UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA ST., N.W.
ATLANTA, GEORGIA 30323

Report No.: 50-400/88-13

Licensee: Carolina Power and Light Company
P. O. Box 1551
Raleigh, NC 27602

Docket No.: 50-400 License No.: NPF-63

Facility Name: Shearon Harris

Inspection Conducted: May 23-27, and August 9-12, 1988

Inspector: J. J. Lenahan — 10/7/88 Date Signed

Accompanied by: R. P. Carrion (May 23-27, 1988)

Approved by: J. J. Blake, Section Chief — 10/11/88 Date Signed
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection was conducted in the areas of followup on previous inspection findings, concerns pertaining to design activities and piping installation, and the snubber surveillance program.

Results: In the areas inspected, violations or deviations were not identified. In order to resolve the concerns regarding structural steel design activities, the licensee performed independent reviews of design calculations. These independent reviews represent initiatives which go beyond NRC requirements. As a result of these initiatives, the licensee's design control procedures have been improved. The licensee's design organization is staffed by competent and qualified engineers. A large percentage of these individuals are registered professional engineers.

REPORT DETAILS

1. Persons Contacted

   Licensee Employees

   *D. J. Dyksterhouse, Structural Engineer
   **G. Forehand, Site QA Manager
   **C. S. Hinnant, Plant General Manager
   J. Hopkins, Stress Analyst
   M. Inman, Mechanical Engineer
   R. Johnson, In Service Inspection Specialist
   R. Knott, Structural Engineer
   #J. W. McKay, Principal Engineer, Harris Nuclear Plant
   *W. H. Moeller, Structural Engineer
   *J. A. Neville, Section Manager, Nuclear Engineering Department
   R. Panella, Senior Structural Engineer
   R. Parsons, Manager, Prudiencey Audit Group
   M. Pugh, In Service Inspection Coordinator
   D. Shackley, QA Specialist
   **D. Tibbitts, Manager, Regulatory Compliance
   P. Tingen, QA Specialist
   #M. G. Wallace, Regulatory Compliance Specialist
   **R. Watson, Vice President, Harris Nuclear Plant
   *H. L. Williams, Principal Engineer, Civil/Structural Unit
   *J. Zaalouk, Manager, Nuclear Engineering Projects

   Other licensee employees contacted during this inspection included three civil engineers and two QA specialists.

   NRC Resident Inspectors

   G. Maxwell
   **W. Bradford
   **M. Shannon

   *Attended May 27 exit interview
   **Attended August exit interview
   #Attended both exit interviews

2. Case RII-87-A-0086

   a. Background

      An individual, hereinafter referred to as the alleger, contacted NRC Region II and expressed several concerns relating to undersized welds on structural steel, structural steel design methodology, and design of welded pipe attachments. Inspections were performed from November 16 to December 11, 1987, to follow up on these concerns. The results of the inspection are documented in NRC Inspection Report No. 400/87-41. During the previous inspection, the concerns regarding design of welded pipe attachments and undersized structural steel welds were resolved. The concerns regarding structural steel design methodology had been previously documented by the licensee in various internal CP&L documents or had been previously identified by NRC. In order to resolve these concerns, the licensee decided to conduct an independent review of structural steel design calculations to specifically address the previously identified concerns regarding structural steel design methodology. The independent review was conducted by CP&L structural engineers who had not been involved in the Harris structural steel design work, and by an outside consultant, Applied Research Associates. The findings of the outside consultant are summarized in Applied Research Associates report titled "Review of Structural Design at the Shearon Harris Nuclear Power Plant," dated January 1988. The findings of the CP&L structural engineers' independent review are summarized in a CP&L proprietary report titled "Independent Review Structural Steel Design - Harris Nuclear Power Plant," dated February 1988. The inspectors reviewed these reports and conducted an independent review of structural steel design calculations and other supporting documents. The results of this review are summarized in Paragraphs 2.b and 2.f, below.

b. Review of RAB 248 Platform Steel Calculations

Potential deficiencies regarding design of the RAB 248 platform design are summarized in CP&L memorandum MS-876288(E), dated June 22, 1987. Since the memorandum addressed potential code violations and improper design techniques, a nonconformance report (NCR) 87-097 was issued to disposition the problem. The concerns and their resolutions are summarized below.

(1) Concern

On page 1 of 13, Scope Tab of Book 1 of the RAB 248 calculations, the purpose stated for the calculations is to verify the structural adequacy of the platform with all attachments. However, a statement in paragraph 2 indicates that loads from attachments added to the RAB 248 platform between March 1985 and May 1986 were not considered during final design verification of the RAB 248 platform. Therefore, the calculation is incomplete since the actual as built loads were not used in the final design analysis documented in the calculations.

Resolution

Loadings from additional attachments to the RAB 248 were documented on Interdiscipline Review Requests (IRRs), Field Change Requests (FCRs), Permanent Waivers (PWs) and Field Modifications (FMs) which were transmitted to the HPES civil-structural unit for a preliminary review to assure that the additional loads would not overstress the platform. The loads from the additional attachments were incorporated into the final RAB 248 platform design between July 1987 and December 1987. This analysis is contained in Calculation Book 6. The inspector examined calculation Book 6. Drawings titled North Half, South Half in the calculation book show the location of the additional attachments on the RAB 248 platform and revised loads on the platform. None of the connections required modification due to the new attachments or revised loads. The additional loads were small and did not result in over stressing of the RAB 248 platform steel. The majority of the connections had interaction equations less than 0.75 versus allowable interaction of 1.0. The interaction equation was computed to be less that 0.5 for approximately one-half of the connections.

