APPENDIX

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Inspection Report: 50-445/94-02
50-446/94-02

Licenses: NPF-87
NPF-89

Licensee: TU Electric
Skyway Tower
400 North Olive Street, L.B. 81
Dallas, Texas

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

Inspection At: Glen Rose, Texas

Inspection Conducted: January 3-14, with in-office inspection through January 20, 1994

Inspectors: L. E. Ellershaw, Reactor Inspector, Maintenance Branch
Division of Reactor Safety
P. A. Goldberg, Reactor Inspector, Engineering Branch,
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Approved: Dale A. Powers 02/11/94
Dr. Dale A. Powers, Chief, Maintenance Branch — Date
Division of Reactor Safety

Inspection Summary

Areas Inspected (Units 1 and 2): Routine, announced inspection to determine the effectiveness of the licensee's program for assuring the reliability and operability of safety-related check valves.

Results (Units 1 and 2):

- The check valve reliability program was comprehensive, well planned, and provided clearly defined guidance and instructions (Section 2.2).

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- The design application review was very comprehensive and included consideration of the relevant factors affecting check valve durability (Section 2.3).

- The check valve reliability program has evolved into a program based on non-intrusive testing which should identify check valves that may have been initially misprioritized (Section 2.3).

- The acoustic emission test program was well established and was aggressively implemented. The extent of acoustic emission testing was considered a strength (Section 2.4).

- The industry information review system for check valves was controlled by sufficiently detailed procedures and a good tracking system had been implemented (Section 2.5).

- The check valve maintenance program was well defined and implemented (Section 2.6).

- The check valve surveillance program was well established and was considered a strength (Section 2.7).

- The check valve trend analysis program was well defined, but was in its early stages of implementation (Section 2.8).

- The check valve reliability program failure analysis function was very thorough and was considered to be a strength (Section 2.9).

Summary of Inspection Findings:

- No inspection findings were opened or closed.

Attachments:

- Attachment 1 - Persons Contacted and Exit Meeting

- Attachment 2 - Documents Reviewed and Check Valve Sample Identification

DETAILS

1 PLANT STATUS

Comanche Peak Steam Electric Station (CPSES), Units 1 and 2, were both in Mode 1 at 100 percent power during this inspection period.

2 PERFORMANCE OF SAFETY-RELATED CHECK VALVES (TEMPORARY INSTRUCTION 2515-110)

The purpose of this inspection was to determine the effectiveness of the licensee's program to provide assurance of the operability and reliability of check valves in safety-related systems.

2.1 Background

In recent years, numerous deficiencies related to check valves have been identified throughout the nuclear industry. Information pertaining to these deficiencies has been disseminated by the NRC in information notices (INs), and by the Institute of Nuclear Power Operations (INPO) in significant operating experience reports (SOERs).

INPO issued and distributed SOER 86-03, dated October 15, 1986, to licensees in order to call attention to check valve deficiencies and failures. The SOER attributed the major causes of failures to valve misapplication and inadequate preventive maintenance. The SOER provided recommendations and guidelines/attributes for establishing a preventive maintenance program and for performing a design review of check valve installations. Coincidentally, with the development of the SOER, a program was initiated by the Electric Power Research Institute (EPRI) to develop application guidelines for check valves to assist utilities in responding to the SOER. This resulted in the development of EPRI Report NP5479, "Application Guidelines for Check Valves in Nuclear Power Plants."

2.2 Check Valve Program

Procedure STA-750, "Check Valve Reliability Program (CVRP)," Revision 2, dated December 15, 1993, provided the program elements that were designed to identify existing undetected check valve failures, incipient failures, and to prevent future failures through the use of non-intrusive monitoring and disassembly examination. Although inservice testing establishes check valve operability under test conditions, it does not ensure check valve actuation under other anticipated operating conditions. Thus, the CVRP was structured to recognize the need for establishing check valve reliability in order to enhance operability under all conditions.

The responsibility for implementing the CVRP rested with the CVRP responsible engineer, who reported to the maintenance engineering manager. The responsibilities of other groups whose actions could impact the CVRP (i.e., design engineering, inservice testing, maintenance, system engineering, etc.), were clearly delineated. Procedure STA-716, "Site Modification Process," Revision 10, dated October 6, 1993, provided the methodology for causing review and impact assessments regarding design activities which could affect programs, including the CVRP, through the use of Form STA-716, "Operations Impact Assessment," Revision 6, dated October 6, 1993.

