APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

NRC Inspection Report: 50-445/92-20
50-446/92-20

Unit 1 Operating License: NPF-87
Unit 2 Construction Permit: CPPR-127
Expiration Date: August 1, 1992

Licensee: TU Electric
Skyway Tower
400 North Olive Street
Lock Box 81
Dallas, Texas 75201

Facility Name: Comanche Peak Steam Electric Station, Units 1 and 2

Inspection At: Glen Rose, Texas

Inspection Conducted: May 15-29, 1992

Inspectors: W. D. Johnson, Chief, Project Section A
T. Reis, Project Engineer, Project Section B
S. McCrory, Senior Examiner, Operator Licensing Section
G. E. Werner, Resident Inspector

Reviewed by: _____ June 1 1992
L. A. Yandell, Chief, Project Section B Date
Division of Reactor Projects

Inspection Summary

Inspection Conducted May 15-29, 1992 (Report 50-445/92-20; 50-446/92-20)

Areas Inspected: Special, announced inspection of the circumstances surrounding the loss of spent fuel pool cooling on May 12, 1992. The special inspection team reviewed the following areas:

- The design modification process as it related to this event;
- The Unit 1/Unit 2 interface control program as it related to this event;
- The work control program as it was related to this event;
- Communications throughout the operations organization;
- Procedural compliance in this event;
- Operator attentiveness to control board indications;
- The effectiveness of the shift turnover process; and
- The effectiveness of previous corrective actions.

Results:

Within the areas inspected, seven apparent violations, some with multiple examples, were identified, as discussed in paragraphs 3.1.2, 3.1.3, 3.2.2, 3.2.3, 4.1, 4.8, and 6.4. These apparent violations involve human performance problems, the adequacy of corrective actions for past events, the control of the interface between the operating Units 1 and 2, the control of safety-related equipment not identified in the Technical Specifications, and the adequacy of technical reviews and administrative controls for plant procedures. One unresolved item (paragraph 4.6) concerning the adequacy of control room staffing for two-unit operation and one inspection followup item (paragraph 4.4) concerning control room communications were also identified.

DETAILS

1. PERSONS CONTACTED

TU ELECTRIC

*W. Taylor, Executive Vice President
*W. J. Cahill, Group Vice President, Nuclear Engineering and Operations
*H. D. Bruner, Senior Vice President
*A. B. Scott, Vice President, Nuclear Operations
*J. J. Kelley, Plant Manager

U.S. NUCLEAR REGULATORY COMMISSION

*T. P. Gwynn, Deputy Director, Division of Reactor Projects
*L. A. Yandell, Chief, Project Section B
*T. Bergman, Project Manager, Nuclear Regulatory Regulation
*W. B. Jones, Senior Resident Inspector

*Present at the exit interview.

Other persons contacted and present at the exit interview are listed in Attachment 1. In addition to these personnel, the inspectors held discussions with various operations, engineering, technical support, maintenance, and administrative members of the licensee's staff.

2. EVENT OVERVIEW

On May 12, 1992, the senior resident inspector noted contradictions in licensee log entries, active annunciators, and control board valve lineups concerning component cooling water (CCW) servicing a spent fuel pool (SFP) heat exchanger. Subsequent investigation by the licensee discovered that the SFP had been without cooling for approximately 17 hours. As initial corrective action, the licensee provided cooling to the affected heat exchanger with the Unit 2 CCW system. The Unit 2 CCW system was not under the full control of the operations department, did not contain functional radiation monitors, and was not recognized in the licensing basis as being capable of providing cooling to the common SFP heat exchangers at that time.

Section 9.1.3.1 of the Final Safety Analysis Report (FSAR) defines the principal function of the SFP cooling and cleanup system as removing heat generated by stored fuel elements from the station's SFPs. The maximum SFP temperature recognized in the FSAR under worst case loading conditions is 152°F. Given that the SFP contained only one-third of the Cycle 1 core, which was placed in the pool in October 1991, the actual heat load in the pool was relatively low. The rise in the SFP temperature during the 17-hour interruption of cooling was about 5°F, from approximately 80 to 85°F. Section 9.1.3.3 of the FSAR notes that the system can be taken out of service for reasonable amounts of time to support maintenance.

2.1 Event Chronology

The chronology of the event as given below is excerpted from a licensee evaluation report designated FX-92-417. Through review of operations logs, personnel interviews and plant tours, the team verified the chronology developed by the licensee's investigation team and considers that it accurately depicts the sequence of events as they occurred on May 11, and May 12, 1992. A schematic representation of the system arrangement is provided as Attachment 2 to this report.

Prior to the event on May 11, 1992, Unit 1 was operating at 100 percent power. The SFP cooling system was in service with Pump X-02 providing flow through Heat Exchanger X-01 with the heat sink being Unit 1 CCW. Pump X-02 had just been returned to service following a 41 day outage. Maintenance was being planned on an SFP flow indicator which would require isolation of the SFP side of Heat Exchanger X-01.

At approximately 9:30 p.m. (CDT), the Unit 2 unit supervisor, who was handling clearances, reviewed and discussed the clearance, X-92-1140, associated with the work on the flow indicator with the Unit 1 balance of plant (BOP) reactor operator. They reportedly discussed isolating Heat Exchanger X-01 and placing Heat Exchanger X-02 in service with Pump X-02 still providing the motive force. The BOP reactor operator reviewed SOP-506, "Spent Fuel Pool Cooling and Cleanup System," and noted the appropriate sections for securing Heat Exchanger X-01 and lining up Pump X-02 through Heat Exchanger X-02. The BOP reactor operator reportedly also noted that the procedure directed him to SOP-502A, "Unit 1 Component Cooling Water System," to provide cooling to Heat Exchanger X-02. He reportedly was distracted at this time and did not review SOP-502A.

At approximately 10 p.m., Pump X-02 was secured from service after what appeared to be a motor bearing failure, which was reported by the auxiliary building auxiliary operator.

At approximately 10:15 p.m., the Unit 1 unit supervisor directed the BOP reactor operator to start Pump X-01 aligned with Heat Exchanger X-02 in order that maintenance could proceed on the flow indicator associated with Heat Exchanger X-01.

At approximately 10:30 pm, the BOP reactor operator sent a working copy of Procedure SOP-506, "Spent Fuel Pool Cooling and Cleanup System," to the field with the extra auxiliary operator, after having a brief discussion of the lineup to take place. The extra auxiliary operator was to assist the auxiliary building auxiliary operator in the evolution. The BOP reactor operator had reviewed SOP-506 again and noted the applicable section to be used for the revised lineup. This section referred him to SOP-502B, "Unit 2 Component Cooling Water System," for the establishment of CCW flow to Heat Exchanger X-02, but he reportedly did not note the distinction from the previously referenced SOP-502A.

At 11:18 pm, the auxiliary building auxiliary operator started Pump X-01 and did not observe indication of SFP flow as expected. The auxiliary operator then secured the pump, checked the valve lineup, found the pump discharge valve closed, and repositioned it. The pump was restarted and, again, no flow was observed. The auxiliary operator again checked the lineup, found the Heat Exchanger X-02 inlet valve closed, and opened the valve. This time flow through the SFP side of the heat exchanger was established.

The auxiliary operator then called the BOP reactor operator and asked for direction in establishing CCW flow to Heat Exchanger X-02. The BOP reactor operator reported that at this time he examined SOP-502A, "Unit 1 Component Cooling Water System," and could not find directions for aligning Unit 1 CCW to Heat Exchanger X-02. The BOP reactor operator reported sensing urgency in reestablishing cooling to the SFP and, therefore, referred to the CCW system Piping & Instrumentation Diagrams to determine the alignment.

At approximately 11:20 pm, the BOP reactor operator directed the auxiliary operator to open the CCW to Heat Exchanger X-02 inlet valve and throttle the outlet valve to the same position as the CCW to Heat Exchanger X-01 outlet valve. The BOP reactor operator then directed the auxiliary operator to open the CCW to Heat Exchanger X-01 outlet valve to the as-found position of the CCW to Heat Exchanger X-02 outlet valve. When the CCW to Heat Exchanger X-01 outlet valve was opened, the BOP reactor operator observed an increase in total CCW system flow on a control room instrument and believed he had established Unit 1 CCW flow to Heat Exchanger X-02. The establishment of this flow path was not physically possible due to the existence of spectacle (blind) flanges separating Unit 1 CCW from Heat Exchanger HX-02.

The BOP reactor operator and the Unit 1 unit supervisor failed to note that the annunciator for low CCW flow to Heat Exchanger HX-02, which had been illuminated for several months, did not clear.

At approximately 3 a.m. on May 12, 1992, the BOP reactor operator reported to the Unit 1 unit supervisor that SFP Pump X-01 was in service through Heat Exchanger X-02.

A shift turnover occurred from 6 - 6:30 a.m. and the oncoming shift also failed to note the discrepancy between the logged heat exchanger lineup and the illuminated annunciator for low CCW flow to Heat Exchanger X-02.

