



Entergy Operations, Inc.
17265 River Road
Killona, LA 70066
Tel 504 739 6242

Early C. Ewing III
Director, Nuclear Safety Assurance
Waterford 3

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A4.05
PR

December 22, 1999

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

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Reporting of Licensee Event Report

Gentlemen:

Attached is Licensee Event Report (LER) 99-018-00 for Waterford Steam Electric Station Unit 3. This report provides details of operating with valve SI-417B open in violation of Technical Specifications. This condition is being reported pursuant to 10CFR50.73(a)(2)(i)(B), any operation or condition prohibited by the plant's Technical Specifications.

This LER does not contain any commitments.

Very truly yours,

E.C. Ewing
Director,
Nuclear Safety Assurance

ECE/CED/ssf
Attachment

IE22

cc: E.W. Merschoff (NRC Region IV), C.P. Patel (NRC-NRR),
A.L. Garibaldi, P. Lewis - INPO Records Center,
J. Smith, N.S. Reynolds, NRC Resident Inspectors Office,
Louisiana DEQ/Surveillance Division

PDR ADOCK 05000382

Estimated burden per response to comply with this mandatory information collection request: 50.0 hrs. Reported lessons learned are incorporated into the licensing process and fed back to industry. Forward comments regarding burden estimate to the Records Management Branch (T-6 F33), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, and to the Paperwork Reduction Project (3150-0104), Office of Management and Budget, Washington, DC 20503. If 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.

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)
Waterford Steam Electric Station, Unit 3

DOCKET NUMBER (2)
05000-382

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TITLE (4)
Operating in a Condition Prohibited by Technical Specification 3.5.2 Due a Valve Reach Rod Failure

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 NAME	DOCKET NUMBER
11	27	99	99	018	00	12	22	99	N/A	N/A
									N/A	N/A

OPERATING MODE (9)	POWER LEVEL (10)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR § (Check one or more) (11)								
4	0	20.2201(b)	20.2203(a)(2)(v)	X	50.73(a)(2)(i)	50.73(a)(2)(viii)				
		20.2203(a)(2)(i)	20.2203(a)(3)(i)		50.73(a)(2)(ii)	50.73(a)(2)(x)				
		20.405(a)(1)(ii)	20.2203(a)(3)(ii)		50.73(a)(2)(iii)	73.71				
		20.2203(a)(2)(ii)	20.2203(a)(4)		50.73(a)(2)(iv)	OTHER				
		20.2203(a)(2)(iii)	50.36(c)(1)		50.73(a)(2)(v)	Specify in Abstract below or in NRC Form 366A				
		20.2203(a)(2)(iv)	50.36(c)(2)		50.73(a)(2)(vii)					

LICENSEE CONTACT FOR THIS LER (12)

NAME: **Charles E. DeDeaux / Licensing Supervisor** TELEPHONE NUMBER (Include Area Code): **(504) 739-6531**

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

SUPPLEMENTAL REPORT EXPECTED (14)

YES (If yes, complete EXPECTED SUBMISSION DATE): NO: EXPECTED SUBMISSION DATE (15): MONTH: DAY: YEAR:

ABSTRACT (Limit to 1400 spaces, i. e., approximately 15 single-spaced typewritten lines) (16)

On 11/27/99, with the plant in Mode 4, it was discovered that Waterford 3 Operated for 7 days in a condition prohibited by Technical Specification (TS) 3.5.2. TS 3.5.2 requires two Low Pressure Safety Injection (LPSI) Pumps to be Operable. On 11/19/99 with the plant in Mode 1, SI-417B was opened to recirculate the Refueling Water Storage Pool (RWSP); however, following completion, SI-417B was not closed due to the failure of its reach rod. The reach rod handwheel was locked closed but the valve was open. With SI-417B open, enough LPSI flow is diverted such that the TS flow requirements cannot be met. This condition occurred from 11/19/99, when the valve was left open, to 11/26/99, when the plant entered Mode 3 with pressurizer pressure < 1750 psia and Reactor Coolant System (RCS) average temperature < 500°F.

The root cause of the event is failure of SI-417B reach rod due to a roll pin in the roto-hammer linkage backing out, which resulted in not identifying that SI-417B was left open. Upon discovery of this condition, SI-417B was closed and locked at the local handwheel. There is minimal safety significance associated with this event. A limited amount of inventory was drained from the RCS. Core cooling was maintained throughout the event. The health and safety of the general public were not adversely affected.