During review of the RAB 248 calculations, an error was discovered in that four previous connection modifications had not been included on NCR 87-081. The proposed modifications were re-evaluated. Three connections were found to be acceptable when they were re-analyzed and, thus, it was concluded that the modifications were not required. The remaining modification was required. PCR 2192 was issued for installation of this modification.

(2) Concern

Assumption No. 3 (a through e) on page 4 of 13 of the calculation to not consider the effects of thermal loading on platform was not justified.

Resolution

Licensee engineers provided justification for neglecting the thermal stresses by reference to page 3.8.3-13 of Amendment 20 of the FSAR which states that thermal load can be neglected if they are secondary and self-limiting in nature.

(3) Concern

A Finite-element program was used to derive allowable loads for various types of typical connection used throughout the platform. The allowable loads were developed by averaging the stress values for the individual elements across the connections. Use of the average stress values resulted in higher allowable connection loads than would have resulted if the highest stress in an individual element had been used as the limiting stress for calculation of the connection loads. Use of average stress values was not appropriate and resulted in non-conservative allowable connection loads.

Resolution

The inspectors examined results of finite element method (FEM) analyses performed on several "typical" RAB 248 platform connections. Review of the FEM data showed that stresses in excess of code allowable values sometime occurred in one or more elements in a connection, or on one side of an element. It is standard structural engineering design practice to average the stresses shown for the elements across a connection to calculate the allowable connection load. It has been recognized since the 1950s that local stress concentrations occur in some connections and that some local yielding may occur. However, since steel is a ductile material, the stresses are redistributed when yielding occurs. The fact that this occurs is documented in various textbooks (e.g., see "Steel Structures, Design and Behavior," by Salmon and Johnson) and in AISC publications.

Since finite element modeling techniques and assumptions used in the analysis have a significant effect on the results, interpretation of the FEM data requires judgement of experienced structural engineers to obtain reasonable and correct design information. Based on review of data used to design various typical connections, the inspectors concluded that the design techniques utilized by licensee engineers complied with standard industry practices and conformed to FSAR commitments and the AISC code. The resulting connection loads are not non-conservative. Conversely, using the maximum FEM stresses as the limiting values would result in a grossly over-conservative design.

(4) Concern

The interaction equation listed on page 2 of 97 of the Connection Allowable Tab is not in compliance with the AISC code and requires justification for its use.

Resolution

The interaction equation used is conservative in that maximum values of the Von Mises uniaxial stresses are used to compute allowable stresses. The output from the STAR DYNE FEM is in terms of Von Mises stresses. The inspectors reviewed derivation of the interaction equation with licensee engineers. Based on this review, the inspectors concur with the interaction equation used in the analysis.

(5) Concern

On page 3a of 97, Correction Allowable Tab, there is statement that some connections showed a slight overstress. There is no evidence of any additional analysis being performed to justify these overstressed connections.

Resolution

Review of this concern by licensee engineers disclosed that the connections were reanalyzed using actual loads acting on the connection and that the connections were subsequently qualified. The reanalysis is contained in the "Connection Analysis" calculations but are not well documented and cross-referenced. However, this does not affect the structural integrity of the platform. The inspector examined calculations for selected connections and verified that the connections were qualified for the "as-built" loads acting on the beams.

(6) Concern

The method used to determine load - deflection is not adequately justified and use of average values for only 7 beams with different load cases out of total of 600 is questioned.

Resolution

Beam deflection is related to beam loading and stiffness. Licensee engineers determined that although a sample of 7 beams out of a total of 600 was statistically small, the worst cases were analyzed.

(7) Concern

The statement, "Due to the high axial loads on the beam members, preliminary calculations indicate failure in bending in the angles." is not addressed.

Resolution

Based on their review of the calculations licensee engineers concluded that bending failure of the clip angles was adequately addressed. In cases where actual connection loads exceeded the allowable loads, the connections were redesigned and modified as required. However, documentation of the reanalysis is not well documented in the calculation. Modifications to the redesigned connections were implemented in FCR AS 9894, Revisions 0, 1, and 2.

(8) Concern

On page 27A of 97 in the Connection Allowable Tab, allowable loads were calculated using the averaging technique of element stresses obtained from FEM analysis.

Resolution

This is same concern as expressed in concern (3) above. As stated, the average stress approach is good design practice.

(9) Concern

The use of 22 KSI as an allowable stress is not justified. The FEM model produces stresses from axial, shear, and bending which have differing allowable loads per the AISC code.

Resolution

Use of 22 KSI is justified since the maximum values of Huber-Von Mises-Henck, "Energy of Distortion" Theory is used to compute uniaxial stresses for comparison with the allowable yield stress. The inspectors reviewed the derivation of the 22 KSI allowable stress with licensee engineers. The inspectors concurred with use of the 22 KSI allowable stress.

(10) Concern

Verify that clip angle connections were modeled correctly. Questioned whether it was appropriate to consider bolts in a friction-type connections acting in conjunction with welds.

Resolution

Review of the calculations disclosed that some connections were strengthened with welds after the bolts had been installed. This is standard construction practice to strengthen existing connection. This practice is addressed in AISC specification 1.15.10. The welds were sized to carry the axial loads in the connections.

(11) Concern

Calculations were not available for review by author of letter MS-876288(E) showing the check of actual stress levels in the connections modeled versus allowable stresses.

