

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-341/86012(DRS)

Docket No. 50-341

License No. NPF-43

Licensee: Detroit Edison Company
2000 Second Avenue
Detroit, MI 48226

Facility Name: Fermi 2

Inspection At: Fermi Site, Newport, MI
Stone and Webster Engineering Corporation, Boston, MA (S&W)

Inspection Conducted: March 10, April 9-10, 15-17, 22-24, 29-30,
May 1, 6-8, 20-22, 28-29, June 10-13, and 17-20, 1986
at the site

June 3-5, and July 1-2, 1986 at S&W

Inspector: *I. Yin*
I. Yin

7/25/86
Date

Approved By: *D. H. Danielson*
D. H. Danielson, Chief
Materials and Processes Section

7/25/86
Date

Inspection Summary

Inspection on March 10 through July 2, 1986 (Report No. 50-341/86012(DRS))

Areas Inspected: Special, announced inspection of embedded support base plates, design change documentation, environmental qualification of equipment, welding of studs to embedded plates, the reconciliation of piping stress analysis and support calculations to the latest design and as-built condition, the completion of outstanding major design tasks, the S&W evaluation of design documents, documentation of small bore piping calculations and licensee event reports.

Results: Of the areas inspected, one item of violation was identified (inadequate design control for small bore piping and suspension systems - Paragraph 9.d).

DETAILS

1. Persons Contacted

Detroit Edison Company (DECo)

- °B. R. Sylvia, Group Vice President
- °R. Wooley, Acting Supervisor, Licensing
- *L. Simpkin, Director, Nuclear Engineering (NE)
- °*D. Spiers, General Supervisor, Projects and Plant Engineering
- °*G. M. Trahey, Director, Nuclear Quality Assurance
- B. R. Maters, Legal Staff
- °J. H. Flynn, Legal Staff
- °*S. H. Noetzel, General Director, NE
- T. Randazzo, Director, Regulatory Affairs
- A. F. Colandrea, Lead Engineer, Architecture/Civil
- M. L. Batch, Supervisor, Mechanical/Civil/Piping
- S. P. Zoma, Lead Electrical Engineer
- J. W. Contoni, Lead Mechanical Engineer
- °*L. Fron, Supervisor, Supervising Engineer
- *C. E. Alderson, Advisor to the Vice President
- R. S. Lenart, Plant Manager
- G. R. Overbeck, Superintendent, Operations
- R. A. Bryer, Systems Engineer
- M. S. Williams, Engineer
- J. A. Hughs, Engineer
- °J. R. Green, Supervisor, Systems Engineering
- °M. Bufalini, Supervisor, Media Relations
- Q. H. Duong, Supervisor, MEG and EQ
- L. Raisanen, Lead EQ Engineer
- *J. Conen, Licensing Staff
- A. K. Lim, Systems Engineer
- J. R. Mullens, NDE Engineer
- D. Ferencz, Principal Quality Engineer
- W. Ackerman, Senior QA Engineer
- R. Tassell, Senior Engineering Technician
- B. Wickman, QA Supervisor
- D. Johnson, Quality Engineer
- L. Collins, Systems Engineer
- S. Uema, Engineer
- A. E. Wegele, Senior Licensing Engineer
- E. Wilds, Systems Engineer

Stone and Webster Engineering Corporation (S&W)

- °F. K. Sestak, Jr., Assistant Engineering Manager
- W. R. Curtis, Lead Engineer, Engineering Assurance
- M. B. Stetson, Assistant Chief, Structural Engineering
- J. Keevil, Engineer, Operations Services
- C. F. Bergeron, Consultant
- E. F. Heneberry, Senior Electrical Engineer

F. M. Fortini, Senior Control Engineer
P. F. McHale, Supervisor of Specialists
O. Lowe, Engineering Mechanics
J. Murphy, Lead Licensing Engineer
S. Ramamurthy, Lead Engineering Mechanics/Structural Engineer
R. Strych, Director of Nuclear Design
W. M. Eifert, Chief Engineer, Engineering Assurance
K. L. Polk, Engineer, Engineering Mechanics
B. C. Dave, Lead Task Engineer
D. Parikh, Principal Engineer

Sargent and Lundy Engineers (S&L)

A. Furlager, Site Manager
N. Z. Shah, Supervising Design Engineer
J. S. Yaneza, Senior Structural Engineer
M. Zentgraf, Engineering Analyst

Multiple Dynamics Corporation (MDC)

F. E. Gregor, President
D. F. Lehnert, Vice President
K. A. Hagan, Senior Engineer

U.S. Nuclear Regulatory Commission, Region III (RIII)

°J. G. Keppler, Regional Administrator
°A. B. Davis, Deputy Regional Administrator
°C. J. Paperiello, Director, Division of Reactor Safety
°J. J. Harrison, Chief, Engineering Branch
°D. H. Danielson, Chief, Materials and Processes Section
°J. W. Muffett, Chief, Plant Systems Section
°R. Lickus, Chief, State and Government Affairs
°R. Marabito, Public Affairs Officer
G. C. Wright, Chief, Projects Section
°R. W. DeFayette, Project Manager
°W. Rogers, Senior Resident Inspector
W. G. Guldemon, Chief, Operational Programs Section
P. Kaufman, Reactor Inspector
M. E. Parker, Resident Inspector
°*I. T. Yin, Senior Mechanical Engineer
°M. D. Lynch, Licensing Project Manager (NRR)

*Denotes those attending the management exit meeting held at the site on June 20, 1986.

°Denotes those attending the management meeting held at RIII on June 26, 1986.

2. Licensee Action on Identified Item

- a. (Closed) Violation (341/86012-01): Small bore piping design deviated from cookbook design rules without engineering justification. See Paragraph 12 for details.

- b. (Closed) Violation (341/85052-01): Inadequate design control for pipe support embedment plate. See Paragraph 5 for details.
- c. (Closed) Unresolved Item (341/85052-02): Questionable DECo design verification, and problems related to cable tray support base plates. See Paragraphs 8 and 9 for details.

3. Licensee Action on LERs

- a. (Closed) LER (341/85082-LL): DECo reported on January 3, 1986, the identification of potentially overloaded embedded support plates. See Paragraph 5 for details.
- b. (Closed) LER (341/86002-LL): DECo reported on March 1, 1986, that some of the design calculations and stress reports were not current. See Paragraph 9 for details.
- c. (Closed) LER (341/86012-LL): DECo reported on June 11, 1986, that the Reactor Water Cleanup (RWCU) high energy line break detection system did not meet the FSAR commitment. See Paragraph 13 for details.
- d. (Closed) LER (341/86016-LL): DECo reported on June 27, 1986, that one of the Nutech calculations was found to be in error and system modification was required. See Paragraph 9.i for details.

4. RIII Meetings with DECo

RIII personnel met with DECo and its A-E, S&W, on March 10, 1986, at RIII, and April 9, 1986 at the site. The licensee presented to RIII the status of its design reevaluation and documentation programs to correct and to improve the recently identified weaknesses in design verification, design change control, and QA related activities. The presentation addressed the following programs:

- a. Evaluation of design modifications to ensure an adequate seismic review was performed for these modifications. This issue was inspected by RIII, and closed in Inspection Report No. 50-341/85052.
- b. Evaluation of a number of embedded support base plates that could be overstressed based on conservative design loads. This issue was closed. See Paragraph 5 for details.
- c. Review of design changes generated by DECo Nuclear Engineering (NE), site and Troy office. This issue was closed. See Paragraph 6 for details.
- d. Evaluation of design modifications to ensure adequate environmental qualification (EQ) review was performed. This issue was closed. See Paragraph 7 for details.
- e. Verification of the adequate welding of Nelson studs to embedded plates. This issue was closed. See Paragraph 8 for details.

- f. Reconciliation of piping stress analysis and support calculations to design drawings, specification changes and the as-built conditions. This issue was closed. See Paragraph 9 for details.
- g. Status of completion of outstanding tasks by the DECo Nuclear Engineering Department. This issue was closed. See Paragraph 10 for details.
- h. S&W evaluation of DECo design documents and design change control. This issue was closed. See Paragraph 11 for details.

The NRC inspector's followup on the licensee's actions is documented in this inspection report. In a meeting at RIII on June 26, 1986, DECo presented the status of completion and the results of the above programs. The DECo programs to resolve the design issues were found to be acceptable to RIII management. The NRC evaluation of the appropriateness of DECo's decision not to complete the above program prior to plant licensing remains open.

5. Evaluation of Embedded Plate Design

DECo informed RIII that a number of safety-related pipe support embedded plates could be overstressed based on the conservative design loads that were used. The NRC inspector reviewed the licensee efforts to resolve this potential problem.

a. DECo Design Review Control

The NRC inspector reviewed selected DECo design reports and correspondence. This review identified that the final load check for safety-related structures included wall and floor embedment plates as a part of the planned design activities. The documents reviewed included:

- ° "DECo Architectural Civil Division As-Built Loading Design Verification Status Report," April 4, 1984.
- ° DECo internal memorandum, "Fermi 2 Project Engineering A/E Management," December 21, 1984.
- ° DECo "Fermi 2 Engineering Meeting Notes, F2E-85-0260," February 7, 1985.
- ° DECo Task No. PMO-3, "Fermi 2 Engineering Reactor/Auxiliary Building Embedded Plate Analysis," March 19, 1985.

