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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 149 TO FACILITY OPERATING LICENSE NO. DPR-26

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

DOCKET NO. 50-247

1.0 INTRODUCTION

By letter dated July 13, 1989, Consolidated Edison Company of New York, Inc. (the licensee) requested an amendment to the Technical Specifications (TS) for Indian Point Nuclear Generating, Unit No. 2 (Indian Point 2). The proposed TS amendment would increase the design basis ultimate heat sink (UHS) temperature from 85°F to 95°F and increase the maximum containment temperature limit from 120°F to 130°F. The analyses for this proposed amendment were performed at reactor core power levels of up to 3071.4 MWt, the power level approved in License Amendment No. 148, issued on March 7, 1990. Accordingly, the licensee proposed revisions to the Limiting Conditions for Operation (LCO) in TS Sections 3.3.F.4, 3.3.F.5, and the associated Bases 3.3 and 4.4. Certain editorial changes were also proposed consistent with the 10°F increase in the UHS temperature limit. The licensee assessed the impact of increased UHS temperature on the ability to cool the plant under both normal operation and accident conditions. A safety evaluation was performed by Westinghouse for the licensee and was documented in Westinghouse topical report, WCAP-12312, "Safety Evaluation for an Ultimate Heat Sink Temperature Increase to 95°F at Indian Point 2."

The Indian Point 2 service water system (SWS) draws water from the Hudson River (i.e., the ultimate heat sink) to (1) cool various safety related and nonsafety related components thus ensuring component operability, (2) dissipate reactor heat following an accident, and (3) maintain the plant in a safe shutdown condition. The warmed cooling water is returned to the river.

In the summer of 1988, the service water (SW) inlet temperature occasionally rose higher than the documented design limit of 85°F necessitating the need for emergency TS relief. An emergency temporary TS amendment was approved to allow continued operation of the plant with SWS inlet water temperature of up to 90°F (approved by License Amendment No. 135, which was issued on August 19, 1988 and which expired on October 1, 1988).

On July 26, 1989, the licensee requested that the July 13, 1989 amendment request be issued as an emergency TS change since the SWS inlet water temperature had briefly exceeded the 85°F limit again on July 25, 1989. On July 27, 1989, the NRC staff issued a temporary waiver of compliance to permit the licensee to continue to operate Indian Point 2 at up to 100% rated thermal power with SWS inlet water temperatures of up to 90°F and with containment air temperatures of up to 130°F. The temporary waiver of compliance was effective immediately and was to remain in effect until the NRC staff completed processing of the licensee's request for an emergency TS change. On August 2, 1989, the staff orally notified the licensee that its review of the July 13, 1989 submittal would not be completed in sufficient time to issue the requested emergency TS change. Therefore, the licensee submitted an emergency TS change request on August 3, 1989, to increase the allowable SWS inlet water temperature from 85°F to 90°F and to increase the allowable containment air temperature to 130°F. Approval of the temporary waiver of compliance and the subsequent emergency TS amendment (License Amendment No. 143, issued on August 7, 1989) was based on the staff's analysis performed for License Amendment No. 135 which was for 90°F SWS inlet water temperature rather than the 95°F temperature requested in the July 13, 1989 submittal. The July 13, 1989 proposed TS change for 95°F SW inlet temperatures would again set up a margin for the SW inlet temperature to prevent a plant shutdown should abnormally hot weather conditions recur.

In the July 13, 1989 submittal, the licensee evaluated the systems and components cooled by the SWS for their ability to support safe plant operation and shutdown during normal, abnormal, and post accident conditions with a maximum SWS inlet temperature of 95°F. The staff's evaluation of the licensee's submittal is discussed below.

2.0 EVALUATION

2.1 Component Cooling Water System

The SWS provides cooling to the Component Cooling Water System (CCWS) which in turn cools various components needed for safe 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 heat removal capability of the CCWS and developed a thermal/hydraulic model for the CCWS flow network. The licensee analyzed the hydraulic performance of the CCWS using the Westinghouse computer program PEGISYS and assumed that system flow can be adjusted to the various components served by operating component throttle valves as necessary to ensure adequate cooling and protect against pump runout in the event of an accident. The original design of the CCWS was based on having all component throttle valves in a single position. In a post-LOCA alignment, the licensee assumed a single CCW pump delivering flow to the RHR heat exchangers and other system users because only one CCW pump is available with loss of offsite power concurrent with an accident and a single active failure. Based on this assumption, the licensee calculated minimum and maximum allowable pump flow rates, i.e., a minimum of 1275 gpm flow to one RHR heat exchanger and maximum of 5400 gpm flow to both RHR heat exchangers to prevent pump runout. The staff has reviewed the licensee's hydraulic analysis of the CCWS flow network and finds that the analysis is conservative for demonstrating proper CCW pump performance.