At approximately 1 p.m., the senior resident inspector questioned the lineup of cooling flow to the SFP system based on a discrepancy between the alignment on the control board mimic, a valve switch position, and the lit annunciator indicating low CCW flow to the heat exchanger.

At 2:30 p.m., the licensee determined that no CCW flow was being provided to Heat Exchanger X-02.

At 3:10 p.m., the licensee performed Section 5.2.6 of Procedure SOP-502B, "Unit 2 Component Cooling Water System," and provided Unit 2 CCW flow to Heat

Exchanger HX-02. To achieve this configuration, two valves designated to be locked closed during Unit 2 construction (LC-2) were required to be opened.

On May 13, 1992, the licensee realigned the systems to a normal configuration, with Unit 1 CCW supplying Heat Exchanger X-01, which had been placed in service to cool SFP 1.

On May 14, 1992, based on questions posed by the senior resident inspector, the licensee performed a 10 CFR Part 50.59 safety evaluation for the use of Unit 2 CCW in providing cooling to the SFP system.

3.0 DESIGN CONTROL

The team found that less than adequate implementation of design control processes contributed to the event. The deficiencies involved inadequate transcription of design requirements into operational procedures, lack of staff training, inadequate Unit 1/Unit 2 interface controls, and inadequate operational assessment of maintenance work documents. The findings are described in detail below.

3.1 Design Modification 91-076

The SFP water is cooled by two redundant cooling loops, each of which contains a pump, heat exchanger, and associated piping, valves, and instrumentation. By design, the dual unit SFP system was intended to allow cooling through a combination of either heat exchanger with either pump using multiple flow path configurations. Prior to the implementation of Design Modification (DM) 91-076, which physically isolated Unit 1 CCW from SFP Heat Exchanger X-02, the system was configured to allow the use of either of the units' nonsafeguards CCW to supply cooling water flow to the SFP heat exchangers. As depicted in Attachment 2, the Units 1 and 2 CCW lines to the SFP heat exchangers were separated by two 12-inch butterfly valves which were in the same location as shown by the present spectacle flanges.

Subsequent to the licensing of Unit 1, which included the certification of the entire SFP cooling and cleanup system, the normal system lineup for SFP cooling allowed any configuration on the SFP water side that supplied water to and from SFP 1. The heat sink was provided by CCW which was supplied from Unit 1, and the position of the CCW crosstie valves was based upon the selected heat exchanger.

The licensee implemented DM 91-076 in September 1991 in order to provide system isolation between Unit 1 and Unit 2 CCW safeguards loops and one nonsafeguards CCW loop due to leakage past the installed butterfly isolation valves. The purpose of the isolation valves in the safeguards loop was to provide a means to cross-connect the units to allow either unit to supply cooling loads in the event of a complete loss of either unit's CCW capability. The nonsafeguards loops of Units 1 and 2 were cross-connected in order to permit either unit to supply common cooling loads. However, due to the design of the butterfly valves, leakage had been observed during earlier Unit 1 and 2

preoperational testing due to differences in CCW pressures between the units.

The modification consisted of removing three Unit 2 safeguards, 24-inch diameter, CCW crosstie valves and replacing the valves with blanked off spool pieces. The nonsafeguards loop was also modified by installing spectacle flanges in place of two, 12-inch diameter, common CCW SFP cooler crosstie valves.

The spectacle flanges consisted of a hollow spacer connected to a blank flange in a "figure eight" arrangement. The spectacle flanges were installed with the blank flange aligned with the system flow path, thus preventing Unit 1 CCW from supplying common SFP Heat Exchanger X-02. The intent of using the spectacle flanges took into consideration the possibility of losing SFP Heat Exchanger X-01. The flanges could be reversed to supply Unit 1 CCW to common SFP Heat Exchanger X-02.

The ability to supply SFP Heat Exchanger X-02 with Unit 1 CCW via reversal of the spectacle flanges was necessary in order to preserve redundancy in the design as required by the FSAR, since Unit 2 CCW was not operable.

3.1.1 Safety Evaluation

In support of DM 91-076, Safety Evaluation 91-091, Revision 0 was performed to analyze for possible changes to the licensing documents and/or design basis accidents. The analysis focused primarily on piping stress calculations and the installation of the spectacle flanges in the CCW system. The SFP cooling system was impacted by this modification in that the redundant heat exchanger would be unavailable until the spectacle flanges could be reversed to supply Unit 1 CCW to SFP Heat Exchanger X-02.

The removal of the ability to crosstie the units' CCW safeguards piping was not evaluated. As stated by the licensee, the basis for this determination was that, without Unit 2 in operation, no accident evaluation or other Unit 1 safety-related design basis event could utilize Unit 2 CCW. Furthermore, the Unit 1 licensing basis did not recognize the use of Unit 2 CCW until Unit 2 becomes operational.

As concluded in the subject safety evaluation, the revised piping configuration was analyzed and no unacceptable loads would be transmitted to Unit 1 systems or structures. Additionally, the licensee performed an evaluation of the interim piping configuration which concluded that there was adequate constraint of the piping systems, and pipe stress levels and loads on pipe supports would not significantly increase in the event of an earthquake.

The results of these analyses concluded that the use of spectacle flanges would not increase the probability of failure of the SFP cooling system to perform its safety function as a result of this design modification. However, the licensee did identify that the installation of the spectacle flanges did conflict with the safety evaluation per FSAR 9.1.3.3 which, in part, states that a redundant heat exchanger is available to ensure continuity of effective

cooling. Based on the heat load of the spent fuel and available makeup water, sufficient time would be available to allow the spectacle flanges to be reversed in the event of failure of a SFP heat exchanger. This assumption was predicated on a maximum time allowance of 24 hours to reverse the flanges, which would maintain the minimum depth of 23 feet of water above the fuel as specified by the Technical Specifications.

3.1.2 Operational Impact Assessment of DM 91-076

As stated, the DM did not envision Unit 2 CCW, under the control of the Unit 2 startup program, being used as the cooling medium for Heat Exchanger X-02. Further, the design basis for the SFP cooling system, as defined in Section 9.1.3.3 of the FSAR would preclude the use of Unit 2 CCW as a cooling medium, without further evaluation.

The design modification was approved for implementation on July 22, 1991. As part of the design modification process per Procedure STA-716, "Site Modification Process," operations performed an assessment of the impact of the modification on its operational and administrative procedures on September 3, 1991. Operations identified the modification as impacting Procedures OWI-103, "Locked Closed Valves;" SOP-502A, "Unit 1 Component Cooling Water;" and STA-618, "Station Labeling Control."

3.1.2.1 Inadequate Translation of Design Requirements into Operational Procedures

Although Procedure SOP-502A was identified as being impacted, the revision issued in support of the modification on October 5, 1991, did not correctly translate the design requirements, as specified in DM 91-076, into the operational procedure. In lieu of providing instructions to supply Unit 1 CCW to Heat Exchanger X-02 by reversing the spectacle flanges, the revision simply deleted the provisions for supplying Heat Exchanger X-02 with Unit 1 CCW.

Procedure SOP-506, "Spent Fuel Pool Cooling and Cleanup System," was not identified as being impacted by DM 91-076. Yet a revision to SOP-506 issued on January 28, 1992, provided explicit instructions to use the Unit 2 CCW as a cooling medium for SFP Heat Exchanger X-02. Previous revisions to the procedure only provided guidance to ensure CCW was in service to the heat exchanger selected for use. The procedure, Revision 5, was developed for two-unit operation. There were no precautions provided in the procedure to prohibit use of Unit 2 CCW until such time that Unit 2 was licensed for operation. This procedure also failed to provide instructions for servicing SFP Heat Exchanger X-02 with the Unit 1 CCW as intended by DM 91-076.

Without instructions to provide Unit 1 CCW to Heat Exchanger X-02, the licensee did not correctly translate the design basis as delineated in DM 91-076 into operational procedures. This is an apparent violation of Criterion III, Appendix B, 10 CFR Part 50. (445/9220-01) (Example 1)

The team examined other shared safety-related systems or components which, by design, would allow the use of either Units 1 or 2 CCW. These systems or components included the uninterruptable power supply air conditioning condensers and the control room air conditioning condensers. The team found the respective operating procedures did not direct the use of Unit 2 CCW.

The impact of DM 91-076 on the annunciator response procedures for SFP Heat Exchangers X-01 and X-02 low CCW flow indication was also not recognized by the licensee. Alarm Procedure ALM-0032A was not revised in conjunction with the modification. On May 15, 1992, the inspectors found the procedures provided erroneous guidance in that they were not revised to reflect the inability to cross connect CCW to either SFP heat exchanger. This is a second example of the licensee's failure to properly translate design requirements into operational procedures. This is an apparent violation of Criterion III, Appendix B, 10 CFR Part 50. (445/9220-01) (Example 2)

3.1.2.2 Failure to Properly Assess the Need for Training

Procedure STA-716, "Site Modification Process," requires the Design Modification Review Group (DMRG) to convene and perform an Operations Impact Assessment. Each DMRG member is required to complete Form STA-716-4, "Operations Impact Assessment." For DM 91-076, the DMRG member for nuclear training merely annotated on the form dated September 4, 1991, that the modification may affect training programs. No specifics were identified. The training department then performed an internal assessment of the modification's impact. This was documented on Form NTD-CIA-91SE001. On September 16, 1991, the cognizant training manager designated that training was required. On January 22, 1992, the form was revised to specify that no training was required.

