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

Report No.: 50-400/86-77

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

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

Facility Name: Harris

Inspection Conducted: September 9 to December 12, 1986

Inspector: J. J. Lenahan 5/26/87
Date Signed

Accompanying Personnel: O. Mallon, Consultant (September 30 - October 3 and November 17-18, 1986)

R. M. Compton, Consultant (October 14-17 and November 18-21, 1986)

Prior to this inspection, on August 25-29, 1986, T. McLellan, IE, and O. Mallon performed an inspection of concerns discussed in paragraph 5.

Approved by: J. J. Blake, Section Chief 5/27/87
Engineering Branch Date Signed
Division of Reactor Safety

SUMMARY

Scope: This routine, unannounced inspection was in the areas of followup on concerns pertaining to design and construction activities expressed by former employees.

Results: Two violations were identified; Failure to Implement Adequate Design Control Measures, paragraphs 5.d and 7.b., and Undersized Welds on Cable Tray Supports, paragraph 5.d. No deviations were identified.

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REPORT DETAILS

1. Persons Contacted

Licensee Employees

*P. L. Brady, Civil Engineer
***G. L. Forehand, Director Quality Assurance/Quality Control (QA/QC)
***M. Holveck, Principal Engineer
**R. Marlar, Project engineer, HPES Civil
J. W. McKay, Resident Civil Engineer
***G. A. Meyer, General Manager - Construction
**W. Pridgen, Senior Engineer
**W. E. Seyler, Construction Manager
V. Stephenson, Civil Engineer
J. Turner, Civil Engineer
***M. G. Wallace, Regulator Compliance Specialist
*R. A. Watson, Vice President, Harris Nuclear Project
*H. L. Williams, Principal Engineer - Civil
**J. L. Willis, Plant General Manager

Other licensee employees contacted included ten civil engineers, eight civil QC inspectors, and twenty contract design engineers.

Other Organizations
(EBASCO)

K. Fitzgerald, Civil Engineer
V. N. Khandehlar, Civil Engineer
E. S. Kowaliki, Senior Supervising Engineer
T. McCarthy, Senior Structural Engineer
E. Odar, Senior Structural Engineer
D. Patel, Civil Engineer

NRC Resident Inspectors

*S. P. Burris
*G. Maxwell

*Attended November 21, exit interview
**Attended December 12, exit interview
***Attended both exit interviews

2. Exit Interview

The inspection scope and findings were summarized on November 21, and December 12, 1986, with those persons indicated in paragraph 1 above. The

inspector described the areas inspected and discussed in detail the inspection findings. No dissenting comments were received from the licensee. The following new items were identified during this inspection:

- Violation 400/86-77-01, Failure to Implement Adequate Design Control Measures, paragraphs 5.d and 7.b.
- Violation 400/86-77-02, Undersized Welds on Cable Tray Supports, paragraph 5.d.
- Unresolved Item 400/86-77-03, Possible Inadequacies in Design Verification and Design Change Control Procedures, paragraph 7.b.
- Inspector Followup Item 400/86-77-04, Resolution of Cable Tray Riser Design Concerns, paragraph 7.c.
- Inspector Followup Item 400/86-77-05, Painting of Restricted Embeds, paragraph 7.e.
- Inspector Followup Item 400/86-77-06, Review of Discrepancies Identified in RG 1.29 Walkdown Program, paragraph 7.g.
- Inspector Followup Item 400/86-77-07, Followup on Justification for FCR AS-2381, paragraph 7.j.

The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspector during this inspection.

3. Licensee Action on Previous Enforcement Matters

This subject was not addressed in the inspection.

4. Unresolved Items

Unresolved items are matters about which more information is required to determine whether they are acceptable or may involve violations or deviations. One unresolved item identified during this inspection is discussed in paragraph 7.b.

5. Case RII 86-A-0218

a. Background

An individual, hereinafter referred to as the alleger, contacted NRC Region II on July 21, 1986, and reported that he had been terminated by Carolina Power and Light Company because he had raised concerns about the acceptability of several safety-related problems relating to engineering design calculations. The concerns, which related to design of cable tray supports, were examined by an inspector from the Office of Inspector and Enforcement, and an NRC consultant during the week of August 25-29, 1986. Additional followup inspections were performed on the concerns discussed in paragraphs 5.d and 5.e below by the

consultant and the NRC Region II inspector. Subsequent to contacting NRC, the individual filed a complaint with the U. S. Department of Labor on July 29, 1986, alleging discriminatory employment practices in violation of the Energy Reorganization Act. The results of the Department of Labor's investigation into the allegation are not discussed in this inspection report.

b. Failure to Perform Design Analysis of Field Modification Prior to Installation

Concern

The alleger stated that a field modification permitted the licensee to install a tension member for a cable tray support with an eccentricity of 7 1/2 inches. The design drawings permitted a maximum eccentricity of only 1/4 inch for this member. The alleger was concerned that the changes permitted by this field modification were not analyzed prior to its implementation. The specific member involved was that installed in Work Plan EN 2362-A-3 for cable tray support number 67.

Discussion

The inspectors examined Section 3.2 of the CP&L HPES Manual of Instructions, Processing and Control of Field Modifications and CP&L Design Guideline 7.1.H, Guideline for Civil Unit Field Modifications. Review of these documents disclosed that field modifications (FM) could be implemented by the craft prior to design approval and design verification of the FM. The procedures specify that design verification can be completed after field implementation of the FM. The IE inspector and the consultant reviewed the calculations for the FM, CP&L design verification EN 2367-A-3, dated August 11, 1986, and found them to be adequate.

Findings

The allegation was not substantiated. The licensee did not violate their procedures or NRC regulations by implementing the FM for cable tray support number 67 prior to design verification. The design verification was properly completed after implementation of the FM.

c. Cable Tray Support Brace Angle

Concern

The alleger stated that the angle for a brace on a cable tray support was changed. The alleger stated that no original calculations were performed to verify this change was acceptable. The alleger stated that when he asked why calculations were not required, he was told they would be redundant. This concern relates to Work Plan EN 26242, support 242, on elevation 262.

Discussion

Review of this concern disclosed that the change to the brace angle was implemented by a field modification. The concern was similar to that discussed in paragraph 5.b above, in that the field modification was implemented prior to design verification. As discussed in paragraph 5.b above, this is not a violation of the licensee's procedures. The IE inspector and the consultant examined CP&L design verification EN 26242 and determined that the field modification had been design verified prior to its final acceptance.

Findings

The allegation was not substantiated.

d. Connection Detail Used on Cable Tray Supports

Concern

Some of the cable tray supports were inadequate due to problems with engineering calculations. An example of this was generic detail G, shown on drawing number CAR-2168-G-251, S01. The alleger stated that calculations used to qualify this support were inadequate.

Discussion

The cable trays in the containment building are supported on U-shaped frames attached below the elevation 286 platform steel. The vertical legs of the U-shaped supports are W10X26 wide flange steel members which are connected to the platform steel using two 4 x 3 1/2 x 3/8 clip angles. The connection detail on drawing number CAR-2168-G-251-S01, Detail G, specifies that the clip angles are to be welded to the 286 platform steel and the vertical members of the U-shaped frame using 1/4 inch fillet welds.

In 1985, site engineering personnel noticed, while implementing a modification to add additional lateral braces to the cable tray supports, that the clip-angle connections had not been welded as shown on Detail G, but instead were supported with temporary erection bolts. On October 18, 1985, CP&L personnel issued field modification FM-C-CAR-2168-G 251 S01 (Detail G) directing site construction personnel to weld the connection in accordance with the requirements shown in Detail G. The site engineer involved in issuing the FM performed some simple calculations which indicated that the 1/4 inch welds specified on Detail G were of insufficient size. The engineer also had additional questions pertaining to methodology used in design of the cable tray supports. Since the original calculations had been performed by the Architect/Engineer, EBASCO, and EBASCO had retained the design calculations in their files, these questions were unresolved until the original calculation books could be obtained from EBASCO and transmitted to of this model was 69.4 Kips, compared with 70.0 Kips determined by analytical techniques. The ultimate tensile capacity of the connection with the first 3/8 inch weld installed (which represents as-built conditions) was determined analytically by the finite element model to be 118 Kips.

Subsequent to the August 25-29 inspection, the generic implication of inadequate design control measures were examined by the consultant and the Region II inspector. This review focused on possible generic problems with end connections on other cable tray supports, and other structural steel connections. The review also addressed other areas of design involving design assumptions by the individual responsible for the original Detail G connection design. The licensee performed a detailed review of structural steel connection designs utilized in safety-related structures. The results of this review were informally transmitted to NRC Region II in an undated report titled "Assessment of Issues in Structural Steel Design." The regional inspector and consultant reviewed this assessment, examined various connections on structural steel in Category I structures, and reviewed the calculations for the connections.

During the licensee's assessment, the licensee determined that the only other structural steel connections similar to Detail G were those on the Reactor Auxiliary Building (RAB) 248 platform steel and the connections for the containment building (CB) platform steel radial beam to the secondary shield wall embedded steel. The licensee also concluded that no other cable tray supports had connection similar to Detail G. The inspector examined cable trays in the auxiliary and diesel generator buildings and verified that no other Detail G type (i.e., clip angles attaching WF members to embeds/structural steel) connections were used on cable trays other than the 54 affected by Detail G for installation in the reactor building. The inspector also examined various other structural connections in Category I buildings and verified that no other Detail G type connection existed except the RAB 248 and CB structural platform steel connections identified by the licensee. Review of the calculations for the RAB 248 platform steel connections disclosed that the configuration of these connections were generally not the same as Detail G and axial loads were not the principal loads acting on these connections. The principal stresses in the connections were the results of bending stresses. Review of the CB platform connection design disclosed that while some connections were similar to Detail G, the connections were very stiff and the assumptions used for distribution of stresses in the welds within the K+t distance were acceptable.

The inspectors examined approximately 900 additional calculation sheets. The emphasis of this review was to determine if correct assumptions were used in the design analysis. Two cases were identified where incorrect assumptions were used, but these two were re-evaluated by the licensee using the proper assumptions and found to have no effect on the completed calculations. Thus, these errors had

the site for review. After reviewing the EBASCO calculations it was determined that calculations to size the weld connecting the clip angle to the platform steel had not been performed in the original analysis. The on site engineering staff performed some additional calculations in February 1986 and determined that the 1/4 inch fillet welds were undersized. The calculations are documented in calculation number FM-C-CAR 2168-G-251-S01 (Detail G) R-1, Justification of New Welding Details, dated February 27, 1986. As a result of these calculations, the weld size was increased from 1/4 inch to 3/8 inch. A field modification, FM-C-CAR-2168-G-251-S01 (Detail G) R1, was issued on March 7, 1986, to implement the change in weld size. Design verification of these calculations was performed on May 28, 1986.

During the August 25-29, 1986 inspection, the IE inspector and consultant examined the original weld calculations and the revised February 27, 1986, calculations performed to justify the FM. The inspector and consultant concluded that these calculations were inadequate and nonconservative since the original calculations did not include design of the weld size to attach the clip angle to the platform steel and since the FM calculations did not consider bending in the clip angle leg attached to the platform steel. In addition, the assumptions used to distribute stresses to the outer leg of the angles beyond the K+t distance were erroneous. However, these calculations had been checked, verified, and signed off as acceptable by EBASCO and/or licensee engineers. The failure of the EBASCO and/or licensee's engineer to identify the inadequate design methodology pertaining to the Detail G calculations (both the original and the FM) was identified to the licensee as a violation of 10 CFR 50, Appendix B, Criterion III, in that the licensee's design verification program was not adequately implemented. This is violation item number 400/86-77-01, Failure to Implement Adequate Design Control Measures.

As a result of the inspection findings, licensee and EBASCO engineers performed a detailed analysis of the Detail G connection, tested a full scale mockup of Detail G, and performed an indepth review of EBASCO and licensee design calculations to determine if any similar connections had been used elsewhere in Category I structures.

Prior to performing the re-analysis of the Detail G connection, the as-built configuration of the cable tray supports were evaluated and the actual loads acting on the structure were recalculated. The actual tensile load was determined to be 15.2 Kips instead of the 32.6 Kips used in the original design. The re-analysis of the connection was performed using the ultimate strength method for design of welds per the AISC manual and a finite element analysis. The re-analysis showed that the connection was adequate for the reduced loads although some local weld overstressing was indicated. The results of the full scale model of the connection demonstrated that the finite element analytical techniques used in the re-analysis were accurate. In the full scale mockup of the connection, the first 3/8 inch of weld was omitted from the heel of the clip angle. The ultimate tensile capacity

no safety significance. Based on review of the calculations and structural steel connections, the inspectors concluded that the problems associated with Detail G were isolated and were not generic.

