UNITED STATES NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

Report of Construction Inspection

IE Inspection Report No. 050-329/76-04
IE Inspection Report No. 050-330/76-04

Licensee: Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Midland Plant
Units 1 and 2
Midland, Michigan

License No. CPPR-81
License No. CPPR-82
Category: A

Type of Licensee: PWR (B&W), Unit 1 - 650 MWe
Unit 2 - 818 MWe

Type of Inspection: Announced, Special

Dates of Inspection: April 19-21, May 3, 6-7, 13-14, and 20, and June 7-8, 1976

Principal Inspector: I. T. Yin *I. Yin* 7/2/76 (Date)

Accompanying Inspectors: F. J. Jablonski *F. J. Jablonski* 7/2/76 (Date)

C. C. Williams *C. C. Williams* 7/2/76 (Date)

Other Accompanying Personnel: J. G. Keppler
D. M. Hunnicutt
C. E. Norelius
J. C. LeDoux
D. W. Hayes
G. A. Phillip

Reviewed By: D. W. Hayes, Chief *D. W. Hayes* 7/2/76 (Date)
Projects Section

SUMMARY OF FINDINGS

Inspection Summary

Inspections on April 19-21, May 3, 6-7, and 13-14, 1976, (Unit 1, 76-04) and (Unit 2, 76-04): Perform in-depth QA inspection to identify the underlying causes of weakness in the Midland QA program implementation, primarily recent problems in reinforcement steel placement. As a result of the inspection, five items of noncompliance relative to inadequate quality inspection, corrective actions, work procedures, and documentation were identified. Two deviation items were also identified in regard to QA audits and design engineers QA training. Management meetings on May 20 and on June 7 and 8, 1976: Reviewed corrective action planned by the licensee relative to the inspection findings.

Enforcement Items

Items of Noncompliance

A. Violations

None.

B. Infractions (Units 1 and 2)

1. Contrary to Criterion V, documented instructions were not available for the drilling and placement of reinforcement steel dowels. (Paragraph 4.a.(1), Report Details)

2. Contrary to Criterion V, Nonconformance Reports concerning reinforcement steel deficiencies were not adequately evaluated to determine need for corrective action to prevent recurrence as required by the Bechtel Power Corporation Field Inspection Procedure G-3, Paragraphs 4.10.1 and 4.10.3. (Paragraph 4.d, Report Details)

3. Contrary to Criterion X, reinforcement steel installations in some instances were not adequately inspected to verify conformance to applicable drawings. (Paragraph 4.c.(5), Report Details)

4. Contrary to Criterion XVI, a meaningful evaluation was not performed relative to the significance of the deficiency documented on Bechtel Power Corporation Nonconformance Report No. 260 and its reportability pursuant to the requirements of 10 CFR 50, Paragraph 50.55(e). (Paragraph 1.d., Report Details)

5. Contrary to Criterion XVII, results of reviews, interim inspections, and monitoring of reinforcement steel installations were not documented and available for review. (Paragrapn 4.c.(1), Report Details)

C. Deficiencies

None.

Licensee Action on Previously Identified Enforcement Items

Licensee action and/or resolution of previously identified enforcement items were not reviewed during this inspection.

Other Significant Items

A. Systems and Components

1. Unresolved Matter: Based on the results of the safety analyses on the cumulative effects on the Auxiliary Building due to rebar omission and reworks. Bechtel concluded that the missing rebar, even if not replaced, will not affect the integrity of the structure. This position was accepted by the licensee's engineering department. IE:III requested an independent technical evaluation through IE:HQ to verify the finding. Subsequently, this evaluation was conducted by the IE:HQ technical personnel, and no problem areas were identified. The results of the IE:HQ structural review will be documented in a future IE:III inspection report. This item remains open pending issuance of this report.

2. Unresolved Matter: Following the licensee's interim 50.55(e) report on missing rebar dated April 21, 1976, other possible discrepancies involving placement of rebar were identified by CP. These discrepancies are documented in NCR QF-95, No. QF-96 and No. QF-100 and will be reviewed during a future inspection.

3. Unresolved Matter: Bechtel QA Trend analysis reports, not identified to the IE inspector until completion of the inspection on May 14, 1976, will be reviewed at the site during a future inspection. (Paragraph 4.d, Report Details)

4. Unresolved Matter: A monthly Civil/Structural Drawing Change Notice (DCN) control log is transmitted to site document control group. Because of the size of these transmittals (several hundred pages) and the fact that the latest changes are not highlighted, the value of this logging system in identifying DCN updates was questioned. Further review is planned during a future inspection.

