CP&L

Carolina Power & Light Company

Brunswick Nuclear Project
P. O. Box 10429
Southport, NC 28461-0429
February 19, 1990

FILE: B09-13510C 10CFR50.73
SERIAL: BSEP/90-0130

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

BRUNSWICK STEAM ELECTRIC PLANT UNIT 2
DOCKET NO. 50-324
LICENSE NO. DPR-62
SUPPLEMENT TO LICENSEE EVENT REPORT 2-88-001

Gentlemen:

In accordance with Title 10 to the Code of Federal Regulations, the enclosed Supplemental Licensee Event Report is submitted. The original report fulfilled the requirement for a written report within thirty (30) days of a reportable occurrence and was submitted in accordance with the format set forth in NUREG-1022, September 1983.

Very truly yours,

J. L. Harness, General Manager
Brunswick Nuclear Project

TMJ/mcg

Enclosure

cc: Mr. S. D. Ebneter
Mr. E. G. Tourigny
BSEP NRC Resident Office

IE22
1/1

NRC FORM 366 (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Brunswick Steam Electric Plant Unit 2	0 5 0 0 0 3 2 4	1 OF 0 9

TITLE (4) Manual Reactor Scram Due to Decreasing Main Condenser Vacuum and Failure of Primary Containment Group 2 Valves G16-F003, F004, F019, and F020 to Close on Isolation Signal

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 NAMES	DOCKET NUMBER(S)
0 1	0 2	8 8	8 8	— 0 0 1 —	0 5	0 2	1 9	9 0		0 5 0 0 0
										0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 0 5 5

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

20.402(b)	20.405(c)	X 50.73(a)(2)(iv)	73.71(b)
20.405(a)(1)(i)	50.36(c)(1)	X 50.73(a)(2)(v)	73.71(c)
20.405(a)(1)(ii)	50.36(c)(2)	X 50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
20.405(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
	AREA CODE	
T. M. Jones, Regulatory Compliance Specialist	9 1 9	4 5 7 - 2 3 1 5

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
X	J M	I S V	G 0 8 2	Y		X	J M	I S V	G 0 8 2	Y	
X	J M	I S V	G 0 8 2	Y		X	J M	I S V	G 0 8 2	Y	

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		0 6	1 5	9 0

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

While performing a routine reactor shutdown in preparation for the Unit 2 1988 refueling/maintenance outage, a manual reactor protection system trip (scram) was initiated at 0017 hours on 1/2/88, due to a decreasing condenser vacuum. Reactor power was approximately 55% and vacuum had decreased to approximately -22 inches mercury. During the expected vessel level shrink following the scram, vessel level decreased to approximately 153 inches, thus initiating primary containment isolation valve groups 2, 6, and 8 at low level 1 (> 162.5"). Operator verification of these valve closures determined that the group 2 valves 2-G16-F003, -F004, -F019, and -F020 failed to close. These are the inboard and outboard isolation valves for the drywell floor drain sump (F003, F004) and the drywell equipment drain sump (F010, F020). The remaining safety systems operated as designed during this event.

Investigation of the decreasing vacuum condition determined it resulted from numerous leaks on the main turbine and main steam reheat interconnecting piping to the main turbine, which were repaired during the unit outage. To date, the cause of the group 2 PCIVs failure to close has not been determined. By 6/15/90, a supplement to this report will be issued to update the root cause determination of the failure of the valves to close.

NRC Form 366B
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER) FAILURE CONTINUATION

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

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	
X	JM	RLY	G082	Y							

NRC FORM 366A (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	PAGE (3)
Brunswick Steam Electric Plant Unit 2	0 5 0 0 0 3 2 4	8 8	— 0 0 1	— 0 5	0 3 OF 0 9

TEXT (If more space is required, use additional NRC Form 366A's) (17)

Initial Conditions

At approximately 2015 hours on 1/1/88, a power reduction was commenced from 69% power to commence a scheduled 16-week refueling and maintenance outage. This initial condition represented the maximum attainable reactor power due to operating cycle fuel depletion. After approximately two hours, at a power level of approximately 50%, problems were encountered maintaining condenser vacuum. At 0017 hours on 1/2/88, a manual reactor protection system (EIIS/JC) trip (scram) was initiated with main condenser (EIIS/SG) vacuum at approximately -22 inches mercury (Hg) and decreasing in anticipation of an automatic scram due to the main turbine (EIIS/TA) trip on low vacuum at greater than 30% power. At the initiation of the scram, plant emergency core cooling systems and other safety systems were operable.