On October 17, 1986, the inspector discussed the need for re-inspection of the Detail G welds with the licensee. The inspector was concerned that the welds may have been possibly undersized because of generic structural steel weld inspector problems identified by the licensee during construction of the Harris project. These problems are summarized in NRC Inspection Report Number 50-400/86-69. The licensee conducted the re-inspection subsequent to this discussion. As a result of the re-inspection, the licensee determined that 49 of the 54 welds were slightly undersized. These welds had been previously inspected and accepted by licensee inspectors. This problem was documented in NCR OP-86-0149. This NCR was dispositioned by repairing thirteen of the most critical connections with undersized welds. The failure to complete the welds in accordance with the design requirements (CAR 2168-G-251-S01 (Detail G) R-1) and the failure of the licensee's QA/QC inspectors to identify the undersized welds was identified to the licensee as Violation Item 400/86-77-02: Undersized Welds on Cable Tray Supports.

The licensee also analyzed the cable tray supports which incorporated Detail G with a three-dimensional model of the frames using a Stardyne Computer Analysis. The results of this analysis indicated that the as-built Detail G connection welds were overstressed at 17 additional connections. This analysis incorporated as-built conditions and addressed concerns documented by a design engineer who had formerly been involved with the Detail G and cable tray frame design. These concerns are summarized on a list of pending concerns regarding design of the cable tray supports in containment which the individual submitted to his supervisor (at the supervisor's request) prior to his leaving employment at the site to accept a position with another employer. The engineer's concerns are discussed in additional detail in paragraph 7.c, below.

The Stardyne analysis indicated that the Detail G connection was locally overstressed due to a moment transfer between the connection and supporting beam which act on the weld parallel to the major axis of the platform steel. The vertical load obtained by this analysis was reduced to 6.7 Kips. The analysis incorporates very conservative assumptions, the most conservative being the one which assumes a moment transfer takes place between the connection and supporting beam. As a result of the weld reinspection and the re-analysis using the 3-D frame, 30 of the connections were modified.

Findings

The concern was substantiated. As a result, the inspector determined that the licensee's design verification program was not adequately implemented regarding design of the Detail G connection. This was identified to the licensee as a Violation Item No. (400/86-77-01).

During review of the concern, the violation pertaining to undersized welds (Item 400/86-77-02) was also identified. This violation was not directly related to the concern, but was the result of the detailed inspection of the Detail G connection which was conducted by the inspectors and licensee to resolve the concern.

e. Abuse of Use of Engineering Judgement

Concern

The alleger stated that the Civil Engineering Section at the Harris Plant was encouraged and coerced to use simple statements such as "acceptable by engineering judgement" or "considered. adequate by engineering judgement" to substantiate justification of inspection report deficiencies on numerous occasions. Some of the deficiencies were of such simple nature that minimal research and no additional calculations were necessary to justify approval. On the other hand, many of the deficiencies were of a complexity requiring additional investigation and revised calculations to determine the approval or disapproval of the existing condition, and this required work was not performed due to coercive pressures by supervisors to approve by engineering judgement.

Discussion

The inspector discussed this concern with numerous engineers employed at the Harris site. Some of the individuals questioned did indicate that, in their opinion, use of "acceptable by engineering judgement" in calculations was sometimes abused. However, the engineers who made these comments could not identify any specific calculations or design work where the inspector could find errors. As discussed in paragraph 5.d above, two examples of incorrect assumptions were identified by the inspectors during review of design calculations. With the exception of some isolated examples of incorrect "acceptable by engineering judgement" disclosed during review of numerous design calculations examined to resolve allegations discussed in this report, the inspector concluded that the term "acceptable by engineering judgement" was not incorrectly used to justify acceptance of design changes or QC inspection report deficiencies. The examples found by the inspector more often involved poor documentation of assumptions rather than acceptable by engineering judgement. That is, the term "acceptable by engineering judgement" was used in place of documenting in the calculation that the loads were compared to those in other calculations and since they were much lower, are obviously acceptable. Re-evaluation of these cases disclosed that they had no safety significance.

Findings

The concern was not substantiated. While there were some isolated occurrences of "acceptance by engineering judgement" when detailed calculations should have been performed, these cases were found to have no safety significance when detailed calculations were completed. The final output of the calculations were not affected by the design calculation revisions.

f. Conclusions

One of the four concerns expressed by the alleger was substantiated. This resulted in Violation Item No. 400/86-77-01 in that the licensee did not adequately implement the design verification program. An additional violation was also identified during review of this concern pertaining to undersized welds on the Detail G connection. The remaining three concerns were not substantiated.

Within the area inspected, no deviations were identified.

6. Case RII 86-A-0243

a. Background

An anonymous individual sent an unsigned letter to NRC Region II in which he expressed several concerns relating to design of pipe supports and steel plates embedded in concrete (embeds). A copy of a quality check, number 6635, was attached to the unsigned letter. Followup on these allegations is discussed in paragraphs 6.b thru 6.f below.

b. Training of Engineers in Use of Computer Programs

Concern

CP&L committed to NRC to conduct training classes to ensure all engineers were familiar with computer programs used in design of pipe supports and base plates. No formal training classes were even held to provide this training except for a 10 minute class taught during lunch time on one occasion. The alleger stated that absolutely nothing was taught during this class and that all attendees treated it as a joke. The alleger also stated that a Quality Check was reported on these training sessions but that no action was taken to correct the problem.

Discussion

Review of NRC Region II inspection reports and CP&L commitments to NRC disclosed that the licensee had never committed to provide computer training to all engineers involved in pipe support/baseplate design. Therefore, the statement in the above concern is incorrect; however, review of the inspection reports disclosed that a similar concern was raised by another individual in 1985. Review of this concern was performed by Region II inspector, Mr. W. Liu, during an inspection conducted September 30 - October 4, 1985 (see Inspection Report

50-400/85-36). During the inspection, Mr. Liu identified a weakness in the licensee's program in the area of training newly hired engineers in the use of STRUDL computer programs. The matter was identified as Inspection Followup Item 400/85-36-01. Mr. Liu reviewed this item during an inspection conducted April 21-25, 1986 (see Inspection Report No. 50-400/86-32). He examined the results of a technical review conducted by the licensee of randomly selected STRUDL analyses of pipe supports which confirmed the competence of engineers using STRUDL. In addition, the licensee generated procedure 7.6.K, Guidelines for Computer Control Programs, to establish requirements for control and use of computer programs.

In order to followup on this latest concern regarding training, the inspector examined procedure 7.6.K and discussed training requirements for use of computer programs with responsible licensee engineers. Review of procedure 7.6.K disclosed that the procedure requires that engineers using the computer programs are required to have prior experience in use of the particular program they were using. The procedure also required that each individual using the programs had completed the user's manuals, and that project engineers maintain lists of personnel authorized to use various programs. Discussions with licensee supervisory engineers disclosed that the majority of engineers who performed analysis of pipe supports and baseplates were hired based on previous experience in this area, including use of STRUDL and other computer programs. In cases where individuals didn't have previous experience in a particular computer program, the individuals, were trained on a one-on-one basis, as required by procedure 7.6.K, by an experienced engineer assigned by the unit lead Project Engineer. Further discussion with licensee engineers disclosed that a Quality Check, QCR number 4891, was submitted by an individual on December 19, 1985, regarding training of engineers in use of computer programs.

The inspector reviewed the QCR 4891 and the licensee's response to it. Review of the QCR disclosed that it was almost verbatim as the concern listed above. Review of the licensee's response to the quality check disclosed that a training session was held during lunch time on four consecutive days, November 12-15, 1985. The subject matter was General Input Mistakes. The inspector discussed the purpose of the training sessions with the licensee engineer who served as instructor for the training. These discussions disclosed that the reasons for the meeting was to discuss computer input errors and efficient computer utilization. The training was not for the purpose of qualifying individuals to use computer programs. During the training sessions, individuals were asked to discuss problems with the programs. The instructor stated that these types of sessions were held often to provide information to computer program users.

Findings

The concern was not substantiated. The licensee had never committed to provide formal training classes to engineers using computer programs. Engineers using the programs were qualified through previous experience and review of users manuals, or by one-on-one training if they had not had previous experience in use of the programs.

c. Supervision of Design Engineers

Concern

Engineers were in fear of their jobs since IDR took over. The hanger group was manipulated to play loose with work procedures and design guidelines. In addition, there was obvious conflict of interest with the owner of the contract engineering firm managing his own employees.

Discussion:

IDR is the abbreviation of a company called Independent Design Review. The licensee had a contract with this firm to provide design engineers to supplement the licensee's staff. These engineers are typically referred to as "job shoppers" and are hired by utilities and other companies for short duration assignments. The licensee had similar contracts with several other firms. NRC does not require that the licensee have direct supervisory control of job shop engineers. The licensee may delegate this authority to any qualified individual. Whether any potential commercial conflict of interest would exist with a contract engineering firm manager having direct supervisory control over his own employees and being in a position where he was able to recommend to licensee management whether to hire and/or fire employees of other contract engineering firms is not within the purview of NRC regulations. In addition, the number of IDR engineers employed at the site was relatively small compared to the total number of contract engineers employed onsite. A total of 23 IDR engineers had been employed in the Hangers subunit at the Harris site compared to a maximum of approximately 200 contract civil-structural engineers employed at one time in the Civil, Hanger and Stress subunits and a maximum of approximately 500 contract engineers employed in all disciplines on site. Putting this concern in the proper perspective, the employment of IDR engineers had little impact on design/construction of the Harris project.

The inspector discussed this concern with numerous engineers employed at the Harris site. These discussions disclosed that after IDR was retained by the licensee, the IDR owner was appointed supervisor in the hanger engineering group. The individual was under the direct supervision of a CP&L employee who is currently the manager of Nuclear Engineering. At the time IDR was retained, several engineers were laid off for various reasons in the hanger engineering group. Some but not all were replaced with IDR personnel. The discussions disclosed that some engineers were in fear of their jobs due to lay-off in the hanger

engineering group. However, none of the individuals questioned felt that engineers were being pressured to perform and accept design work which did not comply with good engineering practices and project and NRC requirements. Some of the individuals questioned, implied that use of engineering judgement may have been abused at times, and that some IDR personnel may not have been qualified. However, the engineers who made these comments could not name any specific calculations or design work where the inspector could find errors. One or two individuals mentioned problems detected with specific pipe supports during the review process but these errors were detected and corrected by the licensee (Review of specific problems disclosed by various individuals is discussed in paragraphs 6.f and 7.i below). Concerns over use of engineering judgement and qualifications of pipe support engineers were previously brought to the attention of NRC Region II in 1985. These concerns were examined by Region II inspector W. Liu. Results of this inspection, which are documented in Region II Report 50-400/85-36, were that the concerns were not substantiated. To followup on this latest concern, the inspector reviewed the resumes of the 23 IDR engineers who had been employed at the Harris site. This review disclosed that all of them had prior experience in hanger design. Twenty-one of the 23 had BS or MS degrees in engineering. The two individuals who did not have degrees had extensive previous experience and background in pipe hanger design.

Findings

The concern was not substantiated. There were apparently numerous conflicts between the IDR manager and the engineers he was supervising. However, there is no evidence that these differences affected the adequacy of design of pipe supports and/or baseplates.

d. Loads Due to Self-Weight Excitation

Concern

None of the hangers, HVAC, instrumentation, conduit, and cable tray loads have included loads due to self weight excitation. Prior to June 1985, no self weight excitation was considered for any hanger, and since then, only long unbraced structures have been evaluated for self weight excitation.

Discussion

The problem addressed by this concern was identified during the NRC Integrated Design Inspection (IDI) conducted December 1984 through February 13, 1985 (See Inspection Report No. 50-400/84-48). This was identified as a design deficiency item D.34-1, Pipe Support Strut Design. In response to this finding, the licensee conducted field walk downs and drawing reviews and identified 27 slender struts. Detailed dynamic analyses were conducted on seven of the slender struts. The results of the analysis, which were reviewed by the NRC IDI team, indicated that calculated stresses were within code allowable values, and that calculated strut axial displacement were within project

commitments. The licensee revised Design Guideline 7.2.c, Completion of Hanger Calculation Packages to address the design of unbraced slender seismic supports. The NRC IDI team found the licensee's corrective actions to be acceptable and resolved this item during a followup inspection conducted on July 22 - 24, 1985. (See Inspection Report No. 50-400/84-48, Supplement 1).