Resolution

Allowable beam end loads for the various standard (generic) connections analyzed were compared with actual beam end loads. Connections not included in the generic connection allowables were analyzed using hand calculations. Licensee engineers performing the independent review used the NRC "vertical slice" method to select connections to be analyzed during the independent review.

(12) Concern

The allowable stresses listed on pages 96 and 97 of Connection Allowable Tab are non-conservative and should not be used.

Resolution

This concern has been previously addressed in response to concerns 3 and 8. Use of averaged stress values across the connection is a proper design practice.

(13) Concern

Actual loads from computer analysis are compared to allowable loads on summary check sheets on pages 46a through 277 of the Beam End Loads Tab. Question whether this analysis is appropriate since the allowable loads were determined using the averaging methods discussed previously.

Resolution

The question of the use of average stress values and allowable loads has been previously addressed. Documentation of the calculations is poor but does not affect structural integrity of the platform.

(14) Concern

Item No. 4 on page 1 of 36, Welds Tab, states that force per inch of weld is found by dividing by the length of the weld. This is not appropriate and non-conservative since it results in checking the average stress in the weld against code allowables and not the maximum stress in the weld determined from the FEM.

Resolution

The use of nominal shear stress is standard industry practice for weld design. Redistribution of usually high stresses by plastic deformation is commonly assumed in weld design practice.

(15) Summary of Independent Review Conducted by Applied Research Associates (ARA)

ARA performed a review of design methodology used to qualify the RAB 248 beams and non-standard connections. ARA reviewed qualification of the beams and determined that licensee engineers enveloped the highest stressed beams and checked those to verify that the beam stresses were within allowable stress values. ARA found the beam check procedures to be in compliance with AISC specifications. However, ARA noted that documentation and cross-referencing in the calculations could be improved. ARA reviewed design of selected "non-standard connections in the RAB 248 platform." ARA concluded that the licensee used a uniform systematic approach in qualifying connections and that all appropriate AISC specifications were complied with. ARA noted that licensee engineers modified connections when they determined a component of the connection was inadequate. ARA recommended that the CP&L independent review team verify the design of the W8 X 18 beams used in the RAB 248 platform steel with unbraced lengths of 8.0 feet or more.

(16) Review of Design Calculations

The inspectors reviewed the following design calculations associated with the RAB 248 platform steel.

(a) Connection Analysis

(b) Justification for FCR AS-9894, R1

(c) "Vertical Slice" sample calculation generated by CP&L independent review team

(d) Design of W8 X 18 beams with unbraced length greater than 8 feet (included in "Vertical Slice"). These calculations were alternate calculations performed to resolve ARA concerns. The beams evaluated were within AISC allowable stresses.

The inspector also walked down the 248 platform and examined modifications to connections which are shown on FCR AS-9894, R0, R1, and R2. These modifications were required due to changes in platform loading which resulted in overstressing of the original connections. The design calculations associated with this FCR were completed in February 1986, prior to issuance of CP&L memorandum No. MS-876288(E). These problems were identified as part of the normal design review and construction completion program.

(17) Conclusions Regarding RAB 248 Platform Steel Design

The RAB 248 platform steel design calculations have been reviewed by ARA and the licensee's independent review team. In addition, NRC personnel have reviewed portions of the calculations during this current inspection and during previous inspections. The consensus of opinion of the reviewers is that the RAB 248 platform design complies with AISC Code and NRC design requirements. One problem the reviewers and inspectors noted concerned the poor documentation within the calculation packages. This does not affect the structural integrity of the platform steel, but makes it more difficult to review the calculations. The problem concerning the incomplete documentation was identified as a NED potential design deficiency 88-3. A memo was issued to all Civil Unit personnel re-emphasizing the need for complete documentation in design calculations. The deficiency was closed out on July 22, 1988.

The inspectors concluded that the concerns raised in CP&L memorandum MS-876288(E) are resolved. The inspectors have no further questions regarding the RAB 248 platform steel design.

c. Review of Containment Building Design Concerns

Potential deficiencies regarding design of the containment building platform steel were documented in an internal CP&L memorandum dated June 22, 1987. These concerns had been previously identified and resolved by CP&L structural engineers in the Fall of 1986. The concerns are listed in a Table on page 6 of NRC Inspection Report No. 50-400/87-41. A summary of the results of the licensee's independent review and resolution of the CB structural steel design follows below:

(1) Concern

Connections were modeled in the computer analysis as pinned connections when in fact some were as built as rigid (fixed) connections.

Resolution

Revisions were made to some connection details which changed characteristics of the connection from a pinned end condition to a fixed end condition. These connections and beams were analyzed in Calculation Book CAS-20. Licensee engineers reviewed the calculations and concluded that the platform analysis was acceptable. In cases where the fixed connections were found to be unacceptable, field modifications were issued to change the connection characteristic to a pinned end condition. The inspector reviewed calculations for these and other modifications during an inspection documented in RII Inspection Report 50-400/87-41.

(2) Concern

Stress calculations were not performed for angles and plates in some connections.

Resolution

Licensee engineers re-reviewed Calculation Book CAS-13A and concluded that connection angles and bent plates were checked and found to be acceptable.

(3) Concern

Load reversals not summed correctly.

Resolution

Licensee engineers reviewed Calculation LV-54 and concluded that reversal of loads from cable tray risers had been considered in the platform steel calculations. This concern was examined in detail by the inspectors in resolution of Unresolved Item 400/86-69-03 (see Inspection Report No. 50-400/87-41).