3.1.3 Operator Training

10 CFR Part 55.59 specifies the requalification requirements for operators' licenses. The requalification process includes, in part, lectures, simulator training, theory and principles of operation, performance of plant evolutions, and on-the-job training. Additionally, each operator must be knowledgeable of design changes, procedure changes, and license changes. Technical Specification 6.4 as implemented through the CPSES Training Manual requires a retraining and replacement program to be maintained for the unit staff. Procedure TRA 204, "Licensed Operator Requalification Training Program," Revision 6, provides the programs necessary to maintain and enhance the skills and knowledge of licensed operators necessary to accomplish routine and emergency duties. Section 6.2.1 of TRA-204 states, "The requalification program shall ensure licensed personnel are informed of changes to plant procedures, modifications to plant design, facility license changes, and relevant industry or facility operating experience." The inspectors reviewed the licensee's implementation of the training associated with DM 91-076. As a result of reviews of the licensee's procedures and training records, it was determined that the licensee failed to provide training with respect to the design modification and the associated procedural changes.

Procedure TRA-202, "Auxiliary Operator Training," Revision 5, delineates the training program requirements for the development and maintenance of qualified auxiliary operators. Section 6.2 of TRA-202 requires auxiliary operators to participate in periodic training lectures on a scheduled basis, which could be accomplished in continuing, recurrent, and requalification training. Furthermore, TRA-202, Sections 6.2.1.1 through 6.2.1.3 established the criteria for continuing training of the auxiliary operators, which is to be conducted in a timely manner in order to ensure that all personnel are informed of plant modifications and procedure changes. This required training of the auxiliary operators was not accomplished. Auxiliary operator training on the design modification had been included in the requalification training schedule for future presentation, but training on this modification had not been included in the licensed operator requalification training program.

The licensee's failure to provide training for licensed and nonlicensed operators on changes to the facility as a result of DM 91-076 and associated procedure changes is an apparent violation of 10 CFR Part 55.59 and Technical Specification 6.4 requirements. (445/9220-02)

3.2 Interface Controls

The team found that the licensee has three formal programs in place for controlling Unit 1/Unit 2 interfaces. They are STA-821, "Unit Interfaces and Isolation Control Program;" the ODA-403, "Operations Department Locked Valve Control," program; and aspects of STA-606, "Work Requests and Work Orders," which evaluates the impact of Unit 2 work on Unit 1.

3.2.1 STA-821 Program

The purpose of STA-821 is to provide for the necessary controls for work or testing activities affecting isolation points and interface equipment on shared systems providing separation from the fluid, electrical, structural, and heating, ventilation, and air conditioning processes of Units 1 and 2. It also provides additional controls for systems which contain or may contain radioactive fluids. Essentially, the licensee has identified as isolation points throughout the plant those physical points of isolation (i.e., locked closed valve, blind flange, or determinated cable) that completely separate the operating Unit 1 portion of the shared system from the Unit 2 portion. Also identified as interface equipment is that equipment which has the capability to impact the isolation point and, therefore, Unit 1 operations. An example of interface equipment would be piping hangers which, if removed, would transmit stresses to Unit 1 piping. Isolation points and interface equipment are clearly identified in the field, and the team found that the program provides for adequate controls for necessary work, testing, or operation of the defined equipment.

Prior to DM 91-076, defined isolation points in the STA-821 program for Unit 2 CCW were at the inlet and outlet of the SFP HX-02. These valves were identified as 2CC-0312 and X-HV-4649, respectively. Subsequent to and separate from DM 91-076, the defined isolation points were transferred to the

spectacle flanges installed by DM 91-076. This transfer was made to give control of the inlet and outlet valves to the Unit 2 startup organization to facilitate flushing of the Unit 2 CCW system, including the shell side of SFP Heat Exchanger X-02. Although the transfer conformed to program requirements, it resulted in the loss of an administrative barrier which may have precluded Unit 2 CCW being used for a safety-related function.

In relation to this event, the STA-821 program was found to be ineffective in precluding the operation of a Unit 2 system from impacting licensed operational activities. The situation which occurred is beyond the current purpose and scope of STA-821.

3.2.2 ODA-403 Locked Valve Program

Inlet and outlet Valves 2CC-0312 and X-HV-4649 are also included in a subset of valves in the licensee's ODA-403, "Operations Department Locked Valve Control," program which are designated as LC-2. Valves designated as LC-2 are valves which are required to be locked closed during the construction of Unit 2. These valves, in their locked configuration, are specifically designated LC-2 in the flow diagrams in the FSAR and, thus, form part of the current licensing basis for CPSES Unit 1. Additionally, they are configured as locked closed in the licensee's Design Basis Documents. Procedure ODA-403 allows for deviations from the locked position for LC-2 valves with shift supervisor approval. The deviated position must be logged in OWI-103, "Locked Valve Deviation Log." ODA-403 does not provide for any periodic review of the deviation log to ensure adherence to the design and licensing basis.

Since the LC-2 valves are specifically designated in the FSAR as locked closed during the construction of Unit 2, any deviation from the locked closed status would constitute a change in the Unit 1 facility as described in the FSAR. Accordingly, a safety evaluation pursuant to the requirements of 10 CFR Part 50.59 was required to be performed prior to opening these valves.

The licensee recognized this requirement as it is clearly reflected in an internal engineering report, ER-ME-15, "Locked Valve Criteria," dated March 8, 1989. Paragraph 6.1.1 of the report states, in part, "for valves which are described in the FSAR (depicted on flow diagrams), a change in the locked requirement would have to be accompanied by a written safety evaluation." The requirement, however, was not incorporated into the operational procedures for the control of locked valves, ODA-403, "Operations Department Locked Valve Control," and OWI-103, "Locked Valve List and Deviation Control."

Valves X-HV-4649 and 2CC-0312, designated LC-2, are required to be open to provide Unit 2 CCW to SFP Heat Exchanger X-02. From review of Form OWI-103-3, "Locked Valve Deviation Log," the team determined that the valves had been in an unlocked status since October 17, 1991, and January 5, 1992, respectively. The deviations were performed in accordance with existing station procedures.

As immediate corrective action upon the discovery of the interruption of CCW to the SFP, the licensee authorized the use of SOP-502B, "Unit 2 Component

Cooling Water System." The procedur specifically directed manipulation of the referenced LC-2 valves. Previous operations department 10 CFR Part 50.59 screening of this procedure had resulted in a determination that a safety evaluation was not required. The licensee explained that personnel performing the screens for this and all other Unit 2 procedures which designate manipulation of LC-2 valves relied on ODA-403 to control LC-2 valves and thus were able to confirm that implementation of the activity would not change the facility as described in the FSAR. Had the inadequacy in ODA-403 been realized, it would have appropriately determined that a safety evaluation was required to authorize manipulation of the valves.

The unlocked status of Valves X-HV-4649 and 2CC-0312, the deficiencies in Procedures ODA-403 and OWI-103, the use of Procedure SOP-502B and the actual use of Unit 2 CCW in a safety-related application constitute an apparent violation of 10 CFR Part 50.59 requirements (445/9220-03). The licensee Evaluation Team identified an additional 33 LC-2 valves which had been repositioned from the required closed position. A safety evaluation and an environmental review for each of these valves which were left open was reported as complete by the licensee prior to the end of this inspection period.

3.2.3 Impact Review for Maintenance

Station Administrative Procedure STA-605, "Clearance and Safety Tagging," provides for an operations impact review prior to taking equipment out of service and hanging clearance tags for maintenance. On May 8, 1992, operators assigned to the support shift in the work control center performed an impact review for the maintenance and clearance associated with a flow element downstream of SFP Heat Exchanger X-01 (Clearance X-92-01140; Work Order C92-1074). Section 6.4 of STA-605 requires the qualified operator serving as the clearance preparer to review the Impact Sheet against applicable approved station drawings, design modifications, and procedures. It also requires the licensed operator serving as the clearance reviewer to review the Impact Sheet for completeness and accuracy. Section 6.5 of this procedure requires the senior licensed operator serving as the clearance screener to review the Impact Sheet and Clearance Report for impact on plant equipment. The impact reviews performed for the maintenance and clearance for Flow Element X-FE-4848A were inadequate in that they did not identify that, without reversing the spectacle flanges in the Unit 1 CCW lines, Unit 1 CCW would be unavailable to cool the X-02 heat exchanger while the X-01 heat exchanger was out of service for maintenance. The licensee's failure to perform an adequate impact review for Clearance X-92-01140 and Work Order C92-1074 is an apparent violation of Technical Specification 6.8.1 (445/9220-04). The inspectors noted that the operators performing the impact review on May 8, 1992, were the same individuals who were on shift and who implemented the system realignment and clearance on May 11, 1992.