Findings

This concern is substantiated in that self-weight excitation loads were not included in design of hanger, HVAC, Instrumentation, conduit and cable tray loads. However, for rigid supports with high natural frequencies the effect of self-weight excitation on the support would be minimal and thus were not considered. The licensee evaluated seven of the worst case supports with low natural frequencies (i.e., long slender, unbraced supports) considering the effects of self-weight excitation and found that both deflections and stresses were within code allowable, even under vibrational loading, for these supports (struts). Thus, the licensee concluded that their method of analysis was sufficiently conservative. The NRC IDI Team accepted the licensee's conclusions. This concern did not impact safety.

e. Qualification of Embedded Plates

Concern

A statistical sampling method used to qualify all embeds (embedded plates) may not have been adequate since major loads were not investigated and effect of adjacent attachments and embeds were not considered.

Discussion:

In order to verify the adequacy of as-built reinforced concrete walls and floor/ceiling slabs (panels), and the embedded strip plates contained within the panels, the licensee conducted a design verification study of selected areas in Category I buildings at the site. The results of this study are summarized in a report titled "Panel Verification Report." This report is commonly referred to as report PVR-1. The study involved selection of panels to be analyzed, walkdowns to obtain as-built data, determination of loads action on panels from walkdown data and design calculations, and design evaluation of embedded strip plates and concrete panel sections. The inspector made a detailed review of the report, conducted field walkdowns, and reviewed design calculations. Details of the review follow below.

(1) Selection of Panels to be Analyzed

The inspector discussed the criteria used to determine which panels would be evaluated with the licensee and EBASCO engineers.

These discussions disclosed that considerations in panel selection included:

- Number and density of embedded plates, anchored (surface mounted) plates and other type of concrete anchorages

- Magnitude of loads from attachments to embedded plates and concrete anchorages

- Panel thickness and span length

- Number and size of penetrations/openings in panels

The discussions disclosed that the panels selected for analysis represented the worst case conditions. That is, panels were intentionally selected which had combination of maximum span widths, largest numbers and concentrations of embeds, largest openings, and heaviest loads acting on them. The inspector, accompanied by licensee and EBASCO engineers, walked down portions of the auxiliary building on elevations 236, 261, and 286 and verified that slab and wall panels analyzed were selected in accordance with the criteria listed above. The locations of panels analyzed under the panel verification program are indicated on drawing number CPL-2-167-S-9508, General Key Plan - Slab and Wall Panels for Panel Verification Walkdowns.

(2) Verification of As-Built Information

After panels were selected for analysis, a detailed walkdown inspection was conducted by teams of licensee and EBASCO engineers to obtain the following data for the analysis.

- Size and location of embedded strip plates, engineered plates and surface mounted (with expansion anchors) plates.

- Location and description of attachments to these plates.

- Location and size of penetrations, core drilled holes, door openings, access openings, etc.

- Any other pertinent information deemed necessary by the engineer.

This information was recorded on sketches during the field walkdowns. Full size drawings were prepared from the sketches. The inspector examined drawing numbers CPL-2167-S-9508-AB1 through - AB8, AB-13, AB-15, AB-18, AB-19, AC-1, AC-4, AC-6, AC-7, AC-10, AC-11, AC-13, and AC-19 which show attachments to various panels

in the auxiliary building. The inspector performed a walkdown inspection and examined slab panel numbers AB-5 (Column lines B-C, 23-26), and AB-4 (column lines C-D, 31-36) and wall panel. Numbers AB-12, (column lines E-D, elevation 236 to 261), AB-15 (column lines C-D, elevation 236 to 261) and AB-18 (column lines 36-39, elevation 261 to 286). During the walkdown inspection, the inspector verified the as-built details of the panels were accurately shown on the appropriate panel verification drawings. These details included location and identification of attachments to embedded and surface mounted plates, and location of openings in the panel. The inspector noted, during the walkdown inspection, that a small number of hangers supporting small diameter piping, primarily fire protection branch sprinkler lines, were not indicated on the as-built panel drawing. However, the loads imposed on the embeds by these hangers were negligible compared to embed capacity.

(3) Review of Calculations

The inspector reviewed the calculations which form the basis of report PVR-1. Calculations examined were as follow:

- Calculation Book PVP-1, Panel Verification - General Information
- Calculation Book PVP-2, Strip Plate Calculations
- Calculation Book PVP-3, Capacity of Embeds, Panels AB-1, AB-2, and AB-3
- Calculation Book PVP-4, Capacity of Embeds, Panels AB-4 and AB-5
- Calculation Book PVP-5, Capacity of Embeds, Panels AB-6 and AB-7
- Calculation Book PVP-6, Capacity of Embeds, Panels AB-8 and AB-9
- Calculation Book PVP-16, Capacity of Embeds Panels AC-11 and AC-12
- Calculation Book PBP-17, Capacity of Embeds Panels AC-13 and AC-14
- Calculation Book PVC-1, Panel Verification Computer Analysis, Panel AB-8
- Calculation Book PVC-2, Panel Verification Computer Analysis, Panel AC-7

Review of the calculations disclosed that embed capacity was checked for all strip embed plates where two or more attachments were less that 12 inches center to center, where single attachments or plates had heavy loads, and where attachments on strip plates were located where edge distance of studs from adjoining plates or openings is less than required to develop full stud capacity. All of the embeds were found to be adequate. None of the attachments exceed embed capacity.

The capacity of the concrete panels was checked using finite element calculations. Strength capacity of panels complied with project design requirements.

Findings

The concern was not substantiated. The calculations used to qualify the embedded plates did consider major loads and affect of adjacent attachments and embeds.

f. Review of QCR 6635

Introduction

Quality Check Report (QCR) No. 6635 contained numerous concerns related to the design of pipe supports and embedded plated and the licensee's PVR-1 report discussed in paragraph 6.e, above. The inspector reviewed the licensee's response to this QCR and performed an independent review of each concern expressed in the QCR. The concerns and the results of the inspector's review of the concerns are summarized below:

(1) Limitations of EBASCO Interaction Equation

QCR Concern

The EBASCO interaction equation has several limitations which result in reducing conservatism of embed analysis. The QCR stated that the EBASCO equation did not consider stud allowable reduction for seams in the embed plates, adjacent attachments, free edge distance violations, pipe sleeves, or concrete defects. The QCR also stated that the EBASCO equation was based on only one attachment within 12 linear inches on the embed and did not account for additional attachments within the 12 inches.

Discussion

Embedded strip plates used on the Harris project were one of two types installed in the concrete walls, floors and ceiling at approximately 4'0" centers. These were designated Type 1, (6" wide, 3/4" thick A-36 steel plates with one row of Nelson

studs on 12 inch maximum centers) and Type 2, (8" wide, 1" thick A-36 steel plates with two rows of Nelson studs on 12" maximum centers). The spacing of the Nelson studs were reduced at seams in the plates. In addition to the strip plates, embeds specifically designed for a particular use, or loading e.g. a very large pipe support, were installed in the concrete. These were designated Engineered Plates and were rectangular or square plates of various sizes or thickness depending on design requirements.

The inspector discussed the use of the EBASCO interaction equation with licensee engineers and examined HPES procedure 7.1.I, Guidelines for the Analysis of Embedded Plates. These discussions disclosed that the EBASCO Interaction formula which was used to design the strip embed plate is based on a linear (i.e., straight line) interaction equation which contains a design margin of approximately 20 percent. The straight line equation is as follows.

$$\frac{F}{F_{all}} + \frac{M}{M_{all}} \leq 1.0$$

where F is shear force acting on embed

F_{all} is allowable shear force

M is bending moment acting on embed

M_{all} is allowable bending moment

This equation was initially used to check loads acting on the embed plates. If the embed was not acceptable by use of this method, the embed was checked using a interfacing-interaction curve developed by EBASCO. This curve more closely represented the behavior of the embed and did not contain an extra 20 percent design margin, though this equation still had some built-in conservatism.

Both the linear interaction equation and the non-linear interfacing-interaction equations are based on assumption that the attachments to the strip embed plates will have an eccentricity of two inches. That is, the loads were assumed to act two inches from the centerline of the embed, even though they were generally attached at, or in close proximity to the centerline. The assumption of the two inch eccentricity introduces additional conservatism into the strip embed analysis.

If the embedded plates still could not be qualified using the interfacing-interaction curve, the licensee had the option to use one of two proprietary finite element baseplate design programs, the NPS Baseplate or CDC Baseplate II programs. These programs permit the designer to more closely duplicate the actual loading conditions for the embedded plate and eliminates the additional conservatism inherent with the EBASCO equations. The analysis performed using the finite element programs incorporates all design loads, safety factors, and allowable stresses required by industry codes and NRC regulations. However, the additional conservative assumptions (load acting directly over a Nelson stud, two inch eccentric loading, loads acting as point loads, not distributed over the area of attachment) incorporated into the EBASCO equations are not included in the finite element programs. To summarize this discussion, the EBASCO interaction linear equations are simple to use and always give very conservative results. However, if use of this equation indicates that the stresses in the strip embeds are unacceptable, more refined analytical techniques can be used to determine the actual stresses acting on the embedded plates. It is acceptable and is normal design engineering practice to approach a design problem using very simple, conservative analytical techniques and use more sophisticated techniques when the simple conservative ones do not give reasonable results.

The limitations of the EBASCO interaction equations listed in the QCR could also be considered limitations in any method of baseplate analysis. However, these factors were considered in generic design of the embed strip and engineered plates.

In addition, the licensee's panel verification program (PVR-1), demonstrated the adequacy and design conservatism used for design of the embedded plates on the Harris project. This program selected and analyzed the worst case conditions using very conservative techniques and no deficiencies were identified. In addition, the restricted embed program discussed in paragraph 7.e indicated that the licensee's embed design program accounted for the limitations expressed in the QCR.

Findings

The concern was not substantiated. The inspector concluded that analytical techniques used in design of embedded plates were conservative.

(2) Unevaluated Embeds

QCR Concern

The ceiling embeds in the auxiliary building on elevations 236 and 261, Columns B to D, and 26 to 39 contain thousands of unevaluated 12 inch spacing violations. In addition, embeds on both sides of the secondary shield wall in the containment building contain numerous violations. The embeds in these areas were so close together that they never would have satisfied the basic assumptions on stud capacity which made the EBASCO interaction formula valid.

Discussion

The inspector walked down the areas mentioned in this concern. Based on this walkdown inspection the inspector concluded that although these areas contain numerous attachments to embeds, the embeds in the area examined by the PVR-1 program had more attachments. The inspector discussed this concern with numerous licensee and contract engineers who currently were or had been involved in design of embeds and individuals named by the alleger in Case No. RII-86-A-0254 (See paragraph 7). Two individuals stated they had concerns regarding the area in the auxiliary building specified in the concern.

The inspector discussed this concern with licensee HPES supervisory engineers. In order to expedite resolution of this concern, the licensee agreed to analyze embeds in areas named in the concern. The inspector selected two areas on the ceiling above elevation 236 (bottom of slab elevation 259) between column lines C-D and 26-28, designated as slab Panel AB-21 and between column lines C-D, 36-38, designated as slab Panel AB-22 for analysis. A licensee engineer with extensive experience in design of embedded plates and attachments performed a walkdown of the containment building and selected 10 areas on the secondary shield wall which represented worst case loading conditions for analysis. The licensee assigned experienced design engineers to prepare as-built drawings of the embeds in these areas and to perform an analysis of the embedded plates. After the analysis was completed, the inspector walked down the area and verified that the as-built sketches accurately reflected the type and location of attachments to the embeds, and included the locations of adjacent embeds or expansion anchors which would have overlapping shear cones, openings in slabs, free-edge violations, and the presence of concrete defects, if any. The inspector also verified that the worst case conditions were selected for analysis. After the walkdown was completed, the inspector made a detail review of the design calculations performed to qualify the embeds. The inspector verified correct attachment loads were included in the analysis, verified that the proper design methods were used and that safety factors used in the analysis were appropriate. All the embeds design verified during this analysis complied with project requirements.

Findings

The concern was not substantiated. The PVR-1 program analyzed the worst case conditions. The licensee was cooperative in performing the additional analysis described above to resolve the concern. The additional analysis demonstrated the conservatism in the licensee's embed design program.

(3) Concerns Regarding PVR-1 Program

QCR Concern

The QCR stated that the author of the PVR-1 report had reservations regarding the embed program at the site and recommended in the report that no additional attachments be made within 12 inches of existing attachments to embeds. The QCR also implied that the data in the report was manipulated to control sample selection to justify the licensee's design approach for embeds.

Discussion

The inspector questioned the author of the PVR-1 reports and other engineers involved in the PVR-1 program regarding any reservations they had concerning the embed program at the Harris site. All these individuals felt that the PVR-1 program was conservative. None had any reservations concerning embeds, or any other matter which impacted safety. Review of the PVR-1 report disclosed that there were no recommendations or conclusions that no additional attachments could be made within 12 inches of existing attachments. Also, based on review of PVR-1, the inspector concluded that sample selection was manipulated to pick worst case conditions, not to select only areas which would result in minimum loads as the QCR implied.