(4) Concern

Eccentricity not considered in connection or weld design.

Resolution

Eccentricity was considered in design of welds. Licensee engineers reviewed Calculation LV-54 and referenced calculations and verified that eccentricity was considered. Eccentricity was not considered in connection angle design since the moments due to eccentricity would be insignificant and the clip angles are assumed to be pinned.

(5) Concern

Wrong load case chosen as most critical.

Resolution

Due to the vector sign convention chosen, there appears to have been some isolated cases where load case 7 slightly exceeded the load case chosen on the most critical. The inspectors examined calculation CAS-14 and concluded that this would have no effect on the structural integrity of the platform steel because of the conservative nature of the selected design load, and the fact that allowable stresses were well within the elastic range.

(6) Concern

Torsional loads not considered.

Resolution

The inspectors examined Calculation Books CAS-14, CAS-21, and CAS-24. Torsional loads were not explicitly considered due to the numerous lateral supports provided by secondary members spanning between the primary members. Torsion on the primary members is transferred to the secondary members as major or minor axis bending, depending upon the orientation of the secondary member. Because the bending stiffness of the secondary members is much greater than the torsional stiffness of the primary members, any torsional load on the primary members is relieved as bending on the secondary members.

(7) Concern

Whip restraint loads not considered.

Resolution

Although the whip restraint loads were not included in the computer analysis, they were evaluated manually. The inspector reviewed Calculation Book CAS-16 where the whip restraint loads were added to load case 24 and compared with load cases 23 and 25. If the added whip restraint loads were greater, the higher loading was evaluated. The inspectors reviewed analysis of randomly selected member number 580 and verified that the whip restraint loads were considered.

(8) Concern

Expansion joints used to limit thermal stresses are not functional.

Resolution

The cable tray riser structure bridges two expansion joints. Therefore, these joints are not functional. The inspectors reviewed Calculation LV-66, Cable Tray Riser Frame (Final Verification). The thermal stresses in the riser structure were calculated using thermal movements of the platform steel. These thermal movements were calculated assuming the platform expansion joints were functional, and the strains (thus corresponding stresses) imposed by these movements were added to the riser structure. See paragraph 6.e of this report for additional discussion of review of Calculation LV-66. The inspectors reviewed Section 9 of Calculation LV-54 where the effect of the nonfunctional expansion joints were considered in the design of the platform steel. In this analysis, the footprint loads from the riser structure (which included the stresses due to the restrained thermal movements) were imposed on the platform steel. The inspectors concluded the analysis was acceptable.

(9) Concern

The value for accident thermal temperature, i.e., WT = 148°F, was not justified.

Resolution

The inspector reviewed page 328 of Calculation Book CAS-16, where the justification for the accident thermal temperature of WT = 148°F is derived. The selected WT is acceptable.

(10) Concern

Use of 1.1 interaction factors were not justified.

Resolution

The use of the 1.1 interaction is acceptable due to conservatism built into the overall analysis. The allowable stresses are well within the elastic range and the loadings are conservative. The use of the interaction equations greater than 1.0 (up to 1.1) are justified on the case by case basis where they occur. Selected justifications were reviewed by the inspectors and licensee engineers. The justifications were found to be acceptable.

(11) Concern

Reduced horizontal "g" values were applied to vertical loads in seismic analysis.

Resolution

This concern was previously addressed by licensee engineers who performed a detailed review of the platform response spectra. The design methodology and application of "g" values was found to be consistent with FSAR Section 3.7.2-1.

(12) Concern

Supplemental steel was added to CB platform to stiffen members and reduce weak axis stresses. However, the loads from the supplemental steel were not included in analysis.

Resolution

The horizontal forces transferred to other beams were evaluated except where negligible in Calculation LV-54.

(13) Concern

Hanger footprint loads were not resolved to beam centroids.

Resolution

The hanger footprint loads were transferred to the beam centroids in Calculation LV-54.

(14) Concern

Effect of DBE loads from pipe supports on platform steel not checked.

Resolution

Licensee engineers concluded that when the effect of DBE and OBE loads from pipe support loads acting on the platform steel were evaluated, it was found that OBE loads controlled, since the allowable DBE stresses are greater than OBE allowable stresses. In addition, the pipe support loads were often reduced in the final hanger package rollups, but the reduced loads were not applied to the platform steel. Licensee engineers concluded that DBE loads would not impact structural integrity of platform. The inspectors concur.

(15) Concern

Use of rigid plate theory used to check embeds is not justified.

Resolution

Review of embed design disclosed that ratio of plate thickness to span between embedded bolts/studs qualified plates for utilization of rigid plate theory. The proprietary "Baseplate II" program was used to analyze the embed plates. This method is acceptable.

(16) Summary of Independent Review Conducted by Applied Research Associates (ARA)

ARA performed a review of design methodology used to design randomly selected beams in the reactor containment platform steel. ARA determined that the design procedures used to qualify the beams and connections complied with the AISC specification; that reasonable engineering assumptions were made, and acceptable techniques were utilized when direct design methodology is not suggested by the AISC specification; and cases where designs do not conform to the specification are justified. ARA recommended that the licensee's independent review verify the assumptions listed below which were not fully documented in the calculation. These assumptions and results of licensee's review were as follows:

(a) Verify that assumptions that axial compressive stresses were less than 15 percent of allowable for beams with combined axial and bending stress for which only AISC Equation 1.6-2 was checked. Since ARA performed independent calculations to verify this assumption, licensee engineers concluded that additional calculations would be redundant. Licensee engineers stated that calculations performed by ARA were adequate.

