ENCLOSURE 1

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-482/96-03

License: NPF-42

Licensee: Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, Kansas

Facility Name: Wolf Creek Generating Station

Inspection At: Coffey County, Burlington, Kansas

Inspection Conducted: March 18-25, 1996

Inspectors: D. Solorio, Resident Inspector, San Onofre Nuclear Generating Station
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Approved: Arthur T. Howell for H.J. Wong 4-24-96
H. J. Wong, Team Leader Date

Inspection Summary

Areas Inspected: Special, announced inspection to review the licensee's corrective actions related to restart following the January 30, 1996, icing event. In addition, the inspection reviewed the event and assessed the NRC Augmented Inspection Team (AIT) findings.

Results:

- Errors were made in the design calculations for the essential service water (ESW) system related to the assumed temperature of warming line flow and flow rate during ESW operation. The errors caused a de facto change to the system from that described in the safety analysis report which described freeze protection for the ESW system being provided by the warming lines. This represents apparent violations of 10 CFR Part 50, Appendix B, Criterion III, and 10 CFR 50.59 (Section 2.1).

- There were several opportunities for the licensee to have reviewed the ESW warming line design bases and identify the design errors. pecifically:

- In 1993, the licensee performed an evaluation of a manual valve in the warming line flow path which was stuck in the 50 percent open position. The design calculations containing the errors were reviewed at that time, but the review failed to identify the errors.

- A frazil icing event occurred at the FitzPatrick plant in 1993 and that information was received by the licensee, but the event description was not transmitted to licensee personnel because of the general belief that frazil icing was not credible at Wolf Creek.

- The licensee performed an evaluation and approved a Technical Specification (TS) interpretation in 1991 in response to a direct question related to whether frazil icing was possible. Engineering responded that frazil icing was not a concern because the pumphouse was enclosed and heated. This demonstrated that engineering did not understand the frazil icing phenomena.

- NRC IE Circular 78-13 described a frazil icing event at the Salem facility. The licensee's architect-engineer performed a review of the circular and erroneously concluded that the warming lines provided protection from icing.

The licensee failed to identify the ESW design errors when the above opportunities to review the design bases of the ESW warming lines occurred. This is an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI (Section 2.2).

- Control room operators during the icing event failed to follow the ESW system operating procedure and improperly aligned the ESW system. This caused a reduction in the warming line flow going to the ESW intake structure and hastened the onset of icing on January 30, 1996. This is an apparent violation of Technical Specifications (TS) 6.8.1 (Section 2.3).

- During work on the turbine-driven auxiliary feedwater (TDAFW) pump on January 25, 1996, licensee personnel failed to follow the instructions of the work package to install the packing gland follower nuts in a "snug" condition. This is an apparent violation of TS 6.8.1 (Section 3.1.1).

- For work on the TDAFW pump on January 25 and 30, 1996, planners failed to include appropriate repacking guidance in the work instructions. This is an apparent violation of 10 CFR Part 50, Appendix B, Criterion V (Section 3.1.2).

- For work on the TDAFW pump on January 25, 1996, licensee personnel failed to follow the work control procedure and inappropriately

classified the packing gland follower removal and reassembly activities as "troubleshooting" on the outboard portion of the pump. This is an apparent violation of TS 6.8.1 (Section 3.1.3).

- There were two instances related to previous maintenance performed on the TDAFW pump which were inadequately resolved. These were related to packing installation problems in 1994 and inadequate thread engagement of packing gland follower nuts. This is an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI (Section 3.1.4).

- In two instances, licensee personnel failed to follow document control procedures in that procedures were found missing from the control room document files. The first instance (missing reactor trip response procedure) was identified during the icing event and the second instance (missing alarm response procedure) was identified by NRC inspectors when reviewing the licensee's corrective actions. This is an apparent violation of TS 6.8.1 (Section 4.1).

- The licensee failed to cool down and achieve Mode 4 on January 30, 1996, in the time required by TS Action Statement 3.7.1.2.b when two auxiliary feedwater pumps were simultaneously inoperable. This is an apparent violation of TS 3.7.1.2.b (Section 4.2).

- While the licensee's emergency action level (EAL) charts were consistent with industry guidance, the charts did not specifically address icing conditions. One contributor to the difficulty in the licensee's use of the charts was that training had reinforced management's guidance that the Administrative EAL Chart was only to be used if the other technical charts did not apply (Section 6.1).

- Operations weaknesses were evident during the icing event in that important information related to degrading ESW system conditions was not transmitted to the shift supervisor (Section 6.2).

- Several weaknesses were identified in engineering work products: (1) warming line design errors, (2) failures to take advantage of later design review activities to identify the design errors, (3) weak evaluation of a manual valve left in the 50 percent open position, (4) weak technical bases for an ESW operability evaluation, and (5) weak technical bases for a TDAFW pump operability evaluation (Section 7).

- The licensee's corrective actions related to the restart issues identified in Enclosure 1 of the NRC's letter to the licensee dated March 7, 1996, were found to be generally acceptable. These corrective actions are discussed in detail in Sections 2.1, 2.2.1, 2.3, 3, 4.1, 5.1, 5.2, and 6.1.

Summary of Inspection Findings:

- Apparent Violations 482/9603-01 and 482/9603-02: Design errors in ESW warming line calculations (temperature and flow rate) (Section 2.1)
- Apparent Violation 482/9603-03: Actions not taken to identify and correct design errors in ESW warming line flow calculations (Section 2.2)
- Apparent Violation 482/9603-04: Failure to follow procedures for alignment of the ESW system (Section 2.3)
- Inspection Followup Item (IFI) 482/9603-05: Evaluation of the ESW pump operability determination and additional training on frazil icing (Section 2.4)
- Apparent Violation 482/9603-06: Failure to follow work instructions for installation of packing gland follower nuts on the TDAFW pump (Section 3.1.1)
- Apparent Violation 482/9603-07: Failure to include in work instructions appropriate guidance on TDAFW pump repacking (Section 3.1.2)
- Apparent Violation 482/9603-08: Failure to follow procedures when classifying work on the TDAFW pump as "troubleshooting" (Section 3.1.3)
- Apparent Violation 482/9603-09: Actions not taken to fully resolve deficient conditions previously identified related to the TDAFW pump (Section 3.1)
- Apparent Violation (482/9603-10): Failures to have required copies of procedures in the control room (Section 4.1)
- Apparent Violation (482/9603-11): Failure to cool down in the time specified by TS Action Statement 3.7.1.2.b (Section 4.2)
- IFI 482/9603-12: Weaknesses were identified in several engineering work products and licensee plans for assessment of four safety systems (Section 7)
- IFI 482/9603-13: Auxiliary boiler reliability (Section 8)
- IFI 482/9603-14: Reactor engineering advice on termination of boration (Section 8)

Attachment:

- Persons Contacted and Exit Meeting

DETAILS

1 BACKGROUND

1.1 Event Description

In the early morning hours of January 30, 1996, due to extreme cold and windy conditions at the Wolf Creek Generating Station, icing of the traveling screens was occurring at the circulating/service water intake structure. Based on the potential loss of the service water system, operators started the ESW system, but failed to properly isolate the ESW system from the service water system. This system misalignment caused a reduction in the flow through the ESW warming lines.

The pending loss of the circulating and service water systems caused the licensee to initiate a manual reactor trip. On the reactor trip, five control rods were noted to not be fully inserted into the core. Subsequently, a packing leak on the TDAFW pump caused the licensee to declare the pump inoperable after approximately 1-1/2 hours of operation. Also, one train of the ESW system became inoperable after frazil icing conditions affected its operation. After shift turnover to the day shift, control room operators recognized and corrected the misalignment of the ESW system. However, the frazil icing conditions continued to jeopardize the remaining train of the ESW system until measures to add additional heat loads to the system cleared the ESW intake structure of frazil ice.

The licensee made two separate emergency declarations (both Notifications of Unusual Event). The first occurred at 8:48 am on January 30, 1996, when both the turbine-driven auxiliary feedwater pump and Train A ESW pump were simultaneously inoperable. The second occurred at 10 a.m. on January 31, 1996, when divers identified ice blockage of the Train A ESW system intake.

As a result of the icing and resultant equipment and operator issues, the licensee initiated an Incident Investigation Team (IIT). The IIT's findings are documented in the licensee's IIT Report 96-002. Also, the NRC established an AIT to review the event, the plant equipment and operator response to the event, and the licensee's emergency response. The NRC's AIT findings are described in NRC Inspection Report 50-482/96-05.

1.2 NRC AIT Findings

The AIT concluded that, while the licensee successfully recovered the plant, weaknesses were evident in both operational performance and engineering support to operations. Specifically, operations personnel did not recognize the potential loss of both trains of the ESW system. Engineering had made errors in the original design of the system and had not considered frazil icing of the ESW system to be credible at Wolf Creek. Inadequate engineering guidance also contributed to the degraded condition of the TDAFW pump. Operator errors in alignment of the ESW system and failures to promptly

correct the condition complicated the event. Weaknesses in the control of emergency procedures also complicated the operators' response to the event.

1.3 Purpose of Special Inspection

The NRC initiated a special inspection as followup to the NRC's AIT's efforts. The purpose of the special inspection was to: (1) examine the licensee's corrective actions related to the restart issues detailed in Enclosure 1 to the NRC letter to the licensee dated March 7, 1996; and (2) perform a followup inspection to the AIT findings related to potential enforcement issues.

In the course of the inspection, the Special Inspection Team had discussions with licensee personnel and managers; reviewed documents, records, and procedures; observed plant hardware and work activities; and attended briefings and training sessions. The licensee's corrective actions related to the restart issues were described in letters dated March 15 and 26, 1996.

1.4 Public Restart Meeting

On March 28, 1996, the NRC conducted a public meeting at the Wolf Creek site to discuss the licensee's progress in completing restart activities listed in Enclosure 1 to the NRC letter dated March 7, 1996, and also discussed some of the licensee's long term corrective actions. A summary of the meeting and the NRC conclusion on acceptability of plant restart is documented in the NRC letter to the licensee dated March 29, 1996.

2 INADEQUATE ESW WARMING LINE FLOW (92901, 92902, 92903)

The ESW system provides safety-related cooling water from the ultimate heat sink to various safety-related components, including the component cooling water heat exchangers, diesel generators, containment coolers, and a number of room coolers for safety-related pumps and motors, and also provides an emergency supply of water for the auxiliary feedwater system.

During the icing event, one train of the ESW system became inoperable and the remaining train nearly became inoperable due to frazil ice conditions at the ESW intake structure. The licensee's review of the cause of the frazil icing identified: (1) design errors related to the assumed temperature of the warming line water and flow rates in the ESW lines; and (2) ESW system misalignment errors made by operators on January 30, 1996. The Special Inspection Team also identified several opportunities for the licensee to have reviewed the design of the ESW system specifically related to determining the adequacy of warming line flow. These issues are discussed in detail below.

2.1 Design Errors

The Wolf Creek Updated Safety Analysis Report (USAR), Section 9.2.1.2.2.3, describes that freeze protection for the ESW system is provided by warming lines from each ESW discharge line during ESW system operation and during normal operation.

Bechtel Calculation K-20-01-F, "SNUPPS Wolf Creek Site ESWS Pumphouse," dated May 17, 1976, was performed to determine the required ESW system discharge flow which would prevent frazil ice accumulation on the trash racks and traveling screens. The licensee's IIT determined that the calculation incorrectly assumed that the warming line temperature would be 35°F. The licensee determined that during the event the actual warming line return temperature to the suction bay was less than 1°F above freezing. The Bechtel calculation determined that 4000 gpm flow was necessary to prevent the formation of frazil ice with a 3°F temperature differential (35°F warming line temperature).

