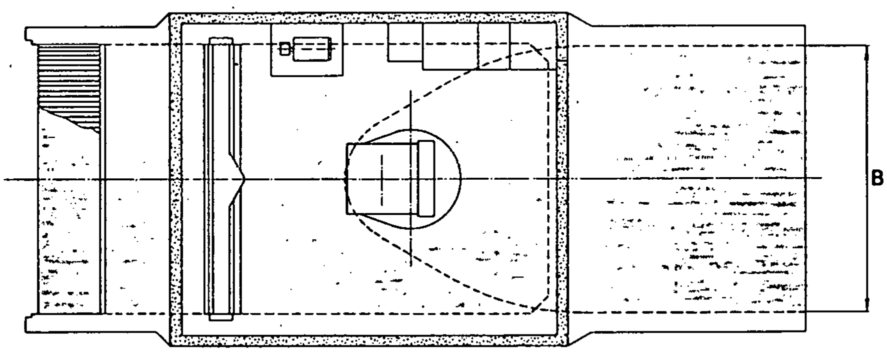
Arthur Meland
President

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.

NORTHERN WATER POWER

Water Power Equipment/Project Management
Operation and Maintenance/Field Installation/Governor Service
P.O. BOX 49 • HARRISVILLE, NEW HAMPSHIRE 03450 • (603) 827-3367

November 6, 1978

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

Attention: Mr. Don Lystra, P.E.

Gentlemen,

We are happy to provide budget pricing for the supply of components compatible for use on the #1 and #2 units of the French Landing Hydro Plant on the Huron River, Michigan.

We are declining to put together pricing for new equipment for the Ypsilanti site as we are not in a position to justify the economics of preparation of such a proposal for your firm. We would be happy to negotiate with your firm for work on such a proposal. We point out that the site deserves close attention and that at some future date we would be happy to make a field inspection trip to the Van Buren site for the gathering of relevant information for such a proposal.

The pricing for the French Landing site does not include overhaul of the existing waterwheel governor. We are able to provide replacement actuators for such units or we can overhaul the Allis Chalmers governor.

At the moment we can not offer a used generator that would be suited for use at the French Landing site. We therefore are submitting prices for parts of the #1 and #2 units:

- Thrust Bearing
- Shafting
- Water Lubricated Bearing
- Sorensen Gate Control Console
- Replacement Francis Runner

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We would suggest that your proposal for the Van Buren site include a consideration of gate position actuator with overspeed, water level and speed or load position controls. The gate position actuator is not a governor, however, it can be used to regulate load on the machine, subject to predetermined external parameters, as long as the generator is to be run in parallel with the utility's network.

We are enclosing Sorensen's literature on their control consoles. We have installed Sorensen's equipment for them in the past and we have had no complaints from our customers about their operation. We offer, in addition to installation service, repair services for the various waterwheel governor businesses owned by Sorensen Governor Service. We shall be pleased to assist you with any governor or governing problems.

We will be pleased to discuss any part of this proposal with you or your firm in the future.

Yours very truly,

NORTHERN WATER POWER, INC.

Everett Hosking

Everett Hosking
Vice President

EH/cac
Enclosure

SECTION I - PRICE AND DELIVERY

Northern Water Power, Inc. proposes to supply the following equipment for installation at the French Landing Hydro Plant in Van Buren, Michigan. All prices are F.O.B. Van Buren, Michigan, exclusive of any local and all State and Federal taxes or tariffs. All budget prices are in October 1978 United States dollars. Prices are based on results of discussions with our subcontractors using preliminary dimensional information supplied to Northern Water Power, Inc. Items 5 and 6 below are believed to be valid for the early part of 1979. Pricing for Items 1 through 4 are budget prices with estimated limits of plus-or-minus 15%.

