UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 98 TO FACILITY OPERATING LICENSE NO. DPR-64

POWER AUTHORITY OF THE STATE OF NEW YORK

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

DOCKET NO. 50-286

1.0 INTRODUCTION

By letter dated July 24, 1989, as supplemented December 20, 1989 and March 29, 1990, the Power Authority of the State of New York (the licensee) requested an amendment to Facility Operating License No. DPR-64 for the Indian Point Nuclear Generating Unit No. 3 (Indian Point 3). The proposed Technical Specification (TS) would increase the design basis ultimate heat sink (UHS) temperature limit from 85°F to 95°F and increase the maximum normal containment temperature limit from 120°F to 130°F. Accordingly, the licensee revised TS Sections 3.1, 3.3, 3.6, 4.1 and 4.4 to incorporate the increased UHS temperature limit and revised plant procedures such as temperature monitoring, instrumentation set point requirements, containment temperature limit verification, and containment leak rate test pressure consistent with the increased UHS temperature limit.

The Indian Point 3 Service Water System (SWS) draws water from the Hudson River (i.e., the ultimate heat sink) to (1) cool various safety-related and non-safety-related components to ensure component operability, (2) dissipate reactor heat from the containment following an accident, and (3) maintain the plant in a safe shutdown condition. The design of the SWS is currently based on an inlet river water temperature not exceeding 85°F. Based on recent meteorological conditions, the service water (SW) inlet temperature exceeded the documented design limit of 85°F a few times during the past summers. This condition resulted in the need for emergency amendments on August 19, 1988 (License Amendment No. 82) and August 11, 1989 (License Amendment No. 87). The December 20, 1989 submittal indicated that a Hudson River temperature as high as 91°F has been recorded within the last two summers at the Indian Point 3 site. Therefore, past history has established the need for the proposed TS changes.

Westinghouse has performed safety analyses for the licensee on containment performance and on each safety-related component cooled by the SWS to confirm that the design basis accident analyzed in the Final Safety Analysis Report (FSAR), Chapter 14, or component operability assumed in the accident analyses are not exceeded. The licensee's safety evaluation to support the TS changes is provided in two Westinghouse topical reports: WCAP-12313, "Safety Evaluation For An Ultimate Heat Sink Temperature Increase To 95°F At Indian Point, Unit 3" and WCAP-12269, "Containment Margin Improvement Analysis For Indian Point, Unit 3." The following is the staff evaluation of the licensee's submittals.

The licensee, by letters dated December 20, 1989 and March 29, 1990, provided supplemental information. This supplemental submittal information was not outside the scope of the proposed TS change noticed in the Federal Register (54 FR 32147) on August 4, 1989 and did not affect the staff's proposed determination that no significant hazards would result from these changes.

2.0 EVALUATION

2.1 Auxiliary Cooling Systems Cooled by the Service Water System

2.1.1 Component Cooling Water System

The SWS provides cooling to the Component Cooling Water System (CCWS) which in turn cools various equipment and components needed for normal plant operation. The CCWS also serves as an intermediate system between the Reactor Coolant System (RCS) and the SWS to remove residual and sensible heat from the RCS via the Residual Heat Removal (RHR) System during plant shutdown and post-accident conditions. The licensee evaluated the CCWS to determine the impact of higher SWS temperatures on the system's heat removal capability.

The licensee analyzed thermal and hydraulic performance of the CCWS using the Westinghouse computer program PEGISIS and developed a thermal/hydraulic model for the CCWS flow network. The licensee calculated the minimum and maximum balancing flows taking into account both equipment cooling requirements and pump performance acceptance criteria. The minimum and maximum balancing flow rates were determined based on operation of only one Component Coolant Water (CCW) pump because the design basis of the CCWS requires one CCW pump to be capable of operating in the post-LOCA mode. The weakest pump and strongest pump were also determined based on the minimum or the maximum branch line flows for each component. The licensee also performed flow balancing tests and found that original design flow rates to most components were met when considering the minimum acceptable pump performance criteria and actual resistances. Proper CCW flow to system components can be provided by rebalancing CCW flow as necessary based on SW temperature as discussed further below.