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REPORTABLE OCCURRENCE

On November 27, it was discovered that Waterford 3 operated for 7 days with one LPSI subsystem inoperable without entering the appropriate Action of TS 3.5.2. SI-417B [ISV] was inadvertently left open due to a reach rod failure. With SI-417B open, the LPSI B Subsystem would be unable to meet its TS flow requirements because some flow would be diverted to the RWSP [TK].

Waterford 3 operated for 7 days without entering the appropriate Technical Specifications Action statement for one LPSI pump [BP-P] out of service. This event was discovered when Waterford 3 was in Mode 4 which is outside the Mode of Applicability for requiring two LPSI pumps to be operable.

This occurrence is being reported due to operation prohibited by the plant's Technical Specifications pursuant to 10CFR50.73(a)(2)(i)(B).

INITIAL CONDITIONS

When this condition was identified on 11/27/99, Waterford 3 was operating in Mode 4. The plant was shutdown on 11/26/99 due to a leak on the outlet piping of the main steam drip pot which is unrelated to this event. There was no known equipment out of service and no TS Limiting Condition for Operation action statements in effect that were specific to this event.

EVENT DESCRIPTION

On 11/27/99, while in Mode 4, it was discovered that Waterford 3 had operated in Modes 1-3 in a condition that is prohibited by TS. The LPSI B Subsystem was discovered to be inoperable due to SI-417B not being closed following manipulation on 11/19/99. Subsequent to this event, it was confirmed that there is minimal safety significance associated with this event. A limited amount of inventory was drained from the RCS [AB] and core cooling was maintained throughout the event.

On 11/19/99 at 1703, Boric Acid Makeup Tank "A" [TK] was pumped to the RWSP to raise boron concentration and level in preparation for the partial draining and refilling of Safety Injection Tank 2B

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[TK]. At 1704, LPSI Pump "B" was declared inoperable to place the RWSP on recirculation. Technical Specification 3.5.2 was entered at that time due to the need to reconfigure the system for recirculation. At 1715, the RWSP was placed on recirculation using LPSI Pump "B", which requires five hours of recirculation time. Shift turnover was completed at approximately 1814.

On 11/19/99 at 2230, the Shift Chemistry Technician notified the Control Room that he sampled the RWSP at 2220. At 2235, LPSI Pump "B" was secured. At 2258, the restoration lineup in Attachment 11.12 of OP-009-008, Safety Injection, was completed and TS 3.5.2 was exited. The restoration lineup in Attachment 11.12 included only one valve to be operated outside the Control Room, which was SI-417B, Shutdown Cooling Heat Exchanger B [BP-HX] to Refueling Water Storage Pool Isolation.

On 11/26/99 the plant commenced a shutdown due to an unisolable Main Steam line leak upstream of the Main Steam Isolation Valve (MSIV) [SB-ISV]. On 11/27/99 at 0447, during the alignment of LPSI Train "B" for Shutdown Cooling operations, SI-407B, RC Loop 1 SDC Suction Outside Containment Isolation, was being positioned to open, in accordance with OP-009-005, Shutdown Cooling System. Reactor Coolant System (RCS) pressure and pressurizer level were immediately noticed to be rapidly lowering. The Control Room Supervisor directed the Secondary Nuclear Plant Operator to close SI-407B, which was still in the process of opening. At 0448, the Control Room Supervisor directed the Primary Nuclear Plant Operator to secure the two remaining Reactor Coolant Pumps that were operating due to low RCS pressure. SI-407B was verified closed and RCS parameters were stabilizing. At 0449, it was noticed that RWSP level had risen approximately 1%. This corresponds to an approximate inventory transfer of 5000 gallons. The appropriate procedures, OP-901-131 and OP-902-002, were entered and performed concurrently. At 0507, High Pressure Safety Injection Pump (HPSI) "A" [BQ-P] was started in accordance with OP-901-131 to add inventory to the RCS via hot and cold leg injection. Pressurizer level was restored to the normal shutdown band at 0516 and HPSI pump "A" secured.

On 11/27/99 at 0533, Waterford 3 declared an Alert with the Initiating Condition E/A/I, plant conditions warrant precautionary activation of the Technical Support Center. Plant parameters were stabilized at

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0611. Shift turnover was then performed and completed at approximately 0705.

On 11/27/99 at 0815, during a walkdown of Safety Injection Train "B" components, it was discovered that SI-417B was actually open with the reach rod remote handwheel indicating locked closed. SI-417B was then closed and locked at the local handwheel on the valve. With SI-417B open, a direct path from the RCS to the RWSP was established through the LPSI System.

