ATTACHMENT 3

# NEW YORK POWER AUTHORITY

## NUCLEAR ENGINEERING AND DESIGN

## SERVICE WATER TEMPERATURE ANALYSIS

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# SERVICE WATER TEMPERATURE ANALYSIS

## INTRODUCTION

The objective of this analysis was to evaluate the methodology used to determine the temperature of the river water entering the service water system. The analysis addressed the following areas:

1) Accuracy of the instrumentation used.
2) Determination of service water system inlet temperature.
3) Dynamics of the Hudson river Adjacent to the plant.

## DISCUSSION

### 1. Accuracy of Instrumentation

The temperature of the river water entering the service water system is determined hourly by monitoring temperature readings at six different locations in the circulating water system of Unit #3. These readings are taken in each of the circulating water pipe inlets to the main condenser. The temperature sensors utilized are thermocouples which provide their signals to a central processing unit, the output of which is available to the plant operators. The indicated temperature readings have been verified to be within 0.5 degree F of calibrated thermometer readings at approximately 85$^{\circ}$F.

### 2. Determination of Service Water System Temperature

Water temperature is measured across the entire face of the intake i.e., in each of the six circulating water inlet pipes. The temperature variation among the intake pipes during the summer is less than 1$^{\circ}$F. This small temperature variation is due to the fact that river flow in front of the plant is highly dynamic and nonuniform. As a result of the small temperature variation across the intake, and the fact that the service water bays are located in the center of the intake, it is reasonable to assume that the arithmetic average of the six circulating water bay temperatures represents the temperature of the water entering the service water system.

The methodology used to determine the temperature of the water entering the service water system has been evaluated. It has been determined in Attachment 3 ("Service Water System Temperature Analysis") that the temperatures recorded at the circulating water inlets are accurate and that the average of these temperatures represents the temperature of the water entering the service water system.

A Service Water temperature of 87$^{o}$F will affect Fan Cooler Unit (FCU) performance and therefore, the containment integrity analyses as well as diesel generator operating temperatures.

In addition, higher service water temperature will reduce the ability of the Component Cooling Water System to cool the various CCW heat loads during the post-LOCA recirculation phase.

An evaluation has been performed to demonstrate that the post-DBE containment pressure will remain within the design pressure and that all components required to mitigate the accident will perform their intended function in their intended manner at service water temperatures up to 87$^{o}$F.

Attachment 1 entitled, "Justification for Continued Operation with a Service Water Temperature of 87$^{o}$F at Indian Point Unit 3", documents the evaluations performed by Westinghouse. Specifically, the containment integrity analysis was reanalyzed for operation with service water temperature of 87$^{o}$F at an initial containment temperature of 130$^{o}$F. The increase in service water temperature to 87$^{o}$F impacts the heat removal ability of the FCUs and results in a slight increase in the peak containment pressure (less than 1.5 psig) to 40.73 psig. The design case for an initial containment temperature of 120$^{o}$F and service water pressure of 87$^{o}$F was evaluated. Peak containment temperature was shown to remain below 40.6 psig for that case. This is well below the containment design pressure of 47 psig. Containment leak rate testing has been performed at pressures in excess of the 40.73 psig peak containment accident pressure calculated for 87$^{o}$F service water temperature.

The component cooling loop has been evaluated for a service water supply temperature of 87$^{o}$F. The loop will provide sufficient cooling to enable continued sump and core recirculation following a LOCA. All safety-related heat loads served by Component Cooling during the recirculation

# OPERATION WITH SERVICE WATER TEMPERATURE OF 87°F

## I. PURPOSE

The purpose of this evaluation is to demonstrate the acceptability of continued plant operation with service water temperatures in excess of the original design temperatures for this system for 1988. In addition, this evaluation addresses the impact of higher than design service water temperatures on the Component Cooling Water System.

## II. DESCRIPTION

The Service Water System is designed to supply cooling water from the Hudson River to various heat loads in both the primary and secondary portions of the plant. Provisions exist to assure a continuous flow of cooling water to those systems and components necessary for plant safety during normal operation or under abnormal and accident conditions. This is accomplished either directly or via the Component Cooling Water System (CCWS). The Component Cooling Water System is designed to remove residual and sensible heat from the RCS via the RHR loop during plant shutdown, to cool the letdown flow to the CVCS during power operation, and to provide cooling to dissipate waste heat from various primary plant components. During the injection phase of a LOCA (combined with a blackout) the CCWS serves as a heat sink for the high head Safety Injection (SI) pump bearings and recirculation pump motors. During the recirculation phase, the Component Cooling System serves as an intermediate loop for the transfer of decay heat from the recirculation sump via the RHR heat exchangers and for cooling of various heat loads associated with the safeguards pumps. The component cooling loop transfers its heat load to the Service Water System via the component cooling heat exchangers.