Item #1	a.	1-62" nominal throat diameter Francis runner rated 780 KW at 164 r.p.m. and operating with a net hydraulic head of 32 feet. For use in #2 unit. Delivery 34-38 wks, A.R.O.	$ 96,890.00
	b.	1-92" nominal throat diameter Francis runner rated 1600 KW at 120 r.p.m. and operating with a net hydraulic head of 32 feet. For use in #1 unit. Delivery 34-38 wks, A.R.O.	$198,700.00
Item #2	a.	Set of 4 UHMW 1900 guide bearing blocks for use in #2 unit. Delivery 6-9 wks, A.R.O. Extra blocks	$ 2,970.00 lot $ 700.00 ea.
	b.	Set of UHMW 1900 guide bearing blocks for use in #1 unit. Delivery 6-9 wks, A.R.O. Extra blocks	$ 3,370.00 lot $ 800.00 ea.
Item #3	a.	Replacement drive shaft for #2 unit, 2 pieces with integral coupling flanges 200 mm nominal diameter. Delivery 24-28 wks, A.R.O.	$ 27,570.00 lot
	b.	Replacement drive shaft for #1 unit, 2 pieces with integral coupling flanges 250 mm nominal diameter. Delivery 24-28 wks, A.R.O.	$ 41,125.00 lot
Item #4	a.	Thrust bearing housing and assembly for #2 unit, compatible for use with Item #3a. Complete. Delivery 12-15 wks, A.R.O.	$ 26,690.00
	b.	Thrust bearing housing and assembly for #1 unit, compatible for use with Item #3b. Complete. Delivery 12-15 wks, A.R.O.	$ 49, 270.00
Item #5	a.	Supply 1 Sorensen Electro-Hydraulic Control Console model 2AM for use on #2 unit. Delivery 6 months, A.R.O.	$ 8,750.00
	b.	Supply 1 Sorensen Electro-Hydraulic Control Console model 2AM for use on #1 unit. Delivery 6 months, A.R.O.	$ 8,750.00

SECTION I - PRICE AND DELIVERY (Cont.)

Item #5	c.	Supply Northern Water Power, Inc. water level controller for use on Sorensen control consoles. Delivery 16 wks, A.R.O.	$ 4,265.00 ea.
		or lot of 2	$ 8,250.00
Item #6	a.	Provide field inspection for purpose of gathering relevant field data for preliminary sizing and design of new turbines for the Ypsilanti, Michigan site. Report will summarize all necessary information for outline dimensions and design parameters and supply budget pricing guide lines for replacement equipment.	$ 2,290.00

NEYRPIC SOCIETE ANONYME AU CAPITAL DE 40.100.000 F - R. C. GRENOBLE B 309 021 749

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,

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 correspondance to the attention of :

Mr CHADENSON

Departement Microcentrales

Grenoble, 4th December 1978

FRENCH LANDING

VAN BUREN TOWNSHIP, MICHIGAN

Renovation project for hydroelectric plant

SPECIFICATION AND ESTIMATE FOR TURBINES :

Two versions are proposed. In each, the site characteristics are taken as follows :

Average head : 9,75 m

Maximum turbine discharge : 17 m^3/s.

VERSION 1 :

2 identical horizontal-axis RAD bulb turbines

Bulb type : 710

Runner diameter : 1250 mm

Runner type : 4 bladed variable pitch propeller type.

Unit discharge variation : 8,5 m^3/s to 4,0 m^3/s

Maximum unit power : 640 kW with 8,5 m^3/s on output shaft

Generator speed : 900 rpm for 60 cycles

Turbine altitude (see drawing 451 505) :

- top of runner (point A) no higher than that which would cause more than 15° slope of turbine centreline.
- top of draft tube (point B) no higher than 500 mm below lowest tail water.

Tail gate dimensions : 2200 x 2200 mm

Annual production : about 5 400 000 kWh at generator terminals, according to your flow duration figures, and assuming generator efficiency of 95 %.

...

VERSION 2 :

3 different horizontal-axis RAD bulb turbines

Turbine n°	1	2	3
Bulb type	440	560	710
Runner diameter	800	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)	315	442	605
Generator speed (rpm)	900	900	900
Turbine altitude	same conditions as Version 1		
Tail gate dimensions (mm)	1440 x 1440	1800 x 1800	2200 x 2200

Total annual production : About 5 260 000 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, tailgates, intake and draft tubes, drainage equipment, handrails and ladders.
- Civil works and their drawings.

PRICES

VERSION 1 :

Price of one RAD bulb turbine, type 710, runner diameter 1250 mm, variable pitch runner, 640 kW under 9,75 m head at 8,5 m^3/s.:

1 187 000 FF

Total for two of the above machines : 2 374 000 FF

VERSION 2 :

- Price of one RAD bulb turbine, type 440, runner diameter 800 mm, fixed pitch runner, 315 kW under 9,75 m head at 4,0 m^3/s :

  625 000 FF

- Price of one RAD bulb turbine, type 560, runner diameter 1000 mm, fixed-runner, 442 kW under 9,75 m head at 5,5 m^3/s :

  732 000 FF

- Price of one RAD bulb turbine, type 710, runner diameter 1250 mm, fixed-pitch runner, 605 kW under 9,75 m head at 7,5 m^3/s :

  892 000 FF

TOTAL for the three above machines : 2 249 000 FF

...

