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March 20, 2001

SVP-01-024

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

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Request for Revision of National Pollutant Discharge Elimination System (NPDES) Permit No. IL0005037

In accordance with Technical Specifications, Appendix B, Section 2.2, "Reporting Related to the NPDES Permits and State Certifications," our recent request for revision of Quad Cities Nuclear Power Station NPDES permit and revised temperature monitoring curve are enclosed in the attachment.

Should you have any questions concerning this letter, please contact Mr. W. J. Beck at (309) 654-2241, extension 3609.

Respectfully,

Wally J. Beck for

Timothy J. Tulon
Site Vice President
Quad Cities Nuclear Power Station

Attachment: Request for Revision of NPDES Permit No. IL0005037

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

C001

Attachment
Request for Revision of NPDES Permit No. IL0005037

Exelon. Nuclear

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March 14, 2001

Mr. Blaine Kinsley
Division of Water Pollution Control
Illinois Environmental Protection Agency
1021 North Grand Avenue East
P.O. Box 19276
Springfield, IL 62794-9276

Subject: Request for Revision of Quad Cities Station NPDES Permit
NPDES Permit No. IL0005037

Dear Mr. Kinsley:

Exelon Generation Company, LLC (Exelon) submitted a request for revision of Quad Cities Station NPDES Permit No. IL0005037 on August 28, 2000 for the proposed Extended Power Uprate (EPU) project. As discussed in our meeting of December 15, 2000, the design discharge temperature has been slightly adjusted based on completion of a detailed heat balance.

The EPU will increase power generation from 2511 megawatts thermal (MW_t) to 2957 MW_t on each unit. The resultant effect on permitted outfalls 001 and 002 will be to increase the design temperature rise above ambient from 23°F to 28.0°F. The proposed changes will not require any increase or other revision to the permitted flow rates or permit limits.

Proposed Revision. Exelon proposes to revise the last part of Special Condition 6 beginning on page 6 of the current NPDES permit. The revisions involve reference updates, monitoring condition updates, and re-ordering of the special condition for clarity. The affected part of Special Condition 6 currently provides:

> *Permittee shall monitor river flow weekly and ambient river temperature (at or upstream of unit intakes) daily. When river flows are greater than 16,000 cfs and ambient temperatures are 5°F or more lower than the monthly limiting temperatures, the permittee shall be deemed in compliance with the above temperature limitations, based upon the temperature monitoring curve.*[1] *If river flows are greater than 11,000 cfs and ambient temperatures are within 5°F of the monthly limiting temperatures, the permittee may demonstrate compliance with the above temperature limitations by use of plant load, river flow, and ambient*

temperature data and the temperature monitoring curve in lieu of actual measurement of the 500 feet downstream river cross section temperature. If river flows are less than 11,000 cfs, temperature surveys at the 500 feet downstream river cross section shall be performed once per week during any week that the generating units discharge heated effluent to the river.[2] *In the event that the compliance monitoring shows that the permittee has caused the monthly limiting temperature to be exceeded the number of hours of such exceedance shall be reported on the permittee's Discharge Monitoring Report.*

The following data shall be collected and recorded:

1. *Daily continuous recording of the station discharge rate.*
2. *Daily continuous recording of the temperature of the station discharge.*
3. *Weekly determination of the river flow rate (daily when river flows fall below 18,000 cfs)*
4. *Daily determination of the ambient river temperature.*
5. *Daily determination of the station load.*
6. *As deemed necessary according to the above data, daily determination of the induced cross sectional average temperature at the 500 foot downstream cross section in the river.*

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[1] *The temperature monitoring curve identified as TMC-1 as shown on p.31 of the January 1990 "evaluation of the Quad Cities Nuclear Generating Station Diffuser Pipe System at Low River Flows."*

[2] *Temperature surveys shall not be required during periods when ice formation renders the Mississippi River inaccessible or unsafe for marine activity.*

Exelon proposes this part of Special Condition 6 be revised to provide as follows:

The following data shall be collected and recorded:

