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L30-88(07-26)-LP
1A.120

ILLINOIS POWER COMPANY

CLINTON POWER STATION, P.O. BOX 678, CLINTON, ILLINOIS 61727

July 26, 1988

Docket No. 50-461

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Clinton Power Station
Environmental Protection Plan

Dear Sir:

In accordance with Section 3.2 of the Environmental Protection Plan (EPP) for the Clinton Power Station, attached is a copy of a requested variance to the National Pollutant Discharge Elimination System (NPDES) permit. Please contact me if you have any questions on this submittal.

Sincerely yours,

F. A. Spangenberg, III
Manager - Licensing and Safety

DWW/krm

Attachment

cc: NRC Clinton Licensing Project Manager
NRC Resident Office
Regional Administrator, Region III, USNRC
Illinois Department of Nuclear Safety

C001
1/1

ILLINOIS POWER COMPANY

500 SOUTH 27TH STREET, DECATUR, ILLINOIS 62525-1805

July 25, 1988

HAND-DELIVERED

Illinois Environmental Protection Agency
Division of Water Pollution Control
2200 Churchill Road
Springfield, Illinois 62706

Attention: Mr. Mark T. Books
Environmental Protection Specialist
Compliance Assurance Section

Dear Mr. Books:

Clinton Power Station
Application for Provisional Variance

In accordance with the provisions of Sections 35 through 38 of Title IX of the Illinois Environmental Protection Act (the "Act"), and the requirements of Part 180 of Title 35, Subtitle A, Chapter II, Procedures and Criteria for Reviewing Applications for Provisional Variances of the Illinois Environmental Protection Agency (the "IEPA"), Illinois Power Company ("IPC") submits this application for a provisional variance to temporarily suspend, for a period of 45 days, the effluent temperature limitations currently applied at the end of the discharge flume for discharges to Clinton Lake at IPC's Clinton Power Station ("Station"). IPC requests a provisional variance, for a period of 45 days from the date of granting, from the effluent temperature limitations imposed by the Illinois Pollution Control Board ("Board") in its Order of May 28, 1981 under PCB 81-82 (the "Order"), which states that the daily average discharge temperature of discharges to Clinton Lake from the Station shall not

exceed 99°F during more than 12 percent of the hours (approximately 44 days) in twelve-month periods ending with any month and at no time exceed 108.3°F. The information required by the IEPA provisional variance application procedure in support of IPC's request is presented as follows:

1. Applicable Thermal Limitations

The effluent temperature limitations for discharges to Clinton Lake at the Station were imposed by the Board in the Order, as stated above. The Order was issued by the Board on May 28, 1981, and it provided that "the daily average discharge temperature [for effluent discharges to Clinton Lake from the Station] shall not exceed 99°F during more than twelve percent of the hours in twelve-month periods ending with any month and shall at no time exceed 108.3°F." Monitoring for determining compliance with these limitations is performed at the end of the discharge flume. With the instant application, IPC requests a provisional variance from these limitations at that point. As of July 21, 1988, IPC had experienced 25 days in which the discharge temperature at the station exceeded 99°F since July 22, 1987 with 19 more days allowed through July 31, 1988 under current limitations (a). The maximum daily average discharge temperature observed recently was 106°F on July 19, 1988.

(a) Actually 21 more days would be allowed as of July 31, 1988 as two days will be recovered from the period July 22 through July 31, 1987. Similarly three more days will be recovered in August (August 1, 2, and 3) before the Board's next meeting on August 4.

IPC recognizes that, as of the date hereof, there are 19 days remaining of the 44 days allowed. However, because of a current station operating situation (only two circulating water pumps are presently in service) IPC believes this count will be reduced to 11 by August 4. This is certainly not sufficient for operating the station through September, nor may it be sufficient to operate the station until the Board's next meeting on August 18 even if full cooling water flow is restored shortly after the August 4 Board meeting. Similarly, because only two circulating water pumps are currently in service, cooling water flows are reduced and the station is thermally constrained by the Board's thermal limitations. Power levels are currently limited to approximately 93 percent. However, even though discharge flume temperatures may currently approach the limitations of the Board Order, the quantity of heat energy (btu/hr) being discharged to the Clinton Lake is substantially reduced.

On June 3, IPC filed with the Board, pursuant to Section 37(a) of the Act and 35 Ill. Adm. Code Part 104, a Petition for Variance, (the "Petition") requesting relief, until October 1, 1990, from both of the limitations imposed by the Board on its Order. A copy of the Petition and Exhibits A through H thereto (collectively, the "Exhibits") were served upon the IEPA on that date. The Petition was docketed for hearing as PCB

88-97. The Petition and the Exhibits are hereby incorporated by reference as if fully set forth herein. The primary purpose of the variance requested in the Petition was to enable IPC to collect two years of actual operating data from the Station and lake temperature and meteorological data. This data will be evaluated with a refined, more sophisticated thermal model and, based on this evaluation, IPC will formulate long-term strategies with respect to thermal effluent discharges at the Station. See paragraph 16 of the Petition.