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 451 549 gives a possible installation. A 1250 mm dia. machine is shown. Of course, you could situate the turbines anywhere else in the power house as long as the conditions relating to the distance below low tail water are respected.

GROUPE HYDRAULIQUE
Le Directeur Commercial,

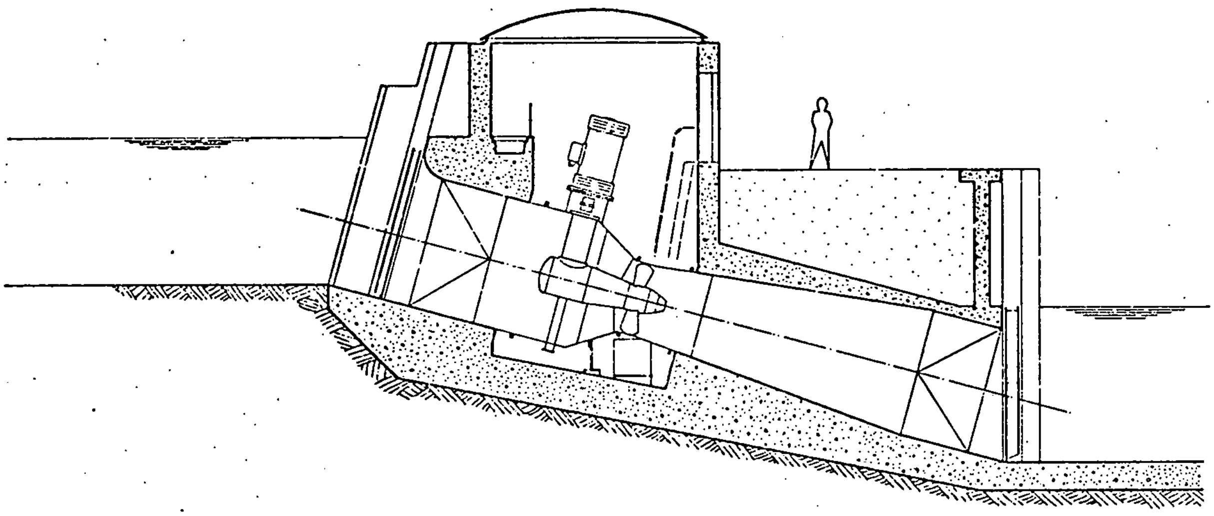
L. MEGNINT

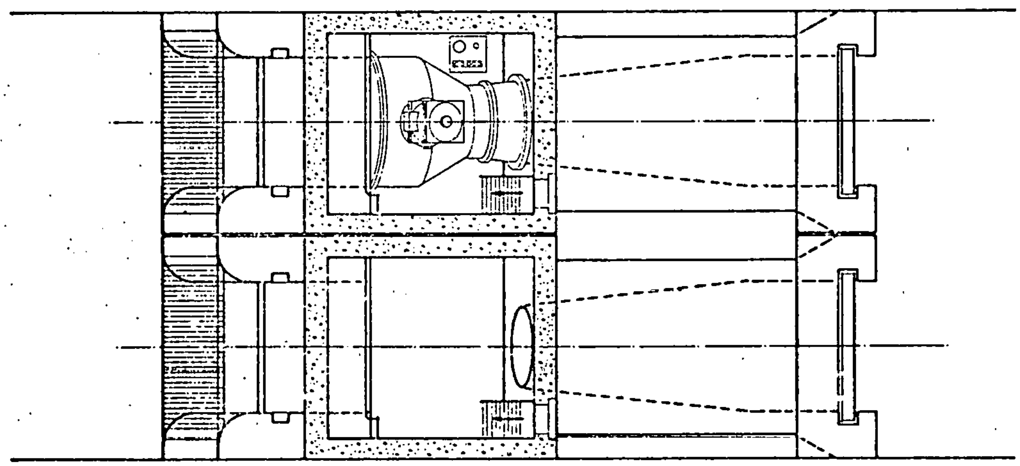
NEYRPIC

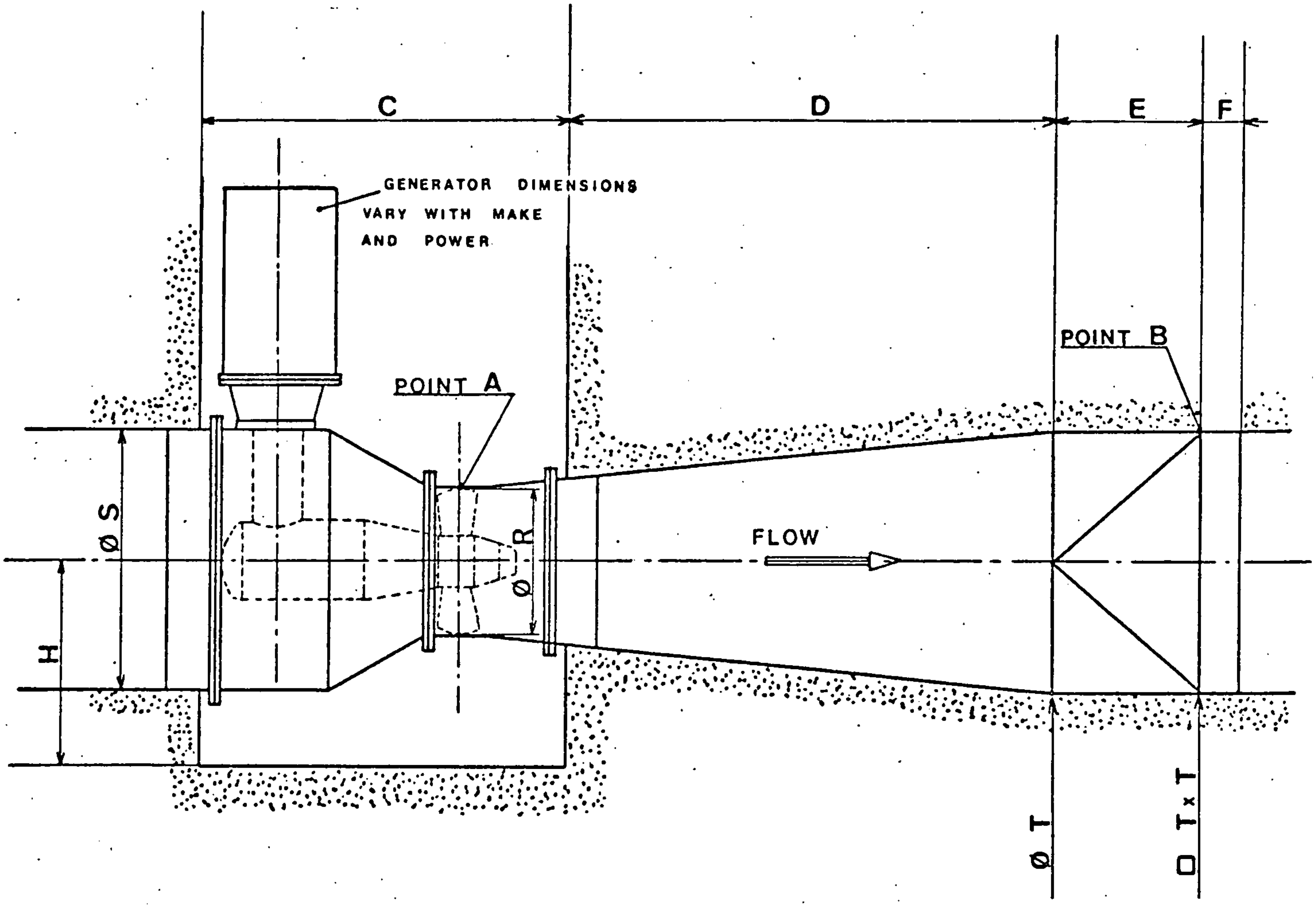
GRENOBLE FRANCE

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.

SULZER BROS. INC.

SULZER

Mailing Address:

19 Rector Street
New York, N.Y. 10006

Telephone
Area Code 212
Hanover 5-4560

Cable Address: Sulfre
Telex: 232126

RECEIVED SEP 25 1978

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

Attn: Mr. Donald W. Lystra

Please quote our reference in correspondence and telephone calls

Your Reference	Your letter of	Our reference	Date
		Mo/ur	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.

./.