3.3 Conclusions

Existing interface control programs were not effective in precluding an unapproved Unit 2 system from being used to support a licensed activity on Unit 1. Implementation of existing programs for translating approved design modifications into operational procedures and operator training and for the assessment of the operational impact of maintenance activities was inadequate.

4. OPERATIONS PERSONNEL PERFORMANCE

4.1 Procedure Adherence

The inspectors identified several instances of failure to adhere to procedures between 6 p.m., May 11, and 6 a.m., May 14, 1992. Those procedural adherence problems related to the operation of the SFP cooling system and the CCW system to maintain cooling of the Unit 1 SFP to permit scheduled maintenance on SFP cooling Heat Exchanger X-01. The inspector findings were obtained from a review of licensee logs, procedures, and other records and through interviews with various licensee personnel, including shift operators and their supervisors.

On May 11, 1992, at about 10 p.m., the night shift BOP reactor operator directed the auxiliary building auxiliary operator to secure the lineup of SFP cooling Pump X-02 to Heat Exchanger X-01 following the failure of a motor bearing on SFP cooling Pump X-02. The auxiliary building auxiliary operator was directed to use Section 5.1.14 of SOP-506, Revision 5, "Spent Fuel Pool Cleanup and Cooling System." In the course of securing Pump X-02, the auxiliary building auxiliary operator failed to open Valves XSF-0008, SFP HX X-02 inlet valve, and XSF-0005, SFP cooling water Pump X-01 discharge valve, as required in Step E of Section 5.1.14 of SOP-506. This complicated later efforts to restore SFP cooling to SFP 1 as described below. The auxiliary building auxiliary operator's failure to position the valves as required is an apparent violation of Technical Specification 6.8.1, and ODA-407, Revision 3, "Guidelines on use of Procedures" (445/9220-05) (Example 1).

On May 11, 1992, at about 10:30 p.m., the BOP reactor operator directed the auxiliary building auxiliary operator to place SFP cooling Pump X-01 in service through Heat Exchanger X-02 in accordance with SOP-506, Revision 5, "Spent Fuel Pool Cooling and Cleanup System," Section 5.1.13. At 11:18 p.m., the auxiliary building auxiliary operator started Pump X-01 and immediately secured it when the local instruments indicated no flow through the pump. The auxiliary building auxiliary operator checked the system lineup and discovered a closed valve in the pump flow path, which was not addressed by Section 5.1.13 of SOP-506. After opening the valve, the auxiliary building auxiliary operator started Pump X-01 a second time and again had no flow indication. The auxiliary building auxiliary operator rechecked the lineup and discovered another closed valve, similarly not addressed by Section 5.1.13 of SOP-506, in the pump flow path. After repositioning that valve, the auxiliary building auxiliary operator obtained proper flow indication. The

auxiliary building auxiliary operator then contacted the BOP reactor operator for instructions to place CCW in service through Heat Exchanger X-02. ODA-407, Revision 3, "Guidelines on use of Procedures," Sections 6.1.6 and 6.2.1.6, require that shift supervision be notified of procedural inadequacies in the form of errors or insufficient guidance before taking further action. The auxiliary building auxiliary operator did not inform shift supervision, the BOP reactor operator, or any other control room shift member of the discovery of improperly positioned valves at that time or at any subsequent time prior to the senior resident inspector's discovery of SFP system alignment problems. The failure of the auxiliary building auxiliary operator to inform either the shift supervisor or unit supervisor (directly or via the BOP reactor operator) is an apparent violation of Technical Specification 6.8.1 and ODA-407 (445/9220-05) (Example 2).

On May 11, 1992, at 10:30 pm, the auxiliary building auxiliary operator began aligning the SFP cooling system in accordance with Section 5.1.13 of SOP-506, Revision 5, "Spent Fuel Pool Cooling and Cleanup System," to place SFP cooling Pump X-01 in service through SFP cooling Heat Exchanger X-02. Step A. of SOP-506, Section 5.1.13, required that the prerequisites of Section 2.1 of SOP-506 be met. Section 2.1 stipulated that CCW be available. At about 11:20 p.m., the auxiliary building auxiliary operator contacted the BOP reactor operator to obtain guidance for aligning CCW through Heat Exchanger X-02 after having placed Pump X-01 in service through Heat Exchanger X-02. After failing to identify an existing procedure, and while using a CCW system print, the BOP reactor operator directed the auxiliary building auxiliary operator to open Valves XCC-0062, Heat Exchanger X-02 inlet, and XCC-0067, Heat Exchanger X-02 outlet, in an attempt to establish flow through SFP cooling Heat Exchanger X-02 from unit 1 CCW. The failure of the auxiliary building auxiliary operator to establish the prerequisites of Section 2.1 of SOP-506 and the failure of the BOP reactor operator to use an approved procedure to direct CCW alignment constitute an apparent violation of Technical Specification 6.8.1 and ODA-407, Section 6.1.1 (445/9220-05) (Example 3).

On May 11, 1992, at about 11:20 p.m., after failing to identify an existing procedure, and while using a CCW system print, the BOP reactor operator directed the auxiliary building auxiliary operator to open Valves XCC-0062, Heat Exchanger X-02 inlet, and XCC-0067, Heat Exchanger X-02 outlet, in an attempt to establish flow through SFP cooling Heat Exchanger X-02 from Unit 1 CCW. The BOP reactor operator directed that action without the knowledge and consent of either the unit supervisor or shift supervisor contrary to the requirements of ODA-407, Revision 3, "Guidelines on use of Procedures," Section 6.2.1.6. That section of ODA-407 requires notification of shift supervision when a situation is encountered which is not addressed by procedures. The failure of the BOP reactor operator to inform shift supervision of procedural difficulties and to obtain approval for the actions taken is an apparent violation of Technical Specification 6.8.1 and ODA-407 (445/9220-05) (Example 4).

On May 11, 1992, at about 9:30 p.m., the unit supervisor for Unit 2

(designated to process clearances for the shift) briefed the Unit 1 unit supervisor and BOP reactor operator on STA-605 Clearance X-92-1140. The clearance established conditions to permit work on Flow Element XFE-48484A on the outlet of SFP cooling Heat Exchanger X-01. The special instructions of the clearance required that SFP cooling Pump X-01 not be in service prior to hanging tags. At about 10:15 p.m., and following the failure of SFP cooling Pump X-02, the Unit 1 unit supervisor directed that SFP cooling Pump X-01 be placed in service through Heat Exchanger X-02. That directive was completed by the auxiliary building auxiliary operator under the direction of the BOP reactor operator at about 11:30 p.m. On May 12, 1992, at 1:10 a.m., the shift supervisor authorized the implementation of Clearance X-92-1140 and the tags were attached by 3:15 a.m. Throughout that time SFP cooling Pump X-01 remained in service. The special instructions on Clearance X-92-1140 were not revised to permit the use of Pump X-01 and no impact review was performed for the duration in which the clearance was in effect. The failure of the shift crew to establish the requirements of Clearance X-92-1140, or to review the impact of using SFP cooling Pump X-01 and to revise the special instructions of Clearance X-92-1140 is an apparent violation of Technical Specification 6.8.1 and STA-605, Revision 10, "Clearance and Safety Tagging" (445/9220-05) (Example 5).

On May 13, 1992, between 6 p.m. and midnight, using SOP-506, Revision 5, "Spent Fuel Pool Cooling and Cleanup System," Section 5.1.15, the auxiliary building auxiliary operator secured the SFP cooling lineup with SFP cooling Pump X-01 providing flow through SFP cooling Heat Exchanger X-02. Subsequently, the auxiliary building auxiliary operator restored SFP 1 cooling to the preferred lineup using Heat Exchanger X-01 in accordance with Section 5.1.1 of SOP-506. On May 20, 1992, a member of the NRC inspection team inquired as to the position and status of Valve XSF-0011-RO, the SFP HX X-01/X-02 crosstie. An operator on shift inspected the valve and reported it to be closed but not locked. Step C of SOP-506, Section 5.1.15, required that Valve XSF-0011-RO be closed, locked, and independently verified. No record was found to indicate that an independent verification had been performed at any time between the repositioning of the valve on May 13 and the reported condition on May 20. ODA-407, Revision 3, "Guidelines on Use of Procedures," Section 6.2.1.8, required that procedural steps marked with the symbol "[IV]" be independently verified and that the verification be documented and retained. Further, the locked valve deviation log in the control room indicated that the valve was unlocked and open since May 11, 1992. The failure of the on-shift crew to lock and independently verify Valve XSF-0011-RO is an apparent violation of Technical Specification 6.8.1 and ODA-407 (445/9220-05) (Example 6).

4.2 Attitudes on Procedure Adherence

On May 19-20, 1992, the senior examiner reviewed operator statements and facility licensee interview notes and interviewed operators involved in the event as well as operators unaware of the event until NRC investigations were begun by the senior resident inspector on May 13, 1992. In part, these interviews focused on operator attitudes toward procedure use and compliance.