The Indian Point 3 Technical Specifications do not contain a limiting Condition for Operation (LCO) or a Surveillance Requirement for a specific service water temperature of 85°F. The Westinghouse Standardized Technical Specification (STS) specify an LCO for an average water temperature under an optional specification for Ultimate Heat Sink. The STS further specifies a surveillance requirement to determine that the ultimate heat sink is operable at least once every 24 hours by verifying that the average water temperature is within its defined limit. Accordingly, at least once every 24 hours, the average service water temperature (i.e., IP-3 ultimate heat sink) is verified less than 87°F.

3. Hydrodynamics of the Hudson River Adjacent to the Plant

The temperature that is observed during ebb tide represents the ambient temperature of the river in the Indian Point vicinity, i.e., that which exists without the recirculation of heated water discharged from the plant.

During ebb tide and slack before flood tide, heated water from the discharge canal is transported and remains downriver of the plant. Under these tidal conditions, the temperature of water withdrawn by the plant from the river would be that of ambient river water.

During flood tide and slack before ebb tide, heated water from the discharge canal that is recirculated in front of the intake, could increase the temperature of the river in the Indian Point vicinity by up to 5°F. If the discharge of heated water into the river is terminated during slack before ebb tide, any residual heated water in front of Indian Point would be relatively stationary. Under this scenario, water temperatures above river ambient that are due to the recirculation of heated discharge water, could occur for up to the length of the slack tide, i.e. approximately 1 hour. After slack tide, the water mass in front of the plant would be swept downriver by the ebb tide. If the discharge of heated water into the river is terminated during flood tide, the movement of the tide would displace heated water upriver where it would be diffused.

## CONCLUSIONS

The methodology used to determine the temperature of the river water entering the service water system has been evaluated. It has been determined that the temperatures recorded at the circulating water inlets are accurate and that the average of these temperatures represents the temperature of the water entering the service water system. The highest temperature in the service water system would occur during the periodic recirculation of heated water discharged into the river during normal plant operation.

phase have been evaluated at a service water temperature of $87^{0}$F. In each case all required equipment is shown to remain operable at the elevated temperature of $87^{0}$F over the time period for which it must function (24 hours in the recirculation phase followed by one year of long-term recirculation).

In addition, certain other equipment cooled by Service Water is required to operate to support accident mitigation equipment, specifically the emergency diesel generators and FCU motor coolers. Accordingly, a review has been conducted to determine the impact of elevated service water temperatures on this equipment.

With respect to the emergency diesels, Attachment 2 documents a service water system evaluation demonstrating that the diesels will remain operable with service water supply temperatures up to $90^{0}$F for the maximum loading combination associated with the injection and recirculation phases of a design basis event. Similarly, the fan motor coolers have been evaluated (see Attachment 1) and shown to remain operable during the course of a design basis event for the elevated service water temperature condition.

Service water is also provided to the instrument air compressors and CCR air conditioning. All safety systems are designed to perform their safety function with loss of instrument air. Service water that flows to the CCR air conditioning will remain largely unchanged. Such air conditioning performance will not degrade beyond acceptable limits.

The component cooling water operability determinations are contingent upon having a minimum flow of 3600 gpm through the residual heat exchangers. In order to assure this flow, two Component Cooling pumps must be in operation during the recirculation phase. With less than two Component Cooling pumps operating action must be taken to reduce the termal input ot the Component Cooling loop. Operation during the recirculation phase of a LOCA with only one CCW pump will require isolation of the spent fuel pool loop. This has been incorporated into the appropriate operating procedures.

III. <u>REVIEW AND ANALYSIS</u>

See supporting documents attached.

IV. <u>SUMMARY AND CONCLUSIONS</u>

In summary, the above described evaluation of plant operations at service water temperatures up to $87^{0}$F can be performed based on the following conclusions:

A. This change will not increase the probability of an occurrence or consequences of an accident or malfunction of equipment important to safety previously evaluated in the FSAR. Temporary plant operation at service water temperatures up to $87^{0}$F will not result in peak accident containment pressure in excess of the containment design pressure nor above the maximum pressure at which containment and associated pressure containing component shave been periodically tested. The component cooling system and the equipment cooled by it will remain operable to perform their safety related function during and following a design basis event. Accordingly, neither the probability of an occurrence nor the consequences of an accident or malfunction of equipment important to safety will be increased.

