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SUBJECT: LER 89-011-00:on 890410,inoperable RVLIS due to misinterpretation of EQ submergence requirements.

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July 13, 1989

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Docket No. 50-316

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In accordance with the criteria established by 10 CFR 50.73 entitled Licensee Event Reporting System, the following report is being submitted:

89-011-00

Sincerely,

W. G. Smith, Jr.
Plant Manager

WGS:afh

Attachment

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U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
D. C. COOK NUCLEAR PLANT - UNIT 2	0 5 0 0 0 3 1 6	1 OF 0 6

TITLE (4) INOPERABLE REACTOR VESSEL LEVEL INSTRUMENTATION SYSTEM DUE TO MISINTERPRETATION OF EQ SUBMERGENCE REQUIREMENTS/MISCOMMUNICATION OF DESIGN SPECIFICATIONS

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 4	1 0	8 7	8 9	0 1 1	0 0	0 7	1 3	8 9	D.C. COOK PLANT-UNIT 1	0 5 0 0 0 3 1 5
										0 5 0 0 0

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	0 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
T. P. BEILMAN INSTRUMENTATION AND CONTROL DEPARTMENT SUPERINTENDENT	AREA CODE 6 1 6 4 6 5 - 5 9 0 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

Recently, Environmental Qualification (EQ) discrepancies were discovered in the installation of the Reactor Vessel Level Instrumentation System (RVLIS) in both units. These discrepancies have existed since the time the RVLIS was installed in both units in 1981.

On June 13, 1989, at 1630 hours the discrepancies were determined to have rendered the system outside of its design basis error allowances during post-accident conditions. This finding led to a determination that both trains of RVLIS in Units 1 and 2 had been inoperable. Since the limiting conditions for operation for post-accident instrumentation (Technical Specifications Sections 3/4.3.3.8 for Unit 1 and 3/4.3.3.6 for Unit 2) had unknowingly not been met, a violation of the Technical Specifications existed on both units.

Both trains of the RVLIS have now been restored to a condition of operability in both units.

Conditions Prior To Occurrence

Unit One in Mode 5 (Cold Shutdown).
Unit Two in Mode 5 (Cold Shutdown).

Description of Event

During Unit 2 refueling activities, a Quality Assurance audit, conducted on November 4, 1988, found that a Reactor Vessel Level Indication System (RVLIS) (EIIS-AB/LI) resistance temperature detector (RTD) (EIIS-AB/TM) cable splice box (junction box) (EIIS-AB/JBX) for the four-cable internal assembly did not have an outer heat shrink per the design drawing and as required by the Electrical Design Standard (EDS). The subject RTD is a part of the temperature compensation network in the RVLIS capillary tubes (EIIS-AB/TBG). The design installation requirements of the RVLIS RTD splice boxes are as follows:

> The 14 RVLIS RTD splice boxes in the trains of each unit are mounted inside the reactor containment building. Each splice box contains four cables which are individually spliced and fitted with a heat shrink over each splice and then wrapped with an additional heat shrink around the four wrapped cables. The outgoing cables run in a conduit to the reactor building penetrations (EIIS-NH/PEN).

The initial Engineering evaluation reviewed the Environmental Qualification Equipment List (EQEL), and found that the RVLIS RTDs were not included. The evaluation also reviewed documentation concerning the effect of RTD failure on the operability of the RVLIS. The evaluation did not indicate that the above condition had any significant adverse impact on the overall design basis accuracy requirements of the RVLIS.

Investigation of the cause of the discrepancy revealed that the organization responsible for installation of the RVLIS did not receive the EDS/design drawing specified for this particular installation. This cause led to the conclusion that the remaining RTD's specified on the EDS were also installed without the outer heat shrink. The RVLIS was determined to remain operable, even with the likely installation discrepancies of all RTD's, based on the conclusions of the initial Engineering evaluation. Corrective action was initiated for both units and scheduled to be performed during unit shutdown due to the inaccessibility of the junction boxes while at power.

On January 23, 1989, an inspection of all 14 splice boxes in Unit 2 confirmed that the outer heat shrink was missing in each of the 14 splice boxes. Outer heat shrink material was installed immediately, while Unit 2 was still in the refueling outage. Unit 2 resumed operation on March 17, 1989.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

Unit 1 was shut down for refueling on March 18, 1989. Inspection of the junction boxes on May 9, 1989 found all outer heat shrink to be missing and were installed at that time, before unit startup.

A more detailed technical evaluation was begun in April 1989 to quantify potential uncertainties in system errors with the as-found condition. This was performed due to increased concerns that the splices without the outer heat shrink, under harsh environmental conditions during or after an accident, may cause the RVLIS error uncertainties to be seriously impacted. After confirmatory discussions with Westinghouse in late April 1989 regarding potential Environmental Qualification (EQ) impact of the as-found condition, it was established for the first time that a failed RTD, e.g., due to water or water vapor ingress into the cables, could result in RVLIS overall errors in excess of the system design requirements.

During the subsequent investigation, an additional EQ concern related to the need to submergence qualify the RVLIS components was raised. As a result of this new concern, a further discussion was held with Westinghouse on May 16, 1989 to request clarification of the EQ requirements of the RVLIS, particularly with regard to potential floodup or submergence under accident/post-accident conditions. Clarifications obtained from Westinghouse confirmed the need to ensure floodup/submergence qualification of portions of the RVLIS inside the containment. We determined that all outgoing cables from the splice boxes in both units were of a safety-related type conforming to IEEE 323-1974, capable of withstanding the harsh environment (except submergence) during accident/Post-accident conditions.