Calculation EF-13, "Wolf Creek ESW Discharge Line Flow Distribution," dated December 21, 1984, was performed to determine the flow distribution between the ESW discharge line and warming line. The calculation determined the flow distribution for the ESW discharge and warming lines for four operating conditions related to the heat loading on the ESW system. These four conditions were post-LOCA, normal power operation (winter), normal shutdown operation (winter), and loss of offsite power operation. The total flow required to handle post-LOCA heat loads was determined to be 13,563 gpm with an associated warming line flow of 4,800 gpm. This calculation assumed full pipe flow. The licensee's IIT determined that it was inappropriate to assume full pipe flow and the more appropriate assumption of partially filled piping would result in a reduction in the amount of flow in the ESW system and warming lines.

The inspectors noted that the licensee's IIT report used a value in Calculation EF-13 for the required ESW warming line flow that was incorrect. That value in fact represented the total discharge flow through the ESW system and was taken from a portion of the calculation which was not applicable to the emergency mode of operation for the ESW system. The licensee referenced a value of 4413 gpm, which was for Train B ESW total flow under normal power operation (winter, not emergency conditions). This calculation was based on the heat loads which would be present during normal (winter) power operation. The actual value for the required ESW warming line flow, based on Calculation EF-13, is 4800 gpm (under post-LOCA conditions) and is 4000 gpm to prevent frazil icing based on Calculation K-20-01-F. The licensee subsequently corrected this value in a letter to the NRC dated March 26, 1996. During the icing event, the licensee postulated that the actual warming line flow achieved was approximately 1700-2000 gpm due to less than full pipe conditions and the system misalignment problem.

10 CFR 50.59 states that changes in the facility as described in the safety analysis report may be made without Commission approval unless the change involves an unreviewed safety question. Also, a change shall be deemed to involve an unreviewed safety question if the probability of occurrence of a malfunction of equipment important to safety is increased. In addition, 10 CFR Part 50, Appendix B, Criterion III, states, in part, that measures

shall be established to assure that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions.

The inspectors concluded that as of January 30, 1996, the licensee had made a de facto change to the facility as described in the Safety Analyses Report without Commission approval in that the ESW warming lines did not provide the freeze protection as specified in USAR Section 9.2.1.2.2.3. Incorrect design assumptions in warming line water temperature and flow rates resulted in the degradation in the freeze protection capability provided by the warming lines from initial plant operation until the day of the event (January 30, 1996). This created an unreviewed safety question in that the probability of a malfunction of the ESW system was increased. In addition, the inspectors concluded that the licensee failed to assure that the design bases of the ESW system (protected from natural phenomena) for freeze protection was appropriately translated into specifications, drawings, procedures, or instructions. The inspectors concluded that the design errors represented apparent violations of 10 CFR 50.59 (482/9603-01) and 10 CFR Part 50, Appendix B, Criterion III (482/9603-02).

2.1.1 Corrective Actions

The licensee implemented a number of short term corrective actions after the event to ensure that frazil ice blockage in the ESW trash racks would not occur until a permanent design solution could be implemented. The licensee developed a "Contingency Plan for Ice Prevention Measures at the ESW Intake," dated February 20, 1996, which described the measures to keep the trash racks and traveling screens at the ESW pump bays free of ice.

For long-term corrective actions, the licensee stated that a design change would be made to the ESW system discharge to the ultimate heat sink and the warming line to assure appropriate distribution of warming line flow. The licensee stated that lake water temperature indication would be incorporated into the design basis to ensure accurate readings. In addition, the licensee was evaluating the need for a permanent air sparging system to provide an ability to mitigate frazil ice formation.

2.1.2 Inspectors Review

The inspectors reviewed the plan and noted that the plan contained instructions for monitoring for suction bay levels and the early formation of frazil ice conditions, provided for the use of temporary heaters, and provided a means for cleaning the front of the trash racks. The inspectors noted that the contingency plan was thorough and would likely prevent the formation of frazil ice. However, the inspectors and licensee concurrently noted that the plan was not considered a controlled document, although it was present with other contingency plans in the control room. The licensee initiated Performance Improvement Request (PIR) 96-0899, dated March 19, 1996, to review whether adequate measures were in place to assure appropriate

control of contingency plans. The inspectors walked down the ESW pumphouse and noted that the equipment called for in the contingency plans were in place.

The inspectors reviewed the licensee's long-term design change to the ESW system. The inspectors reviewed Calculation EF-M-029, Revision 1, which calculated the minimum ESW system temperature rise during all modes of plant operation. The calculation determined that the minimum temperature rise of the ESW system when the ESW pump was running was 0.55°F. The inspectors also reviewed Calculation EF-M-030, Revision 0, which determined the minimum flow required through the warming line to prevent frazil ice from forming. The calculation determined that a nominal flow of 5000 gpm was required to prevent the formation of frazil ice. The inspectors reviewed Calculation EF-M-031, Revision 1, which determined the orifice sizes and associated system resistance coefficients for the ultimate heat sink outlet and warming line outlets required to ensure a 5000 gpm ESW warming line flow. In addition, the inspectors reviewed Calculation EF-M-032, Revision 0, which calculated the minimum hydraulic grade line elevation required at the ESW warming line branch during operation at normal lake level to ensure that it would remain full if operation at the minimum pump suction level was required. The inspectors concluded that the calculations were technically appropriate.

The licensee stated that a design change package (DCP) was being prepared to increase back pressure of the ESW discharge line to the ultimate heat sink in order to achieve full pipe flow and 5000 gpm in the warming line. Back pressure on the discharge to the ultimate heat sink would be raised downstream of the warming line tee by resizing the back pressure orifice located upstream in the discharge line. Back pressure in the warming line would also be raised to achieve full pipe flow. The inspectors reviewed DCP 06441, Revision 1, "Reinforce Existing Unit 1/2 ESW Discharge and Warming Crosstie Pipe Caps (4)." The object of the modification was to reinforce four existing 30 inch diameter blanking plates of the Units 1 and 2 ESW discharge and warming crosstie lines so that the discharge system pressure could be upgraded from 10 psig to 75 psig. In addition, the inspectors reviewed DCP 06355, Revision 0, "Delete ESW Warming Line Valves." This modification was prepared to remove a manual ESW warming line valve in each train and replace it with a flanged spool piece. The purpose was to have less turbulent flow which would benefit the measurement of water flow using ultrasonic equipment. The inspectors reviewed DCP 06349, Revision 1, for the fabrication of the orifice plates for the discharge and warming lines. At the time of the inspection, the modification for the installation of the orifice plates in the discharge and warming lines was not available.

2.1.3 Conclusions

The inspectors concluded that the licensee's interim corrective actions of putting a contingency plan in place until a modification to the design ESW system could be developed and implemented was appropriate. A preliminary

review of the licensee's initial calculations and proposed design modifications showed appropriate considerations for assuring ESW operability.

2.2 Previous Opportunities to Review ESW Warming Line Design Bases

2.2.1 Evaluation of ESW Manual Valve Left in 50 Percent Open Position

On October 19, 1993, as the result of an NRC violation (NRC Inspection Report 50-482/93-31), the licensee performed an operability evaluation to assess the system flow impact for leaving manual Valve EFV0263 in a 50 percent throttled position. This valve is one of two valves in series which provides flow to the warming line for Train B ESW. The inspectors reviewed PIR 93-0941 and an evaluation ("EFV0263 - ESW Warming Water Line-Freeze Protection") which constituted the operability evaluation. The evaluation concluded that the ESW system would not be affected as long as the other ESW warming isolation valve was fully functional.

The inspectors noted the evaluation did not discuss the potential flow reduction with a partially closed valve, but simply listed four design calculations which were reviewed and coordinated with two other engineers and then drew the conclusion that the ESW system was not affected. No technical bases was stated for this conclusion. The inspectors noted that, of the four calculations reviewed, two calculations (K-20-01-F and EF-13) were the ones which contained the design assumption errors discussed in Section 2.1.

In discussions with the engineer involved with the evaluation and other engineering representatives, the licensee stated that flow reductions for butterfly valves throttled to approximately 50 percent were minimal. The inspectors noted that this assumption was not documented in the 1993 evaluation, nor when asked by the inspectors for information demonstrating the validity of this assumption could any data be produced. The inspectors noted that the licensee had performed an evaluation following the January 30, 1996, icing event which determined that the effect of 50 percent throttling of Valve EFV0263 would have been a reduction of warming line flow of approximately 600 gpm (a 12.5 percent reduction), assuming full pipe flow conditions. The inspectors concluded that the evaluation on October 19, 1993, was flawed, did not thoroughly evaluate the impact of the valve's position, and was nonconservative.

The inspectors concluded that the evaluation performed for warming line Valve EFV0263 being only 50 percent open was a clear opportunity for the licensee to review the original design calculations and identify or question the original design assumptions. This is an example of an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI.

2.2.1.1 Corrective Actions for 50 Percent Open Manual Valve

In the letter dated March 15, 1996, the licensee provided corrective actions related to the 50 percent open manual isolation valve in the Train B ESW warming line (Valve EF-HV-263). The licensee's short-term corrective actions

were to refurbish or replace all of the warming line valves and validate current system engineering practices for action request reviews.

The licensee's long-term corrective actions were to have system engineering closely monitor the warming line valves for additional problems in the future, pursue the appropriate corrective action, and ensure outstanding corrective maintenance action requests were appropriately evaluated in a timely manner (to be implemented by June 1, 1996).

2.2.1.2 Inspectors Review

The inspectors reviewed the licensee's short-term corrective actions. The inspectors performed a walkdown of ESW manual isolation Valves EF V-262, -263, -264, and -265 and verified they had been replaced or refurbished and that from external observation they appeared to be in good condition. The inspectors observed significant rust associated with one of the pipe flange connections. The inspectors discussed that condition with the system engineer who stated that the rust was only surface rust and indicated that the rust would be cleaned up. In addition, the inspectors reviewed Component Change Package 05843, which controlled the installation of the valves, and determined that the change package was appropriate for valve installation activities. At the end of the inspection period, the licensee removed two of the manual isolation valves which would allow the subsequent installation of flow measuring devices. The licensee has calibrated ultrasonic flow measuring instruments which can provide flow data and is evaluating possible permanent flow measuring instruments for the warming lines.

The inspectors were provided a printout of outstanding action requests against various plant systems which were still currently being reviewed by system engineering personnel. The review was almost complete and was expected to be completed by unit restart. The inspectors verified that there were actually very few system engineers who had not completed the reviews against their systems. The response coordinator indicated that there were no additional significant items identified by re-review conducted to date. The inspectors interviewed the safety-related battery, safety-related switchgear, safety injection system, and auxiliary feedwater system engineers and determined that the expectations communicated regarding their reviews were appropriate. In addition, the inspectors surveyed these system engineers regarding significant results. The system engineers confirmed that the reviewed information did not reveal significant actions requiring immediate corrective actions. The inspectors reviewed, by sampling, several of the outstanding actions and did not identify any items which appeared to warrant more immediate corrective action.

Related to the licensee's proposed long term corrective actions, the inspectors interviewed several system engineers and determined that normally, on a daily basis, system engineers are required to review new corrective maintenance action requests generated against their systems individually and as a group. In addition, the inspectors interviewed an engineering supervisor who stated that normally the same items are reviewed during a daily

supervisory meeting. The inspectors also noted that the licensee's action request process required system engineers and engineering supervisors to screen recently initiated action requests to determine the need for further investigation.

