



George A. Lippard
Vice President, Nuclear Operations
803.345.4810

February 1, 2017

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


Dear Sir / Madam:

Subject: VIRGIL C. SUMMER NUCLEAR STATION (VCSNS), UNIT 1
DOCKET NO. 50-395
OPERATING LICENSE NO. NPF-12
LICENSEE EVENT REPORT (LER 2016-004-01)
STEAM PROPAGATION BARRIER DEGRADED DUE TO MISSING
ORIFICES

Attached is Licensee Event Report (LER) 2016-004-01, for the Virgil C. Summer Nuclear Station. This revised report supplements LER 2016-004-00. This report describes an event that was identified based on an extent of condition review for LER 2016-003-00 Steam Propagation Door (DRIB/107) Discovered Propped Open. The station identified orifices that were not installed in the correct drain lines as specified in a design change package. The station has completed an evaluation of the impacted areas if a High Energy Line Break (HELB) event occurred. This report is submitted in accordance with 10CFR50.73(a)(2)(v)(D) and 10CFR50.73(a)(2)(i)(B).

Should you have any questions, please call Mr. Bruce Thompson at (803) 931-5042.

Very truly yours,


George A. Lippard

BAB/GAL/ts
Attachment

c:	K. B. Marsh	S. A. Williams	Marsh USA, Inc.
	S. A. Byrne	NRC Resident	Maintenance Rule Engineer
	J. B. Archie	Inspector	NSRC
	N. S. Carns	L. W. Harris	RTS (CR-16-04716 & CR-16-04801)
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LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)

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Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollections.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME

VC SUMMER-UNIT 1

2. DOCKET NUMBER

05000 395

3. PAGE

1 OF 6

4. TITLE

STEAM PROPAGATION BARRIER DEGRADE DUE TO MISSING ORIFICES

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
09	14	2016	2016	004	01	02	01	2017	FACILITY NAME	DOCKET NUMBER
										05000
										05000
9. OPERATING MODE		11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)								
1		<input type="checkbox"/> 20.2201(b)		<input type="checkbox"/> 20.2203(a)(3)(i)		<input type="checkbox"/> 50.73(a)(2)(ii)(A)		<input type="checkbox"/> 50.73(a)(2)(viii)(A)		
		<input type="checkbox"/> 20.2201(d)		<input type="checkbox"/> 20.2203(a)(3)(ii)		<input type="checkbox"/> 50.73(a)(2)(ii)(B)		<input type="checkbox"/> 50.73(a)(2)(viii)(B)		
		<input type="checkbox"/> 20.2203(a)(1)		<input type="checkbox"/> 20.2203(a)(4)		<input type="checkbox"/> 50.73(a)(2)(iii)		<input type="checkbox"/> 50.73(a)(2)(ix)(A)		
		<input type="checkbox"/> 20.2203(a)(2)(i)		<input type="checkbox"/> 50.36(c)(1)(i)(A)		<input type="checkbox"/> 50.73(a)(2)(iv)(A)		<input type="checkbox"/> 50.73(a)(2)(x)		
10. POWER LEVEL		<input type="checkbox"/> 20.2203(a)(2)(ii)		<input type="checkbox"/> 50.36(c)(1)(ii)(A)		<input type="checkbox"/> 50.73(a)(2)(v)(A)		<input type="checkbox"/> 73.71(a)(4)		
		<input type="checkbox"/> 20.2203(a)(2)(iii)		<input type="checkbox"/> 50.36(c)(2)		<input type="checkbox"/> 50.73(a)(2)(v)(B)		<input type="checkbox"/> 73.71(a)(5)		
		<input type="checkbox"/> 20.2203(a)(2)(iv)		<input type="checkbox"/> 50.46(a)(3)(ii)		<input type="checkbox"/> 50.73(a)(2)(v)(C)		<input type="checkbox"/> 73.77(a)(1)		
		<input type="checkbox"/> 20.2203(a)(2)(v)		<input type="checkbox"/> 50.73(a)(2)(i)(A)		<input checked="" type="checkbox"/> 50.73(a)(2)(v)(D)		<input type="checkbox"/> 73.77(a)(2)(i)		
		<input type="checkbox"/> 20.2203(a)(2)(vi)		<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)		<input type="checkbox"/> 50.73(a)(2)(vii)		<input type="checkbox"/> 73.77(a)(2)(ii)		
				<input type="checkbox"/> 50.73(a)(2)(i)(C)		<input type="checkbox"/> OTHER		Specify in Abstract below or in NRC Form 366A		

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT

Bruce Thompson

TELEPHONE NUMBER (Include Area Code)

(803) 931-5042

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

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	KM	CHU	N418	Y					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

LER-2016-003 documented a steam propagation door (DRIB/107) to the Chiller Room for XHX0001C-VU propped open on September 13, 2016 without compensatory actions during routine operator rounds.