Subsidiary of Sulzer Brothers Limited, Winterthur, Switzerland

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

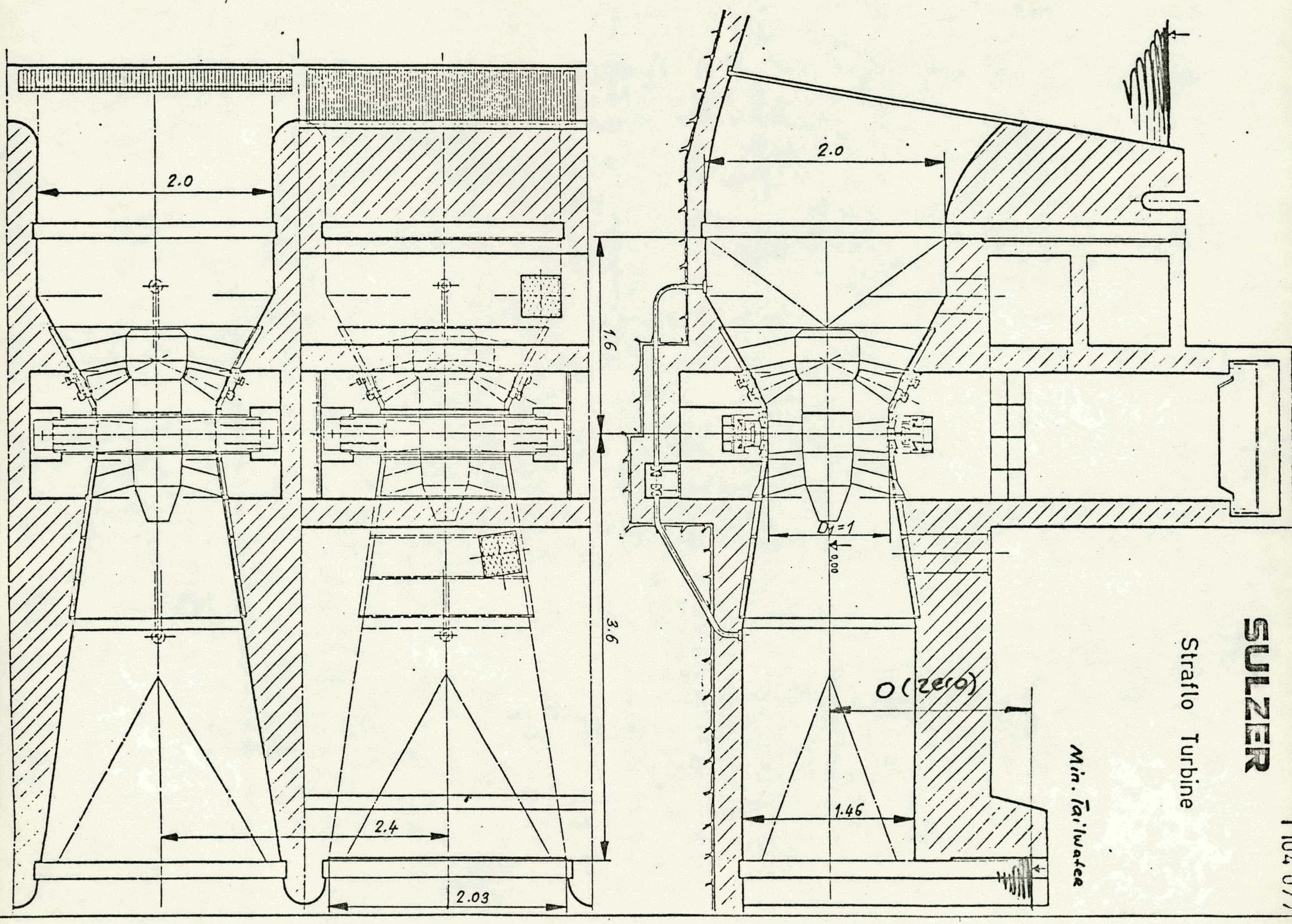
B. E. Moser

B. E. Moser
Vice President

Encl.

as mentioned

CC: Mr. van der Schaar
Mr. Sennhauser


2.0
2.0
1.6
3.6
$D_1=1$
▽0.00
O (zero)
1.46
2.4
2.03
SULZER
Straflo Turbine
Min. Tailwater

ALLIS-CHALMERS
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.