The current CVRP population consisted of 149 Unit 1 and 146 Unit 2 check valves, of which 116 and 113, respectively, were also included in the inservice testing program. One of the goals identified in the CVRP was to collect baseline acoustic emission (AE) data on all of the CVRP check valves prior to the end of each unit's refueling outage (RFO) 2. The basis for this goal was to eliminate the need to open valves for the purpose of verifying AE baseline data (the premise being that the valves would still be in near-new condition). For a variety of reasons, 16 Unit 1 check valves were not AE monitored prior to the end of 1RFO2 (October 23 through December 26, 1992). However, during the ensuing mid-cycle outage and 1RFO3 (October 6 through December 16, 1993), an additional five check valves were AE monitored. The remainder were scheduled for completion prior to the end of 1RFO4. AE baseline data has been acquired on 78 of the 146 Unit 2 CVRP check valves. To date, Unit 2 has not undergone a refueling outage.

The inspectors also noted that Procedure STA-750 provided for the re-establishment of baseline data following any maintenance activities that physically affect or alter the valve body or internals. The CVRP also addressed valve disassembly to confirm possible degraded conditions identified during the performance of AE monitoring, including immediate examination of similar valves.

The inspectors considered Procedure STA-750 to be a comprehensive and well-planned program document that provided clearly defined guidance and instructions.

2.3 Design Application Review

The licensee contracted Kalsi Engineering (Kalsi) to perform a design review of selected check valves at CPSES. The review was conducted in response to INPO SOER 86-03, which directed utilities to perform an application review of check valves installed in the following systems: main steam, feedwater, auxiliary feedwater, chemical and volume control, safety injection, residual heat removal, essential service water, and diesel air start. The following systems were also reviewed: component cooling water, condensate, and extraction steam. A total of 278 Unit 1 and common valves were included in the 11 systems. A number of check valves (129) installed in the reviewed systems were not included in the complete analysis and review process. The valves not reviewed were valves which were less than 2 inches in size and valves that were used infrequently, less than five percent of the plant operating cycle. The objectives of the review were to identify potential check valve misapplication, develop a preventive maintenance program to monitor check valve degradation, and recommend design improvements to ensure reliable check valve performance. The inspectors' review concluded that the Kalsi effort was based on the guidelines provided in EPRI NP-5479.

Flow conditions, upstream disturbances, valve orientation, and component materials and dimensions were tabulated for each valve. The minimum flow velocity needed to keep the check valve fully open (Vmin) was calculated for each valve. When flow velocities fell in the range of 70 to 115 percent of Vmin, the disc was assumed to be tapping and an estimate of the stress developed in the disc stud was made and used to calculate the fatigue life of the disc stud. When flow velocities were less than 115 percent of Vmin, an oscillation angle and frequency were computed for input into a calculation of hinge pin wear, which was assumed to be the limiting wear component. When the flow velocity was less than 70 percent of Vmin, the disc was assumed to be oscillating. To be conservative, 50 percent hinge pin wear was assigned a value of 100 percent wear life. When the flow velocity was greater than 115 percent of Vmin, the check valve was assumed to be in the fully open position with no tapping and no wear or fatigue. From this information, hinge pin wear and fatigue wear rates were calculated. Based on the wear rates, each check valve was assigned a disc pin fatigue index and a hinge pin wear index ranging from 1 (which was very low) to 5 (which was very high). The magnitudes of these indices corresponded to a recommended disassembly and inspection frequency ranging from 1-10 years.

The Kalsi report for CPSES was dated November 30, 1989. The report summarized the wear and fatigue indices for each check valve and recommended a frequency for inspection of the internal components. In addition, the Kalsi report recommended specific valve components that should be inspected at the recommended frequencies. The Kalsi report concluded that all but 25 of the 149 fully analyzed check valves were suitable for reliable long-term plant operation. The report further stated that 15 valves were candidates for accelerated hinge pin wear and an additional 10 should be checked for proper disc seating. Nineteen of the 25 valves were swing check valves manufactured by Borg-Warner. The Kalsi report recommended, and the licensee performed a thorough design review of the Borg-Warner valves to address specific items to be considered with respect to prioritization of inspection/maintenance activities. The report also identified 18 valves in the feedwater system as possible candidates for erosion/corrosion and recommended that these valves should be initially monitored on an annual basis, with frequency changes based on inspection findings. The inspectors verified that monitoring (disassembly and inspection) has been performed and controlled by Procedure STA-730, "CPSES Corrosion Monitoring Program," Revision 2, dated September 18, 1992.