1. *Weekly determination of the river flow rate (daily when river flows fall below **23,000** cfs)*
2. *Daily determination of the ambient river temperature **(at or upstream of station intakes).***
3. *Daily recording of the station discharge rate.*
4. *Daily continuous recording of the temperature of the station discharge.*
5. *Daily determination of the station load.*
6. *As deemed necessary according to the above data, daily determination of the cross-sectional average temperature at the 500 foot downstream cross section in the river.*

Compliance with the thermal limitations of Special Condition 6 shall be demonstrated as follows:

1. *When river flow **is 21,100** cfs **or greater** and ambient **river** temperature **is** 5°F or more lower than the monthly limiting temperatures, the temperature monitoring curve[1] **establishes that the Permittee is in compliance for all power generation levels;***
2. *When river flow **is less than 21,100 cfs** and/**or** ambient **river** temperature **is** within 5°F of the monthly limiting temperatures, **the Permittee shall demonstrate compliance using either:***
   - *(a) Plant load, river flow, ambient **river** temperature, and the temperature monitoring curve, **or***
   - *(b) **Field** measurement[2] of the river cross-section**al average** temperature **taken** 500 feet downstream **of the diffusers**.*

*In the event that compliance monitoring shows that the permittee has **exceeded** the monthly limiting temperature, the number of hours of such exceedance shall be reported on the Permittee's Discharge Monitoring Report.*

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[1]*The **revised** temperature monitoring curve identified as **Figure 2 in** the **December 2000 "Revised Temperature Monitoring Curve for Quad Cities Nuclear Generating Station."***

[2]***When conditions such as** ice formation render the Mississippi River inaccessible or unsafe for marine activity, **the Permittee may demonstrate compliance with the thermal limitations of Special Condition 6 by using the most recent field measurement data collected at a river flow equal to or less than the flow for which field measurement data cannot be collected. The most recent field measurement data shall be normalized to the power production level for the day when the river is inaccessible.***

Discussion. Exelon suggests the Agency reorganize the portion of Special Condition 6 to the format proposed above. This suggested format plainly states the data that must be recorded and the three methods of demonstrating compliance using these recorded data.

Exelon also proposed to revise the current permit language relating to continuous recording of the station discharge rate. There is no flow meter on this discharge. Rather, the discharge rate is calculated by determining the combination of circulating water and service water pumps that are operating. This value is reported as a calculated value on the monthly discharge monitoring report.
In connection with the EPU project, Exelon retained Dr. Subhash C. Jain to revise the temperature monitoring curve to reflect an increase in the discharge temperature of 5.0°F. Dr. Jain was one of the principle investigators responsible for conducting the 1990 study

that established the temperature monitoring curve referenced in the current permit. The report "Revised Temperature Monitoring Curve for Quad Cities Nuclear Generating Station" is enclosed for your review. The revised temperature monitoring curve indicates that at river flows of 21,100 cfs and greater, sufficient mixing is observed in the river to conclude that at any power level, the plant will not cause exceedence of the permitted thermal limits. Exelon proposes the Agency revise the permit to reflect this value and change Footnote 1 to reflect the revised temperature monitoring curve.

The current permit identifies 18,000 cfs as the level that triggers daily monitoring of river flows, 2000 cfs higher than the 16,000 cfs threshold where compliance with thermal limits may be demonstrated by plant load, river flow, ambient temperature monitoring data, and the temperature monitoring curve. To retain a margin of safety for triggering daily river flow monitoring, Exelon proposes the Agency increase the daily river flow monitoring threshold to 23,000 cfs.

The current permit lists 11,000 cfs as the flow below which field temperature measurements downstream of the diffuser are required once per week. This threshold apparently represents the lowest river flow for which field data were collected on August 15, 1989 (see Jain and Kennedy "Evaluation of the Quad Cities Nuclear Generating Station Diffuser Pipe System at Low River Flows," Iowa Institute of Hydraulic Research Limited Distribution Report No. 174). In view of the compliance demonstrations proposed for Special Condition 6, Exelon believes this requirement is no longer necessary.

