For the cases where no exception time is specified for inoperable components, this time is assumed to be zero.

*In the event that service water temperature exceeds 87° F, the unit shall be placed in at least hot shutdown within the next seven hours, and be in at least cold shutdown within the following thirty hours unless service water temperature is reduced to 87° F or less within these time intervals as measured from initial discovery or until the reactor is placed in a condition where this service water temperature is not applicable.

3.1 REACTOR COOLANT SYSTEM

Applicability

Applies to the operating status of the Reactor Coolant System; operational components; heatup; cooldown; criticality; activity; chemistry and leakage.

Objective

To specify those limiting conditions for operation of the Reactor Coolant System which must be met to ensure safe reactor operation.

Specification

A. OPERATIONAL COMPONENTS

1. Coolant Pumps

   a. When a reduction is made in the boron concentration of the reactor coolant, at least one reactor coolant pump or one residual heat removal pump (connected to the Reactor Coolant System) shall be in operation.

   b. When the reactor coolant system T_{avg} is greater than 350°F and electrical power is available to the reactor coolant pumps, and as permitted during special plant evolutions, at least one reactor coolant pump shall be in operation. All reactor coolant pumps may be de-energized for up to 1 hour provided no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and core outlet temperature is maintained at least 10°F below saturation temperature.

   c. When the reactor coolant system T_{avg} is greater than 200°F and less than 350°F, and as permitted during special plant evolutions, at least one reactor coolant pump or one residual heat removal pump (connected to the Reactor Coolant System) shall be in operation. All reactor coolant pumps may be de-energized with RHR not in service for up to 1 hour provided no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and core outlet temperature is maintained at least 10°F below saturation temperature.

   d. When the reactor coolant system T_{avg} is less than 200°F, but not in the refueling operation condition, and as permitted during special plant evolutions, at least one residual heat removal pump (connected to the Reactor Coolant System) shall be in operation.

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Amendment No. ~~48~~, 53

*This specification expires at 0001 hours, October 1, 1988

OPERATION WITH SERVICE WATER TEMPERATURE OF 87^{0}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^{0}F. The Westinghouse Standardized Technical Specification (STS) specify an LCO for an <u>average</u> 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^{0}F.

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^{0}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^{0}F.

Attachment 1 entitled, "Justification for Continued Operation with a Service Water Temperature of 87^{0}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^{0}F at an initial containment temperature of 130^{0}F. The increase in service water temperature to 87^{0}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^{0}F and service water pressure of 87^{0}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^{0}F service water temperature.

The component cooling loop has been evaluated for a service water supply temperature of 87^{0}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

phase have been evaluated at a service water temperature of 87°F. In each case all required equipment is shown to remain operable at the elevated temperature of 87°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°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. REVIEW AND ANALYSIS

See supporting documents attached.

IV. SUMMARY AND CONCLUSIONS

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^{0}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^{0}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^{0}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^{0}F does not involve a change in the Environmental Technical Specifications.

H. Temporary plant operation at service water temperatures up to 87^{0}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^{0}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^{0}F river water).

3. Service Water System Temperature Analysis.

ATTACHMENT 1

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OF PAGES

Westinghouse Electric Corporation

Power Systems

Nuclear Technology Systems Division

Box 355
Pittsburgh Pennsylvania 15230-0355

Mr. Pete Kokolakis
Manager, Nuclear Licensing
New York Power Authority
123 Main Street
White Plains, NY 10601

August 4, 1988
INT-88-703

NEW YORK POWER AUTHORITY
INDIAN POINT UNIT 3
JCO WITH A SERVICE WATER TEMPERATURE OF 87 DEGREES F

Dear Mr. Kokolakis:

Attached to this letter is the Justification for Continued Operation (JCO) for Indian Point Unit 3 based upon a plant service water temperature of 87°F. This safety assessment addresses plant operation with the Hudson River water temperature in excess of the Component Cooling Water System (CCWS) design temperature and supports the ability of the CCWS to perform its intended safety function during Normal and Post-Accident conditions. It must be noted that in order to permanently change the Indian Point Unit 3 design basis to incorporate a service water temperature of 87°F, additional confirmatory design calculations will be required.