The inspectors reviewed the Kalsi report in detail and discussed questions with the licensee. The inspectors concluded that the Kalsi review was very comprehensive and included consideration of the relevant factors affecting check valve durability. The methodology appeared consistent with the guidelines presented in EPRI NP-5479.

During the review of the Kalsi report, the inspectors were concerned that a lack of conservatism in engineering judgement and an apparent imprecision in the input data may have worked together to result in a less than reliable determination of the check valves most vulnerable to deterioration. In some cases, the Kalsi report may have misprioritized check valves for scheduling of inspection and maintenance. The points supporting this position are listed below:

1. Disc Oscillation Frequency

Kalsi calculated the disc oscillation frequency of each check valve using three methods: disc natural frequency, disc pendulum frequency, and flow eddy frequency. The disc oscillation frequency is directly proportional to the hinge pin wear rate. Based on the engineering judgement of the person performing the analysis, one of the three frequencies was selected for input into a calculation of check valve hinge pin wear. For almost every check valve reviewed by Kalsi, the flow eddy frequency was selected for input into the wear calculation. The calculated flow eddy frequency was the lowest of the three calculated frequencies for almost every check valve reviewed by the inspectors. As an example, Check Valve SW-0373 was calculated to have a disc natural frequency of 1.89 hertz (Hz), a flow eddy frequency of 0.49 Hz, and a disc pendulum frequency of 1.11 Hz. The flow eddy frequency was used in the wear calculation.

The nonconservative selection of the flow eddy frequency resulted in as much as five times decrease in the wear rate which would result from use of the natural frequency.

2. Weight and Dimensional Data Input

The dimensional and component weight values used on wear and fatigue calculations were based on check valve manufacturer specifications where available. In cases where information from the manufacturer could not be found, the study used a "program default" data base where specifications from similar valves were used. These values were not exact and were based upon proportions used by several valve manufacturers, and minimum thickness calculations for the discs based on ASME Section III formulas for the size and pressure rating of the valves. For the check valves reviewed, the inspectors found that program default values were used frequently. The inspectors were concerned that use of potentially imprecise information in the wear and fatigue calculations could have had a significant effect on the accuracy of the calculated values.

3. Lack of Iterative Analysis

Wear rates were calculated for most of the check valves using dimensions of new check valves. The licensee's personnel stated that actual dimensions from some of the valves had been supplied to Kalsi. However, as a check valve wears, the wear rate increases as a result of increasing dimensional tolerances between moving parts. This effect was not modeled in the Kalsi report.

As a result of the above nonconservatisms in the Kalsi analysis, it is possible that some check valves determined to have low susceptibility to wear and fatigue may in fact be experiencing higher rates of deterioration. This would more likely apply to check valves that are oscillating at natural frequencies, but were analyzed at flow eddy frequencies. Upon questioning, the licensee informed the inspectors that the nonconservatism had been identified after the initial use of the Kalsi report recommendations regarding check valve inspection priorities. This caused recognition for the need to establish and implement a non-intrusive test program in order to identify those valves which could be affected by the nonconservatisms. This subsequently resulted in changes being made to inspection frequencies in order to account for the nonconservatisms.

The CVRP initially adopted the Kalsi analyzed 149 Unit 1 valves and the corresponding Unit 2 valves as the check valve program population. Prior to incorporating the Unit 2 valves into the program, the licensee reviewed configuration differences between the Unit 1 and 2 valves and raised the priority for any Unit 2 valve with a configuration less conservative than its Unit 1 counterpart. In addition, the licensee initiated technical evaluation (TE) 93-200 to evaluate 74 of the Unit 1 and common check valves which had been eliminated from the Kalsi analysis due to being either less than 2 inches in size or check valves which were infrequently used. The evaluation was completed March 2, 1993. The 74 valves were evaluated against design requirements to determine if they were necessary or not. The evaluation concluded that 20 of the valves reviewed were not necessary and could have their discs removed. The remaining 54 valves had close functions identified. The licensee was in the process of preparing a TE to determine which of the check valves discussed in TE 93-200 should be included in the CVRP. Based on preliminary information, the licensee anticipated the addition of 23 valves per unit to the CVRP.