The proposed compliance language attempts to simplify compliance demonstration by emphasizing that there are two means of demonstrating compliance: use of the temperature monitoring curve and use of field measurements. For flows of 21,100 cfs and greater and ambient river temperatures more than 5°F below the applicable monthly limit, the revised temperature monitoring curve demonstrates that Exelon is in compliance with thermal limits at all power generation levels. For flows less than 21,100 cfs or ambient river temperatures within 5°F of the applicable monthly limit, proposed Special Condition 6 allows Exelon to demonstrate compliance with thermal limits using field measurements or the temperature monitoring curve in conjunction with a combination of river flow, ambient river temperature, and power generation level.

In practice, Exelon uses the temperature monitoring curve as an indicator for the need to collect field measurements. The history of temperature monitoring curve use since 1987 shows that on 12 occasions in non-winter months, the temperature monitoring curve indicated that low flows would result in a potential excursion at 100 percent power level. However, field measurements conducted by Exelon show that actual excursions above thermal limits did not occur on any of these 12 occasions. This indicates that the temperature monitoring curve is conservative in the sense that it predicts a higher cross sectional average temperature than is actually observed. If this were not the case, roughly one half of the thermal excursions predicted by the curve would have been field verified.

However, this conservatism is beneficial because by prompting field measurements before excursion conditions are reached, more informed decisions can be made concerning the operating level of the plant in relation to use of the excursion hours granted by the permit. Therefore, Exelon wishes to retain the conservatism and not adjust the curve.

Relying on field measurement provides a useful method of determining compliance. However, field measurement is not always possible because the river may be inaccessible due to icing or other dangerous river conditions. In these cases, the temperature monitoring curve can be used to determine compliance, but because of the above-mentioned conservatism inherent in the curve, sole reliance on the curve will result in significant, unnecessary reductions in power generation.

The average monthly Mississippi River flows for December, January, and February are 37,470 cfs, 32,785 cfs, and 35,939 cfs, respectively and average monthly minimum Mississippi River flows for these same months are 22,353 cfs, 26,033 cfs, and 27,753 cfs. From these data, it is apparent that river flows below 21,100 cfs are likely to occur at regular frequencies during times when ice formation makes river accessibility problematic. Therefore, to avoid unnecessary de-rating of power production, Exelon requests the Agency allow the use of the most recent field temperature survey conducted at an equivalent or lesser river flow to demonstrate compliance with the thermal limits, adjusted to accommodate differences in power generation. The average cross sectional temperature increase from the field survey would be normalized to the power generation rate (percent of capacity) for the day(s) when field measurements are not possible due to river conditions using the formula:

$$TI_{adj}\ (^{\circ}F) = \frac{TI_{meas}\ (^{\circ}F)}{(1 + (power_{meas} - power_{miss}))}$$

where: TI_{adj} is the normalized temperature increase above ambient at the downstream edge of the mixing zone (500 ft downstream of the diffusers)

TI_{meas} is the most recent measured downstream cross sectional average temperature increase above ambient at a flow less than or equal to the winter flow

$power_{meas}$ is the operating power level occurring on the day when the downstream cross sectional average temperature increase above ambient was measured

$power_{miss}$ is the operating power level occurring on the day when the downstream cross sectional average temperature increase above ambient could not be measured

This approach ensures that temperature data are collected at an equivalent or more restrictive flow condition while preventing personnel from being placed in conditions that may be unsafe or require extraordinary actions to gain access to the river. The approach is technically sound because the same amount of heat is required to raise the ambient river temperature a given increment (i.e. 5°F), regardless of whether the ambient river temperature is 35°F or 75°F. Allowances for this type of compliance approach were included in the NPDES permit up until the December 4, 1991 re-issuance of the NPDES permit. Prior to that, the NPDES permit allowed:

> "If ambient river temperatures are within 5°F of the limiting temperatures for each month, temperature surveys at the 500 ft. downstream cross section are required once per week <u>only when the river discharge is less than the minimum value for which compliance has been verified by temperature surveys in the field</u>." [emphasis added]

The proposed project will not require an increase or other modification of any permit effluent limit, nor will it add any parameters subject to a numeric or narrative water quality standard. Since the proposed EPU will neither result in an increase of any permit limit, nor will it involve the imposition of a new permit limit, it is not subject to review under the Agency's current anti-degradation practice or proposed anti-degradation rules.