As part of the extent of condition on September 14, 2016 the station discovered an additional degradation to the steam propagation barriers. Steam propagation barriers (orifices) were not installed as designed between the Chiller rooms and Chilled Water (VU) pump room floor drains therefore, in the as-found configuration, there was no separation between the rooms. When any chiller room door was open, even with administrative contingencies in place, the other chiller rooms and pump rooms were not protected from a High Energy Line Break (HELB). The station has completed an evaluation to determine the impact on the rooms during a HELB event. This event is reportable under 10CFR50.73(a)(2)(v)(D) as any event or condition that could have prevented the fulfillment of a safety function and 10CFR50.73(a)(2)(i)(B) as a condition prohibited by Technical Specification (TS).

**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

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1. FACILITY NAME		2. DOCKET NUMBER		3. LER NUMBER		
VC SUMMER-UNIT 1		05000-	395	YEAR 2016	SEQUENTIAL NUMBER 004	REV NO. 01

NARRATIVE**1.0 EVENT DESCRIPTION**

LER-2016-003 documented a steam propagation door (DRIB/107) to the Chiller Room for XHX0001C-VU propped open on September 13, 2016. The door was discovered during operator rounds and was determined not to have all compensatory measures in place.

As part of the extent of condition, the station discovered an additional degradation to the steam propagation barrier on September 14, 2016. Steam propagation barriers (orifices) were not installed as designed between XHX0001A-VU Chiller room and Chilled Water (VU) pump room and between the XHX0001B-VU and XHX0001C-VU Chiller room floor drains. In the as-found configuration, there was no separation between XHX0001B-VU & XHX0001C-VU chiller rooms nor XHX0001A-VU chiller and chilled water pump rooms via the floor drain system. The station has completed an evaluation to determine the impact on the rooms during a High Energy Line Break (HELB). This event is reportable under 10CFR50.73(a)(2)(v)(D) as any event or condition that could have prevented the fulfillment of a safety function and 10CFR50.73(a)(2)(i)(B) as a condition prohibited by Technical Specification (TS).

2.0 EVENT ANALYSIS

In preparation for replacement of all three VU chillers, Engineering Change Request (ECR) 50585 (Base) was issued to perform, amongst other things, chiller room separation. The separation scope was intended to fully isolate each chiller room from each other to allow online chiller replacement with one set of chiller room doors propped open for an extended period of time. The intent of the design was with a door propped open during a HELB in the Intermediate Building (IB) only the chiller room with the open doors would be impacted. One potential steam path between the chiller rooms was via the floor drain system. The ECR was to modify existing orifices in the floor drains between the IB 412 foot elevation and the chiller rooms, as well as install additional flow limiting orifices between chiller rooms. The floor drain orifices between the XHX0001A-VU and XHX0001B-VU chiller rooms were incorrectly installed. The orifices were installed in the piping between the IB and the chiller pump rooms instead of between the chiller room and the adjacent chiller room and chilled water pump room. The base ECR was issued in 2006. The work order steps for orifice installation were planned between August 2007 and September 2008. The orifices were installed between November 2008 and January 2009. The installed configuration did not provide the required separation. High Energy Line Breaks are discussed in FSAR 3.11.2.2.2.2 and 15.4.2. The VU System has two trains and is designed to provide safety related cooling to various areas and equipment as discussed in FSAR 9.4.7.2.4. The open pathway could have affected the functionality of both trains of VU.

The station conducted a Root Cause Analysis (RCA-16-04801) on the condition, where the flow limiting orifices were installed in the wrong location. The following root causes and contributing causes were identified:

Root Cause (RC01): The planning supervisor assigned ECR 50585 to a maintenance planner with no previous modifications planning experience. This individual did not have the level of experience/competency necessary to successfully plan the work. There were no means of ensuring/verifying competency for maintenance planners prior to task assignment related to planning plant modifications. This resulted in less than adequate reviews and verifications of the work package, as well as insufficient information regarding the locations of the orifice plates in the sumps.