B. Facility Items (Plans and Procedures)

1. Unresolved Matter: The adequacy of document control procedures relative to filing Field Change Notices by the licensee's project office could not be determined. Further review of this matter is planned for a subsequent inspection.

2. Unresolved Matter: The use of department standards such as No. 501 and No. 502 by the Bechtel civil design engineering group to replace or supplement the Engineering Department Procedures (EDP) and PSAR was questionable. Subsequent to the inspection Bechtel indicated that they will abandon the use of these standards. (Paragraph 4.b.(2), Report Details)

3. Unresolved Matter: The use of NCRs to document engineering changes which affect completed work does not appear to be in consistence with requirements. Subsequent to the inspection the licensee stated that this practice would be discontinued. (Paragraph 4.c.(3), Report Details)

4. Unresolved Matter: The current Bechtel QC inspection practice of having the QC Engineer submit inspection plans directly to the Field Coordinator, does not appear to be consistent with paragraph 3.1 of the Bechtel Project Special Provision No. 16, Revision 0, dated October 2, 1974. Followup review is planned.

5. Unresolved Matter: The wording of some Bechtel nonconformance reports is unclear or sufficient detail is not provided such that the exact nature of the discrepancy is apparent. These reports are to be revised and followup review is planned during a future inspection.

C. Managerial Items

None.

D. Noncompliance Identified and Corrected by Licensee

None.

E. Deviations

1. Contrary to the licensee ASLB hearing commitments, licensee control of A-E's safety-related work activities has not been effective, and some of the audits had not been performed in accordance with approved audit schedules.

2. Contrary to the licensee commitment during the ASLB hearing that CP QA policy was to be implemented not only by CP, but by the NSS supplier and the A-E, the Bechtel design engineers QA training was not in compliance with CP policy.

F. Status of Previously Unresolved Items

The resolution of previously unresolved items was not reviewed during this inspection.

Management Interview

A. An informal information exchange type meeting was held at the site with Bechtel and CP management personnel on May 14, 1976, at the conclusion of the inspection. Those present were informed that this meeting was not the formal management exit meeting but that the formal meeting would be held with CP corporate personnel on May 20, 1976.

1. Attendees:

Consumers Power Company (CP)

F. M. Southworth, Director, Project QA Services
H. W. Slager, Midland QA Administrator
J. L. Corley, Midland QA Superintendent
R. E. Whitaker, QA Engineer
T. C. Cooke, Midland Project Superintendent
B. H. Peck, Field Supervisor

Bechtel Power Corporation (Bechtel)

P. A. Martinez, Project Manager
D. R. Johnson, Chief QC Engineer
J. F. Newgen, Project Superintendent
J. Milandin, QA Manager
T. C. Valenzano, Project Field Engineer
A. J. Boos, Assistant Project Field Engineer
G. L. Richardson, Lead QA Engineer
W. F. Holub, Project QA Engineer
J. P. Connolly, Project Field QC Engineer

Bechtel Associates Professional Corporation (BAPC)

E. A. Runbaugh, Engineering Manager
H. Hermeston, Construction Manager
R. L. Castleberry, Project Engineer
J. L. Hurley, Assistant Project Engineer

2. The inspectors discussed the results of the inspection and apparent underlying causes contributing to repetitive reinforcement steel (rebar) deficiencies that have occurred at the Midland site. The underlying causes discussed included:

   a. Lack of QA training for the working level design engineers.

   b. Improper use of Nonconformance Reports (NCR) for documenting design changes.

   c. Inadequate review of fabrication drawings by Field Engineers.

   d. Lack of clarity of problem description in NCRs.

   e. Insufficient field alertness to design drawing revisions, and other changes affecting their activities.

   f. Failure of Field Engineers and Quality Assurance Engineers (QAE) to review NCRs for generic problems and to take corrective actions.

   g. Failure of QAE to detect improper or inadequate QC activities.

   h. Failure of Quality Control Engineers (QCE) to determine interim inspection or surveillance results.

   i. Incomplete or inadequate preparation of QC inspection plans.

   j. QC inspection made against fabrication drawings instead of using these drawings only as reference with work acceptance against the design drawings.

   k. Apparent lack of adequate or effective training for Field Engineers, QA Engineers and QC Engineers.