Initially, CPSES utilized the Kalsi report recommendations for prioritizing the inspection of check valves. Rather than disassembling and inspecting the valves as recommended by Kalsi, the licensee initiated non-intrusive testing on each check valve in the check valve reliability program. Paragraph 2.4 of this report describes the CPSES non-intrusive testing. After each test, the licensee prepared a TE to evaluate the results of the tests and implement applicable recommendations, including changing the time between tests based on the evaluation results. The licensee stated that they have changed 14 of the Kalsi recommended priorities based on the results of the non-intrusive tests.

The inspectors concluded that the Kalsi report recommendations were only used for the initial check valve program valve selection and initial prioritizing of check valve testing. The CVRP has evolved into a program based on non-intrusive testing which should identify check valves that may have been initially misprioritized.

2.4 Non-Intrusive Testing

The primary diagnostic method for monitoring the performance of the check valves in the CVRP was AE testing, which is a non-intrusive examination method. Magnetic flux testing was performed on a case-by-case basis as an accompaniment to AE testing. All of the valves in the CVRP have been scheduled for AE testing. Discussion with the CVRP responsible engineer and review of records indicated, to date, that 138 of the 149 Unit 1 CVRP check valves and 78 of the 146 Unit 2 CVRP check valves have had their baseline data established. The first AE test conducted on each valve was considered the baseline test.

The inspectors determined that not all of the valves had been disassembled and refurbished prior to performing the baseline test. The licensee stated that since CPSES was a new plant, there had been no need to disassemble the check valves prior to baseline testing. The licensee stated that a check valve was not disassembled unless the AE test showed that there was a problem with the valve.

The licensee prepared a TE after each AE test to evaluate the results. The inspectors reviewed a number of TEs (identified in Attachment 2) and found, typically, that they validated the Kalsi report results. However, as previously noted, 14 Kalsi-recommended priorities were revised as a result of AE test results (increased frequencies). The reviewed TEs were thorough evaluations of the AE test data, and included recommendations if any problems were observed. In general, the recommendations addressed the validation of AE test data by disassembly and inspection. Review of work orders substantiated implementation of recommendations.

The inspectors concluded that the AE test program was well established and was being aggressively implemented. The extent of AE testing (with the intent to test every valve in the CVRP) was considered a strength.

2.5 Industry Information

The inspectors reviewed Procedures (1) STA-514, "Nuclear Plant Reliability Data System (NPRDS) Program," Revision 1, dated July 15, 1993, which was used for collecting and using INPO's industry-wide data system regarding component engineering and failure data; (2) TNL-4.01, "Correspondence with the Nuclear Regulatory Commission, Other Regulatory Agencies and Selected Industry Groups," Revision 2, dated June 19, 1992, which was used for the control of generic letters and bulletins; and (3) NQA 2.30, "Industry Operating Experience Report Review Program," Revision 2, dated December 3, 1993, which was used for the control of NRC information notices. The procedures assigned responsibility for control and dispositioning of regulatory or industry correspondence and information, and provided the method for tracking actions resulting from review of the information. The inspectors considered the procedures to have sufficient detail to properly handle regulatory and industry information.

The inspectors reviewed a number of the licensee's permanent record files for NRC INs and bulletins in order to assess the licensee's evaluations and applicable actions. The inspectors reviewed Information Notices 86-01, 89-62, 90-03, 90-79, 93-16, and Bulletin 83-03, concerning check valves. In all cases, it appeared that the licensee had performed a thorough review and had taken appropriate actions, some of which were validated by the inspectors' review of identified work packages.

The inspectors concluded that the licensee had appropriately documented their review of each of the documents and had sufficiently detailed procedures to properly handle regulatory and industry correspondence/information. The licensee had established a tracking system to assure that required actions were implemented.