PMO-3 indicated the final load check should be completed by June 30, 1985. The task was not completed on time. The DECo closure of this matter was based on a sample review which concluded that the embedded plates were adequately designed.

b. DECo Identification of Deficiencies

DECo's subsequent final design verification to resolve PMC-3 showed that a significant number of embedded plates could be overloaded in the reactor and auxiliary buildings. A DECo Deviation/Event Report (DER), No. NP-85-0652, was issued on December 4, 1985. In accordance with the requirements of 10 CFR 50.72 and 73, DECo reported this finding to RIII through LER No. 85-082-00, "Potentially Overloaded Embedded Support Plates," on January 3, 1986. An interim report, LER No. 85-082-01, was sent to RIII on January 31, 1986. The LER No. 85-082-02, which closed out this finding, was sent to RIII on February 28, 1986.

c. DECo Corrective Actions

The DECo solution to the problem consisted of (1) DECo NE refinement of original hanger design loads using a method acceptable to NRC-NRR, (2) S&W recalculation of hangers based on the reduced design loads, and (3) S&L reevaluation of embedded plates utilizing the S&W results and the actual as-built hanger attachment locations. DECo documented its corrective actions in the "Chronology of Embedded Plate Design Verification from August 5, 1985, to January 18, 1986."

d. Sample Selected for NRC Review

S&L letter (SLS-EF-175) to DECo, "Reactor/Auxiliary Building Final Load Verification of Embedded Plates," October 17, 1985, provided some evaluation results, and made a request for the following additional information:

- ° Category A: DECo should furnish Dead Load (DL), OBE, and SSE seismic loads.
- ° Category B: Embedded plates were overstressed. DECo should provide design load refinement.
- ° Category C: DECo should provide DL and auxiliary steel seismic excitation load.

A second S&L letter (SLS-EF-195) to DECo, same subject, November 6, 1985, provided the following update on the number of hangers in each of the above three categories.

<u>Categories</u>	<u>No. of Hangers</u>	<u>No. of Embedment Plates</u>
A	5	9
B	38	46
C	49	64
Total	92	119

Some of the 92 hangers were included in the Mark I modification program for torus attached piping (TAP). Ten of these TAP hangers failed the S&L final load verification; consequently, these hangers received all three phases of the load refinements and reevaluations listed in Paragraph 5.c above. These 10 TAP hangers are:

<u>The 10 TAP Hangers</u>	<u>Categories</u>
E 21-3148-G35	A
E 11-3153-G15	A
E 21-3149-G08	A
E 11-3154-G16	A
E 11-3154-G21	A
E 21-3148-G36	A
T 48-2096-G14	B
T 48-2906-G08B	B
T 48-2099-G02	B
E 21-3144-G06	B

e. Review of Design Criteria

The NRC inspector reviewed the following DECo reevaluation program documents:

- (1) The Mark I TAP support dynamic design loads were combined using the absolute sum method. The DECo NE refinement of the Mark I loads used the square-root-of-the-sum-of-squares (SRSS) method approved by NRC-NRR in its report "Safety Evaluation by the Office of Nuclear Reactor Regulation for Acceptability of the SRSS Method for Combining Dynamic Responses in Mark I Piping Systems," March 10, 1983.
- (2) The S&W pipe support evaluation criteria:
 - ° Engineering Mechanics Division Memorandum, No. CHOC-EMDM-81-27, "Design Criteria for Detroit Edison Company Category I, II, and III Pipe Supports," October 11, 1984.
 - ° Interoffice Memorandum, No. 15681.03, "Method of Determining Pipe Support Loads on Embedment Plates," January 19, 1986.
- (3) Appendix F (Design Criteria - Final Load Check of Embedded Plates in Reactor and Auxiliary Building) of S&L Procedure, DC-SE-01-EF, "Project Structural Design Criteria, Enrico Fermi - Unit 2, Reactor/Auxiliary Building and RHR Complex," Revision 8, October 11, 1985.

f. Review of Support As-Built Drawings

The NRC inspector selected two hangers from the list included in Paragraph 5.f above for review:

(1) Hanger No. E 21-3149-G08

- ° DECo EF-2 As-Built Record, As-Built Mechanical (ABM), No. 0071, "Stress Report CS-07," Revision A, June 8, 1984.
- ° Hanger, Mark No. E21-3149-G08, ABM-0071, Sheets 35 to 37.

(2) Hanger No. T 48-2099-G02

- ° DECo EF-2 As-Built Record, No. ABM-0154, "Stress Report 13067.06, AX-T48-02, No. 6," Revision C, May 29, 1984.
- ° Hanger, Mark No. T48-2099-G02, ABM-0154, Sheets 62 to 66.

The records included sufficient documentation of hanger construction, as-built inspection, and drawing revisions.

g. Review of Calculations

The NRC inspector reviewed the following pipe support and embedded plate calculations:

- (1) DECo Calculation, No. 2494 (Plant Identification System No. T23-02-G), "Torus-Attached Piping Support Load Reduction Calculations," Revision A, January 17, 1986.

The NRC inspector concurred with the DECo's justification to delete seismic anchor movement loads, and independently verified the accuracy of design input. For the Mark I Condensation Oscillation (CO) loading defined in the Nutech Report No. DET-19-076-6, "Plant Unique Analysis Report for Torus Attached Piping and Suppression Chamber Penetrations," Revision 0, June 1983, the NRC inspector questioned the use of a load reduction factor of 0.65. The factor of 0.65 is discussed in Section 1-4.1.7.1 (CO Loads on the Torus Shell) of Nutech Report No. DET-04-028-1, "Plant Unique Analysis Report, Volume 1, General Criteria and Load Methodology," April 1982, and Revision 1, November 1983, and Nutech Internal Memorandum No. RAL-83-026, "Standardized Fermi Penetration Analysis Procedure," March 17, 1983. Nutech allowed load reduction in the evaluation of post chug torus motions and post chug and CO loadings on submerged structures inside the torus, but did not mention load reduction for piping and pipe support design. In response to NRC inspector questions, DECo provided the following response:

- ° Was the reduction factor applicable to the design of TAP and its supports?

DECo and Nutech concluded that the CO load reduction factor is applicable to TAP design. An As-Built Notice (ABN), No. 5625-1, "Mark I Evaluation of Torus Attached Piping, Revision 0, June 1983," was issued on April 29, 1986 to revise DECo Specification 3071-534 and to clarify the matter.

- Was the reduction factor used the second time after the original design?

Based on a DECo request, Nutech examined its analyses and computer results, and verified that the load reduction factor was not used in the original design calculations. The NRC inspector reviewed the evaluation documented in a Nutech letter (DET-56-002) to DECo, "CO Load Reduction Factor Review," April 21, 1986, and considered it acceptable.

(2) S&W hanger calculations using STRUDL computer program:

- PM01C-024, "Load Calculation at Attachment Point for Support No. BBC-M031 and BBC-M032 (Hanger No. E21-3149-G08), Reference Calculation No. DC-678," Revision 2, January 21, 1986.
- PM01C-005, "Load Calculation at Attachment Point for Support No. 2A-M16, M17 (Hanger No. T48-2099-G02), Reference Calculation No. DC-804," Revision 2, January 20, 1986.

(3) S&L calculations for the embedded plates based on S&W design input and "Embedment Plate Walkdown" drawings:

- SS-0023, "Reactor/Auxiliary Building Embedded Plates Final Load Check: BBC-M031 and BB-M032 of Hanger No. E21-3149-G08," January 27, 1986.
- SS-0023, "Reactor/Auxiliary Building Embedded Plates Final Load Check: 2A-M16 and 2A-M17 (Hanger No. T48-2099-G02)," January 27, 1986.

h. Conclusion

The NRC inspector determined, based on the above review, that the licensee's program was acceptable, and that the program was effectively implemented. No violations or deviations were identified.

6. Verification of Design Changes

Due to a lack of procedural requirements, design reviews for Engineering Design Packages (EDPs), Engineering Change Requests (ECRs), and As-Built Deviations (ABNs) were not completely documented. DECo Deviation/Event Report (DER) No. 85-712, "Documentation of Design Verification, Review, and Approval," December 11, 1985, was issued to document this problem. The NRC inspector reviewed the licensee's efforts to resolve this potential problem.

a. Extent of DECo Verification

Using the DECo developed computer program, the following required reverification work scope was compiled by DECo NE:

	<u>No. of DECo NE (Site,) Issued Safety Documents</u>	<u>No. of DECO NE (Troy) Issued Safety Documents</u>
EDPs	97	84
ECRs	267	Included in EDPs
ABNs	233	388

As of April 23, 1986, the status of work completion was as follows:

(1) Verification of DECo NE (Site) Issued Design Changes

- ° Review of EDPs, ECRs, and ABNs was completed on February 28, 1986.
- ° Three minor hardware changes were required; these were correcting sizes and voltage class of fuses, removing spare fuses, and replacing a pipe snubber.

