ENCLOSURE 2

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Docket No.:	50-382
License No.:	NPF-38
Report No.:	50-382/96-14
Licensee:	Entergy Operations, Inc.
Facility:	Waterford Steam Electric Station, Unit 3
Location:	Hwy. 18 Killona, Louisiana
Dates:	December 1, 1996 through January 11, 1997
Inspectors:	L. A. Keller, Senior Resident Inspector T. W. Pruett, Resident Inspector C. E. Johnson, Reactor Inspector G. M. Good, Senior Emergency Preparedness Analyst C. J. Paulk, Reactor Inspector
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ATTACHMENT: Supplemental Information

EXECUTIVE SUMMARY

Waterford Steam Electric Station, Unit 3
NRC Inspection Report 50-382/96-14

This routine, announced inspection included aspects of licensee operations, maintenance, engineering and plant support. The report covers a 6-week period of resident inspection.

Operations

- Observed operations activities were generally performed in a manner consistent with safe operation of the facility (Section O1.1).

- Operations inappropriately signed off a condition report (CR) on a low pressure safety injection (LPSI) Train B water hammer that occurred on November 19, 1996, as a condition not affecting system operability. This conclusion was premature in that the cause of the water hammer, the repeatability of the pressure spike experienced, and an analysis of the effect on system components had not been performed (Section O2.4.5).

- On November 19 and 21, LPSI Train B experienced a water hammer and no actions were taken to discover the root cause until a subsequent water hammer event occurred in LPSI Train A on December 13. This was despite clear evidence that the conditions that caused the water hammer would exist during an accident. This issue is unresolved pending further NRC review of the licensee's actions (Section O2.1b.5).

- Licensee analysis indicated that there was not reasonable assurance of ability to remotely initiate shutdown cooling following a water hammer in the LPSI piping due to potential pressure locking of LPSI flex-wedge gate valves. The inspectors concluded that there was a potential common-mode failure for pressure locking flex-wedge gate valves in both trains of LPSI. This issue related to the licensee's response to the water hammer events is unresolved pending further NRC review (Section O2.1b.5).

Maintenance

- The inspector prevented a welding procedural violation by prompting craft personnel to take a required interpass temperature reading (Section M1.2).

- The inspectors determined that the hydrogen analyzer calibration procedure was inadequate. The discrepancies indicated a lack of rigor during the development of maintenance procedures for the hydrogen analyzer and constituted preconditioning. A violation was identified for not maintaining an adequate test procedure (Section M1.3).

- The licensee's participation in the Arkansas Nuclear One (ANO) Technical Specifications (TS) audit was a positive initiative to assess the adequacy of their surveillance program for the plant protection system (Section M3.1).

- The licensee's determination that the channel functional test was not in accordance with the licensing basis and the subsequent corrective actions were appropriate. The failure to perform channel functional tests on the core protection calculators (CPC) in accordance with the licensing basis is considered a noncited violation (Section M3.1).

Engineering

- The system engineer did not observe surveillance testing of the hydrogen analyzer and was not informed when trouble shooting was performed when the analyzer failed the test. Also, the system engineer did not identify in reviewing the test procedure that it was preconditioning the test (Section M1.3).

- Engineering support in investigating the November 19 and 21 water hammer incidents in LPSI Train B was poor. The lack of rigor and questioning attitude regarding the cause of these water hammer incidents left the LPSI system vulnerable to further water hammer and loss of shutdown cooling function. Engineering support following a subsequent water hammer in LPSI Train A was significantly better, including a good recommendation for modifications to flex-wedge gate valves (Section O2.1).

Plant Support

- A poor radiation protection (RP) work practice was observed in which maintenance technicians breached an overhead contaminated system without face shield protection (Section M1.2).

- The licensee substantially improved the quality of permanent and temporary lighting in the protected area. However, the failure of a security patrol officer to report a lighting deficiency is considered a violation of TS 6.8.1.a (Section S1.1).

Report Details

Summary of Plant Status

The plant operated at 88 percent power on December 6 and 7 to perform CPC channel functional checks. On December 16 and 17, the plant operated at 63 percent power to perform maintenance on the main feedwater pumps. The plant operated at essentially 100 percent power during the remainder of this inspection period.

I. Operations

O1 Conduct of Operations

O1.1 General Comments (71707)

Using Inspection Procedure 71707, the inspectors performed frequent reviews of ongoing plant operations, control room board walkdowns, and plant tours. Observed activities were generally performed in a manner consistent with safe operation of the facility. Housekeeping and material condition were generally good. Operators were familiar with causes for lit control room annunciators. Preparations for cold weather were adequate. Shift turnover and plan-of-the-day meetings were professional and informative. However, certain activities appeared to be in violation of NRC requirements or indicate problem areas, as discussed below.

O1.2 Nuclear Auxiliary Operator Tours (71707)

The inspectors observed two nuclear auxiliary operators during the performance of plant tours. The inspectors noted that the auxiliary operators were attentive to plant equipment and material discrepancies during the tours. Several minor discrepancies, involving lighting, minor leakage from pumps and valves, and general plant cleanliness, were identified and resolved. Operators were knowledgeable of plant conditions and operating trends of plant equipment.

O2 Operational Status of Facilities and Equipment

O2.1 LPSI System Nitrogen Pockets and Water Hammer Events

a. Inspection Scope (71707, 37551)

The inspectors reviewed the circumstances surrounding the water hammer events that occurred in LPSI Train A on December 13 and in LPSI Train B on November 19 and 21, 1996. Additionally, the inspectors reviewed the licensee's operability analysis that was completed to evaluate the presence of nitrogen gas pockets in LPSI Train B.

b. Observations and Findings

b.1 LPSI Train A Water Hammer

On December 13, during a routine surveillance start of LPSI Pump A, a pressure spike caused by a water hammer occurred in the system piping. An operator observing the plant computer display at the time the pump was started, noted that LPSI pump discharge pressure briefly reached 317 psig (shutoff head of the pump is approximately 213 psig). The operator at the pump, as well as the operators in the control room, heard a banging noise after the pump was started. As a result of the water hammer, the shift supervisor declared LPSI Train A inoperable and appropriately entered TS 3.5.2.