3. The inspectors acknowledged the corrective items that had been initiated by CP and Bechtel relative to the rebar

problems. (These items are listed below) It was also acknowledged that some of these corrective actions are on an interim basis pending further review and development of needed policy and procedure changes to affect long term resolutions.

a. Modify preplacement rebar inspection plan to include specific requirements as to review of design drawings and extra verification at locations where changes in direction or interruptions occur.

b. Provide documented instructions to the field engineers to use design drawings as primary documents for rebar checkout and to improve interpretation of design drawings.

c. Improve fabrication drawing preparation and control.

d. Provide specific instructions to craft supervisors, field engineers, and quality control engineers relative to rebar deficiencies.

e. Provide documented instructions to QC engineers to use design drawing for rebar inspection and to use fabrication and detail drawings only as references.

f. Bechtel Project Field QC Engineer or Lead Civil QC Engineer to review the inspection criteria and the rebar placement for a minimum of twenty (20) concrete placements.

g. CP QA Engineers to inspect and verify proper rebar placement for all safety related pours prior to their release for concrete placement.

h. CP Civil Engineering Section to investigate rebar problems to determine underlying causes and to recommend measures to preclude repetition.

i. One additional CP Civil QA Engineer temporarily assigned to the site to strengthen the QA work force.

j. Provide more intensified training for Bechtel QC Engineers on the rebar problems.

k. Bechtel QA to develop detailed trend analyses on the rebar deficiencies and other related problems.

l. Bechtel QA to develop more visibility on QA trend analyses, based on NCR's audit findings, supplier audits, etc.

m. Management Corrective Action Report (MCAR-12) issued by Bechtel on April 1, 1976, to identify the rebar deficiencies and the causes of the problem. MCAR-12 not to be closed until resolution has been satisfactorily achieved.

n. Bechtel to evaluate the working technique of QC inspectors.

o. Bechtel QA to review the results of the review of 20 concrete placements (see Item No. f) and to assess the QA inspection effectiveness.

B. A formal management exit interview was held on May 20, 1976 at CP's Corporate Offices.

1. Attendees:

Consumers Power Co. (CP)

J. D. Selby, President
S. H. Howell, Vice President
G. S. Keeley, Project Manager
F. Southworth, Director, Project QA Services Department
H. W. Slager, Midland QA Administrator

USNRC

J. G. Keppler, Regional Director
D. M. Hunnicutt, Chief, Reactor Construction and Engineering Support Branch
C. E. Norelius, Assistant to the Director
J. C. LeDoux, Chief, Engineering Support Section
D. W. Hayes, Chief, Projects Section
I. T. Yin, Reactor Inspector, Projects

2. Matters discussed and comments on the part of management personnel were as follows:

a. A presentation of inspection findings were given by NRC IE:III Chief, Projects Section. The following is the essence of the presentation:

(1) The primary concern relative to the inspection findings is the apparent breakdown in the effectiveness of CP's QA/QC systems in that both failed to recognize and deal effectively with repetitive rebar problems.

(2) The conduct of the inspection concentrated on two areas: (a) verify that commitments made by CP and Bechtel in the past, and those concerning current rebar problems are being implemented, and (b) identify underlying causes leading to repeated omissions of rebars.

(3) The status of CP and Bechtel adherence to previous commitments was discussed.

(4) Rebar omission problems including inspection dates and apparent causes were summarized and discussed.

(5) Regarding underlying causes, IE:III inspectors examined four areas: (a) Design, (b) Field Activities, (c) Quality Control, and (d) Quality Assurance. Results of the inspection did not identify any generic causes concerning the rebar deficiencies. However, it was concluded that the field QA/QC groups had not fully carried out their responsibilities. If each of the groups involved had followed established procedures, it is likely that these problems would not have occurred.

(6) The underlying causes observed by IE:III inspectors were presented. This presentation was similar to that given earlier at the Midland site (see Paragraph A.2., Management Interview). Two additional items were also discussed that may have contributed to the rebar omission problems. They were:

(a) The lead time between completion of design and start of construction.

(b) Some simplification of design drawings and elimination of multiple references may be possible.

(7) The noncompliance items identified as a result of this inspection were also discussed.

b. In conjunction with the inspection findings, the NRC IE:III Regional Director indicated that the licensee should take effective and acceptable corrective actions to include:

(1) A program to correct identified problems and to provide a high degree of assurance they will not recur.

(2) A program to verify that similar QA/QC weaknesses do not exist in other areas and, if weaknesses are identified, that appropriate corrective action is taken.

(3) A program to establish confidence that reinforcement steel in other areas has been properly installed and to provide reasonable assurance that no other omissions of reinforcement steel has remained undetected.

c. At the conclusion of the meeting, the President of Consumers Power Company expressed CP's general concurrence with the inspection findings. CP will increase their QA/QC efforts at the Midland site, and will reexamine the fundamental issues involving architect-engineer (A-E) design review and group interfaces. CP will develop a formal plan of action in response to the NRC concerns and will be prepared to review these plans with NRC Region III personnel in the very near future.

