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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 28 TO FACILITY OPERATING LICENSE NO. NPF-58

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY, ET AL.

PERRY NUCLEAR POWER PLANT, UNIT NO. 1

DOCKET NO. 50-440

1.0 INTRODUCTION

The Cleveland Electric Illuminating Company, Duquesne Light Company, Ohio Edison Company, Pennsylvania Power Company, and Toledo Edison Company are licensees for the Perry Nuclear Power Plant Unit No. 1.

On January 7, 1990, the Perry Nuclear Power Plant Unit 1 experienced a loss of feedwater transient and reactor scram which resulted in automatic initiation of High Pressure Core Spray and Reactor Core Isolation Cooling (RCIC) at level 2 in the reactor vessel. After approximately 37 minutes of operation, the RCIC system isolated because of indicated high differential temperature (delta-T) in the RCIC equipment room. The high delta-T trip measures the temperature between the RCIC room temperature and the downstream temperature of the RCIC room cooler cooling coils. It is intended to trip RCIC upon indication of a steam leak.

Investigation into the cause of the isolation by the licensees revealed that the trip was not caused by a steam leak in the RCIC equipment room but by a decreasing temperature indication at the RCIC room cooler thermocouple (of about 68-70°F) with a steady ambient room temperature of about 105-107°F. The RCIC room cooler cooling coils are cooled by the Emergency Closed Cooling (ECC) system which is in turn cooled by the Emergency Service Water (ESW) system whose temperature is highly dependent on lake water temperature. As lake temperature decreases, so does ESW temperature and correspondingly, ECC temperature. As ECC water is being supplied to the RCIC room cooler during the winter months (with lake temperatures as low as 32°F), air flow across the cooling coils causes the temperature, sensed by the downstream thermocouple, to decrease. During the January 7 event, the decrease was sufficiently low enough as to actuate the high delta-T trip even when no steam leak existed in the RCIC equipment room.

On January 19, 1990, the licensees submitted a TS change request pursuant to 10 CFR 50.91(a)(5) describing the emergency circumstances that existed and why they could not be avoided. The proposed change would delete the RCIC high delta-T isolation feature from the TS. Based upon discussions with the staff, the licensees modified their proposed TS change on January 26, 1990 to modify the trip setpoint for the RCIC high delta-T trip. The staff issued Amendment No. 26 to the licensees for Perry Unit 1 on January 31, 1990. This amendment

revised the RCIC delta-T trip but was only in effect until Lake Erie temperature reached 55°F.

2.0 DISCUSSION

The licensees performed analyses to determine one trip setpoint which could be used year-round, throughout the range of expected Lake Erie water temperatures, to provide automatic RCIC isolation if actual steam leaks of sufficient amount occur, but to prevent spurious RCIC isolation. First, a series of calculations was completed to determine the temperature rise in the RCIC Equipment Room following postulated steam leaks of various sizes. The calculations were performed using the personal computer version of the COMPARE computer code.* Some of the key input parameters used by the code were room volumes, initial room temperatures/pressures, initial relative humidity, steam leak rates, and relief areas from the rooms. Two flow models were used - Inertial Model, which is flow with inertia based on a solution of the one dimensional momentum equation, and Moody Flow Model, which is two-phased water critical flow based on F. J. Moody, "Maximum Flow Rate of a Single Component, Two Phase Mixture," February 1965. Sensitivity analyses were performed, varying the flow model, initial relative humidity, room cooling, and the flow path to the environment. For those calculations run with room coolers operating it was assumed that the RCIC room cooler cooling water exhaust valve was positioned to supply approximately 15 gpm flow from the ECC System at all times, even with cold lake temperatures. This was done so that repositioning of this valve would not be required seasonally due to lake water temperatures. The January 19, 1990 submittal had discussed that repositioning of this valve was difficult, and could have played a part in the undesired RCIC isolation on January 7. The licensees concluded that the Moody flow model yields the most conservative results while the other parameters varied in the sensitivity analyses do not have a significant effect on the analysis.

From these calculations, the licensees generated RCIC room temperature rise versus time graphs for various steam leak rates. These graphs indicated that for each steam leak rate the RCIC room temperature would reach a maximum temperature within 1 to 5 minutes (these graphs assumed no isolations of the RCIC system occur, in order to examine room temperature responses). Since this maximum RCIC air temperature would be sensed by the wall mounted temperature detector (T_{hot}) of the RCIC room delta-T circuit, this value could be used in determining valid delta-T setpoints for various lake water temperatures. Two extreme cases had to be considered--cold winter conditions, with only RCIC heat loads on ECC, and hot summer conditions, with other "post LOCA" heat loads on ECC. For the cold winter conditions, the temperature instrument located in

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* "COMPARE-MOD 1: A Code for Transient Analysis of Volumes with Heat Sinks, Flowing Vents, and Doors," LA-7199-MS, NRC-4, Los Alamos Scientific Laboratory, March 1978.

the RCIC room cooler exhaust (T_{cold}) would sense a minimum of 54°F based on a lake temperature of 33°F. For the hot summer conditions, the T_{cold} instrument would sense a maximum temperature of 101°F based on a lake temperature of 80°F. Having establishing T_{cold} for hot and cold conditions and using the T_{hot}'s discussed above, the licensees developed a series of delta-Ts for various steam leak rates for both cold and hot water temperature conditions.

