U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

Division of Reactor Inspection and Safeguards

Report No.: 50-313/89-200
Docket No.: 50-313

Licensee: Arkansas Power and Light (AP&L) Company
P.O. Box 551
Little Rock, Arkansas 72203

Facility Name: Arkansas Nuclear One (ANO) - Unit I

Inspection at: AP&L Corporate Offices in Little Rock Arkansas and ANO Site

Inspection Conducted: July 10, 1989 through July 21, 1989

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TABLE OF CONTENTS

Arkansas Nuclear One (ANO) - Unit 1
Bulletin 79-02 and 79-14 Follow-up Inspection
July 10 through 21, 1989

1. BACKGROUND INFORMATION

Inspection and Enforcement (IE) Bulletin 79-02, Revision 0, "Pipe Support Base Plate Designs Using Concrete Expansion Anchor Bolts," was issued on March 8, 1979 to ensure the adequacy of the design and installation of pipe support base plates using concrete expansion anchor bolts. IE Bulletin 79-14, Revision 1, "Seismic Analysis for As-Built Safety-Related Piping Systems," was issued on July 2, 1979 (16 days after the initial issuance) to ensure conformance between the as-built safety-related piping systems and the associated seismic analyses (i.e., the as-design piping configuration).

As a result of inspections recently conducted at various facilities, the NRC has been getting indications that the actions requested by Bulletins 79-02 and 79-14 may not have been properly completed by all licensees. Consequently, the NRC staff has decided to review implementation of these bulletins at a few representative plants. The first plant selected for this review was ANO, Unit 1.

2. PURPOSE OF INSPECTION

The purpose of this inspection was to assess Arkansas Power and Light (AP&L) Company's commitment to implement IE Bulletin 79-02 and Bulletin 79-14.

3. INSPECTION EFFORT AND REPORT ORGANIZATION

3.1 Inspection Effort

For Bulletin 79-02 the inspection team reviewed the licensee's program as well as implementation of that program to verify conformance with the subject bulletin. A site walkdown of various pipe supports was performed to evaluate the adequacy of randomly selected installed baseplate and anchor bolts, as well as a review of pipe support designs selected from the piping analyses reviewed by the team.

For Bulletin 79-14 six piping analyses were identified by the inspection team as potential inspection subjects during a pre-inspection visit to the AP&L offices on June 28 and 29, 1989. These analyses were identified to permit AP&L to assemble copies of the associated piping calculations and pipe support drawings such that the inspection team could begin work immediately upon arrival. The six chosen analyses included the following portions of systems:

(a) Emergency feedwater (EFW) from pump discharge nozzles to containment penetrations.
(b) EFW turbine steam supply.

(c) Decay heat removal (DHR) suction piping from the containment penetrations to the DHR pump suction nozzles.
(d) Main feedwater safety-related piping located outside of containment.
(e) DHR discharge piping from the DHR pumps to the DHR heat exchanger.
(f) Service water piping located in the intake structure building.

The inspection methodology was composed of a comprehensive review of design criteria documents, design inputs, drawings, computer models, walkdowns to verify consistency between the field installations and the analyzed configuration and review of other design basis documents, as applicable, to ensure compliance. The piping runs modeled in the six analyses were walked down on a sampling basis to verify agreement between the installed configuration and the analytical model. Due to time constraints, only the first four analyses [i.e., (a) through (d)] had a detailed design review performed by the inspection team.

3.2 Report Organization

Section 4 lists those practices which were viewed by the inspection team to be indicative of licensee weaknesses. Section 5 provides those licensee good practices that were favorably viewed by the inspection team to be indicative of licensee strengths. Observations on SAR compliance are provided in Section 6. Section 7 provides the overall conclusions reached by the inspection team.

Three appendices are attached to the report. Appendix A lists the most significant discrepancies identified by the inspection team. Appendix B lists the discrepancies primarily identified as a result of the inspection team's walkdown that are not included in Appendix A. Appendix C lists the personnel contacted during the inspection.

4. LICENSEE WEAKNESSES

4.1 Sample Size Associated With Bulletin 79-02

The number of bolt samples selected and tested was approximately one tenth that required by IE Bulletin 79-02. IE Bulletin 79-02 required that bolt samples would be selected randomly and tested to achieve a 95 percent confidence level that less than 5 percent defective bolts were installed in any one of the safety-related piping systems, and that this level of confidence be achieved for each system. The contractor who performed this task for the licensee had randomly selected and tested bolts to achieve the 95 percent confidence level with less than a 5 percent defective bolt criterion from the whole plant, not system by system. Since there were 11 safety-related piping systems at ANO-1 Unit 1, the total number of bolt samples required by IE Bulletin 79-02 would have been about 10 times more than that selected and tested. The licensee has acknowledged the sampling deficiency and committed to perform additional sample testing to correct the deficiency.

4.2 Consistency Between the As-Built and As-Designed Piping

AP&L acknowledged they did not possess nor could the architect-engineer readily retrieve the original 79-14 walkdown documentation. Based on the lack of original 79-14 documentation and the continuing identification of field discrepancies, AP&L initiated the Iso-Update Program in 1986 to improve the quality of design drawings and later in 1987 expanded the scope of the program to be a reconciliation between the as-built seismic Class I piping/supports and the governing design.

At the time of the inspection AP&L had completed approximately 10 percent of the Iso-Update Program for ANO Unit 1. AP&L indicated that in its previous walkdown program approximately 50 percent of the plant systems had been completed, but due to a change in walkdown criteria the program was started over. Based on the discrepancies that continued to be identified by this program, as well as the discrepancies identified by the inspection team (see Appendices A and B), it is apparent that the action in response to Bulletin 79-14 is incomplete and AP&L will not have assurance that the piping design matches its field installation until the Iso-Update Program is completed. Current planning by AP&L was to complete the program between five and eight years from the date of this inspection. The team concludes that a higher priority on the completion of this program is warranted. AP&L has not completed the actions requested by NRC Bulletin 79-14.

4.3 Missing Pipe Support Calculations

The original pipe supports were designed by Grinnell through a contract with the architect-engineer. The design loads for pipe supports were shown on the pipe support sketches, but the design calculations to substantiate the adequacy of these supports were not available. AP&L stated that efforts had been made to recover the pipe support design calculations from Grinnell but were not successful.

Since ANO Unit 1 was one of the early-vintage nuclear power plants, the inspection team believed that the situation of unavailable or missing design records for pipe supports was not uncommon. The design practice for pipe supports at that time was mainly a catalog type of selection and the need of record keeping was not universally followed among pipe support designers.