C. A followup management meeting was held on June 7 and 8, 1976 at CP Corporate Offices.

1. Attendees:

Consumers Power Company

S. H. Howell, Vice President
G. S. Keeley, Project Manager
F. Southworth, Director, Project QA Services Department
H. W. Slager, Midland QA Administrator

USNRC

J. G. Keppler, Regional Director (June 8, 1976, only)
D. M. Hunnicutt, Chief, Reactor Construction and Engineering Support Branch
D. W. Hayes, Chief, Project Section
J. C. LeDoux, Chief, Engineering Support Section

2. Matters discussed:

The licensee discussed the results of their review and analysis of the findings identified during the IE:III inspections in April and May 1976. Each finding (issue) was discussed individually along with CP's proposed plan for corrective action.

CP's analysis of the issues was considered to be thorough and the corrective action plans responsive to NRC concerns. However, some action items and/or dates for accomplishment remain to be defined.

During the meeting on June 8, 1976, CP notified IE:III of two more ommissions of reinforcement steel and that a stop work order had been issued by the licensee and the contractor for all concrete placement involving safety-related structures.

Subsequent discussions centered on those corrective action plans that should be completed and implemented before concrete placement activities are resumed. The licensee agreed to expedite final development and schedules for implementation of these plans. The licensee also agreed to provide Region III an opportunity to review the results prior to lifting the stop work order.

REPORT DETAILS

Persons Contacted

In addition to the individuals listed under the Management Interview section of this report, the following persons were contacted:

Consumers Power Company (CP)

R. E. Whitaker, Field QA Engineer
D. E. Horn, Field QA Engineer
C. E. Hunt, Executive Engineer
R. W. Rogness, Senior Engineer

Bechtel Power Corporation

Z. G. Tucker, QC Supervisor

Bechtel Associates Professional Corporation

P. R. Cassidy, Vice President and Area Manager
M. F. Daubenheyer, Senior Construction Engineer
M. G. O'Mara, Quality Engineer Supervisor
J. R. McBride, Project Quality Engineer
J. C. Arora, Group Leader, Auxiliary Building
V. J. Venma, Senior Civil Engineer
J. N. Pasrija, Civil/Structural Engineer
M. Jumra, Civil/Structural Engineer

Results of Inspection

1. Recent Licensee Report on Rebar Placement Problems

a. On March 22, 1976, the inspector was informed by the licensee, that subsequent to concrete placement CP discovered that certain rebars in the auxiliary building had been omitted. As a result of this discovery, a stop work order for all safety related concrete placement activities was issued by the licensee's site QA representative.

The problems were identified as follows:

(1) "A" Line Rebars

As described in Bechtel NCR No. 396, groups of six No. 8 vertical rebars, 23'6" long, starting from EL.614'-0",

were not placed in the shear wall columns at the intersections of line "A" and line "5.6", and line "A" and line "7.4". A total of 12 No. 8 rebars had been omitted.

(2) "7.8" Line Rebars

As described in Bechtel NCR No. 398, sets of five No. 11 horizontal right angle bent rebars, at 2'3" O.C. vertcally from EL.614'-0", had not been placed in line "7.8" concrete wall at four locations, on each face of line "J", and line "K" walls. A total of 20 No. 11 rebars had been omitted.

b. During the management exit interview following the routine site inspection of March 16-18 and 24-26, 1976, the inspector requested CP to inform him when the stop work order was to be lifted and the status of the following items of concern:

(1) The cause of the problem.

(2) The corrective methods, or interim fix, approved by Bechtel and accepted by CP.

(3) If additional reinforcement of the structure is required because of the omitted rebars, the analyses, the corrective work requirements, and approval and acceptance of work procedures prior to their use.

(4) If no additional reinforcement is necessary, the documented evaluation and analyses supporting this decision.

(5) Management immediate action, and plans to prevent occurrence of future similar problems.