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Root Cause (RC02): The work order steps for installing the orifice plates were classified as non-nuclear safety related work. When QC reviewed the work order, they determined that no QC was necessary based on the work order safety classification. However, the ECR classified this work as Quality Related. This resulted in the orifice installation being performed without QC verification. No guidance existed at the time the work orders were planned that would have instructed QC inspectors to review ECR packages for safety classification during the QC work order routing reviews.

Potential Root Cause (RC03): The potential exists that the information (ECR section) included in the work package was not sufficient to provide adequate work instruction. If the ECR instructions were not included in the work package, the information available to the workers for the orifice plate installation locations was inadequate. The detailed drawing, included in the work package, was incorrect for the "A" Chiller orifice plate location. Due to this occurring over seven years previous, the workers could not recall what led up to or contributed to the orifice plates being located in the wrong location. Neither the planner nor the workers could recall whether or not the ECR section was included in the work package.

Potential Root Cause (RC04): The potential exists that the workers failed to follow work (ECR) instructions if it had been included in the work package. The ECR written instructions provided sufficient detail for the orifice plates to be installed in the correct locations. If the ECR was included in the work package, the workers would have had adequate work instructions, but failed to follow it. The Work Order instructions available to the workers did not include the room numbers. Due to this occurring over seven years previous, the workers could not recall what led up to or contributed to the orifice plates being located in the wrong location. Neither the planner nor the workers could recall whether or not the ECR section was included in the work package.

Contributing Cause (CC1): The interface review comments were provided but were not resolved in a manner to aid in determining proper installation locations per the drawings. There were two comments made during the ECR interface review that would have clarified the orifice plate installation locations. A promissory resolution was given to an incorrect drawing and the second comment on the clarity of the orifice plate locations was dismissed with no resolution. There was no formal tracking in place for the resolution of interface review comments. As a result, the information provided in the ECR lacked clarity.

Contributing Cause (CC2): No guidance existed at the time the work orders were planned that would have directed the planner to base safety classification on ECR information. This resulted in the planner basing the non-nuclear safety classification on the CMMS system listing for floor drains instead of the quality related classification of the ECR.

The root cause analysis determined that the causes associate with this event did not reflect current performance. Corrective actions to address the causes in RCA-16-04801 are addressed in CR-16-04801.

The VU System provides cooling to safety related areas (TS Table 3.7-7) as an attendant cooling system and supports the comfort requirements for the Control Room Emergency Filtration Systems (CREFS). The VU System is needed to ensure that equipment located within these areas can withstand the environmental effects of a postulated FSAR Chapter 15 event. With a nonfunctional chiller unit, its associated VU train will become nonfunctional, thereby affecting room temperatures and the reliability of the train's associated equipment. The most limiting area for temperature limits has been identified as the charging pump rooms. Per TS 3/4.5.2, one charging pump has to be operable per train of Emergency Core Cooling System (ECCS) during Mode 1-3.

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TS 3/4.7.9, "Area Temperature Monitoring", and associated Table 3.7-7 describe the area temperature limits during normal operation due to cooling provided by the VU System. If the chiller cooling a Chilled Water loop is not running, room temperatures will rise over time. If the temperature in a given area exceeds the limit shown in TS Table 3.7-7 for eight hours, a Special Report detailing the basis for continued operability must be submitted to the NRC within thirty days. In addition, if the Technical Specifications limit for a given area is exceeded by thirty degrees for four hours, the equipment in the associated area must be declared inoperable.

TS 3/4.7.6, "Control Room Emergency Filtration Systems (CREFS)", states that two CREFS trains shall be operable. The surveillance requirements under TS 3/4.7.6 require each CREFS train to be demonstrated operable through verification that the control room air temperature is less than or equal to 85 degrees Fahrenheit.

VCSNS contracted an engineering firm to conduct an assessment of the impact on equipment affected by this condition. Specifically, this evaluation considers a condition where steam propagation barriers (orifices) in the floor drainage system were installed incorrectly between the 'B' and 'C' Chiller Rooms and the 'A' Chiller Room and the Chilled Water Pump Room. While this condition existed, these rooms were connected by an 8-inch drain line, as were the Chilled Water Pump Room. This condition could have led to steam propagation from the Intermediate Building (IB) Harsh Area into Mild Areas during postulated HELB events when the door of a Chiller Room was propped open and the associated ventilation system HELB dampers were closed as required.

A thermal hydraulic model was developed using the GOTHIC computer code (version 8.1) to calculate the environmental conditions that could have existed at IB 412 foot elevation during a postulated HELB event. The GOTHIC computer program is a general purpose analysis tool that solves the conservation equations for mass, energy, and momentum for multi-component, multi-phase flow, and it has been used extensively for compartment transient analysis in nuclear power plants. The results are discussed below.