2.6 Maintenance Program

As discussed earlier, the CVRP is comprised of two elements: non-intrusive testing and maintenance (disassembly and inspection), with a heavy emphasis on non-intrusive testing to minimize the physical disturbance of the check valves. Procedure STA-750 addressed the performance of disassembly and inspection activities primarily as a means to confirm a condition identified by non-intrusive testing. It also provided for disassembly and inspection of the remaining valves in the applicable Kalsi grouping upon identification of negative conditions in any one valve in the group. The maintenance activities have been incorporated into specific mechanical maintenance check valve disassembly procedures, 10 of which were reviewed by the inspectors (identified in Attachment 2).

The inspectors reviewed the work histories of the following 9 valves: 1-8949A, 1-8956B, 1AF-0032, 1AF-0078, 1AF-0101, 1FW-0076, 1FW-0191, 1FW-0192, and 1MS-0143. The following are comments on the work histories of the sampled valves:

- 1-8956B, Accumulator Check Valve

  Work Order 92-500447, dated October 29, 1992, disassembled and inspected the valve internals. The valve internals were found in good condition and the disc operated properly. This valve was scheduled for AE testing every four refueling cycles but has not yet been tested to date. The licensee's representative indicated that instead of testing, they may decide to disassemble and inspect every fourth outage.

- 1AF-0032, AFW Turbine Driven Pump Suction Valve

  AE testing performed in March and April 1993 on this valve was evaluated in TE 93-1054. The TE recommended disassembly of the valve due to disc oscillation. AE testing was performed again in May 1993 and evaluated in TE 93-1256. The TE again recommended disassembly of the valve during 1RF03. Work Order 93-316331, initiated to disassemble the valve during 1RF03, found the disc was making some contact with the valve body. One Form 93-1887 and DCN-93-07123 were prepared to evaluate the condition and grind the valve body to provide more disc clearance. The valve was repaired under Work Order 93-316331. The inspectors concluded that the AE test had been effective in finding a problem with the valve.

- 1FW-0192, Bypass Line Containment Isolation Valve

  AE tests were performed during 1RF01 and 1RF02 in accordance with Work Orders 91-005088 and 92-326531. The AE data was evaluated in TE 92-02296 for the 1RF01 data and TE 93-01180 for 1RF02 data. In addition, the licensee stated that the valve had been tested during 1RF03. The test schedule specified that the valve was to be tested every refueling outage, which was in accordance with the Kalsi report.

- 1MS-0143, Steam Supply To Auxiliary Feed Pump Turbine Valve

  The inspectors reviewed the work history on this valve and identified two documented examples of this valve not seating properly (i.e, failing a reverse-flow test). One Form FX-91-419, dated March 25, 1991, documented the valve's reverse-flow test failure. The initial disposition directed that a retest be performed, and if the retest failed, a work request was to be generated. The valve failed the retest performed on March 26, 1991, and Work Request FX91000419 was initiated to rework the valve. At some point during this time period, and before the actual work order was initiated, a decision was made to retest the valve a second time. The second retest was performed on April 27, 1991, and the valve passed the acceptance criterion. At that time, rework of the valve was not considered necessary and a request to cancel the work request was made. For some reason, the work request was not cancelled and Work Order C910001538 was created on April 16, 1991, to implement the work (disassemble, inspect, and repair) during 1RF01, scheduled to begin during October 1991. On October 23, 1991, the work order was implemented and a seal ring was replaced. Work was completed on October 24, 1991, and the valve successfully tested on December 6, 1991.

  AE tests conducted during March and April 1993 on this valve were evaluated in TE 93-1054. The evaluation determined that there was a low-magnitude impact tapping. AE testing was again performed in May 1993 and evaluated in TE 93-1256. The recommendation from the evaluation was to continue to monitor the valve every four years.