At the end of the inspection period, the licensee had not developed an outline of criteria for the review of outstanding corrective action maintenance requests; however, the assignment to develop the pilot program had been assigned to system engineering as documented in the licensee's commitment identification and closure system as Item 96-061.

2.2.1.3 Conclusions

The inspectors concluded that the actions taken regarding the 50 percent open manual valve in the ESW warming line were appropriate and should provide enhanced system performance in the future, especially in conjunction with the design change to the ESW system to provide adequate warming line flow.

While the majority of the corrective actions related to system engineering reviews had not been fully completed at the end of the inspection period, the inspectors verified that the licensee was making progress towards completion and appeared to be on track to complete all actions within time frames previously indicated.

2.2.1.4 Other Design Weaknesses Identified in the Evaluation

The inspectors reviewed the four calculations referenced in the 1993 evaluation:

- SA-90-039, Revision 1
- EF-11, Revision A
- EF-13, Revision A, and
- K-20-01-F, Revision 0

The inspectors noted that calculations in EF-13 were intended to determine the amount of flow going through the ESW discharge and warming lines based on different plant conditions (i.e., post-LOCA, normal plant operations, and loss of offsite power). However, the calculations were based on flow values for the flow that was required to remove the heat from the various components under the various conditions rather than what the system could actually deliver.

In addition, the inspectors reviewed Calculation SA-09-039 (a probabilistic rick assessment (PRA) calculation) and noted it contained a statement that the ESW warming line isolation valves were not necessary for successful system operation. The inspectors questioned this statement since, with the valves closed, there would be no warming line flow. The inspectors interviewed personnel from the PRA group and determined that the intent of the statement was to communicate that the failure of the manual isolation valves to be in

the correct position for the warming line operation was not modeled in the PRA, and not that the isolation valves did not need to be open or closed to ensure the function of the warming line. However, this was not what the calculation stated.

The inspectors were concerned that: (1) the engineer reviewing the calculation in 1993 did not question the meaning of the statement, and (2) if the calculation had been used exclusively for making an operability determination, the result could lead to an erroneous assumption that the effect on a throttled isolation valve, such as Valve EFV0263, would be negligible. The inspectors discussed these observations with the Acting Vice President of Engineering. He stated that it was not his expectation that at any time engineers should use PRA analysis solely for making operability assessments. Upon further review of the programmatic guidance for preparing operability assessments, he determined that there were no guidelines outlining the use of PRA assessments for operability determinations. He indicated that the confusing statement in the PRA document and operability determination procedure to address the use of PRA information would be revised. In addition, a letter would be issued to all engineering personnel outlining management expectations regarding the use of PRA calculations. The inspectors concluded that the completed and proposed corrective actions were adequate.

2.2.2 FitzPatrick 1993 Icing Event

The inspectors reviewed the February 25, 1993, loss of screenwell water level due to intake icing event at the James A. FitzPatrick plant, of which the licensee had received notification. The cause of the partial intake blockage was determined to be ice formation due to environmental conditions. The frazil or slush ice formation around or in front of the intake bars partially blocked the flow of water into the plant. The blockage reduced the ability of the intake to meet the circulating water system pump flow requirements which caused the level in the screenwell to drop until the pumps were stopped.

The licensee stated that they did not enter the event in the licensee's industry events review program because of a 1991 Technical Specification interpretation which stated that frazil ice was not a credible event.

The inspectors concluded that the FitzPatrick event was another opportunity to assure that the intake and warming line design was adequate to prevent frazil icing conditions. This is an example of an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI.

2.2.3 1991 TS Interpretation

The inspectors reviewed the licensee's letter, NP 90-2162, dated December 21, 1990, from design engineering to operations concerning the ESW system warming line design basis. The operations department had requested information regarding flow requirements of the ESW warming lines. The engineering response stated that, since the ESW pumphouse was heated and the traveling screens were enclosed by the building, frazil ice formation on the trash racks

and traveling screens was not a credible event. This letter referenced Calculations EF-13 and C-K-20-01-F discussed in Section 2.1 of this report. Based on this letter, the licensee prepared Technical Specification Interpretation 003-88, dated January 8, 1991, for TS 3.7.4. The interpretation stated that frazil ice formation was not a concern since the pumphouse was enclosed and heated.

This conclusion was in error and reflected that the frazil icing phenomena was not understood by engineering personnel. Heating of the traveling screens would be ineffective in preventing frazil ice as this type of icing occurs as a bulk water phenomena when water temperatures throughout the water are close to 32°F. Ice formation occurs on the first available surface (i.e., trash racks) and grows outward towards the lake. Heating of the traveling screens would not prevent the ice formation on the upstream trash racks as was evident during the January 30, 1996, event.

The inspectors concluded that when resolving a direct question related to the possibility of frazil ice formation in the ESW system the licensee missed another clear opportunity to identify the errors in the calculations and determine that frazil ice formation was indeed possible. This is an example of an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI.

2.2.4 NRC IE Circular 78-13

The inspectors reviewed NRC IE Circular 78-13, dated July 10, 1978, which described a frazil icing event at the Salem Generating Station. Salem experienced high strainer differential pressure and the loss of four of six service water pumps within 30 minutes. Circular 78-13 stated that the combination of silt, low river water, and frazil ice probably caused the pumps to receive only ice entrained water. Circular 78-13 recommended that licensees and construction permit holders review the service water design and conditions in the ultimate heat sink to determine if conditions could precipitate inoperability of the service water system.

Bechtel Power Corporation (the licensee's architect-engineer) evaluated the circular to determine if a similar combination of circumstances would result in loss of the ESW system at Wolf Creek. The inspectors reviewed Bechtel's response, dated June 19, 1979, which stated that provisions had been made to prevent frazil ice blockage of the trash racks and traveling screens. The letter further stated that warming water was provided in front of the trash racks at the ESW pumphouse intake from the service water system during normal plant operation and from the ESW system during emergency operation.

The inspectors concluded that Circular 78-13 was another opportunity to assure that the warming line flow was adequate to prevent frazil ice formation. This is an example of an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI.

2.2.5 Conclusions

10 CFR Part 50, Appendix B, Criterion XVI, states in part that "measures shall be established to assure that conditions adverse to quality, such as deficiencies, and nonconformances are promptly identified and corrected." The inspectors concluded that there were several opportunities to have reviewed the ESW warming line design related to the potential for frazil ice formation during the life of the plant and to have identified the warming line design errors. These opportunities are described in Sections 2.2.1, 2.2.2, 2.2.3, and 2.2.4. The inspectors concluded that these opportunities constituted examples of an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI, for the failures to identify a condition adverse to quality (482/9603-03).

2.3 ESW System Misalignment During Event

The event at Wolf Creek developed as a result of extreme cold weather that resulted in loss of the circulating and service water systems due to icing. During the event, conditions in the control room were described as busy with a growing volume of communications both from within the control room as well as outside. After receiving alarms in the control room and noting a low service water system discharge pressure and rising turbine lube oil temperature, the shift supervisor directed the reactor operator to isolate the service water system from the ESW system and place the ESW system in service. The reactor operator reviewed the applicable low service water discharge pressure alarm response procedure and advised the shift supervisor that he needed system operating Procedure SYS EF-200. The alarm response procedure only directed the operator to initiate the ESW system using Procedure SYS EF-200 without any other specific system alignment details. The shift supervisor indicated to the reactor operator that he wanted the ESW system placed in service immediately.

The reactor operator proceeded to place the ESW system in operation and to isolate it from the service water system without the procedure. He did so in keeping with his understanding of ESW system operation. The resulting lineup had the service water discharge valves to the ESW system closed as required by Procedure SYS EF-200; however, the reactor operator opened the ESW discharge valves to the service water system (Valves EF HV-39, -40, -41, and -42) and closed to the throttled positions of the ESW discharge valves to the ultimate heat sink and ESW warming lines (Valves EF HV-37 and -38), which were not in accordance with Procedure SYS EF-200. The reactor operator stated that he was not "comfortable" with the resulting lineup and the shift supervisor noting his concern went to the control board to check it. The shift supervisor, noting that the lineup was not correct, assuming the reactor operator was still in the process of aligning the system, and being distracted with other activities, did not make a note to followup.

The reactor operator retrieved a copy of Procedure EF-200, but did not have an opportunity to verify the system lineup because he became involved in the plant power reduction. Operator interviews by the licensee revealed that at

the shift turnover, the oncoming reactor operator, during the joint tour of the boards, observed that the system lineup was not normal and was told by the offgoing reactor operator that he had been told to do it that way. The oncoming reactor operator did not bring this to the attention of his supervising operator or shift supervisor.

Shortly after the securing of the Train A ESW pump at 7:47 a.m. on January 30, 1996, and the subsequent loss of the TDAFW pump at 7:50 a.m., the supervising operator became aware of the ESW system misalignment and directed the reactor operator to correct the lineup in accordance with Procedure SYS EA-120, "Service Water System Startup." The ESW system misalignment occurred at 1:59 a.m. and was corrected at 8:05 a.m. on January 30, 1996.

After the initial misalignment on the ESW system, there existed numerous opportunities to identify and correct the misalignment until it was finally recognized and corrected. While it is recognized that even if the alignment were properly conducted, frazil icing still would have occurred. However, the misalignment hastened the onset of frazil ice formation. This caused Train A of the ESW system to become inoperable sooner than it would have and nearly resulted in inoperability of Train B of the ESW system. In discussions with Performance Assessment managers and a review of quality audits and surveillances, it was apparent that the audits and surveillances had not identified any similar concerns in the operations area. The managers agreed with the inspectors that it would be prudent to evaluate the audit and surveillance techniques being used to determine whether additional techniques would be beneficial identifying these types of weaknesses earlier.

Technical Specifications 6.8.1 requires that written procedures be established, implemented, and maintained covering the activities recommended in Appendix A, of Regulatory Guide 1.33, Revision 2, February 1978. This appendix specifies procedures for abnormal, offnormal, or alarm conditions. The licensee's alarm response Procedure ALR 00-008B, "SERV WTR PRESS HI LO," Revision 8, directed the operator to establish operation of the ESW system using Procedure SYS EF-200, "Operation of the ESW System." This procedure requires that system Valves EF HV-37 and -38 be opened and Valves EF HV-39, -40, -41, and -42 be closed. The failure to use the prescribed procedure resulted in system Valves EF HV-37 and -38 being closed (to throttled positions) and EF HV-39, -40, -41, and -42 being opened and is an apparent violation of TS 6.8.1 (482/9603-04).

2.3.1 Corrective Actions for Operator Misalignment of ESW System

The licensee proposed both short- and long-term corrective actions for the misalignment of the ESW system. The short-term actions were to revise Administrative Procedure AP 15C-002, "Procedure Use and Adherence," and to provide operations management briefings to the operating crews during the scheduled reactor startup training at completion of the current refueling outage. The long term actions were: to review and revise all control room alarm response procedures to incorporate any immediate system actions into the alarm response procedure; implement the use of a codeword concept to signify

to control room personnel an issue needing immediate attention and resolution; and implement training to reinforce management expectations.

2.3.1.1 Inspectors Review

The inspectors reviewed Procedure AP 15C-002, Revision 6, through On The Spot Change 96-0372. The licensee had revised the procedure to strengthen management's expectations regarding followup activities by allowing operating personnel to take expedient actions which minimize the possibility for personal injury or damage to equipment. When these actions are performed without referencing an approved procedure, the following actions are to be implemented by the shift supervisor: "(1) Engineering evaluations of the effects of any abnormal equipment/system operation, as soon as practical; (2) Return equipment/system to an approved lineup or initiate appropriate procedure changes, as soon as practical." The change also established the use of the "follow-up buttons," which have been provided to control room personnel for use in identifying items for which a followup review is required.

