ENERGY NORTHWEST

P.O. Box 968 ■ Richland, Washington 99352-0968

August 7, 2002
GO2-02-125

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397, VOLUNTARY LICENSEE EVENT REPORT NO. 2002-003-00**

Dear Sir or Madam:

Transmitted herewith is Licensee Event Report No. 2002-003-00 for Columbia Generating Station. This report is being submitted voluntarily because it might be of generic interest to the nuclear industry.

Should you have any questions or desire additional information regarding this matter, please call Ms. CL Perino at (509) 377-2075.

Respectfully,

R. L. Webring
Vice President, Operations Support/PIO
Mail Drop PE08

Attachment

cc: EW Merschoff - NRC RIV
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IE22

NRC FORM 366 (1-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 6-30-2001

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LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Columbia Generating Station	50-397	1 OF 6

TITLE (4)

Water Leakage Paths Through Fire Rated Floor Assemblies

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
05	03	2002	2002	- 003 -	00	08	07	2002	FACILITY NAME	DOCKET NUMBER

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply) (11)			
POWER LEVEL (10)	100	20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
		20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
		20.2203 (a)(1)	50.36(c)(1)(i)(A)	50.73(a)(2)(iv)(A)	73.71(a)(4)
		20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
		20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	X Other
		20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	Specify in Abstract below or in NRC Form 366A
		20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
		20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
		20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
		20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
R Brownlee	509-377-2085

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX		CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	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 3, 2002, at 1540 hours approximately 15 to 20 gallons of water spilled onto the floor of the Radwaste Building Cable Spreading Room (CSR). A small amount of water leaked down into the Remote Shutdown Room below the CSR floor. The pathway for leakage through the floor of the CSR was through cracks in the concrete that allowed a penetration flood seal to be bypassed, and through shrinkage and flexural cracks in the reinforced concrete floor slab. The shrinkage and flexural cracks in the CSR floor were also the source of a small amount of leakage from the spilled water into the Division II switchgear room. Operability of safety-related equipment in the Remote Shutdown Room and Division II switchgear room was not affected.

The root cause of this event is unsealed cracks that allowed leakage through floors. Contributing cause codes are associated with inadequate attention to emerging problems, as well as inadequate decision making, improper mindset, and tunnel vision. Immediate corrective action was to post compensatory one-hour fire/flood tours, and to seal the cracks that leaked. This Licensee Event Report is being submitted voluntarily because it might be of generic interest to other licensees.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* ***(17)***

Description of Event

On May 3, 2002, at 1540 hours approximately 15 to 20 gallons of water spilled on the floor of the Radwaste Building 484' elevation Cable Spreading Room (CSR). A small amount of the water leaked down into the Remote Shutdown Room below the CSR floor. It has since been determined that the pathway for CSR floor leakage was through cracks in the concrete due to abandoned concrete anchors, and through shrinkage and flexural cracks in the reinforced concrete floor slab. Shrinkage and flexural cracks in the CSR floor were also the source of a small amount of leakage from the spilled water into the Division II switchgear room [EB]. Shrinkage and flexural cracks are also present at the Radwaste Building 525' elevation above the Control Room where the floor has not been entirely sealed.

Immediate Corrective Actions

A barrier impairment was initiated for the CSR and for the 525' elevation above the Control Room, with compensatory action to include these areas on an hourly fire/flood tour. With the hourly fire/flood tours in place, the floors of the CSR and the room above the Control Room were declared "operable but degraded" per a formal assessment of operability. In addition, the cracks that were known to have leaked were sealed.

Further Evaluation

The potential for any significant water flow between adjacent rooms via shrinkage cracks in the concrete floor/ceiling that might result in the potential for equipment damage had previously been considered to be not credible. As demonstrated by the May 3, 2002 event, the potential for water leakage from area to area through shrinkage and flexural cracks in concrete floor slabs that have not been finish coated with a water-resistant seal is credible. This condition exists for the 484' elevation CSR floor and the 525' elevation above the Control Room where the floors have not been entirely sealed. Per Columbia Generating Station Technical Memorandum (TM)-2103 Revision 2, water/flood barriers for floors between opposite Post Fire Safe Shutdown (PFSS) division fire areas should be "leak tight." In addition, during a moderate energy line break event, the floor should remain "leak tight" to ensure that redundant safety related equipment is not exposed to moisture resulting in failure. The term "leak tight" implies that the seal configuration has no measurable leakage at maximum differential design pressure. This conservative "leak tight" criteria is warranted to ensure redundant PFSS divisions and safety-related flood mitigation equipment remain operable.