The licensee also analyzed CCWS thermal performance with PEGISYS. Since the RHR heat exchangers are the major heat load on the CCWS during plant cooldown, refueling, and post-LOCA recirculation, the licensee modeled the RHR heat exchanger and evaluated the capability of the CCWS to transfer heat from the RHR systems during the recirculation mode when the heat transfer rate of the RHR heat exchangers is not manually controlled. CCW is also used to cool ECCS pumps during post-LOCA recirculation. In this mode, sump water temperature has a direct effect on CCW supply temperature. The licensee evaluated containment sump performance using several assumptions which maximize sump water temperature and also performed a containment integrity analysis using these assumptions to maximize containment temperature and pressure.

Since CCWS is required to be in operation during all plant modes, the licensee calculated the CCW supply temperature to the components served for various alignments. The result showed that the CCW supply temperature would decrease proportionally with increased SWS flow rate and the maximum CCW supply temperature would occur when one of the CCW heat exchangers is out of service. The highest CCW temperature resulted from either maximum containment sump heat input to the CCWS, or low CCW flow to the RHR heat exchangers. This temperature was found to be 203°F at the shell side of the RHR heat exchanger which is slightly higher than the original CCWS design operating temperature of 200°F. The licensee stated that the calculated CCW temperature is based on the post-LOCA mode, and as such does not constitute a revision to the operating design temperature of the RHR heat exchangers which is based on continuous use rather than transient conditions. The maximum allowable design temperature of the CCWS piping is 250-500°F at the low pressure portion of the system under transient condition. With decreasing containment sump temperature as post-accident decay heat levels drop, CCW temperature in excess of the normal operating design limit for short time periods should have an insignificant impact on component integrity.

The staff has reviewed the CCWS thermal analysis and finds that the licensee has adequately analyzed the heat removal capability of the CCWS.

2.2 Residual Heat Removal System

The licensee evaluated the ability of the residual heat removal (RHR) system to provide normal and post-fire (Appendix R) cooldown of the plant, and to maintain subcooling of the sump fluid during post-LOCA recirculation. During normal cooldown, the RHR is used to remove decay heat and sensible heat from the reactor coolant system from approximately 350°F to 200°F for plant cold shutdown, or to 140°F for refueling. As the SWS temperature rises, the cooldown capability of the RHR system declines and the time required to cool the plant increases. The licensee applied Westinghouse computer code RHRCOOL to analyze the plant cooldown transient and calculated the pressure, temperature, and flow distribution for the RHR flow network. The result indicated that the times required to reach the cold shutdown temperature and refueling temperature under the worst case conditions were

29 hours and 83 hours respectively. TS 3.0.1 requires that the plant be in cold shutdown (200°F) within 30 hours from hot shutdown (350°F) if an LCO is not met. In addition, Appendix R requires that the plant be capable of achieving cold shutdown within 72 hours. The licensee's analysis shows that the TS limits can be met. Further, the changes in cooldown rate will not impact the plant's ability to achieve cold shutdown within 72 hours following an Appendix R fire. The staff finds this analysis to be acceptable.

In the post-LOCA alignment, the licensee assumed a single CCW pump was available to deliver flow to both RHR heat exchangers and other system users, and to define maximum flow to system users at maximum pump performance based on a minimum pump header pressure. Because CCW flow through the RHR heat exchangers must be increased to maintain the RHR heat exchanger outlet temperature within the design limit, flow to other users must be reduced to prevent CCW pump runout. Since the containment sump water is required to be subcooled to prevent flashing in the reactor vessel, the licensee evaluated the recirculation sump performance and indicated that adequate subcooling from the RHR heat exchangers is available to the recirculated sump fluid under the assumed flow conditions. The staff finds this analysis to be acceptable.

2.3 Containment Integrity Analyses

Because the SWS provides cooling to the RHR system through the CCWS, the higher SWS temperature will affect the containment integrity analysis for accident conditions. The licensee performed containment pressure and temperature analyses for a LOCA and main steam line break using the Westinghouse computer program COCO. The containment was modeled assuming an initial containment temperature of 130°F and a SWS temperature of 95°F. The analyses indicated that the calculated peak pressures and temperatures for both design basis accidents are below current design limits. The staff therefore, finds that the increased SWS temperature has no adverse impact on post-accident containment pressure and temperature.

2.4 Turbine/Generator Cooling

The SWS provides cooling to several components that are required to support operation of the turbine/generator, i.e. main turbine oil coolers, generator hydrogen coolers, generator seal oil coolers and generator stator cooling water coolers. These coolers are not safety related components, but sudden failure of the turbine/generator could lead to a loss of external electrical load transient. The licensee evaluated cooler performance and found that cooling with 95°F SW will not increase the probability of a loss of load transient. The staff finds the licensee's evaluation to be acceptable.