(2) Verification of DECo NE (Troy) Issued Design Changes

- ° All the 84 EDPs and the 7 ECRs were verified, and no hardware changes were required.
- ° All the 388 ABNs were verified, and no hardware changes were required.

b. Upgrade of Design Verification Procedure

The cause of the problem relating to the lack of design change review documentation was attributed to DECo Procedure NE 2.5.7, "Design Verification," effective since May 23, 1983, not requiring documentation of design verification other than signatures of the verifiers. Subsequently, DECo revised this procedure (from Revision 1 to Revision 2) on January 31, 1986, to provide more stringent verification control and to include additional review checklists for design changes issued after January 26, 1986.

DECo NE Procedure Change Notice (PCN), No. 1, Revision 0, for NE 2.5.7, Revision 2, was issued on January 31, 1986 for the verification of DECo NE site design change documents issued before January 26, 1986.

As the verification of DECo NE site design change documents came close to completion, DECo determined that similar records issued from the DECo NE, Troy office, should also be verified. PCN No. 2, Revision 1, for NE 2.5.7, Revision 2, was issued on April 4, 1986 to control this effort.

c. Personnel Qualification and Training

The qualification requirements for personnel conducting the design change verification review are documented in EP-2.5.7, Paragraph 5.5.

The NRC inspector reviewed indoctrination and training records for the technical personnel involved in the following two areas and had no adverse comments.

(1) Verification for DECo NE (Site) Generated EDPs, ECRs, and ABNs

The verification review was conducted by DECo NE and contractor under DECo NE supervision. The number of engineers assigned to the program varied from 15 to 30. The personnel training was recorded in the following documents:

- ° DECo training attendance records, "Design Verification," February 3 and 5, 1986.
- ° NE documents, "Indoctrination and Training - Revised Checklist and Instruction", January 15, 16, and 23, 1986.

(2) Verification for DECo NE (Troy) Generated EDPs, ECRs, and ABNs

The work was assigned to S&L, and the number of engineers varied from 25 to 35. The personnel training was recorded in the following documents:

- ° S&L interoffice memoranda, from the assigned verifiers to file, confirming that they have read the required procedures and PCNs.
- ° DECo letters to S&L, "Procedure Compliance Reading," March 8 and 17, 1986.
- ° DECo training attendance records, "Design Verification," March 11, 13, and 20, 1986.

The NRC inspector noted that the S&L personnel were trained to NE-2.5.7, Revision 2/PCN No. 2, Revision 0, instead of PCN No. 2, Revision 1 requirements. DECo staff presented the NRC inspector a DECo letter to S&L, "Reconciliation of Electrical and I&C Calculations and Design Verification of Troy EDPs," April 10, 1986, requesting S&L evaluate the effects of the changes between Revision 0 and Revision 1 on the completed verification packages. The NRC inspector reviewed PCN No. 2, Revision 0 and Revision 1, and considered the differences mostly administrative.

d. Review of Audit Report

The NRC inspector reviewed DECo QA Audit Report No. A-QS-S-86-07, "Audit of the Design Reverification Process," conducted on March 7 through 18, 1986. The audit report was issued on March 27, 1986.

The NRC inspector reviewed records included in DECo audit package and the following four audit findings:

- (1) Inadequate instruction on how to use the checklists.

- (2) Lack of design verification methods in procedure, NE-2.5.2, "Design Calculation."
- (3) Questionable DECo NE assessment on review areas considered "Not Applicable."
- (4) Use of obsolete procedure, NE-2.5.2, approval sheets.

The DECo NE responses and corrective actions were documented in the following letters to QA:

- For findings Nos. 1 and 3 above, No. NE-QE-86-0048, April 14, 1986.
- For finding No. 2 above, No. NE-86-0074, April 9, 1986.
- For finding No. 4 above, No. NE-PJ-86-0193, April 11, 1986.

e. Review of Reverification Packages

The NRC inspector selected the following Design Verification Records (DVRs) for review:

(1) DECo NE (Site) Generated Design Changes

- DVR, "EDP, No. 2116, Revision D, October 1, 1985, Disconnect Existing Power Feed to Valve T50-F421A and Provide An Alternate 120V AC Power Feed to Resolve an Appendix R Concern," January 17 through March 17, 1986.
- DVR, "EDP, No. 4144, Revision 0, July 17, 1985, Addition of Flanges to HPCI Control Valve Gland Seal Leak Off Lines," January 20 through 24, 1986.
- DVR, "EDP, No. 4707, Revision 0, October 17, 1985, and Revision A, December 27, 1985, Adjust the Stop Setting of the IRM Range Switches," January 18 through 23, 1986.
- DVR, "ECR, No. 1509.04, December 20, 1985, Modification to the Dryer/Separator Lifting Device," January 30 through February 25, 1986.
- DVR, "ABN, No. 3406-1, Revision 0, July 5, 1985, Include ASTM A588 Grade B Steel As Approved Material," January 23 through February 14, 1986.

(2) DECo NE (Troy) Generated Design Changes

- DVR, "EDP, No. 1439, Revision B, July 19, 1985, Replacement of Two 460V AC Limitorque Motor Operators Utilizing Electrical Motor Brakes With Operators Utilizing Mechanical Brakes," March 14 through April 4, 1986.

- ° DVR, "EDP, No. 1579, Revision A, October 22, 1984, Install Fuses and Revise Associated Wiring in QA Level I HVAC Panels H21-P296A, P296B, and P296F," March 13 through April 12, 1986.
- ° DVR, "EDP, No. 2140, Revision 0, July 12, 1985, and ECR, No. 2140-i, Revision 0, Documentation of Various Process Radiation Monitoring Setpoints," March 18 through April 1, 1986.
- ° DVR, "ABN, No. 3662-1, Revision 0, September 17, 1985, Revise Multi-Cable Transit Tabulation to Show As-Built Conditions," March 17 through April 23, 1986.

f. Conclusion

The NRC inspector determined, based on the above review, that the latest DECo program to verify design changes contained in EDPs, ECRs, and ABNs was adequate, and that the task was implemented in accordance with procedure requirements. No violations or deviations were identified.

7. Equipment Qualification (EQ) Review for DECo NE Design Changes

The EQ review for DECo NE, site and Troy, generated design changes was included in the verification program discussed in Paragraph 6.

In November and December 1985, DECo NE completed an EQ sample review program for the design change documents. The program consisted of 273 EDPs and ECRs taken from 21 safety related systems having EQ electrical equipment. The DECo NE review is documented in letter (NE-QE-85-0046), from DECo NE Supervising Engineer to Director of DECo NE, "Completion of EDP Review," December 10, 1985. The NRC followup inspection is documented in NRC Inspection Report, No. 50-341/85051, December 18, 1985.

Based on the NRC inspector's review discussed in Paragraph 6 above, and the RIII acceptance of the DECo's sample review program in December 1985, the issue is considered closed.

8. Nelson Stud Welding

During plant system low power testing, one of the base plate embedments to which a 52" steam manifold hanger was attached, was pulled away from the concrete embedment. The DECo investigation identified evidence that the welds attaching the Nelson studs to the base plate had high porosity. DECo documented its findings in DERs No. NP-85-0517, "Pipe Hanger Failure," September 30, 1985, and No. 003678, "Embedded Plates Stud Weld Failures Discovered in DER NP-85-0517," May 7, 1986. The failed embedment plate was verified to be commercial grade (non-safety-related) material purchased from Darin and Armstrong Company (D&A). A records search identified that 251 D&A embedment plates had been installed in the plant; 87 were used for temporary rigging, structural framing (no tension loading) and without attachments (loads), and the remaining 164 embedment plates were all 1/2" in thickness with 1/2" diameter by 8-1/8" long Nelson studs attached. These embedment plates are used to support cable tray hangers (CTHs). There are 234 CTH attachments

welded to these 164 embedment plates. Twelve of the CTH attachments are located in the reactor building, and the remaining 222 CTH attachments are located in the cable spreading room (below the control room) inside the auxiliary building.

DECo initiated a verification program to determine the adequacy of Nelson stud welding. The program consisted of the following ultrasonic examinations and pull tests being performed on the embedded plates and CTHs.

