

George A. Lippard
Vice President, Nuclear Operations
803.345.4810



January 31, 2018
RC-17-0184

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 2017-002-01)
LOW FEEDWATER FLOW TO THE 'B' SG CAUSES AUTOMATIC REACTOR
TRIP

Reference: G. A. Lippard, SCE&G, letter to NRC Document Control Desk, "Licensee Event
Report (LER 2017-002-00), Low Feedwater Flow to the 'B' SG Causes Automatic
Reactor Trip," dated August 25, 2017 (ML17237C012) (RC-17-0114).

Attached is a supplemental Licensee Event Report (LER) 2017-002-01, to LER 2017-002-00, as
referenced. This report describes the Reactor Trip due to low Feedwater flow to the 'B' Steam
Generator. This report is submitted in accordance with 10CFR50.73(a)(2)(iv)(A).

Should you have any questions, please call Mr. Michael S. Moore at (803) 345-4752.

Very truly yours,

A handwritten signature in black ink, appearing to read "George A. Lippard", is written over a horizontal line.

George A. Lippard

RLP/GAL/
Attachment

J. E. Addison
W. K. Kissam
J. B. Archie
N. S. Carns
J. H. Hamilton
G. J. Lindamood
W. M. Cherry
C. Haney

S. A. Williams
NRC Resident Inspector
L. W. Harris
Paulette Ledbetter
J. C. Mellette
ICES Coordinator
K. M. Sutton
INPO Records Center

Chris Crowley
Marsh USA, Inc.
R. J. Schwartz
NSRC
RTS (CR-17-03674)
File (818.07)
PRSF (RC-17-0184)



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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to 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

V.C. Summer Nuclear Station, Unit 1

2. DOCKET NUMBER

05000 395

3. PAGE

1 OF 4

4. TITLE

Low Feedwater Flow to the 'B' Steam Generator Causes Automatic Reactor Trip

5. EVENT DATE

MONTH	DAY	YEAR
06	29	2017

6. LER NUMBER

YEAR	SEQUENTIAL NUMBER	REV NO.
2017	002	01

7. REPORT DATE

MONTH	DAY	YEAR
01	31	2018

8. OTHER FACILITIES INVOLVED

FACILITY NAME	DOCKET NUMBER
	05000
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 checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)

10. POWER LEVEL

100

<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 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

Michael Moore, Manager Nuclear Licensing

TELEPHONE NUMBER (Include Area Code)

(803) 345-4752

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
B	SI	FCV	F130	YES					

14. SUPPLEMENTAL REPORT EXPECTED

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

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
10	31	2017

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

1.0 ABSTRACT

On June 29, 2017 at 0857, VCSNS Unit 1 automatically tripped due to low Feedwater (FW) flow to the 'B' Steam Generator (SG). The trip was the result of a spurious closure of the Main FW to 'B' Steam Generator Flow Control Valve, IFV00488-FW. The Flow Control Valve's closure resulted in low SG level coincident with the low FW flow, which caused an automatic reactor trip. The plant trip response was normal.

The cause of this event was determined to be the inadvertent closure of IFV00488-FW due to solenoid valve failure. The solenoid valve failure appears to be a result of an inadequate solder applied to the solenoid coil during the manufacturing process.

**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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to 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		
V.C. Summer Nuclear Station, Unit 1		05000-	395	YEAR	SEQUENTIAL NUMBER	REV NO.
				2017	002	01

NARRATIVE**2.0 EVENT DESCRIPTION**

On June 29, 2017 at 0857, VCSNS Unit 1 automatically tripped due to low FW flow to the 'B' Steam Generator (SG). The trip was the result of a spurious closure of the Main FW to 'B' Steam Generator Flow Control Valve, IFV00488-FW. The Flow Control Valve's closure resulted in low SG level coincident with the low FW flow which caused an automatic reactor trip. The plant trip response was normal. Both Motor Driven (MD) Emergency Feed (EF) pumps and the Turbine Driven EF pump started on SG level LO/LO, as designed. Some secondary atmospheric steam dumps did lift and reseal due to the pressure excursion per design. No other automatic actuations occurred.

The apparent cause of this failure appears to be a manufacturing deficiency due to the lead wire to solenoid coil wire having inadequate solder applied to prevent intermittent failure of the solenoid coil. The faulty solenoid coil failure resulted in the closure of IFV00488-FW, which caused the plant trip.

The air supply solenoid was sent off for testing to Exelon PowerLabs for inspection, disassembly, and testing. During the testing, Exelon PowerLabs found the lead wire easily unwound from the solenoid coil wire with no indication of a wetted solder bond. The evidence found during the cause investigation suggests the lack of wetted solder bond was due to a manufacturing deficiency (Cause Code – N1) that has a low probability of recurrence from the manufacturer.

During the June, 2017 plant downpower, the 'A' and 'B' air supply solenoids were replaced on the 'B' Feedwater Regulator Valve (FRV). These 2 valves were sent to Exelon PowerLabs for testing. Disassembly results showed the 'A' solenoid with a properly soldered connection while the 'B' solenoid showed no indications of a wetted solder bond.

Following a subsequent downpower on August 28, 2017, in service 'B' air supply solenoids were removed from the 'A', 'B', and 'C' FRVs, as a preventative measure. The 2 solenoids removed on June 30, 2017, the 3 solenoids removed on August 28, 2017, and a spare solenoid from the warehouse were sent to be tested by DfR Solutions at the request of ASCO. During this investigation, all other solenoids were found to have properly soldered connections between the lead wire and the solenoid coil wire.