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 futher 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

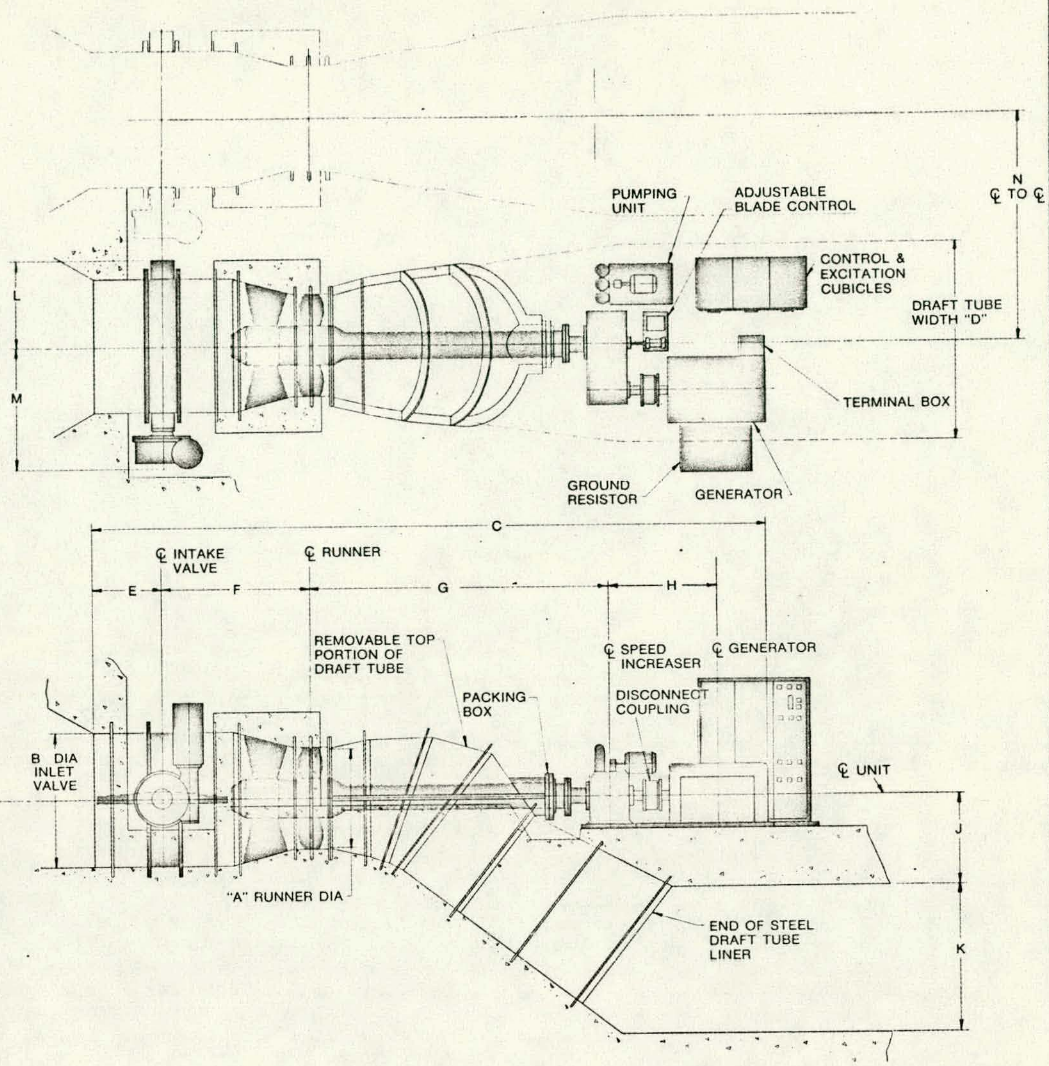


Figure 3

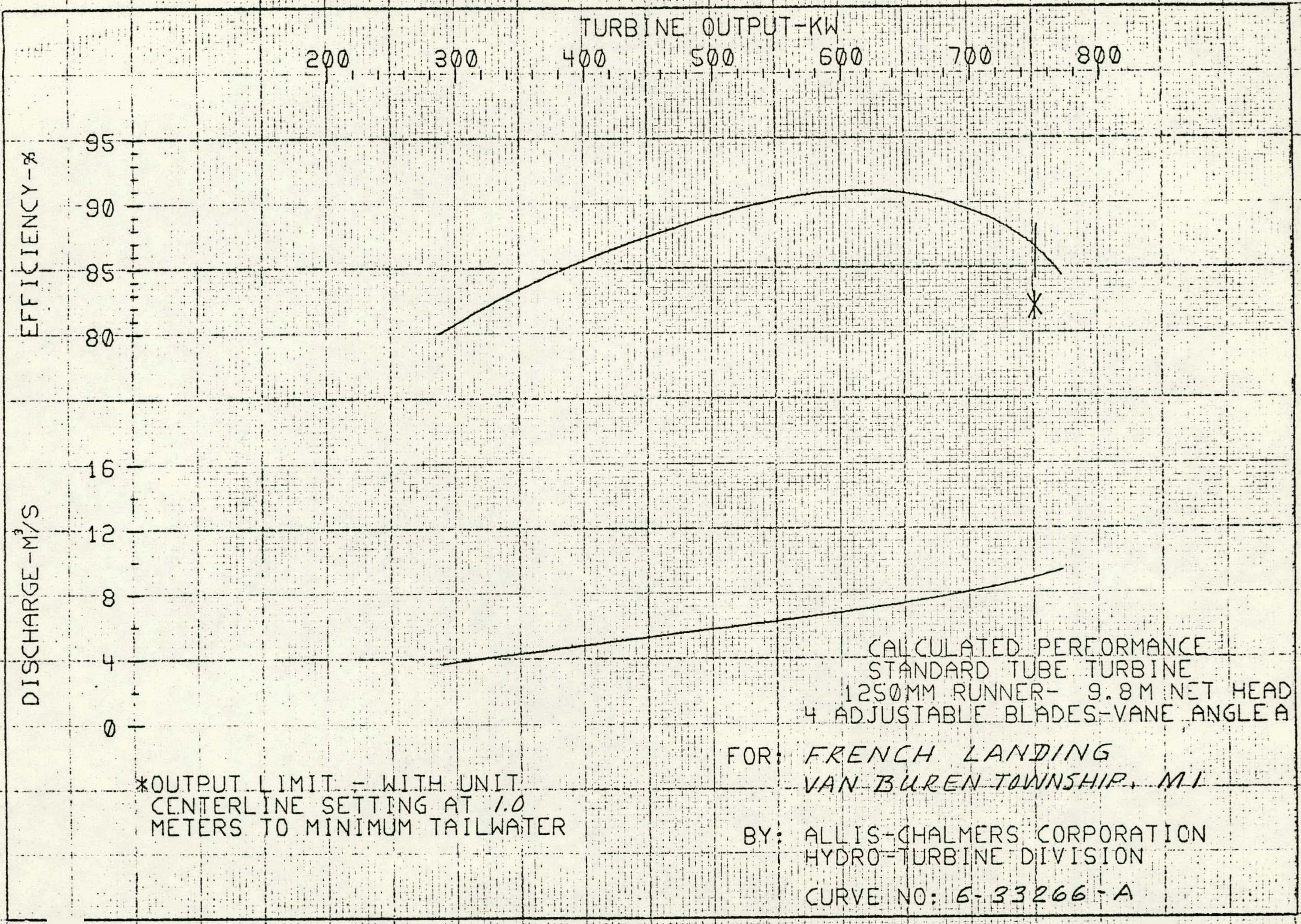
BASIC DIMENSIONS

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.


TURBINE OUTPUT-KW
200
300
400
500
600
700
800
EFFICIENCY-%
95
90
85
80
DISCHARGE-M³/S
16
12
8
4
0
CALCULATED PERFORMANCE
STANDARD TUBE TURBINE
1250MM RUNNER- 9.8M NET HEAD
4 ADJUSTABLE BLADES-VANE ANGLE A
FOR: FRENCH LANDING
VAN BUREN TOWNSHIP, MI
*OUTPUT LIMIT - WITH UNIT
CENTERLINE SETTING AT 1.0
METERS TO MINIMUM TAILWATER
BY: ALLIS-CHALMERS CORPORATION
HYDRO-TURBINE DIVISION
CURVE NO: 6-33266-A

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 0 2 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

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

RECEIVED JAN 2 3 1979

Negotiation No. GGSH 791215 DG A

Date January 19, 1979

Your Inquiry Budget Prices

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 fo 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 John Haney

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

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

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.