	<u>No. of CTH Attachments</u>	<u>No. of CTH Attachments Examined By UT</u>	<u>No. of Pull Tests Performed on CTH Attachments</u>
Cable Spreading Room	222	56	<ul style="list-style-type: none"> ° 15 having high UT weld indications ° All 5 having severe design loads
Reactor Building	12	3	<ul style="list-style-type: none"> ° 1 having high UT weld indication

a. Review of Procedures

The NRC inspector reviewed the following procedures and had no adverse comments:

- ° DECo NE-PJ-86-0214, "Confirmation of D&A Embedment Capacity of Safety-Related Attachments," April 22, 1986.
- ° DECo NE-PJ-86-0249, same title as above, May 5, 1986. Appendix A of the procedure incorporated UT calibration transfer method from bare metal surface to painted metal surface. Appendix B of the procedure provided pull test requirements to OBE equivalent loadings.
- ° NE Procedure, SOE-T2200-86-01, "Diagnostic Data Collection, Sequence of Events - Ultrasonic Examination of Studs Welded to Embedment Plates," Revision A, April 22, 1986.
- ° NE Procedure, SOE-T2200-86-02, "Diagnostic Data Collection Sequence of Events - Pull Testing of Attachments to Embedded Plates," April 30, 1986, and amendment, May 6, 1986.
- ° S&L letter (SLS-EF-265) to DECo, "Embedded Plate Test Load Calculations," May 5, 1986.
- ° Section 4.7, "Test Loads for Embedded Plates Supporting Cable Tray Hangers," contained in S&L Calculation, No. SS-0023, Revision 0, May 5, 1986.

b. UT Performed on Nelson Stud Welding

The UT results are documented in the following interoffice memoranda:

- RC-QA-86-1037, "UT Data," May 8, 1986
- RC-QA-86-1034, "Data From Embedment Plate UT," May 8, 1986
- NE-PJ-86-0279, "Embedded Plate UT Results," May 8, 1986

There were no rejectable UT indications in the welds joining the embedment plates and the Nelson studs.

c. Pull Tests Performed on CTHs

- (1) The following 20 pull tests were performed on CTHs in the cable spreading room:

<u>CTH No.</u>	<u>Tray I.D.</u>	<u>S&L OBE Test Load (lbs)</u>	<u>Remarks</u>
3D-T144	QU3H11B	2570	Notes 1 and 2
3D-T344	QU2H13	1340	Notes 1 and 2
3D-T458	QU70HV1	5160	Note 2
3D-T474	QU3H7A	5720	Notes 2 and 3
3D-T489	QU1H25	1870	Note 2
3D-T031	QU3H24	670	Note 1
3D-T040	QU14H16	2780	
3D-T059	QU2H22	1640	Note 1
3D-T067	QU2H2	3100	Note 1
3D-T080	QU2H11	1000	Note 1
3D-T168	QU3H12	1220	Note 1
3D-T242	QU13H15A	1290	
3D-T328	QU12H29	2260	
3D-T342	QU2H15	1940	Note 1
3D-T426	QU1H23A	1440	
3D-T432	QU1H23B	1470	
3D-T462	QU14HV2	2980	
3D-T495	QU13H14	875	
3D-T482	QU3H7C	1140	
3D-T282	QU14HV10	1275	Note 1

- (2) One pull test was performed on a CTH in the Reactor Building, fourth floor:

<u>CTH No.</u>	<u>Tray I.D.</u>	<u>S&L OBE Test Load (lbs)</u>
W80-T3	FF1HV4	110

Notes:

1. Higher weld defect stud weld back reflections were shown on UT; however, they were within UT acceptance criteria.

2. One of the 5 severe design cases (high tension and shear interaction coefficient) determined by S&L.
3. The NRC inspector witnessed the pull test on May 7, 1986. The CTH tested has the highest OBE test load and the highest design interaction coefficient (0.78).

There were no indications of structural or mechanical defects during and after the pull tests.

d. Conclusion

The NRC inspector reviewed the "Embedded Plates Testing and Qualification Program," a compilation of program engineering and test records, contained in DECo interoffice memorandum NE-PJ-86-0295, "Acceptance of Embedded Plates for DER-NP-86-180," May 13, 1986, and had no adverse comments. Based on discussions with DECo staff during the program development, observation of testing, and a review of test data and reports, the NRC inspector concluded the evaluation program was acceptable, and the procedures were correctly implemented.

9. Design Calculation Reconciliation to the As-Built Conditions

This activity was scheduled to be completed prior to plant fuel loading; however, after some limited reviews which resulted in no hardware modifications or design changes, DECo project management decided to delay the completion date. DECo documented this deviation in DER No. NP-86-0064, "Stress Reports and Hanger Design Calculations Out of Date," February 11, 1986. This DER superseded a previous DER No. NO-86-006, same title, January 30, 1986. In accordance with the requirements of 10 CFR 50.72 and 73, DECo reported this deviation to RIII through LER No. 86-002-00, "Potentially Reportable Condition - Design Calculations and Stress Reports are Not Current," on March 1, 1986. The following documents were identified as being affected by the DECo Design Calculation Reconciliation Program (DCRP).

<u>Design Disciplines</u>	<u>No. of Documents</u>
° Large Bore (L/B) Piping	
- Stress Reports	177
- Hanger Calculations	266
° Small Bore (S/B) Piping	
- NE Stress Reports and Hanger Calculations	708
- S&W Stress Reports and Hanger Calculations	398
° Mechanical Systems	
- S&L Systems Calculations	43
- S&L Equipment Anchor Bolts	39
- MDC Calculations	63

°	Electrical	26
°	Instrumentation and Control (I/C)	36
°	Civil	41

a. Review of Procedures

The NRC inspector reviewed pertinent portions of the following DCRP procedures and had no adverse comments:

- ° NE Program Book, "Design Calculation and Stress Report Reconciliation Program," April 9, 1986.
- ° Section 7.5 of PCN No. 5, Revision 0, February 6, 1986, for NE-2.5, "Design Control," Revision 0.
- ° Paragraph 3.4 of F2E-4.15, "Stress Reports," Revision 0, March 7, 1985.
- ° Section 8.2, and Attachment 9.4 of PCN, No. 2, Revision 3, April 7, 1986, for NE NE-2.5.2, "Design Calculations," Revision 0.
- ° PCN, No. 1, Revision 0, January 31, 1986, for NE-2.5.7, "Design Verification," Revision 2.
- ° S&W Nuclear Design Instruction (NDI) - 11, "Incorporation of Change Papers/Supplemental Calculations Into Non-SWMI Pipe Stress and Pipe Support Calculations," Revision 1, April 18, 1986.
- ° S&W NDI-12, "Incorporation of Change Papers Into SWMI Pipe Stress and Pipe Support Design Calculations," April 10, 1986.
- ° S&L SLM-EF-545, "Procedure for Review of Piping Reconciliation Packages," March 28, 1986.
- ° S&L Project Instruction EF-32, "Equipment Foundation Design Verification and Change Document Verification Program," Revision 0, April 21, 1986.

b. Review of Reconciliation for L/B Piping Stress Reports

The NRC inspector reviewed the following stress reports:

- ° NE DC, No. 2652, Volume 1A, "Reactor Water Cleanup System Outside Drywell," Revision C, April 30, 1986.
- ° NE DC, No. 2653, "RHR Return Piping Outside Containment," Volume 1A (base calculation), Revision C, April 30, 1986, and Volume 2 (EDPs), Revision A, April 30, 1986.

The NRC inspector determined that the DECo NE staff had performed the reconciliation in accordance with the procedures. In a response to a suggestion by the NRC inspector, all the design revisions and

change documents are being formally filed as a part of the engineering evaluation record.

c. Review of Reconciliation for L/B Pipe Support Calculations

The NRC inspector reviewed the following pipe support calculations:

- ° NE DC, No. 697, Volume 1, "RCIC Suction from Suppression Chamber and Condensate Storage System, 6M721-3176-2," Revision E, May 19, 1986.
- ° NE DC, No. 720, Volume 1, "RBCCW and EECW Division 1 Supply Header, 6M721-3362-2," Revision D, April 21, 1986.

The NRC inspector determined that the DEco NE staff had performed the reconciliation in accordance with the procedures. In response to a suggestion by the NRC inspector, all the design revisions, change documents, and review requests (such as DECo memorandum F2E-86-0025, "Request for ABNs," January 14, 1986, for Hanger No. E51-3176-G22, contained in NE DC No. 697, Volume 1, and other hangers contained different DCs) are being formally filed or referenced as a part of the engineering evaluation record.

d. Review of Reconciliation for NE S/B Piping

The NRC inspector reviewed NE DC No. 2159, "Small Bore Hanger Design and Piping Stress Analysis for Isometrics: 6WI-P44-7038-1, Revision B and 6WI-P44-7038-3, Revision A, RBCCW and EECW Supply to Drywell," April 8, 1986. The NRC inspector observed that S&W procedures had been followed during the as-built reconciliation; however, the following two findings relative to the original S/B piping design were identified:

- (1) The design of S/B piping and supports was based on S&L Report SL-3159, "Small Piping Design Standard, Enrico Fermi Atomic Power Plant - Unit 2," Revision 1, July 29, 1977, which contained cookbook type design guidelines. During his review of S/B hangers 6WI-P44-7037-G04 and 6WI-P44-7037-G09, the NRC inspector observed that the designer selected Rules 2 and 4 contained in Appendix B, Section B-2, of SL-3159 for use in the selection and placement of these two hangers. Rule 4 limits additional concentrated weight (such as a valve) to 40% of the weight of the span of piping. The concentrated weight between Hangers G04 and G09 far exceeded the rule limitation. Furthermore, there was no documentation of an analysis concerned with the loads which exceeded the guidelines. As a result of discussions with the DECo NE responsible engineers, the NRC inspector concluded that SL-3159 was largely ignored by both designers and reviewers during construction. This deviation from the cookbook design rules without documentation of engineering justification, or alternative design methods is considered a violation of 10 CFR 50, Appendix B, Criterion III (341/86012-01).