AP&L and its contractors had analyzed some of the as-built piping systems and the analysis results had yielded new loads for pipe supports. These new loads were then compared to the design loads shown on the Grinnell pipe support sketches. If the new load was 5 percent greater than the original design load, new design calculations would be required and generated for the pipe support. Otherwise, the pipe support was considered to be adequate and was not reanalyzed. If the new design calculations resulted in the need for physical modifications to the pipe supports, modifications would be performed. The inspection team believed that the licensee's logic for assessing the adequacy of pipe supports was reasonable because the 5 percent tolerance limit was small enough to avoid overloading the pipe support.

4.4 Design Input and Modeling Practices

In reviewing the piping analyses the inspection team checked the coding of computer input against design information, and identified some modeling inconsistencies which amounted to incorrect and/or under prediction of design loads and stresses. The representative examples included inaccurately modeling thermal modes, failure to consider the effects of mass eccentricity, zero period acceleration, seismic anchor movements, and using various truncated models to amend and reduce model size. AP&L attempted to defend some of the items by demonstrating consistency with original modeling methods, engineering judgments, or documented internal memorandums. The inspection team took exception to these arguments and concluded that modeling techniques based on nonconservative engineering judgments were not acceptable.

4.5 Code Compliance

The original code of record for ANO Unit 1 nuclear piping was ANSI B31.7 draft Edition of February 1968, with Errata of June 1968. The current analysis code utilized by AP&L was the ASME-III 1977, including Winter 1979 Addenda. However, AP&L indicated that they still had the caveat to use the original code despite their current analysis intentions. The inspection team took exception to this approach. AP&L needs to establish the code of record, and then to consistently apply it. AP&L had hired a consultant to do the code reconciliation and the associated report was scheduled to be issued in January 1990.

5. LICENSEE STRENGTHS

5.1 Implementation of Bulletin 79-02 - Excluding Sample Size

A description of the work performed for IE Bulletin 79-02 at ANO Unit 1 was contained in a report entitled "Arkansas Nuclear One NRC IE Bulletins 79-02 and 79-14 Summary Report" prepared by Bechtel Power Corporation, February 1985 and revised September 1985. The scope of the work for IE Bulletin 79-02 was handled by two Bechtel subgroups; engineering and construction. The engineering group identified all the safety-related pipe supports with flexible baseplates, evaluated them for adequacy, and redesigned the inadequate pipe supports. The construction group performed plant walkdowns, and tested expansion anchor bolts using torque verification methods, verified the as-built pipe support configurations against the design, and physically modified pipe supports in accordance with the redesign by the engineering group.

All the safety-related pipe supports with flexible baseplates were reanalyzed for the adequacy of expansion anchor bolts. The pipe support loads were taken from the Grinnell pipe support sketches and factors of safety for expansion anchor bolts were then calculated by a computer program which had accounted for baseplate flexibility. Expansion anchor bolts having a factor of safety less then two required immediate or short-term pipe support modification. Pipe supports with expansion anchor bolts having a factor of safety between two and four (nonshell bolts) and five (shell bolts) were given a longer time for the completion of modification.

All the associated pipe support modifications had been completed before December 12, 1979, and had been determined to meet IE Bulletin 79-02 requirements.

Except for the deficiency in the number of bolts sampled, the licensee responded rapidly and performed well with respect to IE Bulletin 79-02. All the pipe supports anchored by expansion bolts had been upgraded with a factor of safety equal to, or greater than four for nonshell bolts and five for shell bolts. Such a high factor of safety for expansion anchor bolts had been commonly recommended by bolt manufacturers for design, and normally followed by designers. The factor of safety makes allowances for any differences between actual field conditions and laboratory test conditions. Bolt behavior studies have shown that significant differences could occur due to the baseplate flexibility effect, concrete cracking near bolts, and improper installation of bolts. The baseplate flexibility effect was generally not considered by Bechtel during original design due to its complexity, but was considered by Bechtel during its re-analysis for the adequacy of expansion anchor bolts at ANO-1 Unit 1. No concrete cracking near bolts was observed by the inspection team during walkdowns. The aforementioned evidence indicated that sufficient safety margins existed in the field with bolts still having a minimum factor of safety of four. The proper installation of bolts was verified at ANO-1, although the sample size was not up to the standard specified in the IE Bulletin 79-02. The effect of the small sample size in determining the safety margin of expansion anchor bolts was secondary compared to the primary effects of baseplate flexibility, concrete cracking near bolts, and improper installation of bolts. Therefore, with all things considered, the licensee's activity with respect to IE Bulletin 79-02 had reasonably assured the safety of pipe supports with expansion anchor bolts in spite of relatively low sample size.

5.2 Staffing and Inspection Support

AP&L was directly responsible for the performance, supervision, control, and management of nuclear safety-related piping analysis and support design work; having taken over the scope of this work from the original architect-engineer firm, Bechtel, in October 1986.

The inspection team was generally satisfied that AP&L had established a competent design and management team to conduct nuclear safety-related piping design work. The design organization appeared to be very responsive to operational issues and where broad problems were identified, a program was already in place which would eventually correct the situation if fully and properly implemented (i.e., Iso-Update, program configuration management, snubber reconciliation and specific piping technical guidance). Without exception, all AP&L personnel interfaced during the inspection showed a high degree of professionalism, competence in understanding of technical issues, willingness to provide information, and contributed to discussions in an objective manner to resolve comments.

5.3 Current Analytical Techniques and Design Criteria

The inspection team found the current piping analysis methods, such as modeling techniques and loads specification, recently employed by AP&L to be appropriate and comparable to methods used elsewhere in the industry. Contributing to the adequacy of analytical techniques was the apparent competence and concern with ANO piping design quality exhibited by the project engineering staff. Also, AP&L had taken steps to improve the piping design process during the past two years. The standardization and guidance provided by Specification APL-M-2514, entitled, "Technical Specification for the Design of Piping," Revision 0, dated June 10, 1987 and the yet to be issued document 88-E-0125-01, "Structural Design Guide," were examples in this regard. The specification included topics such as closely-spaced modes, 3-directional earthquake, use of zero period acceleration (ZPA) in assuring minimum pipe motion, seismic anchor movement, use of actual support stiffness, deflection check at restraints, backside anchor load calculation, adequacy of the multiplication factor between operational basis earthquake (OBE) and design basis earthquake (DBE) responses, friction force in support design, and load combinations. Although the specification did include a caveat which permitted exceptions to the criteria, AP&L statements and inspection team observations indicated that it was seldom invoked. However, the inspection team did conclude the specification should be revised to eliminate exceptions and thereby ensure consistent application of project requirements. The planned release of the design guidelines as controlled documents would also promote piping design quality.