However, since IPC has continued the scheduled hearing of PCB 88-97(a), the Petition, if granted at all, will not be granted in time to enable IPC to avoid exceeding the 44-day limitation, a highly probable occurrence for the reasons noted previously, as well as the 108.3°F limitation which could certainly be exceeded under current operating conditions and would likely be exceeded under normal plant operations if prolonged dry and warm summer conditions persist. Thus, the instant provisional variance is needed to avoid the almost certain exceeding of the 44-day limitation before the onset of cooler fall weather and to allow the Clinton Power Station to be operated in a less constrained mode under current conditions and without constraint when full circulating cooling water flow can be restored.

(a) On July 20 IPC filed with the Board its Motion for Continuance of Hearing and its Waiver of Decision Date; and on July 22 IPC filed its Amended Waiver of Decision Date. With the Motion and the Amended Waiver IPC extended its hearing until December, 1988 and extended the decision date until February 2, 1989.

2. Station and System Descriptions

The major process components of the nuclear-fueled electrical generating station at Clinton include one boiling-water reactor, one steam-turbine generator, normal operating and emergency shut down heat dissipation systems and various electrical transmission facilities. The instant application is primarily concerned with the circulating cooling water system, which is a part of the normal operating heat dissipation system. The circulating cooling water system is designed to deliver water from Clinton Lake to the main condenser in sufficient quantities to condense the turbine exhaust steam, the turbine bypass steam, and other turbine cycle flows. (The individual components of the circulating cooling water system are discussed in somewhat greater detail in Exhibit H to the Petition.) The heat from the turbine cycle flows is then transferred to the circulating cooling water system flow, which is pumped to the discharge flume and thereby conveyed to Clinton Lake, together with the service water flow. (The service water also is drawn from Clinton Lake.) The lake then acts as a heat sink, dissipating the heat transferred from the condenser and down the discharge flume by the combined service water and circulating water flows. These combined flows constitute the thermal effluent discharge which is subject to the Board's Order.

3. Activity Description (Materials Used and Wastewaters Discharged)

The thermal effluent discharge which is subject to regulation by the Board is basically attributable to the normal operation of the Station. The Station is designed to generate 933 net megawatts of electricity. This corresponds to a heat rejection rate to the discharge flume of 6.71×10^9 btu/hr. This is the amount of heat which, after allowing for some heat dissipation in the discharge flume itself, is eventually transferred to Clinton Lake by the combined service water and circulating cooling water flows (collectively, these flows are hereinafter referred to as the "discharge flume flow"). The magnitude of flows is approximately 1470 cfs (950 MGD) at normal lake elevation (690.0 ft. m.s.l.).

IPC has been monitoring water intake temperatures at the Station screenhouse and flume discharge to (1) characterize the severity of the 1988 summer with respect to the 1955 summer (the summer historically used for modeling), and (2) anticipate when the thermal limitations of the Board will be approached. Monitoring data for the month of July are tabulated on Attachment 1.

During the first 17 days of the month, intake water temperatures ranged from a minimum of 75°F to a maximum of 84°F. Average daily flume discharge temperatures during this period ranged from 94°F to 103°F. Reactor power levels ranged from 18 percent (a) to 100 percent.

(a) A scram of the reactor occurred on July 12 for an unrelated reason.

On July 18, 1988 at approximately 12:45 a.m., a circulating water pump failed resulting in a reduction of approximately 446 cfs (288 MGD) of circulating cooling water flow. Since that time only two circulating water pumps have been in service. Station management personnel believe this pump will remain out of service until August 6.

The effect of the reduced circulating cooling water flow is obvious. Referring again to Attachment 1, power levels were reduced to (1) avoid exceeding the 108.3°F maximum daily average temperature limitation, and (2) maintain power cycle efficiency. Average daily flume discharge temperatures rose 106°F on July 19. Instantaneous flume discharge temperature reached 107°F. Intake temperatures varied only slightly, however, after July 17. During the period of two circulating water pump operation, average daily flume discharge temperatures have and will continue to exceed 99°F.