When questioned directly regarding procedure use and compliance, operators affirmed personal commitment to procedure use and compliance. However, responses to questions regarding plant conditions, work loads, and division of duties and responsibilities on shift conveyed a prevalent attitude of "get the job done" which permitted procedural adherence to be subordinated. Three of the six apparent violations related to procedure adherence support this conclusion. The BOP reactor operator, believing that procedures did not adequately address use of Unit 1 CCW to cool SFP cooling Heat Exchanger X-02, took steps to accomplish the task of restoring SFP cooling through Heat Exchanger X-02 with Unit 1 CCW without bothering the unit supervisor. The auxiliary building auxiliary operator, believing that the procedure for placing SFP cooling Pump X-01 in operation through Heat Exchanger X-02 failed to account for two valves in the flow path, took action to establish the obviously required lineup to get Pump X-01 in service. The shift supervisor, with apparent concern to get the maintenance activity underway on the Heat Exchanger X-01 flow element, authorized the placement of tags under Clearance X-92-1140 without regard to the special instruction to ensure that Pump X-01 was out of service.

4.3 Attentiveness to Instruments and Indicators

On May 12, 1992, the senior resident inspector observed the SFP cooling Heat Exchanger X-02 CCW low flow alarm annunciator to be illuminated while SFP 1 cooling flow was being directed through the X-02 heat exchanger. Additionally, it was observed that an air operated valve on the CCW inlet to Heat Exchanger X-02 had the open indication light illuminated at the remote handswitch in the control room with the handswitch in the shut position. Further investigation disclosed that no CCW flow existed through SFP cooling Heat Exchanger X-02 and that the air operated valve was open with the operating air isolated. On May 11, 1992, operators on the night shift failed to recognize that this alarm had not cleared when actions were taken to align Unit 1 CCW to SFP Heat Exchanger X-02. The annunciator window had been illuminated for several months because Heat Exchanger X-02 had not been placed in service since the refueling outage in the last quarter of 1991. Similarly the disparity between the valve handswitch and position indication had existed for an indeterminate but lengthy time period. Inspectors observed that approximately 17-20 annunciators were routinely in alarm condition during normal plant operations, which may have reduced operator sensitivity to some annunciators.

During the course of aligning components to provide Unit 1 CCW to Heat Exchanger X-02, the auxiliary building auxiliary operator failed to verify indication of CCW flow on local instruments. During an interview the auxiliary building auxiliary operator stated that he did not know that local instruments were available to check CCW flow. On May 12, 1992, the shift crew relieving at 6 a.m., failed to recognize the alarm discrepancy after having been informed of the change in the SFP cooling lineup during the course of turnover. During the manipulation of the CCW valves on Heat Exchangers X-01 and X-02 while placing Heat Exchanger X-02 in service, the BOP reactor operator observed an increase in total CCW flow of about 1000 gpm on control

room indication. The BOP reactor operator accepted that instrument response as positive indication that Unit 1 CCW had been aligned to Heat Exchanger X-02 when, in fact, the increase was a result of the CCW outlet on Heat Exchanger X-01 being cycled to verify its throttled position.

Operator performance with respect to instruments and indications appeared to reflect weaknesses in knowledge of system operation, installation and design as well as inattentiveness to indications. The failure to observe the contradictory indications at the air valve handswitch was a specific instance of inattentiveness to indications. The presence of the CCW low flow alarm required not only conscious observation but also a cognitive awareness of its significance to system operation. The auxiliary building auxiliary operator's lack of knowledge of local instrumentation was a further example of system knowledge weakness.

4.4 Communications

The senior examiner reviewed operator statements, interviewed operators, and observed control room activities during routine operations and turnover to assess communication impact on the May 11, 1992, event. During routine activities which did not rise to the threshold of being infrequent, complex, or high risk, communications among staff members often went unacknowledged or elicited vague responses. During observation of control room shift activity, when responses were given to information reports, they typically tended to take the form of a nod or a vague verbal response such as "OK" even when the report related to annunciator alarms. Resident inspectors reported observing more disciplined and closed communications during activities identified as high risk. In contrast during interviews, operators characterized communications as reasonably disciplined in that some sort of paraphrased repeat back almost always accompanied information reports and directives for routine activities. The inconsistency between operator statements and NRC staff direct observations of shift communications during routine operations is a concern which warrants additional inspection followup. This will be tracked as Inspection Followup Item (IFI) (445/9220-06).

Review of operator statements and operator interviews established that shift members did not perceive the shifting of the SFP cooling pumps and heat exchangers on May 11, 1992, as anything other than routine, although one operator felt a sense of urgency during part of the evolution. As a result, communications were fragmented and informal. Interviews and statements established that the briefing relating to work order C92-1074 was conducted in pieces, with different operators, and over a long period of time. Further, the impact of the failure of SFP cooling Pump X-02 was not factored into any of these briefings beyond the directives to secure Pump X-02 and start Pump X-01. The lack of a comprehensive briefing, involving all participants, both prior to and subsequent to the failure of Pump X-02, appeared to have precluded the opportunity for operators to share their perceptions relating to the urgency, complexity, or scope of the evolutions. Further, the apparent double standard of communication discipline applied to routine versus non-routine (infrequent, complex, or high-risk) operational evolutions permitted

the communication deterioration that contributed to the event. This aspect of control room communications will be reviewed as a part of IFI (445/9220-06).

4.5 Shift Turnover

Through interviews and review of statements the senior examiner determined that multiple weaknesses exhibited by the on-shift crew carried over to the oncoming crew during the shift turnover process. The oncoming crew similarly failed to recognize the inconsistent annunciator alarm and valve handswitch and position indications. It was apparent that turnover did not routinely include an assessment of the status of outstanding annunciator alarms. The licensee promulgated a requirement on May 13, 1992, to evaluate and record the reason for each outstanding annunciator alarm within 1 hour of shift turnover. That appeared to be in direct response to the recent event. Although the shift of the SFP cooling lineup was reported during turnover, the realignment of the CCW system was not. Further, when one of the operators on the oncoming crew had doubts regarding the status of SFP cooling as recorded on the turnover logs, he failed to convey those concerns to shift supervision and to investigate the actual status of SFP 1 cooling.

On May 20, 1992, the senior examiner observed shift turnover activities during the 6 a.m. shift turnover. Operators appeared to be focusing on turnover information appropriately and to be adequately assessing annunciator alarm status immediately following shift relief.

4.6 Unit Supervisor Administrative Workload

The lack of direct supervisory involvement was a significant contributor to the event. The senior examiner determined through interviews and review of statements that the unit supervisor was routinely tasked with substantial administrative responsibilities in addition to direct operational oversight. Operators reported that the impact of that situation varied among unit supervisors, but that the ability of all unit supervisors to stay current on the status of various operational activities was reduced. It was determined, through review of licensee records and interviews, that at the time of the event, the control room shift was manned with two licensed reactor operators and one licensed senior reactor operator dedicated to Unit 1 operations, one licensed reactor operator and one licensed senior reactor operator to support Unit 2 construction and testing, and a licensed senior reactor operator with overall supervisory responsibility for both units. The administrative burden on the unit supervisor on the evening of May 11, 1992, was light and the low level of activity on Unit 2 permitted its unit supervisor to handle part of the administrative load for Unit 1 activities. Ostensibly, that was to provide more opportunity to the Unit 1 unit supervisor for closer operational supervision. However, the Unit 2 unit supervisor provided the principal operational briefing to the Unit 1 operators regarding the work package relating to SFP Heat Exchanger X-01. Further, the Unit 1 unit supervisor reported that the level of direct oversight of operational activities was comparable to that of a normal day shift when administrative demands are significantly higher. It appeared that a pattern of low supervisory

involvement in routine operational activities existed on May 11, 1992. That pattern of supervisory involvement further appeared to have been fostered by the frequently large administrative work load of unit supervisors. An apparent consequence of the low supervisory involvement in routine evolutions was that operators had developed a sense of responsibility to carry out routine evolutions with minimal disturbance of the unit supervisor.

The availability of licensed operators assigned to Unit 2 activities to support the Unit 1 crew are conditional and unpredictable in large measure. As the pace of Unit 2 pre-operational testing increases, there will be less opportunity for Unit 2 operators to support Unit 1 activities. This is of particular concern with respect to the number of senior reactor operator licensed individuals assigned to a shift. The facility's proposed shift manning of senior operators once Unit 2 becomes operational is at the same level as current shift levels of senior operators. In as much as supervisory operational oversight was inadequate to prevent the operational errors associated with the events of May 11-14, 1992, and that reliance is presently placed on the Unit 2 Unit Supervisor to address the administration burden on Unit 1, it is unclear that the proposed shift manning of senior operators to support two unit operation will assure adequate supervisory involvement in routine operations. The facility licensee reported being aware that administrative duties were impacting the unit supervisor on shift prior to the events of May 11-14, 1992. However, no course of action had been implemented prior to the event. The sufficiency of shift manning for two-unit operation with regard to licensed senior operators is an unresolved item (446/9220-07).