Since the CCW pump operating flow rate as defined by the vendor is a function of net positive suction head (NPSH) available, the licensee analyzed the design basis NPSH available based on the expected higher system temperature and CCW flow balance test. The original design basis NPSH available was 46 feet for a fluid temperature of 180°F and a pump flow of up to 6000 gpm and NPSH required under these conditions was 36 feet. The most limiting NPSH conditions occur during the LOCA recirculation phase when CCW pump flow is near runout with both RHR heat exchangers in operation, and CCW system temperature is maximized. The licensee calculated the NPSH available to be 36 feet using a higher CCW temperature of 203°F and lower CCW pump flow of 5500 gpm for the expected higher system temperatures due to the increase in SW temperature. The NPSH required for this condition is approximately 29 feet. The licensee also determined the highest pump suction temperature with at least 10% margin between NPSH required and available to be 197°F. The licensee stated that adequate NPSH would be available during LOCA recirculation with a SWS temperature of 95°F since the system flow can be rebalanced to maintain CCW pump flow rate and suction temperature within the calculated values.

The staff has reviewed the licensee's hydraulic analysis of the CCWS and finds that the analysis is conservative for demonstrating proper CCW pump performance and is acceptable. The licensee has revised the operating procedure for the CCWS to provide guidance to the operator to limit CCW pump flow and suction temperature as appropriate based on SW temperature.

The licensee calculated the maximum CCWS temperatures for each mode and compared them to the system design temperatures. In startup and power operation, the highest CCWS supply temperature was calculated to be 118°F assuming one CCWS heat exchanger is out of service. In this alignment, CCW flow to the RHR heat exchangers is required to be throttled to prevent runout of one CCW pump and the CCWS supply temperatures are manually controlled to a value equal to or less than 120°F. The highest CCWS supply temperature was calculated to be 215°F at the RHR heat exchanger outlet during the post-LOCA initial switchover to sump recirculation which is higher than the original CCWS design temperature of 200°F. The licensee justified this increase as follows: (1) the post-LOCA mode of RHR operation is a fault condition, and as such does not constitute a revision to the design temperature of the RHR heat exchanger which is based on continuous use rather than transient conditions, (2) the fluid leaving the RHR heat exchanger would remain subcooled and remain in single phase flow, and (3) the highest outlet temperature of the RHR heat exchanger is of a short duration since the containment sump temperature would decrease with time as the decay heat level drops.

The staff has reviewed the CCWS thermal/hydraulic analysis and finds that the licensee has adequately analyzed the heat removal capability of the CCWS for the increased SW temperature limit and properly justified the acceptability of a higher CCW supply temperature. The staff, therefore, finds the licensee's analysis acceptable.

2.1.2 Residual Heat Removal System

The licensee evaluated the ability of the RHR system to provide normal and post-fire 10 CFR Part 50, Appendix R, cooldown of the plant and to maintain subcooling of the sump fluid during post-LOCA recirculation. During normal cooldown, RHR is used to remove decay heat and sensible heat from the reactor coolant system (RCS) from approximate 350°F to 200°F for plant cooldown, or to 140°F for refueling. As the SWS temperature rises, the cooldown capability of the RHR declines and the time required to cool the plant increases. The licensee applied the Westinghouse computer code RHRCOOL to simulate the plant cooldown transient and calculated pressure, temperature and flow distribution for the RHR flow network. The licensee recalculated the FSAR design basis normal cooldown time with a SWS inlet temperature of 75°F, 85°F, and 95°F. The results showed that the RCS cooldown times from a temperature of 350°F to 140°F were 19, 32, and 59 hours, respectively. The licensee stated that the throttle valves used to control CCW flow to the RHR heat exchangers will be repositioned to allow for an adequate plant cooldown rate.