The inspectors attended the operations management briefing of one of the operating crews during the scheduled reactor startup training and observed the crew conduct during part of the first simulator scenario for the startup training. The management briefing covered procedure use expectations by reviewing, along with other issues, shift relief and turnover, conduct of operations, personnel communications, main control board walkdowns, control room board awareness, and supervisory monitoring and coaching. Personnel performance during the portion of the observed scenario was satisfactory, with evident emphasis on attention to detail, communications, and command and control.

At the time of the inspection, the licensee had reviewed 226 alarm response procedures. Of those reviewed, 15 had been identified for revision and revision was in process for inclusion of immediate implementation steps. The inspectors reviewed several of those that had been revised including Procedure ALR 00-008B, "Service Water Pressure HI LO." The inspectors found the revisions to be accomplished and appropriate. Completion of the licensee's review and revision efforts is presently scheduled to be completed by October 1, 1996.

In an effort to strengthen communications, the licensee implemented the use of a codeword to be used by any operations personnel in the control room. This practice is documented in Procedure AP 15C-002, "Procedure Use and Adherence." In effect, any control room operator who states the codeword will become the focus of attention in the control room. The operator will then state his concern and it will be evaluated and acted upon by shift supervision. This corrective action has been implemented, but is considered a long term action because it will be reviewed during the next 6 months to determine its effectiveness. The inspectors did not observe the use of the codeword in observation of control room activities or in the simulator.

The licensee implemented the use of magnetic followup buttons in the control room as a reminder mechanism for operators. In discussions with control room personnel, the inspectors noted that the buttons were viewed to be helpful reminders for items which could be forgotten and the noticeable color made it easy to spot on the control panels. During some control room tours, the inspectors noted that some followup buttons were not labeled as to who had placed them or what their purpose was. In addition, there did not exist specific operations guidance related to the labeling of the buttons. Operations management indicated that guidance would be provided to assure discussion of followup buttons during shift turnover and the logging of any followup buttons which remained on the panels longer than a shift. This appeared to be appropriate.

The inspectors interviewed the Superintendent of Operations Training to determine any training anticipated as a result of the icing event. The long term planned action was to introduce new scenarios during the upcoming requalification training cycle that will include all the lessons learned from the icing incident. This will include enhancement of systems training where needed. The scenarios will be developed to assure practice in the use of the codeword and followup button concepts and reinforce management expectations in the areas of watchstanding practices, procedure use and adherence, and operations standards.

2.3.1.2 Conclusions

The inspectors concluded that the implemented and planned corrective actions in response to the misalignment of the ESW system were appropriate and covered the concerns identified in the licensee's IIT report and the NRC's AIT report.

2.4 ESW Pump Operability Evaluation During Event

After the manual reactor trip at 3:37 a.m. on January 30, 1996, the licensee secured and declared the Train A ESW pump inoperable on two occasions. The Train A pump was initially declared inoperable at 7:47 a.m. on January 30 when the operators noticed that the ESW pump's suction bay level was decreasing, pump discharge pressure was low, and the discharge strainer differential pressure was high. The licensee initiated compensatory measures, including installing supplemental heaters, stationing watchstanders, and venting the Train A ESW system. Subsequently, the Train A ESW system pump suction bay levels returned to normal. The licensee started the Train A pump, which appeared to be functioning normally, and declared the pump operable approximately 2 hours later. However, approximately 1 1/2 hours later, the pump was declared inoperable again at 7:23 p.m. on January 30 due to fluctuations in pump flow and discharge pressure. In addition, the licensee later noted that the pump suction bay level was 10 feet below normal.

The inspectors reviewed the shift supervisor's logs for January 30, 1996, and noted that the shift supervisor had declared the pump operable on the basis of an engineering evaluation. The engineering evaluation indicated that the pump was operable because the Train A ESW pump had been running properly for

approximately 2 hours, supplemental heaters were available and functioning, a continuous fire watch was observing bay levels, and a previously existing engineering evaluation stated that, as long as strainer differential pressures were within the allowable values, the ESW system was operable.

The inspectors concluded that the evaluation was inadequate for several reasons.

- The evaluation did not address the root cause of the inoperability, which was frazil icing on the ESW trash racks. The evaluation considered the pump's ability to run for approximately 2 hours, but did not evaluate the cause of the degraded suction bay levels and the impact on pump operability.

- In addition, the reliance on additional heaters was technically flawed in that the heaters would have little effect on frazil icing conditions (a bulk water phenomena). The heaters would only affect the water surface and would not appreciably affect frazil ice suspended throughout the water.

- The compensatory actions of stationing watchstanders to monitor the suction bay levels and watch for icing would only be effective in identifying icing conditions, but would not prevent frazil ice formation.

The inspectors reviewed PIR 96-0368, initiated February 9, 1996, which was prepared to address the adequacy of the operability determination. At the time of this inspection, corrective actions had not been finalized. The licensee stated that they were considering training on frazil ice and training on operability calls as corrective actions. Pending the completion of the licensee's evaluation of the operability evaluation and additional training on frazil ice and NRC review, this matter is an IFI (IFI 482/9603-05).

2.5 ESW System Degradation

The ESW system degradation evidenced during the event is considered to be significant not only based on the impact on ESW system operability, but also on the barriers which failed to prevent the frazil icing conditions. The barriers which failed include design errors, failures to take advantage of opportunities to identify the design errors, and system alignment errors which hastened the onset of frazil icing. Specifically, errors made in the original design of the ESW system remained uncorrected until after the event; clear opportunities to discover the design errors were not utilized based on a mindset that frazil icing was not a credible event; and operator system alignment errors and failure to promptly correct the errors during the event contributed to hastening of the onset of frazil icing of the ESW system.

These failures resulted in the inoperability of Train A of the ESW system, with the near loss of the remaining train. The licensee's IIT report stated

that, while the Train B ESW pump was always operable during the event, there were clear indications of frazil ice blockage (surface ice was observed upstream of the trash racks, abnormal suction bay levels were observed, and some pump discharge pressure variations were observed). The licensee's report acknowledges that, if the operators had not increased heat loads in the Train B ESW system in the evening of January 30, 1996, the suction bay level for Train B would most likely continued to have dropped and resulted in degraded or eventual loss of Train B. At that point in time, tne Train A ESW pump had been declared inoperable due to indications of pump problems (decreasing suction bay levels, pump discharge pressure low, and pump strainer differential pressure high). Had the Train B ESW pump become inoperable at that time, the ESW system would not have been available to supply cooling water to components. The nonsafety-related service water system had also experienced problems with icing conditions.

The significance of the loss of the ESW system is described in the licensee's Individual Plant Examination Summary Report dated September 1992. The report states that, in a loss of both the service water and ESW systems, reactor coolant pump seals without cooling will leak and result in a significant loss of reactor coolant inventory. This loss will ultimately result in core damage if ESW, component cooling water, and safety injection are not recovered. To mitigate the loss of reactor coolant pump seal flow, operators would attempt to cool down the reactor coolant system with the turbine-driven auxiliary feedwater pump and steam generator atmospheric dump valves. As discussed in Section 3 of this inspection report, a significant packing leak occurred on the turbine-driven auxiliary feedwater pump during the event. The turbine-driven auxiliary feedwater pump was declared inoperable at 5:14 a.m. on January 30, 1996, due to this leak.

3 TDAFW PUMP PACKING LEAK (92902 and 92903)

The TDAFW pump automatically started following the reactor trip at 3:37 a.m. on January 30, 1996. At 5:14 a.m., operators declared the TDAFW pump inoperable due to a severe pump inboard packing leak. The packing leak was noticed by security personnel at approximately 5 a.m. As a result of the pump's inoperability, operators entered TS 3.7.1.2, which required restoration of the pump within 72 hours or commencement of shutdown to Mode 3 within the following 6 hours and to Mode 4 within the following 6 hours.

The consequences of the inoperable TDAFW pump increased at 7:47 a.m., when operators declared the Train A ESW pump inoperable due to low suction pressure. As a result of the Train A ESW pump being declared inoperable, the Train A emergency diesel generator would not have adequate cooling water supply and would not be expected to function for an extended period of time. In addition, the Train A ESW system provided an emergency water source to the Train A auxiliary feedwater (AFW) system and cooling to the Train A AFW pump room cooler. Thus, the Train A motor-driven AFW pump was also declared inoperable. The inspectors noted that the Train A AFW pump was available and capable of supplying water to the steam generator from the condensate storage tank for a limited time under emergency conditions.

Due in part to the failed packing for the TDAFW pump, the licensee initiated an incident investigation to determine the cause of the packing failure and to implement corrective actions. The licensee's evaluation was documented in IIT Report 96-001, "TDAFW Pump Trip Throttle Valve (FC-HV-0312) Retest Failure & TDAFW Pump Inboard Packing Failure." The initial reason for the report was a failure of the TDAFW pump's trip throttle valve to open during a postmaintenance test following scheduled maintenance on January 25, 1996, with investigation of the packing failure being added after the January 30 event. The circumstances surrounding the trip throttle valve failure are discussed in NRC Inspection Report 50-482/96-04. Overall, the inspectors concluded that the licensee's investigation related to the TDAFW pump packing failure was critical and probing.

3.1 Inadequate Maintenance Work Planning and Implementation

3.1.1 Work Package (WP) Instructions Not Followed

The most recent maintenance on the TDAFW pump preceding the packing failure on January 30 occurred on January 25, 1996, while the licensee was investigating trip throttle valve problems experienced following scheduled maintenance. At that time, maintenance personnel determined that the TDAFW pump shaft sleeve nut (for securing the shaft sleeve in place) had unscrewed from the shaft. In order to reinstall the shaft sleeve and nut, WP 108952 was initiated. Under Task 6 of the WP, the shaft sleeve and nut was reinstalled. This task also included reassembly of the packing gland followers. Task 6, Step 5.4, required that the packing gland follower bolts be secured "snug." However, during interviews conducted by the licensee's investigation team following the packing failure, it was determined that the bolts had been only finger tightened. The licensee concluded that this resulted in the packing gland follower not entering the pump stuffing box and, thereby, did not adequately reseat the packing and most likely contributed to the failure of the packing on January 30. The purpose of the packing gland follower is to apply pressure to the packing in the pump suffing box for packing leakage adjustment and for retention of the packing in the stuffing box. The inspectors reviewed the drawings for the pump stuffing box and packing, discussed the failure mechanism with the pump vendor, and agreed with the licensee's conclusion regarding the failure mechanism.

TS 6.8.1 requires that written procedures shall be established, implemented, and maintained covering the activities . . .," including those recommended by Appendix A of Regulatory Guide 1.33, Revision 2, February 1978. Regulatory Guide 1.33 recommends procedures for performance of maintenance. Maintenance Procedure 16C-002, Revision 2, "Work Controls," Step 6.6.7.5, stated worker responsibilities are to "Perform work in accordance with work instructions and referenced documents." On January 25, 1996, a maintenance craftsman, working in accordance with WP 108952, Task 6, did not implement Step 5.4 as required. Rather than tightening the packing gland follower nuts "snug," he tightened them "finger tight." The inspectors concluded that the failure to perform the WP step as required by procedures is an apparent violation of TS 6.8.1 (482/9603-06).