- 1FW-0191, Bypass Line Containment Isolation Valve

  The licensee had randomly selected this valve (a Borg-Warner check valve) to be disassembled and inspected during 1RF03. An internal commitment had been made by the licensee to install a modification in all Borg-Warner Check valves to ensure proper alignment at the time valves were disassembled for inspection. During November 1993, Check Valve 1FW-0191 was disassembled for inspection under Work Order 1-93-060918; however, the parts needed to implement the modification were not available. Therefore, the modification was deferred until 1RF04 (end of 1994). Subsequently, during December 1993, Surveillance Work Order 5-92-501946-AB was issued to perform the required exercise test on this ASME Category C valve, using Operations Test Procedure OPT-511A. The acceptance criteria in the procedure required that there be no pressure increase on the downstream test gage after the valve was supposed to be closed. During performance of the test, the valve exhibited leakage which was the procedural criterion used to show the valve was open. This method was used because it was positive and easy to perform, and, as discussed in NRC Generic Letter 89-04, was an acceptable method for exercise testing of check valves. As a result of the identified leakage, a retest was performed and a downstream vent was used to quantify the leakage. The leakage was determined to be 0.5 liters/minute. TE 93-2383, which was closed December 9, 1993, was performed by engineering personnel, and it was determined that (1) the valve was shut, (2) the valve was performing its intended safety function, and (3) the valve met the requirements of ASME Section XI and, therefore, passed the surveillance test.

  The shift supervisor accepted the surveillance test results and considered the valve operable based on the TE conclusion.

- 1-8949A, Letdown Heat Exchanger Tube Out Check Valve

  The documentation pertaining to this valve showed that it had undergone AE testing on Work Order 3-92-326532, with the data entered on CVRP Data Log Sheets dated December 2, 1992. TE 93-1434 was initiated on July 9, 1993, to evaluate the AE data. The data supported the Kalsi analysis, and the TE and work order were closed on July 13, and July 15, 1993, respectively. The inspectors raised a question regarding the timeliness of data evaluation. The CVRP responsible engineer indicated that the data had been reviewed even though a formal TE had not been generated at that time. Because of outage-related work loads and the fact that the review did not identify any anomalies, there wasn't any urgency associated with initiating a TE.

- 1FW-0076, Feedwater Header Check Valve

  This check valve was disassembled and inspected under Work Order P910009136. There were no problems identified and the work order was accepted and signed off by the shift supervisor on December 12, 1991. Work Order P910005091 was issued to perform AE testing and the data was acquired on March 4, 1992. The information was evaluated in TE 92-689, which was initiated on March 16, 1992, and completed on April 9, 1992. Work Order 3-92-326531 was initiated and AE testing was performed on October 23, 1992. This data was evaluated in TE 92-2216, dated October 27, 1992.

- 1AF-0078, Turbine Driven Auxiliary Feed Water Pump Discharge Check Valve and 1AF-0101, Motor Driven Auxiliary Feed Water Pump Discharge Check Valve

  Both of these check valves underwent AE testing on December 23 and 20, 1992, respectively, on Work Order 92-326531, dated January 8, 1993, and were subsequently evaluated on TEs 93-165 and 93-090, respectively. There were no negative indications identified.

With the exception of Check Valve 1-8956B, the inspectors verified that AE testing had been performed and evaluated. The licensee will determine at a later date as to whether that check valve will receive AE testing or be disassembled and inspected once every four refueling outages. The inspectors noted that the AE test results closely paralleled the Kalsi design engineering report. Where corrective maintenance was required, the inspectors verified that the appropriate ONE Forms and work order packages had been initiated and implemented. In general, the inspectors considered the licensee to have a well defined check valve maintenance program that appeared to be well controlled and implemented.

2.7 Surveillance Testing

Surveillance testing, which obtains information used in determining the operational readiness of certain Class 1,2,3, and non-code class pumps and valves, was an integral part of the licensee's CVRP. Procedure STA-711, Revision 4, dated August 20, 1993, which controlled the licensee's inservice test (IST) program, was developed in accordance with the ASME Section XI, 1989 Edition and ASME/ANSI OM-1987, Part 10 (including OMa-1988 Addenda), "Inservice Testing of Valves in Light-Water Reactor Power Plants." The program was applicable to both Unit 1 and 2.

During this inspection, the inspectors reviewed the IST requirements and associated test documentation for 23 check valves from each unit (identified in Attachment 2). The inspectors reviewed each of the selected check valves' work orders related to the IST surveillance test procedures (identified in Attachment 2) and verified that the methodology complied with ASME Code requirements. The inspectors also verified that test frequencies were adhered to and that the sampled valves were either tested and/or inspected, and that none of the valves had been inadvertently omitted from the testing programs. In addition, a review of the applicable surveillance test procedure records associated with the sampled valves was made for technical adequacy and clarity, and no discrepancies were identified. The inspectors established that the check valve full-stroke tests met the criteria specified in Generic Letter 89-04.