The proposed Technical Specifications require the plant to be in hot shutdown within seven hours and in cold shutdown within the following 30 hours if the Limiting Condition for Operation for SW temperature of 95°F or less is not met. Shutdown can be terminated if the temperature falls below 95°F. In a telephone conversation the licensee stated that the plant can be brought to cold shutdown (200°F) from hot full power in 33 hours with all auxiliary loads on the SWS and in 23 hours with all loads dropped off. Thus, the licensee has flexibility to meet the required shutdown times in the Technical Specifications by adjusting the flow through the system. The staff finds these shutdown times acceptable.

The licensee calculated minimum subcooling capability for the recirculation sump fluid assuming a 5% surface area reduction and fouled heat transfer coefficient for the RHR heat exchanger as well as the higher cooling water temperature at the initiation of recirculation following a LOCA. The analysis indicated that at least 30°F of subcooling from the RHR is available to the recirculation sump fluid under the assumed flow conditions. Thus, the containment sump water would remain be subcooled. The staff finds this acceptable.

The licensee also analyzed the RHR system against the fire protection program (Appendix R) cooldown criteria with a CCW supply temperature increased to 125°F and one RHR heat exchanger in operation because system flow must be controlled to within the runout capability of a single CCW pump. The result showed that the plant can achieve cold shutdown within 72 hours provided that (1) total CCWS flow is greater or equal to 4500 gpm, (2) CCWS flow greater than or equal to 3500 gpm is directed to the one operable RHR heat exchanger, and (3) the RHR system is initiated at approximately 29 hours after plant shutdown. The staff finds the licensee's analysis conservative, and the approach to achieving Appendix R cooldown within the 72-hour requirement is acceptable.

2.1.3 Spent Fuel Pit Cooling

CCW is provided to the shell side of the spent fuel pit (SFP) heat exchanger to remove decay heat generated by the spent fuel assemblies in storage. The SFP temperature is a function of CCW supply temperature, CCW flow rate, and SFP heat load. The licensee calculated the SFP bulk temperature assuming a SW inlet temperature of 95°F. The result showed that the SFP is capable of being maintained below the concrete design temperature of 150°F for normal refueling discharge conditions. The highest SFP temperature occurs during the initial discharge of spent fuel to the SFP during plant refueling. The maximum SFP temperatures for a normal one-third and abnormal full core discharge were calculated to be 128°F and 153°F, respectively. The abnormal heat load temperature is slightly higher than the 150°F concrete temperature limit.

Therefore, the licensee committed to maintain the SFP temperature within the design limit by manually adjusting CCW flow to the SFP heat exchanger and throttling other system valves to equipment which is not required to operate during refueling when the fuel core is offloaded. The staff finds this acceptable.

2.2 Safety-Related Components Cooled by The SWS

2.2.1 Reactor Containment Fan Coolers

The SWS provides cooling for the reactor containment fan cooler (RCFC) units which in turn cool, filter, and recirculate the containment atmosphere during normal operating and post-accident conditions. The licensee evaluated the RCFC heat removal capability for containment temperatures ranging from 130°F to 300°F using the Westinghouse computer code HECO. The result showed that the RCFC can maintain the normal containment temperature below the 130°F limit with 95°F service water. The licensee will monitor the containment temperature during normal power operation to ensure that the maximum allowable containment temperature is (130°F) not exceeded. The licensee also used the calculated RCFC heat removal rate for the containment integrity analysis. The analysis indicated that the RCFC is adequate to maintain the containment pressure and temperature within design limits during accident conditions. The staff finds the licensee's evaluation to be acceptable.

2.2.2 RCFC Fan Motor Heat Exchanger

The licensee evaluated the RCFC fan motor heat exchanger to determine the maximum motor winding temperature with 95°F service water. The analysis indicated that the motor winding temperature will be maintained within acceptable limits resulting in no degradation of the fan motor life. The staff finds this acceptable.

2.2.3 RCFC SW Return Radiator Monitor

The RCFC SW return radiation monitors are used to detect radiation leakage from the containment into the SW return line thru the RCFCs and motor coolers. The licensee evaluated the radiation monitor performance and found that the SW temperature to 95°F has only a very minor impact. The licensee stated that the ratio of supply-side SW flow to return-side SW flow into the mixing nozzle will be regulated to protect the radiation monitors from excessive temperatures during post-accident conditions. The staff finds this acceptable.