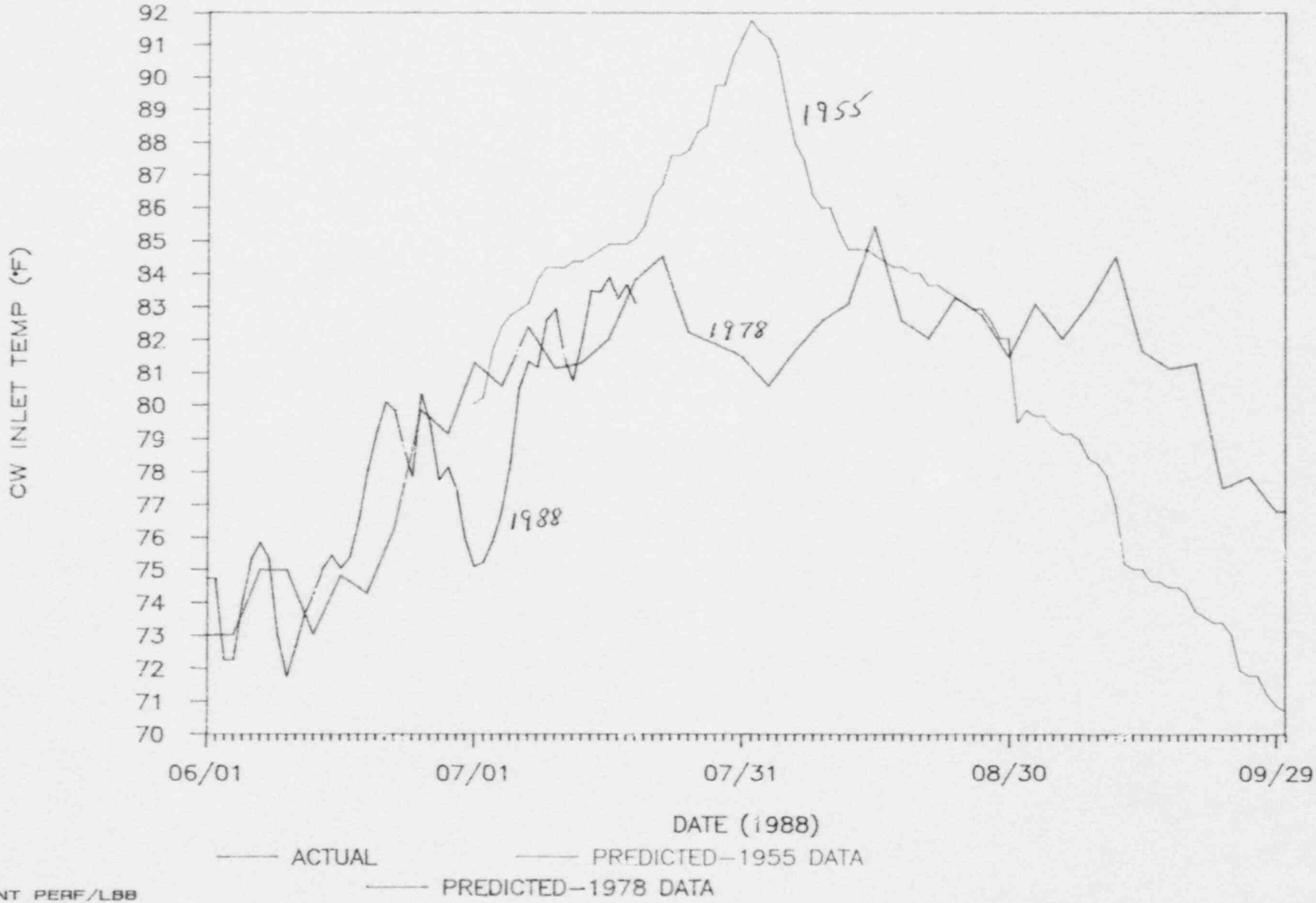
Actual and predicted daily average cooling water intake temperatures are plotted on Figure 1. The predicted values for 1955 (red line) and 1978 (blue line) are based on the modeling performed for the Petition. Temperatures observed in 1988 since June 1 are plotted as the black line.

For much of July actual intake temperatures have most closely approximated those simulated for 1978 meteorological conditions, the fourth warmest summer during the 26 period of record from 1953 to 1978. On two days, however, those being July 10 and July 16, intake temperatures closely approached the temperatures simulated for these days in 1955. This is significant with regard to the maximum daily average temperature limitation of 108.3°F.

Depending upon the cooling that may occur in the discharge flume, discharge flume temperatures should approach the 108.3°F limitation of the Board under normal three circulating water pump operation as intake water temperatures approach 84°F. The most recent modeling suggests this might occur by mid to late July, based on 1955 meteorological conditions, and extend throughout the third week in August. IPC is concerned that because the summer of 1988 may be as dry as 1955, actual intake water temperatures will approach the simulated temperatures thus resulting in discharge flume temperatures approaching 108.3°F even during normal three circulating water pump operation. During two circulating water pump operation, such as currently exists, discharge flume temperatures could quickly exceed 108.3°F due obviously to the reduced circulating water flow.

Clinton Power Station

ACTUAL AND PREDICTED CW INLET TEMPS



PLANT PERF/LBB

FIGURE 1

IPC contacted the Springfield, Illinois office of the National Weather Service (NWS) to obtain their 90-day outlook for the period of July 1 through September 30, 1988. The NWS has predicted that air temperatures for central Illinois have a 60 percent chance of being at least 1°F above normal during this period. The NWS has also predicted that precipitation for central Illinois has only a 50 percent chance of reaching normal levels during this period. These predictions suggest that the current severe meteorological conditions may only moderate at best through September.