Event Description

At 2015 hours on 1/1/88, reactor power reduction was commenced in preparation for the scheduled refueling/maintenance outage. As power was decreased, condenser off-gas flow slowly began to increase such that, at 2125 hours, the augmented off-gas system bypass valve (EIIS/WE/FCV) automatically opened due to high flow (setpoint; 150 scfm). This increase in off-gas flow was not unexpected in that it had been noted that off-gas flow had increased during previous power reductions. This off-gas power relation is believed to be caused by minor steam leaks at high power levels which become vacuum leaks at lower power levels. Although off-gas flow was increasing, condenser vacuum was showing slight improvement. Power was reduced to 48% at 2215 hours and 2B steam jet air ejector (SJAE) (EIIS/SH/EJR) was secured with 2A SJAE remaining in half load per the plant shutdown procedure. After securing 2B SJAE, condenser vacuum began to decrease and the 2A SJAE was placed in full load at 2245 hours, and reactor power was increased to 51%. These actions caused vacuum to reverse the downward trend and start improving. With vacuum improving, efforts were initiated to identify vacuum leaks for repair/isolation to allow the recommencement of the scheduled power reduction.

At 2345 hours, vacuum again began to decrease with the decreasing trend being at a higher rate than had been observed during the initial decrease following the securing of 2B SJAE. No evolution had taken place during the previous hour which would have caused this change. Attempts to place the 2B SJAE in service were unsuccessful due to a low output from the startup permissive temperature instrument (EIIS/JA/TC). Power was increased to approximately 55% by increasing recirculation flow and control rod withdrawal in an effort to terminate the decreasing vacuum trend. These efforts appeared to have no effect. With the vacuum continuing to decrease, the decision was made to manually scram the reactor prior to receiving the automatic scram due to the turbine trip on low condenser vacuum at greater than 30% power.

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Brunswick Steam Electric Plant Unit 2	0 5 0 0 0 3 2 4	8 8	— 0 0 1 —	0 5	0 4 OF 0 9

TEXT (If more space is required, use additional NRC Form 366A's) (17)

At 0017 hours on 1/2/88, a manual scram was initiated at a condenser vacuum of approximately -22 inches Hg and decreasing. A normal scram recovery was initiated using the emergency operating procedures. Immediately following the scram, reactor vessel level decreased to approximately 153 inches due to expected void collapse and returned to the normal operating level. As a result of decreasing below a reactor vessel level of 162.5 inches (low level 1), an automatic scram signal was initiated along with an automatic primary containment isolation system (PCIS) (EIIS/JM) signal for groups 2, 6, and 8.

A verification that these automatic functions, per the emergency operating procedures, occurred at 0020 hours determined that the PCIS group 2 valves (EIIS/JM/ISV), 2-G16-F003, -F004, -F019, and -F020, failed to close. These valves are the inboard and outboard isolation valves (both located outside the primary containment) for the drywell floor drain sump (EIIS/IJ/SNK) (F003, F004) and the drywell equipment drain sump (EIIS/IF/SNK) (F019, F020). Failure of these valves to shut represented a failure of both redundant safety divisions as PCIS valves F004 and F020 are associated with one logic division, and PCIS valves F003 and F020 are associated with the other logic division. Following identification of the failure of these valves to close, each valve was given a manual close signal from the Control Room reactor turbine gauge board (EIIS/NA/CBD), at which time the F003 and F004 valves went shut. No change in position status was noted for the F019 and F020 valves. At approximately 0023 hours, the F020 was observed to be in the closed position. No evolution could be identified which would have caused the F020 to close during this three-minute time frame. Another manual close signal was given to the F019 valve at approximately 0023 hours and again, no change in position noted; however, the F019 valve was observed to be in the closed position at 0025 hours. Again, no evolution could be identified which would have closed the F019 valve following manual operation.

Further review of the plant response to this scram indicated that the remaining plant safety systems operated per design. Five control rods (EIIS/AA/ROD) were identified to be at the 02 position following the scram and they were fully inserted by 0030 hours using plant procedures.

Investigation Summary

Decreasing Condenser Vacuum

At approximately 2220 hours on 1/1/88, vacuum began to decrease following the removal of the 2B SJAE from service per procedure. Following an increase in power and the placing of 2A SJAE in full load, vacuum began an improving trend. One hour later at 2345 hours, vacuum again began to decrease due to no apparent cause, as no plant evolutions had been undertaken within that hour

which would have affected vacuum. Vacuum continued to decrease until the manual scram was initiated at 0017 hours, at which time vacuum recovered quickly, decreased for a short period of time, and then gradually increased until leveling out at -28 inches of Hg.