The leakage into the Remote Shutdown Room also resulted in an electrical ground on Division 2 battery bus S1-2 [EJ]. The source of the ground was determined to be water contacting pre-existing damage to a cable in a CSR floor penetration, and was not a result of water entering the Remote Shutdown Room. Battery operability was not impacted. Operators inspected inside the Remote Shutdown Panel (E-CP-C61/P001) and determined that some water infiltrated into the panel. A minor amount of water accumulated in a Unistrut channel that runs along/near the bottom of the panel but no water was noted near any electrical terminations inside the panel. The water infiltration path into the Remote Shutdown Panel itself was along the electrical cables that pass from the 484' to 467' elevation through a floor penetration. No water was observed in any other panel.

Cause of the Event

The root cause of this event is unsealed cracks that allowed leakage through concrete floors. Contributing cause codes are associated with inadequate attention to emerging problems (Code O-2), as well as inadequate decision making (Code O-5), improper mindset (Code MJ4), and tunnel vision (Code SK1). Normally, a small amount of water on Radwaste Building floors would not be a concern as there are floor drains present. In this case, it was assumed that the original slab design/installation failed to ensure leak tightness of the floors to provide the necessary leak tight barrier between redundant PFSS fire areas (Code MJ4). Other opportunities to address the issue of barrier leakage were missed when Energy Northwest responded to Inspection and Enforcement Notice (IEN) 88-60, "Inadequate Design and Installation of Watertight Penetration Seals," (Code O-2), and when problem evaluation requests identified the credibility of leakage paths through cracks at construction joints in concrete slabs. Only the construction joints were ultimately sealed because they were the only leakage locations known to exist at the time. Floor leakage through shrinkage and flexural cracks was not believed to be a credible scenario (Codes MJ4 and SK1). When the spallation cracking occurred at the Hilti Drop-In (HDI) concrete anchors adjacent to a CSR floor penetration, the damaged concrete was not subsequently repaired or sealed. Based on design specifications and procedural requirements at the time, there would have been no perceived need to repair the concrete spallation cracking (Codes O-2 and O-5). Lastly, Maintenance Rule structural inspections, that are intended to identify and correct structural flaws, did not identify shrinkage or flexural cracks as potential leakage paths (Code MJ4).

Assessment of Safety Consequences

Two specific paths of water seepage associate with the CSR floor of the Radwaste Building have been identified. The first path is associated with cracks in the concrete that bypassed a floor penetration flood seal, and the other was through incidental cracks existing in the concrete floor. The incidental cracks appear to be shrinkage and flexural cracks, normal on concrete slabs, and

possibly other cracks/paths associated with drilled holes for installation of various types of concrete anchors. The specific cracks responsible for the leak paths were identified via field walkdown and have been sealed. For the 525' elevation above the Control Room, there are incidental cracks that also appear to be shrinkage and flexural cracks.

Operations personnel estimated that the flow rate into the Remote Shutdown Room through the damaged penetration seal was 1 cc/min. The flow rate into the Division 2 Critical Switchgear Room through the normal concrete cracking was estimated to be 8 cc/hr (4 drops per min). A small amount of water was found on top of the E-IN-5A cabinet and the E-CB-8/3 cubicle in the Division 2 Critical Switchgear room. No water entered either of these components.

Given the amount and type of combustibles and the overall geometry of the CSR, the amount of water required to fight the maximum probable fire will be significantly less than that required for current design basis conditions. The flood heights in the cable spreading room will be bounded by fire protection scenarios, and not by moderate energy line breaks. A model has been developed for the PFSS flooding analysis of the Cable Spreading Room. Preliminary results indicate that the maximum pool depth in the Cable Spreading Room to fight the maximum probable fire is about 1.7 inches after 30 min.

The maximum pool depth at the 525' elevation above the Control Room should be significantly less than that in the CSR. There are only small deluge fire protection systems which would drain so as not to contribute to ponding of water on the floor. Manual fire protection would be from a single hose stream, based on the low combustible loading. In addition, there is a large duct chase in the floor to permit water drainage.