Exelon respectfully requests the Agency consider the information provided herein and revise the Quad Cities Station permit accordingly. If you have any questions, please contact me at 630-663-5124.

Respectfully,

Terry L. Steinert
Sr. Environmental Analyst

cc John Petro
Paul Behrens
Mark Stuhlman
Manager, Quad Cities Regulatory Assurance
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REVISED TEMPERATURE MONITORING CURVE FOR QUAD CITIES NUCLEAR GENERATING STATION

By
Subhash C. Jain
Professor and Research Engineer
Iowa Institute of Hydraulic Research
The University of Iowa

Submitted to
Commonwealth Edison Company
Chicago, Illinois

Report No. 102
Jain Engineering
914 Talwrn Court
Iowa City, Iowa 52246

December 2000

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REVISED TEMPERATURE MONITORING CURVE FOR QUAD CITIES NUCLEAR GENERATING STATION

I. INTRODUCTION

The Quad Cities Nuclear Generating Station (QCNGS) of the Commonwealth Edison Company (CECO) utilizes a diffuser-pipe system (Jain et al., 1971) to distribute its condenser-water discharge across the Mississippi River near Cordova, Illinois. A temperature-monitoring curve (TMC) is currently being used for the operation of the station to be in compliance with the thermal standards stipulated in NPDES Permit No. IL 005037. The existing TMC was developed for a maximum condenser-water temperature rise and discharge of 23 °F and 2094 cfs, respectively.

The objective of the present investigation is to develop a revised temperature-monitoring curve for a maximum condenser-water temperature rise and discharge of 28.0 °F and 2192 cfs, respectively.

II. EXISTING TMC

The existing TMC, presented in Figure 1, was developed by modifying the old TMC (Commonwealth Edison, 1981) with the use of the QCNGS thermal-plume data collected by Iowa Institute of Hydraulic Research (IIHR) during the drought of 1988 and 1989. The method for the development of the existing TMC is included in a report by Jain and Kennedy (1990). The field data that were utilized in developing the existing TMC are presented in Table 1 that also includes the maximum excess temperature observed, $(T-T_a)_{max\ obs}$, at a river cross-section 500 ft downstream from the diffuser pipe and the corresponding maximum excess temperatures estimated at full load, $(T-T_a)_{max\ full}$, where T = water temperature and T_a = ambient water temperature. The maximum excess temperatures at full load were estimated under the assumption that the local excess temperatures are directly proportional to the fractional plant load, P, defined as