4. Assessment of Adverse Environmental Impacts

IPC retained J. E. Edinger Associates, Inc. ("Edinger") to perform a hydrothermal modeling study to determine the impact which normal operation of the Station under the 1955 meteorological conditions specified in paragraph 3, above, would have upon water temperatures at Clinton Lake. The modeling study utilized the Laterally Averaged Reservoir Model ("LARM") to generate two-dimensional temperature profiles of Clinton Lake at a number of locations. The results of Edinger's newly-generated LARM study, together with a brief description of the modeling technique and the underlying assumptions, are included as Exhibit E to the Petition.

As is clear from the Exhibit, LARM predicts the maximum daily average discharge temperature under one-unit operation at 100 percent load and full circulating water flow during the worst case summer to be 111.7°F (44.3°C). This value is subject to an allowance of ±1.5°F to account for the use of

off-site (Springfield, Illinois) average daily meteorological data. This predicted maximum exceeds the present maximum limitation imposed by the Order, 108.3°F, by only 3.4°F. (The 108.3°F value also derives from the assumption of one-unit operation at 100 percent load.) In addition, LARM also predicts that the daily average discharge temperatures will exceed 99°F (37.2°C) during 18.9 percent of the hours in the twelve-month period encompassing the worst case summer (with an allowance of ±2.5 percent), as compared to the limitation imposed by the Order of 12 percent of the hours in twelve-month periods ending with any month. A direct comparison of the 18.9 percent value with the 12 percent limitation is deceptive, however, in that the 18.9 percent value corresponds to operation at 100 percent load over the course of the entire worse-case summer, whereas the 12 percent limitation derives from the assumption of a 92 percent load over that summer. See paragraph 10 of Petition. (Please note that while this brief summary of the LARM results focuses on the impact which operating the Station under the above-specified conditions will have on temperatures at the discharge, the newly-generated LARM results also estimate water temperatures at various points throughout the lake.)

Currently, IPC is operating the station at approximately 93 percent power at a circulating cooling water flow of approximately 660 MGD. This abnormal operating configuration was not investigated during the LARM 3 modeling effort (but would be as part of the modeling to be performed during the period of variance). Edinger estimates, however, that at a 90 percent level for 1955 meteorological conditions, discharge flume temperatures could reach 113.9°F. In segment 16 (the lake segment to which the flume discharges) water temperatures at the surface could reach 108.9°F.

With regard to the updated modeling study, IPC also retained Environmental Science and Engineering ("ESE") as its consultant to assess the biological impacts of the thermal effects expected under the newly-generated LARM results. The results of ESE's biological study are included as Exhibit F to the Petition. Sections 5 and 7 of Exhibit F contain the impact analysis of thermal addition to Clinton Lake fish using U.S.E.P.A. protocol and procedures. The U.S.E.P.A. protocol and procedures are, by their very nature, conservative. In spite of these conservatisms the analysis shows that bluegill, largemouth bass, gizzard shad, carp, and channel catfish are expected to produce and maintain good populations in Clinton Lake under worst-case meteorologic conditions like those of 1955, the worst-case summer. According to the U.S.E.P.A. protocol white crappie could be eliminated from the lake during the warmest summer. The protocol would also indicate white crappie may be eliminated from the lake with no Station heat load under 1955 conditions. However, projections based on the protocol may be overly pessimistic. Data from another Illinois cooling lake indicates crappie have survived temperatures higher than those predicted under 1955 conditions.

Recent creel studies indicate white crappie constitute approximately 94 percent of the Clinton Lake sport fish harvest. In the past six years anglers have harvested an average of 241,579 white crappie each year. The American Fisheries Society has determined that $2.00 is an appropriate reimbursement value for a nine-inch white crappie. Based on the average annual harvest IPC estimates the annual value of the white crappie in Clinton Lake to be approximately $483,157.

Ongoing monitoring and fish management programs by the Illinois Department of Conservation and IPC will assure maintenance of a diverse fishery. If a kill of white crappie occurs as a result of discharging cooling waters to Clinton Lake consistent with the conditioned provisional variance requested in this application, IPC will mitigate the damage.

The results of the above analysis are similar to those predicted under the current thermal limitations in effect at Clinton Lake. See Section 6 of Exhibit F to the Petition. Therefore, IPC believes that allowing the Station to operate under the conditions requested by this provisional variance (which are discussed in Section 7) will not result in effects which are significantly different or worse than the effects already found to be acceptable by the Board, in its Opinion of June 25, 1981 (the "Opinion") supporting the present limitations. The Opinion was filed as Exhibit B to the Petition. See Opinion at 4 ("The Board is satisfied that one-unit operation will not produce unacceptable lake conditions.")