For large breaks, the IB rooftop blowout panels actuate, allowing much of the energy released to vent directly to the environment. As a result, IB conditions at an open Chiller Room door do not degrade significantly during these HELB transients. The entry of air/steam from the IB into a Chiller Room does not lead to significant changes in Battery/Battery Charger and Chiller Area room conditions. For example, the highest Chiller Area room is 100°F and the Battery/Battery Charger Area rooms remain in their normal operational band ~78°F.

For small breaks, the mass and energy release rates are low and the IB rooftop blowout panels do not actuate. Although temperatures within the IB rise, IB pressure remains low, so that propagation of air/steam from the IB is small. As a result, entry of air/steam from the IB into a Chiller Room does not lead to significant changes in Battery/Battery Charger and Chiller Area room conditions. For example, the highest Chiller Area room without an open door to the IB reaches 94°F and the highest Battery/Battery Charger Area rooms remain in their normal operational band ~78°F.

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NARRATIVE

For intermediate breaks, the mass and energy release rates could be high enough to result in degraded conditions at an open Chiller Room door, but low enough to not actuate the IB rooftop blowout panels. As a result, intermediate breaks have the potential to produce the largest changes in Battery/Battery Charger and Chiller Area room environmental conditions. For this worst case, the Battery/Battery Charger Area room temperatures remain in their normal operational band (~78°F) and relative humidity remains at normal values (~69%-74%). When the assumed open door is for the 'A' Chiller Room, which is the Chiller Room that is connected via floor drains to the Chiller Pump Room, the Chiller Pump Room temperature rises out of its normal operational band to ~164°F and relative humidity rises to ~100%. However, analysis of these Chiller Pump Room conditions shows that the equipment in this room would be expected to remain functional under these conditions. The motors used in the Chiller Pump room were originally tested by Westinghouse to high temperatures and condensation for long durations consistent with harsh environment outside containment qualification requirements. These tests assure the motors functionality in the postulated environment. The 'B' and 'C' Chillers would have not been affected; therefore two trains of Chilled water would remain available. The analysis also shows that in the times that the 'B' or 'C' Chiller was out of service and its door propped open to support maintenance activities, the steam propagation between 'B' and 'C' Chiller rooms would likely cause the failure of the in-service Chiller. The 'A' Chiller room temperature remains in the normal operational band (~95°F) and relative humidity remains at normal values (~61%). Plant records were reviewed to identify when either Chiller 'B' or Chiller 'C' doors were open for longer than allowed by TS 3.5.2 LCO of 72 hours. Two such periods were found. This occurred with the 'B' Chiller only, in which the 'C' Chiller would have been in-service and rendered non-functional, leaving only the 'A' Chiller available. The times were as follows.

- August 4, 2014 at 1519 to August 8th, 2014 at 0127 (3 days, 10 hours and 8 minutes)
- July 31, 2016 at 1759 to August 4, 2016 at 0839 (3 days, 14 hours and 40 minutes).

In conclusion, the spectrum of HELB events analyzed demonstrates that there is reasonable assurance that there would be no impact on the operability of equipment in the Battery/Battery Charger Rooms (which remain at normal environmental conditions) or the functionality of equipment in the Chiller Pump Room and in at least one of the three Chiller Rooms.

3.0 SAFETY SIGNIFICANCE

A HELB event postulated to occur during the times when the non-conforming HELB barrier configuration existed would not have impacted the functionality of equipment in the Battery/Battery Charger Rooms (which remain at normal environmental conditions) or the functionality of equipment in the Chiller Pump Room and in at least one of the three Chiller Rooms. There is no change to the result in the PRA model, and the condition is determined to be not risk significant.

4.0 PREVIOUS OCCURRENCE

No previous occurrence within the last three years.

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NARRATIVE**5.0 CORRECTIVE ACTIONS**

Immediate action taken: On September 14, 2016, stopped all associated VU chiller work and ensured all steam propagation doors were closed. Station Order 16-05 was issued that directs that no work can be performed in the chiller rooms that would require the door(s) to be propped open. The Station Order was in place until the orifice installations in the sumps was corrected.

Interim action taken: On September 21, 2016, Nonconformance (NC)-16-04716-005 Repair Disposition #1 was issued to correctly install the orifice plates. This work was completed on October 6, 2016.

Corrective Actions to address the causes in RCA-16-04801 are addressed in CR-16-04801.