- (2) The selection of specific types of hanger components was based on DECo Specification, No. 3071-185, "Instrument and Control Standard for Seismic Category I and Non-Seismic Fabrication and Erection of Tube Supports," Revision K, October 1984. The design piping isometric drawing, specified hanger 6WI-P44-7037-G03 to be an anchor; however, the contractor designer incorrectly selected a Type 1A-3-2 clamp from (Specification 185) for the application. Specification 185 states that a Type 1A-3-2 "shall be used when slide connection is required for seismic installation and/or thermal expansion." The DECo procedures require the contractor QC inspector to verify the correctness of hanger component selection; however, the QC inspection signoff dated June 24, 1983, failed to identify the above failure to follow the piping drawing. Additionally, contrary to what was documented for this QC inspection, the piping system as-built drawing, 6WI-P44-7038-1, Revision B, with QC signoff, October 30, 1984, identified G03 to be an anchor. The support was reverified by DECo staff during the NRC inspection on April 30, 1986 to be an anchor. On May 2-5, 1986, DECo personnel performed walkdown inspections for all the S/B piping systems contained in isometric drawings 6WI-P44-7037-1 and 6WI-P44-7038-1. The inspection showed that the S/B support locations were within the installation tolerances. All 16 multiple S/B supports were in conformance with the 7 standard design types. The QC "Instrument Support Verification Sheet" signoffs were also found to be in order. Based on the above results, the NRC inspector determined that the support G03 record error was an isolated case. This matter was considered resolved.

e. Review of Reconciliation for S&W S/B Piping

(1) Review of DCs

The NRC inspector reviewed DECo NE DC No. 3625, Volume Ib, "Small Bore Piping Stress Analysis for Isometrics: 6WI-B21-7420-1, Revision B; 3WI-B21-7390, Revision E; 3WI-B21-7391, Revision E; and 3WI-B21-7392, Revision E," Revision A, April 23, 1986. This DC documented the reconciliation review of S&W Calculation No. 13067.25, "AX-X28A-003-01," Revision 4, September 22, 1984. The NRC inspector also reviewed a number of system supports to verify that the latest design loads were incorporated in the support design. The document reviewed was DECo NE DC No. 3978, Volume I, "Stone and Webster Hanger Calculations - Isometrics T71-I2837-58," Revision A, May 2, 1986.

(2) Review of Program Description

During review of the DCs, the NRC inspector observed that Paragraph 3.9.2.7, "Field Run Piping Systems," and Paragraph 5.2.1.19, "Field Run Piping," in the latest FSAR, Amendment 57, May 1984, did not clearly address S/B piping stress analyses using computer programs in lieu of cookbook type methods. The DECo staff informed the NRC inspector that no short-cuts were taken when performing S/B analysis using the L/B computer program;

however, the handling of load data that was generated was different due to the distinct differences in configuration and characteristics between S/B and L/B supports. A FSAR Change Notice, No. 86-033, was issued on May 8, 1986 to clarify the matter.

f. Review of S&L Reconciliation for Mechanical System Calculations

The NRC inspector reviewed DECo NE DC No. 557, "RHRSW Pressure at Reactor Building Wall," Revision A, April 6, 1986. This revised DC documents S&L's evaluation of DECo NE DC No. 557, "Pressure RHRSW at Reactor Building Wall - From RHR Complex," November 18, 1976. The NRC inspector noted that there was no source reference on pump suction reservoir high and low water levels in the pump net positive suction head calculation. The information was later identified in DECo FSD No. E11-51-SD, "Functional System Description for RHR Complex Service Water System," December 16, 1979. The reservoir water levels used in the DC were verified to be correct. The reconciliation package was revised to include the appropriate design reference. Furthermore, DECo made a request that S&L perform additional design source checks on a generic basis.

g. Review of MDC Reconciliation for Mechanical System Calculations

The NRC inspector reviewed DECo NE DC No. 470, "Sizing of Vacuum Relief Valves on Main Steam SRV Discharge Lines," Revision A, April 22, 1986. This revised DC documents the MDC evaluation of DECo NE No. 470, same title, September 21, 1973, to reflect the as installed Crosby vacuum relief valve configuration and specification requirements.

h. Review of Audit Reports

The NRC inspector reviewed the following DECo Quality Engineering surveillance and audit reports:

- ° Quality Surveillance Report, S-EA-86-02, "NE Design Calculation Reconciliation Program," May 9, 1986. The surveillance was performed on March 19 through May 2, 1986.
- ° Audit Report, A-EA-P-86-10, "Audit of Multiple Dynamics Corporation," May 12, 1986. The audit was conducted on April 8-10, 1986.

i. System Modification

As a result of the DECo design calculation reconciliation effort, 5 systems were identified to require modification. The DECo staff discussed these system modifications with the NRC inspector and the Senior Resident Inspector on June 12, 1983. The NRC staff concurred with the DECo planned actions. The deficiencies and planned system improvements were documented in the following DERs:

- ° No. NP-86-0224, "Low Voltage to AC Equipment - Division 1 During Degraded Grid," May 27, 1986. Setpoints on the eight

affected grid relays will be changed.

- ° No. NP-86-0216, "Undersized Cables," May 23, 1986. Five cables, each less than 50 feet in length, will be replaced in cable trays and conduits.
- ° No. NP-86-0238, "Essential Cooler Setpoint," May 24, 1986. The existing setpoint of 95° will be changed to 75°.
- ° No. NP-86-0233, "Additional Support Required for a Core Spray Piping Test Connection," June 5, 1986. One pipe restraint will be added to the 3/4" line.
- ° No. NP-86-0232, "Partial Removal of Insulation on the Nitrogen Supply to Vacuum Breaker Piping," June 9, 1986. Insulation on the affected 1" line will be removed.

One additional modification resulting from the base/original calculation deficiencies was also discussed. The problem and the resolution are addressed in a DER No. NP-86-0128, "Design Calculation DC 3183 Nutech Sequence 193," March 18, 1986. One pipe anchor and one pipe guide will be added to the S/B portion of the system. LER No. 86-016-00, "Misinterpretation of Computer Data Results in Calculated Pipe Stress to Exceed ASME Code," June 27, 1986, was forwarded to NRC reporting this problem.

DECo forwarded LER No. 86-002-01, "Design Calculations and Stress Reports are not Current Resulting in Hardware Deficiencies," June 23, 1986, reporting the problems identified in the above 5 DERs. In addition, 2 other design deficiencies documented in the following DERs were also reported.

- ° No. 86-0254, "Reactor Building Heat Load Calculation," June 23, 1986.
- ° No. 86-0255, "Inadequate EECW Cooling Capacity to Handle Drywell Cooler Loads During a Small Break Accident," June 24, 1986.

Hardware changes resulted from these LERs will be verified during a future inspection.

j. Conclusion

The NRC concluded, based on the above reviews, that the program provisions were adequate and the overall program was effectively implemented. During the NRC inspector's review of the S/B piping design based on the cookbook type method, deficiencies in design control were identified. This is a violation of 10 CFR 50, Appendix B, Criterion III. However, DECo initiated extensive corrective measures to resolve the problem. RIII followup of the DECo actions is documented in Paragraph 12 of this report.

10. Completion of Engineering Tasks

DECo Fermi 2 Engineering and Nuclear Operations staff reviewed the remaining engineering work for the project on April 8 and 15, 1985. Project Management Organization (PMO) task numbers were assigned at this

time. These PMO task descriptions and planned schedules for completion were documented in a Fermi 2 engineering planning report, "Report on Remaining PMO Engineering, 1985 Yearly Orders and Engineering Design Packages as of March 1, 1985." The following is a summary of the tasks:

- PMO-1: Prepare hanger as-built load tables and drawings for design verification of reactor and auxiliary building framing.
- PMO-2: Complete structural design verification for reactor and auxiliary buildings including analyses of cut rebar, hanger superstructure loads and steam tunnel pipe break effects.
- PMO-3: Verify reactor and auxiliary building standard embedded plate load carrying capacities to support as-built loads.
- PMO-4: Receive, review, approve, and issue S&L drywell structural steel drawings and torus overhead slab design drawings.
- PMO-5: Prepare hanger load tables for design verification of reactor building superstructure steel.
- PMO-6: Update non-safety-related drawings (such as plot plans, parking, road).
- PMO-7: Review hanger design load changes in reactor, auxiliary, and RHR buildings.
- PMO-8: Update penetration drawings including identification of sealants used.
- PMO-9: Complete rigging manual.
- PMO-10: Document rattlepace resolutions.
- PMO-11A: Respond to the backlog of seismic design qualification open items.
- PMO-11B: Assemble seismic qualification document packages.
- PMO-12: Prepare a seismic design qualification manual describing the process.
- PMO-13: Complete design verification of reactor, auxiliary, and RHR building cable tray hangers to support as-built loads.
- PMO-14: Complete design verification of drywell structure steel to account for hanger load changes after March 1984.
- PMO-15: Prepare index of non-safety-related structure design calculations.
- PMO-16: Complete instrument setpoint verification calculations.