6. SAFETY ANALYSIS REPORT (SAR) COMPLIANCE

The inspection team identified no areas of noncompliance with the SAR. This was mainly due to the vintage of the plant and that ANO Unit 1 was not committed to the standard review plan format. Thus, the ANO Unit 1 SAR was rather terse and did not address design specifics, such as load combinations, which were included in lower level design input documents referenced in Section 5.3.

The inspection team reviewed the smoothed response spectrum curves and found them acceptable on the basis of the vintage of the plant and the SAR commitments. Unlike the current position in Regulatory Guide 1.122, there was no specific guidance on spectrum peak broadening when the plant was constructed. The spectrum peaks were therefore smoothed, but not broadened.

The ground response spectra used for ANO-1 design was less conservative than the Regulatory Guide 1.60 spectra, but typical for plants of that vintage. However, the damping values used for piping analyses were very conservative, which is 0.5 percent for both DBE and OBE, for pipes of various sizes.

Another exception regarding current licensing requirements concerned the cut-off frequency in the dynamic analysis, which was specified at 30 Hertz in lieu of 33 Hertz. Considering that zero period acceleration (ZPA) was planned to be included in the piping analysis for assuring adequate representation of support motion, the staff feels that the absence of higher modes would not have significant effect on the piping response, and, therefore, was acceptable.

7. CONCLUSIONS

For Bulletin 79-02, the inspection team concluded that AP&L had not adequately completed the actions specified in the bulletin because of having tested too few bolts. All other aspects of the program were satisfactory and the inspection team concluded that adequate anchorage for baseplates had been provided, even though some additional testing is appropriate.

For Bulletin 79-14, AP&L had not adequately completed the actions specified in the bulletin. The inspection team identified numerous inconsistencies between the constructed piping system and the piping analyses, the walkdown program was only 10 percent complete, good engineering practices were inconsistently considered (e.g., ZPA, eccentric masses, SAM, etc.), and additional analyses that were needed (i.e., local stresses for lugs, valve seismic qualification, water hammer, etc.). In addition, AP&L had independently identified that the wrong response spectra had been used in the service water piping analysis for the intake structure. Similar problems may exist in the piping analyses of other systems. Therefore, the Iso-Update Program needs to be completed in a timely and thorough manner to bring ANO Unit 1 into conformance with Bulletin 79-14.

APPENDIX A - Significant Discrepancies

Bulletin 79-02 Discrepancies

Bulletin 79-14 Discrepancies

APPENDIX A

SIGNIFICANT DISCREPANCIES

The discrepancies identified in this appendix are considered to be the most significant issues resulting from this inspection and are numbered separately. They are categorized by their applicability to the individual bulletins. For Bulletin 79-14 the discrepancies are further broken down into headings of piping analysis nonconservatisms, as-designed and as-built piping differences, and additional analyses needed to justify current plant configuration. The AP&L action item number that was assigned to the individual issues during the inspection are also provided as an aid in providing continuity between the inspection and the report. The inspection team acknowledges AP&L's commitment to individually resolve and track all issues identified during this inspection such that their resolution could be verified at a later date.

Bulletin 79-02 Discrepancies

1. Sample Size of Bolts to be Tested 50-313/89-200-01 (OPEN)

Bulletin 79-02 required that bolt samples should have been selected randomly and tested to achieve a 95 percent confidence level that less than 5 percent defective bolts were installed in any one of the safety-related piping systems, and the sampling program conducted on a system-by-system basis. However, AP&L's architect-engineer had randomly selected and tested bolts to achieve the aforementioned confidence level from the whole plant, not on a system basis, without increasing the size of the sample. Since there were 11 safety-related piping systems at ANO-1 Unit 1, the total number of bolts sampled should have been increased by a factor of 10 to comply with the original scope of this bulletin. The work done for Bulletin 79-02 at ANO Unit 1 was contained in a report entitled "Arkansas Nuclear One NRC IE Bulletins 79-02 and 79-14 Summary Report," prepared by Bechtel Power Corporation, dated February 1985 and revised September 1985. (Refer to AP&L Action Item No. 54.)

Bulletin 79-14 Discrepancies

A. Piping Analysis Nonconservatisms

(1) Pump Nozzle Loadings 50-313/89-200-02 (OPEN)

In reviewing the Decay Heat Removal (DHR) suction piping analyses, the inspection team identified three unjustified modeling discrepancies which if corrected would have increased the suction nozzle loadings on the DHR pumps and the reactor building spray pumps. First, in modeling the normal shutdown cooling mode, a temperature of 300°F was assumed for almost 15 feet beyond closed valves DH-8A and DH-8B without any justification for this assumption. A realistic temperature gradient in these lines would result in a temperature distribution of less than 300°F and would increase the loading on the DHR suction nozzles (Refer to AP&L Action Item 32).

Second, the effect of eccentricity of mass for the actuator of valve BW-8A which was oriented in the horizontal position was not considered in the analysis model. AP&L indicated that the mass of manually operated valves could be ignored as indicated in the Pistar modeling guidelines manual. The inspection team took exception to these guidelines and advised AP&L that no guidelines should be followed blindly. In this case, the subject valve although manually operated, had a significant amount of eccentric mass due to the handwheel gear box, unlike most other manually operated valves and needed to be evaluated. In addition, the actuator was oriented in the horizontal position and was located in close proximity to DHR Pump 34A suction nozzle (Refer to AP&L Action Item No. 41).

Third, according to AP&L guidelines, valves were modeled as equivalent pipes with twice the nominal wall thickness and flanges were modeled as pipes with additional mass. Both of these practices make the piping system more flexible than it would have been with realistically modeled flanges and valves. While this practice may be conservative from a seismic standpoint, it underpredicts the loads and stresses in the thermal expansion analysis. Specifically, the inspection team was concerned that the thermal loads on the nozzles of reactor building spray (RBS) Pump 35A had been similarly underestimated. (Refer to AP&L Action Item No. 66.)

During the inspection, AP&L did not provide information to the team that demonstrated that operability of the DHR and RBS pumps had not been adversely affected or provide assurance that similar modeling nonconservatism was adequately considered for other analyzed safety-related systems. Also, conservative guidance with regard to the consideration of eccentric masses of valve actuators and thermal analysis modeling was not yet established.