5. Hardship Created

Residential, commercial, and industrial electrical demand is generally greatest during the months of July, August, and September. To meet that demand, the Station must be operated at or near full capacity. During the month of June, IPC's own demand could not have been satisfied 18 of 30 days without the full generating capacity of the station. Therefore, the primary and unreasonable hardship created by the existing thermal

limitations is that they require IPC to derate even though the effects of the elevated flume discharge temperatures on the lake may be inconsequential.

So far as IPC has been able to determine, the 99°F value for the temperature limitation is a historical result from earlier Board thermal proceedings and is not biologically necessary or significant. The current modeling result suggests derating of as much as 20 percent may be required to maintain compliance with the existing 108.3°F thermal limitation at full circulating cooling water flow. A derating of as much as 55 percent at full circulating cooling water flow would be required to maintain daily average flume discharge below 99°F if intake temperatures reach 89°F, the temperature predicted by the LARM 3 modeling for ambient 1955 conditions. This derating could be avoided if the present thermal limitations were suspended and IPC was allowed to operate the Station for the duration of the 45-day provisional variance period subject to the conditions described in Section 7.

The cost of derating the station by 20 percent with respect to IPC's investment costs to build the Station are summarized on Attachment 2. For each day of such a reduction approximately $450,000 of investment costs must be paid for the idle generating capacity from which no customer benefit is being obtained. This is not a hypothetical situation, however. The power station is thermally constrained at this time. Power station management personnel estimate power levels could be increased and the station could maintain a reasonable power cycle efficiency. The extent of increase would be subject to the conditions of Section 7.

6. Proposed and Alternate Methods to Achieve Compliance

IPC presently lacks both sufficient data to select the most efficient method of achieving compliance with the 44-day limitation and with the 108.3°F maximum temperature limitation imposed by the Board, and sufficient time to implement such a method yet this summer. Sargent and Lundy Consulting Engineers were recently contacted to estimate the costs of installing three supplemental cooling systems to reduce predicted maximum flume discharge temperatures to 108.3°F. Their preliminary report is enclosed as Attachment 3. Capital costs for these systems have been estimated to range from six million to 18 million dollars. At the very least, many months would be required to install such systems. Supplemental cooling systems other than those evaluated in this preliminary study may be more feasible for the station but such determinations cannot now realistically be made on the basis of existing information.

IPC also considered the feasibility of increasing service water flows to the discharge flume as a short term measure for reducing discharge flume temperatures. Three service water pumps are mounted at the screenhouse for providing cooling water to equipment that is not safety related. This would include turbine oil coolers, generating coolers, and component cooling heat exchangers. Two pumps are typically operated while the other is maintained on standby as a spare.

Increasing service water flows to the flume is not feasible for the following reasons. First, all flows must go through the system. Direct bypass to the flume is not possible. Second, service water flows may be as

warm as the circulating cooling water flow. And third, starting the third service water pump would not result in additional flow to the flume as flows through the system are regulated by air and motor operated outlet control valves. These valves would close with the hydraulic overload to maintain the balance of flow to and from all equipment.

Until IPC obtains the data necessary to satisfactorily assess its options for ensuring compliance with the thermal limitations at Clinton Lake, its only alternative to seeking this provisional variance would be to derate and operate the Station at less than full capacity. However, this alternative is uneconomical and the biological evaluations demonstrate that the effects of the elevated flume discharge temperatures will be inconsequential (see Exhibit F to the Petition). Furthermore, IPC presently lacks the necessary data to precisely determine the extent that it must derate at the Station to achieve compliance with the existing thermal limitations or to determine the duration over which this derating must continue. Unless and until IPC obtains additional Station operating data, IPC will not be able to derate the Station in the most efficient and cost-effective manner.

Given the above considerations, IPC's proposed plan for achieving long-term compliance is as follows: IPC would rely on the instant provisional variance and the conditions noted in Section 7 to negate the possibility of exceeding the 44-day and 108.3°F limitation at the end of the discharge flume until after the Board has had an opportunity to render a decision on the pending Petition. Assuming the Board grants the Petition, IPC would then be able to operate the Station under normal conditions until October 1, 1990 free from existing thermal limitations. During this

interim period of approximately two years, IPC would be monitoring Clinton Lake, and obtaining actual station operating data and lake temperature and meteorological data for use in assessing its long-term options for achieving compliance with the thermal effluent limitations at the lake. These options could include, without limitation, adding another pump to increase the water flow, and thus reduce the temperature of the discharge; operating the plant at less than full capacity under specified conditions; seeking regulatory relief from the Board; or installing another supplemental cooling system.

7. Provisional Variance

IPC requests a 45-day provisional variance period beginning on the day such provisional variance is granted by the Board, and terminating 45 days thereafter. IPC also requests that the provisional variance be conditioned as follows:

1. That IPC be authorized to monitor temperatures at the edge of a 23-acre mixing zone centered around the flume discharge point in Clinton Lake. A sketch of the proposed mixing zone and temperature monitoring points is attached as Figure 2. IPC's proposed monitoring program is described on Attachment 4.