To address the issue of submergence, a walkdown was conducted on Unit 1 RVLIS during the period from May 21 to 26, 1989. It was discovered that all cables and splices, excluding the RTD and its capillary tubes, were installed above the maximum calculated flood-up level. It was concluded that the RVLIS in Unit 1 presented no EQ concerns with respect to submergence.

A similar Unit 2 walkdown was performed in June 1989, when the unit was shutdown. It was discovered that RVLIS splice boxes (one in each train) and one cable were located below the flood-up level. The shutdown was extended to correct this configuration. Also, as a result of the finding, the plant declared both trains of RVLIS in Unit 2 inoperable on June 13, 1989, which was when the event was considered as reportable.

Cause of the Event

The failure to install the outer heat shrink was due to a failure to effectively communicate the details of the design specifications to the personnel installing the design change.

At the time the RVLIS design was being implemented, it was not considered cables/splices associated with RVLIS RTDs were required to be submergence qualified.

Analysis of Event

This report is being submitted pursuant to 10 CFR 50.73(a)(2)(i)(B), as operation prohibited by the Plant's Technical Specifications.

The original design basis error allowance for the entire RVLIS channel is ±6 percent. This ±6 percent is the maximum uncertainty, in reactor water level indication, expected both during and following an accident. The allowable capillary temperature sensor (RTD) error, which compensated for the density changes in the vertical capillary runs, is ±.75 percent, and is included in the ±6 percent design basis error.

The revised technical evaluation dated June 7, 1989 concluded that "a failed RTD circuit will cause output saturation of some of the process equipment resulting in a system error in excess of design accuracy requirements." In addition, the technical evaluation dated June 27, 1989 further concluded that "Failure of the compensating RTD's could have resulted in system errors greater than 6 percent." In supporting these technical evaluations, we performed a number of calculations that show that the RVLIS errors, due to the possible "shorting" or "opening" of the RTD cables in the splice boxes, could be quite large. Had these errors occurred during the various accident scenarios, an operator could have received a reactor water level indication that was erroneous and, in some cases, could have been misleading.

Given that (1) the RTD cable splice boxes were found to be in a configuration that had not been environmentally qualified, and (2) the two technical evaluations performed in June 1989 indicate that the design basis error allowance in the RVLIS could have been exceeded during design basis accident situations, both RVLIS trains on Units 1 and 2 have not met operability requirements since installation in 1981. The revision of the Technical Specifications which added the RVLIS to the Post Accident Monitoring Instrumentation was issued on April 10, 1987 for both Units 1 and 2.

Chapter 14, "Safety Analysis," of both FSAR's for Cook Nuclear Plant Units 1 and 2, does not take credit for operation of the RVLIS during an accident or a transient. The Emergency Operating Procedures (EOP's) for Cook Nuclear Plant were reviewed to assess the potential safety consequences of having erroneous indication in the RVLIS during the mitigation phase of an emergency.

The most conservative scenario that can be postulated is all the RVLIS trains giving an indication with a 100 percent error (100 percent RVLIS indication with either actual low level in the vessel or high void content), with the operator not being aware of that condition. In addition, independent evaluations indicate that the most likely failure mode is for both RVLIS trains to drift over a period of time in the same direction, however, it is plausible to postulate that the two trains drift in opposite directions. Both scenarios have been examined below for the most critical application of RVLIS.

The use of RVLIS in EOP, "Response to Inadequate Core Cooling," is identified as the limiting case in the EOP's, since the operator would be directed to that procedure from the critical function status trees. In addition, this EOP is the highest priority red path that uses RVLIS indication as an entry condition.

With diverging RVLIS train indications, the operator would conclude that RVLIS was not reliable and would utilize other available indications, e.g., the Core Exit Thermocouple readings, to direct the recovery actions. Even for the worst case scenario (100 percent error in all RVLIS indicators in the same direction), it is anticipated that corroborating indicators would eventually make the operator aware of the unreliability of RVLIS and would lead him to take the necessary actions to limit the consequences of the accident and protect the public health and safety. It is also important to note that the EOP rules of usage would be applied to any situation where an operator could not perform a given step (e.g. where an indicator is not available as specified in the EOP). These rules would direct the operator to continue on with the procedure.

Corrective Action

The design installation discrepancy regarding the missing outer heat shrink on each of the 14 splice boxes in the two trains in Unit 2 was corrected on January 23, 1989.

The splice boxes in Unit 1 were corrected on May 9, 1989.

Relocating the two splice boxes and rerouting the one cable were completed prior to Unit 2 startup on June 24, 1989, returning both trains of RVLIS in Unit 2 to a fully environmentally qualified condition.

All RVLIS RTD's and associated equipment located inside of containment are being added to the Environmental Qualification Equipment List. Initial documentation of the RTD's Environmental Qualification is complete and the applicable test reports were found acceptable.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

As a result of a previous similar event involving the design change control process which also occurred in the same time frame (1981), procedure enhancements are in progress to preclude further similar events. These enhancements are scheduled for completion by August 1, 1989 (reference LER Number 88-010, Revision 1, Docket Number 50-315).

Failed Component Identification

No component failures were found to be the cause of this event.

Previous Similar Events

LER 315/88-010-01