(b) Verify on welded clip angle connections in the containment building platforms, that the beam web thickness exceed the dimensions of the weld leg. Licensee engineers reviewed the platform steel drawing and verified that the beam web thickness exceeded the weld leg.

(17) Conclusions Regarding Containment Building Platform Steel Design

Since 1986, the CB platform steel design calculations have been reviewed extensively by licensee engineers, NRC inspectors, the licensee's independent design review team, and ARA. The consensus of opinion of the engineers, reviewers, and inspectors is that the CB platform design complies with the AISC code, the FSAR, and NRC requirements. A similar problem as identified with the RAB 248 platform calculations regarding poor documentation and lack of cross-referencing within the calculations was noted by the reviewers. However, this does not affect the structural integrity of the platform steel.

d. Review of FCR/FM Justifications

A concern was raised regarding adequacy of justifications for field change requests (FCR) and field modifications (FM) issued by the HPES civil-structural unit during construction of the Harris project. During the licensee's independent review, justifications for 75 randomly selected FCRs and FMs were reviewed. The justifications were found to be satisfactory. In addition, the inspector reviewed justifications for several FCRs during inspections documented in Inspection Report Nos. 50-400/86-77 and 50-400/87-41. The justifications were found to be satisfactory.

e. Review of Steam Generator Lower Lateral Supports

A concern was raised regarding the effect of loads from additional attachments added to the steam generator lower lateral supports. The inspectors reviewed the results of the licensee's independent review of this concern. The independent review examined methodology used to add pipe support loads to the lower lateral supports and verified that the 31 pipe support loads specified on IRR H-4284 were considered in design of the steam generator supports. Design of the lower lateral supports was found to be satisfactory.

f. Findings

The concerns were not substantiated. These licensee's structural steel design criteria and methodology meet FSAR and NRC requirements.

Within the areas inspected, no violations deviations were identified.

3. Case RII-88-A-0030

a. Background

An individual, hereinafter referred to as the alleger, contacted NRC, Region II and expressed concerns relating to the licensee's handling of Adverse Trend Reports. The concerns were apparently generated by testimony given before the North Carolina Public Utilities Commission (PUC) during rate case hearings and from review of documents submitted by the licensee to the PUC. The alleger submitted a copy of Exhibit 9, CQA 3, Supervisor Trend Report, for Calendar Quarter 2, 1985 with 28 attached pages of CQA-6 Exhibit 1, Document Discrepancy Form. The documents cover QA/QC document review of piping/mechanical records. Followup on these concerns is discussed in paragraphs 3.b to 3.f below.

b. Control of Activities Performed by Document Review Groups

(1) Concern

The alleger expressed concern regarding the licensee's document review groups, which were organized in 1983 or 1984, for purpose of getting records in shape to prevent operating licensee allegations/holdups. The alleger inferred that these groups may have recreated missing documents, and corrected or enhanced others without regard to NRC approved procedures or actual condition of hardware.

(2) Discussion

The inspector discussed this concern with licensee QA personnel and the individual who was Harris Project General Manager when the document review groups were established. These discussions disclosed that the purpose of the document review groups was to perform a detailed review of records required to document that the plant was constructed in accordance with design and NRC requirements. Review of the records was performed prior to turnover of systems to the operations group for startup testing. The number of personnel involved in the document control groups ranged from 100 when the program was initiated to approximately 600 in mid-1985. The licensee's main purpose in establishing this group was to avoid problems like the one which occurred at Zimmer where it was discovered that numerous records were incomplete or missing immediately prior to licensing.

When discrepancies were discovered during review of the records, the licensee attempted to resolve them using appropriate methods. For example, when a document such as a Certified Material Test Report (CMTR) was missing from a package, this would be resolved by getting a copy of the CMTR from the receipt inspection documents, obtaining a duplicate copy from the vendor, or by obtaining a copy from another package. If errors were found in inspection documents, for example, the incorrect heat number listed for a spool piece, the piping would be reinspected to determine the correct heat number stamped on the spool piece. The original records would then be corrected based on the results of the reinspection.

NRC Region II inspectors performed numerous inspections at the Harris plant which involved detailed review of quality records. The inspectors were aware of the licensee's efforts in the document review groups to assure that records were complete, accurate, legible, and retrievable. The inspectors examined the system turnover process during startup testing and were aware that discrepancies had been identified in various records prior to and during the turnover process. The inspectors examined the methods used to correct the errors and verified that they met NRC requirements.

(3) Findings

The concern was not substantiated. The licensee did not "recreate" missing records. When discrepancies were found during review of various documents, licensee personnel used acceptable methods to correct the errors. The licensee's program for reviewing and correcting quality records was typical of those used at most plants licensed since the missing records problem was discovered at Zimmer. In the majority of cases, it is relatively easy to duplicate missing records or correct errors in the records. If significant deficiencies were found during the records review, nonconformance reports were issued to document, properly disposition, and correct the errors.

c. Experience of Management Consultants Employed by Licensee

(1) Concern

The alleger questioned the experience of a management consultant firm retained by the licensee to examine their document review program.

(2) Discussion

The alleger stated that the basis for this concern was that during the rate case hearings, a representative of a management consultant firm retained by the licensee to examine the licensee's document review program was unaware that QA/QC records had been forged at Zimmer.

