

George A. Lippard  
Vice President, Nuclear Operations  
803.345.4810



October 25, 2016

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 2016-001-01)  
LOW REFRIGERANT RENDERS A-CHILLER NON-FUNCTIONAL AND  
A-CHARGING PUMP INOPERABLE

Attached is the revised Licensee Event Report (LER) 2016-001-01, for the Virgil C. Summer Nuclear Station (VCSNS) Unit 1. This report describes an additional cause that rendered the A-Train chiller non-functional that impacted the A-Train charging pump operability. This revised report is submitted in accordance with 10 CFR 50.73(a)(2)(i)(B).

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

Very truly yours,

George A. Lippard

WHK/GAL/wm  
Attachment

c: K. B. Marsh  
S. A. Byrne  
J. B. Archie  
N. S. Carns  
J. H. Hamilton  
S. M. Shealy  
W. M. Cherry  
C. Haney  
S. A. Williams  
NRC Resident Inspector  
QA Manager - L. W. Harris

Paulette Ledbetter  
J. C. Mellette  
ICES Coordinator  
K. M. Sutton  
INPO Records Center  
Marsh USA, Inc.  
Maintenance Rule Engineer  
NSRC  
RTS (CR-15-04395, CR-16-00992)  
File (818.07)  
PRSF (RC-16-0132)

IE22  
NRR

**LICENSEE EVENT REPORT (LER)**

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

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

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 [Infocollect.Resource@nrc.gov](mailto:Infocollect.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 4

**4. TITLE**

LOW REFRIGERANT RENDERS A-CHILLER NON-FUNCTIONAL AND A CHARGING PUMP INOPERABLE

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		
07	22	2016	2016	002	01	10	25	2016	FACILITY NAME	DOCKET NUMBER		
										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 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 ThompsonTELEPHONE NUMBER (Include Area Code)  
(803) 931-5042**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

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

A past operability review determined that HVAC System Mechanical Water Chiller A (XHX0001A-VU) had been non-functional from July 24, 2015, through September 17, 2015, due to a refrigerant leak in Circuit 2. XVM16506A-VU, Chilled Water Chiller "A" Liquid Injection Solenoid Inlet Valve Circuit 2, was replaced and post maintenance testing completed satisfactorily.

On February 24, 2016, Operations started Circuit 2 of XHX0001A-VU to support the interim action and discovered an additional leakage path that is the cause of the initial event described in LER-2016-001-00. An inter-circuit evaporator gasket leak was allowing refrigerant leakage from Circuit 2 to Circuit 1. The gaskets were replaced and post maintenance testing was completed satisfactorily.

This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i)(B).

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

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

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](mailto: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		2. DOCKET NUMBER		3. LER NUMBER		
VC SUMMER - UNIT 1		05000-		YEAR	SEQUENTIAL NUMBER	REV NO.
		395		2016	001	01

**NARRATIVE****1.0 EVENT DESCRIPTION**

On February 24, 2016, the station conducted an interim action that provided indication of an additional leakage path. Under the interim action, suction pressure and compressor amperage were abnormally low shortly after starting Refrigerant Compressor 2. The circuit was determined to be low in refrigerant charge and the HVAC System Mechanical Water Chiller A (XHX0001A-VU) was declared non-functional. The HVAC Chiller C (XHX0001C-VU) was aligned and started on A-Train to restore operability of the Chilled Water (VU) System.

As reported under LER 2016-001-00, on September 16, 2015, XHX0001A-VU Circuit 2 cooling capacity was observed to be degraded during full load operation. A past operability evaluation completed on December 16, 2015, conservatively determined that XHX0001A-VU was non-functional for failure to remove the design basis heat load of the Train-A of Chilled Water from July 24, 2015, until September 17, 2015 (57 days).

**2.0 EVENT ANALYSIS**

XHX0001A-VU is one of three chiller units that provide Chilled Water to the VU System. 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. XHX0001C-VU is used as a swing component that is powered from either train of Safeguards Power.

The VU System provides cooling to safety related areas (Technical Specifications (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 equipment located within these areas can withstand the environmental effects of a postulated FSAR chapter 15 event. With a non-functional chiller unit, the VU train will become inoperable, thereby affecting room temperatures and the reliability of associated equipment within the safety related area. 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).

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.

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 past basis for continued operability must be submitted to the NRC. 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.