Further investigation later that same day indicated that one of the roll pins holding the linkage in place on SI-417B had worked itself completely out and was found on the floor in the general area of the valve. Another roll pin in the linkage was observed to have partially worked out of its hole. Immediate repairs were performed to install new roll pins and to verify the reach rod linkage was in satisfactory condition.

A debriefing of Operations personnel, involved in the recirculation of the RWSP, was conducted on 11/28/99 in accordance with W1.106, Excellence in Human Performance. This was followed up on 11/29/99 by additional interviews and a walkthrough of the lineup with the individuals that performed the restoration lineup outside the Control Room. The individuals that performed the recirculation lineup in accordance with Attachment 11.12 of OP-009-008 stated what they believed occurred on 11/19/99. The Radiation Controlled Area (RCA) Nuclear Auxiliary Operator (NAO) stated that he checked the linkage for SI-417B prior to its manipulation, which is consistent with Operations Management expectations for reach rod valve operation. When directed by the Control Room to lock closed SI-417B, both he and the Reactor Auxiliary Building (RAB) NAO proceeded to the RAB -15 elevation valve gallery where the remote operator was located. There was some discussion concerning local observation of the valve and it was believed that the RCA NAO informed the RAB NAO that he had previously checked the linkage for the valve. Later discussions with Operations Management indicated that this was meeting management expectations. SI-417B was then repositioned in the closed direction. The RCA NAO stated that the valve would no longer travel in the closed direction, checked the pedestal indication, which indicated closed, and then locked the valve in that position. The RAB NAO verified that the lock was properly installed and that turning it in the closed direction resulted in no movement.

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Additional investigations revealed that there are computer points for SI-417B, which are also shown on the Shutdown Cooling mimic on the Plant Monitoring Computer. Personnel interviewed, who were on the night shift from 11/26/99 to 11/27/99, did not remember having this mimic displayed when SI-407B was opened. This could be classified as a missed opportunity to recognize the incorrect positioning of SI-417B. However, displaying of the mimic is not a proceduralized requirement and standard operating practice exhibited by Operations personnel would be the displaying of the mimic prior to starting of LPSI Pump "B" but not during valve lineups.

CAUSAL FACTORS

The failure to comply with Actions of Technical Specification 3.5.2, as appropriate on 11/19/99, was due to the failure of SI-417B reach rod, which resulted in providing false indication that the valve was closed.

Two Root Cause Analysis (RCA) Reports have been performed. One RCA was performed for the diversion of RCS inventory when placing shutdown cooling in service (CR-WF3-1999-1210) and one RCA was performed for the broken reach rod on SI-417B (CR-WF3-1999-1211).

The Root Causes for failing to properly position the valve are preventative maintenance less than adequate and degraded sub-component contributed to failure. Failure of the reach rod resulted in false indication that SI-417B was closed and led to the valve being open and LPSI B being inoperable for 7 days without complying with the TS Actions. The failure was due to one of the roll pins in the roto-hammer linkage for SI-417B being backed out, disengaging one reach rod connection and not allowing the roto-hammer handwheel to operate the valve. The roll pin had become loose in the reach rod holes due to normal loads. Proper preventative maintenance would have identified this looseness and performed the required corrective actions prior to the roll pin coming completely out.

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BELOW ARE FOUR CONTRIBUTING CAUSES.

Corrective action for a previously identified problem was not adequate to prevent recurrence. On 10/19/94, CR- 94-983 identified that the roll pin connecting the valve gallery handwheel to the valve stem for CS-117A had backed out disabling the valve close function. Although the CR identified one of the causes as a worn roll pin and an investigation of the reach rod design would be performed, no overall investigation of the reach rod design was performed to determine if the roll pins are susceptible to backing out. Also, the only safety related valves identified as requiring this inspection were CS-117A&B and CS-111A&B. This inspection should have been extended to all safety-related valves with reach rods. Additionally, the failure of the position indicator, which bottomed out and broke, was attributed to a manufacturer error. However, there is no documentation that this manufacturer error was investigated for all safety related roto-hammer operated valves.