Findings

The concern was not substantiated.

(4) IEB 79-14 Review Process

QCR Concern

No hangers were walked down and no attachments were verified by field inspection. As an example the concern referenced the hanger PD-H-143 calculations which stated that no additional attachments were made to the embed plate when in fact several additional hangers had been attached to the same embed.

Discussion

Numerous inspections of the licensee's IEB 79-14 program were conducted by NRC Region II inspectors. During these inspections, the Region II inspectors verified that the licensee conducted a field walkdown program and prepared as-built drawings of pipe hangers. This program was conducted by the contractor's (Daniel) field engineers in accordance with CP&L Procedure WP-141, "As Constructed Pipe". During the program, the location of other attachments to embeds of the hanger being as-built were not indicated on the hanger drawing. However, the adequacy of the licensee's embed design program has been demonstrated by the PVR-1 program, the restricted embed program, and the results of the other studies conducted at the request of the inspector.

After the final as-built drawings of piping systems were completed, the drawings were submitted to the HPES Stress Analysis Subunit for analysis. The stress analysis group calculated revised hanger loads based on the completed as-built conditions. The revised hanger loads were then submitted to the Hangers Subunit "79-14 Roll-up" group. This group performed final verification checks on the pipe hangers using the as-built final piping loads. In the majority of the cases, the loads acting on the hangers decreased. The Roll-up group did not walkdown pipe hangers or verify attachment loads. The inspector examined the calculations for hanger PD-H-143 and discussed this problem with licensee engineers. These discussions disclosed that the statement of the concern regarding hanger PD-H-143 was based on a note on Page 7 of 9 of the final hanger calculation which stated "There is no other support attached to the plate or loads interact from other bolts." This was an incorrect statement. This problem was identified by and corrected by the licensee on July 23, 1986, during final verification performed for hanger number CX-H-741. This hanger is attached to the same engineered plate as hanger PD-H-143. This error is not indicative of a breakdown in the licensee 79-14 or embed design program.

Findings

The concern was not substantiated.

g. Conclusions

One of five concerns expressed by the alleger was substantiated. However, this problem had been identified by NRC approximately 18 months prior to the date of the allegation. The licensee's corrective actions to resolve this problem were reviewed and accepted by NRC approximately one year prior to the date of the allegation. Thus, the substantiated concern had no safety significance. The remaining four concerns were not substantiated.

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

7. Case RII 86-A-0254

a. Background

An individual contacted NRC Region II and expressed several concerns pertaining to design of cable tray supports, pipe supports, and embeds. The individual was unable to provide the inspectors with any specific information pertaining to the allegations, but did provide the inspectors with names of individuals who he stated had first hand knowledge of the allegations.

In order to followup on the concerns expressed by the individual who had no first hand information regarding the alleged deficiencies, two NRC Region II personnel (an investigator and mechanical engineer) conducted formal interviews with the individuals the alleger stated had first hand information regarding the problems. These interviews were conducted in the presence of and transcribed by a court reporter. The concerns and the results of the inspection of these concerns is discussed in paragraph 7.b thru 7.1 below.

b. Design of Fuel Pool Rack Support Concern

Concern

The alleger stated that incorrect design criteria and assumptions were used in design of the fuel pool racks. The alleger stated that the design problems were cause by failure to properly consider temperature differentials. The alleger could not provide any specific details but provided the inspectors with the names of the calculation where problems could be identified.

Discussion

In order to increase the storage capacity of the fuel pools, the licensee decided to install high density fuel storage racks in the new and spent fuel pools. The high density racks, which are a proprietary design of Westinghouse, have a different installation pattern from those specified in the original design. In the original design, the legs of the spent fuel racks were to be supported directly on steel plates embedded in the reinforced concrete under the fuel pool liner. The change in rack design resulted in some of the high density rack assembly legs resting on the liner plate and not on the embedded support plates. During the installation of the high density racks, the licensee identified a problem with leveling and vertical alignment of the racks. Further investigation of the problem disclosed that a small gap existed below the fuel pool liner plate which permitted the liner to deflect causing the racks to be out of tolerance in vertical alignment. The licensee issued FCR AS-10360 to correct this problem in the new fuel pool. This FCR was reviewed by an NRC Region II inspector during inspections conducted January 21 - 24, 1986 (see Inspection Report 50-400/86-05) and April 21 - 25, 1986 (see Inspection Report 50-400/86-29). The inspector examined the licensee's design changes to address this problem during these inspections but did not review the backup design calculations which formed the basis for these changes. The solution to this problem was to support the high density fuel racks in the new fuel pool on beams installed to bridge the distance between existing embeds.

The inspector questioned licensee engineers regarding the design methodology used to design the fuel pool rack assembly support beams, including the beam embed connections. These discussions and review of the calculations pertaining to FCR AS-10360 disclosed that temperature differentials were considered in the analysis. The effect of the temperature differentials combined with seismic loads produce highly stressed welds in the beam embed connections. Review of the calculations and review of a report prepared by a consultant retained by the licensee in November 1986, to perform an independent review of these calculations disclosed that the weld stresses considerably exceeded code allowable values. In addition, the assumptions used to redistribute and thereby reduce the weld stresses were questionable. However, these calculations had been checked, verified, and signed off as acceptable by EBASCO and/or licensee engineers. Further review of the calculations disclosed that portions of them had been verified/checked by the immediate supervisor of the design engineer performing the calculations in violation of the licensee's design control procedures. The failure of the EBASCO and/or licensee's engineers to identify the above errors pertaining to the FCR AS-10360 calculations

were identified to the licensee as another example of violation item 400/86-77-01, Failure to Implement Adequate Design Control Measures (see paragraph 5.d). The licensee issued NCR No. OP-86-0185 to disposition this problem after the violation was identified by the inspector.

Additional discussion of this problem with licensee engineers disclosed that the original design calculations for FCR AS-10360 had been completed and checked by two individuals, Individuals A and B. These calculations showed unacceptable high stresses in the welds. Another Individual, Individual C, a Supervisor, and Individual C's supervisor then revised Individuals A and B's calculations using the inappropriate methods discussed above. Individual A and B's calculations had been essentially complete except for the HPES principal engineer's signature on the calculations cover sheet. These original calculations were then changed by Individual C to redistribute the weld stresses and accept weld stresses which exceeded code allowable values. The design verification of the revised calculations was performed by Individual C's supervisor. More than 90 percent of original calculations were retained in the revised calculation package. However, the calculations were reorganized (pages renumbered, notes added, etc.) and new sheets added by individual C. The inspector questioned whether the changes to Individuals A and B's calculations should have been handled as a design change. This problem indicates a possible weakness in the CP&L's design control program. Pending further review by NRC Region II of the CP&L's design control procedures, this was identified to the licensee as Unresolved Item 400/86-77-03, Possible Inadequacies in Design Verification and Design Change Control Procedures.

Findings

The concern was substantiated. Incorrect design criteria and design assumptions were used in redesign of the fuel pool rack support structure. The problem was similar to that identified with Detail G. As a result, another example of Violation 400/86-77-01, Failure to Implement Adequate Design Control Measures, was identified.

c. Design of Cable Tray Supports

The alleger stated that 70 percent of the cable tray supports installed in the containment building failed analysis. The alleger had no first hand information regarding the deficiencies in the design analysis of the cable try supports, but provided the following information which the alleger perceived as indications of these alleged design deficiencies.

(1) Concern

An EBASCO engineer, Individual D, was heard to comment that he did not agree with the design criteria employed for design of the cable tray supports. The alleger stated that Individual D refused to "sign-off" on the design criteria.

Discussion

Individual D was questioned by the inspectors and asked if he agreed with the design criteria used to design of the cable tray supports. Individual D stated that at times he had disagreements with some of the criteria, but that those disagreements were minor in nature, and that as the design criteria evolved, his concerns were resolved. Individual D stated that his concerns did not really involve the design criteria, but rather the methods, that is, ways to approach various design problems. Individual D stated that he was satisfied with the design criteria used for support design, although he felt that the finite element technique used to evaluate the "Detail G" connections were overly conservative and did not represent actual physical conditions regarding the true behavior of the connections under design loading conditions. However, since the finite element techniques were conservative, this has no safety significance.

Findings

The concern was not substantiated. Individual D did concur with cable tray support design criteria.

(2) Concern

The analysis of the cable tray support connections to the platform steel (Detail G) considered only axial loads. All other loads (bending, horizontal, etc.) were neglected. Individual E modeled one of the electrical support frames and performed a finite element analysis. Even though the design loads were reduced by 70 percent, the welds still failed. Individual E prepared a list of concerns pertaining to the analysis he performed.

Discussion

The concern regarding Detail G is discussed in paragraph 5.d, above. This same concern was expressed by another individual approximately two months before the alleger contacted NRC. Review of the design calculations disclosed that axial loads were the most significant loads acting on the connections and these loads controlled the design of Detail G. After lateral braces were added to the supports, Individual E prepared a three dimensional

model of the entire frame for finite element analysis. This analysis incorporated as-built conditions, i.e., the actual configuration of the frame and the actual design loads actions on the frame. The actual loads acting in the frames were considerably less than those assumed in the original design analysis. Individual E resigned his position at the Harris site to accept a position with another employer prior to completing the analysis. Prior to leaving the site, Individual E submitted a list of pending concerns regarding design of the cable tray supports in containment to his supervisor. The finite element analysis was completed in November 1986, using the worst case conditions. That is, the frame with the maximum combined loads contributed by cable trays, conduit and piping was analyzed. A summary of Individual E's concern which were pending when he left employment at the site are listed below. The inspector and consultant reviewed the November 1986, Detail G calculations and verified that Individual E's concerns were resolved. Individual E's concerns were as follows:

(a) Concern

The frames were designed using a two-dimensional analysis. The three-dimensional analysis is required to accurately account for frame and connection behavior under dynamic load conditions.

Resolution

A three dimension frame analysis was completed

(b) Concern

Longitudinal bracing was not included in two-dimensional analysis.

Resolution

The longitudinal bracing was included in the 3-D model and analysis.

(c) Concern

Each frame is a unique structure due to a variety of attachments and bracing schemes. Therefore, several unique models may be required to be analyzed instead of one typical mode.

Resolution

The licensee analyzed the "worst" case condition. That is, the frame with the largest attachment loads was analyzed.

(d) Concern

Due to numerous attachments to the structures (e.g., piping, electrical conduit, unscheduled support, etc.) as-built drawings are required. Concern was that as-built loads would exceed the original design loads.

Resolution

The frames were as-built and the as-built loads were used in the analysis. The as-built loads were found to be less than those used in the original analysis.

(e) Concern

Frame may not comply with deflection criteria (1/16" maximum) permitted for attached pipe supports.

Resolution

The deflection was checked and found to be less than 1/16". This complies with pipe support deflection criteria.

(f) Concern

Frequency calculations were not performed for attaching conduit and instrument supports to electrical frames.

Resolution

Conservative values were used for reactions from conduit support loads. These loads were determined from actual as-built condition and multiplied by appropriate "G" factors to determine seismic loads.

As discussed in paragraph 5.d above, the three-dimensional frame analysis indicated that the Detail G connection welds were locally overstressed due to a moment transfer between the connection and supporting beam acting on the weld parallel to the strong (major) axis of the platform steel. This analysis showed torsion, bending moment, and horizontal and axial loads acting on the Detail G connections. The analysis incorporated very conservative assumptions.

Discussions with licensee engineers disclosed that Individual E also had submitted a list of concerns pertaining to containment cable tray riser structures. These structures are shown on drawing number CAR-2168-G- 251S05 and S06. The inspector reviewed the concerns and discussed their resolution with licensee supervisory engineers. These discussions disclosed that the licensee was in the process of finalizing the cable tray riser calculations to resolve these concerns during November - December 1986. After these analysis are completed, the inspector will review calculations and verify they were properly resolved. Review of these concerns was identified to the licensee as Inspector Followup Item 400/86-77-04, Resolution of Cable Tray Riser Design Concerns.

Findings

The concern was substantiated in that problems did exist in the design of the Detail G connection. A similar concern was expressed by another individual previously. Results of review of this concern are discussed in paragraph 5.d above. A violation was identified by the inspectors pertaining to the Detail G connection design (See paragraph 5.d). Also, an individual did have some additional concerns pertaining to design of cable tray supports. However, these concerns have been resolved.