B. Temporary plant operation at service water temperature up to $87^{0}$F does not create the possibility of an accident or malfunction of any type other than those previously evaluated in the FSAR.

C. Service water temperature is not a parameter controlled by Technical Specifications. Accordingly, plant operation at service water temperatures up to $87^{0}$F will not reduce the margin of safety as defined in the basis for the Technical Specifications. The design service water temperature of $85^{0}$F is referenced in the basis of certain technical specifications as an input to the calculation of the peak accident pressure of 40.6 psig ($120^{0}$F initial containment temperature). Analysis of the containment pressure transient, for river water temperatures up to $87^{0}$F, all other conditions remaining the same, demonstrates that the peak accident pressure remains below 40.6 psig. Therefore, this change does not reduce the margin of safety as defined in the basis of the Technical Specifications.

D. Since the peak accident containment pressure is shown to be less than the design pressure and the pressure for which appendix J leak rate testing is performed and the component cooling system has been shown to remain operable, plant operation at service water temperatures up to 87°F does not constitute an unreviewed safety question.

E. As previously noted, there is no Technical Specification control relating to service water temperature. Accordingly, temporary plant operation at service water temperatures up to 87°F does not involve a change in Technical Specifications requiring pre-implementation review of the NRC.

F. Temporary plant operation at service water temperatures up to 87°F does not affect the environmental impact of the plant or involve an unreviewed environmental safety question.

G. Temporary plant operation at service water temperatures up to 87°F does not involve a change in the Environmental Technical Specifications.

H. Temporary plant operation at service water temperatures up to 87°F does not impact and will not degrade the Security Plan, Quality Assurance Program or the Fire Protection Program.

V. REFERENCES AND ATTACHMENTS

1. JCO for Continued Operation with a Service Water Temperature of 87°F, by Westinghouse dated August 4, 1988.

2. Letter to Mr. L. Garafolo (NYPA) from Mr. A. B. Yanchitis (UE&C), Re: Diesel Generator Cooling During Post-LOCA Injection (90°F river water).

3. Service Water System Temperature Analysis.

APPENDIX B TO IPN-88-034

# TEN YEAR (1959-1969) AVERAGE

# HUDSON RIVER TEMPERATURE

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
DPR-64

Table II-3. Ten-year (1959–1969) average Hudson River temperatures (°F) in the vicinity of Indian Point