The LPSI Train A piping was inspected by engineering personnel from the pump to the containment penetrations and no visible signs of piping or hanger damage was noted. Ultrasonic testing (UT) was subsequently performed at several high-point vent areas. The horizontal piping run containing vent Valves SI-133A and -134A was found to contain an apparent void in the pipe (12 inches and 14 inches of arc, respectively). The void was sampled and found to be approximately 97 percent nitrogen.

Valves SI-133A and -134A were then used to fully vent the piping and UT confirmed the piping was full of water. The scope of the UT was then expanded to include the high points of the LPSI Pump A suction, which revealed the piping was full. LPSI Pump A was subsequently started with no abnormal noise or pipe movement. Based on the UT results and successful pump start, LPSI Pump A was declared operable on December 14 and TS 3.5.2 subsequently exited. On December 14, the licensee conducted UT on portions of the LPSI Train B piping and the discharge of the High Pressure Safety Injection (HPSI) Pump A/B discharge piping to ensure the piping was full. No voids were found.

The licensee determined that the source of the nitrogen was leakage of nitrogen-saturated water from the safety injection tanks (SIT). The SITs contain a nitrogen blanket pressurized at approximately 650 psig. The SIT outlet valves are open and the SIT outlet piping connects to a common injection line with LPSI and HPSI. Therefore, the nitrogen-saturated SIT water can freely communicate back to LPSI Header Check Valves SI-142A(B) and -143A(B). Since the solubility of nitrogen in water is greater at higher pressures, the licensee concluded the nitrogen pockets were the result of nitrogen coming out of solution in the relatively low pressure of the LPSI system (less than 50 psig when pump is not running) when the water leaked backward (i.e., from a high to a low pressure area) through a check valve and an isolation valve.

b.2 LPSI Train B Nitrogen Pockets

In an attempt to identify all nitrogen pocket locations, the licensee again expanded the scope of the UT program on December 18 and discovered nitrogen pockets in the LPSI Train B piping at Penetrations 36 and 37. The pockets were located at the high points between Flow Control Valves SI-138B and -139B and the inside Containment Isolation Check Valves SI-142B and -143B. The arc length of the gas pocket at Penetration 36 was 11.3 inches over a length of 18 feet, which equates to a volume of 2.54 cubic feet. The arc length of the gas pocket at Penetration 37 was 10 inches over a length of 16.5 feet, which equates to a volume of 1.74 cubic feet. The locations of these particular nitrogen pockets were such that they could not be removed due to the lack of vent valves in the affected section of piping or the ability to flush them at power. CR 96-1965 was written to document and disposition the presence of these nitrogen pockets. On December 18, the licensee initiated an operability evaluation in accordance with Site Directive W4.101, "Operability/Qualification Confirmation Process," for the LPSI Train B nitrogen pockets.

The W4.101 evaluation concluded that the existing nitrogen pockets would cause a pressure transient on a LPSI Pump B start that would slightly exceed the design pressure of the system (650 psig), but would not prevent the LPSI system from providing emergency core cooling in the event of a loss-of-coolant accident. The basis for this conclusion was that the very scenario of concern had occurred on November 21, in that a start of LPSI Pump B resulted in a pressure spike of 660 psig, which did not result in any obvious component/piping/system damage. The licensee believed that the conditions that resulted from the November 21 pressure transient bounded any future transient.

The inspectors reviewed the operability evaluation completed by the licensee to independently assess the continued operability of LPSI Train B with a nitrogen pocket in the system piping. The specific concern was the capability of the system to physically withstand another water hammer event. At the end of this inspection period, a review of the licensee's operability evaluation and the operability of the LPSI systems by NRC personnel was ongoing. Review of this aspect of the licensee's response to the water hammer events remains unresolved pending the completion of the NRC's review (50-382/9614-01, Example 1).

The W4.101 evaluation also addressed concerns related to potential pressure locking of flex-wedge gate valves in the supply and return lines of the shutdown cooling heat exchanger (Valves SI-125B and -412B) and the effects on Crosby Relief Valve SI-132B. The W4.101 evaluation was completed on December 20 and concluded that shutdown cooling entry could be affected since there was no reasonable assurance that Valves SI-125B and -412B would not be pressure locked following a water hammer when LPSI Pump B started.

The W4.101 evaluation listed the following corrective actions. At the end of this inspection period, the licensee was pursuing the completion of the items.

- Periodically verify by UT that the arc length of the gas pocket at Penetration 36 does not exceed 11.8 inches and the gas pocket at Penetration 37 does not exceed 10.4 inches (as of the end of the inspection period the UT frequency was every 3 days);

- Enter the appropriate limiting conditions for operation (TS 3.9.8.2, 3.4.1.3, and 3.4.1.4) for potential inoperability of flex-wedge Gate Valves SI-125B and -412B;

- Initiate a repair package to install vent lines at Penetrations 36, 37, 38, and 39 during the next refueling outage (currently scheduled for April 1997);

- Design engineering to perform a detailed transient analysis that accurately models the as-found conditions; and

- Determine additional long-term corrective actions through CR 96-1965.

b.3 Crosby Relief Valve SI-132B Concern

Valve SI-132B is the LPSI Train B discharge header thermal relief, which is set at 650 psig. This valve had been identified in CR 96-0463 as having an incorrectly set blowdown ring. The issue of Crosby relief valve blowdown ring discrepancies is discussed in NRC Inspection Report 50-382/96-202. This setting did not affect the set pressure of the valve, but effects the pressure at which the valve reseats after opening. The specified closing pressure was approximately 585 psig (90 percent of set pressure).

The concern was that a water hammer would cause the relief valve to open and the incorrectly set blowdown ring would prevent the valve from reclosing, thereby diverting LPSI flow from the vessel. Since the shutoff head of the LPSI pump is approximately 213 psig, the closing pressure of Relief Valve SI-132B would have to be less than 33 percent of set pressure for the valve to not reclose. Based on the magnitude of the blowdown ring error (off by 10 notches) and previous bench testing of similar valves (worst case reset was 74 percent of set pressure), the licensee concluded that Relief Valve SI-132B would reset under the scenario of concern.