A review of the vacuum trend during this event and previous plant vacuum operating history indicated that, although higher than normal air inleakage did contribute to the decrease in condenser vacuum, the high air inleakage flow rate would not alone cause the high SJAE discharge pressures observed during the event. It is unlikely that a large air inleakage source initiating at 2345 hours would have allowed the vacuum to recover and trend as noted following the scram.

As previously noted, air inleakage had been an identified problem prior to this event during power reductions. Investigations were initiated on 9/25/87 to identify and correct suspected air inleakage problems. The investigation consisted of a complete valve lineup and helium leak testing. These investigations had identified several air inleakage sources during the latter part of 1987 and were still in progress at the time of the event. Repairs had been made where system operation and safety would allow, with the remaining known air inleakage problems to be corrected during the outage. Additional air inleakage sources were still being sought at the time of this event.

In addition to the known and suspected air inleakage, the decreasing trend in condenser vacuum is believed to have been caused by SJAE back pressure. It is believed that excessive moisture in the downstream piping (EIIS/SH/PSX) of the SJAEs was partially the cause for the decreasing vacuum. Indications of this probable cause included a high differential pressure alarm (possible cause; high moisture in the off-gas effluent) received for the off-gas system main stack filter (EIIS/WF/FLT) which cleared when the standby filter (EIIS/WF/FLT) was placed in service as well as a noted decrease in the off-gas system recombiner (EIIS/WF/RCB) temperature. Moisture carryover into the discharge line (EIIS/WF/PSX) may have occurred from the high level noted in the 2A SJAE intercondenser (EIIS/SH/COND), which was operating at a level of 82 inches (normal level is 55 inches).

During the Unit 2 1988 refueling/maintenance outage, extensive leak testing involving use of helium was performed on the main turbine and condenser and the interconnecting piping to the Condensate System (EIIS/SD) and the Main Steam Reheat System (EIIS/SB) as well as the main turbine structure to determine the root cause of the incurred decreasing main condenser vacuum. On February 2, 1988, while the main condenser was intentionally flooded up, water was observed flowing from a discovered 3/4-inch hole in Miscellaneous Vents and Drains (MVD) System line 2-MVD-267-4-E-3 (EIIS/SM/PSX). This 4" line

is the shell pocket drain line from the main turbine moisture separator reheater (MSR) to the main condenser, which collects the MSR shell drains from four 1 1/2" lines (EIIS/SM/PSX), each containing a 1/4" orifice strainer (EIIS/SM/PSX). When the main turbine is online, line pressure upstream of the strainers is that of the main turbine 7th stage extraction steam pressure, which varies with reactor power (80 psig at 56% power to 170 psig at 100% power. Likewise, line pressure downstream of the strainers varies with reactor power, such that as power is decreased, the resulting reduced pressure in the line will cause greater main condenser air inleakage. The hole size was determined to have allowed an air inleakage of approximately 96 standard cubic feet per minute (scfm) at a main condenser vacuum of 28 inches of mercury. Following discovery of the subject hole, the affected line was replaced. In addition to the hole in the MVD line, several other leaks were identified through helium testing. Repairs to these components were performed during the unit outage.

Valve Failures

While performing a scram recovery in accordance with plant procedures, it was determined that the group 2 PCIS valves 2-G16-F003, F004, F019, and F020 failed to close on an automatic isolation signal (low level 1). Subsequent operator action caused the valves to close as previously stated. The following actions were performed in an effort to determine the cause of the PCIS valves' failure to close.

January 2, 1988

1. Following the scram recovery, the four group 2 valves were successfully cycled during normal sump pumping operations with no problems noted with valve operation. The Unit 1 (U/1) valves were also stroked to verify operability.

2. A visual inspection was performed on the wiring (EIIS/JM/CBL1) and relays (EIIS/JM/RLY) associated with the group 2 isolation logic on Unit 2 (U/2).

3. A maintenance history search was initiated to develop the operating history of the failed PCIS valves. This history review determined that the F003 valve had experienced three failures and the F004 valve had experienced one failure since the solenoids (EIIS/IJ/*) were replaced in the spring of 1986 as part of environmental qualification modifications. The remaining two valves on U/2 and the four valves on U/1 did not have a failure history.

*EIIS component description unavailable.

4. Applicable sections of the logic system functional test procedures were performed, with no logic problems identified.

January 3, 1988

1. The F019 solenoid valve (ASCO) (EIIS/JM/PSV) was removed and disassembled. A minor oil film was identified on internal parts and minor debris was found in the solenoid valve. However, no cause for, or evidence of, failure was identified.