References:

a. DHR Original Stress Analysis Calculation No. 669 by Bechtel; Math Model Revision 6, September 22, 1979; Computer Input, May 16, 1980; Check Sheets, June 16, 1980.

b. Stress Analysis Calculation Package 87D-1098-02, File Number ARK 21.0300, Revision 4, pages 1 through 114 and cover sheet.

c. Stress Analysis Calculation Package 87D-1098-20, File Number ARK 21.0307, Revision 1, pages 1 through 64 and cover sheet.

(2) Seismic Anchor Motion (SAM) 50-313/89-200-03 (OPEN)

The piping analysis for the emergency feedwater (EFW) turbine steam supply line (AP&L calculation 87D-1099-02, Qualification of EFW Turbine Steam Supply for MOVATS Changes, Revision 0, dated June 21, 1989) assumed that the subject lines were anchored at the connection to the main steam piping. However, no SAM displacements were modeled because the previous 1980 analysis by the architect-engineer had incorrectly omitted them, and the newer analysis made the same assumptions. This is viewed by the inspection team to be an example of improper verification of input data, as well as a nonconservative modeling assumption. (Refer to AP&L Action Item No. 53.)

Another example of not considering SAM was identified by the inspection team for piping analysis associated with the safety-related main feedwater piping from the containment penetration including the containment isolation valve (Reference Computer Problem No. 441 dated November 30, 1972 and No. 439 dated March 27, 1973). As a result of this and other discrepancies identified by the inspection team and AP&L project personnel, AP&L reran the associated computer analysis. Preliminary, results from AP&L indicate that associated feedwater piping was qualified even with the failure of one existing snubber. As part of their general response to having considered SAMs, AP&L could only verify that the calculation associated with the high pressure core spray had included SAM. (Refer to AP&L Action Item No. 6.)

For the EFW turbine steam piping, AP&L did not evaluate the effect of the seismic displacement effects associated with main steam line piping on the qualification of this piping. In addition, AP&L has not evaluated other safety-related piping analyses to ensure that piping models terminated at nonrigid piping and anchors have been correctly modeled to include the associated seismic anchor movements.

(3) Thermal Expansion for Varying Operating Modes 50-313/89-200-04 (OPEN)

The inspection team identified that a single thermal expansion load case was evaluated for the piping analysis associated with the EFW turbine steam supply line. The case evaluated was associated with the subject piping heated uniformly to the same maximum operating temperature. However, the inspection team identified one example of a thermal mode which was not analyzed where the piping downstream of the steam admission valves (CV/SV 2613 and CV/SV 2663) was relatively cold compared to the upstream piping. An AP&L evaluation of the system operating modes for this piping was not available at the time of the inspection. Although approved on June 21, 1989, the subject piping analysis was actually performed in early 1988. AP&L noted that current analysis practice would require evaluation of thermal expansion load cases. A draft project guideline for the review of operating modes was awaiting approval and available for information.

AP&L had not reviewed and identified all associated EFW turbine steam supply operating modes which may require thermal expansion analysis. Piping stress reanalysis may be required based on the results of this review. Additionally, AP&L had not provided assurance that other safety-related piping analyses included all thermal expansion load cases. (Refer to AP&L Action Item No. 64.)

(4) Zero Period Acceleration (ZPA) 50-313/89-200-05 (OPEN)

In the DHR suction piping analysis for the seismic loading condition, the inspection team noticed that AP&L used a model extraction cut-off of 30 hertz or 100 modes, whichever occurred first. Generally, in most analyses the frequency limit would be reached before the modal limit. However, if the analysis was very large, like the DHR suction piping or involved small bore piping, the 100 mode limit could possibly govern. If the modal limit governed, the dynamic analysis would underpredict support loads and pipe stresses. This practice was further aggravated since AP&L was apparently only considering the larger of the dynamic solution or the ZPA, as suggested in Section 6.3.1 of document APL-M-2514, "Technical Specification for the Design of Piping," Revision 0, dated June 10, 1987. For the four analyses reviewed by the inspection team only two had properly considered ZPA: DHR suction piping and EFW pump discharge piping. Neither the main feedwater piping analysis dated March 27, 1973 nor the EFW turbine steam supply piping analysis dated June 21, 1989 included ZPA. AP&L did not have any justification that other dynamic analyses had been reviewed to ensure that their frequency cut-off commitment of 30 hertz had been met and that it had been combined with ZPA. (Refer to AP&L Action Item 50 which discussed modal cut-off. ZPA was discussed but no action item number was assigned.)

(5) Eccentric Mass of Valve Actuators 50-313/89-200-06 (OPEN)

The inspection team identified two examples where AP&L piping analyses had failed to consider the eccentric mass of valve actuators. The first was previously discussed in discrepancy number 2 of this appendix, in which the eccentric mass of the valve BW-8A, located in the decay heat removal suction piping, was inappropriately omitted in calculating the DHR pump suction nozzle loadings. The second example was associated with the main feedwater containment isolation valve. Preliminary reanalysis of the main feedwater piping by AP&L indicated that the effects to eccentric mass in this application were minimal, however, this was not apparent until the analysis was performed. AP&L's generic response to this issue, included a Bechtel letter numbered MCO-00850 and undated which stated that valve eccentricity was not addressed as part of Bulletin 79-14 and that the NRC had accepted this approach. The inspection team strongly disagreed with exclusion of valve eccentricity from the scope of Bulletin 79-14. Page A-2 of the subject bulletin dated July 18, 1979 clearly stated that valve and valve operator locations and weights were to be included. Based on Bechtel's lack of consideration of the effects of eccentric valve masses, AP&L failed to consider these eccentric mass effects on the operability of other safety-related systems. (Refer to AP&L Action Item No. 5.) Also AP&L did not have conservative procedural guidance with regard to the consideration of eccentric masses in piping analyses.

(6) Containment Penetration Displacements 50-313/89-200-07 (OPEN)

In reviewing the DHR suction piping analysis, the inspection team noted that containment penetration displacements were not considered associated with post-LOCA temperature rise and pressurization of the reactor containment building. Similarly, pressurization effect associated with integrated leak rate testing was not addressed as well as, pressure/temperature increases associated with a main streamline leak. AP&L had not analyzed the DHR system and other safety-related systems that penetrate the containment for these effects. (Refer to AP&L Action Item No. 39.)