Job Performance Standards were not adequately defined. Discussions with Operations Department supervision and personnel indicated that reach rod operated valves are normally checked by alternate methods due to their location being a personnel safety and/or ALARA concern. Management and supervisory personnel have monitored the checks listed below and Operations management expectations were being met at the time. These expectations have been modified for future valve position verification to ensure this type of failure is identified. The reach rod valves were checked using one of the following methods, listed in the order that they are normally performed:

- One operator moves the valve back and forth using the reach rod while another operator verifies proper engagement of the linkage and returns to provide a peer check for the first operator.
- One operator repositions the valve using the reach rod, after receiving a peer check, while another operator monitors the valve for full range of travel locally at the valve.
- One operator verifies reach rod linkage intact and then repositions valve after receiving a Peer check from another operator. After repositioning of the valve, linkage may be checked again.

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Construction and Installation/Setup are less than adequate. The position indicator on the pedestal for SI-417B was found bottomed out. This condition provided adequate resistance to lead the operator to believe the valve was fully closed. Upon further inspection, numerous other reach rod pedestals had their indicators bottomed out with the linkages in satisfactory condition. These indicators were not adjusted properly to ensure that they do not bottom out during valve operation. Therefore, it was normal for operators to observe bottomed out indicators following valve operation.

Construction and Installation/Setup less than adequate. The holes on some of the pinned coupling joints were larger than is necessary for the required interference fit. This may have resulted from an enlargement of the hole(s) during assembly required to compensate for improper alignment.

CORRECTIVE ACTIONS

Immediate Corrective Actions completed for the broken Reach Rod included:

1. Closed SI-407B, RC Loop 1 SDC Suction Outside Containment Isolation Valve, and closed SI-417B, Shutdown Cooling Heat Exchanger B to Refueling Water Storage Pool Isolation.
2. Repaired the reach rod assembly for SI-417B and adjusted the position indicator to prevent bottoming out.
3. Perform inspections of accessible safety and non-safety related, reach rod assemblies to determine if the event represented a common problem among similar valves at Waterford 3.

Actions completed to ensure plant integrity, following the diversion of RCS Inventory event, include:

1. Walked down SDC Train B Piping and Supports.

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2. Walked down Pressurizer Surge Line Piping and Supports.
3. Performed Radiological Survey of RWSP Floor Plug.
4. Performed calibration check of pressurizer wide range pressure instrument.
5. Sampled CCW and RCS for Boron and Radioactivity.
6. Vented SDC Train B piping.
7. Performed confirmation run of LPSI B pump and obtained vibration data.
8. Evaluated Pressurizer surge line thermal gradient.

Intermediate and long term Corrective Actions for the SI-417B reach rod being broken and for the diversion of inventory to the Refueling Water Storage Pool are documented in the Root Cause Analysis Reports for CR-WF3-1211-1999 and CR-WF3-1210-1999, respectively.

SAFETY SIGNIFICANCE

Event Impact

This event resulted in a temporary diversion of inventory from the RCS that was terminated by operator action to isolate the RCS from the shutdown cooling system. While this was a significant transient, its impact on safety of the plant was limited. Prompt action was taken by the operator to close SI-407B and terminate draining of the RCS. Multiple safety related isolation valves were available and operable to be closed that would terminate the diversion of inventory from the RCS. Decay heat was low since the plant had been shutdown for approximately 16 hours. The safety injection system was available for manual actuation and the charging system automatically started to restore Pressurizer level. Shutdown

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Cooling Train A and the ultimate heat sink remained available and were capable of dissipating heat from the RCS and auxiliaries to ensure safe plant shutdown. No piping systems were exposed to pressures or temperatures beyond their analyzed values. The core remained covered with water and cooled since decay heat removal continued with natural circulation cooling. There were no significant challenges to any safety function. This event has minimal safety significance.

RCS Voiding

Based on the temperature and pressure profile in the RCS during the event and the "PIPE-FLO" computer model, voiding did not occur. Even in the unlikely event that a void was formed, it would be limited in size, most likely less than 97 gallons, and would not hinder core cooling. This potential small void volume would have collapsed within 2 minutes after being formed due to inventory makeup by charging pumps and the resultant pressure increase. All RCS temperature indications confirmed that adequate core cooling was maintained during the entire event. The void volume would need to be significantly greater to threaten core cooling. Natural circulation would continue until significant voiding occurred in the steam generator U-tubes or top of RCS hot legs. Reflux boiling would then be available to provide adequate core cooling.