2. That the 108.3°F maximum daily average thermal limit be applied at the edge of this mixing zone.

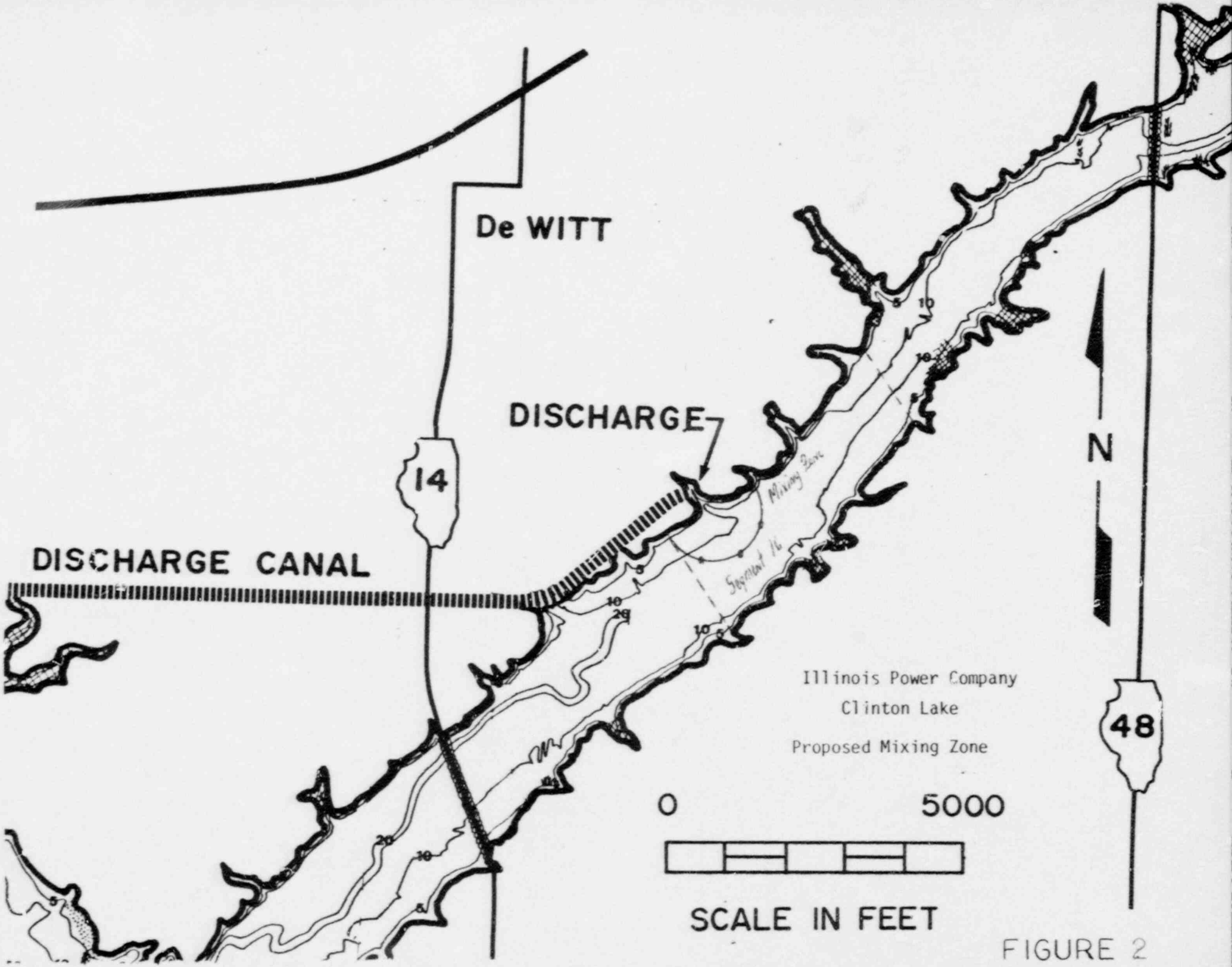

De WITT
DISCHARGE
14
DISCHARGE CANAL
N
48
Illinois Power Company
Clinton Lake
Proposed Mixing Zone
0
5000
SCALE IN FEET

FIGURE 2

3. That the 99°F average daily temperature limitation on the flume discharge be suspended, i.e. if the daily average temperature of the discharge flume exceeds 99°F on any days during the provisional variance period such days shall not be counted toward the 44-day limitation imposed by the Board's Order.

4. That the 99°F average daily temperature limitation also not be applied at the mixing zone edge.

As noted previously, IPC will mitigate the loss of fish, if such should occur, as the result of relocating the 108.3°F maximum daily average temperature limitation to the edge of the mixing zone.

In the pending variance (PCB 88-97), IPC has not proposed any interim temperature limitation but has proposed that the Clinton Station be required to operate in its normal operating mode except during malfunctions or breakdowns. IPC will therefore return to service the third circulating water pump as quickly as possible.