B. As-Designed and As-Built Piping Differences

(1) Nonfunctional Pipe Supports in the Service Water System 50-313/89-200-08 (OPEN)

The inspection team performed a walkdown of the service water system piping in the intake structure building as shown on piping isometric drawings 13-SW-132, Revision 3, and 13-SW-133, Revision 4. Two separate pipe supports, each designated as HBD-2-H1 were identified by the inspection team as not being load bearing. Both pipe supports were designed as vertical supports configured as pipe stanchions welded to the subject piping and in bearing with the floor via sliding baseplates. The inspection team identified that a ¼-inch gap existed between the stanchion and the floor. Therefore the as-built configuration did not agree with the existing analysis. AP&L indicated that these two supports were immediately grouted once the issue was identified. Additionally, in performing a system operability evaluation to support plant operations with one service water pump removed and in preparation for this inspection, AP&L indicated that the wrong response spectra curves had been utilized by their architect-engineer in designing the service water system piping (0.8g used instead of 2.1g). AP&L indicated that the reanalysis of the service water piping using the correct response spectra and with one service water pump removed resulted in an operable system. However, the team concluded that the following would be needed to clearly establish that the operability of the system is unaffected.

a. Verify system operability with the two supports not included in the design analyses.

b. Assurance that the supports when grouted became load bearing and that they were not just cosmetically changed to remove the apparent gap.

c. Include in the reanalysis consideration of all sliding supports that do not use Teflon, Lubrite or other friction reducing material. These frictional considerations apply to the pipe support design as well as the stress analysis.

(Refer AP&L Action Item No. 68)

(2) Recently Re-Worked DHR Pipe Support Not In Agreement With Design 50-313/89-200-09 (OPEN)

As part of the corrective actions associated with a water hammer event, pipe support DH-122 was to be re-worked to its original configuration. The water hammer event and corrective actions were described in an undated and unsigned compilation report entitled "Probable Cause Evaluation, Arkansas Nuclear One-Unit 1, Decay Heat Piping and Support Deficiencies." A walkdown by the inspection team identified that this wide flange box restraint (i.e., DH-122) had a ¼-inch gap at the top of the pipe in lieu of the design value of 1/16-inch. Therefore, from a design perspective the pipe support would not be assumed to restrain the piping in the vertical upward direction. AP&L did not have information to demonstrate the acceptability of the excessive gap for hanger DH-122 including an explanation from a programmatic perspective why QA/QC did not identify and correct this discrepancy. (Refer to AP&L Action Item No. 5.)

(3) Spring Hangers 50-313/89-200-10 (OPEN)

As a result of the inspection team's field walkdown numerous discrepancies were identified with regard to spring hanger design. The issues identified ranged from spring settings outside of the design range by as much as 8 percent (see AP&L Action Item No's 8, 9, 20, 27, 29, 56 and 58), maintenance tags installed for as long as 6 months on potentially inoperable springs (see AP&L Action Item No. 20), extra unanalyzed mass attached to spring hanger, viz. an electrical conduit (see AP&L Action Item 20), no design setting provided on hanger drawing (see AP&L Action Item No. 37), interference with adjacent piping insulation (see AP&L Action Item No. 18), and a spring setting could not be verified due to missing or illegible scales (see AP&L Action Item No's 23 and 29). AP&L did not have an evaluation of all of the aforementioned discrepancies including timeliness of maintenance activities, nor did AP&L have a program to ensure that spring settings were verified and maintained within an acceptable tolerance. (See AP&L Action Item No. 17.)

(4) Snubber Settings 50-313/89-200-11 (OPEN)

During the walkdown of the main feedwater system, the inspection team identified one pipe support, EBD-10/HS-39, Revision 1, whose snubber hot load pin-to-pin dimension exceeded the design value by an amount equivalent to the predicted design movement. AP&L subsequently reviewed the snubber configuration to ensure that the snubber was not bottom-out in either its hot load or cold load position and reviewed the last outage inservice inspection (ISI) data which had independently evaluated the subject snubber's travel and verified that this snubber had an acceptable travel range. Also, AP&L indicated that a snubber reconciliation program had currently reviewed 39 Unit 1 snubbers. The purpose of the snubber reconciliation program was to update the pipe support drawings in accordance with the existing stress analyses and create a data base to augment the ISI evaluation of snubbers. The inspection team concurred with the implementation of the reconciliation program provided it is completed in a timely manner. The inspection team also noted that based on the issues identified in this inspection report and the non-rigorous status of the AP&L piping analyses, the calculated snubber movement may be underestimated. (Refer to AP&L Action Item No. 24.)

(5) Main Feedwater Containment Isolation Valve Interaction With Structural Platform 50-313/89-200-12 (OPEN)

The inspection team, during the system walkdown, identified that the actuator of the main feedwater isolation valve, CV 2680, was actually in contact with the handrail of the ladder of the structural platform. This interference needed to be eliminated to ensure that seismic interaction with the platform would not have any deleterious effect on the valves operability. Additionally, AP&L did not describe what programs had been implemented for ANO Unit 1 to review similar unacceptable seismic interactions and why this example was not previously identified.

C. Additional Analyses To Justify Current Plant Configuration

(1) Main Feedwater Water Hammer Analysis 50-313/89-200-13 (OPEN)

In reviewing the main feedwater stress analysis, the inspection team questioned whether any water hammer evaluations had been performed. Specifically, the inspection team was concerned that AP&L had no justification to ensure that the pressure integrity of the safety-related portion of the main feedwater system would not be breached due to the severe loadings resulting from a water hammer event. Piping integrity is required to permit the emergency feedwater system to fulfill its intended safety function.

AP&L's response from their architect-engineer indicated that the main feedwater water hammer analysis piping design did not consider water hammer as a design transient. Also, the response further stated that the loss of nonseismic piping as a result of a design basis earthquake was not required to be postulated as justified in NRC Generic Letter GL 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment In Operating Reactors."

This response was not acceptable since it inappropriately references GL 87-02 as the justification for assuming that piping designated as nonseismic Category I and located in a nonseismic Category I building would maintain its pressure integrity following a design basis seismic event. The classification of the main feedwater piping located in the turbine building has consistently, since the construction permit was issued, been classified as nonseismic Category I and, as such, was not designed for a seismic design basis event. Therefore, if a design basis seismic event occurred, the nonseismic main feedwater piping located in the turbine building would be postulated to fail instantaneously and the safety-related portion of the main feedwater piping should have been analyzed for the associated water hammer. Therefore, AP&L is requested to provide assurance that the safety-related portion of the main feedwater piping would maintain its pressure integrity subsequent to a water hammer resulting from a design basis seismic event. Without such an analysis or suitable justification, AP&L would not have assurance that the EFW system could meet its licensing design requirements. Also, the team was concerned that other systems may have similarly not considered water hammer loadings. (Refer to AP&L Action Item 3.)