The inspector discussed the management consulting firm's role in the document review program at Harris with the former Harris Project General Manager. These discussions disclosed that the role of the management consulting firm was to examine the overall document review program and suggest any changes that CP&L management should incorporate to improve the document review process. The study by this firm did not cover a technical review of records, or a review of technical procedures which controlled the document review group. The study was simply a management study which did not affect the final product, but was more or less directed at improving the program through better management of the people to save time and thus reduce costs. The inspector reviewed the report prepared by the firm and concluded the study conducted by this firm did not have safety significance.

Regarding the Zimmer project, the problem encountered at the Zimmer site was discovery that large numbers of records were incomplete or missing. In addition, due to methods used to control some processes, e.g., welding, it was not possible to reconstruct the missing records or correct errors following conventional inspection technique used at nuclear power plant construction site. While there were allegations that some records were forged at Zimmer, specifically welder qualification records, the most significant problem was missing and/or incorrect records. The incorrect records were not the result of forgery, but due to errors by various individuals. The missing and erroneous records resulted in cancellation of the Zimmer Nuclear Plant.

(3) Findings

The concern was not substantiated.

d. Significant of Deficiencies Identified on Supervisor Trend Report for Second Quarter 1985

(1) Concern

In a reference to a QA/QC/CI Supervisor Trend report (Exhibit 9 to CQA 3), Calendar Quarter 2, 1985, and 28 attached pages, for piping/mechanical document review, the alleger questioned whether the deficiencies noted in the records were ever corrected. The alleger stated that noted deficiencies appeared to be more than documentation problems, but rather deficiencies in the components, parts, material and procedure themselves. The alleger also questioned if NRC had examined the trend reports.

(2) Discussion

The inspector examined the second quarter 1985 supervisor trend report sent by the alleger to NRC, Region II. Review of the report and the 28 attached pages (CQA 6, document discrepancy forms) disclosed that the problems identified on the report involved review of documentation performed under CP&L work

procedure WP 116, Piping Spool Fabrication and Modification. The inspector noted that all corrective actions necessary to resolve the problems identified on the document discrepancy forms had not been completed by June 28, 1985, the date when the trend report was prepared. This is apparently the basis for the alleger's question regarding whether the deficiencies noted had ever been corrected.

The inspector examined CP&L procedure number CQA-6, QA Records Review - Piping Systems. This procedure was applied to review of documentation for ASME Class I, II, and III pipe, Seismic Category I pipe and Radwaste Q and Fire Protection Q Piping Systems. The procedure covered methodology to be used in performing the reviews, and controls for correcting identified discrepancies. The inspector also examined CP&L Procedure QAI-6.1, Review of ASME and Seismic Category I documentation. This procedure provide detailed instructions for review of various documentation required for ASME Class I, II, and III and Seismic Category piping systems. Documentation reviewed included weld data reports, repair weld data reports, NDE reports, pressure test reports, pipe spool fabrication/ modification records, valve inspection forms, records for work repair, or modification of ASME components, material verification sheets, work travelers, pipe support installation records, and various other documents.

The inspector examined the 28 document discrepancy forms questioned by the alleger. Review of the document discrepancy forms filed in the licensee's QA construction records disclosed that the corrective actions were signed off as completed on the records. The records indicated all corrective actions were not completed until several months after the Supervisor Trend Report had been issued. The specific discrepancies listed did not involve fabrication or modification of spool pieces, but rather errors in documentation. Examples of the errors were missing documentation, discrepancies in heat numbers, omission of some data, e.g., ISO number, revision number, heat number in some packages, etc. The errors were resolved by locating the missing documentation, reinspecting the spool pieces to verify the correct heat number, and/or making any necessary corrections to the records. In some cases, cause of the problems were minor discrepancies on the piping isometric drawings. These were corrected by revising the isometric drawings to incorporate all outstanding design changes, or to clarify spool piece fabrication requirements. The method used to correct the document deficiencies are documented on the signed-off document discrepancy forms, and on the records in the document packages (e.g., on Exhibit 3, to WP 116, Pipe Spool Fabrication/ Modification Record). The inspector examined the licensee's corrective actions and the supporting documentation and concurred with the methods used to resolve the discrepancies.

NRC inspectors reviewed various trend reports during inspections conducted at the Harris project, although the specific report questioned by the alleger was not reviewed. A detailed review of trend reports and the corrective action program was performed during the Construction Assessment Team inspection conducted October 1 through November 2, 1984 (see NRC Inspection Report No. 50-400/84-14). In addition, Region II inspectors examined pipe spool fabrication/modification during routine inspections conducted during construction of the Harris project.

(3) Findings

The concern was not substantiated. The deficiencies noted on the Supervisor Trend Report involved minor errors in documentation, not the actual hardware. All the deficiencies noted were corrected.

e. The CP&L Site QA Manager Overrode the Findings of an Adverse Trend

(1) Concern

The alleger stated that the QA Manager overrode the findings of an adverse trend.

(2) Discussion

The basis for this concern was apparently the QA/QC/CI management review comments section of the Supervisor Trend Report for the Second Quarter 1985 Piping/Mechanical QA/QC Document Review. The form indicates that the QA Manager concurred with discrepancies identified during the document review but did not issue Exhibit 11, CQA-3, Adverse Trend Report, whereas, the QA auditor checked the form to indicate an adverse trend had been observed, with comment "An adverse trend has developed in the area of pipe spool modification/fabrication records (WP 116 Exhibits 1 and 3). During the final review of 214 packages, 41 discrepancies were identified for an error rate of 19.24%."