3.1.2 Work Instructions Not Complete

The licensee's investigation determined that contributing to the inboard packing failure was the failure to incorporate pump repacking guidance, documented in Component Change Package (CCP) 05767, into WP 108952. The CCP was contained in the pump vendor manual which was available to the planner responsible for planning WP 108952, Task 6. The inspectors interviewed the planner and confirmed that the planner failed to review all applicable sections of the vendor manual prior to preparing the WP. The inspectors reviewed the packing guidance and concluded that it was very detailed and most likely, if it had been used to reassemble the packing gland followers, it would have prevented the packing failure on January 30. The inspectors reached this conclusion because the guidance specifically addressed ensuring: (1) that the packing gland follower nuts were tightened evenly to assure proper packing seating; (2) that the packing gland follower was inserted into the pump stuffing box; and (3) that the run time was adequate to obtain proper packing leakoff.

During followup review of additional work conducted on January 30, 1996, the inspectors identified an additional instance in which maintenance planners failed to use the pump repacking guidance contained in CCP 05767. On January 30, 1996, following the TDAFW pump packing failure, the packing was replaced under WP 109087, Task 2. The inspectors reviewed Task 2 and determined that it was also prepared without use of the pump repacking guidance.

10 CFR Part 50, Appendix B, Criterion V, requires in part that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings of a type appropriate to the circumstances. The inspectors concluded that the licensee failed to incorporate updated pump repacking information of CCP 05767 into WP 108952, Task 6, and WP 109087, Task 2, and represented two examples of inadequate work instructions and is an apparent violation of 10 CFR Part 50, Appendix B, Criterion V (482/9603-07).

3.1.3 Troubleshooting Beyond Scope of Procedure

On January 25, 1996, under WP 108952, Task 4 (identified to be "Troubleshooting"), maintenance personnel performed an inspection of the TDAFW pump outboard side shaft sleeve nut because of identified problems with the shaft sleeve nut on the inboard side. The work covered by Task 4 included removal of the packing gland follower halves, verification of the tightness of the sleeve nut and set screws, reinstallation of the packing gland follower halves, and measurement of sleeve protrusion. The work was conducted as a "Troubleshooting" activity as documented in the WP task.

The inspectors reviewed Procedure AP16C-002, Revision 2, "Work Controls," Attachment C, which defined guidelines for the performance of troubleshooting activities. Specifically, Step C.2.1 of Procedure AP16C-002 stated that "Troubleshooting activities of a minor nature may be initiated using a limited Work Package Task based on the following:

1. The troubleshooting activity may include Plant Related Work however these activities are limited to actions that are re'atively insignificant to Plant Operation, (i.e., tightening of leaking fittings, and packing, (excluding MOV's); tightening loose Terminal Strip Connections; replacement of indicating lights and General Housekeeping Practices)."

The inspectors concluded, based on a review of this guidance, that the activities of Work Package (WP) 108952, Task 4 were outside of the guidelines of the licensee's troubleshooting definition in Procedure AP16C-002. The inspectors concluded that the scope of work appeared to be beyond troubleshooting in that the packing gland follower halves had to be removed and reassembled to inspect the shaft sleeve nut. The packing failure on the TDAFW pump and the details provided by engineering in CCP 05767 demonstrated that the proper reassembly of the packing gland follower and nuts is important to maintain proper seal performance. The inspectors were concerned that improper classification of work tasks as "troubleshooting" may lead to problems in WPs because "troubleshooting" work tasks do not require the review and detail of standard WPs.

TS 6.8.1 requires that "written procedures shall be established, implemented, and maintained covering the activities . . ., including those recommended by Appendix A of Regulatory Guide 1.33, Revision 2, February 1978." Regulatory Guide 1.33 recommends procedures for performance of maintenance. Maintenance Procedure 16C-002, Revision 2, "Work Controls," Step 6.6.3, stated "Troubleshooting may be directed and accomplished using a WP task authorized by the CWA/SS (see attachment C)." Attachment C, Step C.2.1.1, defined troubleshooting activities as discussed above. The inspectors concluded that troubleshooting activities performed under WP 108952, Task 4, were outside of the scope of the licensee's definition of troubleshooting as stated in Procedure AP16C-002 and is an apparent violation of TS 6.8.1 (482/9603-08).

The licensee indicated that they disagreed with the inspectors' conclusion that a violation of the work controls procedure occurred. The licensee indicated that the activities in Task 4 were simple enough to be considered "troubleshooting." They stated that the work activity to remove, inspect, and then reinstall the packing gland follower without disturbing the packing was appropriately considered troubleshooting. While the licensee concluded that certain work control areas needed strengthening, they did not consider that a violation of procedures occurred in this instance. As stated above, the inspectors disagreed and considered the work done to be beyond the guidelines established for troubleshooting.

3.1.4 Inadequate Corrective Actions for Previously Identified Issues

The licensee's IIT Report noted two additional concerns associated with previous corrective action efforts for problems identified with the TDAFW pump.

3.1.4.1 PIR 94-1918

On October 30, 1994, PIR 94-1918 was initiated to address the condition in which the TDAFW pump packing was found to have been misadjusted. This resulted in a restriction of packing leakoff following work that was performed in accordance with Work Request (WR) 60242-94. The condition was identified during a pump operability run following maintenance activities. PIR 94-1918 was dispositioned to replace the packing. However, the root cause for the packing misadjustment was not investigated. The licensee failed to determine whether the misadjustment was caused by the worker or the WP guidance. The inspectors agreed with the licensee's conclusion that corrective actions to address the cause for the inadequate packing adjustment were inadequate.

3.1.4.2 WR 05933-94

On October 30, 1994, WR 05933-94 was initiated to address the as-found condition in which licensee personnel observed that the packing gland follower nuts did not have full thread engagement. The WR was closed "in process" because the originator, a maintenance planner, resolved the condition through discussions with the system engineer. Specifically, in the work instruction section of the WR, where the condition was dispositioned, the planer documented per discussion with the system engineer that a nonconformance does not exist because ". . . the vendor manual does not specifically state having full thread engagement when the packing is tightened. No non-conformance exits."

The inspectors agreed with the licensee's conclusion that in this case the corrective actions were inadequate. The inspectors noted that the absence of guidance in the pump vendor manual was not an adequate basis for concluding there was not a nonconforming condition. A technical evaluation of less than full thread engagement should have been performed to determine the ability of the packing gland followers to maintain their relative position in order to maintain proper packing leakoff.

3.1.4.3 Conclusions

10 CFR Part 50, Appendix B, Criterion XVI, specifies that measures shall be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, or deviations are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures shall assure that the cause of the condition is determined and corrective action taken to preclude recurrence.

The inspectors concluded that as of January 30, 1996, in two cases, conditions adverse to quality (packing misadjustment on the TDAFW pump and less than full thread engagement of packing gland follower nuts) were identified, but adequate actions were not taken to correct the deficiency (thread engagement issue) or to determine the cause of the condition (packing misadjustment

issue - a significant condition adverse to quality). The inspectors concluded these two examples represented an apparent violation of 10 CFR Part 50, Appendix B, Criterion XVI (482/9603-09).

3.2 Impact of Inadequate Packing Maintenance on TDAFW Pump Operability

As discussed in Section 3.1.1, the most recent maintenance on the TDAFW pump packing components preceding the packing failure on January 30, occurred on January 25, 1996. For the work performed on the TDAFW pump on January 25, 1996, maintenance planners failed to provide the complete instructions for reassembling the inboard packing gland follower, maintenance personnel failed to implement the work instructions to have the packing gland follower nuts "snug," and licensee personnel failed to adequately resolve previously identified problems. As a result, the TDAFW pump was not reassembled in accordance with pump repacking guidance (the packing gland follower was not inserted into the pump stuffing box, nor was the pump operated for a sufficient period to ensure packing leakoff would not change during pump operation). The licensee concluded that the failures to do so contributed to the packing failure on January 30, 1996.

The inspectors evaluated the capability of the TDAFW pump to perform its design basis function given the effects of the water spray on the pump inboard bearing. The inspectors reviewed the applicable TS and USAR for the AFW system, as well as the licensee's Station Blackout Coping Assessment to determine the design basis of the AFW system. The inspectors determined that the most limiting condition would be the loss of power event which requires the operation of the TDAFW pump for approximately 4 hours, based on the licensee's Station Blackout Coping Assessment.

During the January 30, 1996, event, following the pump inboard packing failure on the TDAFW pump, the water spray from the pump's stuffing box was estimated to be between 15 to 20 gpm. Later, on January 30, 1996, the bearing oil was changed and at that time the licensee estimated there had been an oil-water mixture in the bearing housing of approximately 50 percent oil and 50 percent water. Based on this observation, the inspectors concluded there were two issues which needed to be addressed to assess the significance of the packing failure on the operability of the TDAFW pump.

The first issue involved the effects of the water spray on adjacent components. The inspectors determined that the components in the TDAFW pump room in general were not qualified for a harsh environment; however, there were qualification documents for several specific components. The inspectors walked down the inboard packing area to determine which components would most likely be within the water spray area. The inspectors concluded that the only potentially sensitive components were the pump inboard bearing housing and the turbine governor control circuitry. The inspectors were provided an environmental qualification report for the governor control circuitry which indicated that the equipment was qualified for a 100 percent humidity environment. Based on this report the inspectors concluded that operation of the equipment would most likely be assured for the necessary duration.

The second issue involved the potential effects of the oil-water mixture on the pump inboard bearing and the ability of the bearing to function for the design basis duration (4 hours). The inspectors reviewed an operability assessment prepared by the AFW system engineer that was attached to PIR 96-0296 and was used as part of the licensee's TDAFW pump IIT Report 96-001. The inspectors independently contacted some of the same sources the licensee had contacted in reaching the conclusions for the operability assessment. As documented in the operability evaluation, the licensee concluded that the packing failure would not have prevented the TDAFW pump from performing its safety function.

The inspectors questioned this conclusion based on the following:

(1) The lack of data to substantiate the ability of the bearing to continue to operate with a 50/50 oil-water mixture;

(2) The licensee's lubrication group indicated they could not conclude how long the bearing would function with a 50/50 oil-water mixture;

(3) The bearing manufacturer could not conclude how long the bearing would function with the observed oil-water mixture without performing a detailed failure analysis;

(4) The pump vendor could not conclude how long the bearing would function with the observed oil-water mixture;

(5) The operability evaluation did not address the fact that, as the pump continued to run and the packing continued to put water into the bearing housing, the oil-water mixture would continue to increase in water content, and increase the impact of the increasing water content on the ability of the bearing to function; and,

(6) An assumption made in the evaluation was that, even if the bearing were to fail, the pump load from the failed bearing would be transferred to the turbine inboard bearing and the pump outboard bearing. This assumption was unfounded and assumed a bearing failure which would not impact load transfer.

At the end of the inspection period, the licensee was in the process of providing information to the bearing vendor which was to be used to perform a detailed analysis to determine if the bearing would have functioned long enough to meet the pump's design basis function.

The inspectors also noted that the licensee had not performed the evaluation using guidelines in Procedure KPF-1215 for evaluation of nonconforming conditions of installed plant equipment because the evaluation had not been requested by the shift supervisor, as provided for in the procedure. In essence, engineering personnel used a less formal and less rigorous evaluation methodology in the assessment of the operability of the TDAFW pump than the process that would be used if requested by the shift supervisor. The

inspectors questioned the use of the less formal process when evaluating degraded or deficient equipment conditions. This is further discussed in Section 7.

Based on these activities, the inspectors concluded that the capability of the inboard bearing to continue to function to meet the pump's design function to run for 4 hours was questionable and the engineering evaluation was weak.