Table 1 shows the delta-T values determined by the licensees using this method for various steam leak rates. As shown on the Table, for any given steam leak rate, the differential temperature sensed by the delta-T instrumentation would vary widely from the anticipated cold weather conditions to the hot weather conditions. For example, Table 1 shows that a 5 gpm steam leak would result in a 29°F delta-T during maximum anticipated summer conditions, but would result in a 76°F delta-T during minimum winter temperature conditions.

In order to establish one trip setpoint, the licensees determined a range of steam leak rates which were considered acceptable to meet regulatory requirements, and also prevent spurious trips even under various lake temperature conditions. It was determined that establishing a safety limit differential temperature of 102°F would establish the bounding leak rates for automatic isolation as a range from just above 15 gpm in winter to under 35 gpm in summer (see Table 1). From this safety limit value, an allowable value and trip setpoint were calculated taking into account instrument loop accuracies, instrument calibration accuracies, and instrument loop drift. These calculations established the allowable value at 97.2°F and the trip setpoint at 95.9°F.

The licensees considered several factors in selecting an isolation setpoint and allowable value corresponding to a 15-35 gpm range of leaks. First, the primary method provided in the RCIC Equipment Room for detection and isolation of small leaks is the RCIC Equipment Room Ambient Temperature isolation instrumentation. The ambient room temperature isolation is the primary method of detecting small steam leaks in the RCIC Equipment Room because it isolates the RCIC system on a steam leak of approximately 15 gpm irrespective of lake temperature. The RCIC Equipment Room Ambient Temperature instruments are independent, redundant instruments that also monitor for small steam leaks in the RCIC Equipment Room. The Technical Specification Trip Setpoint for the ambient instrumentation is 143.4°F. This is based on a safety limit value of 152°F. Based on the analysis described above for determining temperature rises in the RCIC equipment room for various steam leak rates, a leak of just above 15 gpm would increase the RCIC room temperature to the ambient safety limit value, regardless of the season. The delta-T instrumentation is consistent with this sensitivity level in the winter, and in the summer remains sufficiently sensitive to be bounded by the USAR analysis of the Main Steam Line Break (MSLB) outside containment discussed in USAR Section 15.6.4.

The RCIC room temperature rise analyses discussed above indicated that RCIC Equipment Room differential temperature would exceed the delta-T safety limit value of 102°F within 45 seconds with cold lake temperatures, and within 2.5 minutes with hot lake temperatures for a 35 gpm leak. The ambient detectors respond to provide an isolation even faster, with the ambient safety limit temperature being exceeded within 35 seconds for a 35 gpm leak. Even so, if it was assumed that a leak of 35 gpm continued for as long as 20 minutes prior to isolation, the resultant leakage released would be less than 4% of the leakage calculated in the MSLB analysis. Therefore, the whole body dose and the inhalation dose would be approximately 1.32% and .11% of 10 CFR Part 100 limits.

The licensees have stated that operators would respond to investigate either ambient or delta-T alarms in the RCIC Equipment Room, alarms which have setpoints lower than the isolation setpoints. The alarm setpoint for both the RCIC Equipment Room ambient and delta-T instrumentation will be established at approximately the 5 gpm range (as discussed above, for the delta-T Trip Setpoint, the alarm setpoint for delta-T will actually cover a range of steam leaks based on lake water temperature while the ambient alarm setpoint will detect at 5 gpm year-round). The operators would respond to these alarms by taking actions to determine if a steam leak exists in the RCIC pump room. Depending upon that determination, the operator would then take appropriate action. In determining the appropriate action, operators would take into account whether the RCIC system was currently responding to perform its design function and, if so, what other systems were available to perform a similar function. If the leak rate increased prior to the operator taking any manual action, the system would isolate at approximately 15 gpm due to the ambient temperature trip and at 15-35 gpm for the delta-T trip. As stated above, the licensees have analyzed that all cases would be bounded by the MSLB analysis in USAR Section 15.6.4.

The staff has reviewed the licensees' analyses and revised trip setpoint and allowable value. The staff has determined that the range of leaks which will cause the RCIC system to isolate are sufficiently small to be bounded by the existing accident analyses while providing adequate diversity of trip function for small break sizes of concern. Additionally, the setpoint and allowable value are sufficiently large to prevent spurious RCIC system isolations (no actual leakage occurs) during year-round operation. Procedures and alarm functions exist such that if a leak of smaller size were to occur, operators would be alerted and would respond in a timely fashion to identify the leakage and take appropriate action. Based on the above discussion, the staff finds the licensees' proposed Technical Specification change to be acceptable.

3.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change to 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 or a change to a surveillance requirement. 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 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.

4.0 CONCLUSION

The staff has 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.

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Dated: May 4, 1990

Attachment:
Table 1

TABLE 1

DIFFERENTIAL TEMPERATURES CALCULATED
FOR VARIOUS STEAM LEAK RATES

Leak Rate (GPM)	Calculated Ambient Temperatures	Calculated Differential Temperatures	
	Year-Round	Hot (Summer Conditions)*	Cold (Winter Conditions)*
5	130°F	29°F	76°F
10	146°F	45°F	92°F
15	150°F	49°F	96°F
25	166°F	65°F	112°F
35	226°F	125°F	172°F

* Hot summer conditions equate to a T_{cold} = 101°F, cold winter conditions equate to a T_{cold} = 54°F.