(3) Concern

The alleger stated that when Individual F discussed concerns that he (Individual F) had regarding design of cable tray supports with a CP&L supervisor, the supervisor stated to Individual F, "Do you know what happened to the last guy that came in with that same concern? I fired him!" The alleger stated that Individual F resigned two weeks later stating "I'm not working under those conditions." The implication of this concern is that Individual F was to make the design work, even if it meant performing an erroneous design analysis, or else he would be terminated.

Discussion

The inspectors questioned Individual F regarding whether or not he was threatened by his supervisor when he raised concerns regarding design of cable tray supports or any other concerns or design problems. Individual F denied that he was ever threatened with any actions when he raised concerns. Individual F also denied that he was reminded by a CP&L supervisor or anyone else on site that the last engineer to raise these same concerns was fired. Individual F was questioned regarding his reasons for terminating his employment at the site. Individual F stated that he resigned to take a new position with another company since the new position offered longer term employment. Individual F said that since design and construction of the Harris plant was completed, he realized that he would be laid off due to a reduction in force within a few weeks and therefore accepted a new long-term position with another company. Individual F stated that another major factor in his accepting a position with his new employer was that his new place of employment would be near his home (several hundred miles from the Harris site) and this would give him the opportunity to live in close proximity to his family. Individual F said that he had good rapport with his supervisor and the he could have remained employed onsite for a while longer, but that he felt it was in his best interest to accept a position which offered longer-term employment.

Findings

The concern was not substantiated.

d. Interpretation of Wyle Test Report Results

Concern

The alleger stated that the licensee extracted whatever data they wanted from a Wyle Laboratories test report for design of the cable tray supports. The Wyle tests simulated a seismic event on a single cable tray on a "Shake Table." The alleger stated that the licensee took data from the report out of context for a single cable tray and extrapolated it to multiple supports with attached conduit loads.

Discussion

The inspector examined Wyle test reports used to qualify the cable trays.

These reports were:

- Wyle Report No. 47241-1, Seismic Simulation Test Program on Seventeen Cable Tray Configurations, Their Attachments, and a 15 KVA Transformer, dated June 24, 1984
- Wyle Report No. 46626-1, Seismic Simulation Test Program for Threaded Rod Conduit Supports and Cable Trays, dated March 24, 1983.

Review of these reports disclosed that the tests summarized in the reports were performed to qualify the various types of cable trays and fittings, e.g. elbows, tees, and connectors. The purpose of these tests was to demonstrate that the prefabricated sheet metal cable tray sections and fittings had the structural capacity to support the electrical cables between supports. The tests did not address cable tray supports. The cable tray configurations tested during the Wyle Laboratories study were the worst case configurations. During the laboratory shake table tests, the effect of fire wrapping of the tray sections was also included in the test. This was done to verify that the structural capacity of the trays would not be exceeded by the combined weight of supported cables and fire wrap materials.

One question which arose during the test was the qualification of the cable tray holddown clamps (clips) which are used to fasten the prefabricated cable trays to the structural supports. During the initial 1984 tests, the holddown clips failed during the test. These were the same type used by the licensee at the Harris site. The holddown clips were replaced on the test sections with larger clips and the tests were continued. As a result of the failures of the holddown clips, several individuals expressed concerns regarding the adequacy of the clips utilized at the Harris site. Individual E documented this as Concern 8 on his list of pending concerns pertaining to the cable tray restraint structures. The licensee evaluated the capacity of the holddown clips used at the Harris site and the reasons for the failure of the clips during the Wyle test in an undated CP&L memorandum, File number HXSP-001-017-962, Subject: Supplemental Information: Cable Tray Holddown Clips, and CP&L memorandum to file HXSP-001-017-962, dated September 30, 1986. Based on this evaluation, the licensee concluded that the hold down clips used on the Harris site were acceptable.

Findings

The concern was not substantiated. The test data referenced by the alleger did not involve design of the cable tray support structures. The licensee did not use any data from these tests in the structural design of the cable tray supports.

e. Qualification of Embeds or Wall Panels

Concern

The alleger stated that he had concerns regarding the selection of embeds/wall panels that were analyzed under the sampling program performed to determine if the attachments loads on embeds/wall panels were within design allowable values. The alleger stated that when Individual G performed an initial review of embeds/wall panels, Individual G found problems with 30 percent of the panels/embeds he examined. The problems he found were that additional attachments were added to panels/embeds which were tagged or marked to state that no additional attachments were to be placed on the embeds/panels. The embeds/panels were tagged to close out FCRS which covered embeds/panels which were loaded to their design capacity. The alleger stated that 14000 FCRs were issued against embeds and implied that many of these FCRs restricted the embeds. He stated that in order to close out the FCRs the licensee instituted a QCA-7 (random sampling) program to clear the backlog of FCRs. The purpose of the program was to sample a small percentage of the embeds and if they were found to be okay, close out the remaining FCRs. The alleger stated that the QCA-7 program was a good program if used properly, but that this particular program was manipulated to give acceptable results. The alleger stated that the

CQA-7 program bypassed a lot of wall panels that should have been looked at. He stated that two individuals, Individuals H and I were directed to select panels to be analyzed that would prove not be problem panels. The CQA-7 problem didn't identify any problems. The alleger stated that several engineers doubted the validity of the CAQ-7 program since no problems were identified. The alleger questioned how the initial small sampling program could identify a large number (30 percent) of problems compared with the results of the CQA-7 program (no problems) unless the CQA-7 program was falsified.

Discussion

During discussions with NRC Region II personnel, the alleger incorrectly used the terms embed and panel interchangeably. Embeds are steel plates embedded in the concrete which are used for attachment of pipe supports, cable tray supports, instrumentation, etc. Panels, as used in the context related to embeds, refers to a term originated in the Panel Verification Report, PVR-1. This report, which is discussed in detail in paragraph 6.e above, was a sampling program conducted by the licensee to determine if the loads acting on embeds were with design allowable limits. The study also included a review of the total loads acting on the panels. Panels, as discussed in PVR-1, refers to sections of floor/ceiling slabs between column lines and sections of walls between column lines and floors.

The inspector conducted an indepth review of the panel verification program. The results of this review are summarized in paragraphs 7.e and 7.f above. The inspector determined during the review that Individuals H and I were not involved in the PVR-1 report or program. Individuals H and I also stated that they had not been involved in the panel verification study when questioned by the inspector. The QCA-7 program mentioned by the alleger refers to a program conducted by the licensee used to evaluate the effectiveness of personnel performance on various areas. This program is controlled by CP&L procedure number CQA-7, Evaluation of Program Effectiveness. This program was used by licensee management to assess the effectiveness of personnel performance in the areas of construction and inspection activities. The program consists of a random sampling plan designed to capture data within the scope and limits of the area being evaluated. Appendix B to procedure CQA-7 specifies the minimum sampling sizes required for various lot or batch sizes. The sample sized are based on Military Standard 105 D. The PVR-1 report was not based on or in any way related to the CQA-7 program. The purpose of the PVR-1 program was to determine if loads acting on a number of embeds and panels were within design allowable limits. The only similarity between the PVR-1 program and the CQA-7 program is that the size of sample (i.e. number to embeds/panels) to be studied was based on Military Standard 105 D.

The alleger's reference to the review of embeds conducted by Individual G is more or less factual. Individual G was assigned to conduct a review of embeds affected by 51 FCRs which had not been closed out.

These FCRs restricted the embeds from additional attachments. That is, the change (new attachment) requested and approved by the FCR was conditioned that no new attachments be made to the embed without the explicit approval of design engineering. The embeds restricted by FCRs were marked by use of an adhesive tag affixed to the embed plate. This tag indicated that no new attachments were to be placed on the embed unless specifically approved by design engineering. This was to preclude the attachment of additional supports for field routed equipment, e.g. small diameter piping, conduit, instrumentation, non-safety-related piping, etc. During the review of embeds affected by the 51 FCRs, Individual G found three were properly tagged, 31 others had no tags or unauthorized attachments, 16 had no tags and additional unauthorized attachments within the restricted areas, and one was not accessible. That is, approximately 30 percent had problems (unauthorized attachments).

Based on the results of Individual G's review, the licensee concluded that the use of adhesive tags to restrict embeds was not effective and that a walkdown program was necessary to identify any restricted embeds that had unauthorized attachments. In addition, the licensee decided to paint the restricted embeds with red paint to permanently mark them as restricted embeds. Appropriate plant procedures were revised to state that no additional attachments were to be made to any embedded plates painted red without prior approval of the HPES structural unit.

Prior to conducting the walkdown inspections, the licensee conducted a review of all FCRs approved by the HPES civil/structural unit. These FCRs, which number approximately 11,000, were prefixed by C (Civil) or AS (Architectural-Structural). These would be the only FCRs which would be issued against embeds. After review of the approximately 11,000 FCRs, the licensee identified 253 FCRs which restricted embeds. Including the 253 which restricted attachments to embeds, the total number of FCRs which affected embeds was less than 1000, not 14,000 as stated by the alleger. The licensee conducted a walkdown of the restricted embeds to determine if additional attachments had been added to the embeds after the FCRs had been approved. During the walkdown inspection, the licensee identified some additional attachments which had been added to restricted embeds without the authorization of HPES engineers. Licensee engineers prepared as-built sketches of the embeds with unauthorized attachments. After the as-built sketches were prepared, HPES engineers performed an analysis of the total loads applied to the embedded plates. This analysis showed that stresses acting on the embeds resulting from the attached loads (authorized and unauthorized) were within design allowable limits. The results of the licensee's analysis of the unauthorized attachments demonstrated that the licensee conservatively restricted embeds and that loads applied to embeds from field routed equipment are relatively low.

The inspector reviewed sequential groups of FCRs and verified that the licensee identified those that restricted attachments to embeds. The inspector walked down selected embeds in the auxiliary, containment, and diesel generator buildings restricted by FCRs and examined attachments to the restricted embeds. The inspector verified that the licensee's walkdown program accurately identified attachments to the embeds, both those authorized the FCRs, and unauthorized ones attached after the FCRs were issued. Embeds examined were those affected by FCR AS-3910, 5235, 5412 and 5476 in the containment building, FCR AS-4195, 6501, 6596, 8211 and 8296 in the diesel generator building, and FCR AS-3201, 4646, 5038, 5196, 5713, 8658, 9345, 9419 and 10006 in the auxiliary building. During the walkdown inspection, the inspector noted that there was apparently some confusion regarding which embeds required painting to indicate that they were restricted. Licensee engineers were coordinating this effort with craft personnel to assure that all restricted embeds were painted. NRC Region II will examine the restricted embeds in a future inspection to verify all restricted embeds were properly painted to clearly indicate that additional attachments are not to be attached to the embeds. This was identified to the licensee as Inspector Followup Item 400/86-77-05, Painting of Restricted Embeds.

Findings

The concern was not substantiated. The sample selection in the PVR-1 program was not manipulated to select only embeds/panels for analysis which would prove not to be problem panels.

f. Disposition of "To Be Analyzed Later" Interdiscipline Review Requests (IRRs)

Concern

The alleger stated that IRRs were approved with notation "To Be Analyzed Later". The alleger stated that he was concerned that these IRRs may never have been analyzed "later" and questioned the impact of the never completed analysis on embeds. The alleger said the "To Be Analyzed Later" IRRs were bought off with the CQA-7 program.

Discussions

The purpose of an IRR is to provide documentation for transmittal of review information and/or design data between various disciplines within the HPES unit, e.g., from the Civil subunit to the Hangers subunits. The alleger also tended to interchange the acronyms IRR and FCR during discussions with NRC personnel, and implied that they were similar. The FCR, or Field Change Request, is a formal controlled change to design documents. The IRRs were a method used to transmit information between disciplines and did not constitute a design change, although the information contained within the IRR could be included as part of the design calculations used to approve an FCR. The IRRs were substituted for written memorandum. Part I of the IRR lists the details of the Review Request; this is completed by the subunit requesting the information or transmitting the design data to the other

subunit. Part II of the IRR is completed by the subunit receiving or responding to the IRR. The Response and Justification to the IRR is entered in Part II of the IRR and it is indicated whether or not design verification is required for the IRR. The inspector reviewed IRRs transmitted between the Civil and Hanger subunits. These included approximately 250 IRRs which originated in Hanger subunit, prefixed with an H, and approximately 100 IRRs which originated in the Civil subunit, prefixed with a C. During the review, the inspector noted that the Civil subunit responded to numerous Hanger subunit IRRs with the notation "Approved - To Be Analyzed Later." However, some IRRs had also been rejected, i.e., the proposed design change summarized in Part I of the IRR was not acceptable and was returned to the Hangers subunit for revision. Few of the "To Be Analyzed Later" IRRs affected embeds. The large majority documented new hanger loads to be applied to structural steel platform supports or cable tray supports. The Civil subunit was responsible for structural steel design. The inspector performed a detailed review of 20 of the "To be Analyzed Later" and verified that they had been properly evaluated during final design verification of the structural steel feature affected by the IRR. During review of IRRs originated in the Civil subunit, the inspector noted that the Hanger subunit responded to some of the "C" IRRs with the notation "Received" or "Thanks". The inspector performed detailed review of two of these IRRs, numbers C-2068, and C-2158. These IRRs affected design of welds on various pipe hangers and pipe whip restraints due to re-analysis performed on the C-1-149, 153, 163, 365, and 366 frames. The inspector examined the pipe support hanger design packages for the pipe hangers listed on the IRRs and verified that the revised loads were considered in design of the affected welds. Based on discussions with responsible engineers and review of the IRRs, the inspector concluded that a random sampling (CQA-7 Type) program was not involved in disposition of the IRRs.