4.7 Attitudes on Unit 1/Unit 2 Interfaces

The senior examiner determined through interviews with operators and other licensee personnel, that there was appropriate concern regarding controlling the interface between Units 1 and 2 when it was evident that an interface was being crossed. Noteworthy is the fact that operator recall of the various interface points between Units 1 and 2 was widely varied and typically did not include electrical interfaces unless prompted by the senior examiner. Lack of training on the CCW design modification affecting SFP cooling was most credited for the failure of operators to be appropriately aware in the interface impact on SFP cooling. To the credit of the BOP reactor operator, his first thought regarding CCW to Heat Exchanger X-02 was to utilize Unit 1 CCW.

4.8 Procedure Errors

On May 18, 1992, the inspector copied a portion of Alarm Response Procedure ALM-0032A from the main control board copy. The licensee had processed a change to this procedure on May 16, 1992, in response to the NRC finding that this procedure had not been revised to reflect the changes made necessary by DM 91-076. For annunciators associated with low SFP heat exchanger CCW return flow, the changes entered into the control room binder on May 16 were incorrect and unapproved versions of the approved changes. A review of the approved version indicated that it contained errors with respect

to which temperature instruments serve the Units 1 and 2 SFPs.

SOP 506, "Spent Fuel Pool Cooling and Cleanup System," Revision 5, included Section 5.1.9, "Cooling Unit 1 SFP with SFP Cooling Water Pump 02 and Heat Exchanger 02." This section incorrectly referenced SOP-502A, the Unit 1 CCW system operating procedure, for aligning CCW to the X-02 SFP heat exchanger. This incorrect reference reportedly misled the reactor operator or reinforced his mistaken impression that Unit 1 CCW could be used to cool the X-02 heat exchanger. Section 5.1.14 of this procedure, "Securing from the Use of SFP Cooling Water Pump X-02 and SFP Heat Exchanger X-02 on Unit 1 SFP," had a potentially confusing error in the section title. The section title should have listed "SFP Heat Exchanger X-01" instead of "X-02."

SOP-502B, "Component Cooling Water System," Revision 1, Section 1.1, referred to Section 5.2.7. This procedure had no section labelled 5.2.7, but had two sections labelled 5.2.6.

These errors indicated a weakness in the adequacy of the technical review and administrative control of changes to operations procedures. The licensee's failure to properly maintain these procedures is an apparent violation of Technical Specification 6.8.1 (445/9220-08).

4.9 Conclusions

During the course of establishing SFP 1 cooling through SFP cooling Pump X-01 and Heat Exchanger X-02, several significant and disturbing operator errors occurred, the most serious of which were taking independent action outside of procedures without supervisory knowledge and concurrence and failing to report abnormal system alignments. It appears that the failures to adhere to procedures may have been the consequence of subordinating procedural adherence to an attitude that "getting the job done" was of higher priority. Following the on-site inspection, a review of regional office files revealed that procedure adherence problems were observed in the most recent licensed operator requalification examinations (Examination Report 50-445/OL 91-03). Further, there were instances of operators taking independent action outside procedures without the knowledge and consent of the unit supervisor. The BOP reactor operator responsible for some of the procedural adherence errors in the recent event failed that requalification examination for the same reasons as noted above.

Another significant area of concern was that of command, control, and communication on the part of the unit supervisor and control room panel operators. Administrative demands on the unit supervisor reduced the opportunity for close involvement with operational activities. That condition promoted two other undesirable conditions. Some unit supervisors developed a habit of low involvement with routine operational activities even when administrative demands were low. Additionally, communication discipline degraded as a result of the general perception that the ongoing activity was routine. Again a mode of low supervisory involvement and poor communication discipline apparently evolved such that it remained dominant when the

administrative pressures were temporarily reduced.

A less serious but widespread weakness relates to operator system knowledge. Operators on both crews involved in the event exhibited weak system knowledge regarding alarms, indications, and instrument locations, in addition to design changes. It was volunteered during the operator interviews that auxiliary operator system training was focusing less on system design, operation, and installation and more on specific auxiliary operator tasks. While the senior examiner concluded that operator attitude toward control of unit interfaces was appropriate, lack of system knowledge contributed significantly to operators being unaware of unit interface concerns both during the impact review of the work order and when aligning the SFP cooling system to permit scheduled maintenance.

5. EFFECTIVENESS OF PAST CORRECTIVE ACTIONS

The inspectors evaluated several past plant events to determine if similar contributing factors had been effectively addressed in the licensee's corrective action plan. Specifically, the inspectors reviewed the corrective actions associated with Enforcement Action 91-189, involving misalignment of certain residual heat removal valves, and Licensee Event Report 92-001-00, which reported a reactor trip caused by a high primary water turbine trip. Additionally, the inspectors reviewed the personnel error reduction program in attempts to ascertain the adequacy of the attempts to reduce personnel errors. The inspectors determined that the licensee's responses to prior events were ineffective in precluding errors involved in the alignment of the SFP system.

Contributing factors, similar to previous events, in the SFP alignment are as follows:

- The unit supervisor did not provide oversight as specified in ODA-407, "Guidelines On Use Of Procedures," when performing nonroutine system alignments.

- The operators failed to use system operating procedures (SOP-506 and SOP-502B). Additionally, the licensed operator failed to follow ODA-410 when changing system configurations.

- The operators failed to communicate with each other and supervision about problems encountered during system lineups.

- The operators failed to check for proper indications of CCW flow.

- Two control room crews failed to identify that the low CCW to SFP Heat Exchanger X-02 annunciator had not cleared.

Another indication of lack of main control board awareness was the discovery by the senior resident inspector of an error in control switch position verses light indication for the CCW outlet valve from SFP Heat Exchanger X-02.

There were numerous other contributing factors to this event. However, these will not be discussed since no correlation could be made to the previous events reviewed.

5.1 EA 91-189 Corrective Actions

Enforcement Action 91-189 was in response to a residual heat removal system misalignment during entry into Mode 3 in December of 1991. The root cause of this violation was personnel error. The contributing factors to this event were similar to the SFP alignment errors and include the following:

- The reactor operator failed to follow the system operating procedure (SOP-102) and the administrative procedure on system configuration control (ODA-410).
- The reactor operator failed to verify system alignment.
- Four crews failed to identify main control board handswitches being mispositioned.

The corrective actions taken to preclude a similar event included the following:

- Management's expectations of operators' awareness of control board configuration and use of available procedures were stressed.
- The requirements of ODA-410 to document abnormal valve configurations in the unit log were emphasized by shift order.

5.2 Corrective Actions for LER 92-001

Licensee Event Report 92-001-00 described a reactor trip in conjunction with a turbine trip caused by high primary water temperature in January of 1992. The root causes for this event were the following:

- Failure of the BOP reactor operator to understand consequences of valve manipulations,
- Failure to hold a formal briefing for this high risk activity, and
- Failure of the shift supervisor to properly supervise and effectively communicate.

The contributing factor in this event was the failure of the BOP reactor operator to use procedures, which was also a contributing factor in the SFP cooling alignment event.

The corrective actions taken to address the root causes that were similar to the SFP alignment error were as follows:

- The shift supervisor was counselled.
- Training on performing high risk activities and infrequent evolutions was conducted
- The use of available procedures was covered in training.

5.3 Personnel Error Reduction Program

During the initial stages of power operation, station emphasis was placed on the resolution of equipment problems. However, in early 1991 the emphasis shifted to personnel performance issues. Due to the reactor trips in the first half of 1991, site wide training was conducted on self-checking techniques, and a task team was formed to develop a personnel performance awareness program.

The task team action plan focused on human performance enhancement by use of training, awards, and media awareness campaigns based on avoiding personnel errors. The reduction of personnel errors was based on the "7 steps for self-verification," (stop, locate, touch, verify, anticipate, manipulate, and observe).

Additional emphasis was stressed in September 1991 due to the increase in plant events caused by personnel errors (TU Electric Memo CPSES-9124679). The memo required managers and supervisors to meet with their organizations and discuss management's expectations on:

- Personnel performance, self-verification, and attention to detail;
- Use of procedures and instructions; and
- Reporting of events - specifically personnel errors.

Other TU Electric correspondence continued to show a concern in the personnel performance area. Recent plant events continued to be caused by lack of self-checking and inattention to detail.

5.4 Summary

The corrective actions implemented by the licensee to address the human performance aspects of the previous events reviewed were not effective in precluding the similar human performance errors which contributed to this event.

6. WORK CONTROL AND CORRECTIVE ACTIONS

The inspector evaluated the licensee's work control process and corrective actions in association with the work on SFP Pump X-02. Concern was expressed with the length of time the pump was out of service for maintenance, the work priority assigned, and the coordination of post work testing.

6.1 SFP Pump X-02 Out of Service for Extended Period

The review of numerous work orders and component tagouts and discussions with both maintenance and work control personnel indicated that SFP Pump X-02 had been out of service for 41 days. SFP Pump X-02 was originally taken out of service on March 30, 1992, for maintenance work to replace flexible gaskets on suction and discharge piping (Work Order C92-9736). Additional work to inspect and replace the pump bearings was added to the tagout under Work Order C92-2273 on April 4, 1992. Pump bearing replacement was completed April 14, 1992, and Clearance X-92-0677 was removed on April 21, 1992, after completion of the gasket replacement. Gasket replacement took longer than originally planned due to a pipe flange alignment problem. After engineering resolution was obtained showing no adverse conditions existed, the gaskets were replaced. TU Electric management failed to closely monitor the work on the pump, and this caused the lack of proper attention to be focused on timely repairs.