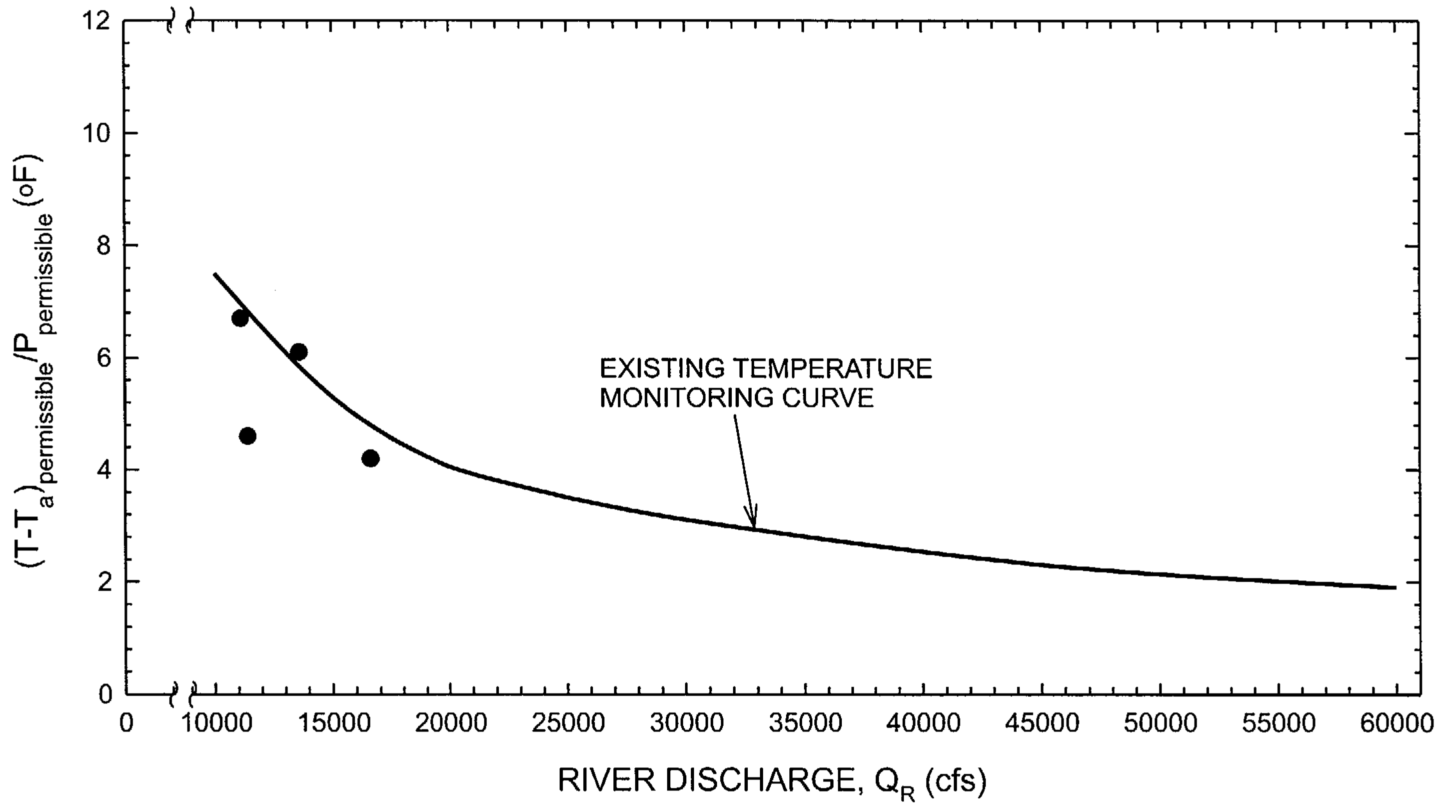

Figure 1. Existing Temperature Monitoring Curve.

Table 1. River Discharge and Plant Effluent Data

Date of Survey	River Discharge Q_R cfs	Effluent Discharge Q_d cfs	Effluent Excess Temperature ΔT_e °F	$(T-T_a)_{max\ obs}$ °F	Plant Load P	$(T-T_a)_{max\ full}$ °F
7-5-88	11,400	2094	22.2	4.5	0.97	4.6
7-11-88	13,600	2094	18.1	4.8	0.79	6.1
8-3-89	16,600	2094	21.4	3.9	0.93	4.2
8-15-89	11,100	2094	20.1	5.8	0.87	6.7

$$P = \frac{Q_d \Delta T_e}{Q_{df} \Delta T_{ef}}$$

where Q_d = actual effluent discharge; ΔT_e = actual effluent excess temperature; Q_{df} = maximum effluent discharge; and ΔT_{ef} = maximum effluent excess temperature. The value of Q_{df} and ΔT_{ef} used in developing the existing TMC is 2094 cfs and 23 °F, respectively. This assumption yields

$$(T - T_a)_{\text{max full}} = \frac{(T - T_a)_{\text{max obs}}}{P} = \frac{(T - T_a)_{\text{permissible}}}{P_{\text{permissible}}}$$

where $(T-T_a)_{\text{permissible}}$ = permissible maximum excess temperature and $P_{\text{permissible}}$ = permissible plant load. Based on this relation, $(T-T_a)_{\text{max full}}$ in Table 1 is replaced by $(T-T_a)_{\text{permissible}}/P_{\text{permissible}}$ in Figure 1.