2.5 Reactor Containment Fan Coolers

The SWS provides cooling for the reactor containment fan coolers (RCFC) which in turn cool, filter, and recirculate containment atmosphere. The licensee evaluated the RCFC performance during design basis accident conditions and found that the heat removal capability of the RCFCs supplied with 95°F service water is sufficient to absorb the energy releases and maintain the peak containment pressure below the containment design pressure. The licensee also evaluated RCFC motor heat exchangers and SWS return line radiation monitor and found that they can function properly with 95°F service water.

The RCFC are also required to maintain equipment operability inside containment during normal operation. However, the licensee stated that the RCFC may not be able to maintain the normal containment temperature below the current 120°F limit with 95°F service water. The licensee has, however, analyzed the effect of the increased containment temperature limit of 130°F on safety-related equipment aging, and has determined that it is negligible. Thus, despite the potential difficulty in maintaining plant operations at the higher limit, the staff finds it acceptable since plant shutdown is required by the technical specification if the limit is exceeded.

2.6 Diesel Generators

The plant has three emergency diesel generators (EDGs) which receive cooling from the SWS to cool the diesel engine jacket water cooler and the lube oil cooler. The licensee evaluated diesel engine performance and indicated that the emergency diesel generator jacket water and lube oil coolers are capable of providing the necessary cooling to the diesel generators with a service water temperature up to 95°F. The staff finds this acceptable.

2.7 Instrument Air Compressors

The instrument air compressors are cooled by the SWS. The licensee performed a heat balance calculation on the heat exchangers of the instrument air closed cooling water system and found that the compressor cooling water outlet temperature would increase about 10°F above the original design value to approximately 125°F. The licensee justified that a margin of about 30°F between the normal operating temperature of the compressor cooling water (120°F) and the high temperature trip set point (150°F) is sufficient to maintain adequate instrument air compressor performance. Thus, the increased service water system temperature will not adversely effect instrument air system operation. The staff finds this acceptable.

2.8 Component Cooling Water Heat Exchangers

The SWS cools the CCWS via the CCW heat exchangers during all modes of plant operation. The CCW flows through the shell side and SW flows through the tube side of the CCW heat exchanger. The design temperature and pressure of the CCW heat exchanger are 200°F and 150 psig respectively. The licensee's analysis with 95°F service water indicated that the highest CCW return temperature at the CCW heat exchanger tube-side outlet was 163°F which is lower than the design limit. The staff finds, therefore, that the CCW heat exchangers will function properly under the increased service water system temperature.

2.9 Other Components Cooled by the CCWS

In addition to the above, the licensee evaluated the integrity of various coolers and heat exchangers cooled by the CCWS assuming the 95°F service water temperature. The following components have been evaluated based on the maximum flow rate and temperature of the CCWS:

2.9.1 Recirculation Pump Cooling

The safety injection recirculation pumps (SIRPs) operate only during a LOCA. The SIRP motors are enclosed water to air cooled motors. The increased CCW supply temperature will cause the motor stator winding and bearing temperatures to increase. These motors were qualified for a containment ambient temperature of 324°F while the maximum containment accident temperature was calculated to be 261°F. Therefore, the staff finds that the SIRPs are capable of performing their safety function during LOCA conditions.

2.9.2 Safety Injection Pump Cooling

The safety injection pumps (SIPs) operate during the injection and recirculation phases following a LOCA. The SIP mechanical seal coolers, mechanical seal jacket coolers and a lube oil cooler are cooled by CCW through a common header. Increased CCW temperature will result in increased oil temperature for the pump bearings, increased pump seal wear, and reduce seal life. The maximum pump suction temperature occurs at the beginning of the recirculation phase, reducing with time. The licensee stated that the increased service water temperature would have little effect on bearing performance or reduction in seal life expectancy since the changes are within the pump operation design limits. The staff finds this acceptable.

2.9.3 RHR Pump Cooling

The RHR pumps operate during the normal cold shutdown phase of plant shutdown and during the post-LOCA injection phase. The RHR pump mechanical seals will be subjected to a peak post-LOCA pump suction temperature of 250°F and a peak CCW temperature of 134°F, both temperatures reducing with time. For Appendix R cooldown operation, the RHR pump suction temperature will be above 300°F for about 12 hours longer than during normal cooldown. The licensee stated that the RHR pump mechanical seals are qualified for operation at these conditions without adversely impacting pump performance. The staff finds this acceptable.