The inspector questioned the auditor who prepared the trend report. These discussions disclosed that the documentation errors occurred over a long period of time and that the decision was made that an adverse trend did not occur in the second quarter. The QA Manager, when questioned regarding the adverse trend stated the same reason. The QA Manager indicated that if these errors had all occurred during the same quarter, an adverse trend may have been appropriate. However, some of the documentation errors had occurred several months to a year earlier, and were not discovered until the second quarter, 1985, since that was the time when the work (piping installation) had been finished, and the final review of the documentation in the package was completed. Regarding the 19.24% documentation error rate, the inspector noted that more than 50 attributes were reviewed in each package. Some packages involved review of several hundred attributes. Considering an average of 50 attributes per package (this number is low), the actual percent error rate would be 41 discrepancies out of a total or more than 10650 attributes examined. This would be less than 1/2 of one percent error.

The inspector examined the summary of the second quarter 1985 nonconformance trend analysis meeting. Based on analysis of the data in the Supervisor Trend Reports, licensee management did not identify an adverse trend in the area of piping/mechanical documentation review. The inspector concurs with the licensee's findings.

(3) Finding

The concern was not substantiated. The QA Manager did not override the findings of the auditor.

f. Conclusions

None of the four concerns were substantiated.

Within the areas inspected, no violations or deviations were identified.

4. Snubber Surveillance Program (70370)

The inspector reviewed procedures which control the snubber surveillance program and examined snubbers installed on safety-related piping systems in the reactor containment building. Acceptance criteria examined by the inspector appear in Technical Specification (TS) 3/4.7.8.

a. Review of Snubber Surveillance Procedures

The inspector examined the following procedures which control the snubber surveillance program:

(1) Procedure No. PLP-106, Technical Specification Equipment List Program

(2) Procedure No. ISI-202, Safety-Related Component Support (hangers and snubbers) Examination and Testing Program

(3) Engineering Surveillance Test Procedure No. EST-215, Snubber Surveillance

The TS references procedure PLP-106 for the specific surveillance requirements pertaining to snubbers. Procedure PLP-106 specifies snubber surveillance requirements for visual inspectors and functional testing of snubbers, surveillance intervals, acceptance criteria, the snubber service life program and requirements for engineering evaluations of inspection and/or test failures.

b. Inspection of Snubbers

The inspector performed a visual inspection of selected snubbers installed on safety-related piping systems inside the reactor containment building. The systems included reactor coolant, safety-injection, steam generator blowdown, RHR, and main steam. During the inspection, the inspector verified that the snubbers were not damaged, and that attachment of the snubbers to the supporting structure and piping was secure.

Within the areas inspected, no violations or deviations were identified.

5. Review of the Snubber Reduction Program

The inspector examined calculation number 2500-2, Snubber Reduction. The purpose of this calculation was to replace snubbers with struts on pipe hangers on portions of the reactor coolant piping system. Specific calculations examined were those to replace the snubbers on hanger numbers 1-RC-H-851, 852, and 853. These hanger support the bottom head drain piping on the steam generators where suspected boric acid leakage was identified by the licensee (see Inspection Report No. 50-400/82-26 for additional details on boric acid leakage). Concerns had been expressed by some individuals that replacement of the snubbers with struts may have resulted in overstressing the piping and caused the boric acid leakage. Subsequent investigation of the cause of the leakage resulted in eliminating pipe overstress as a cause of the leakage.

Discussions with licensee engineers disclosed that the snubbers on hanger numbers 1-RC-H-851, 852, and 852 were replaced with struts installed perpendicular to the plane of predicted movement of the two snubbers or each hanger. The orientation of the strut was determined using the predicted movements shown on the pipe hanger drawings. Tolerances for installation of the struts required that the strut be installed within plus or minus one degree of the locations shown on the sketches. The inspector reviewed the thermal expansion test data for these hangers and determined that the actual piping movement measured during the thermal expansion test differed from the predicted movements. The differences in use of predicted versus actual piping movements to locate the new pipe struts resulted in an approximate difference of ten degrees in the orientation of the struts. The inspector questioned licensee engineers regarding the effect of strut locations calculated using predicted movements which differ from the actual movements, and the effect of installing struts which may exceed the plus or minus 1° tolerance in cases where strut locations (orientation) is determined using predicted piping movement which differs from the actual piping movement measured during thermal expansion. The effect of using actual versus predicted piping movements on the snubber reduction design calculations will be examined by the inspector in a future inspection. This was identified to the licensee as Inspector Followup Item 400/88-13-01, Effect on Calculation of Strut Locations Using Measured Versus Predicted Thermal Movements.

Within the areas inspected, no violations or deviations were identified.

6. Action on Previous Inspection Findings (92701 and 92702)

   a. (Closed) Violation Item 400/86-77-01, Failure to Implement Adequate Design Control Measures

      The licensee's corrective actions for this violation were previously examined by the inspectors during the inspection documented in Inspection Report No. 50-400/87-41. The violation resulted in issuance of nonconformance report numbers (NCR) OP-86-0183 and OP-86-0185. As discussed in Report No. 50-400/87-41, the above reference NCRs were left open pending completion of an independent review of structural steel design methodology. The licensee notified NRC in a letter dated March 30, 1988, that the independent review was completed and that the review had confirmed the adequacy of of the design of Seismic Class I structural steel. The results of the inspector's examination of the independent review of the structural steel is discussed in paragraph 2, above. The inspectors examined the closeout actions for NCR OP-86-0183 and OP-86-0185. The NCRs were closed out on May 23, 1988. Violation item 400/86-77-01 is closed.