Findings

The concern was not substantiated. Although the documentation of the Response/Justification to the IRRs left something to be desired, the inspector concluded that information contained within the IRRs was considered in final design of the equipment affected by the IRRs.

g. Nonsafety-Related Concrete Expansion Anchors

Concern

During questioning of individuals named by the alleger, Individual J discussed concerns related to concrete expansion anchors used in nonsafety-related installations that could impact safety-related items if they failed structurally. These potential interactions of nonsafety and safety systems are addressed by NRC Regulatory Guide (RG) 1.29 and are typically referred to as II/I (Seismic Category II over Seismic Category I) installations. Individual J's primary concern was that the required embedment for nonsafety-related anchors installations was much less than required for safety-related anchors. Individual J's secondary concerns were that the nonsafety anchor designs were for concrete failure, not anchor steel failure and that qualifying anchor load testing was done using static, not seismic, loadings.

Discussion

Work Procedure-33 (WP-33), "Installation of Wedge Expansion Bolt Anchors" delineates the installation criteria for safety and non-safety-related expansion anchors. WP-33, Rev. 14, PCN 6 does specify shallower minimum embedments for nonsafety anchors. However, the allowable design loads for nonsafety anchors are also much lower than for safety-related. For example, the allowable tension load for 1/2 inch diameter nonsafety anchors is 1577 pounds; the allowable tension load for a 1/2 inch diameter safety-related anchor is 3000 pounds.

A review of WP-33 and the manufacturer's (ITT Phillips) catalogue indicates that a minimum factor of safety of four between ultimate load capacity and design allowables has been used for both safety and nonsafety-related expansion anchors. This factor of safety meets the requirements detailed in IE Bulletin (IEB) 79-02, "Pipe Support Base-plate Designs Using Concrete Expansion Anchor Bolts."

With regard to the Individual J's secondary concerns of concrete vs steel failure, the inspector noted that the manufacturer's qualifying tests in almost all cases resulted in concrete failure, not pull-out or anchor metal failure at ultimate loads. Regardless of the mode of failure, the required factors of safety are being used to determine allowable anchor loads.

With regard to the Individual J's secondary concern of static vs seismic testing, the expansion anchor specification and IEB 79-02 only require static tensile testing. Further, independent testing done at the University of California indicated that dynamically loaded anchor pullout values were within 15 percent of static load pullout values. In addition, seismic loadings are included in the engineering analysis of II/I interaction installations identified at Shearon Harris.

During the evaluation of area of concern, the inspector reviewed the licensee's program for identifying and evaluating potential II/I interactions. The inspector reviewed engineering procedure 7.6.B, four walkdown zone documentation packages and QA surveillances of the program. Personnel performing the walkdown, engineering analysis and QA surveillances were interviewed. Approximately 18 II/I interaction installations identified by the walkdown team and evaluated by engineering were inspected in the field.

The program format and walkdown activities in general appeared to be detailed and thorough. However, the program did not provide for any actual inspection for proper installation of nonsafety hardware identified as II/I installations, either by the walkdown crew or the analysis

engineers. Considering the almost total absence of QC inspection of nonsafety installations, it appears that some level of hardware inspection should be required for identified II/I installations. More significantly, the inspector identified numerous instances in the field where the as-built conditions did not conform to the data used for the engineering analysis of identified II/I installations. Discrepancies included the following:

Area Package	Item	Observation
A-2-261-1	136/137	Analysis used hanger spans of 12 ft. Actual spans are 16 and 13 feet and one support also carries two additional conduits not addressed in the calculation.
A-2-261-1	22	Actual conduit support spans are longer than used in calculation by approximately one foot.
A-1-190-1	47	One expansion anchor nut loose. Tubesteel to baseplate weld used in analysis was 1/4 inch fillet. Actual weld size was 1/8 inch on two sides and 1/8 to 1/4 inch on two sides.
A-1-190-1	69/70	Rework after analysis added 2-bolt conduit clamps. Clamps were actually installed with only one expansion anchor due to interference with a stairwell. This installation had been signed off by the walkdown team as having been verified unacceptable. Clamp IDs were also much larger than the conduit O.D.
F-2-236-1	38	Conduit support span lengths are actually longer than spans used in the calculations. In addition, one leg of one trapeze support was common with another trapeze assembly supporting six other conduits. This was not considered in the calculations.

In addition, the inspector noted that the allowable tension load for a 3/4 inch expansion anchor specified on a generic calculation sheet for trapeze type electrical hangers was in error. The sheet allowed 2650 pounds when the correct allowable, based on site testing for reduced embedments on nonsafety-related anchors, is 1838 pounds. The inspector noted that none of the calculations observed were for 3/4 inch anchors and that 5/8 inch anchors are generally used for this type of installation. However, this nonconservative oversight was indicative of a lack of thorough review of program details.

The fact that the II/I program is based on a post installation walkdown, that a low factor of safety (two) is being used to evaluate II/I installations and that significant hardware installation deficiencies have been identified in non safety installations (shallow anchor embedments) made the observed discrepancies more significant.

As a result of the above observations, the following corrective actions were taken by the licensee:

(1) Engineering procedures 7.1.F and 7.6.B detailing the verification walkdown and engineering evaluations were revised to provide more details to the responsible engineers.

(2) A comparison was made between the "conservative" span lengths noted by the walkdown team and the spans used by HPES for analysis. This review yielded 144 cases where less conservative spans were used for analysis or where the walkdown team had not specified a span length. No evaluation of these cases to determine the accuracy and adequacy of the HPES spans had been completed at the end of this inspection. Engineering has committed to an "indepth" evaluation of the "as-built" information, not solely a check of span lengths. This inspector reviewed several packages to check the thoroughness of the licensee's review. No discrepancies were noted. However, a number of cases were noted where the HPES span lengths were much more conservative than the walkdown teams. This could be indicative of supports being added after the supposedly completed system/area was walked down, or an inaccurate walkdown inspection.

(3) The generic calculation worksheet for trapeze hangers was subjected to design review. No 3/4 inch anchors had been evaluated using this calculation sheet. However, this engineering review revealed that the generic calculations were unconservative at low "g" values. Further analysis indicated that all previously accepted conditions were still acceptable. Revised worksheets were issued.

(4) Based on the identified loose expansion anchor nut and other anchor related concerns, the licensee performed a walkdown inspection of 943 expansion anchors. A total of 79 deficiencies were identified; 33 loose or missing nuts and 46 with less than full thread engagement. In addition, 11 other hanger problems were identified such as baseplate gaps, bent rods, missing hardware.

missing anchors, and supports not anchored at all. Also, five cases resulted in changes to the calculations for such items as additional conduits (four cases) and one case of the wrong support being analyzed.

This inspector field verified approximately 12 interaction cases for which the final "confirmatory" walkdown had been completed to the new criteria in the revised walkdown procedure. Discrepancies were noted in six cases in zone A-1-216-1. These discrepancies were basically minor, but involved less than conservative spans or conditions and the wrong number or size of conduits (often there were fewer conduits than originally detailed). However, in one case, one leg of a hanger had been completely disassembled and removed.

The number of discrepancies in this program noted by this inspector and the licensee's own reviews/reinspections indicate that further improvements in inspection detail and accuracy are required.

Findings

Individual J's concerns related to failure mode, qualification test methods and embedment depths of nonsafety-related concrete expansion anchors are not valid safety concerns. The nonsafety-related anchor program at Shearon Harris, as it relates to these features, is in accordance with standard industry practice and IEB 79-02.

However, a number of discrepancies were identified in the program for identifying and evaluating potential II/I interactions. Programmatic corrective actions have been made and are continuing. Additional licensee attention to this issue is required. This area will be identified as Inspector Followup Item 400/86-77-06, Review of Discrepancies Identified in R.G. 1.29 Walkdown Program.

h. Warpage of Baseplates

Concern

During questioning of individuals named by the alleger, Individual K stated that he was concerned that the site engineering resolution to nonconformance report number (NCR) 85-1709 was inadequate. In 1984, a change to the site expansion anchor inspection procedure added requirements and acceptance criteria for measuring gaps between baseplates and concrete surfaces. The NCR was written to have engineering determine if any backfit inspection was required on previously accepted installations. In addition, the NCR stated that the standard practice at Shearon Harris of welding support attachments after installation, inspection and acceptance of the baseplate and expansion anchors sometimes resulted in increased plate to concrete gaps due to plate warpage. The NCR further stated that this welding induced warpage sometimes resulted in overstressing and failure of installed expansion anchors. Individual K stated that the effect of warpage on the expansion anchors had not been addressed by engineering in the NCR resolution.

Discussion

The inspector reviewed the NCR and Permanent Waivers (PW) C-6559 and H-1848 detailing engineering's response to the NCR. The effect of plate warpage on expansion anchors was not addressed in the NCR resolution. In addition, the values for plate to concrete gaps used in the engineering analysis were not based on direct field measurements or even mockup tests, but on the recollections of QC inspectors of typical field conditions. Also, a sketch depicting the assumed warped plate profile and assumptions used in the calculations indicated that there was contact between plate and concrete at each anchor location. Field observations by this inspector on supports AF-H-274, AF-H-421, CX-H-1948 and another CX support were that plates warped continuously from the weld to the plate edge. Gaps existed at the anchors, indicating strain or slippage of the anchor.

At the request of this inspector, the licensee reviewed the approximately 450 Discrepancy and Disposition Reports (DDRs) related to expansion anchor placements to determine the extent of post installation anchor failures. One case, involving 1/4 inch diameter anchors was identified as a failure resulting from attachment welding. In another case, a 1/2 inch diameter anchor failed during attachment welding. There was some indication that these anchors had been damaged during installation of the baseplate, thus, contributing to their failure. Interviews by the licensee of QC inspectors indicated that no unreported failures had occurred that they were aware of. The licensee performed field tests on 11 "worst case" baseplate designs to determine the extent of plate warpage and induced stress. The inspector witnessed the setup and testing of two of these installations. The test results indicated warpage and induced stress in four of the 11 cases. However, no anchors failed and those with induced stresses (thus, exceeding the original anchor preload) still were far short of ultimate failure loads. As future design loads will not be additive to the preload, original or boosted due to weld warpage, the welding process has no adverse effect on the anchor.

Findings

The original engineering resolution to NCR 85-1709 was inadequate in that it did not address the effects of welding induced stresses on expansion anchors, made erroneous assumptions concerning baseplate warp configuration and was not based on known (measured, observed) field conditions. However, subsequent reviews, field inspections, mockup testing and engineering evaluations all indicate that stresses induced in expansion anchors due to attachment welding do not adversely affect the performance of the anchors. Thus, this concern had no safety significance.

i. Errors in 79-14 Rollup Program

Concern

During questioning of Individuals named by the alleger, Individual L informed the inspector that errors were made by a designer in the 79-14 Rollup Group. These errors involved Hanger number PD-H-4198, PD-H-4199, and MS-H-194. Individual L stated that all three hangers had additional attachments within 12 inches which were not considered and that incorrect safety factors were used during computation of capacity of embedded plates for hanger numbers PD-H-4198 and PD-H-4198.

Discussion

The 79-14 Rollup Program was a final design check performed to assure that actual as-built conditions were considered in pipe support design. The 79-14 Rollup pipe support analysis was based on pipe stress computer analysis updated for as-built pipe hanger locations and configurations.