Note that specific recommendations regarding CCW pump operating requirements are provided in the attached JCO. Please be advised that the general requirements upon which these limits are based are to ensure that CCW temperature remains below 152°F. There are a number of general methods to accomplish this.

Interim emergency operating procedures should be developed to be implemented if component cooling heat exchanger temperatures are approaching 150°F. This could occur with possible combinations of pumps operating and the associated flows to the heat exchangers. The object is to maximize the CCW flow through the CCW HX and to reduce the CCW flow to the RHR HX, as necessary, to maintain CCW HX temperatures of 150°F or less.

If only one CCW pump is available, system throttle valves should be adjusted to prevent pump runout. The SFP HX could be valved out if necessary to reduce CCW system temperature.

RECEIVED
AUG 8 1988

If you have any questions on the information presented in this letter please contact A. Ball, Jr. at (412) 374-5750 or the undersigned.

Very truly yours,
WESTINGHOUSE ELECTRIC CORPORATION

S. P Swigart, Manager /for
Operating Plant Projects

cc: J. Lomm
S. Zula
J. Canavan
J. Kern (Field Sales)
G. Fidler (W-Site Service Mgr.)
A. Ball, Jr., ECE-413
J. F. Hofscher

Rev. 0

Justification for Continued Operation

With a Service Water Temperature of 87°F

at Indian Point Unit 3

I. BACKGROUND

Indian Point Unit 3 has requested an evaluation of acceptable plant operation with a Service Water temperature of 87°F. The Service Water provides cooling for the Containment Cooling Fans and fan cooler motors which provide safety related containment cooling. The Service Water System also cools the Component Cooling Water System which in turn cools safety related components to support post-Loss-of-Coolant Accident recirculation.

The following provides an evaluation of the possible safety impact of increased Service Water temperature on the ability of the plant to perform the required safety functions associated with Containment Cooling Fans and Component Cooling Water.

A. Containment Cooling Fans and Fan Cooler Motors

The safety function of the Containment Cooling Fans affected by increasing Service Water temperature is the capability to cool the containment atmosphere following a LOCA. The Containment Cooling Fans operate as part of the Containment Air Recirculation Cooling and Filtration System (CARCFS). The CARCFS was designed to recirculate and cool the containment atmosphere in the event of a Loss-of-Coolant Accident (LOCA) and thereby ensure that the containment pressure will not exceed its design value of 47 psig at 271°F (100% relative humidity). The Technical Specifications currently indicate that the calculated peak post-accident containment pressure is 40.6 psig. The Containment Cooling Fan fan-coolers transfer heat from the containment atmosphere to the Service Water System. The heat transfer capability of the fan-coolers is accounted for in the containment integrity analysis presented in FSAR Chapter 14. Increasing the Service Water temperature will affect the fan-cooler performance and, therefore, affect the containment integrity analysis.

In addition, increasing the service water temperature to 87°F will have a small affect on the fan cooler motor coolers. Adequate cooling for the fan cooler motors is required to ensure that the fan coolers can continue to operate in the post accident enviroment.

B. Component Cooling Water System

The safety functions performed by the Component Cooling Water (CCW) System are:

1. Supply the necessary service to enable continued sump and core recirculation following a Loss-of-Coolant Accident (LOCA).

Following a design basis LOCA (off-site power is assumed to be lost) the Emergency Core Cooling System (ECCS) draws water from the RWST and injects into the RCS cold legs. Pumped safety injection is provided by the RHR pumps and the High Head Safety Injection Pumps. As the RWST inventory is depleted, the ECCS is switched from the injection phase to the recirculation phase. During the ECCS recirculation phase the system is arranged so that the Recirculation Pumps take suction from the recirculation sump in the containment floor and deliver spilled reactor coolant and borated refueling water back to the core through the RHR heat exchangers. The system is also arranged to allow either of the RHR pumps to take over the recirculation function if required.