   b. (Closed) Unresolved Item 400/86-77-03, Possible Inadequacies in Design Verification and Design Change Control Procedures

      This unresolved item was identified by the inspector because of questions regarding the design verification and possible inadequate design control procedures. Violation items 400/86-77-01 and 400/87-41-02 involved errors in design calculations which should have been identified and corrected during the design verification process. Due to reorganization of the design engineering organization, and as part of the corrective action for the above listed violations, the licensee's design control procedures have been revised. The inspector examined NED Guideline E-6, Design Verification, and verified that the revised procedure complied with NRC requirements. The inspector has no further questions at this time. Unresolved Item 400/86-77-03 is closed.

c. (Open) Inspector Followup Item (IFI) 400/86-77-05, Painting of Restricted Embeds

During construction of the Harris plant, licensee engineers determined that several hundred embed plates were loaded close to their design capacity. The licensee restricted attachment of additional supports to these embeds without explicit approval of design engineering. The licensee decided to paint the restricted embeds red to permanently identify them as restricted for attachment of new loads. This item was previously examined during an inspection conducted November 16 - December 11, 1987, which is documented in Inspection Report No. 50-400/87-41. During that inspection, the inspector determined that the licensee's program for painting restricted embeds was incomplete, when in fact, the licensee had stated that painting of all restricted embeds had been completed. The licensee committed to perform an indepth re-examination of restricted embeds. The re-examination of restricted embeds included review of field change requests and an inspection program to determine if additional attachments had been made to restricted embeds and to determine if the correct embed plate had been painted. As of the current inspection date, all 213 restricted embeds located outside of the containment building had been re-examined. Discrepancies were identified for ten of the embeds. These included three which had additional attachments and seven which were improperly painted (restricted area was not painted red per restricted program requirements). Those problems were identified on Plant Change Request (PCRs) numbers 2879 through 2884 and 2902 through 2904. The licensee has made a preliminary determination that the additional attachments on the three embeds do not load the embed plates in excess of design capacity. Final determination will be made after further design review and close out of the appropriate PCRs. There are 33 FCRs which restrict embeds located inside the containment structure. These have been examined by a licensee engineer. Embeds restricted by 30 of the FCRs were found to be correctly painted. The embeds restricted by the remaining three FCRs were not painted, or the incorrect locations had been painted. The licensee was in process of painting the correct embed during the August inspection. The inspector walked down the reactor containment building and verified that embeds restricted by 25 of the FCRs had been correctly painted. The inspector will examined the embeds where discrepancies were identified in a future inspection. Pending closeout of the PCRs written to document discrepancies identified regarding restricted embeds, and determination of the of the safety significance of the discrepancies identified to date, IFI 400/86-77-05 will remain open.

d. (Closed) IFI 400/87-41-01, Add ANSI N690-1984 to List of Applicable Codes, Standards and Specifications in FSAR Section 3.8.3.2

During review of Calculation LV-54, which covers design of the containment building structural steel platforms, the inspectors noted that thermal loads were evaluated using methods specified in

ANSI N690-1984. The licensee has issued an FSAR Amendment Review Approval Form (RAF) to incorporate this ANSI standard in the next update of the FSAR. The inspector reviewed the FSAR Amendment RAF for item No. 1205 which includes this change. The FSAR Amendment RAF was completed in accordance with CP&L Administrative Procedure No. AP-603, FSAR Revisions. Procedure AP-603 covers steps to be followed to assure the FSAR is updated per the requirements of 10 CFR 50.71(e)(1). IFI 400/87-41-01 is closed.

e. (Closed) Violation Item 400/87-41-02, Uncontrolled Change to Design Input

The licensee's corrective actions for this violation are stated in their March 24, 1988 response to NRC for Inspection Report No. 50-400/87-41. Calculation LV-66, Cable Tray Riser Frame (Final Verification), was revised using the correct change in temperature (WT) in calculation of thermal stresses. During revision of Calculation LV-66, licensee engineers discovered that incorrect allowable stresses had been used in some sections of the calculations. These problems were documented on nonconformance report (NCR) 87-151. Further review of Calculation LV-66 disclosed some minor errors in geometry in the computer model of the riser structure analyzed in the original Calculation LV-66. These problems were corrected and incorporated into Revision 2 of LV-66, dated January 15, 1988. The inspectors reviewed Revision 2 to LV-66, including computer outputs - Attachments J, K, L, M, N, O, P, Q, R, S and T to LV-66. The inspectors verified that the reanalysis was done to properly account for WT = 148° for design accident conditions. The inspectors noted that the locations of two beams (numbers 133 and 138) were adjusted in the computer model to represent their actual as-built conditions. The inspector verified that stresses in the riser structure members were within allowable limits. NCR 87-151 was closed following completion of Revision 2 to LV-66. One of the two design engineers and the engineering supervisor responsible for use of the incorrect design input are no longer involved with design activities at CP&L. The other design engineer, who is employed by CP&L in a contract capacity, was counseled in proper documentation and control of design inputs. Section 3.24 of the HPES Manual of Instruction has been established to expand and reinforce the requirements reviewing and checking of calculations per the requirements of 10 CFR 50, Appendix B, Criterion III. Violation item 400/87-41-02 is closed.

7. Exit Interview

The inspection scope and results were summarized on May 27 and August 12, 1988, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results listed below. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

Inspector Followup Item 400/88-13-01, Effect on Calculation of Strut Locations Using Measured Versus Predicted Thermal Movements