NRC Form 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2001

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)

Victoreen Containment High Range Radiation Monitors Not Environmentally Qualified to Withstand Post-LOCA Conditions

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 NAME	DOCKET NUMBER
07	16	1999	1999	--	019	--	00	08	16	1999	D.C. Cook - Unit 2	05000-316
											FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	5	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)											
POWER LEVEL (10)	0%		20.2201 (b)		20.2203(a)(2)(v)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)				
			20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)				
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71				
			20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER				
			20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A				
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)						

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Ms. Brenda W. O'Rourke, Compliance Engineer	(616) 465-5901 x2604

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX

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 15 single-spaced typewritten lines) (16)

On May 21, 1999, during an Environmental Qualification (EQ) program self-assessment, preliminary review identified that the containment high range radiation monitors (HRRM) may not be environmentally qualified to withstand the effects of a Loss of Coolant Accident (LOCA). The self-assessment found that D.C. Cook's evaluation of NRC Information Notice (IN) 97-45, "Environmental Qualification Deficiency for Cables and Containment Penetration Pigtails," failed to adequately address the susceptibility of the containment HRRMs to moisture intrusion. IN 97-45 identified that electrical signal cables and connectors found in HRRMs are sensitive to moisture exposure effects, such as from a LOCA or pipe break event. Industry events have identified that moisture intrusion into the cable jacket and connectors has resulted in erratic indication of radiation levels and loss of HRRM function. Based on continued evaluation of the EQ deficiencies, the Unit 1 and 2 HRRMs were declared inoperable on July 16, 1999.

The apparent cause was inadequate design control. In response to NRC IN 89-63, a design change to the HRRM system added drainage features to several components. However, the EQ requirement that the HRRM system be leaktight against possible moisture intrusion was not considered.

A permanent solution for the susceptibility of the HRRMs to moisture intrusion will be developed to support HRRM operability in Modes 1-4. Options for the permanent solution are currently under review and the method selected will be implemented prior to Mode 4 for each unit. An evaluation of the as-built configuration for other low signal current application EQ equipment is also being performed to identify other electrical equipment that may be susceptible to moisture intrusion due to a LOCA and/or pipe break condition. This evaluation will be completed by September 30, 1999.

This condition has minimal safety significance due to the availability of alternate post-accident radiation monitoring instrumentation.

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Conditions Prior to Event
Unit 1 was in Mode 5, Cold Shutdown
Unit 2 was in Mode 5, Cold Shutdown

Description of Event
On May 21, 1999, during an Environmental Qualification (EQ) program self-assessment, preliminary review identified that the Radiation Monitoring System's (RMS) [EIIS:IL] Victoreen containment high range radiation monitors (HRRM) may not be environmentally qualified to withstand the effects of a Loss of Coolant Accident (LOCA). The self-assessment found that D.C. Cook's evaluation of NRC Information Notice (IN) 97-45, "Environmental Qualification Deficiency for Cables and Containment Penetration Pigtails," failed to adequately address the susceptibility of the containment HRRMs to moisture intrusion. IN 97-45 identified that electrical signal cables [EIIS:CBL1] and connectors [EIIS:CON] found in HRRMs are sensitive to moisture exposure effects, such as from a LOCA or pipe break event. Industry events have identified that moisture intrusion into the cable jacket and connectors can result in erratic indication of radiation levels in containment. In addition, Supplement 1 to IN 97-45 identified that HRRMs have experienced significant positive and negative current flow as a result of induced currents in Rockbestos coaxial signal cables when exposed to high temperature transient conditions. As a result, the detection function of the HRRMs would be impacted.

Recent evaluation of the HRRM EQ deficiencies identified that in response to NRC IN 89-63, "Possible Submergence of Electrical Circuits Located Above the Flood Level Because of Water Intrusion and Lack of Drainage," D.C. Cook added drainage features (e.g., weep holes and slits in sealtite flex conduit) to the HRRM electrical enclosures (conduit and junction boxes [EIIS:JBX]) in containment. However, this resulted in a non-leaktight HRRM configuration, potentially exposing the moisture sensitive components to LOCA conditions. Based on above information, it was concluded that the Unit 1 and 2 HRRMs would not be capable of performing their intended design function. As a result, on July 16, 1999, the HRRMs were declared inoperable at 1558 hours.

Cause of Event
The apparent cause was inadequate design control. In response to NRC IN 89-63, a design change to the HRRM system added drainage features to several components. However, the EQ requirement that the HRRM system be leaktight against possible moisture intrusion was not considered.

Subsequent opportunities to identify this condition were missed during D.C. Cook's evaluation of IN 97-45 and its supplement. The concerns identified in the Information Notice were determined not to be applicable to D.C. Cook because the HRRMs use Brand Rex signal cabling versus Rockbestos cabling as described in IN 97-45.

Analysis of Event
This LER is being submitted in accordance with the requirements of 10CFR50.73(a)(2)(i)(B) for a condition prohibited by plant Technical Specifications. TS 3.3.3.1 requires the containment HRRMs to be operable in Modes 1-4.