The inspectors concluded that the licensee had established and implemented a strong surveillance program, as evidenced by review of the test documentation packages associated with the sampled check valves.

2.8 Trending

CVRP trending activities were controlled by Procedure STA-750. The procedure established provisions for comparison and evaluation of current AE test results with baseline and other previous AE data. Where potentially adverse internal conditions were identified as a result of negative trending results, the procedure addressed validation by disassembly and inspection. Further, trending activities were to be performed in accordance with Procedure STA-736, "Equipment Performance Monitoring Program," Revision 2, through Procedure Change Notice 1, dated November 3, 1993, on a quarterly basis.

The CVRP responsible engineer performed the trending analysis and maintained CVRP trending records. The trend analysis data was provided to the NPRDS coordinator as an input to the "CPSES Failure History Trending and Equipment Performance Monitoring Quarterly Report." This report covered equipment monitoring and history trending for each three-month period to satisfy its stated intent, which was to identify beneficial equipment reliability and availability improvements.

The inspectors reviewed the CVRP responsible engineer's limited trending analysis data to verify that trending, where possible, of AE test results was being performed. It should be noted that the program was in its early stages of implementation regarding collection of sufficient AE test data points required to firmly establish a trend analysis program. However, the limited information was being provided to the NPRDS coordinator for inclusion into the quarterly report.

The inspectors concluded that the mechanics for implementing the requirements for trend analysis have been established and was being appropriately implemented.

2.9 Check Valve Failure Rates

The inspectors requested information regarding failure rates of CVRP check valves. The CVRP responsible engineer provided the inspectors Procedure STA-512, "Failure Analysis and Trending," Revision 2, through Procedure Change Notice 1, dated August 12, 1993, and copies of the three failure analyses performed to date on CVRP check valves. The procedure defined failure as the loss of ability of a component, equipment, or system to perform its intended function. All three pertained to feed water check valves.

TE 93-673 was initiated on March 19, 1993, to perform a failure analysis of Check Valve 1FW-0006, which experienced a dislodged right retaining pin and right pivot pin, as documented in ONE Form X 92-1058. This was identified during the disassembly and inspection performed during 1RF02.

TE 93-1291 was initiated on June 15, 1993, to perform a failure analysis of Check Valve 2FW-0076, which experienced binding due to improper installation of the left-hand torsion spring, as documented in ONE Form FX [illegible]-1117. This condition was identified on March 20, 1993, which was actually before the start of commercial operations for Unit 2.

TE 93-1892 was initiated on October 1, 1993, to perform a failure analysis of Check Valve 2FW-0013, which failed in service, as documented in ONE Form FX 93-1745, and was disassembled and inspected. The valve disc was found to be lodged in the fully open position.

The inspectors reviewed each of the completed failure analyses and considered them to be in-depth evaluations and very thorough. In each case, the appropriate corrective actions were implemented. Each failure analysis contained a review of: (1) generic implications, (2) equipment history, and (3) similar failures identified in the NPRDS database.

The inspectors considered the failure analysis program to be a strength.

3 CONCLUSIONS

The inspectors concluded that the licensee had established a comprehensive and well planned CVRP which provided clearly defined guidance and instructions. The CVRP responsible engineer was knowledgeable, competent, and enthusiastic. The Kalsi design application review was very comprehensive and included consideration of the relevant factors affecting check valve durability. The inspectors identified some elements of the Kalsi review which were considered nonconservative; however, the licensee had also identified these nonconservatisms and had appropriately revised test/inspection frequencies. The AE test program was well established and was being aggressively implemented. The extent of AE testing was considered a strength. The industry information review system was controlled by sufficiently detailed procedures, and a good tracking system had been implemented. The check valve maintenance program was well structured, defined, and implemented. Surveillances verified that surveillances/tests were being performed in accordance with ASME code requirements and within specified frequencies. The trend analysis program was well defined, but was in its early stages of implementation. The CVRP failure analysis program was very thorough and the inspectors considered this to be a strength.