(2) Seismic Qualification of Main Feedwater Isolation Valve
50-313/89-200-14 (OPEN)

The inspection team reviewed the seismic qualification of the main feedwater isolation valves. The qualification analysis was performed for AP&L by Anchor/Darling Valve Company and entitled "Seismic Design Calculations, Bechtel Order 6600-M-258-BC Rev. 8, Valves CV-2630 and CV-2680," September 10, 1974. Bechtel Specification No. 6600-M-123, "Nuclear Class Gate, Globe and Check Valves For Arkansas Nuclear One For The Arkansas Power and Light Company," Revision 2, February 17, 1972, in Section 2.5 required that safety-related valves with operators would be able to withstand an inertial load of 3g in any direction in addition to normal operating loads. In addition, the specification required the extended parts of the valves have a frequency of vibration greater than 20 hertz. In reviewing these requirements, the inspection team noted that the subject valves were not qualified for the orientation in which the valves were installed (i.e., with the actuators in the horizontal position).

AP&L was able to show that the actuator bolt stresses were below the maximum allowable stresses. However, for the yoke, AP&L was unable to demonstrate that the actuator was qualified for the specification requirement of seismic and thrust forces acting concurrently. AP&L initiated a Condition Report 1-89-0415 to verify that the seismic accelerators at the valve were less than 3g's and to have Anchor/Darling produce a new seismic qualification calculation. In addition to these actions, AP&L is requested to review the seismic qualification of other similar valves including containment isolation valves, to determine whether or not this issue is pervasive. (Refer to AP&L Action Item 4B.)

A review of the vendor Technical Manual TM A 391.0010 Section 2.3.1.g was made by AP&L at the request of the inspection team, which verified that these valves may be installed in positions other than with the stem vertical. A review of Anchor/Darling document entitled "Description of Modifications Needed to Convert 18 inch S150DD Valves For Use in Horizontal Lines and Horizontal Steam Positions" dated October 1, 1973 and Anchor/Darling drawing 93-13095, "18 No. S150WDD Series 600...With Limitorque Operator" Revision G, revealed that the additional parts necessary for horizontal steam installation had been added to the subject valves. Therefore, the valves have been installed in an orientation acceptable to the valve manufacturer but needed an updated seismic qualification analyses to demonstrate operability under the governing design conditions.

(3) Damaged DHR Piping 50-313/89-200-15 (OPEN)

In response to questions regarding damaged DHR piping and pipe supports due to postulated water nammer related events, AP&L provided the inspection team a copy of an undated report entitled "Probable Cause Evaluation ANO-Unit 1, Decay Heat Piping and Support Deficiencies." The report contained a summary of each support deficiency, review of operational history, root cause determination, corrective actions, and conclusions/recommendations. Based on the evaluation by their operations and engineering staff, AP&L concluded that Category I deficiencies were caused by independent water hammer related events, occurring at different times, and under different operational scenarios. The inspection team only considered certain aspects of this report as part of the inspection effort. Specifically, AP&L's evaluation and refurbishment of piping and pipe supports including their adequacy for continued service was reviewed. However, certain other aspects of the events such as root cause determination, operational corrective actions, and long-term recommendations to eliminate such events remained outside of the inspection team's scope of review.

The report classified the observed DHR piping and support deficiencies identified by AP&L engineering and QC personnel in three categories:

a. Deficiencies resulting from inadvertent pipe movement due to an unanalyzed mode of operation of the DHR piping system. Included in this category were observed failures such as pipe dents, failed lugs, bent shoes, pulled anchor bolts, and damage to support steel.

b. Deficiencies due to configuration reviews. This category mainly included grouted penetrations, which should not have been grouted per the original design.

c Deficiencies due to construction and maintenance related item, such as, arc strikes, missing washers, poor welds, and bent rods not related to thermal and dynamic conditions.

The report specified corrective actions for all support deficiencies, in the form of physical repair/rework or technical evaluation. Also included were corrective actions from an operational standpoint to avoid future recurrence of these events. AP&L provided a copy of Memorandum MCS-89-0187 from W. Eaton to R. Lane dated March 18, 1989, that included an assessment of the pipe dents identified in the DHR piping in the vicinity of certain welded attachments. This evaluation considered existing pipe stresses at dented areas, adequacy of wall thickness under pressure, reduced section modulus, and ovalling effect. AP&L concluded that the dents were acceptable.

The inspection team was generally satisfied with the report considering material evidence and technical reasoning. However, the report lacked details regarding reportability requirements, operability analysis review and results, and integrated systems review to eliminate water hammer. The inspection team focused its attention mainly to the suitability of the damaged piping and supports. In general, the supports were reworked to their original design configuration and the pipe denting (up to 3/8" density over an approximate 16 square inch area) was accepted-as-is. With regard to this review, AP&L committed to perform the following two actions.

First, AP&L will review the local stresses on all lugs attached to the decay heat removal piping. This action was predicated on lug failures as a result of the postulated water hammer and the use of relatively thin piping (i.e., schedule 10S) in the DHR system. This generic action was further justified since AP&L failed to recognize a potential trend associated with a specific lug design. In evaluating a pipe support, DH-113, as a result of a moderate load increase of 11 percent, AP&L determined that the associated lugs had to be reconfigured to satisfy local stress considerations. However, AP&L did not review any other lug pipe supports to verify their design basis was adequate. This is acceptable since it is the inspection team's view that load increases of only 11 percent should be within the design margin for properly designed lugs. Also, only supports that have had their load increased by 5 percent would have calculations substantiating their configuration since AP&L does not have the original pipe support designs performed by ITT Grinnel.

Second, to confirm that local stain hardening did not occur in the area of the dented DHR piping, AP&L committed to perform hardness testing using a hand held instrument such as an Equitip. (Refer to AP&L Action Item No. 26.)

(4) <u>Code Reconciliation 50-313/89-200-16 (Open)</u>

AP&L was committed to design nuclear piping in accordance with the ANSI B31.7 Nuclear Piping Code, 1968 Edition. However, most reanalyses of piping systems had been performed in accordance with a later Edition and Addenda of the ASME Code Section III, without performing any reconciliation between the two Codes. AP&L had recognized the need to perform the required reconciliation and issued a request for proposal in late 1988. At the beginning of the inspection, AP&L had selected a contractor to perform the required task, but had not authorized work to begin. However, AP&L has indicated to the inspection team that a code reconciliation document would be completed in early 1990. Also, AP&L needs to update the FSAR to indicate the governing Code(s) it intends to use for the design of piping systems. (Refer to AP&L Action Item No. 48.)

