



HYDROPOWER

**INFORMATION PAPER NO. 1
OF THE
ILLINOIS STATE WATER PLAN TASK FORCE**

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PREFACE

The State Water Plan Task Force, through the conduct of advisory group meetings and statewide hearings, has received various questions regarding activities and interests within Illinois concerning hydropower. In response to these questions, the Division of Water Resources has prepared for the information of the State Water Plan Task Force, its Advisory Groups and general public an information paper on the subject of hydropower in the State of Illinois.

For further information on this subject or additional copies of this paper contact Bruce Barker, Illinois Division of Water Resources, Springfield, Illinois.

INFORMATION PAPER ON HYDROPOWER

EARLY DEVELOPMENT

Water power for milling and manufacturing had been developed at numerous Illinois dams in the last century. The advent and rapid expansion of electric power systems at the turn of the century shifted interest to developing or redeveloping projects for hydroelectric power generation.

The fuel efficiency of steam-electric powerplants improved dramatically with the development of steam turbines and improved steam generators and furnaces. Low head hydroelectric plants could not compete by the 1920's. But many hydropower plants built before that time continue to operate, because equipment is long-lived and operating costs are low.

Old powerplants still operating are: Lockport on the Sanitary and Ship Canal; Marseilles on Illinois River; Arsenal, Moline, and Keokuk on Mississippi River; Rockton and Dixon on Rock River; and Dayton on Fox River. Powerplants have been abandoned at: Fordham, Oregon, Upper Sterling, and Sears on Rock River; Aroma Park, Kankakee, and Wilmington on Kankakee River; and the Joliet Upper Dam on Des Plaines River. Projects were started but never completed on Illinois, Kankakee, and Fox Rivers. Many more had been planned.

ILLINOIS WATERWAY

The Illinois Waterway bond issue passed in 1908 in the belief that hydropower revenues would retire the bonds. That same year the Sanitary District began constructing the main channel extension and powerhouse at Lockport.

State construction of the waterway began in 1921. The project was taken over by the Federal government in 1930 and opened in 1933. The State Division of Waterways began powerhouse designs and applied for licenses under the Federal Power Act. It was too late. The sites were no longer competitive with central station, steam-electric powerplants. The powerhouse headgate structures built at Brandon Road, Dresden Island, and Starved Rock Dams remain unused.

The competitive position of low head hydropower continued to worsen through the 1960's. While fuel efficiencies could not improve much, there were tremendous scale economies in 500-1,000 Mw thermal units. Bus bar power costs had dropped to 5 mills per kilowatt-hour.

RENEWED INTEREST

The cost of coal, oil, natural gas, and nuclear fuel began to rise rapidly in the 1970's relative to plant construction costs. This trend is expected to continue until new energy sources are developed. Should the fuel component of electricity costs rise enough, it would offset the high capital cost disadvantage of low head hydropower. The current break-even energy costs of Illinois Waterway sites is about 25-30 mills per kilowatt-hour.

This trend possibility led the Department of Energy and the Corps of Engineers to start a nationwide re-assessment of hydropower in 1976. The National Hydropower Study is nearly complete. This study projects that numerous low head hydropower projects may become feasible at existing dams.

Meanwhile Congress enhanced the financial feasibility of hydropower investments with tax breaks and passage of the Public Utilities Regulatory Act (PURPA). The latter requires generating utilities to purchase power from small hydro producers at the utility's avoided cost of energy. Avoided costs are under review by the Illinois Commerce Commission and range from 20 to 55 mills per kilowatt-hour. The higher results from oil and gas fired peaking units. The lower results from excess nuclear capacity.

The highest avoided cost can be expected to drop sharply as nuclear units replace high cost oil, gas, and coal fired units. Thus feasibility of low head hydropower is still marginal.

A continuation of current price trends could shift hydropower marginality to very high profitability. The potential has raised keen interest and almost frantic competition to secure existing dam sites.

NON-FEDERAL DEVELOPMENT

Non-Federal development of hydropower at Federal dams and on navigable waters has been exclusively controlled by the Federal Power Act since 1920. The Federal Energy Regulatory Commission (FERC) may issue a 50-year license. The licensee pays an annual administration fee and a share of excess profits for the privilege.

FERC may withhold licensing and recommend Federal development to Congress instead. It may recommend Federal takeover of a project when the original license expires. These provisions have rarely, if ever, been exercised.

The result is that the Federal Power Act actually preempts Federal development and favors non-Federal development. The Act also favors municipal development over private development.

A potential license applicant may file for a preliminary permit. The permit provides up to three years to make feasibility studies. During this period the permittee holds priority for licensing. A permit application is simple and costs nothing. Not surprisingly, there has been a flurry of filings on Federal navigation dams.

In virtually every case, FERC granted the permit to a municipality, because of the municipal preference clause. This is shown on the attached "Hydropower Status".