For small breaks the RCS depressurization is augmented by steam dump and auxiliary feedwater addition to the steam generators. For small breaks that do not depressurize enough to allow adequate recirculation flow from the Recirculation Pumps, the system is arranged to deliver water from the RHR heat exchanger to the suction of the high head safety injection pumps and by this external route, to the reactor coolant loops. Thus, if depressurization of the RCS proceeds slowly, the safety injection pumps may be used to augment the flow-pressure capacity of the Recirculation Pumps in returning the spilled coolant to the reactor. The Service Water System provides cooling to the Component Cooling Water loop, which in turns cools the High Head Safety Injection Pump oil and seal coolers, the Recirculation Pump motors, and the RHR pump mechanical seals if the RHR pumps are required to provide backup to the recirculation pumps. Providing adequate cooling to these components ensures that post-LOCA long term cooling can be maintained.

2. "One pump (either recirculation or residual heat removal) and one RHR heat exchanger of the recirculation system provides sufficient cooled recirculated water to keep the core flooded while simultaneously providing, if required, sufficient containment spray flow to prevent the containment pressure from rising above design limits because of boiloff from the core. Only one pump and one RHR heat exchanger are required to operate for this capability at the earliest time recirculation in initiated. With a recirculation (or RHR) pump in operation and with a spray header valve open, no Containment Cooling Fans are required." (FSAR page 6.3-10)

   The Service Water system provides cooling water to the component cooling loop, which in turn, cools the RHR heat exchangers. Only one Service Water Pump and heat exchanger, and only one Component Cooling Water Pump and heat exchanger are required to meet the core cooling function.

II. EVALUATION

A. Containment Cooling Fans

The limiting case containment integrity analysis case was rerun assuming a Service Water temperature of 87°F.

The double-ended pump suction break case with minimum safeguards is the limiting case for containment integrity peak pressure concerns. An analysis was performed to determine the effect of an increased Service Water temperature of 87°F, which affects the fan cooler performance, on the peak calculated containment pressure response for this limiting case.

The base model and approach used for this analysis was described in Westinghouse letter INT-88-641, dated May 27, 1988. The results from the analysis discussed in INT-88-641 showed a peak containment pressure of 39.39 psig.

The initial containment temperature utilized for the evaluation was 130°F. The peak containment pressure based upon the increased Service Water temperature was calculated to be 40.73 psig which is below the design pressure of 47 psig. Considering an initial containment temperature of 120°F, and a 87°F service water temperature, the peak containment pressure is below 40.6 psig.

B. Component Cooling Water System

The ability of the Component Cooling Water (CCW) System to perform its functions is evaluated below.

1. Supply the necessary cooling service to enable continued containment sump and core recirculation following a LOCA.

   The CCWS provides cooling for the following heat loads during the post-LOCA recirculation phase:

   - HHSI pumps (2)
   - Recirculation Pump (1)
   - RHR heat exchanger (1)
   - Auxiliary coolant pumps (2)
   - Spent Fuel Pit Heat Exchanger (several months since refueling)
   - RHR Pump (if required to provide backup to the recirculation pump)

   This portion of the evaluation was performed to ensure that the CCWS provides sufficient cooling to the High Head Safety Injection Pump oil coolers and seal coolers to ensure that the HHSI pumps can perform their post-LOCA recirculation functions if required, and to ensure that the CCWS provides sufficient cooling to the Recirculation Pump Motor air/water heat exchangers to ensure that the Recirculation Pumps can perform their post-LOCA recirculation function. In addition, an evaluation is provided

for adequate cooling of the mechanical seals if a RHR pump is required as a backup to the Recirculation Pump.

The evaluation determined the CCWS temperature as a function of time after the post-LOCA ECCS recirculation phase is established. The equipment was then evaluated to ensure that the CCWS could provide adequate cooling to ensure pump operation.