(5) <u>Updating Stress Analysis Calculations 50-313/89-200-17 (OPEN)</u>

The inspection team's review of the stress analyses for the EFW turbine steam supply was hindered by the fragmented status of the calculation. Three previous calculations, References b through d and the results of those four calculations [i.e., References a, b, c, and d] needed to be considered jointly with one other overlapping calculation, Reference e, to assess the qualification of the subject piping. The relationship of these calculations to each other was difficult to determine. The inspection team found that it was not possible to determine the relationship of the qualification documentation compiled from these calculations to the summary piping qualification as documented in the calculation file without guidance of AP&L personnel familiar with the specific calculation. The inspection team believed that this situation was the result of incomplete documents, incorrect references, and incomplete explanation of file contents. The following paragraphs further illustrate this concern.

During the inspection, neither the inspection team nor project personnel could determine by reference to the calculation file the basis for the pipe support design loads. The pipe stress and support load summaries included in the file for Reference a refer to only one of the included calculations, Reference c. References to the other applicable calculations, References b and d, were not included.

The allowable loads and qualification for the EFW turbine pump nozzle K3 were not included in Reference a. The nozzle load summary sheet included in Reference a refers to Reference b for this information. However, Reference b included neither the allowable nor qualification for the nozzle. The nozzle qualification, including specified allowables, was found to be maintained separately in Reference f.

The inspection team strongly felt that the status of documentation for the piping system was inadequate and that inadequacies would be unlikely to be corrected without guidelines defining when to totally revise piping stress calculations. (Refer to AP&L Action Item No. 49.)

References:

a. AP&L Calculation Number 87D-1099-02, Qualification of EFW Turbine Steam Supply for MOVATS Changes, Revision 0, dated June 21, 1989.

b. AP&L Calculation Number 80D-1083-01, Revision 3, dated November 14, 1984.

c. AP&L Calculation Number 86D-1005-01, Revision 3, date unknown.

d. AP&L Calculation Number 86D-1005-07, Revision 0, dated January 27, 1986.

e. Bechtel Calculation Number 636, revision unknown, dated May 30, 1980.

f. AP&L Calculation Number 88E-0104-26, Nozzle Load Review for the Inlet and Outlet Nozzles on the EFW Pump Turbine Driver K-3, Revision 0, dated November 14, 1988.

APPENDIX B

MINOR DISCREPANCIES 50-313/89-200-18 (OPEN)

This appendix lists the discrepancies identified by the inspection team by system that are not included in Appendix A. The Arkansas Power and Light Company (AP&L) action item number is provided as well as the status of the specific discrepancy. Eventhough some of these discrepancies are closed, they are still examples of differences between the as-built and as-designed piping that had not been reconciled nor documented prior to the inspection. Also, the inspection team acknowledges AP&L's commitment to individually resolve and track all issues identified during this inspection such that their resolution could be verified at a later date.

Drawing/Hanger No.	Discrepancy	Status	AP&L Action Item No.
Main Feedwater System			
Hanger MFW-1, Revision 1	Spring hanger #2 scale read 4860# when drawing specified a hot load (HL) of 4323# and a cold load (CL) of 4593#.	Open	29
Hanger MFW-35, Revision 0	Spring hanger load scale was not visible, i.e., either painted over or does not exist.	Open	29
Emergency Feedwater System			
Drawing 3-EFW-108, Revision 0	Drawing showed two conflicting dimensions for location of Hanger H3.	Open	13
Hanger 3-EFW-108-H8, Revision 0	Drawing showed dimension from center line of pipe to wall as 3'8" when it was actually 2'11".	Open	None
Hanger 3-EFW-109-H8, Revision 0	Spring hanger #1 scale read 395# when drawing specified the loading as HL 409# and CL 415#.	Closed	27
Hanger 3-EFW-109-H5, Revision 0	Spring hanger scale read 1170# when drawing specified the loading as HL 1129# and CL 1132#.	Closed	8
Hanger 3-EFW-111-H3, Revision 0	Spring hanger scale read 675# when drawing specified the loading as HL 654# and CL 670#.	Closed	27
Hanger 3-EFW-111-H7, Revision	Spring hanger scale read 900# when drawing specified the loading as HL 868# and CL 873#.	Closed	9

Drawing/Hanger No.	Discrepancy	Status	AP&L Action Item No.
Hanger 3-EFW-115-H1, Revision 0	Spring hanger scale read 252# when drawing specified the loading as HL 240# and CL 243#.	Closed	27
Hanger 3-EFW-115-H2, Revision 0	Nut loose on one of four anchor bolts for wall support plate.	Closed	15
Hanger 3-EFW-117-H4, Revision 0	No lateral clearance was observed on either side of pipe when the drawing specified 1/16".	Open	14
Emergency Feedwater Turbine Steam Supply System			
Hanger 1-MS-5-H3, Revision 0	Undersized welds (1/8" vs. 1/4")	Open	1
Hanger 1-MS-5-H5, Revision 0	Undersized welds (1/8" vs. 1/4") and weld size could not be verified as all around on baseplate.	Open	1
Hanger 1-MS-118-H6, Revision 0	Undersized welds on bracket (3/16" vs 1/4").	Open	55
Hanger 1-MS-118-H3, Revision 0	Isometric drawing shows hanger location from vertical pipe as 4-1/8" when it was actually 10".	Open	55
Hanger 1-MS-118-H16	Drawing specifies all around weld at channel attachment to embedded steel, but it was only welded on outside of channel not the inside. Drawing specified all around fillet weld on brace, but backside of channel could not accommodate a fillet weld.	Open	19
Decay Heat Removal System			
Hanger DH-14, Revision 2	Drawing showed dimension from centerline of pipe to the symmetrical support rods as 1' 1" when they were actually 1' 10". Hanger was attached to baseplates bolted to the concrete ceiling, not to structural steel as shown. Also, the nut on top of the spring can was loose.	Open	34
Drawing 7-DH-6, Revision 16	Drawing showed dimension from elbow to tee on line GCB-1-6 to be 3' 8-1/2" when it was actually 2' 2-1/2".	Open	None