8. Current Provisional Variance

IPC has not been granted any other provisional variances by the Board in 1988.

9. Current Status of Thermal Limitations

As stated previously, the current limitations on thermal effluent discharges from the Station to Clinton Lake were imposed by the Board's Order of May 28, 1981, under PCB 81-82 (R81-82). The terms of the present limitations are set out in paragraph 1 of this application, supra. These limitations remain in effect at Clinton Lake, although IPC presently has a Petition for Variance pending before the Board in regard to these limitations. See paragraph 1 of the application, supra.

10. Other Related Board Orders and Matters Currently Pending

The Board order (R81-82) and the proceeding currently pending before the Board (PCB 88-97) which are most relevant to the instant application are discussed in paragraph 9, supra, and elsewhere throughout the application. There have been numerous other Board orders issued regarding IPC's activities but there are none currently in effect involving the Station. In addition, although IPC has participated in a number of pending rule-making proceedings, where only the proponent is generally considered a party, it is not a party to any pending Board proceeding other than PCB 88-97.

Illinois Power Company appreciates the Agency's consideration of this request for a provisional variance. Please call this office at (217)424-6834 if you should have any questions regarding this request. We would be happy to meet with you and other members of the Agency staff to discuss this matter if that is believed necessary.

Respectively,

ILLINOIS POWER COMPANY

Jene L. Robinson
Manager Environmental Affairs
Department

JLR8:lem

cc: Michael W. Conlin, Illinois Department of Conservation

bc: P. J. Womeldorff - B-20
D. P. Hall/J. S. Perry - V-275
J. Wilson - T-31A
R. Freeman/E. Kant - V-928C
F. A. Spangenberg/D. W. Wilson - V-920
D. Logan - V928B
J. A. Smithson - T-33
J. L. Robinson/R. L. Cruse/CPS Hydrothermal Modeling File - A-17

Attachment 2

Illinois Power Company
Decatur, Illinois

Clinton Power Station

Derated Investment Costs (1)

Year	Yearly Revenue Requirement Full Investment (Millions $)	Daily Revenue Requirement Full Investment (Millions $)	Daily Revenue Requirement 20% Derated Capacity (Millions $) (2)
1988	825.6	2.26	0.452
1989	718.7	1.97	0.394
1990	684.7	1.88	0.376

(1) Installed Cost of Clinton Power Station: 4.245 billion dollars.

(2) Dollars which must be spent to pay off the installed costs of the idle capacity for which no benefit is being obtained.

SARGENT & LUNDY
ENGINEERS
FOUNDED 1891
55 EAST MONROE STREET
CHICAGO, ILLINOIS 60603
(312) 269-2000
TWX 910-221-2807

ATTACHMENT 3

July 18, 1988
Project No. 7949-46
SLMI-22650

Illinois Power Company
Clinton Power Station - Unit 1

Supplemental Cooling Study

Mr. R. D. Freeman
Manager Nuclear Station Engineering
Illinois Power Company
Clinton Power Station
P.O. Box 678
Clinton, Illinois 61727

Attention Mr. A. Ruwe

Dear Mr. Freeman

As requested on July 15, 1988, we have prepared order-of-magnitude capital cost estimates for three specific supplemental cooling schemes that could be applied to the Clinton Power Station (CPS). Based on Mr. T. L. Davis' memorandum of July 14, 1988 to Mr. F. A. Spangenberg, the three schemes investigated were: (1) trimming cooling tower, (2) discharge flume spray modules, and (3) dilution by the addition of circulating water. For these schemes, the following design criteria were specified: for the cooling tower and spray modules, a heat rate reduction of 1 billion Btu/hr; and for increased circulating water, an additional 125,000 gal/min. In addition, our study is based on a wetbulb temperature of 79 °F which was used in previous studies.

Other supplemental cooling system studies and cost estimates have been developed for the CPS. However, prior studies were based on reducing the circulating water temperature from 108.9 °F at the condenser discharge to 96 °F at the discharge to the cooling lake. At full load for Unit 1, this temperature reduction

requires a heat rejection rate of approximately 3.3 billion Btu/hr. The heat rejection criteria specified for this study is approximately 1/3 of the rate in the previous studies; therefore, the previous studies could not simply be updated to 1988 levels. However, the previous studies were used for reference. The design concepts used to prepare the estimates are presented below.

Supplemental Cooling Tower System

The supplemental cooling tower system consists of one mechanical draft tower with seven (7) cells. The system was sized for 100,000 gal/min flow, two 50,000 gal/min pumps, a temperature range of 20 °F, an approach temperature of 10 °F, tower inlet temperature of 108.9 °F, and a wetbulb temperature of 79 °F. The water is pumped from the discharge flume through the cooling tower and returned to the discharge flume. Design features were estimated based on previous work and no attempt was made to optimize the design. Neither the cooling tower size nor any of the cooling tower design parameters have been reviewed with manufacturers.