The inspector examined hanger number MS-H-194. There were numerous attachments within twelve inches of the two embeds where this hanger was attached. There was also an embed adjacent to the hanger which was restricted under FCR AS-3658. This embed was painted red in accordance with the licensee restricted embed program. The inspector reviewed the hanger calculations and determined that the effect of adjacent attachments were not considered in calculation of the embed capacity. However, the adjacent attachments were for support of small diameter conduit and instrumentation which have relatively small design loads. In addition, the loads from hanger MS-H-194 were well below the capacity of the embeds. Therefore, inclusion of the effect of the adjacent attachments on the embed would not change the hanger design or exceed embed capacity. The inspector reviewed the design calculations for hanger numbers PD-H-4198 and PD-H-4199. The review disclosed that no adjacent attachments within 12 inches were considered in the design of these hangers. However, design loads for these hangers were well below the embed capacity. This review also disclosed that the incorrect safety factors (F.S. 1.5 instead of 2.0 required) were used in the hanger embed qualification design check. However, these errors had been detected and corrected by the licensee. Since the Rollup for both of these hangers was performed by the same designer, the inspector was concerned that this type of error may be generic. The inspector examined eight additional hanger Rollup design packages completed by this same designer and verified that he used the correct factors of safety in qualification of the embeds. These hangers were as follows: SW-H-517, 518, 525, 1504, 1553, and 1660, CX-H-1130, and CC-H-411.

Findings

The concern was substantiated but has no safety significance. The design errors expressed by Individual L had been detected and corrected by the licensee. The results of the panel verification program, PVR-1, demonstrate that the licensee's embed design program was conservative.

j. Capacity of Embed for RAB Elevation 315 Platform

Concern

One of the individuals named by the alleger informed the inspector that he understood that there were problems with the embed capacity used to support a platform on elevation 315.5 of the reactor auxiliary building. The individual referred the inspector to FCR AS-2381, R1.

Discussion

The inspector examined FCR AS-2381 R1. This review disclosed that a licensee engineer had reviewed and identified problems with the justification for the FCR. The problems, which pertain to the assumptions used to qualify the baseplate, are documented on a calculation sheet, dated October 27, 1986, Subject: Embed, Review: Review of Justification for FCR AS 2381. Discussions with licensee engineers disclosed that the concerns were to be evaluated and, if necessary, the baseplate would be re-analyzed using more refined analytical techniques. The licensee's resolution to this problem will be examined by NRC Region II. This problem was identified to licensee as Inspector Followup Item 400/86-77-07, Followup on Justification for FCR AS-2381.

Findings

The concern was substantiated. However, the concern was more or less a statement of facts. This problem had been identified to the licensee who was in process of performing and evaluation of its significance.

k. Installation of New Hangers since PVR-1 Report Completed

Concern

During questioning of individuals named by the alleger, Individual M stated that he was concerned with the accuracy of the PVR-1 Report since approximately 5000 hangers had been installed since the PVR-1 study was completed. Individual M stated that the majority of these hangers were fire protection (FP) and plumbing and drain (P&D) hangers.

Discussion

The inspector reviewed licensee records pertaining to installation of pipe hangers. Review of these records disclosed that as of November 1985, the date when the walkdown for PVR-1 study was started, through December 1986, when construction was completed, 5074 additional pipe hangers were completed at the Harris site. A breakdown of these hangers is shown on the table below.

Table

Status of Pipe Hanger Installation

	Complete* as of November 1985	Complete* as of December 1986
Seismic Hanger	16812	21039
Non-seismic Hanger	10775	11625
Total	27587	32664

*Complete means installation and inspection completed and all outstanding non-conformances dispositioned.

Review of these records showed that the majority of the new hangers were for the fire protection system and comprised small diameter (one to two inches) piping for fire protection sprinkler head branch lines. The loads these hangers impose on the embed are, for all practical purposes, negligible when compared to allowable design loads for the embedded plates. The loads for these hangers were determined from "chart" methods, which give conservative values. In addition, a large percentage of these hangers had been installed prior to start of the PVR-1 walkdowns, but were considered incomplete due to either incomplete final QC inspections or outstanding NCRs. The hangers for large bore piping had been completed prior to start of the PVR-1 walkdown.

During walkdown inspection discussed in paragraph 6.e above, the inspector noted that some of the hangers were not shown on the PVR-1 drawings since they had been installed since the completion of the PVR-1 walkdown. However, the majority of these hangers supported small diameter piping and work have not affected the conclusion of the PVR-1 study.

Based on the studies completed by the licensee of the restricted embeds and of additional embeds selected by the inspector, and the inherent conservatism of the PVR-1 study, the inspector concluded that the installation of the additional hangers since completion of the PVR-1 walkdowns does not impact the structural integrity of embedded plates.

Findings

The concern was substantiated. However, this concern has no safety significance due to the conservative methodology employed by the licensee in design of embedded and surface mounted plates.

1. Design of Platform Steel

Concern

Subsequent to the inspection, on February 13, 1987, the alleger contacted NRC Region II and expressed concerns relative to design of the containment building platform steel. These concerns included modeling of connections and inclusions of loads from attached supports/restraints. The alleger stated that if CASH (The Colation for Alternatives to Shearon Harris, intervenors in the Harris plant licensing proceedings) finds out about this issue that there would be allegation of "cover-up" and could cause the NRC a lot of problems.

Discussion

The licensee identified problems regarding the design of the containment building platform steel in July - August 1986. These problems were identified during final verification of actual loads supported by the platforms and concerned treatment of seismic loads resulting from the attached piping, cable tray supports, and equipment. The final verification included analysis of loads documented on IRR's which were dispositioned "To be Analyzed Later". The seismic loads were considered to act in one direction only, and not in both directions as is required. This load reversal problem was confined to design of the structural steel platforms in the containment building. These problems were identified to the inspector by licensee engineers during an inspection conducted September 4 - 11, 1986, and are documented in Inspection Report No. 50-400/86-69. Unresolved Item 400/86-69-03 was identified pertaining to the licensee's handling of this problem. The inspector and consultant reviewed calculations for design of the platform steel during inspection of concerns relative to Detail G. The inspector and consultant concluded that the seismic load reversal problems had been for the most part resolved and did not result in an unresolved safety issue, but rather concerned final documentation of as-built conditions in order to finalize the calculations. A detailed review of the completed calculations will be performed during closeout of Unresolved Item 400/86-69-03.

Finding

The concern is substantiated in that there were problems regarding design of the containment building structural steel platform. NRC was aware of this provlem and documented it in an inspection report. An indepth review will be performed on the completed calculations by NRC.

m. Conclusions

Five of the thirteen allegations expressed by the alleger or individuals named by the alleger were substantiated. One of the substantiated allegations resulted in another example of Violation 400/86-77-01 in that the licensee did not adequately implement the design verification program in the area of design of the fuel rack assembly support beams. The other four substantiated allegations had no safety significance while the remaining eight allegations were not substantiated.

Within the areas inspected, no deviations were identified.

8. Case RII 86-A-0271

a. Background

An individual, herein after referred to as the alleger, contacted NRC Region II and expressed concerns regarding the engineering design control program at the Harris site. The alleger provided three specific examples (concerns) which he stated provided evidence of design problems at the Harris site. The concerns and the results of the inspection of these concerns is discussed in paragraph 8.b through 8.e below.

b. Design of Fuel Pool Rack Supports

Concern

The alleger stated that a design change in the fuel pool resulted in the legs of the fuel racks not matching up with the embeds that had been installed in the concrete floor of the fuel pool. A study by Westinghouse resulted in a decision to mount the fuel racks directly on the fuel pool liner which consisted of 3/16 inch stainless steel plate. When the racks were installed, they could not be plumbed and it was found that there was a gap averaging 1/4 inch to 3/4 inch between the liner and the concrete floor. The original Westinghouse design for the fuel pool called for the fuel pool liner to be in direct contact with the concrete floor. This design was changed by CP&L during construction and the gap between the liner and floor was built in ostensibly for drainage. The problem of the gap is not documented in CP&L engineering files. A recommendation was made to pressure grout the gap, however, that suggestion was not implemented due to the fact that hydro testing on the fuel pool had already been completed. Engineering then devised a solution of bridging the embeds and installing the fuel racks on the bridges over the embeds. There is a concern that the subsequent changes in the original Westinghouse design of the fuel pool may be inadequate due to nonconservative engineering assumptions in load distribution for the fuel racks in the redesign of the racks.

Discussion

The design change the alleger is referring to is the change to high density fuel racks discussed in paragraph 7.b. above. The original installation did call for the fuel pool to be supported directly on embedded plates. However, the redesign by Westinghouse (high density racks) called for these racks to be supported on the stainless steel liner which was thought to be in contact with the grout/concrete surface below the liner. The presence of the gap became apparent during installation of the high density (redesigned) racks. The sequence of construction of the fuel pool was as follows:

(1) Reinforced concrete was placed to within three inches of the bottom of the liner.

(2) Portland cement grout was then placed over the concrete surface. The top of grout elevation corresponded with the bottom of the liner.

(3) The stainless steel fuel pool liner was installed directly on the grouted surface and welded.

The gaps between the grouted surface and liner were apparently caused by heat distortation during welding. The gaps were not planned, but were the result of minor construction problems. These problems are documented by CP&L in FCR-AS-10360. The solution to resolve the problem was to support the racks on beams installed to bridge the distance between existing embeds.

As discussed in paragraph 7.b. above, nonconservative allowable stresses were used in design of the modification to support the new fuel pool. This design problem were documented in NCR No. OP-86-0185. This problem only applied to the new fuel pool rack redesign since a different design approach was used to redesign the spent fuel pool racks. However, the high density spent fuel racks have not yet been installed in the spent fuel pool. The licensee is presently re-analyzing the redesign of the new and spent fuel racks to eliminate possible design problems. The new fuel racks will be modified to meet redesign requirements.

Findings

This concern is partially substantiated in that a gap does exist between the concrete (grouted) supporting surface and the fuel pool liner. In addition, some nonconservative allowable stress values were used in the design to resolve the problem. As a result of the design errors, the violation discussed in paragraph 7.b. above was identified by the inspector. However, the redesign problem pertaining to installing high density fuel racks was documented in CP&L files. The licensee did not attempt to "cover-up" the problems as the alleger stated, and the gaps were not planned, but was rather the result of a documented problem.

c. Upper Steam Generator Snubber and Buffer Supports

Concern

In December 1986, an NCR was written regarding the "upper snubber and buffer supports" on the steam generator. There was an installation deficiency in that some bolts could not be properly tightened due to a wall that had been constructed adjacent to the supports which blocked access to the supports. Although the problem was resolved by engineering review, there is a concern that the safety factor is at an "absolute minimum." Another concern along this line is that the "safety factor" should have been applied uniformly "across the board" for all engineering problems.

Discussion

This concern involved installation of heavy hex nuts on embedded anchor bolts which are used for attachment of the steam generator snubbers and upper lateral bumper supports to the containment building structural concrete. During the equipment turnover process in October-November 1985, the licensee determined that records for inspection of the installation of the heavy hex nuts were incomplete. Inspection attributes which could not be reinspected at that time due to the fact that some of the nuts were inaccessible were nut material type, and snug tightness of the double hex nuts. These problems were documented on Mechanical Equipment Inspection Turnover Records. The disposition of the problem is documented on Permanent Waiver (PW) AS-10201. The inspector examined the calculations which were completed to justify and accept this PW. Review of the calculations disclosed that the licensee made several conservative assumptions to justify acceptance of the PW. These were as follows:

(1) Due to lack of inspection documentation, the licensee assumed the installed heavy hex nuts were of the lowest available grade, ASTM A-563, Grade A, and not ASTM A-563, Grade DH nuts specified on the construction drawing (EBASCO Drawing CAR-2168-G-248 S01, Embedded Steel for Equipment Supports). Conclusion of the re-analysis was that any grade nut tightened to contact would meet design requirements.

(2) Bolts where nuts appeared to be in loose contact were disregarded in design calculations. That is, the nuts on one of the eight bolts on the steam generator bumper support appeared to be "loose"

(i.e., had point contact only) and were not snug tight as required by design. The bumper supports were re-analyzed by disregarding the one bolt with "loose" nuts. Results of the re-analysis disclosed that seven anchor bolts would be more than adequate to carry design loads.

(3) The nuts on one of four bolts for the snubber supports appeared to be "loose." This snubber support was re-analyzed by disregarding the bolt with the "loose" nuts. Results of the re-analysis disclosed that three anchor bolts would be adequate to carry the design load.

Review of the calculations disclosed that calculated stresses were less than code allowable stresses. Safety factors are applied in calculation of the code allowable stresses and design loads. The safety factors used are those required by various codes used in design. The statement that the safety factors used are at an "absolute minimum" is misleading. Safety factors used are those specified by industry codes and standards and NRC requirements. The safety factors are not applied uniformly "across the board," but vary depending on design loading conditions, type of materials (e.g., concrete, structural steel, stainless steel piping, etc.), techniques used in design, and various other factors. The statement that a uniform safety factor should be applied uniformly across the board for all engineering problems is incorrect, and in fact, would be in conflict with some code requirements.