2.2.4 Emergency Diesel Generator

The plant has three emergency diesel generators (EDGs). The diesel engine jacket water coolers and the lube oil coolers are cooled by SW flow. The licensee evaluated the diesel engine performance for the higher SWS temperature and indicated that the emergency diesel generator lube oil cooler and jacket water cooler temperatures will be maintained within the limits recommended by the manufacturer. The staff finds this acceptable.

2.2.5 Instrument Air Compressors

The SWS provides cooling to the instrument air compressor aftercooler and cylinder jackets through the instrument air closed cooling water system. Westinghouse performed a heat balance calculation on the heat exchangers of the closed cooling water system and found that the instrument air system will function as designed and within original design temperature limits for a SWS temperature of 95°F. In order to ensure the validity of the calculations, the licensee will monitor compressor performance by initiating a surveillance program to record temperatures at various locations of the closed cooling water system. The staff finds this proposal acceptable.

2.2.6 Control Room Air Conditioners

The air conditioning (A/C) system for the control room is an essential system for maintaining a room temperature of 75°F for personal comfort and equipment operation. The licensee's evaluation indicated, with 95°F service water the room temperature would increase from 72°F to 73°F which is still below the allowable temperature of 75°F. The staff finds this acceptable.

2.2.7 Component Cooling Heat Exchangers

The SWS cools the CCWS via the tube side of the CCWS heat exchangers during all modes of plant operation. The design temperature and pressure of the CCWS are 200°F and 150 psig, respectively, corresponding to a SW flow rate of 5313 gpm. The licensee evaluated the heat removal ability of the CCWS heat exchangers with a 95°F SW inlet temperature and calculated the maximum SW outlet temperature to be 140°F which is below the design limit of 200°F.

The maximum CCW flow through the CCWS heat exchanger shell-side occurs when two CCW pumps are operating and one CCWS heat exchanger is out of service. The licensee calculated the maximum flow to be 7500 gpm which is higher than the design flow of 4920 gpm. The licensee performed a flow induced tube vibration analysis and found that neither the CCW heat exchangers nor the excess letdown heat exchanger are subject to excessive tube vibration when exposed to the maximum flow of 7500 gpm. The licensee also revised the CCWS operating procedure to incorporate this new flow rate. The staff finds this acceptable.

2.3 Components Cooled by The CCWS

2.3.1 Safety Injection Pumps

The safety injection (SI) pumps operate during the injection and recirculation phases following a LOCA. An increased CCW temperature would result in increased lube oil temperatures at both the inlet and outlet of the pump bearings. Since the SI fluid pumped during injection phase is cold water from the Refueling Water Storage Tank (RWST), the cooling requirements during the injection phase are not as severe as during the recirculation phase. Following the switchover to recirculation, the CCW supply temperature would increase from 110°F to 140°F, then reduce to 124°F within 36 hours as core decay heat decreases. The licensee evaluated the SI pump performance at the above temperatures and found that the post-LOCA recirculation condition has little effect on the pumps mechanical seal life expectancy. Therefore, the licensee stated, based on the vendor's analysis, that adequate cooling would be provided to support long term operation of the SI pumps. The staff finds this acceptable.

2.3.2 SI Recirculation Pumps

The SI recirculation pumps operate during a LOCA. The increased CCW temperature will result in increased motor stator winding and bearing temperatures. The licensee stated that these motors were qualified for a containment temperature of 324°F and the peak containment temperature was recalculated to be below the current equipment qualification temperature of 287°F. Therefore, the SI recirculation pumps are not adversely effected. The staff finds this acceptable.

2.3.3 Residual Heat Removal Pumps

The RHR pumps operate during normal plant cooldown and also provide a backup to the SI recirculation pumps during post-LOCA recirculation. The RHR pump mechanical seal coolers are cooled by CCW shell side flow. The licensee's analysis indicated that the RHR pump mechanical seals will be subjected to a peak CCW temperature of 140°F, reducing with time. The licensee stated that the mechanical seals were qualified for a temperature of 300°F. Therefore, the increased CCW temperature will have little effect on mechanical seal life expectancy. The staff finds this acceptable.