3.3 Corrective Actions

3.3.1 Summary

The licensee's short-term corrective actions included: immediate replacement of the inboard packing; revision of the auxiliary feedwater pump work instructions to include updated packing instructions and postmaintenance testing; subsequent removal and replacement of the inboard packing using the revised packing instructions; issuance of guidance to maintenance planners as required reading to promote uniform awareness of the planning concerns associated with this issue; conducting a critique training session with all planners concerning the lessons learned and review of the revised packing and maintenance run-in work instructions; assignment of an individual providing oversight, whose sole duty was to ensure correctness of work being done, to oversee unplanned AFW and diesel generator system work activities; and review by the system engineer of the outstanding corrective maintenance backlog on the TDAFW pump.

The licensee's long-term corrective actions included: placing into effect a requirement that a separate and knowledgeable individual responsible for oversight be assigned for unplanned corrective maintenance activities on the TDAFW pump and the emergency diesel generators; providing additional pump packing training to planners, mechanics, and system engineers; and developing appropriate postmaintenance testing methodology relative to maintenance activities.

3.3.2 Inspectors Review

The inspectors reviewed the licensee short term corrective actions as follows.

- The inspectors reviewed WP 109087, Task 2, and confirmed that the packing had been replaced immediately following the failure on January 30, 1996.

- The inspectors reviewed the generic work instruction which would be used for all three AFW pumps to incorporate the relevant updated information on packing installation and adjustment. The inspectors determined that the relevant information was incorporated, with the exception of the pump retest run time. However, the generic WP referred to another task which would implement a 1-hour postmaintenance run to provide for final adjustments prior to the pump operability run.

In addition, the inspectors verified that WP 107850, which was to be used for upcoming maintenance on the Train B AFW motor-driven pump, included the updated packing installation and postmaintenance testing guidance. The inspectors noted that the previous maintenance history for the Trains A and B motor-driven AFW pumps did not include the current guidance, in part because they were last worked prior to 1994, when the updated guidance was developed. However, the inspectors determined by review of operation records and interviews with maintenance and engineering personnel, that both pumps had significant run histories (one pump had over 100 hours) in which pump leakoff during running conditions had been observed to be relatively constant over the pump's recent operating history.

The inspectors determined that the operability surveillance test could not be performed for the TDAFW pump after the maintenance performed on March 15, 1996. The unit had not reached a mode in which a steam supply was available. However, the licensee stated the postmaintenance test would include a 1-hour postmaintenance run.

- The inspectors verified, by review of the completed WP 109554, Task 4, that the packing had been removed and repacked using the revised packing instructions on March 15, 1996.

- The inspectors verified, by review of logs, that the majority of planners had reviewed PIRs 96-0269 and 96-0217. In addition, the inspectors interviewed several planners regarding the PIRs and concluded that the lessons learned had been communicated. The licensee stated that the remaining planners would review the information within the next few weeks.

- On March 22, 1996, the inspectors attended the critique training session. During the training, the root cause of the packing failure on January 30, 1996 (as documented in PIRs 96-0296 and 96-0217), was discussed, as well as relevant corrective actions. In addition, the Maintenance Manager provided guidance regarding expectations for performance of maintenance planning activities. In addition, when provided the opportunity to ask questions, several planners provided very good questions and identified several issues which management needed to address to improve the planning process.

- The inspectors reviewed Maintenance Directive 96-0012, dated March 11, 1996, outlining that a separate and knowledgeable individual responsible for oversight be assigned for unplanned maintenance on AFW and diesel generator systems. During the critique training session as documented above, the maintenance manager provided performance expectations required of the oversight individual.

- The inspectors noted that the preventive maintenance WP had not been completed as of the end of the inspection period. However, the

inspectors discussed the methodology being considered in the development of the preventive maintenance, which included taking periodic measurements to determine movement of shaft sleeve nut, and concluded it appeared appropriate. In addition, the inspectors verified that regulatory commitment tracking Item 96-065 had been initiated to ensure that the item was completed by March 30, 1996.

- The inspectors determined, by review of an electronic report of outstanding deficiencies against the AFW system, and by interview with the AFW system engineer, that there were no significant outstanding backlog items against any of the three AFW pumps.

The inspectors reviewed the licensee's long term corrective actions as follows.

- The inspectors reviewed the guidance which provided the intent and function of the oversight individual and concluded that the guidance was clear. In addition, during planner training for the packing failure event, the inspectors observed that the Maintenance Manager provided additional guidance to planners regarding the role of the oversight individual. The inspector concluded that the additional guidance was sufficient to define what constituted unplanned maintenance as well as general expectations. However, there were no opportunities to observe the effectiveness of this oversight individual.

- At the end of the inspection period, the licensee had not yet developed the additional pump packing training lesson plan; however, regulatory commitment tracking Item 96-068 had been initiated to ensure that the item would be completed by September 1, 1996.

- The licensee had not completed the placement of lessons learned from PIRs 96-0269 and 96-0217 or incorporated the corrected technical manual information into maintenance continuing training; however, regulatory commitment tracking Item 96-069 had been initiated to ensure the item would be completed by September 1, 1996.

- The licensee had completed development of the appropriate postmaintenance testing methodology by the end of the inspection period; however, regulatory commitment Tracking Item 96-070 had been initiated to ensure the item was implemented by September 1, 1996.

In addition, the inspectors noted that the corrective actions outlined in IIT Report 96-001 did not address the causes for the step not being performed by the maintenance craftsman as written. In response to the inspectors observation, the Maintenance Manager reissued guidance to all maintenance personnel regarding management expectation for performance of work, with specific emphasis on following WPs. The inspectors concluded that the licensee's corrective actions were adequate.

The inspectors determined, based on a review of the licensee's IIT report and related documents, that the cause of the inadequate packing adjustment had been subsequently addressed under PIR 94-2095, and Action Request 13005 was initiated to address the thread engagement issue. The inspectors noted that the licensee had not addressed why the initial actions to resolve PIR 94-1918 and WR 05933-94 were inadequate. In response to the inspectors' observation, the licensee initiated PIR 96-0296, which will be incorporated into a maintenance division assessment initiated by another PIR.

3.3.3 Conclusions on Corrective Actions

Overall, the inspectors concluded that the licensee's completed and proposed corrective actions were appropriate; however, the inspectors noted that the licensee had not addressed the root causes of two issues until questioned by the inspectors. Several of the long-term corrective actions including postmaintenance testing had not been completed by the end of the inspection period.

4 OTHER OPERATOR RESPONSE ISSUES (92901)

4.1 Missing Reactor Trip Response Procedures in Control Room

During the early stages of the event on January 30, 1996, with the unstable condition of the service water system and rising main turbine lube oil temperature, the shift supervisor directed a manual reactor trip. Following the reactor trip, the operators entered Procedure EMG E-0, "Reactor Trip or Safety Injection," and proceeded through the immediate actions, noting that five control rods had not fully inserted into the reactor core. The operators continued through Procedure EMG E-0 and completed EMG F-0, "Critical Safety Function Status Trees," then attempted to transition to Procedure EMG ES-02, "Reactor Trip Response." The control room operators discovered that a copy of Procedure EMG ES-02 was not in any of the four procedure sets in the control room. The operating crew was directed by the shift supervisor to proceed from memory while a copy of the procedure was obtained from the computer-based information system. A copy of the procedure was available within approximately 4 minutes.

As a result of the licensee's investigation, one action by the licensee was to conduct a 100 percent review of control room procedures to assure that the control room documents were complete and were the proper revision. This review identified 31 discrepancies which consisted of missing items, voided or superseded procedures and procedure changes still present in the document, and the wrong revision in the file. The inspectors were advised that all discrepancies had been corrected. On March 22, 1996, the inspectors attempted to verify the status of procedures in the control room document file and determined that a procedure identified as missing in the licensee's review was still missing. The inspectors notified the shift supervisor of the discrepancy. The shift clerk obtained and filed a copy of the procedure before the inspectors left the control room. A reverification that all discrepancies had been corrected was conducted by the licensee. This review

identified three additional items that had not been corrected. The items were subsequently corrected. Apparently the four uncorrected items were on a separate list from the other 27 items previously identified. The error was attributed to an individual's oversight and inattention to detail.

TS 6.8.1 states that written procedures shall be established, implemented, and maintained covering the activities recommended in Appendix A, of Regulatory Guide 1.33, Revision 2, February 1978. This appendix specifies procedures for abnormal, offnormal, and alarm conditions. The licensee's Procedure ADM 02-014, "Control of Operations Documents," Revision 5, Section 6.9.3, states that "Procedures will be filed in the appropriate Procedure File Drawers, Procedural Manuals or field areas as applicable." The two examples of the failure to have copies of required emergency response and alarm response procedures on file in the control room is an apparent violation of TS 6.8.1 (482/9603-10).

4.1.1 Corrective Actions

4.1.1.1 Summary

Based on the identification of the missing reactor trip response procedure during the icing event and the 100 percent review of control room documents, the licensee initiated short-term corrective actions to conduct a 100 percent review of the controlled documents located at the auxiliary shutdown panel, the technical support center, and the emergency operations facility. Long-term actions consisted of training the shift clerks to emphasize attention to detail in dealing with document transmittals, revising the shift clerk qualification card to ensure that future clerks will receive the required training, and developing a definitive check list for shift-to-shift verification of document activities by the shift clerk.

4.1.1.2 Inspectors Review

The licensee's review of the auxiliary shutdown panel procedures was completed on March 24, 1996. The inspectors verified selected procedures at the auxiliary shutdown panel on March 26, 1996, against the validated index and found no discrepancies. The audits of procedures in the technical support center and the emergency operations facility had not been completed at the end of this inspection, but was scheduled for completion prior to plant startup following the ongoing refueling outage.

The long-term corrective actions are scheduled to be completed by September 1, 1996.

4.1.1.3 Conclusions

The inspectors concluded that the licensee failed to correct four identified document control deficiencies; however, the implemented and planned corrective actions originally planned and those resulting from the inspectors' findings

in response to the missing procedures were appropriate and appeared to cover the concerns identified.

4.2 Exceeding Reactor Cooldown Time

Following the manual reactor scram resulting from the icing events of January 30, 1996, the operators entered TS Limiting Condition for Operation Action Statement 3.7.1.2.b at 7:47 a.m. Entry into this action statement was required when the Train A ESW pump was placed in "Pull-to-Lock" due to low discharge pressure and high strainer differential pressure. This action disabled the Train A emergency diesel generator and the Train A motor-driven auxiliary feedwater pump. With the TDAFW pump already declared inoperable due to failed packing, Action Statement 3.7.1.2.b was entered with two inoperable auxiliary feedwater pumps. The Action Statement requires that the plant be in hot shutdown in the next 6 hours (at 1:47 p.m.). Hot shutdown (Mode 4) was not entered until 3:31 p.m. on January 30, 1996. The failure to comply with the TS Action Statement 3.7.1.2.b is an apparent violation (482/9603-11).

The licensee identified the root cause of the failure to achieve a timely transition to Mode 4 to be the supervising operator's belief that Attachment A to Procedure GEN 00-005, "Minimum Load to Hot Standby," had to be completed prior to cooldown. This attachment included numerous prerequisites, checkoffs, and system alignments. In subsequent reviews, the licensee determined that many of the steps could have been accomplished in parallel with the plant cooldown. A contributing cause was identified as a lack of experience in a rapid plant cooldown by the operating crew and by operations personnel in general, since they had never been challenged by this need. Training scenarios did not include this type of cooldown scenario in either the initial qualification training or the requalification training. Other contributing causes were identified as a lack of procedural guidance on which steps are required to be performed in order and on which steps could be delayed for the purpose of a rapid cooldown; adherence to procedures is the expectation of Operations; and a change in crew configuration, the regular shift supervisor became ill and was replaced on the day of the event.