| Date | May | | June | | July | | August | | September | | October | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Maximum | Mean | Maximum | Mean | Maximum | Mean | Maximum | Mean | Maximum | Mean | Maximum | Mean |
| 1 | 57.0 | 51.4 | 67.0 | 63.1 | 79.0 | 74.4 | 81.0 | 77.8 | 78.0 | 76.0 | 73.0 | 69.3 |
| 2 | 57.0 | 52.2 | 67.0 | 63.7 | 75.0 | 74.1 | 81.0 | 78.0 | 78.0 | 75.9 | 73.0 | 68.9 |
| 3 | 59.0 | 52.2 | 68.0 | 63.7 | 76.0 | 74.3 | 81.0 | 78.0 | 78.0 | 75.9 | 73.0 | 68.7 |
| 4 | 59.0 | 52.9 | 68.0 | 64.0 | 76.0 | 74.1 | 81.0 | 77.8 | 78.0 | 75.9 | 72.0 | 67.9 |
| 5 | 59.0 | 53.2 | 67.0 | 64.4 | 76.0 | 74.0 | 81.0 | 77.8 | 79.0 | 75.5 | 72.0 | 67.7 |
| 6 | 59.0 | 53.4 | 68.0 | 64.7 | 76.0 | 73.6 | 81.0 | 77.4 | 79.0 | 75.2 | 72.0 | 66.6 |
| 7 | 59.0 | 54.1 | 68.0 | 65.3 | 76.0 | 74.0 | 81.0 | 77.4 | 79.0 | 74.8 | 71.0 | 66.6 |
| 8 | 59.0 | 54.6 | 68.0 | 65.9 | 76.0 | 74.4 | 81.0 | 77.4 | 79.0 | 74.8 | 71.0 | 66.3 |
| 9 | 59.0 | 54.7 | 69.0 | 66.4 | 76.0 | 74.5 | 81.0 | 77.5 | 78.0 | 74.5 | 71.0 | 66.1 |
| 10 | 59.0 | 55.2 | 70.0 | 67.0 | 77.0 | 75.1 | 81.0 | 77.5 | 78.0 | 74.8 | 71.0 | 65.9 |
| 11 | 61.0 | 55.4 | 70.0 | 67.5 | 78.0 | 75.1 | 80.0 | 77.3 | 79.0 | 74.8 | 71.0 | 65.7 |
| 12 | 61.0 | 55.7 | 71.0 | 67.8 | 79.0 | 75.6 | 80.0 | 77.3 | 79.0 | 74.5 | 71.0 | 65.5 |
| 13 | 61.0 | 55.9 | 70.0 | 68.0 | 79.0 | 75.8 | 79.0 | 76.9 | 79.0 | 74.3 | 70.0 | 65.2 |
| 14 | 63.0 | 56.4 | 70.0 | 68.4 | 80.0 | 75.8 | 80.0 | 77.0 | 79.0 | 73.8 | 70.0 | 65.0 |
| 15 | 63.0 | 56.6 | 71.0 | 68.8 | 81.0 | 75.8 | 80.0 | 76.8 | 80.0 | 73.5 | 68.0 | 64.7 |
| 16 | 59.0 | 56.5 | 71.0 | 68.8 | 81.0 | 76.0 | 80.0 | 76.5 | 79.0 | 73.1 | 68.0 | 64.6 |
| 17 | 59.0 | 56.8 | 72.0 | 68.9 | 80.0 | 76.0 | 80.0 | 76.4 | 78.0 | 72.8 | 68.0 | 64.6 |
| 18 | 63.0 | 58.1 | 71.0 | 69.0 | 80.0 | 76.3 | 80.0 | 76.4 | 76.0 | 72.1 | 68.0 | 64.4 |
| 19 | 63.0 | 58.4 | 70.0 | 68.9 | 80.0 | 76.4 | 80.0 | 76.3 | 76.0 | 72.4 | 67.0 | 63.6 |
| 20 | 63.0 | 58.9 | 71.0 | 69.1 | 80.0 | 76.5 | 80.0 | 76.8 | 76.0 | 71.9 | 66.0 | 63.3 |
| 21 | 63.0 | 59.1 | 71.0 | 69.6 | 79.0 | 76.8 | 81.0 | 76.5 | 76.0 | 71.6 | 66.0 | 62.9 |
| 22 | 63.0 | 59.7 | 72.0 | 70.4 | 79.0 | 76.9 | 81.0 | 76.9 | 74.0 | 70.9 | 64.0 | 62.2 |
| 23 | 63.0 | 59.7 | 72.0 | 70.5 | 79.0 | 77.0 | 80.0 | 76.8 | 75.0 | 71.1 | 64.0 | 62.2 |
| 24 | 63.0 | 60.3 | 73.0 | 71.1 | 79.0 | 77.1 | 79.0 | 76.3 | 73.0 | 70.4 | 64.0 | 61.6 |
| 25 | 65.0 | 61.1 | 73.0 | 71.3 | 80.0 | 77.4 | 79.0 | 76.7 | 75.0 | 70.5 | 64.0 | 61.4 |
| 26 | 65.0 | 61.7 | 73.0 | 71.2 | 80.0 | 77.2 | 79.0 | 76.6 | 75.0 | 70.3 | 64.0 | 60.9 |
| 27 | 65.0 | 61.9 | 73.0 | 71.2 | 81.0 | 77.7 | 79.0 | 76.2 | 75.0 | 69.6 | 64.0 | 60.8 |
| 28 | 65.0 | 62.0 | 76.0 | 72.3 | 79.0 | 77.2 | 78.0 | 76.3 | 75.0 | 69.9 | 63.0 | 60.5 |
| 29 | 65.0 | 61.8 | 76.0 | 72.8 | 81.0 | 77.4 | 79.0 | 76.4 | 74.0 | 69.3 | 63.0 | 60.0 |
| 30 | 67.0 | 62.6 | 78.0 | 73.3 | 80.0 | 77.3 | 78.0 | 76.0 | 73.0 | 68.7 | 61.0 | 59.4 |
| 31 | 66.0 | 62.6 | | | 81.0 | 77.7 | 78.0 | 76.1 | | | 61.0 | 59.2 |

Source: U.S. Geological Survey data supplied by applicant (ER, IP-3, Suppl. 11, Table 9-1).