Component Cooling Water Temperature vs Time

For the post-LOCA scenario, the recirculation phase was determined to be the most limiting for the CCW System because the auxiliary heat load going to the CCW heat exchanger would be maximized due to the RHR heat exchanger cooling the recirculation sump water. Based on the sump water temperatures, a CCW system performance study was done to determine the temperature history of the CCW system. The system alignment assumed during post-LOCA recirculation was a minimum safeguards alignment of the CCWS, with one CCW heat exchanger and one RHR heat exchanger in service. It was determined that at the peak containment sump temperature of 274°F (which corresponds to the time at which switchover to recirculation is initiated). The CCW temperature out of the CCW heat exchanger will be no higher than 152°F, and will decrease and is expected to be below 120°F within 24 hours. The RHR heat exchangers will also act to reduce the containment sump temperature during this period, which is expected to fall below 200°F within a 24 hour period. This temperature/time data was then used to determine the resulting effects on the components receiving CCW flow during a post-LOCA scenario.

The preceding evaluation was based on the following restriction:

> During the post-LOCA recirculation phase of operation, one of the following conditions must be met:
>
> 1. Two CCW Pumps must be running.
>
> OR
>
> 2. One CCW Pump must be running, and the CCW flow to the Spent Fuel Pit Heat Exchangers must be isolated.

In addition to evaluating the post-accident performance of the Component Cooling Water System, the impact of 87°F Service Water was evaluated relative to the affect on the CCWS's functions during normal operation.

The components in service during normal operations that are cooled by the CCWS were determined based on feedback from the plant and include:

- Reactor Vessel Support Pads
- Letdown Heat Exchanger (normal letdown)
- Seal Water Heat Exchanger (normal letdown)
- PD Pump (1)
- Reactor Coolant Pumps (4)
- Gross Failed Fuel Detector System
- Spent Fuel Pit Heat Exchanger (several months since refueling)
- Sample Heat Exchanger (1)
- Waste gas Compressor (1)
- Two Component Cooling Water Pumps (cooling not provided)

The CCWS must provide adequate cooling to ensure that the above equipment operates within its design conditions. The maximum recommended CCW temperature for steady-state operation is 105°F and is limited by the RCP Thermal Barrier.

The CCW temperature was estimated based on CCWS capability study (Reference 1) for several Service Water Temperatures. Based on this evaluation it was determined that maximum allowable Service Water temperature is approximately 89°F. Operation with a Service Water temperature above 89°F could result in CCWS temperatures greater than 105°F, and could result in damage to the RCPs.

Component Evaluation

Various auxiliary pumps and associated appurtenances (such as oil coolers and seal coolers) will be subjected to the increased Component Cooling Water temperatures which have been identified for normal plant operation and for the post-LOCA recirculation phase. The increased Component Cooling Water temperatures will have no detrimental effect on the structural integrity of the pumps. Thus the evaluation of auxiliary pumps concerns only the operability of pumps which have appurtenances serviced by component cooling water. For the normal plant operating mode, the evaluation is limited to the positive displacement charging pump and the waste gas compressor. For the post-LOCA recirculation phase, the evaluation is limited to the Recirculation Pump motors, the High Head Safety Injection Pumps, and the RHR Pumps.

Normal Plant Operation

The component cooling water temperature during normal plant operation will not exceed 105°F. This cooling water services the charging pump lube oil cooler and gyrol oil cooler and the waste gas compressor mechanical seal cooler. The thermal-hydraulic performance characteristics of these coolers have been reviewed for the identified component cooling water flow rates and the maximum temperature of 105°F. It has been concluded that the equipment coolers are adequately sized to allow continuous operation of the equipment with the normal plant component cooling water conditions.

Post-LOCA Recirculation Phase

The component cooling water temperature during the post-LOCA recirculation phase is 152°F upon the initiation of recirculation and decays to 120°F within 24 hours. This cooling water services the SI recirculation pump motor coolers and the high head SI pump seal water coolers and lube oil coolers. The descriptions of the operability evaluations for these components follow.

SI Recirculation Pump Motors

The SI recirculation pump motors are totally enclosed water to air cooled motors. The motor exhaust air is cooled by heat exchangers and recirculated to the motor air intakes in an enclosed system. The increased component cooling water temperature will result in increased stator winding and bearing temperatures. These motors were originally qualified by WCAP-7829 for a containment ambient temperature of 324°F. Actual containment temperatures for Indian Point Units 2 and 3 will not exceed 270°F. This qualification demonstrated that the stator winding and bearing temperatures were well within acceptable limits with the ambient temperature of 324°F and various component cooling water temperatures.