Findings

The concern was not substantiated. Safety factors used in re-analysis of the upper steam generator snubber and buffer supports were found to be acceptable.

d. Design of Baseplate for Mainsteam and Feedwater Line Support (IRR 3000)

Concern

IRR 3000 was prepared regarding a support for a "mainsteam and feedwater line." This support is a six inch thick steel plate measuring nine feet by five feet. The support is mounted on a wall between the turbine building and the auxiliary building. This support was attached to the wall with anchor bolts which were not adequate for the loading. There are three baseplates in the wall with 50 anchors overlapping. The engineering calculations considered these anchors individually when they should have been considered as groups.

Discussion

The inspector examined Interdiscipline Review Request (IRR) 3000. This IRR was written for the purpose of determining if design of the engineered plate supporting hanger number MS-H 219 was adequate for revised

79-14 design loads. The engineered plate is attached to the auxiliary building wall with 26 two inch diameter embedded anchor bolts. The anchors are spaced in a pattern over a 6'6" x 2'3" area. The engineered plate was designed by Bergen-Paterson (BP) for hanger loads shown on BP drawing number T-1-286-1-MS-H-219. During the 79-14 review, the loads were revised. All loads decreased by 50 percent or more except for the shear force, (Fy). The increase in shear force was slight compared to the decreases in the other loads. The designer concluded in the justification for IRR 3000 that the small increase in the shear force would have an insignificant impact on the design of the plate when compared to the large decreases in the other loads. The inspector concurs with this conclusion. The licensee revised the calculations for the MS-H-219 baseplate on November 18, 1986, to consider the effect of adjacent embeds (overlapping shear cones). The revised analysis showed that loads from MS-H-219 were within design allowable values.

Findings

The concern was not substantiated.

e. Engineering Staff is not Following QA/QC Program

Concern

The engineering staff is not following the QA/QC program. Also, the CP&L engineering staff is not qualified to perform their jobs.

Discussion

The inspector reviewed the qualifications of selected members of the CP&L engineering staff. This review disclosed that these individuals had at least a Bachelor of Science (BS) degree in engineering. A large number were also registered Professional Engineers and/or also had Master of Science (MS) degrees. Therefore, the inspector concluded that the CP&L engineering staff is well qualified to perform their jobs. During the integrated design inspection conducted on December 3, 1984 through February 13, 1985, the NRC IDI team raised some questions regarding the design capability of the Harris Plant Engineering Section. These concerns were addressed by the licensee and the IDI team closed out this item (see Inspection Report 50-400/84-48 (Supplement 1) dated October 1, 1985). The alleger did not give any specific information regarding failure of the CP&L engineering staff to follow the QA/QC program, except for the three examples cited by the alleger which are discussed in paragraphs 8.b. through 8.d. above. With the exception of the violation discussed in paragraph 5.d and 7.b, review of these concerns did not disclose any violations of the licensee's QA program. The violation cited was due to inadequate review of design calculations pertaining to fuel pool modification. This same allegation had been previously identified to NRC by other individuals.

The licensee's QA/QC controls pertaining to design control have been reviewed by NRC Region II inspectors on numerous occasions during construction of the Harris project. The regional inspectors did not identify any instances which would indicate the licensee's engineering staff was not following the QA/QC program. The violations cited in this report are not indications on a breakdown in the licensee's QA/QC program pertaining to design control.

Findings

The concern was not substantiated. Results of review of the licensee's design control program indicated the licensee's engineering staff complied with QA/QC Program for design control.

f. Conclusion

One of the four concerns expressed by the allegers was partially substantiated. The partially substantiated concern involved design control problems and was also identified to NRC Region II by another individual. (See paragraph 7.b. above.) This resulted in Violation Item 400/86-77-01 for failure to implement adequate design control measures. The portion of the allegation pertaining to a cover up of the fuel rack problems and the cause of the problem was not substantiated. The remaining three concerns were not substantiated.

Within the areas inspected, no deviations were identified.

9. Case RII 86-A-0278

a. Background

A copy of an unsigned, undated affidavit was sent to NRC Region II by a Raleigh television reporter. The affidavit, which presumably was furnished by an individual formerly employed as a carpenter at the Harris site, pertained to alleged improper construction practices. These allegations are discussed in paragraphs 9.b through 9.d below.

b. Rebar was Deleted from the Containment Wall

Concern

The affidavit states that all the reinforcing steel that was supposed to go into the northwest wall of the containment building was buried in a large trench on the northside of the plant. To cover up the fact that there was no rebar in this portion of the containment wall, short lengths of rebar were inserted into holes drilled 16 inches into the wall and "glued" into place with epoxy. The alleger also stated that the craft personnel working on this portion of the wall drank seven to eight cases of beer each night and dumped the empty beer cans into the forms before the concrete was poured. The alleger stated that the cans are the metal that the NRC inspector picked up on his tests when he checked for rebar.

Discussion

Numerous inspections of concrete placements in the reactor building containment walls have been conducted by Region II inspectors at the Harris site. During these inspections, the NRC inspectors verified that licensee QC inspectors had performed pre-placements inspections to assure that the rebar was properly installed and that the forms were free of debris and trash. The results of the QC inspections are documented in the licensee's quality records. The Region II inspectors also examined the concrete forms prior to placement of concrete and verified that they were free of debris and trash, and verified that reinforcing steel was installed in accordance with drawing requirements. NRC inspectors do not use any type of metal detectors to ascertain presence of rebar in the containment walls or in any other structure as is implied by the statement in the affidavit that "the cans are the metal that the NRC inspector picked up in his tests."

During the containment building structural integrity test (SIT) which was conducted February 21 - 23, 1986, the containment was pressurized to 1.15 times the design pressure (51.85 psig). The inspector examined portions of the containment walls, including the northwest wall during the SIT. No defects were found in the concrete. Measured deflections and strains were generally less than 2/3 of those those predicted by EBASCO design engineers. The results of the SIT indicate that the containment walls are "over-reinforced", that is, there is more rebar in them that is required to resist design pressure.

Finding

The allegation was not substantiated. The alleger may have been referring to deficiencies reported to the NRC Region II in late 1979 and early 1980 under 10 CFR 50.55e. These were identified in NRC inspection reports as item number 401/79-23-02, Omission of Rebar in the Unit 2 RAB South Shear Wall and item number 400/80-11-02, Omission of Rebar in the Exterior Wall of the Unit 1 Containment Building. These problems were corrected by the licensee. The inspector and other Region II personnel performed extensive inspections of the licensee's actions to correct these problems. A Confirmation of Action letter was issued to the licensee and placement of safety-related concrete was stopped for a period of time as a result of these problems.

c. Defect in Pouring of Concrete in the Cooling Tower

Concern

The alleger stated in the affidavit that there were serious defects in the concrete pouring process used in several retaining walls of the cooling tower. These alleged defects were early removal of forms, extremely large honeycombs (voids), adding water to get air bubbles out of the concrete instead of using a concrete vibrator, and using too much calcium in the concrete mix.

Discussion

The cooling tower is not a safety-related structure and has not been inspected by NRC. Construction of the cooling towers was performed by a speciality (cooling tower) contractor under a contract separate from construction of the power block and other plant structures. Procedures for construction of the cooling tower were reviewed and monitored by the licensee. Discussion with the licensee's project engineer who oversaw construction of the cooling tower disclosed that form removal was carefully controlled, calcium (calcium chloride) was not used in the concrete, and that excessive honeycomb (voids) were not present in the hardened concrete.

Finding

The allegation was not substantiated. Failure of the cooling tower concrete would not have any safety significance.

d. Problems with X-rays of Welds in the Cooling Tubes

Concern

The alleger stated in his affidavit that he believed certain x-rays of welds in cooling tubes were falsified. He based this opinion on the following:

(1) The x-ray machine did not make the whirring, humming noise when operating.

(2) The alleger's radiation-sensitive badge did not turn color when he stood three to four feet away from the x-ray machine.

(3) The photographer took x-rays while the alleger was in the vicinity of the x-ray machine instead of waiting until the alleger was 20 to 25 feet away from it, which the rules required.

(4) The photographer did not wear his protective vest.

Discussion

The statements made concerning the x-rays of welds in cooling tubes are not creditable for the following reasons:

(1) Whirring, humming noises from x-ray machines are caused by the operation of the cooling units for the x-ray generation components. Most industrial "x-rays" are taken using radioactive sources. These radiographic test units do not have cooling units and do not make any noise during the examination of the welds.

(2) There is no reason to believe that a carpenter on a construction site would be issued any type of radiation-sensitive badge, let alone one that changed color, since Carolina Power and Light does not use badges that change color to measure radiation exposure.

(3) People involved with industrial radiography are working to the requirements of a license which requires very strict compliance to radiation safety measures which include roping off areas, posting warning signs, etc.

(4) Industrial radiographers do not wear protective clothing. Their protection comes from the safety measures taken during the setup of the equipment, and the prudent use of sensitive instrumentation to make sure that they are not being exposed to unnecessary radiation.

In addition, we are not aware of any pieces of safety-related equipment which has cooling tubes with welds that require radiography.

Findings

The allegation was not substantiated. It would appear that whoever provided the description of wrong doing concerning x-rays of welds has not been involved with any industrial radiography or x-rays testing because the details that are provided concerning distances, machine noises, and protective clothing are more appropriately associated with dental or medical x-ray work which most people are familiar with.

e. Conclusions

None of the three allegations were substantiated.

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

10 Case RII-86-A-0318

a. Background

An individual, herein after referred to as the alleger, contacted NRC Region II and expressed concern regarding design of small diameter electrical conduit and capacity of cable support brackets installed in manholes. The alleger provided copies of two Quality Check Report (QCRs) numbers QCR 8172 and 8174, which had been submitted to the licensee by an individual expressing these same concerns. Followup on these concerns, which involved review of the licensee's actions to resolve the QCRs, is discussed in paragraph 10.b and 10.c below.

b. Seismic Capacity of B-194 Brackets

Concern

The alleger was concerned that brackets installed in manholes to support safety-related cables had no capacity to resist seismic forces in the Z-direction (i.e., along the axial direction of the cables they support). These brackets are designated "B-194" brackets on the licensee's drawing.

Discussion

This same concern was expressed to the licensee by an individual who submitted QCR 8172. The inspector examined the results of the licensee's investigation of this QCR and discussed the concern with licensee engineers. The results of the investigation is documented in the justification of IRR-E-1631. Review of this IRR, the discussion with licensee engineers, and review of licensee drawings disclosed that the B-194 supports were installed in the manholes to organize and provide an orderly arrangement of the cables. The B-194 supports are not required to withstand a seismic event. The cables have very little stiffness in the axial direction and, thus, sag between supports. If, during a seismic event the B-194 support bracket would fail, the cables would have to support their own dead weight plus the weight of the B-194 bracket (approximately eight pounds). Since the cables are supported in buried conduits before entering and after exiting the manholes, the length of the unsupported cables after failure of the B-194 bracket would only be approximately six feet. The axial tension resulting from the six foot length of cable and eight pound bracket is well below the pulling tension load, which is the cable tension load allowable.

Findings

The allegation is substantiated in that the B-194 Brackets were not seismically designed in the Z-direction. However, this has no safety significance since the brackets are not required to support the cables.

c. Design of Small Diameter Electrical Conduits

Concern

The alleger was concerned that 1/2 inch diameter, 3/4 inch diameter and one inch diameter electrical conduits are not designed to function as tension/compression members during a seismic event. The alleger stated that maximum allowable space lengths for these conduits needed to be reduced so that the slenderness ratio would be within the allowable limit of 200.

Discussion

This same concern was expressed to the licensee by an individual who submitted QCR 8174. The licensee's engineering staff performed a review of this QCR which is documented in a memorandum to file, dated January 8, 1987, Subject: Response to QCR No. 8174. The licensee concluded that conduits are classified as nonsafety-related and need only meet Regulatory Guide 1.29 requirements to assure structural integrity. This eliminates the requirement that the conduit function as a tension/compression member, i.e., a column. Conduits are designed to support self weight and cable weight (bending stresses) in a seismic event so that structural integrity is maintained. The use of the slenderness (KL/r) ratio is to limit compressive stresses to preclude column failure due to buckling. This is not a concern for conduit that acts primarily as a beam or bending element. The inspector reviewed the licensee's evaluation of QCR 8174 and discussed the findings of the evaluation with licensee engineers. The inspector concurs with the licensee that the use of the Kl/r parameter is not required for the qualification of conduit spans since the small diameter conduit is not designed to function as a tension/compression member, i.e., a column.

Findings

The concern is not substantiated. Small diameter conduit is not required to be designed to function as a column.

d. Conclusion

One of the two concerns was substantiated. However, this concern is simply a statement of fact and has no safety significance. The remaining concern was not substantiated.

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

[illegible]