The inspectors reviewed the licensee's evaluation and conclusions with respect to Valve SI-132B and concluded that they were acceptable.

b.4 Flex-Wedge Gate Valves SI-125A(B) and -412A(B) Concern

The inlet and outlet shutdown cooling heat exchanger isolation valves, SI-125A(B) and -412A(B), are motor-operated, flex-wedge gate valves and were identified by the licensee as being susceptible to pressure locking in the response to Generic Letter 95-07.

The concern with pressure locking was that a water hammer would generate a pressure wave that would be transmitted to Valves SI-125A(B) and -412A(B) and allow pressure to be trapped in the valve bonnets, thereby eliminating the ability to remotely open the valves. On December 20, the licensee concluded that there was no reasonable assurance that pressure locking of the Train B valves would not occur during the scenario of concern and, therefore, declared the valves inoperable. A modification was initiated to install vents in the valve bonnets to prevent pressure locking, which was completed and Valves SI-125B and -412B declared operable on December 22. The licensee decided not to perform the modification on the valves in Train A since voids had not been detected in Train A and since periodic venting and UT was determined to be adequate to prevent water hammer until the modification was completed.

As of the end of this inspection period, the licensee was venting both trains of LPSI once per day and performing UT on both trains of LPSI every 3 days to verify that LPSI Train A was water solid and the nitrogen pockets in Train B were not expanding.

The issue of potential pressure locking of the shutdown cooling heat exchanger inlet and outlet valves causing a loss of shutdown cooling is another aspect of this unresolved item, related to the licensee's response to the water hammer events, pending additional review by NRC personnel (50-382/9614-01, Example 2).

b.5 LPSI Train B Water Hammer Event

On November 19, while starting LPSI Pump B to recirculate the refueling water storage pool (RWSP) for sampling, a water hammer occurred in the downstream piping. Control room operators reported that control room Gauge SI-IPI-036 spiked up to approximately 500 psig. Normal pump operating pressure of approximately 160 psig was observed by the operators for the duration of this pump run. Subsequently, on November 19, CR 96-1831 was written to disposition this event.

On November 20, the shift supervisor signed off CR 96-1831 as a condition that did not affect operability of the equipment/system. The stated basis for this conclusion was: "The pump operated at normal pressure when running. The system engineer was informed and he stated that the start pressure appeared to be a little high. Currently, some air voiding in the pipe/pump/instrument line is suspected, but not enough to cause an operability concern. No water hammer was noted by the shift."

The inspectors considered this conclusion premature in that the cause of the water hammer/pressure spike, the repeatability of the pressure spike experienced, and an analysis of the effect on system components (i.e., flex-wedge gate valves and other components) had not been performed. The inspectors noted that the crew on shift at the time of the event associated a water hammer as a "loud banging noise" and did not consider this transient a water hammer due to the lack of audible indication. The inspectors concluded that whether the event was termed water hammer or pressure spike, the magnitude was sufficiently above normal established parameters to warrant a thorough investigation.

On November 21, LPSI Pump B was again used to recirculate the RWSP. Prior to starting the pump, the Train B piping was vented and a strip chart recorder was installed to closely monitor system pressure. The subsequent pump start resulted in a pressure transient of 660 psig, as recorded on the strip chart recorder. Shortly after this pump run, LPSI Train B Flow Control Valve SI-139B was found partially open because of a valve mispositioning error by the operations crew. Valve SI-139B was closed, LPSI Pump B was restarted, and no pressure transient was experienced. Following this pump run without a water hammer, the licensee took no further tangible efforts to discover why water hammers occurred with Valve SI-139B open until the LPSI Train A water hammer event occurred in December.

The inspectors noted that Valve SI-139B receives an automatic open signal during a safety injection actuation signal and the valve opens before the pump starts. These automatic actions would reestablish the same system configuration that existed when significant water hammers occurred on November 19 and 21. The inspectors noted that there was clear evidence that the cause of the water hammers existed downstream of Valve SI-139B, yet no tangible effort was made to ascertain the cause until a subsequent water hammer occurred in LPSI Train A on December 13. The inspectors concluded that the failure to adequately investigate the cause of the LPSI Train B water hammers left the system vulnerable to future water hammer incidents and potential system operability concerns. As discussed in Section O2.1b2 above, there was no reasonable assurance that loss of shutdown cooling would not occur due to pressure locking of the shutdown cooling flex-wedge gate valves following a pressure transient. This aspect of the licensee's response to the water hammer events is unresolved pending additional review by NRC personnel (50-382/9614-01, Example 3).

The licensee informed the inspectors at the exit meeting that not all engineering efforts to determine the cause of the November 19 and 21 water hammers stopped following the repositioning of Valve SI-139B. The licensee stated that between the November and December events, the LPSI system engineer held discussions with Chemistry and others into the possibility of nitrogen being responsible for the water hammers, and that absent the December 13 event, this line of questioning would have eventually led to the discovery of the nitrogen pockets. The inspectors could not confirm or deny the system engineer's possible intentions, but noted there was

nothing documented in CR 96-1831 nor were there any tangible actions taken (i.e., samples drawn, UT performed, etc.) to confirm/quantify possible nitrogen intrusion into the LPSI system prior to the December 13 event.

c. Conclusions

The inspectors concluded that it was inappropriate for operations to sign off the CR on the LPSI Train B water hammer that occurred on November 19, without pursuing the identification of the root cause of the water hammer events. The licensee's failure to adequately pursue the cause of the November 19 and 21 water hammer events could have resulted in subsequent water hammers during system response to an accident.

The licensee's response to the water hammer that occurred in LPSI Train A on December 13 was significantly better. Subsequent investigations discovered nitrogen gas pockets at various high points in the LPSI system. The licensee was unable to vent two pockets of nitrogen in the LPSI Train B piping near the containment penetrations and, therefore, LPSI Train B was still vulnerable to water hammer in the event of a safety injection actuation signal. The operability of the system and the adequacy of previous corrective actions are unresolved issues. The licensee concluded that the resulting water hammer, although exceeding system design pressure, would not prevent LPSI Train B from providing emergency core cooling. Modifications of the LPSI Train B flex-wedge gate valves for the shutdown cooling system were completed due to pressure locking concerns; however, the LPSI Train A was not completed. The potential for common-mode failure of shutdown cooling is an unresolved issue.