2.3.4 Charging Pumps

The charging pumps use CCW to cool the oil in both the Gyrol drive oil cooler and the pump lube oil cooler. During the most limiting normal operating conditions, the cooling water flow rate to the Gyrol cooler would be a minimum of 82 gpm at a temperature of 118°F which is within the recommended normal limits. The most limiting abnormal operation would be following a postulated plant fire (Appendix R) cooldown when the maximum CCW supply temperature is 125°F. At this temperature, CCW flow must be maintained at or above 85 gpm to ensure adequate cooling. The licensee stated that this cooling flow would be maintained by manually repositioning the CCW throttle valves to the RHR heat exchangers in order to provide greater flow to the charging pumps. The staff finds this acceptable.

2.3.5 Reactor Coolant Pumps

Cooling water is provided to three coolers on the RCPs during normal operation. These are the pump thermal barrier cooler and the motor upper and lower bearing coolers. Oil is used to transfer heat from the bearings to the CCW fluid. The required CCW flow as a function of CCW supply temperature for the thermal barrier cooler was provided by the pump vendor and operation with a CCW supply temperature equal or less than 105°F is considered acceptable. The licensee's analysis indicated that the CCW temperature would rise to 105°F assuming a SWS temperature of 95°F. The licensee stated that if the CCW temperature exceeds 105°F or a RCP upper bearing high temperature alarm occurs, a second CCW pump would be started. The calculated cooler flows with two CCW pumps are within the maximum recommended flow limit. Thus, the licensee indicated that adequate CCW flow to each cooler will be maintained at all times. The staff finds this acceptable.

2.3.6 Reactor Vessel Support Cooling Blocks

The reactor vessel supports are cooled by CCW flow through the support cooling block to keep the concrete temperature at or below 150°F. The original design CCW flow was 3 gpm at 91°F. The licensee calculated the minimum CCW flow required at a maximum CCW temperature of 120°F to be 5 gpm. This is less than the minimum delivered flow of 9 gpm. The staff finds this acceptable.

2.3.7 Sample Heat Exchangers

Sampling capability is required during normal and post-accident operations. The CCW provides cooling to the following sample heat exchangers: pressurizer liquid and vapor sample coolers, reactor coolant sample cooler, and steam generator blowdown sample coolers. CCW flow passes through the shell-side of these coolers to cool the high temperature, high pressure samples on the tube-side. The design CCW flow is 14 gpm and the design inlet and outlet temperatures are 105°F and 125°F respectively. The licensee calculated the minimum CCW flow to be approximately 13 gpm at a CCW supply temperature of 105°F with one CCW pump in operation. The licensee indicated that a second CCW pump would be started if the CCW supply temperature exceeds 105°F. The staff finds this acceptable.

2.3.8 Waste gas compressors

CCW provides cooling to the waste gas compressor seal water during normal operation at a design normal flow of 42.5 gpm at 105°F. The minimum cooling requirement defined by the vendor is at a flow rate of 25 gpm at 105°F. The licensee's analysis indicated that the 105°F temperature limit will be exceeded assuming 95°F service water. The worst flow conditions will range from 32 gpm to 54 gpm at temperatures up to 118°F. The licensee stated that the waste gas compressor would operate satisfactorily with slightly reduced performance when supplied with CCW at up to 110°F. The licensee committed to maintain the maximum CCW temperature within the 110°F limit. The staff finds this acceptable.

2.3.9 Nonregenerative Heat Exchanger

The chemical and volume control system (CVCS) nonregenerative heat exchanger is used to cool reactor coolant to 130°F prior to purification during normal operation. The CCW flow through the shell-side of the heat exchanger is automatically controlled to maintain the tube outlet temperature to below the

127°F alarm setpoint. The licensee stated that the heat exchanger outlet temperature can be maintained below the 127°F alarm setpoint at a maximum CCW supply temperature of 118°F. When the outlet temperature exceeds 130°F, a control room alarm would occur and maximum letdown would be discontinued. The staff finds this acceptable.