- PMO-17: Update GE functional control and DECo logic diagrams in line with DECo schematics and system interface diagrams.
- PMO-18: Review control room design.
- PMO-19: Update liquid radwaste system instrumentation and control drawings to incorporate changes and as-built conditions.
- PMO-20: Reconcile QA 1 large bore hanger support calculations to account for design changes.
- PMO-21: Update QA 1 large bore hanger sketches.
- PMO-22: Update QA 1 large and small bore stress reports.
- PMO-23: Verify adequacy of equipment anchor bolt design.
- PMO-24: Update S&L hanger sketches and calculations.
- PMO-25: Revise HVAC stress report to include as-built documents.
- PMO-26: Upgrade EQ review document to quality record status.
- PMO-27: Conduct electrical equipment qualification tests.
- PMO-28: Reevaluate environmental profile for RWCU line break on second floor of reactor building.
- PMO-29: Conduct mechanical equipment qualification review.
- PMO-30: Review effects of: (1) non-QA 1 circuits routed through Class 1E trays, and (2) low level radiation on electronic devices.
- PMO-31: Update response to NUREG-0588 EQ issues.
- PMO-32: Verify vendor EQ test reports.
- PMO-33: Update electrical equipment EQ files.
- PMO-34: Complete EQ work requirements identified in EDPs.
- PMO-35: Establish a maintenance and surveillance program to implement EQ requirements.
- PMO-36: Prepare and maintain an EQ design qualification manual.
- PMO-37: Prepare NUREG-0588 Category 2C mechanical and electrical EQ listings.
- PMO-38: Review QA 1 motor operated valve vendor drawings.
- PMO-39: Resolve NRC open item 341/84-39-03(DRP).

- PMO-40: Review and update QA 1 project design calculations to reflect as-built configuration.
- PMO-41: Update project specifications.
- PMO-42: Review preoperational test procedures against design, FSAR, technical specifications, and commitments.
- PMO-43: Prepare a test analysis report for engineering review.
- PMO-44: Review design document packages and vendor document lists.
- PMO-45: Verify that project change papers have received design review.
- PMO-46: Incorporate project change papers into drawings and specifications.
- PMO-47: Check for A-E design documentation to ensure retrievability.
- PMO-48: Complete seismic verification for additional structural components.
- PMO-49: Resolve HVAC problems identified during startup and testing.
- PMO-50: Resolve N3 and N5 data report problems.
- PMO-51: Incorporate small bore hanger design changes into calculations.
- PMO-52: Resolve HVAC air balance problems encountered during startup.
- PMO-53: Verify proper snubber, spring hanger, and pipe whip restraint operation and setting.

The NRC inspector selectively reviewed the PMO activities and their resulting closeout.

a. PMO Completion Status and RIII Review as of May 28, 1986

<u>Item</u>	<u>DECo Status</u>	<u>RIII Review Documentation</u>
PMO-1	Closed	
PMO-2	Closed	
PMO-3	Closed	Note No. 1; Paragraph 5
PMO-4	Closed	
PMO-5	Closed	
PMO-6	In progress	Nonsafety-related; no RIII review
PMO-7	In progress	
PMO-8	In progress	
PMO-9	In progress	Non-essential; no RIII review
PMO-10	In progress	Non-essential; no RIII review
PMO-11A	Closed	RIII Report No. 50-341/85052
PMO-11B	Closed	
PMO-12	In progress	

PMO-13	Closed	Paragraph 8 (covered partially)
PMO-14	Closed	
PMO-15	In progress	Non-safety-related; no RIII review
PMO-16	In progress	
PMO-17	Closed	
PMO-18	In progress	NRR's responsibility
PMO-19	In progress	Non-safety-related; no RIII review
PMO-20	In progress	Note No. 1; Paragraph 9
PMO-21	Closed	Paragraph 9
PMO-22	In progress	Note No. 1; Paragraph 9
PMO-23	In progress	Note No. 1; Paragraph 9
PMO-24	Closed	Paragraph 9
PMO-25	In progress	Note No. 1; Paragraph 9
PMO-26	Closed	Note No. 1
PMO-27	Closed	Note No. 1
PMO-28	Closed	Note No. 1
PMO-29	Closed	Note No. 1
PMO-30	Closed	Note No. 1
PMO-31	Closed	Note No. 1
PMO-32	In progress	
PMO-33	Closed	
PMO-34	Closed	Note No. 1
PMO-35	Closed	
PMO-36	Closed	Paragraph 7
PMO-37	In progress	
PMO-38	Closed	
PMO-39	Closed	RIII open item
PMO-40	In progress	Note No. 1; Paragraph 9
PMO-41	In progress	
PMO-42	In progress	Note No. 2
PMO-43	In progress	Note No. 2
PMO-44	In progress	
PMO-45	In progress	Paragraph 6
PMO-46	In progress	Paragraph 6
PMO-47	Closed	
PMO-48	Closed	Note No. 1; RIII Report No. 50-341/85052
PMO-49	Closed	Note No. 2; Paragraph 9
PMO-50	Closed	Michigan State requirement
PMO-51	In progress	Note No. 1; Paragraph 9
PMO-52	In progress	Note No. 2
PMO-53	In progress	Note No. 2

Notes:

1. PMOs are required to be completed prior to plant restart.
2. These are plant operational startup and test activities. Followup review is a part of the RIII routine inspection program.

b. Review of PMOs

The NRC inspector selected PMO Nos. 2, 12, 29, and 41 for review to determine adequacy of DECo actions. These PMOs were not reviewed

during previous NRC inspections and were not discussed during the licensee's presentations discussed in Paragraph 4. above.

(1) Review of PMO-2: Reactor and Auxiliary Building Structural Analysis

(a) Analysis of Rebar Cuts

The analysis criteria are contained in S&L document DC-SE-01-EF, "Project Structural Design Criteria, Enrico Fermi Unit 2, Reactor/Auxiliary Building and RHR Complex," Revision 8, October 11, 1985. The general structural criteria are in Section 8.0 and specific criteria were in Appendix D, "Design Criteria Assessment of Rebar Cuts Due to Cored Holes and Expansion Anchor Installations," May 6, 1985. The extent of rebar cut evaluations is maintained in a S&L Structural Department Rebar-Hit Drawing List. The latest list is dated January 31, 1986.

S&L completed its evaluation and concluded the existing concrete structure will not require modification. This conclusion is documented in a letter to DECo, "Final Load Verification of the Reactor/Auxiliary Building Concrete Structure," January 10, 1986. The letter also provided plans to transfer the original calculations to DECo.

The NRC inspector reviewed a selected sample of S&L Calculation Book No. SS-002-2, "Reactor/Auxiliary Building Final Load Verification Phase 2 - E1. 562'-0"," Revision 0, December 16, 1985, and had no adverse comments.

(b) Analysis of Superstructure

S&L reviewed the effects of the 615 hanger attachments to the Reactor/Auxiliary building superstructure (including girts, columns, roof frame, base plates, connections, and stiffeners). The review criteria were based on Section 8.0 of DC-SE-01-EF (Paragraph 10.b(1)(a)).

An S&L letter to DECo, "Final Load Check of Reactor/Auxiliary Building Superstructure," June 10, 1985, states that 3 of the girts could be overstressed and load reductions were needed to avoid structural modification. The affected girts are:

<u>Girt No.</u>	<u>Hanger Attachments</u>
C9D9 at 696'-11½"	C9D9 - 15, 16, and 17
A9B9 at 696'-11½"	A9B9 - 15, 16, 18, 19, 30, 31, 32, and 33
A9B9 at 696'-11½"	A9B9 - 17

The NRC inspector reviewed the DECo resolution to the potential problems:

- ° For C9D9-15, hanger modification was made to distribute the design loads to 2 girts, and to add a bracer to the hanger. The hanger (T41-2642-F658) modification is shown on EDP 4134, October 28, 1985.
- ° For the other affected hangers, a 2.0% OBE critical damping was used in the hanger structural re-analysis. This re-analysis was performed in accordance with FSAR, Section 3.0, Table 3.7-2 requirements. The NRC inspector reviewed a selected sample of Giffels calculation, "5th Floor HVAC Duct Support Loads - Supports A9B9 - 15, 16, 30, and 31," August 2, 1985, contained in Calculation Book No. 3060, "Loads on Girts and Columns, 5th Floor Reactor Building," Revision A, and had no adverse comments.