2. The group 2 PCIS valve monthly functional test was performed on U/2. No problems were identified.

January 4, 1988

1. A special test procedure was performed to verify the group 2 PCIS valve system logic on U/1. No problems were noted.

January 6, 1988

1. A special test was performed to simulate the conditions present during the U/2 scram. The operation of the valves was observed locally and strip chart recording of electrical circuit operation was obtained. No problems were identified with valve operation.

2. The U/1 valves were shut (normally open), only to be opened for testing and sump pumping operations pending resolution of the failure of the U/2 valves.

January 7, 1988

1. Removed and disassembled the solenoid on the F003 valve with no problems identified.

2. Performed an air cleanliness test of the air supply to the F003 valve and a test of the pressure regulator supplying the F003 valve. No problems were identified.

January 8, 1988

1. Removed the F020 valve solenoid for on-site vendor inspection and performed a pressure regulator test for its air supply. No problems were identified.

January 9, 1988

1. Performed a visual inspection of the logic relays A71-K17 and A71-K18 (EIIS/JM/RLY). An arc strike was identified on terminal 4 of the K18 relay and visual evidence indicates that contact 3-4 had been welded closed as a result of the arc strike.

2. Initiated activities to remove one valve actuator (Miller air motor) (EIIS/JM/84) for inspection.

3. The F020 valve solenoid, removed on 1/8/88, was inspected on site by the vendor with no operability problems identified.

January 13, 1988

1. Removed and inspected the in-line air filter (EIIS/JM/FLT) supplying the F003 valve. No problems were identified (filter was very clean with approximately three years operating history).

January 14, 1988

1. Replaced the A71-K17 and K18 relays, General Electric Part No. CR120A06002AA, on U/2.

January 19 and 20, 1988

1. Removed and inspected the valve actuator for the F020 valve. The internals of the actuator had a liberal coating of grease in accordance with vendor recommendations.

Corrective Actions

Based on results of testing/analysis performed to date, a definite root cause has not been identified. Vendor inspection and analysis of the valves' solenoid valves could not identify evidence which would explain the failure of the valves to open. The inspection did reveal the presence of an oil base film in the solenoid valves' internals; however analysis of the oil film determined it was oil used by the manufacturer for component assembly. Laboratory work at the Carolina Power & Light Company metallurgical and failure analysis facility indicates the incurred failure of the subject solenoids may be the result of a higher than previously expected rate of degradation (oxidation) of the solenoids' valve seat material, ethylene propylene diene monomer (EPDM). This is believed to occur when higher than anticipated ambient temperatures in the solenoid valve bodies, due to the solenoids' being normally energized, combine with the presence of copper in the solenoid valve bodies, which are made of brass. In order to further identify the root cause(s) and required correction actions relative to this problem, the services of a contractor have been retained.

NRC FORM 366A (6-89)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
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LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

On May 25, 1989, action was completed to install Viton-based seating material in the subject Unit 1 valves' solenoids to serve as an interim corrective measure until the subject failure mechanism is clearly understood and final corrective actions are implemented. Completion of corresponding interim action on Unit 2 is expected by December 1, 1989. Viton has been shown to withstand temperatures which would normally degrade EPDM-based material. In addition, the scope of this interim corrective measure has been expanded to appropriately include other normally energized ASCO solenoids on both units utilizing EPDM as a seating material (reference Engineering Evaluation Request 88-076 Rev. 1). Until this action is accomplished, these solenoids will be cycled on a weekly basis to help ensure their operability. An update regarding the results of this effort will be reflected within a supplement to this report to be submitted on or before June 15, 1990.

As a result of this event, the on-site Quality Assurance group performed a surveillance activity (QASR 88-007) on the failure of the valves to close.

Event Assessment

This event was assessed to determine if the event would have been more severe under reasonable and credible alternative conditions as defined in NUREG 1022 (and supplements). This assessment determined that the first event (scram) would not have been more severe as this is an analyzed event in the safety analysis and the plant systems are designed for adequate mitigation. The second event (valve failures) would also not be more severe in that neither a reasonable nor a credible alternative condition could have provided a source term within the drywell. Without the source term, there is no increase in the quantity on material which would be released through these nonisolated penetrations.

A review of our records indicates that the failure of the valves to close is an isolated event for LER reporting criteria (redundant system failure); however, a condenser vacuum problem did initiate a scram in 1985 on U/1 and was reported in LER 1-85-008.