2.3.10 Excess Letdown Heat Exchanger

The CVCS excess letdown heat exchanger is provided as a backup reactor coolant letdown flow path during power operation in the event normal letdown is not available. The design CCW inlet temperature is 95°F and the design CVCS inlet and outlet temperatures are 555°F and 195°F respectively. When the excess letdown heat exchanger (CVCS) outlet temperature reaches 200°F, a control room alarm is sounded. The licensee stated that reactor coolant flow through the excess letdown heat exchanger will be manually controlled to reduce the CVCS outlet temperature to below 200°F, or a second CCW pump will be started to increase CCW flow. The staff finds this approach acceptable.

2.3.11 Seal Water Heat Exchanger

The CVCS charging pumps deliver seal water injection to each RCP at a rate of 8 gpm per pump. The RCP seal leakoffs and excess letdown heat exchanger process flow are directed to the Volume Control Tank (VCT) via the Seal Water Heat Exchanger (SWHX). The design CCW inlet temperature to the SWHX is 105°F and the design CVCS inlet and outlet temperatures are 144°F and 127°F, respectively. The licensee calculated the minimum CCW flow to the SWHX at the increased SW temperature and found that the SWHX is capable of maintaining the CVCS process flow within recommended limits. The staff finds this acceptable.

2.4 Containment Integrity Analysis

Since the containment recirculation sump water is cooled by RHR, which in turn is cooled by the CCWS and ultimately the SWS, the increased SWS temperature will affect the results of the containment integrity analyses. The licensee reanalyzed containment pressures and temperatures for the design bases LOCA and main steamline break (MSLB) events assuming (1) an initial containment temperature of 130°F, (2) minimum safety injection with a 6-second time delay, and (3) zero percent concentration from the boron injection tank. The analytical model and methodology used in this reanalysis are consistent with that discussed in the FSAR. The peak containment pressure for the LOCA and MSLB were calculated to be 40.3 psig and 42.42 psig, respectively, which remain below the containment design pressure of 47 psig. The licensee committed to maintain the containment ambient temperature within the 130°F limit, or a plant shutdown is required by the TS. The licensee also evaluated the impact on equipment qualification (EQ) resulting from the increased maximum containment temperature and found that the peak containment temperature is still below the current EQ envelope temperature of 287°F.

Based on the above, the staff finds that the impact of the increased SWS temperature on containment pressure and temperature transients is minor, and the licensee's revised containment integrity analysis is acceptable.

3.0 SUMMARY

The staff has reviewed the licensee's submittals for the proposed increase in service water temperature and containment temperature limits. Based on this review, the staff concludes that adequate SWS cooling can be provided at the proposed 95°F temperature limit for normal and post-accident heat removal requirements because adjustments in system flow to various system users can be made as necessary to ensure adequate heat removal for proper equipment operation. The equipment or systems which may require CCW and SW flow adjustments include: (1) Component Cooling Water System, (2) Residual Heat Removal System, (3) Spent Fuel Pool Cooling System, (4) RCFC SW Return Radiation Monitors, (5) Charging Pumps, (6) RCP Coolers, (7) Sample Heat Exchangers, (8) Waste Gas Compressors, (9) Nonregenerative Heat Exchanger, and (10) Excess Letdown Heat Exchanger. The licensee's analysis are, therefore, acceptable. The staff also concludes that the licensee's containment integrity analysis which demonstrated satisfactory normal and post-accident containment performance at the greater SWS temperature limit is acceptable. The staff, therefore, concludes that the requirements of GDC 44 for ensuring adequate cooling water capability and GDC 50 for ensuring adequate containment integrity are met, and the proposed TS changes to incorporate the greater containment and SWS temperature limits are acceptable.

4.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change in a requirement with respect to the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR Sec 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

5.0 CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Dated: May 7, 1990

PRINCIPAL CONTRIBUTOR:
J. S. Guo, SPLB