O8 Miscellaneous Operations Issues (92901)

O8.1 The inspectors conducted a survey of the licensee's TS interpretations and determined that none of the documents contained informal references to NRC review and approval without formal NRC documentation. The inspectors emphasized to the licensee that any informal reference to NRC review and approval in a TS interpretation is not recognized by the Commission and is not an acceptable practice.

O8.2 (Closed) Violation 50-382/9517-01: failure to acknowledge fire protection panel alarms. This violation involved the failure of control room operators to recognize and announce fire protection panel alarms affecting the turbine building. In response to the violation, the licensee revised procedures to require operators to verify the extent of fires using the fire detection computer, added a strobe light to the fire detection panel, and developed required reading material describing the event. The inspectors observed that the strobe light was effective in gaining operator attention to the fire detection panel and that operators were utilizing the fire detection computer to determine the extent of potential fires. The inspectors

determined that the licensee's corrective actions were satisfactory to address this violation.

O8.3 (Closed) Violation 50-382/9605-02: control room personnel unaware of activities affecting Emergency Diesel Generator A. This violation involved the operation of the emergency diesel generator fuel rack override lever by an instructor and maintenance personnel without the consent of the control room. In response to this violation, the licensee counseled the individuals involved, discussed the event with the training department, and issued a plant manager memorandum to all site personnel reenforcing expectations about the operation of plant equipment. The inspectors determined that the licensee's corrective actions were satisfactory to address this violation.

II. Maintenance

M1 Conduct of Maintenance

M1.1 General Comments

a. Inspection Scope (62707, 61726)

The inspectors observed all or portions of the following maintenance and surveillance activities:

- MI-003-223 Core Protection Calculator Response Time Verification
- WA 01150587 Installation of a Vent Valve in Charging System
- WA 01150409 Replacement of Charging Pump Discharge Relief
- ME-003-431 Containment Hydrogen Analyzer Functional Test and Calibration
- WA 01153825 Troubleshoot Hydrogen Analyzer Pump A Low Alignment Discharge Pressure

b. Observations and Findings

In general, the inspectors found the conduct of maintenance and surveillance to be adequate. All activities observed were performed with the work authorization (WA) package and/or test procedures present and in active use. Technicians appeared experienced and knowledgeable of their assigned tasks. When applicable, appropriate radiation control measures were implemented. The inspectors observed supervisors monitoring job progress and quality control personnel were present whenever required by procedure. However, certain activities violated NRC requirements or indicated performance problems, as discussed below.

M1.2 Charging Pump Relief Valve Replacement

a. Inspection Scope (62707)

The inspectors observed the replacement of Charging Pump B Discharge Relief Valve CVC-192B. The inspectors observed removal and installation activities, reviewed the applicable work packages and system drawings, and interviewed selected personnel.

b. Observations and Findings

On December 10, 1996, the inspectors observed maintenance technicians breaching an overhead section of the charging system, without protective face shields, during removal of the existing charging pump discharge relief valve and piping/flange connection. The inspectors questioned the RP technician who was in the area monitoring the work activity about the observed practice. The RP technician informed the inspectors that procedures did not specifically require personnel to wear protective face shields when breaching a system. An RP supervisor also confirmed the RP technician's statement. The inspectors expressed concern to the RP supervisor regarding the potential for personnel contamination and/or injury due to this work practice. The licensee subsequently agreed that this was a poor work practice. The licensee informed the inspectors that they initiated a CR to review this issue.

Additionally, the inspectors noted that the bolts and nuts removed from the flange were not the type of material specified by Drawing E-3029-LW3-CH-2. The inspectors were informed that Document Revision Notice (DRN) M-9502513 implemented the material change. The inspectors found that the drawing was stamped with the DRN number; however, the inspectors questioned the licensee as to why the DRN was not included in the work package and why the drawing was not revised after a year. The inspectors were informed that: (1) the subject DRN was inadvertently omitted, and (2) Design Engineering Procedure NOECP-306, "Document Revision Notices," Revision 4, allows a time period for up to 18 months for noncritical drawings to be revised; therefore, no procedural violation was identified.

The inspectors observed fit-up and welding activities for Field Weld SW-17A (socket weld) during installation of the new charging pump discharge relief valve and associated piping. The inspectors noted that after completion of the first weld pass for Weld SW-17A, the maintenance technician (welder) was starting to initiate the second weld pass without verifying interpass temperature (350°F maximum) in accordance with Weld Procedure WPS E-P8-A8. The inspectors stopped the maintenance technician before the second weld pass was initiated and questioned him if the interpass temperature was verified. The inspectors noted that there was no "tempil stick" or pyrometer in the work area for use by the maintenance technicians. Maintenance technicians in the area sent a maintenance assistant to

get a pyrometer. The licensee confirmed that absent the inspector's prompting the interpass temperature would not have been taken.

c. Conclusions

A poor RP work practice was observed in which maintenance technicians breached an overhead contaminated system without face shield protection. The inspectors prevented a welding procedural violation by prompting craft personnel to take a required interpass temperature reading.

M1.3 Calibration of Hydrogen Analyzers

a. Inspection Scope (61726, 37551)

The inspectors observed the performance of the Hydrogen Analyzer Train A calibration in accordance with Procedure ME-003-431, "Co ment Hydrogen Analyzer Functional Test and Calibration," on December 3 96, and trouble-shooting activities involving Hydrogen Analyzer Pur A discharge pressure on January 3, 1997, in accordance with WA 01153825.

b. Observations and Findings

The instrument and controls foreman was present during portions of the calibration and all of the trouble shooting. The system engineer did not observe the surveillance and was not informed of the trouble shooting activities. Several procedure discrepancies were noted during the performance of the surveillance test.

Procedure ME-003-431, Section 8.2.11, required that the hydrogen analyzer loop and measurement flows be verified and adjusted if necessary prior to the performance of the calibration. The inspectors noted that the technicians adjusted the loop flow from 3.8 to 4.0 scfh prior to performing the hydrogen analyzer calibration and that the procedure did not specify an acceptable as-found flow rate for either loop flow or measurement flow. The inspectors noted that returning the gas flow to the technical manual referenced values prior to calibration was preconditioning of the hydrogen analyzer and invalidated the as-found percent hydrogen data obtained by the technicians. The licensee agreed that the adjustment on the loop flow preconditioned the hydrogen analyzer and stated that a revision to the calibration procedure would be performed to ensure as-found percent hydrogen data was obtained prior to adjusting hydrogen analyzer flow rates.