The licensee's delay in entering Mode 4 was viewed by the inspectors to be more indicative of a lack of operator familiarity with conducting a rapid cooldown and training weaknesses, rather than a safety concern with being in hot standby (Mode 3) for 1 3/4 hours longer than intended by TS. It was clear that the licensee intended to achieve Mode 4 but, due to a late start in the cooldown process and the inefficiencies in implementing the procedures, the licensee was not able to meet TS time limits.

4.2.1 Corrective Actions

4.2.1.1 Summary

The licensee revised Procedure GEN 00-005 to provide guidance on which steps are mandatory and which steps may be delayed or performed concurrently in an accelerated shutdown condition.

The licensee had already developed a training tool in the simulator scenario "Reduced Manning." This scenario will continue in future requalification training and will be enhanced to provide for unanticipated crew configuration changes.

Management's expectations on procedure adherence as they relate to this event will be reviewed with the operating crews during the next requalification cycle with an address by senior management personnel.

4.2.1.2 Inspectors Review

The inspectors reviewed On The Spot Change 96-0371 for Procedure GEN 00-005, "Minimum Load to Hot Standby." This change incorporated a note that allows entry into Procedure GEN 00-006, "Hot Standby to Cold Shutdown," while continuing with GEN 00-005 with appropriate cautions. A comparison of the two procedures along with the new note confirmed that the licensee had addressed the concern over procedural inefficiency.

The concern for the disruption that can be caused by the integration of a new individual into an operating crew had already been addressed by the licensee for other reasons. A new "Reduced Manning" simulator scenario was introduced into one training cycle in 1995 and will be continued in the 1996 training year. The licensee was also evaluating the integration of a member from the relief crew into simulator scenarios to focus on cross-crew communication, clarity of expectations, and follow through of given direction. No completion date was provided by the licensee for this corrective action.

A briefing session will be scheduled for an address by a senior manager to each operating crew during the upcoming requalification training cycle. No completion date was provided by the licensee for this corrective action.

4.2.1.3 Conclusions

The inspection team concluded that the implemented and planned corrective actions in response to the failure to achieve Mode 4 in a timely manner were appropriate and appeared to cover the concerns identified in the licensee's IIT report.

4.3 Gap in Implementing Compensatory Actions at ESW Pumphouse

The AIT inspection report (Section 2.3.9) documented that the licensee's compensatory measures (which formed the basis for declaring the Train A ESW system operable) had not been implemented between 6:15 p.m. and 7:23 p.m. on January 30, 1996. The Train A ESW system had been declared operable at 5:45 p.m. that day and had to be declared inoperable 1 1/2 hours later at 7:23 p.m. due to icing problems. The compensatory measures included a continuous fire watch to observe ESW bay levels, watch for icing, and monitor the temporary heaters.

On the basis of discussions with operations managers, preliminarily it appeared that the gap was caused by: (1) a lack of formality in assuring compensatory measures were in place prior to relying on them; (2) a failure to ensure that appropriate personnel were trained/briefed on the actions required prior to relying on their presence; and (3) a failure to consider turnover activities when implementing compensatory measures. The licensee supplemented PIR 96-0899 (related to contingency plan control) to include a root cause evaluation of why the contingency plan compensatory actions were not fully implemented during the event.

4.3.1 Corrective Actions

The licensee will conduct a root cause evaluation of the gap in implementation of the compensatory actions.

4.4 Termination of Boration

4.4.1 Termination of Boration without Shutdown Margin Calculation

The licensee's IIT report identified that operators had terminated boration at 4:39 a.m. on January 30, 1996, based on all control rods being fully inserted. The licensee's report also indicates that the termination of boration was done without completion of a shutdown margin calculation required by Procedure OFN BG-009, "Emergency Boration."

Based on discussions with the reactor engineers involved with the shutdown margin calculation that day and operations management, the inspectors determined that the licensee's conclusion that boration was terminated without a shutdown margin calculation being completed was accurate. However, operations management indicated that Procedure AP 15C-003, "Procedure User's Guide for Abnormal Plant Conditions," Revision 1, Section 6.10.2, provides guidelines regarding the concurrent use of two or more procedures ("branching"). That section states that the operator is only required to perform those portions of subordinate procedures necessary to satisfy the requirements of the main procedure.

During the event, Procedure EMG ES-02, "Reactor Trip Response," was the main procedure which controlled and directed the entry into the subordinate procedure (OFN BG-009) for emergency boration. Subsequently, when the two control rods drifted into the fully inserted position, the licensee stated that the subordinate procedure for emergency boration no longer had to be completed (meaning that a shutdown margin calculation no longer had to be completed) and the emergency boration procedure could be exited. The main procedure, EMG ES-02, would be reentered.

4.4.2 Conclusions

The inspectors agreed that the licensee's procedures allowed the termination of boration without completion of a shutdown margin calculation. In this

case, the conditions for entry into the emergency boration procedure no longer existed and, therefore, completion of the emergency boration procedure was no longer necessary.

5 OTHER EQUIPMENT RESPONSE (92901)

5.1 Circulating and Service Water Systems

During the January 30, 1996, event, the operators manually tripped the reactor due to ice buildup on the circulating water system traveling screens. The traveling screens were in the manual, slow speed operation as required by procedures, which exposed the screens to the outside ambient conditions for approximately 7 minutes during a 36-minute cycle. While exposed to outside ambient conditions, the screens were backwashed by screen wash water spray. The licensee concluded that this spray, when exposed to the ambient conditions, caused an initial ice buildup on the screens, which eventually blocked the screens completely. The trash racks were not covered with frazil ice due to adequate flow through the warming lines.

5.1.1 Safety Significance

The loss of the circulating water system due to icing conditions was the initiator of the event on January 30, 1996. The loss of the circulating water system with the associated pending loss of the service water system caused the licensee to initiate a manual reactor trip and initiate the operation of the ESW system. While the circulating water and service water systems are nonsafety-related systems, their loss or pending loss presented a challenge to the plant safety systems (including the reactor protection system, auxiliary feedwater system, and ESW system).

5.1.2 Corrective Actions

The licensee initiated PIR 96-0265, dated January 30, 1996, to address the ice buildup on the circulating water traveling screens. The inspectors reviewed the PIR, which included a root cause analysis of the event. The licensee determined that there was sufficient warming line flow since a flow measurement was taken which indicated a flow of 23,000 gpm. Because of the flow measurement and the lack of significant ice buildup on the trash racks, the licensee concluded that there was adequate warming flow. The PIR documented the root cause of the icing conditions to be the manual operation of the screen wash system and the screens in slow speed during the harsh weather conditions.

LER 96-001, Revision 0, listed the short- and long-term corrective actions. The short term corrective actions included deleting the requirement to operate traveling screens continuously in the slow manual mode during cold weather. In addition, immediate actions included the erection of a temporary shelter

over the traveling screen area to help minimize the cold weather effects. Heaters were used to warm the traveling screens inside the shelter and portable air compressors were used to provide air sparging near the trash racks.

The licensee indicated in LER 96-001 that a long-term solution was to enclose the traveling screens in a permanent, heated structure. The licensee indicated in the March 15, 1996, letter to the NRC that the resolution would be completed by August 1, 1996.

5.1.3 Inspectors Review

The inspectors walked down the circulating water pumphouse and traveling screens and found that the temporary shelter was in place and there were heaters and air compressors available. The inspectors reviewed Procedure SYS SW-121, Revision 9, "Circulating Water Screen Wash System," and On-The-Spot Change 96-0279. This change revised the procedure to allow the traveling screens to be placed in automatic or secured after performing the daily cycle of the circulating water screens. The inspectors also reviewed Procedure STN GP-001, Revision 17, "Plant Winterization," and On-The-Spot Change 96-0058. This change revised the procedure to delete the requirements for placing the traveling screens in manual, slow operation due to cold weather or to ice formation. The design package for a permanent enclosure was not available during the inspection.

5.1.4 Conclusions

The inspectors concluded that the short-term corrective actions implemented and the long-term corrective actions planned were appropriate.

5.2 Failure of Five Control Rods to Fully Insert

The NRC's review of the failure of five control rods to fully insert when the reactor was manually tripped is documented in NRC Inspection Report 50-482/96-06.

6 EMERGENCY PREPAREDNESS RESPONSE (92904)

During the icing event, the licensee made several formal emergency action level evaluations as the event progressed with each major change in plant status. Two Notifications of Unusual Event were made by the licensee. These emergency classifications were made using the licensee's Administrative EAL Chart, rather than the other more technically related charts.

The NRC AIT identified that communication failures between a relief crew supervising operator (assisting the control room staff) and the shift supervisor resulted in the shift supervisor and plant management not fully understanding the actual decreasing Train B ESW bay level for the operating ESW train.

6.1 Problems with EALs

6.1.1 Adequacy of EAL's

In the NRC AIT's review of the license's implementation of the emergency plan, the AIT verified that the licensee's EAL charts used to classify events did not have specific provisions for ice-related events. However, this was found to be similar to other cold weather sites and other industry and NRC guidance (NUMARC/NESP-007, Revision 2, and NUREG-0654/FEMA-REP-1, Revision 2).

6.1.2 Applicability of Administrative Chart and Training

The NRC AIT also noted that licensee training was conducted which reinforced the approach that the Administrative EAL Chart was to only be used when the other EAL charts were not applicable, rather than being used together. The licensee's intention in using this approach was to minimize inconsistent event classifications, by providing a limitation on when judgment would be used in event classification. Inconsistent event classifications had occurred in the past.

6.2 Failure to Provide Information to Shift Supervisor

The AIT identified that the relief crew supervising operator (an SRO) had received information from an operator at the ESW pumphouse regarding decreasing bay water level. However, this information was discounted and not communicated to the shift supervisor or other plant managers because the relief crew supervising operator incorrectly assumed that ESW Train B was not significantly degraded due to acceptable pump discharge pressure. The information regarding the bay levels was important because it indicated that existing conditions for the operating ESW train were worsening.

6.3 Corrective Actions

6.3.1 Summary

The licensee has revised the Administrative EAL Chart to be similar to the definition of the four emergency classes specified in NUMARC/NESP-007. A problem with the initial revision of the chart was identified by the licensee during a training session and corrected to assure the wording was consistent with the licensee's chart format. In addition, the licensee made provisions in the System Malfunction and Natural Phenomena EAL charts to cover the loss of both trains of cooling water systems (i.e., residual heat removal, component cooling water, or ESW). In addition, training was conducted for those who would be making the event classification determinations and those advising them. Included in the training was discussion of the distinction between a Notice of Unusual Event and an Alert.

6.3.2 Inspectors Review

The inspectors reviewed the revised EAL charts and their associated bases, made comparisons with established industry guidelines (NUMARC/NESP-007), attended a training session, held discussions with those who would be implementing the EAL charts on their understanding of the changes made to the EAL charts, and held discussions with operators regarding their understanding of the important ESW parameters during icing conditions.

6.3.3 Conclusions

The inspectors concluded that the licensee's corrective actions were appropriate and should facilitate easier use of the EALs during other similar events which involve a potential loss of cooling water systems.

7 QUALITY OF ENGINEERING WORK PRODUCTS

As discussed in Sections 2.1.1, 2.2.2, 2.4, and 3.2 of this report, weaknesses were identified in a number of engineering work products. Some are associated with current engineering activities. The weak engineering products include -

- Design errors related to warming line flow in the ESW system (Section 2.1.1).