For many years the Dayton powerplant on Fox River was the only licensed project in Illinois. The other powerplants pre-dated the Federal Power Act. Recently, the City of Carlyle was licensed for the Carlyle Dam project. More recently FERC issued a retroactive license for the Lockport project. But the license conditions have been appealed by MSD.

The remaining permittees are still engaged in feasibility studies. Many may never apply for a license. In those cases the permit can be issued to another interested party.

FERC has tightened rules to better deal with competing parties. Hybrid applications where a municipality files for a private partner are prohibited. Municipalities can no longer file until they come into compliance state municipal utility statutes. Permit durations have been reduced from three to two years.

These changes reduce the municipal preference and discourage more speculative or less serious applicants.

FEDERAL DEVELOPMENT

In the same recent timeframe, the Corps of Engineers became very interested in determining the feasibility of hydropower development at their navigation dams and reservoirs as Federal projects.

The Corps cannot build powerplants unless specifically authorized by Congress. They cannot even study feasibility without a study authority.

In 1976 Congress authorized the Corps to undertake hydropower feasibility studies at existing Corps dams. But the authority lapsed. A decision was made by the Chief of Engineers to utilize existing study authorities to do additional work. Hydropower, in fact, was given a high priority in Corps endeavors.

The Corps now has reconnaissance or feasibility studies underway at numerous dams. Draft feasibility reports for Dresden Island and Brandon Road Dams were recently completed. Illinois Waterway studies are being conducted under the Section 216, general, project modification authority. Mississippi River studies are using the Coon Rapids Dam to Ohio River general investigation authority.

The value of this study effort has since been questioned in Illinois. Federal power has never been marketed in Illinois and no marketing agency exists. There could be little prospect the Administration will recommend and Congress will authorize Federal investment. Rather, the Administration prefers non-Federal development. Moreover, new cost sharing policies require the state to finance 10% to 100% of the project -- Illinois has refused to do this.

Completed Corps hydropower studies can be used as a basis for evaluating non-Federal proposals to assure project purposes will not be adversely affected.

HYDROPOWER AS A WATER USE

Low head hydropower is the most expensive to develop. This is because a huge flow of water is required per unit of output and the hydraulic turbine is proportionately very large. The same facts makes the value of water in this use incredibly low, if the water is pre-empted from another use.

For example, at Dresden Island Dam a turbine flow of 11,400 cfs is required to produce 11,700 kw of generator output. This is 437 gallons per kilowatt-hour. If power could be sold at 30 mills per kilowatt-hour, the gross value of water would be 7¢ per 1,000 gallons. Net value would be less and could be zero for a marginal investment.

This low value leads to the conclusion that hydropower development is acceptable only if it is run-of-the-river and utilizes only surplus flows. The net value of water for hydropower cannot compensate for any pondage damages or displacement of water supply withdrawals.

Rivers, especially the Illinois River, carry deoxygenating wastes. The flow usually has some oxygen deficit when it arrives at the dam. Normal discharge turbulence at the dam results in reaeration and recovery of part of the deficit. On the other hand, turbine flow has almost no deficit recovery. So artificial reaeration equipment may be needed. As before, a low value of hydropower water use cannot compensate a significant impairment of water quality.

STATE LEASING AND LICENSING

Illinois Waterway and a few other powerplant sites are owned by the State of Illinois. Mississippi River sites are not. It is appropriate for the managing state agency, DWR or DOC, to lease the state-owned sites. All powerplants, regardless of state ownership, will need DWR construction permits.

Leases and permits are not required until FERC licensing is assured. Approximately two years is available to complete all preparations for these actions.

The major problem in leasing, of course, is arriving at a mutually satisfactory rent schedule. The objective is simple enough: the state should receive a substantial portion of the economic rent.

Since low head hydro projects are marginal and future net revenues are speculative, it is not certain whether there will be any net revenues or when they may accrue or how much they might be. So there may be little or no economic rent to share with the state.

On the other hand, if speculations materialize, there will be large excess profits. The leasing agency would be highly criticized if it had conferred a windfall.

MUNICIPAL PROBLEMS

Eight permittees are Illinois municipalities. They must conform to the Illinois Municipal Code.

1. Each must establish a municipal electric utility by the Code procedure. Some have done this; some have not yet. A referendum is required.

2. Each must annex the powerplant site. None have done this yet. If the annexation includes state property, state approval is required.
3. Authority to condemn pole line right-of-way outside corporate limits must be obtained from the Illinois Commerce Commission.
4. Electric revenue bonds are limited to 20 years and must be approved by referendum.

Each approval is beyond the control of the municipal government. Two require voter approval; two require state approval.

Financing is another problem. The bond market is not good at this time even for the best utilities. The newly created utilities have no financial record or revenue base. Their bonds may not sell even in a good market. Bond buyers may, therefore, be wary of the speculative nature of hydropower investment.