Time to Core Uncovery with No Operator Action

In an attempt to bound the worst case loss of inventory from the RCS, the time to uncover the core was determined assuming the operator took no action after opening SI-407B. A conservative calculation was performed that determined the expected flow rate from the RCS, at a pressure of 78 psia, to be 2400 gpm. The RCS stabilization pressure of 78 psia following the opening of SI-407B is conservative because RCS pressure would drop to saturation. The highest representative Core Exit Thermocouple (CET) temperature at the time of the event was 308°F, which corresponds to a saturation pressure of approximately 75 psia. Pressure would then slowly decrease as the RCS continued to lose inventory, maintaining the RCS at saturated conditions. The flow rate from the RCS to the RWSP would then slowly decrease from 2400 gpm, as RCS pressure was reduced.

The RCS volume above the top of the core is about 53,500 gallons. Thus, it would take more than 20

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minutes for the core to become uncovered with a constant flow rate of 2400 gpm. This is conservatively short since the flow rate will decrease significantly when the level in the RCS drops to the bottom of the hot leg and steam flows out of the RCS. This time is more than sufficient to expect the operator to take positive actions to stop the inventory loss and makeup to the RCS.

Impact on Fuel

The Waterford 3 nuclear fuel rods are designed to withstand temperature and pressure transients much more severe than this event. There are no restrictions in the ABB/CE fuel pre-conditioning guidelines related to RCS pressure changes. Therefore, a pressure transient of 300 psi at the low pressures that existed during this event is of minimal consequence.

Impact of Large Break LOCA at Full Power with SI-417B Open

Valve SI-417B was in the open position during full power operation since November 19, 1999. This would have diverted some portion of the Low Pressure Safety Injection Train "B" flow to the RWSP through temperature control valve SI-415B. This flow diversion was measured to be less than 800 gpm, and could impact the LBLOCA. The LPSI flow would be less than that assumed in the safety analysis for a large break LOCA, given a concurrent loss of LPSI Train A.

The large break LOCA results are sensitive to the Peak Linear Heat Generation Rate (PLHGR). The maximum PLHGR during the time when SI-417B was open is well below that assumed in the analysis. There is adequate margin between the actual and assumed PLHGR to compensate for a lower LPSI flow to the RCS. Thus, the calculated peak clad temperature would still meet acceptance criteria with the flow diversion discussed above.

The probability of a large break LOCA during the 8 days prior to shutdown when valve SI-417B was open is 1.1×10^{-6} (5×10^{-5} per year x 8 days / 365 days per year). Including the probability of failure of the redundant safety injection train, as assumed in the safety analysis, further reduces the probability and leads to the conclusion that this event was not risk significant.

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Other Accidents at Full Power with SI-417B Open

For the accidents, the dose release due to RCS cooldown via steaming in the steam generators is assumed to stop when shutdown cooling is entered. Shutdown Cooling Train A and the Ultimate Heat Sink remained available and were capable of dissipating heat from the RCS and auxiliaries to ensure safe plant shutdown. Thus, there would be no additional dose release due to the loss of SDC Train B. However, if SDC Train B had been used following an accident, a similar RCS mass transfer to the RWSP would have occurred. The temperature of the RCS fluid would have been cooled as it passed through the SDC heat exchanger and piping to below the liquid flashing temperature. Since no flashing would have occurred in the RWSP, the accident doses would not have changed from those already analyzed.

SIMILAR EVENTS

LER #85-055-01

At 0425 hours on December 17, 1985 Waterford Steam Electric Station Unit 3 was in mode 3 (hot standby) when operations personnel discovered that Containment Spray Pump B discharge valve, CS-111B, was closed. Two trains of Containment Spray trains are required to be Operable in Mode 3. Upon investigation, the operator discovered that the reach rod operator for this valve was disconnected. Corrective Actions including placing an entry in the daily instructions warning the Operations Staff of the limitations of using reach rods and their use in verification of valve positions.

CR-94-0983

On 10/19/94, CR- 94-983 identified that the roll pin connecting the valve gallery handwheel to the valve stem for CS-117A had backed out disabling the valve close function. Although the CR identified one of the causes as a worn roll pin and that an investigation of the reach rod design would be performed, no overall investigation of the reach rod design was performed to determine if the roll pins are susceptible to backing out. Also, the only safety related valves identified as requiring this inspection were CS-117A&B. This inspection should have been

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extended to all safety-related valves with reach rods. Additionally, the failure of the position indicator, which bottomed out and broke, was attributed to a manufacturer error. However, there is no documentation that this manufacturer error was investigated for all safety related roto-hammer operated valves.

ADDITIONAL INFORMATION

Energy Industry Identification System (EIIS) codes are identified in the text within brackets [].