Supplemental Spray Modules

The supplemental spray module system consists of 32 spray modules of a type assumed to have similar performance characteristics to the spray modules used at other power plants in Illinois. The number of modules was estimated based on a condenser discharge temperature of 108.9 °F, a wetbulb temperature of 79 °F, and a NTU heat transfer coefficient of 0.18. Design features were estimated based on previous work and no attempt was made to optimize the design. Neither the number of spray modules nor any of the spray module design parameters have been reviewed with manufacturers.

Increased Circulating Water Flow

In this scheme, the additional 125,000 gal/min flow is pumped from the cooling lake and added to the water in the discharge flume using, in part, the currently unused circulating water system that was installed for Unit 2. The assumed design concept includes one pump, which would be a duplicate to the Unit 1 circulating pumps, to be installed in the existing intake structure. The oversized pump was selected to provide redundancy with the Unit 1 circulating water pumps and to minimize spare parts requirements. The pump was assumed to operate with reduced output. Also, this design concept includes installation of approximately 400 feet of 6 foot diameter pipe and a seal well that would connect the currently installed segments of the Unit 2 circulating water pipe. Design features were estimated based on previous work and no attempt was made to optimize the design.

Capital Cost Estimates

The following capital cost estimates are based on installed costs in 1988 dollars. Since the CPS is an operating nuclear plant, implementation of any of these retrofit schemes would require special construction procedures. Based on our experience with other operating nuclear plants in Illinois and around the country, we have included an adjustment factor for these conditions. The period required to install each of the schemes was assumed to be 40 months from today. Escalation has been based on 24 months and escalation rates of 4.5% for both material and labor. A period of 12 months and a rate of 9.5% have been used for AFUDC. Indirect costs have been estimated at 25%. The cost estimates are presented in Exhibit 1 and summarized below:

	Cooling Tower	Spray Modules	Increased Flow
Capital Cost	16,566,000	5,658,000	3,970,000

A detailed breakdown of these estimates is attached.

Fuel Costs For Auxiliary Power

An operating period of 25 days/yr was specified. A levelized fix charge rate of 11.962% and a levelized fuel cost of 41 mills/KWhr have been used to estimate an equivalent capital cost for auxiliary power. These costs are presented in Exhibit 1.

Capability Charge

A capability charge of $500/kw has been used to estimate capability charges. These costs are presented in Exhibit 1.

Summary

We suggest that these estimates be discussed with Illinois Power Company and Sargent & Lundy since they were prepared in a short time. In addition, specific schedules must be developed to determine whether special station outages may be required to implement any or all of the schemes. Time has not permitted these factors to be considered and, therefore, potential cost implications have not been included. Also, engineering costs have not been included. However, we believe that the design concepts evaluated are feasible and that the capital cost estimates developed are appropriate order-of-magnitude costs.

If additional information is required, please contact us.

Yours very truly,

J. W. Blattner
Project Site Manager

JWB/DPW/cd
Enclosure-All Recipients
Copies:
D. P. Hall
F. A. Spangenberg
T. Davis
D. Logan
CPS DRC
H. M. Sroka
P. L. Wattelet
R. C. Heider
D. K. Schopfer
D. P. Ward
M. Zar
J. G. Petrich

Sargent & Lundy
Engineers
Chicago

CAPITAL COSTS ESTIMATE
SUPPLEMENTAL COOLING

Exhibit 1
7-18-88

	Cooling Tower	Spray Modules	Dilution
Total Construction Cost $	13,596,000	4,580,000	3,258,000
Escalation..... $	1,502,000	536,000	360,000
AFUDC..... $	1,468,000	542,000	352,000
Total..... $	16,566,000	5,658,000	3,970,000
Fuel Cost for Aux. Power..... $	467,805	368,198	799,709
Capability..... $	1,137,376	895,200	1,944,333
Total Equivalent Capital Investment..... $	18,171,181	6,921,398	6,714,042

Attachment 4

Illinois Power Company
Decatur, Illinois

Clinton Power Station

Proposed Mixing Zone Monitoring Program

Mixing Zone Size:	23 acres (a semicircle of 800 ft. radius)
Monitoring Points:	Three
Temperature Monitors:	Continuous recorders (DataSondes) submerged to a depth of 0.5m.
Monitoring Frequency:	Temperatures at each site will be monitored at 30 minute intervals, 24 hours/day, 7 days/week.
Period of Monitoring:	45 days
Frequency of Reporting:	Data from each recorder will be compiled and evaluated at 10 day intervals. A composite average daily temperature will be computed for each day based upon the daily readings of all three recorders. Composite daily average values will be reported with the NPDES Permit Discharge Monitoring Report.
Assurance of Compliance:	Prior to August 4, instantaneous temperature measurements will be made periodically at the mixing zone edge to determine an approximate relationship with flume temperatures at the second drop structure. Power levels will be adjusted based on this initial relationship. Power levels will subsequently be adjusted based upon the developed data.