Procedure OP-903-120, "Containment and Miscellaneous System Quarterly IST Valves Test," Section 7.5, required that the licensee verify the hydrogen analyzer loop flow greater than or equal to 1 scfh during stroke testing of the containment dome hydrogen sample valve. The inspectors noted that Technical Manual Section 3.5, "Pressure Regulation," required that the loop flow rate be set at 4 scfh and that verification of 1 scfh instead of 4 scfh during quarterly inservice testing

(IST) could allow an adverse condition to go uncorrected in that partial opening of the sample valve may allow 1 scfh but not 4 scfh. The licensee stated that a review of the testing procedure would be performed to determine if a different sample flow rate should be specified in Procedure OP-903-120.

The inspectors noted that Teleydyne Analytical Instruments Technical Manual, Section 3.5, stated that the pressure in the return loop is maintained at 10 psig above containment pressure in order to return gas and water to containment at positive pressure and to prevent back pressuring the system. The inspectors observed that the hydrogen analyzer control panel outlet pressure indicated that the return pressure was approximately 1 psig above containment pressure. The inspectors identified that the technicians did not note the abnormal outlet pressure reading and determined that Procedure ME-003-431 did not require that the technicians verify whether or not the hydrogen analyzer pump developed sufficient discharge pressure to ensure the sample gas was returned to containment.

In response to these observations, the licensee: (1) stated that Procedure ME-003-431 would be revised to require recording of the hydrogen analyzer inlet and outlet pressure, (2) initiated a condition identification to document the discrepancy, and (3) performed trouble shooting to verify the actual pressure and flow rates of the hydrogen analyzer.

The inspectors observed the licensee perform the recommended technical manual testing as part of trouble-shooting activities associated with determining why the hydrogen analyzer return pressure was not 10 psig above containment pressure. With 5 psig nitrogen pressure applied to the hydrogen analyzer inlet, the following results were obtained:

Test Location	Actual	Required Per Technical Manual
Pump Suction	2.83	1 psig
Pump Outlet	16.0	15-17 psig
Sample Pressure	4.41	4.0 psig
Loop Flow	4.4	Above 5.0 scfh
Sample Flow	0.25 scfh	Not Specified
Return Pressure	15.5 psia	Not Specified
Containment Pressure	15.0 psia	Not Specified

Based on the results of trouble shooting, the licensee: (1) stated that an 18-month repetitive task would be developed to ensure the hydrogen analyzer pressure regulators were properly adjusted to maintain the required sample and measurement flow rates, (2) determined that the hydrogen analyzer pump developed an adequate discharge pressure, (3) determined that the low return header pressure was due to the effects of containment pressure and the location of the return loop pressure

transmitter, and (4) initiated an additional condition identification to perform testing on Hydrogen Analyzer Train B.

The failure to provide a procedure for calibration of the hydrogen analyzers, which properly implements the testing recommended by the technical manual, is a violation of TS 6.8.1 (50-382/9614-02).

c. Conclusions

The inspectors determined that the hydrogen analyzer calibration procedure was inadequate since several procedural discrepancies existed. Collectively, the discrepancies indicated a lack of rigor by maintenance during the development of procedures for the hydrogen analyzer and by system engineering during review.

M3 Maintenance Procedures and Documentation

M3.1 Inadequate Channel Functional Test Procedure For CPC

a. Inspection Scope (61726)

The inspectors reviewed the circumstances surrounding the licensee's identification that three of the four CPC reactor protective channels were inoperable due to an inadequate TS surveillance procedure.

b. Observations and Findings

The CPCs are digital computers that calculate local power density and departure from nucleate boiling ratio (DNBR). A CPC is installed in each of the four reactor protection channels. The calculated DNBR and local power density are compared with trip setpoints for initiation of a low DNBR trip and the high local power density trip. Each CPC receives the following inputs: core inlet and outlet temperature, pressurizer pressure, reactor coolant pump speed, excore nuclear instrumentation power, selected control element assembly positions, and control element assembly deviation penalty factors.

While assisting ANO personnel who were performing an audit of plant protection system TS surveillance compliance, Waterford 3 personnel discovered an issue related to the TS surveillance channel functional check for the CPCs that was relevant to Waterford 3. The issue involved whether all the various inputs to the CPC were required to be manipulated during the 18-month channel functional test specified by TS 4.3.1.1, or if it was acceptable to manipulate the excore nuclear instrumentation input only, and take credit for testing "overlap" for the other sensor inputs, which was the current practice.

Waterford 3 TS for the CPCs includes the following statement: "This CHANNEL FUNCTIONAL TEST shall include the injection of simulated process signals into the channel as close to the sensors as practicable to verify OPERABILITY including alarm and/or trip functions." The Waterford 3 testing regime had taken credit for testing "overlap" for the 18-month channel functional test for all of the CPC inputs except excore nuclear instrumentation. Overlap testing employs a series of sequential, overlapping tests of individual sections of the channel which, when combined, tested the entire channel. The ANO Safety Evaluation Report indicated that overlap tests for the CPCs were inadequate and that a functional operation check from CPC sensor inputs to the trip output would be required to adequately ensure that the CPCs were operational. The Waterford 3 Safety Evaluation Report indicates that Waterford 3 is to meet the requirements on CPCs in the ANO Safety Evaluation Report; therefore, overlap tests for the CPCs are also inadequate at Waterford 3. The licensee, therefore, concluded that CPC Channels A, B, and C were inoperable pending a satisfactory channel functional test. CPC Channel D was deemed operable because it had successfully passed the reactor trip response time test during the last refueling outage. The reactor trip response time test adequately tests the channel using all the inputs, but is only performed on one CPC channel per 18 months.