UFSAR Section 11.3, states that the Radiation Monitoring System is designed to perform two basic functions: 1) warn of any radiation hazards which might develop, and 2) give early warning which might lead to a radiation hazard or plant damage. The RMS instruments are located at selected points in and around the plant to detect, compute, and record radiation levels. The components of the RMS are designed to operate during all expected environmental conditions for normal operation, and specific components are designed to operate during adverse or accident conditions. The subject radiation monitors include the Victoreen containment high range radiation monitors (1-VRA-1310/1410 and 2-VRA-2310/2410) which provide indication of containment radiation levels during post-LOCA conditions and are utilized in assessing possible core damage.

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A typical HRRM consists of a detector, associated Brand Rex triaxial cabling, conduit, junction boxes and Amphenol connectors. Amphenol connectors are located at the penetration pigtails and other electrical cable connections, and at a junction box located at the top of the containment penetration flood-up tubes. Each Amphenol connector is enclosed in a Raychem boot seal, with the associated detector cabling contained within a conduit system. The junction box and conduit system contain weep holes which were added in response to NRC IN 89-63.

EQ testing performed by Victoreen in 1978 experienced numerous failures in attempting to qualify a connector assembly for in-containment LOCA use. The only documented successful simulated LOCA testing was for cable and connectors that were enclosed in leaktight conduits. This configuration prevents moisture intrusion into the cable and connectors during post-LOCA conditions. NRC IN 97-45, identified potential EQ deficiencies associated with Rockbestos coaxial cables and Amphenol connectors used in containment HRRM systems. Subsequent vendor EQ testing concluded that moisture could permeate the HRRM coaxial cable jacket during a LOCA and cause partial shorting of the monitor signal at the connectors. Because of the small signal current output from the HRRMs (nominally pico-amperes), partial shorting of the signal could result in loss of HRRM function. In addition, Supplement 1 identified that HRRMs cabling is susceptible to thermally-induced currents as a result of extreme temperature transients. Thermally-induced currents have been found to impact the accuracy of the HRRMs.

In 1990, drainage features were added to D.C. Cook's HRRM system in response to NRC IN 89-63. Industry concerns were identified regarding the lack of drainage holes in containment electrical enclosures that may become submerged during a LOCA event. Without the appropriate drainage, water could collect inside the enclosures and cause shorting of the electrical components contained in the enclosures. Although D.C. Cook's HRRM conduit system contains weep holes, the moisture intrusion potential of the subject connectors is much more limited than that described in the Victoreen test reports and NRC IN 97-45. In these tests, the coaxial cable and sealed connectors were directly exposed to steam and spray conditions, whereas D.C. Cook's cable and sealed connectors are contained within a conduit system. Because of the additional protection given by the conduit system, the maximum amount of moisture that could potentially come in contact with the connectors is limited by the internal free air space of the conduit. During the increasing containment pressure portion of a LOCA transient, the steam would fill the conduit, displacing the air inside the conduit and result in the trapped steam condensing on the colder cable and conduit internal walls. This amount of moisture intrusion is much more limited than would occur in an open system (i.e., with no conduit enclosure).

The design function of the containment HRRMs is to provide operators with post-LOCA indication of containment radiation levels which are also utilized in assessing possible core damage. Although the identified EQ deficiencies could render the HRRMs inoperable following a LOCA, alternative means of performing this monitoring function exist through other post-accident monitoring instrumentation. This includes the post-accident monitoring system and the post-accident grab sample pallet in accordance with plant emergency procedures.

Based on the above information, the identified condition has minimal safety significance due to the availability of alternate post-accident radiation monitoring instrumentation.

Corrective Actions

A permanent solution for the susceptibility of the HRRMs to moisture intrusion will be developed to support HRRM operability in Modes 1-4. Options for the permanent solution are currently under review and will be implemented prior to Mode 4 for each unit.

An evaluation of the as-built configuration for other low signal current application EQ equipment is being performed to identify other additional electrical equipment that may be susceptible to moisture intrusion due to a LOCA or pipe break condition. The evaluation will include a review of the current EQ Program documentation regarding requirements for

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leaktight electrical enclosures. This evaluation will be completed by September 30, 1999. Based on results of the evaluation, appropriate corrective actions will be taken to address any identified EQ discrepancies.

AEP:NRC:1260GH, "Enforcement Actions 98-150, 98-151, 98-152 and 98-186 Reply to Notice Of Violation October 13, 1998", dated March 19, 1999, responded to identified programmatic weaknesses in the plant Design and Licensing Basis and the Training and Qualification of personnel. The Engineering Leadership Plan establishes a configuration management program to control plant design and a new design control process, which includes design verification, design document control, vendor technical documentation control and testing of design changes.

As part of the Restart effort, an improved operating experience program is being developed. In addition, the Expanded System Readiness Review project teams are evaluating operating experience information to assess whether applicable industry issues have been adequately addressed for applicability to D.C. Cook.

Previous Similar Events
None