III. REVISED TMC

The main assumption in the development of the existing TMC is that the local excess temperatures are directly proportional to the plant load. This assumption is valid only if complete mixing of the river flow and diffuser effluent is achieved. Using a one-dimensional analytical model, a parameter R, termed discharge ratio, was identified to ascertain the degree of mixing of the ambient flow with the effluent (Jain and Kennedy, 1990). The discharge ratio is defined as the ratio of the ambient flow discharge to the diffuser discharge. The smaller is the discharge ratio, the more intense is the mixing of the ambient flow with the effluent. The discharge ratio decreases with increasing diffuser discharge. Because the diffuser discharge is larger for the revised TMC than the existing TMC, the assumption of complete mixing is valid. It should be mentioned that though complete overall mixing in the field was complete, but it was not uniform. There were local "hot and cold spots". The reason for hot spots is the relative deficiency of dilution water supplied by the ambient flow in the region of hot spots.

For a given plant load, the ratio α of the percentage plant load in the existing TMC to the percentage plant load in the revised TMC is

$$\alpha = \frac{(Q_{df}\Delta T_{ef})_{revised}}{(Q_{df}\Delta T_{ef})_{existing}} = \frac{2192 \times 28.0}{2094 \times 23.0} = 1.27$$

The existing TMC can be modified for applicable to the revised maximum effluent discharge and excess temperature by multiplying its ordinates by the ratio α = 1.27. The revised TMC is presented in Figure 2.

For a known river discharge Q_R and ambient water temperature T_a, the permissible plant load can be determined from the revised TMC as illustrated in the following example for a river discharge Q_R = 15,000 cfs and ambient water temperature T_a = 72 °F in May. The value of the ordinate in Figure 2 for Q_R = 15,000 cfs is 6.7 °F, and permissible temperature rise $(T\text{-}T_a)_{permissible}$ from the thermal standards T_a = 72 °F in May is 5 °F. The permissible plant load is then equal to equal to the $(T\text{-}T_a)_{permissible}$ divided by the value of the ordinate, i.e., $P_{permissible}$ = 5/6.7 = 75%. The allowable effluent excess temperature is equal to 0.75 x 28.0 = 21.0 °F.

For a permissible temperature rise of 5 °F the permissible plant load for a range of river discharge is given in Table 2. The maximum temperature rise, ΔT, for a range of river discharge and three plants loads is given in Table 3.

IV. SUMMARY

The existing temperature-monitoring curve, which is applicable for a maximum condenser-water temperature rise and discharge of 23 °F and 2094 cfs, respectively, was modified to develop a revised temperature-monitoring curve, which is applicable for a maximum condenser-water temperature rise and discharge of 28.0 °F and 2192 cfs, respectively.