Industry codes required the testing of SFP Pump X-02 subsequent to the extensive repair in order to ensure that the pump met minimum operability standards as specified in ASME Section XI. Clearance X-92-0677 was removed and SFP Pump X-02 remained idle for 5 days without the required testing. On April 26, 1992, Clearance X-92-0860 was authorized and electrical maintenance began work to clean a sight glass on the outboard motor end of SFP Pump X-02. The initial scope of the work required the cleaning of the motor oil level sight glass. However, due to unforeseen difficulties, the outboard motor bearing had to be removed to allow access to the sight glass. Licensee management's attention was not properly focused on this work and this caused delays in returning the pump to service by failing to ensure that electrical maintenance turned over the work from one shift to the next. This work was completed and the clearance was released on May 8, 1992. SFP Pump X-02 again remained idle for several days until an ASME Section XI test was performed satisfactorily on May 11, 1992. At this time SFP Pump X-02 was placed in service.

6.2 Wrong Priority Assigned

The repair of the failed motor bearing (May 11, 1992) was not correctly prioritized as specified in Procedure STA-606, Revision 17. Initially the repair work was a Priority 22 which is defined as, "Routine work to be done to support operations. Non-critical items that do not impact reliability. Priority 22 is used for working off the backlog of non-impacting routine tasks on plant equipment as determined by the 12-week rolling schedule. Also enhancement or cosmetic work." Priority 22 is the lowest priority for operations equipment. The correct priority should have been Priority 13 which is defined, in part, as, "Priority 13 is used for maintaining plant reliability, safety issues and longer term Technical Specification Action Statements. These activities will be considered emergent and implemented with the current work week schedule." This incorrect priority assignment led to a delay of 9 days before electrical maintenance identified the wiped bearing.

The inspectors discussed this finding with the work control center manager and the work was upgraded to a Priority 13.

The licensee acknowledged that lack of management oversight caused safety-related equipment to be out of service for an excessive period and caused the assignment of an incorrect work priority to safety related equipment. An ONE Form was initiated to bring about resolution of this deficiency.

6.3 ONE Form Not Initiated as Required

After the operability test, SFP Pump X-02 was aligned to cool SFP 1 on May 11. The pump continued to operate for several hours until the outboard motor bearing failed, resulting in a fire alarm and dispatch of the fire brigade. Contrary to Procedure STA-421, Revision 2, "Operations Notification and Evaluation (ONE) Form," an ONE Form was not initiated after the failure of the motor bearing on May 11, 1992. An ONE Form was initiated on May 20, 1992, after electrical maintenance disassembled the outboard motor bearing.

The ONE Form process reports potential adverse conditions that affect quality-related materials, parts, components, activities, processes, procedures, and documents during the operational phase. Attachment 8.A of STA-421 lists conditions that should be reported on an ONE Form. Contrary to this attachment, an ONE Form was not initiated. Additional instructions in the procedure requires the individual who discovers the adverse condition to initiate a ONE Form. Procedure STA-422, Revision 5, Section 6.1.1 states, "Any individual discovering an actual or potential adverse condition shall identify the condition in accordance with STA-421, which requires the condition to documented on an ONE Form and the ONE Form to be promptly delivered to the Shift Supervisor."

The ONE Form process allows for screening to determine operability and reportability and identification of corrective actions (Procedure STA-422, Revision 5). The initial failure to fill out the required ONE Form contributed to the failure of work control to correctly identify the work priority associated with the emergent repair of SFP Pump X-02.

6.4 Conclusions

The licensee's failure to take prompt and effective actions to restore SFP Pump X-02 to service is an apparent violation of Criterion XVI of Appendix B to 10 CFR Part 50 (445/9220-09). The inspectors were concerned that this safety-related equipment apparently did not receive an appropriate level of management oversight to ensure its prompt repair, testing, and return to an operable status.

7. LICENSEE CORRECTIVE ACTIONS

7.1 Short-Term Actions by the Operations Department

The following actions were initiated by the operations manager on May 14, 1992:

- Each oncoming operations shift was required to log each illuminated annunciator and the reason for the alarm within 1 hour of turnover.
- As an interim measure, crosstying of Units 1 and 2 systems required the approval of the operations manager until a full review of impact is completed. Releases in accordance with STA-821 could be handled in accordance with procedures.
- Use of Unit 2 systems to supply Unit 1 nonsafety-related components after a full review of the impact is completed could be approved by the shift supervisor after verification of certain conditions. Any such use is to be logged in each unit log and in the station log.
- Crossties of safety related and important-to-safety systems require STA-821 and operations manager approval.
- Unit 2 personnel must be made aware of crossties to ensure that the Unit 2 system remains reliable. A list of systems which could be crosstied was to be provided to operators.
- Personnel were reminded that they must seek assistance when performing an evolution and encounter conflicting information.
- Personnel were directed to comply with procedures at all times and to submit revisions to procedures when necessary.
- SFP Heat Exchanger X-02 was to be used only in an emergency in which Heat Exchanger X-01 was unavailable.
- Shift supervisors were directed to discuss procedure implementation and prerequisite verification with their crews.
- Shift supervisors were directed to discuss with each crew member individually the requirements of ODA-407 and ODA-410.
- Shift supervisors were directed to discuss control board awareness expectations with their operators.
- A meeting of shift supervisors was conducted on May 14 in which the recent event and station expectations were discussed.

7.2 Other Corrective Actions

On May 15, the licensee established an Evaluation Team to address issues related to the event identified on May 12. This team was tasked to:

- Review the adequacy of the STA-821 interface control program;
- Review the schedule and controls over implementation of interface design modifications;
- Support the NRC special inspection;
- Review and evaluate personnel performance; and
- Review the adequacy of previous corrective actions taken.

This team completed its evaluations, including a root cause evaluation of the system alignment errors, and issued its report on May 22, 1992. Several recommendations were made by the team in its report. Some of these had been or were being implemented by the licensee at the end of the inspection period and others were being considered by licensee management. The recommendations included the following:

- Develop a procedure for reversal of the CCW spectacle flanges.
- Review the event with personnel who complete operations impact assessments.
- Consider creating a formalized checklist for use in reviewing future operations impact assessments.
- Inform operators of the SFP heat up rates using Design Basis Document information.
- Review and correct as required the administrative duties and responsibilities of the unit supervisors.
- Consider adopting self-verification techniques for procedure writers and technical reviewers.
- Consider field walkdowns of procedures, revisions, and changes.
- Take various actions to ensure that all personnel understand their responsibilities regarding self-verification and procedure compliance. These actions included various measures to increase supervisory and independent oversight of plant activities.
- Strengthen personnel accountability by using performance evaluations and establishing a Performance Enhancement Review Committee.
- Audit operational impact assessments for design modifications.
- Develop a more effective method to inform operators of design changes.

- Consider including main control board alarms and indications in operating procedures.
- Review the event with applicable personnel and take individual corrective action as necessary.
- Perform a failure analysis of SFP Pump X-02.
- Complete the effort which was underway to check the interface equipment list for applicable systems and independently verify its accuracy.
- Perform a 10 CFR Part 50.59 safety evaluation and a radiological assessment prior to opening LC-2 valves which are not on the interface list.
- Review other locked closed valves to identify other areas requiring a safety or radiological evaluation.
- Accelerate the ongoing review being conducted to determine the feasibility of combining the LC-2 and STA-821 programs.
- Perform safety and radiological evaluations for procedures affecting LC-2 valves.
- Document the radiological evaluation which should be performed when removing unit isolation boundaries.
- Accelerate the implementation date for the Unit 2 ODCM.

The Evaluation Team performed a comprehensive review in a short time period. The findings of this team closely paralleled those of the NRC special inspection team.