Based on the results of WCAP-7829, the stator winding temperatures with increased cooling water temperatures are expected to remain within the maximum allowable temperature limit for Class F insulation systems. Thus no abnormal insulation degradation is expected to occur within the 24 hour period of component cooling water temperatures above 120°F. There will be no reduction of the motor qualified life. The motor bearing temperatures are predominantly dependent on the ambient temperature and not the component cooling water temperature. The test results for the ambient temperature of 324°F are bounding for the actual ambient temperature in conjunction with the increased component cooling water temperature. Therefore, the recirculation pump motors will remain operable for the component cooling water temperatures experienced during the post-LOCA recirculation phase.

Safety Injection Pumps

The safety injection pumps contain two mechanical seal coolers and a lube oil cooler which are serviced by component cooling water. The mechanical seal coolers are intended to maintain temperatures in the mechanical seal chambers within limits that will prevent abnormal seal wear. The lube oil cooler is required to maintain the oil temperature at a level which will provide adequate lubrication to the bearings and prevent accelerated viscosity breakdown. These coolers are supplied cooling water through a common header which delivers a total of 15 gpm. The evaluation considered that each cooler receives a cooling water flowrate of 5 gpm.

SI Pump Mechanical Seals

The high head SI pumps utilize John Crane mechanical seals. The mechanical seals are cooled by component cooling water which flows through the pump seal coolers. Seal chamber fluid is pumped by a pumping ring through the mechanical seal coolers and returned to the seal chambers. Mechanical seals are installed on both ends of the pump shaft and each seal has its own mechanical seal cooler.

The cooling water temperature to the seal coolers was determined to be 152°F at the beginning of the LOCA decaying to 120°F within 24 hours. The seal evaluation considered that 5 gpm of cooling water flows to each seal cooler. The seal chamber temperature is influenced by the pump suction temperature due to migration of the pumped fluid into the seal chamber. Therefore it was also considered that the pump suction temperature will correspond to the discharge temperature from the RHR heat exchanger at the beginning of the LOCA (approximately 215°F), reducing with time.

The effect of elevated temperatures on the seal would be an increase in seal wear and a reduction in seal life. Tests performed by the seal manufacturer with 300°F seal cavity temperatures with no seal cooling resulted in insignificant wear to the seals. The seal temperature conditions posed here are much less severe especially since there will be cooling of the seal cavity temperature from the seal coolers. Consequently, it was determined that the post-LOCA recirculation conditions will have little effect in reducing seal life. Lastly, both of these seals are furnished with a safety bushing which in the event of catastrophic failure to the primary seal will limit leakage from the seal to maintain the operability of the SI pump.

SI Pump Lube Oil Cooler

The safety injection pumps utilize a pressurized lubrication system which provides oil to the two shaft journal bearings and a thrust bearing. The hot oil leaving the bearings is drained to a 3 gallon reservoir. This reservoir is the source of oil for the lube oil pump which supplies oil through the lube oil cooler to the pump bearings. The oil used in the pumps has a nominal viscosity rating of 150 SSU at 100°F.

Increased component cooling water temperatures will result in increased oil temperatures at both the inlet and outlet of the pump bearings. The thrust bearing is the most sensitive to oil temperature and is the source of the majority of heat load in the oil system, thus only the thrust bearing must be evaluated for the increased oil temperatures. The journal bearings will be bounded by this evaluation since the heat load is less than the thrust bearing heat load.