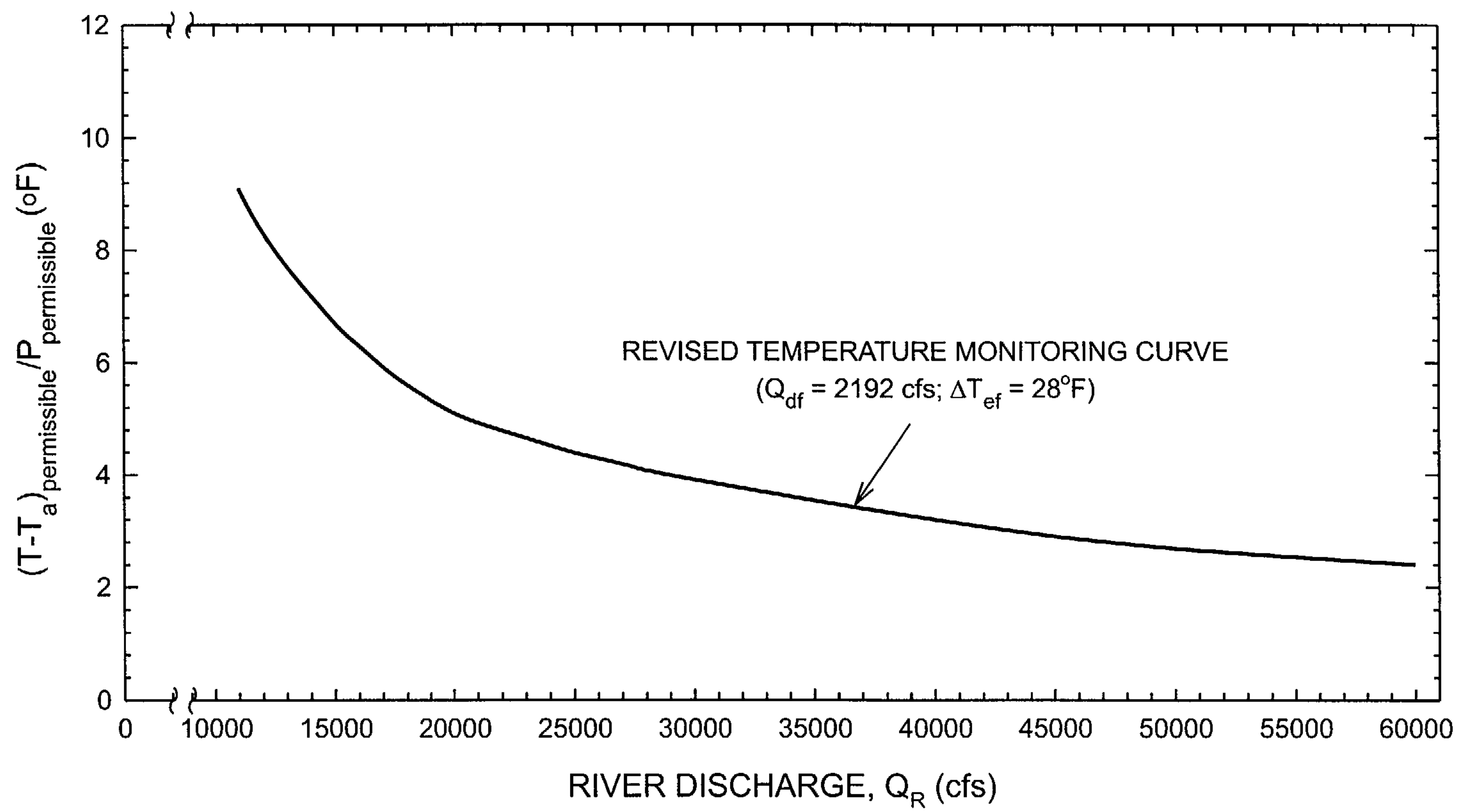

Figure 2. Revised Temperature Monitoring Curve.

Table 2. Permissible Plant Load (Q_{df} = 2192 cfs; ΔT_{ef} = 28°F).

River Discharge cfs	Plant Load %
11,000	55
12,500	62
15,000	75
16,000	78
17,500	86
20,000	98
22,500	106
25,000	114
27,500	119
30,000	128
45,000	172
60,000	208

Table 3. Maximum Temperature Rise (Q_{df} = 2192 cfs; ΔT_{ef} = 28°F)

River Discharge cfs	ΔT at 100% Load °F	ΔT at 75% Load °F	ΔT at 50% Load °F
11,000	9.1	6.9	4.6
12,500	8.0	6.0	4.0
15,000	6.7	5.0	3.4
16,000	6.4	4.8	3.2
17,500	5.8	4.4	2.9
20,000	5.1	3.8	2.5
22,500	4.7	3.5	2.3
25,000	4.4	3.3	2.2
27,500	4.2	3.1	2.1
30,000	3.9	3.0	2.0
45,000	2.9	2.2	1.5
60,000	2.4	1.8	1.2

REFERENCES

Commonwealth Edison (1981), "Supplement to 316 (a) and 316 (b); Demonstration for the Quad Cities Nuclear Generating Station."

Jain, S. C., Sayre, W.W., Akyeampong, Y.A., McDougall, D., and Kennedy, J.F. (1971), "Model Studies and Design of Thermal Outfall Structures Quad-Cities Nuclear Plant," IIHR Report No. 135, Iowa Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa.

Jain, S.C., and Kennedy, J. F. (1990), "Evaluation of the Quad Cities Nuclear Generating Station Diffuser Pipe System at Low River Flows," IIHR Limited Distribution Report No. 174, Iowa Institute of Hydraulic Research, The University of Iowa, Iowa City, Iowa.