(c) Analysis of Steam Tunnel Pipe Hits

The DECo letter to S&L, "Pipe Break in Steam Tunnel," June 24, 1985, stated the purpose and scope of the analysis. The criteria used by S&L are stated in Section 8.0 of DC-SE-01-EF (Paragraph 10.b(1)(a)). The steam tunnel is considered a part of the Auxiliary Building structure in Section 8.0. The loading definition and profile of high energy line breaks is discussed in FSAR Appendix C, Section C.4.

S&L completed the evaluation, and concluded that no modifications were required. This conclusion is documented in a letter to DECo, "Final Load Verification of the Reactor/Auxiliary Building Concrete Structure," January 10, 1986.

The NRC inspector reviewed a selected sample of S&L calculation, "Final Load Check - Reactor/Auxiliary Building Walls, Walls No. W81 and No. W82," Revision 0, September 20, 1985, contained in S&L Calculation Book No. SS-0026, "Reactor/Auxiliary Building Final Load Verification of Concrete Wall and Columns," and had no adverse comments.

(2) Review of PMO-12: Seismic Design Qualification Manual

The "Fermi 2 Seismic Design Qualification Manual (F2 SDQ Manual)," Revision 0, May 19, 1986, was developed by DECo Generation Engineering, and issued by DECo Nuclear Engineering. The F2 SDQ Manual compiles information pertaining to seismic qualification work at Fermi 2 as required by DECo NE Procedures and Work Instructions. The manual also includes NRC Seismic Qualification Review Team (SQRT) activities and provides a SQRT listing of equipment seismic qualification. The NRC inspector reviewed the manual, and had no adverse comments.

(3) Review of PMO-29: Mechanical Equipment Qualification

The DECo safety-related mechanical equipment qualification program was reviewed and accepted by NRC-NRR (Fermi SSER 5, Section 3.11.4.2). The NRC inspector reviewed the mechanics of the program, on a broad basis, including:

- ° Fermi 2 Plant Order, EFP 1089, "Nuclear Production Environmental Qualification Program," Revision 0, May 7, 1986.
- ° NE-1.16.9-EQM, "Environmental Qualification of Safety-Related Mechanical Equipment for Harsh Environment - Program Description," Revision 0, November 15, 1985.
 - ° NE-1.16.9-EQM.1, "PIS/Tag Number Index," Revision 0, November 15, 1985.
 - ° NE-1.16.9-EQM.2, "Equipment Summary Sheets," Revision 0, November 15, 1985.
- ° NE Qualification Engineering Group Memorandum to Nuclear Production, Safety and Performance Analysis, and Material Engineering, No. F2E-85-2393, "Maintenance and Surveillance Requirements for Safety-Related Mechanical Equipment Qualification," October 30, 1986.

The NRC inspector noted that the program was comprehensive in terms of both scope and thoroughness.

(4) Review of PMO-41: Project Document Update

S&W was contracted by DECo to incorporate design change paper into the original project documents. The design papers are:

- ° Engineering Design Package (EDP)
- ° As-Built Notice (ABN; and ASB prior to August 1984, very few still open)
- ° Engineering Change Request (ECR)
- ° Design Change Request (DCR)
- ° Field Modification Request (FMR)

DCNs, DCRs, and FMRs are design change documents initiated during construction. EDPs, ABNs, and ECRs were issued during plant design and construction.

The NRC inspector reviewed the following documents and had no adverse comments:

- ° DECo Contract, No. NX-317407, awarded to S&W, "Incorporation of Outstanding Change Documents," October 24, 1985.

- DECo Generation Engineering Department procedure, No. 4.8, "Incorporating Design Change Documents," Revision 1, July 30, 1985.

c. Conclusion

The NRC inspector determined, based on the results of sample review in structural engineering, equipment seismic qualification, equipment environmental qualification, and project document update, that the licensee PMO task implementation actions were adequate. No violations or deviations were identified.

11. S&W Evaluation of DECo Engineering Document

a. Purpose of RIII Review

DECo awarded a contract to S&W to conduct an engineering document evaluation of design activities through March 1, 1986 to determine if design documents for the project were complete and current; and if not complete and current to identify the affected activity. The evaluation was not a technical audit or independent design review, but one of the means by which DECo management was to determine the readiness for plant restart. The purpose of the RIII review of the S&W evaluation was to assess the adequacy of the scope of review and the effectiveness of implementation. The NRC review was also to determine if the S&W evaluation was conducted in a consistent manner, and if their conclusions were justified.

b. S&W Report Conclusions

The S&W report, "Evaluation of Engineering Documentation for the Core Spray System, Fermi Unit No. 2," April 18, 1986, documented 10 findings as a result of the S&W review of the following engineering disciplines:

	<u>Finding* Nos.</u>
◦ Structural Engineering	
◦ Power (Mechanical Systems)	7, 8, 10
◦ Electrical Engineering	9, 11
◦ Instrumentation and Control	
◦ Engineering Mechanics	1, 2, 3, 4, 5, 6
◦ Licensing	
◦ Nuclear Technology	
◦ Plant Services (Operations)	

*All findings, except No. 9 (Paragraph 11.d.(3)), were potential findings or concerns. DECo subsequently resolved all issues raised by S&W.

c. Review of S&W Evaluation Control Measures

The NRC inspector reviewed the following evaluation criteria, and had no adverse comments:

- S&W and DECo joint effort document, EA-077, "Stone and Webster Evaluation Plan Completion of Engineering Work, Fermi 2," Revision 1, March 4, 1986.
- S&W letter from Assistant Engineering Manager (Evaluation Team Leader) to the Team Members, "S&W Evaluation Work Scope," February 28, 1986.

d. Review of S&W Engineering Evaluations

(1) Structural Engineering

The NRC inspector agrees with the S&W decision not to review the structural procurement specification. The NRC inspector selected their review of cut rebar and the loading of secondary structures (including girts) for review. Review of the S&W evaluation notes confirmed that both areas were addressed. The DECo review of pipe break location calculations, and generic basis, is included in PMO-25. A review of design change documents for affected pipe whip and jet impingement is required by DECo Procedure NE-25.

(2) Power (Mechanical Systems)

The NRC inspector reviewed the S&W overall evaluation in this area and had no adverse comments. The CS pump seismic, EQ design criteria, and vendor qualification test/analysis were selected for review. The CS pump was manufactured by Byron Jackson Company, and supplied by GE. The seismic qualification was based on analysis using the site specific multiple axis static equivalent seismic loading method. The pump motor was tested above the design accident temperature. The use of non-metallic Ethylene Propylene was determined to be acceptable by the DECo EQ evaluation group.

(3) Electrical Engineering

S&W's evaluation raised the question as to whether or not some of the motors on the MOVs will start properly under degraded grid undervoltage of 20% below the motor rating as required in DECo DC No. 968, Revision B, January 18, 1985. The problem and resolution is documented in a DECo DER No. 86-0224. This problem was reported to NRC through LER No. 86-002-01, on June 23, 1986. While the design issue is resolved, DECo is still investigating the cause of the above identified problem.

(4) Instrumentation and Controls

The NRC inspector selected CS pump discharge pressure transmitter 2E21 N055 AE for review. Review areas included seismic, EQ, and component test data. The NRC inspector reviewed the DECo Purchase Specification No. 3071-315-PUR-102, "Seismic Qualification Summaries," and had no adverse comments. The pressure transmitter was supplied by Rosemount Company. The

NRC inspector reviewed the Rosemount Report No. 08300131, "Type Test Report for Pressure Transmitters, Rosemount Models 1153, Series B and D, Output Code R," Revision A, and had no adverse comments.

(5) Engineering Mechanics

The NRC inspector reviewed the S&W evaluations, including design interface control, use of correct valve weights, use of valve center of gravities, and selection of correct versions of the computer program for the piping stress analyses, and had no adverse comments. He also checked the embedded plate design to verify compliance with the IE Bulletin 79-02 requirements. No deficiencies were identified. During the review, the NRC inspector observed that the DECo S/B design document for process piping was evaluated by S&W. No written justification was provided as to why the DECo S/B piping calculations were not evaluated.

(6) Licensing

The NRC inspector reviewed the S&W evaluation and considered it acceptable. The following 2 areas were not evaluated by S&W:

- a. In DECo commitment No. 2513, the removal of discs from certain check valves was approved in a DECo letter EF2-66804, January 10, 1984. The S&W evaluation did not perform record check to ensure work had been carried out. The NRC inspector reviewed DECo Field Modification Request No. 7264, May 25, 1984, and DECo Maintenance Order No. 556478, July 5, 1984, and considered the matter resolved.
- b. DECo commitment No. 5873, concerns containment spray headers, but was inadvertently classified as a CS item. The S&W evaluation did not determine if this is a generic problem. The NRC inspector discussed the issue with the DECo Senior Licensing Engineer (SLE) at the site. The SLE was aware of the problem, and stated that improvement of retrievability by system abbreviation was a part of the latest tracking system upgrade. The system upgrade involved a review of approximately 9000 items. The SLE documented the discussions in two memoranda to the file:
 - o No. RC-LG-86-0053, "Brief History of Commitment Tracking at Fermi 2," June 13, 1986.
 - o No. RC-LG-86-0052, "Assignment of System Numbers and Keywords RACTS Items," June 13, 1986.