A thermal evaluation of the oil cooler for a cooling water flow

rate of 5 gpm demonstrated that there will be an 18 degree temperature differential between the cooling water entering the cooler and the oil exiting the cooler. At the maximum cooling water temperature of 152°F, the oil leaving the cooler will have a temperature of 170°F. This temperature corresponds to the thrust bearing inlet temperature. The thrust bearing was analyzed for nominal 150 SSU oil at a temperature of 170°F and the thrust load that will act on the bearing during the post-LOCA operating mode. The analysis demonstrated that the oil viscosity at 170°F is adequate to maintain an oil film thickness sufficient to prevent bearing failure. The analysis also predicted a maximum bearing metal temperature of 187°F and an oil outlet temperature from the bearing of 186°F. The bearing metal temperature is well below the limit of 200°F which will prevent accelerated bearing wear. The oil outlet temperature is slightly higher than the continuous operating limit of this oil, which is 185°F. However, for short term operation oil temperatures as high as 195°F are acceptable to prevent excessive oil viscosity breakdown, since oil breakdown is a function of both time and temperature. The cooling water temperature will drop by 3 degrees in less than 2 hours and the oil temperature at the bearing outlet will fall below the continuous operating limit within this very short period of time. Thus the analyses of the lube oil cooler and the thrust bearing have demonstrated that the increased component cooling water temperatures will have no detrimental effect on the functioning of the SI pump lube oil system.

RHR Pump Mechanical Seals

The RHR pump is equipped with a mechanical seal cooler which is serviced by component cooling water. The mechanical seal cooler is intended to maintain temperatures in the mechanical seal chamber within limits that will prevent abnormal seal wear. The RHR pump mechanical seals are manufactured by John Crane and are very similar in design to the high head SI pump mechanical seals. The RHR pump mechanical seals will be subjected to a peak pump suction temperature of 274 degrees, reducing with time, and a peak component cooling water temperature of 152 degrees F, also reducing with time. Thus the manufacturer test which qualified the seal for 300 degree F seal chamber temperatures with no seal cooling bounds the RHR pump mechanical seal operating conditions. It was determined that the increased component cooling water temperatures for the post-LOCA recirculation conditions will have an insignificant effect on the mechanical seal life and will not affect the pump operability.

Reactor Containment Fan Cooler Motors

The Reactor Containment Fan Cooler (RCFC) Motor coolers are cooled by Service Water and are therefore evaluated for an increase in Service Water temperature to 87°F.

The RCFC motors are closed cycle air cooled units with an integral heat exchanger mounted in the base of the motor stand.

The heat exchanger is cooled with service water and maintains the motor circulating air temperature below maximum containment temperature for accident conditions. The RCFC's are also used during normal operations. An increase of two degrees F in the cooling water will cause a proportional small increase in the motor temperature, however the effect on motor lifetime would not be significant since the temperature increase would only occur during a few months of the year at most.

The RCFC motors were qualified by test for use in a nuclear reactor containment during and after a LOCA. The testing was performed in a steam chamber to a temperature of 324 degrees F. Considering that a LOCA is specified to reach 274 degrees F maximum there is considerable margin in the test vs actual temperature requirements.

Conclusion of Auxiliary Pump Evaluation

The auxiliary pumps and associated appurtenances have been evaluated for the increased component cooling water system temperatures. The evaluation determined that normal plant operation for extended periods of time with a cooling water temperature of 105°F will have no effect on the operability of the auxiliary pumps. The evaluation also determined that a post-LOCA cooling water temperature of 152°F decaying to 120°F within 24 hours will have no effect on the operability of the pumps during this short period of operation. Beyond this 24 hour period of operation, the pumps will remain capable of performing their long-term safety related functions with component cooling water temperatures below 120°F.

2. Provide sufficient cooled recirculation flow to prevent containment pressure from rising above design limits because of boiloff from the core.

The heat removal capability of one train of Containment Cooling Fans and one recirculation loop was assessed. The heat transfer through the RHR heat exchanger to the CCW in conjunction with the heat removed by the Containment Cooling Fans exceeded the decay heat load during the recirculation phase. Because the heat removal capability exceeds the decay heat load, the containment sump temperature decreases with time as reflected in the CCW temperature transient described above. It is our judgement, therefore, that adequate heat removal capability is provided to prevent the containment pressure from rising above design limits because of boiloff from the core during recirculation.