By________________

cc: Detroit Office

jc

THE FALK CORPORATION
MILWAUKEE, WISCONSIN

SPECIAL UNIT QUOTATION

DATE: 1-23-79
SHEET 2 OF 4

TO: ______ AT ______

FROM: ______ AT ______

SUBJECT: Ayres, Lewis, Norris & May FALK INQ. NO.: 78G852-684

NO.: ______

FOR Generator DRIVE, 670 HP, 300-1200 RPM, 3.95:1 RATIO, 1.25 SF, ______

QUOTE 1- 20×4.8 ZXVIS

PRICE 30,100.00 NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES	NO		YES	NO	
☐	☒	BEDPLATE	☐	☒	FANS ( )
☒	☐	LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)	☒	☐	~~MOTOR~~ BRACKET Gen.
☐	☒	SOLEPLATE (UNDER UNIT ONLY)	☐	☒	BACKSTOP
☐	☒	MOUNTING OF CUSTOMER'S MOTOR	☐	☒	H.S. CPLG. GUARD
☐	☒	MOUNT ½ OF CUSTOMER'S H.S. CPLG.	☐	☒	L.S. CPLG. GUARD
☐	☒	MOUNT ½ 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 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 ~~[illegible]~~, WILL NOT BE REQUIRED. ~~RATE OF PAYMENT PER SALES PRIORITY LETTER #322.~~

DELIVERY 34 wks.

COMMENTS max rated speed 2500 rpm

THE FALK CORPORATION
MILWAUKEE, WISCONSIN

SPECIAL UNIT QUOTATION

DATE: 1-23-79
SHEET 3 OF 4

TO: ______ AT ______

FROM: ______ AT ______

SUBJECT: Ayres Lewis Norris & May FALK INQ. NO.: 78G852 - 684

REF. NO.: ______

FOR Generator DRIVE, 804 HP, 300-1200 RPM, 4:1 RATIO, 1.25 SF,

QUOTE 1- 22.5×4 ZXVIS

PRICE 31,500.00 NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES	NO		YES	NO	
☐	☒	BEDPLATE	☐	☒	FANS ( )
☒	☐	LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)	☒	☐	~~MOTOR~~ BRACKET Gen.
☐	☒	SOLEPLATE (UNDER UNIT ONLY)	☐	☒	BACKSTOP
☐	☒	MOUNTING OF CUSTOMER'S MOTOR	☐	☒	H.S. CPLG. GUARD
☐	☒	MOUNT ½ OF CUSTOMER'S H.S. CPLG.	☐	☒	L.S. CPLG. GUARD
☐	☒	MOUNT ½ 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 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

IE [illegible]K CORPORATION
I[illegible] [illegible]EE, WISCONSIN

SPECIAL UNIT QUOTATION

JAN 2 5 1979

DATE: 1-23-79
SHEET 1 OF 4

J. SCHNEIDER AT DETROIT

ROM: R. HESER AT MILW.

UBJECT: WIRES, LEWIS, NORRIS + MAY / FALK INQ. NO.: 78G852-684

.. NO.:

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

UOTE 1- 20×3.5 ZXVIS

RICE 28100.00 NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES	NO		YES	NO	
☐	☒	BEDPLATE	☐	☒	FANS ( )
☒	☐	LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)	☒	☐	~~MOTOR~~ BRACKET GEN.
☐	☒	SOLEPLATE (UNDER UNIT ONLY)	☐	☒	BACKSTOP
☐	☒	MOUNTING OF CUSTOMER'S MOTOR	☐	☒	H.S. CPLG. GUARD
☐	☒	MOUNT ½ OF CUSTOMER'S H.S. CPLG.	☐	☒	L.S. CPLG. GUARD
☐	☒	MOUNT ½ 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 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.

C[illegible]NTS 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

REF. NO.: ______

FOR Generator DRIVE, 1072 HP, 300-1200 RPM, ______ RATIO, 1.25 SF, ______

QUOTE 1- 22.5 x 5ZXVIS

PRICE 34,100.00 NET/UNIT.

PRICE INCLUDES THE FOLLOWING ACCESSORIES:

YES	NO		YES	NO	
☐	☒	BEDPLATE	☐	☒	FANS ( )
☒	☐	LUBE SYSTEM (1 PUMP & 1 COOLER ONLY)	☒	☐	~~MOTOR~~ BRACKET Gen.
☐	☒	SOLEPLATE (UNDER UNIT ONLY)	☐	☒	BACKSTOP
☐	☒	MOUNTING OF CUSTOMER'S MOTOR	☐	☒	H.S. CPLG. GUARD
☐	☒	MOUNT ½ OF CUSTOMER'S H.S. CPLG.	☐	☒	L.S. CPLG. GUARD
☐	☒	MOUNT ½ 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 Thrust Brg.

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DELIVERY 34 wks.

COMMENTS max rated speed 2500 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

Ronald A. Corso
Deputy Director, Division of
Licensed Projects

Enclosure:
Excerpts from Regulation