On December 5, 1996, the licensee declared CPC Channels A,B, and C inoperable due to the failure to adequately perform Surveillance Requirement 4.3.1.1 and entered the action requirements of TS 3.3.1 and 4.0.3. TS 3.3.1 requires at least two CPC channels operable or entry into TS 3.0.3, which requires that within 1 hour, action be initiated to place the unit in hot standby within the next 6 hours. However, TS 4.0.3 allows the action requirements to be delayed up to 24 hours to complete the surveillance. On December 6, testing was satisfactorily completed on Channel A by utilizing the reactor trip system response time test, which is normally performed during refueling outages. The inspectors verified that appropriate precautions were taken to perform this surveillance at power. Performance of this test required a power reduction to 88 percent due to the necessity of taking both channels of the control element assembly calculator system out of service for the test. The restoration of Channel A resulted in two operable channels, which is allowed under TS 3.3.1. Channels B and C were satisfactorily tested and returned to service on December 6 and 7, respectively.

The inspectors reviewed the relevant documentation in the Waterford 3 and ANO Safety Evaluation Reports and the Waterford 3 surveillance test procedures for CPC. The inspectors concluded that the failure to adequately test all the sensor inputs to the CPCs during the channel functional test is a violation of TS 4.3.1.1. This licensee-identified and corrected violation is being treated as a noncited violation, consistent with Section VII.B.1 of the NRC Enforcement Policy. Specifically, the violation was identified by the licensee, was not willful, actions taken as a result of a previous violation should not have corrected this problem, and appropriate corrective actions were completed by the licensee (50-382/9614-04).

c. Conclusions

The licensee's participation in the ANO TS audit was a positive initiative to assess the adequacy of the Waterford surveillance program for the plant protection system. The licensee's determination that the channel functional test was not in accordance with the licensing basis and the subsequent corrective actions were appropriate. The failure to perform channel functional tests on the CPCs in accordance with the licensing basis was a noncited violation.

M4 Maintenance Staff Knowledge and Performance

M8 Miscellaneous Maintenance Issues (92902)

M8.1 (Closed) Inspection Followup Item 50-382/94402-02: failure to follow an installation weld detail. The inspectors previously identified a program weakness regarding a failure to follow an installation weld detail during replacement of piping. The inspectors performed an inspection on a portion of replaced piping between the high-pressure turbine and first-stage feedwater heaters. The inspectors observed that Weld FW-20A was not conducted in accordance with the drawing. This resulted in the condition of an undressed, notched flame-cut surface on the edges of the hole, through the pressure piping which was not in accordance with the drawing. This condition was not identified by the responsible craft, quality control (QC), or supervision. The licensee documented this condition in CR 94-337. The licensee had committed to the following:

- Conduct training for all craft personnel (fitters/welders) involved in cutting and welding processes, and

- Revised Procedure MM-001-056 to require QC to verify the ID of the half couplings and ID match the hole cut of the sockolet.

The inspectors found that the licensee had closed CR 94-337 before the commitments were implemented. The licensee initiated CR 96-1452 as a result of the inspectors' finding. CR 96-1452 indicated that the Waterford 3 welding manual would include appropriate guidance in Design Engineering Administrative Manual (DEAM), Appendix 2, E-TCG, "Thermal Cutting and Gouging."

The inspectors reviewed DEAM, Appendix 2 (E-TCG and E-GWS-1) and determined that the document provided adequate instructions and details for thermal cutting and gouging. The inspectors also determined procedural guidance included in DEAM, Appendix 2 was adequate to prevent recurrence for safety- and nonsafety-related components.

M8.2 (Closed) Violation 50-382/9508-01: failure to follow procedures to ensure adequate storage of loose items and correct usage of measuring and test equipment (M&TE). This violation involved the licensee's failure to ensure loose items were adequately

secured in safety-related areas and to ensure out-of-calibration M&TE was not used for testing. In response to the failure to secure loose items, the licensee issued a site-wide newsletter, performed training during shop meetings to all personnel, and revised the construction department craft guide handout. In response to the failure to use the correct M&TE, the licensee provided training to personnel on procedural adherence and revised the maintenance procedure to provide additional clarification on M&TE calibration requirements. The inspectors determined that the licensee implemented effective corrective actions for this violation.

III. Engineering

E2 Engineering Support of Facilities and Equipment

E.2.1 Review of Facility and Equipment Conformance to UFSAR Description

A recent discovery of a licensee operating a facility in a manner contrary to the UFSAR description highlighted the need for a special focused review that compares plant practices, procedures and/or parameters to the UFSAR descriptions. While performing the inspections discussed in this report, the inspectors reviewed the applicable portions of the UFSAR that related to the areas inspected. The inspectors verified that the UFSAR wording was consistent with the observed plant practices, procedures and/or parameters. No anomalies between the UFSAR and operation of the facility were identified.

E8 Miscellaneous Engineering Issues (92903)

E8.1 (Closed) Violation 50-382/9607-02: failure to perform adequate control room envelope testing. This violation involved the licensee's failure to perform control room envelope testing with one of the two airlock doors as the boundary. The licensee determined that the root cause was a deficient procedure in that engineering information used to establish requirements for operation of airlock doors was not periodically verified. Consequently, during the performance of maintenance on one airlock door, the second airlock door was unable to maintain the integrity of the control room envelope.

The licensee's corrective actions included implementation of TS Amendment 115, which allowed breaches of the control room envelope for a period not to exceed 7 days, repaired envelope door seals, performed acceptable pressurization testing of the envelope, established criteria for operations to enter the applicable TS limiting condition for operation whenever an airlock door was inoperable, and revised plant procedures to ensure TS entry prior to performing maintenance.

To improve the ability of the control room ventilation system to maintain the envelope, the licensee developed Modification PC 8028, which will trip the reactor auxiliary normal building ventilation on a toxic gas signal. Additionally, the licensee initiated Modifications PC 8027 and SPEER 9601658, which will replace the control

room envelope doors with better sealing doors. The inspectors determined that the implemented and planned corrective actions were effective for this violation.

E8.2 (Closed) Violation 50-382/9513-06: failure to establish design control measures. This violation involved plant configuration control problems such as missing solenoid valve exhaust port covers and weep holes not drilled in the bottom of environmentally-qualified terminal boxes. The inspectors verified the corrective actions described in the licensee's response letter, dated May 19, 1995, to be reasonable and complete. No similar problems were identified.

E8.3 (Closed) Violation 50-382/9513-07: failure to identify conditions adverse to quality. This violation involved the failure to initiate a CR for several material condition deficiencies (i.e., a pipe cap was missing from the tail piece of Valve EFW-MV-108A). The inspectors verified the corrective actions described in the licensee's response letter, dated May 19, 1995, to be reasonable and complete. No similar problems were identified.