ATTACHMENT 1

1 PERSONS CONTACTED

1.1 Licensee Personnel

*J. Barker, Independent Safety Engineering Group Manager
*O. Bhatty, Senior Regulatory Compliance Engineer
*R. Cockrel, Mechanical Engineer
*L. Elmer, Total Plant Services Support Supervisor
*W. Grace, Safety Services Manager
*D. Heintz, Senior Nuclear Specialist
*B. Homan, Total Plant Services Support Analyst
*N. Hood, Emergency Planning Manager
*T. Hope, Regulatory Compliance Manager
*B. Lancaster, Plant Support Manager
*R. Locke, Senior Engineer
*R. Mays, Codes and Standards Mechanical Engineering Supervisor
*D. McAfee, Manager, Quality Assurance
*G. Merka, Licensing Engineer, Regulatory Affairs
*J. Muffett, Station Engineering Manager
*M. Smith, Plant Support System Supervisor
*D. Stewart, Check Valve Reliability Program Responsible Engineer
*R. Withrow, Component Test Supervisor
*T. Wright, Senior Engineer

1.2 <u>Hartford Steam Boiler and Inspection Company</u>

*J. Hair, Authorized Nuclear Inservice Inspector

1.3 <u>NRC Personnel</u>

*H. Bundy, Reactor Inspector
*D. Graves, Senior Resident Inspector

*Denotes personnel attending the exit meeting.

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

2 EXIT MEETING

An exit meeting was conducted on January 14, 1994. During this meeting, the inspectors reviewed the scope and findings of the report. The licensee acknowledged the inspection findings documented in this report. The licensee did not identify as proprietary any information provided to, or reviewed by, the inspectors.

On January 20, 1994, the licensee's Regulatory Compliance Manager provided additional information in response to the inspectors' request, thus resolving minor questions that had been addressed during the exit meeting.

ATTACHMENT 2

DOCUMENTS REVIEWED

Technical Evaluation No.	Valve No.
TE 93-1054	1AF-0032 & 1MS-0143
TE 93-1256	1AF-0032 & 1MS-0143
TE 93-1798	1CC-0031
TE 91-1027	1DO-0058
TE 92-689	1FW-0076
TE 93-1180	1FW-0192
TE 93-2435	1-8481A
TE 93-2413	1-8922A & B

Maintenance Procedures

MSM-CO-8740, "Crane Swing Check Valve Maintenance," Revision 0 through PCN 4, dated September 30, 1993

MSM-CO-8741, "Crane Check Valve Maintenance (Tilting Disc)," Revision 0 through PCN 2, dated October 16, 1990

MSM-CO-8743, "Crane Check Valve Maintenance (Pressure Seal Bonnet Tilting Disc)," Revision 0 through PCN 5, dated October 30, 1993

MSM-CO-8800, "Borg Warner Check Valve Maintenance (Bolted Bonnet)," Revision 0, dated June 30, 1993

MSM-CO-8801, "Borg Warner Check Valve Maintenance (Pressure Seal," Revision 5, dated June 30, 1993

MSM-CO-8815, "Rockwell Tilting Disc Check Valve Maintenance," Revision 0 through PCN 2, dated November 9, 1993

MSM-CO-8819, "TRW Mission Check Valve Maintenance," Revision 1 through PCN 1, dated May 7, 1993

MSM-CO-8821, "Velan Swing Check Valve Maintenance," Revision 0 dated November 6, 1989

MSM-GO-0221, "Sensor Mount Installation," Revision 0 dated June 19, 1992

MSM-SO-8800, "Section XI Check Valve Disassembly Inspection," Revision 0 through PCN 4, dated September 23, 1993

CHECK VALVE SAMPLE

AF-0032	CS-8481B	SI-8922A
AF-0078	CT-0042	SI-8922B
AF-0101	DO-0058	SI-8956B
CC-0031	FW-0076	SI-8949A
CC-0713	FW-0192	SW-0373
CC-0831	MS-0143	SW-0374
I-8043	RH-8730A	
I-8044	MS-0680/0681	

E-Mail report to D. Sullivan (DJS)

bcc to DMB (IE01)

bcc distrib. by RIV:

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2/11/94	2/11/94	02/11/94	02/11/94	2/17/94	2/17/94