- Several failures to take advantage of opportunities to identify the design errors (evaluation of 50 percent open valve, evaluation of another plant icing event, and resolution of a question regarding the possibility for frazil icing of the ESW system) (Section 2.2.2).

- Weaknesses in the engineering evaluation of a valve left in the 50 percent open position (Section 2.2.2)

- Lack of an adequate technical bases for the ESW operability evaluation performed during the event (Section 2.4).

- Weak technical bases for a TDAFW pump operability evaluation (Section 3.2).

The inspectors noted that the licensee's program provided for formal operability evaluations in accordance with Procedure KGP-1215, Revision 2, "Evaluation of Nonconforming Conditions of Installed Plant Equipment." The inspectors noted that the engineer did not perform the 1993 evaluation of a valve left in the 50 percent open position in accordance with Procedure KGP-1215 because only requests from the shift supervisor required its use. Based on a review of Procedure KGP-1215 the inspectors concluded that, if the procedure had been used, a more rigorous evaluation may have been performed. In addition, the PIR that was initiated related to the valve being in a 50 percent open position was not treated as a significant concern. This may

have been the reason that a more rigorous and thorough eva'uation was not performed. This also appeared to be the case for the evaluation performed for the TDAFW pump.

The inspectors discussed this observation with the licensee management. In response to the inspectors' concern, the licensee stated that additional corrective action was warranted to ensure that operability evaluations were conducted with more rigor and were more consistently implemented within procedural guidelines for operability assessments. The inspectors concluded that the licensee's proposed corrective actions were adequate.

Because of the ESW design errors identified, the licensee also indicated during the March 28, 1996, public meeting that safety system functional assessments for four risk-significant safety-related systems would be performed. These systems were: auxiliary feedwater; ESW; component cooling water; and residual heat removal.

On the basis of the number of weaknesses identified in the engineering area, the inspectors had discussions with Performance Evaluation managers and reviewed audits and surveillances in the engineering area to understand what was being done in this area. The inspectors determined that the audits and surveillance had been performed in the traditional areas of design changes and modifications; however, there were no evaluations of the technical adequacy of operability assessments. The licensee agreed that this was an area which needed additional management attention.

Pending the completion of the licensee's evaluation of the root cause of the weak engineering work, functional assessment of four safety-related systems, and NRC review, this is an IFI (IFI 482/9603-12).

8 LONG-TERM CORRECTIVE ACTIONS

The NRC letter to the licensee dated March 7, 1996, listed several issues in Enclosure 2 related to the icing event, but which were considered to be long-term matters. Several of these issues have been discussed in this inspection report. For tracking purposes, the other issues that are listed in Enclosure 2 which are not discussed in this report or NRC Inspection Report 50-482/96-06 have been assigned IFI numbers as shown in the following table.

INSPECTION FOLLOWUP ITEM TRACKING

ISSUE DESCRIPTION	SECTION DISCUSSED IN THIS INSPECTION REPORT	INSPECTION FOLLOWUP ITEM NUMBER
Auxiliary Boiler Reliability		482/9606-13
Operator Training on Frazil Icing	Section 2.4 IFI 482/9603-05	
1991 TS Interpretation	Section 2.2 Apparent Violation 482/9603-03	
Reactor Engineering Advice on Termination of Boration		482/9603-14
Failure to Reach Mode 4 in Timely Manner	Section 4.2 Apparent Violation 482/9603-11	
Train A ESW Operability Determination	Sections 2.4 and 7 IFIs 482/9603-05 and 482/9603-12	
TDAFW Operability	Sections 3.1, 3.2, and 7 IFI 482/9603-12	
Validation of Safety System Design Assumptions	Section 7 IFI 482/9603-12	
ESW - past industry experience	Section 2.2 Apparent Violation 482/9606-03	
Control Rod Failures to Fully Insert	Refer to NRC Inspection Report 50-482/96-06	

ATTACHMENT

1 PERSONS CONTACTED

Wolf Creek Nuclear Operating Operations

*N. Carns, President and CEO
*K. Craighead, Emergency Planning
*J. Dagenette, Engineering Specialist/Emergency Planning
#*T. Damashek, Supervisor, Regulatory Compliance
*K. Davison, Supervising Operator
*D. Dullum, Supervisor, Plant Trending and Evaluation
*D. Fehr, Superintendent, Operations Training
#*R. Flannigin, Manager, Nuclear Engineering
*M. Gayoso, Chief Business Officer
*K. Harvey, Manager, Document Services
C. Hatch, Regulatory Compliance Specialist
*S. Hopkins, Maintenance Planning Supervisor
*D. Jacobs, Assistant Maintenance Manager
*R. Johannes, Chief Administrative Officer
*S. Koeing, Supervisor, Quality Evaluations
#*W. Lindsay, Manager, Performance Assessment
#*O. Maynard, Vice President, Plant Operations
#*B. McKinney, Manager, Operations
#*R. Meister, Senior Engineering Specialist/Regulatory Compliance
*G. Miller, Quality Specialist/Quality Evaluation
G. Moore, Manager, Maintenance
*T. Morrill, Manager, Plant Support
#*W. Norton, Vice President, Engineering
*E. Peterson, Supervisor, Quality Evaluation/Performance Assessment
*L. Ratzlaff, Supervisor Engineer, System Engineering
*R. Sims, Supervisor, Operations Support
*L. Stevens, Supervisor, Nuclear Safety Engineering
J. Weeks, Manager, Emergency Planning

Others

*C. Dumsday, Westinghouse
*K. Mazachek, Sr. Internal Audit Engineer, Western Resources

U.S. Nuclear Regulatory Commission

*J. Dixon-Herrity, Resident Inspector, Wolf Creek Generating Station
*P. Goldberg, Reactor Inspector
*W. Johnson, Chief, Reactor Projects Branch B
*M. Murphy, Operator Licensing Examiner
*J. Ringwald, Senior Resident Inspector, Wolf Creek Generating Station
*D. Solorio, Resident Inspector, San Onofre Nuclear Generating Station
#*H. Wong, Chief, Reactor Projects Branch E
D. Graves, Project Engineer, Branch B

* Denotes those attending the preliminary exit meeting on March 25, 1996.
# Denotes those attending the telephone exit meeting on April 5, 1996.

In addition to the personnel listed above, the inspectors contacted other personnel during this inspection.

2 EXIT MEETING

A preliminary exit meeting was conducted on March 25, 1996, and a final exit meeting was conducted on April 5, 1996. During these exit meetings, the inspectors reviewed the scope and findings of the report. The licensee acknowledged the inspection findings documented in this report. The licensee indicated that they did not agree that a violation occurred related to the classification of a work activity on the TDAFW pump as "troubleshooting." This matter is described in detail in Section 3.1.3. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.

V. PREDECISIONAL ENFORCEMENT CONFERENCES

Whenever the NRC has learned of the existence of a potential violation for which escalated enforcement action appears to be warranted, or recurring nonconformance on the part of a vendor, the NRC may provide an opportunity for a predecisional enforcement conference with the licensee, vendor, or other person before taking enforcement action. The purpose of the conference is to obtain information that will assist the NRC in determining the appropriate enforcement action, such as: (1) a common understanding of facts, root causes and missed opportunities associated with the apparent violations, (2) a common understanding of corrective action taken or planned, and (3) a common understanding of the significance of issues and the need for lasting comprehensive corrective action.

If the NRC concludes that it has sufficient information to make an informed enforcement decision, a conference will not normally be held unless the licensee requests it. However, an opportunity for a conference will normally be provided before issuing an order based on a violation of the rule on Deliberate Misconduct or a civil penalty to an unlicensed person. If a conference is not held, the licensee will normally be requested to provide a written response to an inspection report, if issued, as to the licensee's views on the apparent violations and their root causes and a description of planned or implemented corrective action.

During the predecisional enforcement conference, the licensee, vendor, or other persons will be given an opportunity to provide information consistent with the purpose of the conference, including an explanation to the NRC of the immediate corrective actions (if any) that were taken following identification of the potential violation or nonconformance and the long-term comprehensive actions that were taken or will be taken to prevent recurrence. Licensees, vendors, or other persons will be told when a meeting is a predecisional enforcement conference.

A predecisional enforcement conference is a meeting between the NRC and the licensee. Conferences are normally held in the regional offices and are not normally open to public observation. However, a trial program is being conducted to open approximately 25 percent of all eligible conferences for public observation, i.e., every fourth eligible conference involving one of three categories of licensees (reactor, hospital, and other materials licensees) will be open to the public. Conferences will not normally be open to the public if the enforcement action being contemplated:

(1) Would be taken against an individual, or if the action, though not taken against an individual, turns on whether an individual has committed wrongdoing;

(2) Involves significant personnel failures where the NRC has requested that the individual(s) involved be present at the conference;

(3) Is based on the findings of an NRC Office of Investigations report; or

(4) Involves safeguards information, Privacy Act information, or information which could be considered proprietary;

In addition, conferences will not normally be open to the public if:

(5) The conference involves medical misadministrations or overexposures and the conference cannot be conducted without disclosing the exposed individual's name; or

(6) The conference will be conducted by telephone or the conference will be conducted at a relatively small licensee's facility.

Notwithstanding meeting any of these criteria, a conference may still be open if the conference involves issues related to an ongoing adjudicatory proceeding with one or more intervenors or where the evidentiary basis for the conference is a matter of public record, such as an adjudicatory decision by the Department of Labor. In addition, with the approval of the Executive Director for Operations, conferences will not be open to the public where good cause has been shown after balancing the benefit of the public observation against the potential impact on the agency's enforcement action in a particular case.

As soon as it is determined that a conference will be open to public observation, the NRC will notify the licensee that the conference will be open to public observation as part of the agency's trial program. Consistent with the agency's policy on open meetings, "Staff Meetings Open to Public," published September 20, 1994 (59 FR 48340), the NRC intends to announce open conferences normally at least 10 working days in advance of conferences through (1) notices posted in the Public Document Room, (2) a toll-free telephone recording at 800-952-9674, and (3) a toll-free electronic bulletin board at 800-952-9676. In addition, the NRC will also issue a press release and notify appropriate State liaison officers that a predecisional enforcement conference has been scheduled and that it is open to public observation.

The public attending open conferences under the trial program may observe but not participate in the conference. It is noted that the purpose of conducting open conferences under the trial program is not to maximize public attendance, but rather to determine whether providing the public with opportunities to be informed of NRC activities is compatible with the NRC's ability to exercise its regulatory and safety responsibilities. Therefore, members of the public will be allowed access to the NRC regional offices to attend open enforcement conferences in accordance with the "Standard Operating Procedures For Providing Security Support For NRC Hearings And Meetings," published November 1, 1991 (56 FR 56251). These procedures provide that visitors may be subject to personnel screening, that signs, banners, posters, etc., not larger than 18" be permitted, and that disruptive persons may be removed.

Members of the public attending open conferences will be reminded that (1) the apparent violations discussed at predecisional enforcement conferences are subject to further review and may be subject to change prior to any resulting enforcement action and (2) the statements of views or expressions of opinion made by NRC employees at predecisional enforcement conferences, or the lack thereof, are not intended to represent final determinations or beliefs. Persons attending open conferences will be provided an opportunity to submit written comments concerning the trial program anonymously to the regional office. These comments will be subsequently forwarded to the Director of the Office of Enforcement for review and consideration.

When needed to protect the public health and safety or common defense and security, escalated enforcement action, such as the issuance of an immediately effective order, will be taken before the conference. In these cases, a conference may be held after the escalated enforcement action is taken.