E8.4 (Closed) Violation 50-382/9521-01: failure to perform proper, detailed engineering analysis of solenoid-operated valves to establish and maintain equipment qualification. The inspectors verified the corrective actions described in the licensee's response letter, dated February 14, 1996, to be reasonable and complete. No similar problems were identified.

E8.5 (Closed) Inspection Followup Item 50-382/9513-05: improperly installed terminal box on an environmentally-qualified shutdown cooling heat exchanger resistance temperature detector.

The inspectors reviewed and discussed the licensee's actions, documented in their commitment tracking system (A 22451) related to this item, with an environmental qualification engineer. The inspectors also reviewed the following environmental qualification documents to evaluate the qualification of resistance temperature detectors and associated cable:

LPL-EQA-39.03, "Environmental Qualification Assessment for Rosemount Resistance Temperature Detectors," Revision 3;

LPL-EQA-39.04, "Environmental Qualification Assessment for Weed Instrument Company Resistance Temperature Detectors," Revision 5;

LPL-EQA-6.3C, "Environmental Qualification Assessment for Rockbestos Radiation Resistant SR Cable (KF-550 Methyl Phenol Vinyl Silicone Rubber Insulation)," Revision 0; and,

DC 3301 RTD Cable Replacement Report, dated July 15, 1991.

The item was initially opened because a nonenvironmentally-qualified resistance temperature detector junction box was found loose by an NRC inspector. During review of this item, the inspectors noted that the environmentally-qualified resistance temperature detectors had different maintenance requirements to ensure adequate sealing. The inspectors also noted that the licensee had not identified, during the review of this issue, any examples of environmentally-qualified resistance temperature detector junction box covers being improperly sealed. The inspector found no problems with the sealing of environmentally-qualified resistance temperature detector junction boxes.

During the discussions with the licensee engineer, the inspectors noted that the engineer was preparing a design change to replace the resistance temperature detector cables inside containment. The inspectors learned that this was not the first time that the cables were to be replaced. In 1991, the licensee replaced the original Samuel Moore cables with Rockbestos Firewall SR high-temperature instrumentation cable. The inspectors noted that the replacement was required because the original cable had deteriorated as a result of being too close to reactor coolant piping.

The inspectors noted that the replacement cable was qualified by similarity by the manufacturer and accepted by the licensee. The similarity was based on the construction of the signal conductors being the same. The similarity evaluation did not consider the cable shields that were on the replacement cable. The shields were not considered because their purpose was to reduce or dampen signal noise. The inspectors found the similarity evaluation to be acceptable.

The inspectors noted that the licensee experienced noise problems in the instrument loops after installation of the replacement cables, prior to returning the circuits to operation. The noise was attributed to the shield wire being grounded in more than one location, with a resulting potential difference causing circulating currents. The licensee engineers attributed the cause of the multiple grounds to be due to the porosity of the braided jacket and high humidity in the containment building. This allowed a current path to the plant ground through the conduit system. In addition to the path to the plant ground, the shield wires were connected to the instrument bus ground, which was not common to the plant ground. The ground buses were at different potentials, which caused the circulating currents and resultant noise.

To correct this issue, the inspectors noted that the shield wires were lifted at the outboard containment penetration, breaking the circuit created by the grounded shield wire inside containment. The inspectors found that the lifting of the shield wires was an acceptable action to reduce the noise in the circuits. Since three elements were necessary to induce noise in a circuit (a source of electromagnetic noise, a means of coupling of noise from the source, and a circuit sensitive to the noise), the breaking of the circuit eliminated the problem.

The inspectors did not identify any problems with the qualification documentation for the resistance temperature elements or the cable. The documentation for these items met the requirements of 10 CFR 40.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants."

The inspectors noted an additional potential mechanism for creating a ground path in the cables, which was damaging of each cable during installation. This mechanism was not considered credible by the licensee since most of the circuits experienced the noise problems.

The inspectors also noted that the licensee had developed a design change to improve the existing design. In this change, the cable was to be replaced with a similar cable that had an insulating jacket between the twisted, shielded pairs and the braided jacket. This layer would provide protection from physical damage and also provide a waterproof barrier, thereby eliminating the potential means of coupling the noise to the circuit. The inspectors found that the design change was an enhancement to the existing configuration.

The licensee had adequate procedures to address the sealing of environmentally-qualified resistance temperature detector junction boxes. The existing configuration of the instrument cable and its shield wires was acceptable. The proposed design change to the cable configuration was an enhancement.

IV. Plant Support

R8 Miscellaneous RP Issues (92904)

R8.1 (Closed) Violation 50-382/9610-03: failure of personnel to comply with health physics warning signs. This violation involved the failure of personnel to properly control contaminated M&TE and the failure of personnel to comply with warning signs prohibiting drinking in a radiologically controlled area.

In response to the control of M&TE, operations communicated expectations in the daily instructions, provided training to operations on the requirements for the control of contaminated equipment, placed new locks on the M&TE lockers, and required that the shift supervisors be initially accountable for access to the lockers. The inspectors performed periodic observations of the contents of the lockers and determined that contaminated items were properly labeled and contained.
In response to the failure to adhere to signs prohibiting drinking in radiologically controlled areas, the licensee removed the cooler from the area, provided training during safety meetings to plant personnel, and developed a guidance directive on the use of thirst quencher in radiologically controlled areas. The inspectors reviewed Directive 96-2, "Outage Emergent Items," and noted that the use of thirst quencher was to be established for heat stress controls and that individual containers were to be placed in a secured ice chest labeled "FOR EMERGENCY USE ONLY."

The inspectors determined that the licensee's corrective actions were effective for the examples involving this violation.