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

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

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](mailto:Infocollections.Resource@nrc.gov), and to the Desk Officer, Office of Information and Regulatory Affairs, NEOF-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	2. DOCKET NUMBER	3. LER NUMBER		
VC SUMMER - UNIT 1	05000-	YEAR	SEQUENTIAL NUMBER	REV NO.
		2016	001	01

**NARRATIVE**

Investigation after the LER-2016-001-00 event conservatively determined that XHX0001A-VU was not capable of performing its design basis function for 57 days, from July 24 through Sept 17, 2015. The investigation also found that XHX0001A-VU was intermittently operating as the only chiller on A Train while unable to remove the design basis heat load during the following time frames:

Placed In Service Removed From Service Total Time

07/29/2015 at 00:18 08/18/2015 at 1:18 20.05 days

08/19/2015 at 17:04 08/26/2015 at 22:41 7.23 days

08/26/2015 at 23:20 09/03/2015 at 00:06 7.03 days

During the 34.31 day period, XHX0001C-VU was not aligned on the A Train of VU. The A Train of VU was unavailable for greater than 72 hours which exceeds the TS 3/4.5.2 action requirements for XPP0043A-CS, Charging/Safety Injection Pump A.

The failure to provide design basis heat load cooling capacity was caused directly by low refrigerant on Circuit 2. The initial apparent cause evaluation (ACE) determined that the low refrigerant on Circuit 2 was due to a refrigerant leak around the threaded connection of the Chilled Water Liquid Injection Solenoid Inlet Valve for Circuit 2.

On February 24, 2016, interim actions were completed as part of the initial ACE for LER-2016-001-00. The corrective maintenance and troubleshooting efforts performed by a subsequent ACE indicated an additional leakage path at the evaporator. The evaporator is common to both Circuit 1 and Circuit 2 on the XHX0001A-VU design. The evaporator heat exchanger is designed with two circuits and the passes separated by eighth of an inch thick and a quarter of an inch wide neoprene gasket. Pressure testing supported that the gasket region of the evaporator heat exchanger was allowing refrigerant leakage. The initial apparent cause was reevaluated and determined that the gasket leakage was due to inadequate compression of the neoprene gasket and inadequate evaporator head gasket design. Therefore, both the threaded connection and gasket leakage allowed refrigerant leakage which resulted in the event.

**3.0 SAFETY SIGNIFICANCE**

The Final Safety Analysis Report (FSAR) 9.4.7.2.4 describes the Safety Class Chilled Water System. This section states that continuous operation of one of the three chillers and chilled water pumps is required during normal and emergency periods to provide 45 degrees Fahrenheit water to the chilled water coils. The availability of three chillers and three chilled water pumps permits one unit to undergo extended maintenance. When all three chillers and pump sets are available, one is designated as a spare and its breaker(s) is racked out. All chillers may be started locally.

The impact of this event was not risk significant. The VU system is not modeled in the Probabilistic Risk Analysis (PRA) model, and would have minimal impact, but can be conservatively modeled by taking Charging Pump A (XPP0043A-CS) out of service during the period that XHX0001A-VU was non-functional.

The past risk impact of both the 57 day period and the 34.31 day period (each conservatively modeled by the same basic event of removing XPP0043A-CS from service) on the PRA is found using EOOS. Since the Charging Pumps are modeled in the baseline PRA, the total change in CDF is conservatively found as the impact of taking XPP0043A-CS out of service for the entire 57 day period of interest.



# LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

(See NUREG-1022, R.3 for instruction and guidance for completing this form  
<http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1022/r3/>)

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 [Infocollects.Resource@nrc.gov](mailto:Infocollects.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	2. DOCKET NUMBER	3. LER NUMBER		
VC SUMMER - UNIT 1	05000- 395	YEAR 2016	SEQUENTIAL NUMBER 001	REV NO. 01

## NARRATIVE

### 3.0 SAFETY SIGNIFICANCE (continued)

The delta CDF for the 57 day period out of service is 4.61E-08/yr  
The delta LERF for the 57 day period out of service is 5.82E-10/yr

### 4.0 PREVIOUS OCCURRENCE

On October 24, 2011, a refrigerant leak on Circuit 1 of XHX0001A-VU was observed. The leak was identified as coming from XVR16482A-VU, Chilled Water Chiller "A" Condenser Vessel Relief Valve Circuit 1A. XVR16482A-VU was reinstalled with new sealant and a follow up leak check was completed satisfactorily.

### 5.0 CORRECTIVE ACTIONS

For the refrigerant leak around the threaded connection of XVM16506A-VU, Chilled Water Chiller "A" Liquid Injection Solenoid Inlet Valve Circuit 2, XVM16506-VU was replaced.

The gaskets were replaced on the north and south side of the evaporator per maintenance procedures. Post maintenance testing was conducted satisfactory to ensure the inter circuit leak was resolved.