8. SUMMARY OF TRACKING ITEMS

The following items were opened in this inspection report:

VIOLATION	EXAMPLE	PARAGRAPH	TOPIC
445/9220-01	1	3.1.2	No Flange Reversal Procedure
445/9220-01	2	3.1.2	ALM not Revised
445/9220-02		3.1.3	Training of Operators
445/9220-03		3.2.2	Safety Evaluation on LC-2
445/9220-04		3.2.3	Operational Impact Review
445/9220-05	1	4.1	Failure to Follow SOP
445/9220-05	2	4.1	Failure to Follow ODA
445/9220-05	3	4.1	Failure to Use SOP
445/9220-05	4	4.1	Failure to Follow ODA
445/9220-05	5	4.1	Clearance Special Instruction
445/9220-05	6	4.1	Locking and Independent Verification

445/9220-08	4.8	Procedure Errors
445/9220-09	6.4	Corrective Action on SFP Pump
Inspection Followup Item		
445/9220-06	4.4	Control Room Communications
Unresolved Item		
446/9220-07	4.6	Control Room Staffing

9. EXIT MEETING

An exit meeting, open to public observation, was conducted on May 29, 1992, with the persons identified in paragraph 1 of this report. Other exit meeting attendees are listed in Attachment 1. The licensee did not identify as proprietary any of the materials provided to, or reviewed by, the inspectors during this inspection. During this meeting, the inspectors summarized the scope and findings of the inspection. Also, during this meeting, TU Electric confirmed the following completed or planned corrective actions:

- The event has been reviewed with auxiliary operators, reactor operators, and senior reactor operators.
- Supervisor seminars have been conducted for unit supervisors.
- The positive discipline program will be implemented for certain individuals.
- Increased observations to ensure the meeting of expectations by plant personnel are being implemented.
- First line supervisors will normally be expected to spend half of their time with their workers.
- An auxiliary operator supervisor position reporting to the unit supervisor has been established and will be permanently staffed.
- Safety and environmental reviews for open LC-2 valves have been completed and documented.
- The DMRG will review design modifications, including safety evaluations, to ensure adequate operations impact assessments are performed.
- Nuclear overview will increase its presence in the conduct of operations activities.
- An observations manager will provide increased oversight to verify increased awareness and implementation of self-verification.
- A 10 CFR Part 50.59 safety evaluation will be performed prior to using

Unit 2 components for Unit 1.

- The above commitments will be verified for effectiveness and implementation.

ATTACHMENT 1

PERSONS CONTACTED

TU ELECTRIC
*R. J. Adams, Instrumentation and Control Supervisor
*D. W. Barham, Emergency Planner, Local Government Liaison
*L. G. Barnes, Technical Staff Training Manager
*O. Bhatty, Site Licensing
*B. Bird, Outage Manager
*J. Blackwell, Licensed/Nonlicensed Operator Training Supervisor
*J. R. Blevins, Director of Nuclear Overview
S. Burnett, Operations Support
*D. E. Buschbaum, Supervisor, Compliance
*R. C. Byrd, Manager, Quality Control
*R. R. Carter, Technical and Administrative Assistant, Maintenance
*B. Cockrel, Mechanical Engineering
*D. L. Davis, Manager, Plant Analysis
*J. W. Donahue, Manager, Operations
*E. L. Dyas, Jr., Quality Specialist
*T. Eckert, Principal Engineer, Plant Engineering
*D. Fiorelli, Senior Engineer/Communications
*B. Fish, Construction Operations Support Group
*J. Gallman, Trend Analysis Manager
B. Gastinel, Plant Engineering
*G. L. Goldston, Emergency Planning Supervisor
*W. G. Guldemond, Manager, Independent Safety Engineering Group
*L. M. Haltom, Senior Engineer, Regulatory Evaluation
*N. Hood, Emergency Planning Manager
*T. Jenkins, Assistant to Chief Engineer
S. Johnson, Plant Engineering
*D. C. Kay, Radiation Protection Supervisor
*D. C. Kross, Unit 2 Operations Manager
*J. J. LaMarca, Manager, Technical Programs Manager
*B. T. Lancaster, Manager, Plant Support
*J. Lee, Manager, Community Relations, Glen Rose/Granbury
T. Marsh, Unit 2 Shift Supervisor
*R. B. Mays, Supervisor, Mechanical Codes and Standards
*J. F. McMahon, Manager Nuclear Training
D. R. Moore, Work Control Center Manager
*J. W. Muffett, Manager of Design Engineering
*S. S. Palmer, Stipulation Manager
*M. C. Patel, Licensing Engineer
*D. E. Pendleton, Unit 2 Regulatory Services Manager
D. Preston, Nuclear Overview
*R. J. Prince, Radiation Protection Manager
*C. W. Rau, Unit 2 Project Manager
*D. J. Reimer, System Engineering Manager
*A. L. Saunders, Independent Safety Engineering Group Assessment Manager
*E. J. Schmitt, Independent Safety Evaluation Group
*D. D. Schroeder, Senior Engineer
*A. J. Scoggin, Security Manager
*W. R. Sly, Jr., Assistant Instrumentation and Control Manager

*P. B. Stevens, Manager, Plant Engineering
*M. W. Sunseri, Performance and Test Manager
*C. L. Terry, Chief Engineer
*S. C. Tugwell, Emergency Planning
*J. R. Vozzella, Planning & Scheduling Manager
*J. R. Walker, Operations Engineering Training
*B. W. Wieland, Manager, Maintenance
*D. R. Woodlan, Docket Licensing Manager

CITIZENS ASSOCIATION FOR SOUND ENERGY (CASE)
*O. L. Thero, Consultant

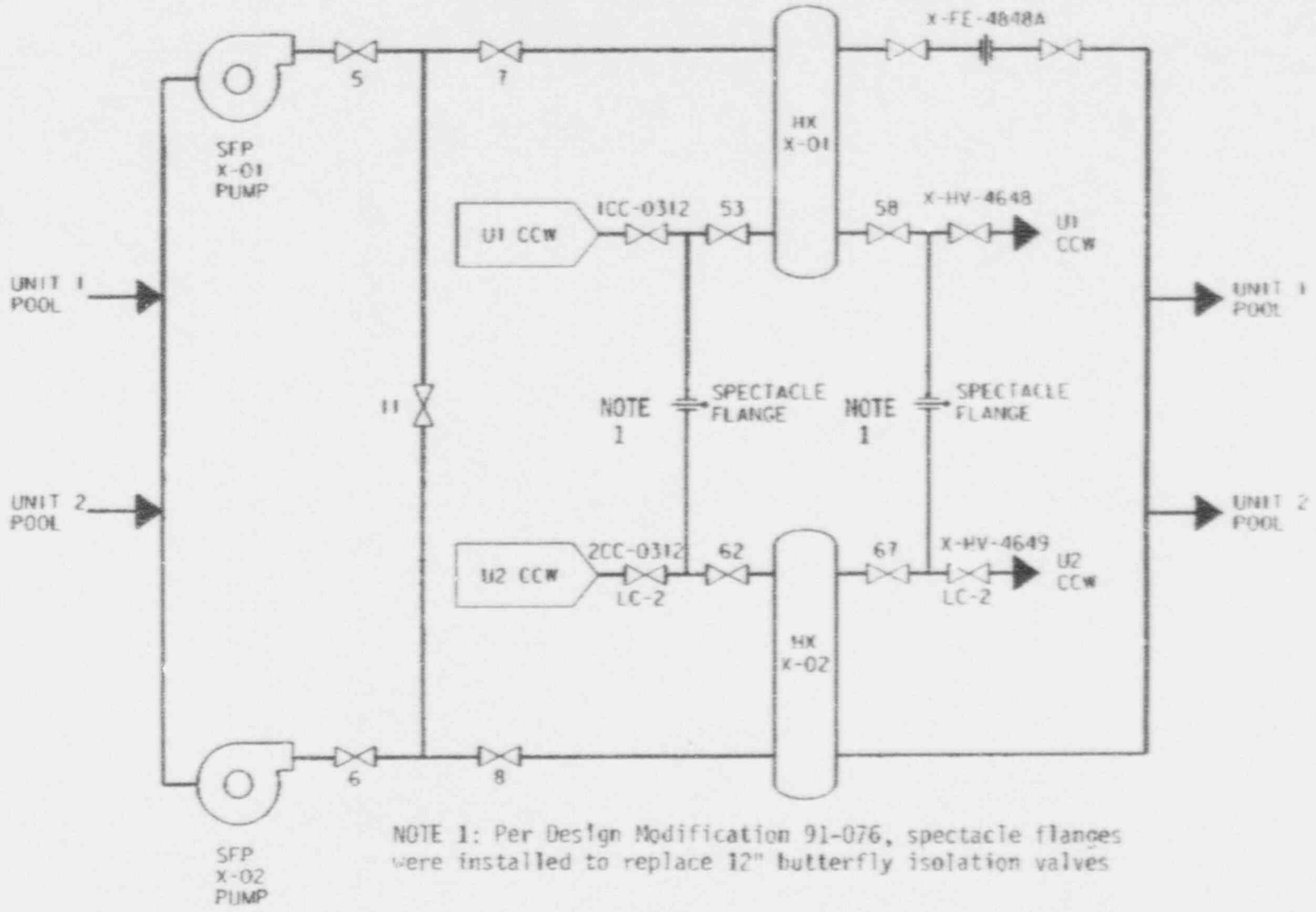
OTHERS
*J. C. Hair, ANII/ANI, Hartford Steam Boiler Inspection and Insurance Co.
*D. Reep, Reporter, Cleburne Times Review
*M. Whitely, Reporter, Fort Worth Star Telegram
*D. W. French, Journeyman Millwright, Brown & Root

U. S. NUCLEAR REGULATORY COMMISSION
*David N. Graves, Senior Resident Inspector
*R. M. Latta, Resident Inspector
*V. G. Gaddy, Intern
*C. E. Johnson, Project Engineer, Unit 2

*Present at the exit interview.

"ATTACHMENT 2"

EXCERPTED FROM TU ELECTRIC FX-92-417



NOTE 1: Per Design Modification 91-076, spectacle flanges were installed to replace 12" butterfly isolation valves