P3 EP Procedures and Documentation

P3.1 Licensee Onshift Dose Assessment Capabilities (TI 2515/134)

a. Inspection Scope

Using Temporary Instruction 2515/134, the inspectors gathered information regarding:

- Dose assessment commitment in emergency plan
- Onshift dose assessment emergency plan implementing procedure
- Onshift dose assessment training

b. Observations and Findings

On December 17, 1996, the inspectors conducted an in-office review of the emergency plan and implementing procedures to obtain the information requested by the temporary instruction. The inspectors conducted a telephone interview with the licensee on December 18, 1996, to verify the results of the review. Based on the documentation review and licensee interview, the inspectors determined that the licensee had the capability to perform onshift dose assessments using real-time effluent monitor and meteorological data and that the commitment was described in the emergency plan and implementing procedures.

c. Conclusion

The commitment to perform onshift dose assessments was described in the emergency plan and implementing procedures. Further evaluation of the information obtained using the temporary instruction will be conducted by NRC Headquarters personnel.

S1 Conduct of Security and Safeguards Activities

S1.1 Illumination of Protected Area

a. Inspection Scope (71750)

On December 17, at 10:45 p.m., the inspectors performed a tour to determine the adequacy of illumination in the protected area.

b. Observations and Findings

The inspectors observed that the quality of permanent and temporary lighting in the protected area was substantially improved from previous tours performed in January and May 1996 (NRC Inspection Reports 50-382/9522 and 50-382/9605). Nevertheless, the inspectors observed inadequate illumination between the insulators shack and the water treatment building.

The inspectors noted that the licensee had staged temporary lighting in the affected area, but that the extension cord had been removed from the electrical outlet even though a security placard was attached to the end of the cord which stated "Temporary security lighting, do not remove." The inspectors informed the shift security supervisors of the lighting discrepancy. The security supervisors toured the area with the inspectors and agreed that illumination was less than 0.2-footcandles and reenergized the temporary lighting.

The inspectors questioned security to determine if the security patrol officer identified the discrepancy on the evening tour. Security informed the inspectors that the evening patrol officer noted the discrepancy and documented the poor illumination on the security patrol log. However, the individual did not inform the security shift supervisor of the discrepancy. The inspectors noted that the supervisors were not aware of the discrepancy until informed by the NRC. The failure to notify additional personnel of the lighting deficiency is of concern because compensatory measures may not have been effective in the event of an actual security threat.

Security Procedure PS-012-102, "Protective Lighting," Section 5.3.2, requires that, in the event a protective lighting system deficiency or failure is observed when lighting is needed, the reporting officer will immediately notify the central alarm station or the secondary alarm station. The inspectors determined that the security patrol officer's failure to notify the central or secondary alarm station of the deficiency is a violation of TS 6.8.1.a (50-382/9614-04).

In response to the inspectors identification, security management implemented immediate corrective actions which included counseling the patrol officer and security shift supervisors, performing additional walkdowns of temporary lighting, and discussing the importance of temporary lighting with personnel who may deenergize temporary lighting during daylight hours.

C. Conclusions

The inspectors identified a violation for the failure to notify the central or secondary alarm station of a lighting deficiency. The licensee has significantly improved the quality of permanent and temporary lighting within the protected area.

V. Management Meetings

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on January 15, 1997. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

R. G. Azzarello, Manager, Maintenance
C. M. Dugger, General Manager, Plant Operations
J. J. Fisicaro, Director, Nuclear Safety
T. J. Gaudet, Acting Manager, Licensing
D. C. Matheny, Manager, Operations
M. B. Sellman, Vice-President, Operations
D. W. Vinci, Superintendent, System Engineering
A. J. Wrape, Director, Design Engineering

INSPECTION PROCEDURES USED

37551	Onsite Engineering
61726	Surveillance Observations
62707	Maintenance Observations
71707	Plant Operations
71750	Plant Support Activities
92901	Followup - Plant Operations
92902	Followup - Maintenance
92903	Followup - Engineering
92904	Followup - Plant Support
TI 2515/134	Licensee Onshift Dose Assessment Capabilities

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-382/9614-01	URI	Review of the licensee's response to the water hammer events that occurred in the LPSI system (Section O2.1)
50-382/9614-02	VIO	Inadequate procedure for testing the hydrogen analyzers (Section M1.3)
50-382/9614-03	NCV	Inadequate channel functional test for CPCs (Section M3.1)

50-382/9614-04	VIO	Failure to follow security lighting reporting procedures (Section S1.1)

Closed

50-382/9517-01	VIO	Failure to acknowledge fire protection panel alarms (Section O8.2)
50-382/9605-02	VIO	Control room personnel unaware of activities affecting Emergency Diesel Generator A (Section O8.3)
50-382/9614-02	NCV	Inadequate channel functional test for CPCs (Section M3.1)
50-382/94402-02	IFI	Failure to follow an installation weld detail (Section M8.1)
50-382/9508-01	VIO	Failure to follow procedures to ensure adequate storage of loose items and correct usage of M&TE (Section M8.2)
50-382/9607-02	VIO	Failure to perform adequate control room envelope testing (Section E8.1)
50-382/9513-06	VIO	Failure to establish design control measures (Section E8.2)
50-382/9513-07	VIO	Failure to identify conditions adverse to quality (Section E8.3)
50-382/9521-01	VIO	Failure to perform proper, detailed engineering analysis of solenoid-operated valves to establish and maintain equipment qualification (Section E8.4)
50-382/9513-05	IFI	Improperly installed terminal box on an environmentally qualified shutdown cooling heat exchanger resistance temperature detector (Section E8.5)
50-382/9610-03	VIO	Failure of personnel to comply with health physics warning signs (Section R8.1)

LIST OF ACRONYMS USED

ANO	Arkansas Nuclear One
CFR	Code of Federal Regulations
CR	Condition Report
CPC	Core Protection Calculator
DNBR	Departure from Nucleate Boiling Ratio
DEAM	Design Engineering Administrative Manual

DRN	Document Revision Notice
HPSI	High Pressure Safety Injection
IST	Inservice Testing
LPSI	Low Pressure Safety Injection
M&TE	Measuring & Test Equipment
NRC	Nuclear Regulatory Commission
psig	Pounds per Square Inch Gauge
PDR	Public Document Room
QC	Quality Control
RP	Radiation Protection
RWSP	Refueling Water Storage Pool
SIT	Safety Injection Tanks
scfh	Standard Cubic Feet per Hour
TS	Technical Specifications
UFSAR	Updated Final Safety Analysis Report
URI	Unresolved Item
UT	Ultrasonic Testing
WA	Work Authorization