2.9.4 Charging Pumps Cooling

The charging pumps provide reactor coolant makeup and reactor coolant pump (RCP) seal injection during normal operation and during plant cooldown following postulated accidents other than a LOCA. CCW provides cooling to the charging pumps Gyrol drive oil cooler and lube oil cooler. The licensee calculated the maximum CCW temperature to the charging pump for normal operation to be 118°F with 95°F service water. This value is higher than the recommended CCW temperature of 110°F. The licensee indicated, however, that flow rate adjustments will be made to maintain the proper charging pump cooling water temperature. The staff finds this acceptable.

2.9.5 Reactor Coolant Pump Cooling

The RCP bearing and thermal barrier coolers are cooled by the CCWS. The licensee indicated that the recommended maximum CCW temperature is 110°F for continuous RCP operation. The licensee stated that CCW flow to the RCP can be adjusted to maintain the bearing temperatures within design limits, thereby reducing the chance of a sudden bearing failure. The staff finds this acceptable.

2.9.6 Spent Fuel Pit (SFP) Cooling

CCW is provided to the shell side of the SFP heat exchanger to remove decay heat generated by spent fuel assemblies in storage. The SFP temperature is a function of CCW supply temperature, CCW flow rate, and SFP heat load. The licensee performed a parametric study to evaluate SFP heat exchanger performance. The result indicated that the SFP is capable of being maintained below the concrete design temperature of 150°F for a normal refueling discharge with a 120°F CCW inlet temperature to the SFP heat exchanger. If an increase in service water system temperature results in a CCW temperature above 120°F during refueling, CCW flow to the SFP heat exchanger can be increased by isolating other system users which are not operating during refueling in order to maintain the SFP temperature within the 150°F limit. The staff finds this approach acceptable.

2.9.7 Reactor Vessel Support Cooling

The reactor vessel support cooling blocks are cooled by CCW flow to ensure that the concrete temperature is maintained at or below 150°F. The licensee's analysis indicated that sufficient CCW flow can be provided with a service water temperature of 95°F to maintain the 150°F limit without changes in flow alignment. The staff finds this to be acceptable.

2.9.8 Sampling Heat Exchangers

Sampling capability is required during normal and post accident conditions. There are three sampling heat exchangers cooled by the CCWS, the pressurizer liquid and vapor, reactor coolant, and steam generator blowdown sample coolers. The licensee indicated that their analysis showed that some adjustment in CCW flow may be necessary to maintain proper sample temperatures. The staff finds this acceptable.

2.9.9 Waste Gas Compressors

The waste gas compressor uses CCW to cool the mechanical seals. It is required only during normal operation and has no safety function. The licensee stated that waste gas compressor performance would be slightly reduced when supplied with 110°F CCW. However, the licensee stated that CCW flow can be increased above the normal design flow to compensate for CCW temperature increases. The staff finds this acceptable.

2.9.10 Non-Regenerative Heat Exchanger

The CVCS non-regenerative heat exchanger is used to cool reactor coolant to approximately 130°F prior to purification. CCW flow to the non-regenerative heat exchanger is automatically controlled to maintain the outlet process temperature to approximately 127°F. The licensee stated that when the heat exchanger outlet temperature exceeds 130°F, automatic isolation of the letdown flow is provided to prevent maximum letdown. The staff finds this acceptable.

2.9.11 Excess Letdown Heat Exchanger

The CVCS excess letdown heat exchanger is provided as a backup letdown flowpath during normal operation in the event the normal letdown flowpath is not available. The design CCW inlet temperature at the tube side of the heat exchanger would be exceeded with a SW temperature of 95°F. The licensee stated that a control room alarm is provided to alert the operators of a high excess letdown heat exchanger outlet temperature and reactor coolant flow through the excess letdown heat exchanger could be manually reduced to limit the outlet temperature below the alarm setpoint. The staff finds this acceptable.

2.10 Summary

The staff has reviewed the licensee's submittal for the increased service water and containment temperature limit of 95°F and 130°F respectively. 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 various heat load adjustments in system flow to various equipment including isolation of certain components can be made as necessary. The equipment for which component cooling water system and/or letdown system flow adjustments may be required include (1) charging pump cooling, (2) reactor coolant pump cooling, (3) spent fuel pit cooling, (4) sampling heat exchangers, (5) waste gas compressors, (6) non-regenerative heat exchanger, (7) excess letdown heat exchanger, and (8) RHR heat exchangers. The staff concludes that this approach is acceptable since appropriate procedures have been provided for this purpose. The staff also concludes that the licensee's analyses which demonstrated satisfactory normal and post-accident containment performance at the higher limit of 130°F are 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 technical specification changes are acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

This amendment changes 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 this amendment involves no significant change in the types or significant increase in the amounts 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 Section 51.22(c)(g). 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.

4.0 CONCLUSION

We have concluded, based on the considerations discussed above, that: (1) there is no 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: March 27, 1990

PRINCIPAL CONTRIBUTION:
J. S. Guo