It can be expected that many of these ventures will fail before, during, or after FERC licensing. Thus, state agencies should be cautious of premature commitments. Only annexation appears to be irretrievable, so it should be approved very cautiously.

Permits and leases can be written with termination clauses. An annexation agreement could also be prepared with a termination clause. So there are prudent means for dealing with these problems that, nevertheless, encourage site development.

SUMMARY

Where there is municipal-private and inter-municipal competition for the sites, the choices are made exclusively by FERC pursuant to the Federal Power Act. The state cannot even influence this decision.

However, FERC is reasonably receptive to reasonable state requests for license conditions. State intervention is the available means for assuring that projects are run-of-the-river and utilize only surplus flows. Other conditions, such as aeration, can be introduced where necessary.

The DWR permit is a means adding minor conditions of no interest to FERC. A state lease is the means for capturing a portion of excess profits, if any.

The preliminary permit duration gives ample time to conduct state reviews and work out conditions for permits, leases, annexation. Annexation approval should be granted only when it is certain the project will go.

FUTURE OF HYDROPOWER

Currently there is high interest in developing low head hydropower sites in Illinois. But there is no certainty any of these sites will actually be developed. Interest could pass over the scene briefly as it did in the early 1900's.

Engineers believe there are few, if any, potential improvements in the economy of hydropower which can make it more competitive. Instead, its competitive position is controlled solely by all other means of producing electricity. Some avoided costs are higher than hydropower. But, the generators responsible for this are also the obvious candidates for replacement.

Fortunately, whether or not hydropower is developed is of very minimal consequence to meeting Illinois energy needs.

HYDROPOWER STATUS

PROJECT	FERC	CORPS
<u>Mississippi River</u>		
Lock & Dam 12	Applications for prelim. permit by Bellevue, Iowa & Mitchell Energy Co.	Reconnaissance underway
Lock & Dam 13	Prelim. permit to Eastern Iowa Light & Power Coop.	Reconnaissance underway
Lock & Dam 14	Prelim. permit to LeClaire, Iowa.	Feasibility report underway
Lock & Dam 15	Prelim. Permit to Winnetka, Ill.	Reconnaissance underway
Lock & Dam 16	Prelim. Permit to Eastern Iowa Light & Power Coop.	Reconnaissance underway
Lock & Dam 17	Prelim. Permit to Eastern Iowa Light & Power Coop.	Reconnaissance underway
Lock & Dam 18	Prelim. Permit to Eastern Iowa Light & Power Coop.	Reconnaissance underway
Lock & Dam 19	Keokuk powerplant, Union Electric Co.	None
Lock & Dam 20	Prelim. Permit to Missouri Joint Municipal Electric Utility Comm.	Reconnaissance underway
Lock & Dam 21	Prelim. Permit to Missouri Joint Municipal Electric Utility Comm.	Reconnaissance underway
Lock & Dam 22	Prelim. Permit to Missouri Joint Municipal Electric Utility Comm.	Reconnaissance underway
Lock & Dam 24	Prelim. permit to Missouri Joint Municipal Electric Utility Comm.	Reconnaissance underway
Lock & Dam 25	Prelim. permit to Missouri Joint Municipal Electric Utility Comm.	Reconnaissance underway
Lock & Dam 26	Prelim. permit to Missouri Joint Municipal Electric Utility Comm.	Reconnaissance underway
<u>Big Muddy River</u>		
Rend Lake Dam	Preliminary permit to Marissa, Illinois	None

Illinois Waterway

Lockport L&D	License appln. by MSD for existing powerplant	None
Brandon Road L&D	Prelim. permit to Rockdale, Ill.	Feasibility report draft completed
Dresden Island L&D	Prelim. permit to Channahon, Ill.	Feasibility report draft completed
Marseilles L&D	Prelim. permit to Marseilles, Ill.	Feasibility study underway
Starved Rock L&D	Prelim. permit to Peru, Ill.	Feasibility study underway

Kaskaskia River

Shelbyville Dam	Prelim. permit to Shelbyville, Ill.	Feasibility study underway
Carlyle Dam	License to City of Carlyle, Ill.	Feasibility study underway
Kaskaskia L&D	Prelim. permit issued to Marissa	None

Ohio River

Smithland L&D	Prelim. permit issued to Vanceburg, Ky.	
Lock & Dam 52	Prelim. permit surrendered by Mitchell Energy Co. Project infeasible.	None
Lock & Dam 53	Prelim. permit surrendered by Noah Co. Project infeasible.	

Rock River

Rockton Dam	South Beloit Water, Gas & Electric Powerplant	None
Fordham Dam	Commonwealth Edison powerplant abandoned	None
Oregon Dam	Prelim. permit to M&M White	None
Dixon Dam	Commonwealth Edison powerplant	None
Upper Sterling Dam	Prelim. permit to Rock Falls, Ill.	None
Sears Dam	Prelim. permit to M&M White	None