During disassembly testing at DfR Solutions (contracted by ASCO), it was found that Exelon PowerLabs did not include the lead wire to solenoid coil wire connections from the failed 'B' FRV solenoid in the return shipment. Follow-up with Exelon PowerLabs concluded that these parts were unintentionally disposed of and therefore could not be independently investigated by DfR solutions. As detailed in the Exelon PowerLabs report, one lead to solenoid coil wire connection exhibited no indication of a wetted solder bond, while the other exhibited some localized indications.

ASCO previously issued an information notice, dated March 6, 2017, informing consumers that RTV 108C off-gases acetic acid during the curing process. The acetic acid then attacks the solder that is applied to the connection between the lead wire and the solenoid coil wire, causing an intermittent loss of electrical power. The lack of evidence for testing led ASCO to attribute the failure of the 'B' solenoid to the use of acetic acid off-gassing sealant. Additional analysis requested of Exelon exhibited no presence of acetic acid or the associated corrosion products on the areas where the solder should be applied.

**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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to 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		
V.C. Summer Nuclear Station, Unit 1		05000-	395	YEAR	SEQUENTIAL NUMBER	REV NO.
				2017	002	01

NARRATIVE**3.0 EVENT ANALYSIS**

The FW System continuously supplies FW from the Condensate System to the steam generators at the same rate as the steam leaves the steam generators, thus maintaining steam generator water level.

The FW System transports the condensate collected in the deaerator storage tank to the steam generators via a series of pumps, FW heaters, and flow control valves. Four FW booster pumps take suction on the deaerator storage tank. These pumps discharge to the suctions of three FW pumps.

The FW pumps discharge through two parallel strings of FW heaters, which preheat the FW before it enters the steam generators. From the outlet of the FW heaters, the water flows through three separate flow paths, one to each steam generator. Each of these three flow paths contains a FW regulating valve and a FW isolation valve for FW flow control and FW isolation.

The main feed regulating valves (IFV-478, 488, 498) are 16-inch, angled, plug valves. They are direct-acting and pneumatically-controlled. The actuator's air diaphragm is connected to the valve stem and receives its air signal from one of two redundant Digital Valve Controllers.

Air to the Feed Water Regulator Valve (FRV) must pass through 2 solenoid valves, 20A & 20B. These solenoid valves port plant supplied air to the Digital Valve Controllers that control the FRVs and also provide control air to the quick exhaust valves. The quick exhaust valve vents actuator air from the valve to provide quick closure of the FRVs to meet stroke time requirements. In this event, the 20B solenoid valve intermittently deenergized and allowed the quick exhaust valve to open, venting the FRV actuator. The 'B' FRV quickly closed, isolating FW flow to the 'B' SG. The low SG level coincident with low FW flow caused the automatic reactor trip.

4.0 SAFETY SIGNIFICANCE

A PRA sensitivity study was performed as a result of this reactor trip. This trip was modeled as a partial loss of main FW. VCSNS uses a frequency for partial loss of main FW of 0.206/yr. based on a generic frequency of 0.1615/yr. updated with plant specific experience of 3 events in 10.8 years.

For the sensitivity study, the partial loss of main FW initiating event frequency was set to 1.0/yr. The resulting change in CDF is 2.70E-07/yr. and the resulting change in LERF is 1.17E-08/yr. The baseline CDF and LERF for the model (version 8a2) used for this study are 3.28E-06/yr. and 1.01E-07/yr. respectively, so the changes constitute an 8% increase in CDF and an 11% increase in LERF.

The changes in CDF and LERF described above are not considered significant.

5.0 PREVIOUS OCCURRENCE

No previous occurrence within the last three years.

**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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to 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		
V.C. Summer Nuclear Station, Unit 1		05000-	395	YEAR	SEQUENTIAL NUMBER	REV NO.
				2017	002	01

NARRATIVE**6.0 CORRECTIVE ACTIONS**

A troubleshooting plan was performed to provide backup monitoring to IPCS for FRV and Feedwater Isolation Valve limit switch position indication.

The potential failed components were replaced per the Failure Modes Analysis and post maintenance testing was successful.

The following components associated with the 'B' FW Regulating Valve IFV00488-FW were replaced under Work Order 1708087:

- Primary XACT Feedback Transducer IFY00488A-ZT
- Solenoid Valve IFV00488-20A-FW
- Solenoid Valve IFV00488-20B-FW
- Quick Exhaust Valves IFV00488-EV2 and IFV00488-EV3
- Contacts 7 and 8 on relay K636

- Solenoid Valve IFV00478-20B-FW was replaced under Work Order 1712469
- Solenoid Valve IFV00488-20B-FW was replaced under Work Order 1712471
- Solenoid Valve IFV00498-20B-FW was replaced under Work Order 1712472

The following components were sent off for testing:

- K636 Contacts 7/8 Cartridge: No issues identified by Applied Technical Services
- IFV00488-20A-FW and IFV00488-20B-FW ASCO Solenoid Valves: Inadequate solder connection identified at magnet wire on IFV00488-20B-FW.
- Solenoid Valve IFV00478-20B-FW
- Solenoid Valve IFV00488-20B-FW
- Solenoid Valve IFV00498-20B-FW
- Spare Solenoid Valve S/S A612152-015, Date Code 1038 – never placed in service