In the case of the leaking seal penetration in the CSR floor, the surrounding material (concrete) was degraded to the point of providing a pathway for water to circumvent the penetration flood seal and flow into the Remote Shutdown Room. The degradation was caused by spallation (cracking) of the concrete that occurred during installation of HDI anchors adjacent to floor seal. The spallation occurred because the edge distance between the HDI anchors and the floor penetration was insufficient to provide the necessary resistance to tensile shear crack formation. Water was able to flow through the cracked concrete and around the penetration. Even with a maximum pool depth in the Cable Spreading Room of 1.7 inches, the leakage rate through the damaged penetration would be similar to what was observed for this event, because there would not be a significant change in the driving head of water.

Based on the thickness of the Cable Spreading Room floor, it is expected that it would experience minimal seepage. Uncracked concrete is porous but practically watertight, essentially only passing enough fluid to become dampened over time. Based on the rebar placement, it is estimated that the

flow rate through the floor considering cracking would be 8 times that of an uncracked floor. Therefore, for an otherwise sound floor, water would not be present long enough in most flooding scenarios to create leakage through the bottom surface and equipment on the floor below would not be adversely effected.

To assess equipment operability for this event, it is assumed that for the most probable flooding scenario in the CSR, the expected water leakage through the floor of the CSR will be no greater than what actually occurred for the reported event. For this event, neither the water that entered the Remote Shutdown Room nor the water that entered the Critical Switchgear Room caused safe shutdown or safety-related equipment to become inoperable. The water that dripped onto the top of the E-CB-8/3 cubicle did not enter the cubicle and therefore no equipment was affected. Water on or even in E-IN-5 will not affect safe shutdown equipment since neither the inverter nor any equipment supplied from the inverter is credited in any safe shutdown scenario. From a safe shutdown perspective, even if water were to affect equipment in E-CB-8/3, the result would be the loss of the preferred offsite power source, but no safe shutdown credited equipment, e.g. the emergency diesel generator power source, would be affected.

It should be noted that small amounts of water entering the Remote Shutdown Room and the Critical Switchgear Room are not likely to affect any equipment. In order for inadvertent water entry to become significant, it would be necessary for the water to collect and remain in an area where electrical contacts or terminals are located. These electrical contacts could then be erroneously connected or grounded through leakage currents such that spurious signals are generated. The spurious signals might then cause inadvertent actuation of equipment, fuse clearing resulting in loss of power to safe shutdown components or circuit faults occurring that prevent actuation of required equipment.

These scenarios are very unlikely given the typical physical construction of panels, racks, terminal boxes and junction boxes. These are typically enclosed with few water entry points and circuit termination points that are vertically mounted with minimal potential water collection points.

Actions to Prevent Recurrence

Columbia Generating Station has sealed the 484' elevation CSR with a flexible epoxy coating, and is in the process of sealing the Radwaste Building 525' elevation. We will develop inspection criteria and revise existing essential PFSS fire/flood penetration seal installation/inspection procedures as necessary to include inspection of surrounding concrete for damage or degradation. We will also develop inspection criteria and revise existing periodic structural inspections as necessary to include

PFSS credited coating barriers. We will re-review and evaluate the Energy Northwest response to IEN 88-60, and will develop a position paper (e.g. Technical Memorandum) on concrete cracking to address any future similar scenarios.

Previous Similar Events

There have been no previous similar events at Columbia Generating Station that were reported as a License Event Report, or as an unanalyzed condition that significantly degrades plant safety. Other past similar events associated with floor flooding barriers were:

1) In 1984, the need for sealing CSR floor construction joint cracks was identified, due to a water leakage path to the Division 1 Critical Switchgear Room.

2) In 1996, it was discovered that the large block-out floor penetration seals (full-depth silicone foam) in the CSR were not qualified by pressure test for the calculated flood depth in the room. As a result of this discovery penetration flood seals were upgraded.

3) In 1998, a water leakage event occurred on the 525' elevation above the Control Room with the water flow path through construction joints in the concrete slab. In 1999, an additional similar water leakage event occurred in the CSR in that the flow path was through construction joints. These similar incidents determined that credible water leakage paths through concrete floors via construction joints existed. Critical construction joints in the Radwaste and Reactor Buildings were identified and sealed as necessary. This action did not preclude this present event because the implemented corrective actions were too narrowly focused on the critical construction joints rather than the entire floor.

4) Lastly, there are 80 identified non-PFSS flood barrier problems in the Reactor Building that are being addressed separately by a repair project. The problems are similar and identify unanalyzed water flow paths between different elevations in the Reactor Building. However, the subject unanalyzed flow paths are via open floor (unsealed) penetrations and/or circumvented/degraded curbs that had been credited in the design basis fire system and moderate energy pipe crack flooding analysis. Compensatory measures associated with this issue are in place.