FSAR Chapter 6.2.2 (page 6.2-10) states that if one recirculation (or RHR) pump is in operation and one spray header valve is open, that no containment fans are required. This configuration (only one Recirculation Pump, and no Containment Cooling Fans available) is beyond the design basis as the Containment Air Recirculation Cooling and Filtration System and the Containment Spray System are both designed as a two train, redundant systems. The single failure of one train of safeguards will provide a minimum of one train (three out of five) of Containment

Cooling Fans and one recirculation loop (Recirculation Pump, heat exchanger and spray header valve).

III. SUMMARY/CONCLUSIONS

Westinghouse believes that the continued operation of Indian Point Unit 3 is justified for a Service Water Temperature of 87°F based on the following:

1. Containment integrity has been reanalyzed with a Service Water temperature of 87°F and it has been determined that acceptable containment cooling is provided.

2. The Component Cooling Water System has been evaluated for a Service Water temperature of 87°F, and it has been determined that the CCW provides sufficient cooling to enable continued sump and core recirculation following a LOCA.

3. The recirculation loop/Component Cooling Water System and the Service Water/containment cooling fan heat removal capability is sufficient to prevent containment pressure from rising above design limits as a result of boiloff from the core during recirculation.

4. The CCWS can perform its cooling functions during normal operations with a Service Water Temperature of 87°F.

IV. REFERENCES

1. FRSS-SS-IPP/INT-1173, dated 7/31/88

TELECOPY NO. 3263
TO: L. GAROFOLO - WPO
FROM: A. B. YANCHITIS - UNITED
(1 PAGE)

ATTACHMENT 2

August 9, 1988

Re: DIESEL GENERATOR COOLING FOR POST-LOCA

This teleocpy supercedes Telecopy 3262, sent on 8/7/88, which addressed only diesel generator cooling during the post LOCA injection phase. This telecopy addresses diesel generator cooling during both post-LOCA injection and recirculation.

As you requested, UNITED has performed an evaluation to determine if the Service Water (SW) system can adequately cool the diesel generator coolers during the post-LOCA injection phase when the river temperature is 90°F.

The condition that UNITED has evaluated is as follows:

*Service water flow:	400 gpm
River water temperature:	90°F

At these service water conditions, the diesel generator coolers can support a heat load of approximately 4.7 million Btu/hr provided that the heat exchangers are not fouled beyond design fouling. During the post-LOCA injection phase, diesel #32 would be operating at 2262 HP (per Table 8.2-1 of the FSAR) which corresponds to a heat load of 4.0 million Btu/hr. Since the coolers can support a heat load greater than the heat load applied, the service water system can provide adequate cooling at 90°F.

Diesel generator cooling during the post-LOCA recirculation phase was also evaluated for a service water temperature of 90°F. The results of this evaluation concluded that the diesel generators could be adequately cooled for the recirculation phase service water conditions (Reference Calculation Set 6604.219-8-SW-010). This evaluation assumed a guillotine break of the 10 inch SW header supplying the diesel generator coolers, which resulted in a service water flow rate of approximately 250 gpm to diesels 32 and 33.

Note that even at the maximum operating loads on the diesel generators during both the Post-LOCA injection and recirculation phases as defined in Table 8.2-1 of the FSAR, the diesels would remain operable for all post LOCA operating modes with a service water temperature of 90°F.

UNITED will formalize the results of the evaluation for the post-LOCA injection phase in a calculation set and submit it to NYPA by 8/19/88.

A. B. Yanchitis

* For conservatism, UNITED used a flow of 400 gpm, which corresponds to the coolers' design flow. The actual service water flow during injection, concurrent with a loss of instrument air, would be 440 gpm. (Reference Case 4 of the Service Water Evaluation Report).

ATTACHMENT 3

NEW YORK POWER AUTHORITY

NUCLEAR ENGINEERING AND DESIGN

SERVICE WATER TEMPERATURE ANALYSIS

REVISION	DATE	PREPARED BY	REVIEWED BY
0	8-5-88	D. DUNNING	J.L. BENCIVENGA
1	8-9-88	D. DUNNING	B.T. YOUNG B.G.Y.

APPROVED BY:

Brian G. Young for K.M.

Director of Nuclear
Engineering & Design

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°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°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.

3. <u>Hydrodynamics of the Hudson River Adjacent to the Plant</u>

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 Inddian 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.