Drawing/Hanger No.	Discrepancy	Status	AP&L Action Item No.
Drawing 7-DH-6 Revision 16	Drawing showed dimension from Hanger DH-307 to centerline of tee as 4' 6" when it was actually 5' 4-1/2". [*Note that this discrepancy was included in the stress analysis but not documented on the fabrication isometric (fab iso).]	*Closed	33
Drawing 7-DH-6 Revision 16	Drawing showed dimension from Hanger DH 16 to centerline of elbow as 3' 7" when it was actually 3' 2". (*Note that this discrepancy was included in the stress analysis but not documented on the fab iso).	*Closed	33
Hanger DH-?05 Revision 0	Spring hanger scale read 640# when drawing specified no HL or CL settings; centerline of pipe elevation specified as 325' 11" on hanger drawing did not agree with isometric drawing; weld missing between pipe and support plate; weld symbolism problems, such as, no weld size specified and weld type not specified. Height of spring support drawing was 9-3/4", verses actual measurement of 14". Location dimension of 8' 7" shown on plan was actually 7' 0".	Open	37
Hanger DH-306 Revision 2	Drawing dimension between upper support rod and lower support rod indicated as 8" when it was actually 2-1/2"; Drawing dimension between centerline of pipe and support angle iron indicated as 3' 0" when it was actually 3' 4". Clarify note on drawing which stated that hanger should not be loaded.	Open	36
Drawing GCB-4, Sheet 1, Revision 6	Sheet 1 of the drawing showed a dimension between the tee (Item 156) and the elbow (Item 170) as 3' 4" when it was actually 2' 4". (*Note that this discrepancy was included in the stress analysis but not documented on the fab iso.)	*Closed	46
Drawing HCB-2, Sheet 2, Revision 6	Drawing showed dimension from Hanger DH-106 to centerline of elbow as 2' 0" when it was actually 2' 4".	Open	44

Drawing/Hanger No.	Discrepancy	Status	AP&L Action Item No.
Hanger DH-103, Revision 2	Drawing did not show weld symbols or weld sizes. Top wall baseplate had 1/4" gap at lower right anchor. Bottom wall baseplate had 3/8" gap at upper right anchor. Floor baseplate did not have anchor bolts as specified for items 9 and 10 but had installed studs with nuts.	Open	42
Hanger DH-105, Revision 4	Upper left anchor bolt on lower wall baseplate was installed at an 8 degree angle with no beveled washer as required by the installation specification.	Open	43
Hanger DH-106, Revision 1	Drawing showed 2' 1" span for location of support on ceiling I beam when it was actually 3' 9"; End of I beam (pc. 8) ends at mid-point of 6" channel imbed, therefore, weld length is approximately 3" instead of 6" as indicated on drawing.	Open	44
Hanger DH-108, Revision 6	Drawing showed all around fillet weld for six locations and only three sides were welded; 1/4" shim plate used but not specified on drawing.	Open	45
Hanger DH-116, Revision 1	Drawing showed hanger assembly flange welded to 6" embedded inserts. The flange was actually welded to a 4" by 6" plate which was welded to the insert, with the plate oriented in such a way that the flange to plate weld was just 4" on two sides rather than the 6" required on the drawing.	Open	61
Hanger DH-117, Revision 1	Spring load was 3600# versus design values of CL = 3860# and HL = 3814#	Open	56
Hanger DH-124, Revision None	Spring hanger scale read 3050# when drawing specified the loading as HL [illegible] and CL 2896#	Open	58

Drawing/Hanger No.	Discrepancy	Status	AP&L Action Item No.
Hanger DH-125, Revision 1	Drawing showed a 1/4" fillet weld, all around, at each connection between Items 1 and Item 4 (top and bottom), and between Item 4 (top and bottom) and column when the actual condition was a 1/4" fillet weld on just one flange and each side of the web.	Open	59
Hanger HCB-2-H1 Revision 0	Item #8 on bill of material was a smaller plate than that installed, also it appeared to be stainless steel rather than the specified carbon steel A-36. Tack welds on the saddle were not specified on the drawing.	Open	60
Hanger HCB-2-H2, Revision 0	Lug welds were undersized; 1/8" to 3/16" verses 1/4" specified.	Open	62
Service Water System			
Drawing 13-SW-133, Revision 4	The location for Valve SW-1B was shown as 2' 5" from Valve SW-2B when it was actually 2' 0"; two locations were shown for Support HBD-2-H1, one location near Pump A and the other near Pump C.	Open	67
Hanger HBD-2-H1, Revision-unknown	Baseplate anchors were not in agreement with hanger drawing for support located near Pump C; Gaps up to 1/4" existed between entire surface of "free to slide" plate and baseplate; No drawing for support located near Pump A which was also designated as HBD-2-H1. (Note that 2 supports were not load bearing.)	Open	68
Hanger HBD-2-H2, Revision 2	Baseplate anchors on slide support not as shown on drawing, bolts were apparently welded and ground flush with baseplate.	Open	68&69
Hanger HBD-2-H3, Revision 1F2	Two hanger sketches were provided for Support HBD-2-H3 and both designated as Revision 1F2, each indicated different locations for the support.	Open	70

Drawing/Hanger No.	Discrepancy	Status	AP&L Action Item No.
Hanger HBD-2-H4, Revision 1F2	Pipe restraint shown on Revision 1F of drawing did not exist.	Open	71
Hanger HBD-20-H51, Revision 2	Baseplate anchors on slide support not as shown on drawing, bolts were apparently welded and ground flush with baseplate.	Open	72
Various	In the package provided to the NRC inspection team there were several discrepancies regarding hanger locations and some outdated hanger sketches were provided that were not stamped obsolete or superseded.	Open	73

APPENDIX C

PERSONNEL CONTACTED DURING INSPECTION

Name	Title	Affiliation
*D. Bauman	Design Configuration Document Project Lead	AP&L
M. Browning	Mechanical Engineer	AP&L
*C. Chadbourn	Mechanical Engineer	AP&L
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R. Edmunds	Pipe Stress Engineer	AP&L
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A. Halbert	Supervisor Engineering - Site	AP&L
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D. James	Licensing Engineer	AP&L
*G. Jones	General Manager of Engineering	AP&L
R. Lane	Manager of ANO Engineering - Site	AP&L
A. McGregor	Superintendent of Engineering Services	AP&L
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D. Peschong	Supervisor Structural Engineering	AP&L
B. Rodgers	Supervisor Mechanical Engineering	AP&L
*D. Saunders	Senior Engineer/Iso Update Lead	AP&L
G. Smith	Pipe Stress Engineer	AP&L
M. Tull	Licensing	AP&L
*W. Turk	Manager of Licensing	AP&L
W. Watson	Project Engineer	Bechtel
G. Wiedstein	Pipe Stress Engineer	AP&L
M. Wood	Iso Update - Engineering Technician	AP&L
*A. Wrope	Manager of Electrical, Instrumentation & Control Engineering	AP&L

*Attended Exit Meeting