The NRC inspector further reviewed the following control procedures, and had no adverse comments:

- ° DECo Procedure NE-2.1.9, "Licensing Commitment Register Instruction," September 22, 1983.
- ° DECo Nuclear Operations Interfacing Procedure, No. 11.000.05, "Regulatory Action on Commitment Tracking System," May 1, 1986.

(7) Nuclear Technology

The NRC inspector reviewed the S&W evaluation of the shielding design for a diagonal wall near the torus, a pipe break inside the containment, and the effects of a pipe break outside containment. No deficiencies were identified as a result of the review.

(8) Plant Services (Operations)

Recently, at other facilities, piping suspension system damage was not identified in a timely manner after conducting scheduled equipment testing. The S&W evaluation identified that the CS pump and valve operability test procedures Nos. 24.203.02 (04) and (05) required observations to detect any excessive vibration, erratic noise and behavior. In addition, the shift operations procedure, No. 21.000.01, provided system surveillance on a weekly basis. The NRC inspector stated that he was satisfied with these measures to assure prompt identification of possible system damage.

The NRC inspector noted that system maintenance requirements were not evaluated by S&W. Subsequently, the DECo representative provided the NRC inspector the following DECo QA audits that had included maintenance as a part of the audit scope.

- ° Report No. A-QS-F-85-42, "Fermi 2 Engineering - Qualification Engineering (F2E-QE) Environmental Qualification Program Activities," November 14 through December 4, 1985.
- ° Report No. A-QS-P/TS-86-17, "Audit of the Environmental Qualification Program," May 7 through 21, 1986.

The NRC inspector reviewed the above documents, and had no further comments.

e. Summary and Conclusion

The NRC assessment of the S&W evaluation of DECo design documentation was conducted in two separate inspections. During the first visit to the S&W office, the NRC inspector selected Engineering Mechanics and Licensing matters for review. He found the S&W control of evaluations was less structured than that normally used for a formal design audit or a technical review.

As a result of discussions with DECo and S&W, S&W redeveloped a more stringently controlled review item/discipline matrix. Detailed (but limited in scope) evaluations checklists for all involved disciplines were also established. The NRC inspector's followup review of the latest S&W evaluation is documented in the preceding paragraphs. The NRC inspector concluded that the overall program was acceptable in terms of scope and implementation. No violations or deviations were identified.

12. DECo Reevaluation of S/B Piping Design Calculations (DCs)

To correct the violation (No. 341/86012-01) identified in Paragraph 9.d.(1) of this report, DECo developed a reevaluation program for the S/B piping design completed by the DECo S/B Design Group during construction using the cookbook type method. The program included a review of 708 instrument and control (I&C) tubing and S/B process piping DCs. The reevaluation program was structured to identify deviations and nonconformances, and provide dispositions as required.

a. Review of Contract Scope Documents

DECo assigned S&W to review the 363 I&C tubing DCs, and S&L to review the 344 S/B piping DCs. The NRC inspector reviewed the following documents:

- ° DECo letter, NE-PJ-86-0310, to S&W, "Reconciliation of I&C Tubing Base Design Calculations (SCP-PMO-40-2)," May 17, 1986.
- ° DECo letter, NE-PJ-86-0321, to S&W, "Transfer of Calculations from S&W to Sargent and Lundy," May 22, 1986.
- ° DECo letter, NE-PJ-86-0309, to S&L, "Reconciliation of Small Bore Piping and Design Calculations," May 17, 1986.

The DECo "Scope Document to Support Organization" papers attached to the contract letters included scope of work, expected product, review criteria, QA requirements, and an attribute checklist guide.

b. Review of Procedures

The NRC inspector reviewed the following I&C tubing and S/B piping DC evaluation procedures:

- ° S&W Nuclear Design Instruction, NDI-15, "Procedure to Reconciliate Small Bore Base Design Calculations," May 23, 1986.
- ° S&L Project Instruction, "PI-EF-33, "Reconciliation of Small Bore Piping and Instrument and Control Tubing Base Design Calculations," Revision 0, May 19, 1986.

c. Review of DCs

As of June 8, 1986, the status of work completion was as follows:

A-E	Total No. of DCs	No. of DC Evaluations Completed by A-E	No. of DC Evaluations Approved by DECo
S&W	269*	242	82
S&L	439*	426	302

*Due to difficulty in meeting the completion schedule, 94 S&W responsible DCs were reassigned to S&L.

The NRC inspector selected the following DCs for review:

- ° DC No. 2267, "Small Bore Piping Stress Analysis for Isometrics: 6WI-P50-7519-1, Revision D, and 6WI-P50-7519-3, Revision C," Revision C, June 13, 1986. S&W completed the evaluation and signed off the checklist on June 5, 1986.
- ° DC No. 2448, "Small Bore Hanger Design for Isometrics: 6WI-P50-7554-1, Revision C, and 6WI-P50-7554-3, Revision C," Revision C, June 13, 1986. S&W completed the evaluation and signed off the checklist on June 5, 1986.
- ° DC No. 1639, "Small Bore Hanger Design for Isometrics: 6WM-P44-5274-1, Revision B' 6WM-P44-3057-3, Revision F," Revision B, June 9, 1986. S&L completed the evaluation and signed off the checklist on June 1, 1986.
- ° DC No. 1922, "Piping Stress Analysis for Small Bore Piping: 6WM-E41-5082-1, Revision F, and 6WM-E41-5082-3, Revision F," Revision B, June 11, 1986. S&L completed the evaluation and signed off the checklist on June 4, 1986.

d. Conclusions

As of June 18, 1986, the S&W and S&L evaluations of I&C tubing and S/B piping base calculations disclosed that design calculations needed to be upgraded; however, no hardware modifications were required. Considering the DECo design verification upgrading effort discussed in this report, and the broad and generic evaluation accomplished for all affected tubing and S/B piping, the NRC inspector concluded that the DECo corrective actions to avoid further violations were adequate. The corrective action program will be completed prior to plant restart. This violation (341/86012-01) is closed.

13. Review of LER No. 86-012-00

DECo reported through a LER No. 86-012-00, on June 11, 1986, that a design error was found when they assessed the time required for the RWCU isolation valves to close during a postulated high energy line break (HELB). The FSAR states that the closure time should be within 20 seconds. The present system performs in the following manner:

- a. Using the existing differential leak flow detection system, the isolation valves take 44 seconds to close.

- b. Using the existing temperature sensing devices installed in the pump rooms A and B, the heat exchanger room, and the phase separator room, valve closure time can be within 20 seconds. However, based on the manner the instruments are connected, signals received in one of the rooms in which will close either the inboard or the outboard isolation valve. As such, any malfunction at the activated isolation valve could delay system shutoff time to exceed the FSAR limit.

More detailed design deficiency descriptions are documented in the following DERs:

- No. NP-85-0404, "EQ Profile Rendered Indeterminate because of Invalid Safety Analysis Assumption," July 30, 1985.
- No. NP-86-183, "Failure of the Reactor Water Cleanup Steam Leak Detection Logic to Meet the Single Failure Criteria," May 8, 1986.

The DECo corrective actions:

- Maintain the use of the one ambient temperature sensor (ATS) in each room.
- Modify the differential temperature sensor (DTS) to become the second ATS in each room.
- Evaluate HELB effects to ensure survival of the ATSS.
- Adjust the thermocouple set points in accordance with temperature rising/time function evaluations.
- In each room, one ATS controls the closure of the inboard, and the second one controls the closure of the outboard isolation valve.

The NRC inspector reviewed the following corrective action documents:

- EDP-5702, "Modification of the RWCU Steam Leak Detection System Isolation Actuation Instrumentation (PDC-5702 and DER-NP-86-183)," June 19, 1986.
- Design Verification Record Package for EDP-5702, June 19, 1986.
- NE document, No. NE-NS-86-0200, "Revision to Request for Technical Specification Amendment," June 19, 1986.

The NRC inspector stated that, based on the above review, he had no further comments. Subsequent to the site inspection, DECo telephoned the NRC inspector on June 24, 1986, and informed him that the amount of time estimated to get the Technical Specification change approved could cause a restart delay. Therefore, instead of modifying the DTSs, they would install 4 new ATSS to resolve the problem. The NRC inspector concurred with this alternative fix. The LER is considered closed. Hardware changes will be verified during a future inspection.

14. Exit Interview

The Region III inspector met with licensee representative (denoted in Paragraph 1) at the conclusion of the inspection on June 20, 1986. The inspector summarized the scope and findings of the inspection. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed by the inspector during the inspection. The licensee representatives did not identify any such documents/processes as proprietary.