(6) Training sessions conducted for engineers, QA/QC personnel, and rebar placement crews.

c. Subsequent to the site inspection, on March 31, 1976, the licensee informed the inspector that the stop work was being lifted, and addressed the concerned items. The licensee also indicated that detailed investigation and evaluation of the problem was underway and that the results would be reported pursuant to requirements of 10 CFR 50, Paragraph 50.55(e).

d. Also, during the March 16-18 and 24-26, 1976 inspection, a number of NCRs submitted as required by ALAB 106, Condition 4 requirements were reviewed for proper resolution. One of the selected NCRs was Bechtel NCR No. 260, issued on December 23, 1974, and resolved on November 3, 1975. This NCR concerned omission of reinforcement steel in several wall areas within the Auxiliary Building. During further review of this NCR in the IE:III office and based on the problem as documented, the inspector determined that the licensee has not performed a meaningful evaluation as to the significance of the problem and reportability pursuant to 10 CFR 50. Paragraph 50.55(e) requirements. Such findings were based on the following occurrences:

(1) During March 16-18, and 24-26, 1976, IE:III site inspection, neither Bechtel Assistant Project Field Engineer, nor Bechtel Lead Civil Quality Control Engineer knew exactly how many dowels were omitted from rebar placement. From reading NCR 260, it appeared to be that 96 #8 horizontal rebars (walls No. 27 through No. 32) and 12 #8 vertical rebars (wall No. 31) were omitted. Subsequent to the inspection, licensee reported that a total of 77 #8 rebars were omitted, and a revision of NCR 260 was to be written.

(2) During April 19-21, 1976, IE:III site inspection, Bechtel Project Field Engineer and licensee QA Engineer reported that no rebars were omitted in walls No. 27 and No. 28, but 52 #8 horizontal rebars were omitted in walls No. 29 through No. 32, and 12 #8 vertical rebars were omitted in wall No. 31.

(3) Reviewing licensee 50.55(e) letters, dated April 21, 1976, and May 21, 1976, and the attached Bechtel safety evaluation, titled "Investigation of Missing Horizontal Reinforcing Steel for Midland Auxiliary Building Walls 29, 31 and 30, 32 at Walls 7.4 and 5.6, Respectively (NCR 260)" addressed the 52 #8 omitted horizontal rebars in walls No. 29 through No. 32. The omitted 12 #8 vertical rebars reported in NCR 260, and during April 19-21, 1976, IE:III site inspection, had apparently not been taken into consideration.

2. Similar Rebar Problems In The Past

Several rebar placement problems were identified and reported to IE:III since late 1974. The events were as follows:

a. On December 5, 1974, the licensee reported that, as a result of an audit performed on December 5, 1974, by the CP QA Engineer, rebar spacing was found to be out of specification in about 50 locations within the Unit 2 Containment Building Lift No. 6. The deficiencies were reported to NRC per 10 CFR 50, Paragraph 50.55(e) requirements. The details of the problem and resolutions are documented in CP NCR QF-36, and reported in IE:III Inspection Reports No. 050-330/75-01, No. 050-330/75-02, and No. 050-330/75-03.

b. On March 5 and 10, 1975, the IE:III inspector was informed by the licensee that deficiencies were found in the auxiliary building concrete rebar placements. The deficiency areas included: (1) 50% of the required #6 rebars (56 in number) were not placed in a horizontal concrete beam, (2) four #6 bars had not been placed in the wall near the opening, and (3) two #6 rebars were placed into the floor slab where three No. #8 rebars are required.

The details of the problem and resolutions were documented in Bechtel NCR No. 295, and reported in IE:III Inspection Reports No. 050-329/75-03 and No. 050-330/75-03.

c. A management meeting was conducted by IE:III personnel at Consumers Power Company Corporate offices on March 12, 1975. The purpose of this meeting was to discuss reinforcement steel placement problems. The meeting is documented in a IE:III letter to Consumers Power Company dated April 16, 1975.

d. On August 21, 1975, the licensee reported, that a number of tiebars had been left out during auxiliary building concrete pours. Bechtel Nonconformance Report NCR-326 identifies that the missing 42 sets of tiebars are located in the "Hk" line wall, between column lines 7.8 and 8.6. The approximate dimensions of the wall are 15' x 13' x 3.5',

with an 8' diameter pipe tunnel opening. The original design called for 23 sets of double #6 ties for the horizontal concrete beam and 19 sets of double #6 rebar ties for the vertical beam, above and on one side of the pipe tunnel. Instead, only single #6 rebar ties had been placed during the pours.

The IE:III inspection of the reported deficiency and the resolution of the problem is documented in IE:III Inspection Report No. 050-329/75-07, and No. 050-330/75-07.

3. Review of All Past NCRs Relative To Rebar Placements

As a result of problems identified in Bechtel NCR 260, the past and recent rebar omission problems, described above in paragraphs 1 and 2, the inspector reviewed all NCRs dating back to 1970 and made a chronological listing of the omissions and other rebar problems documented in these reports. The purpose was to identify the extent of the problems concerning rebar placement and any possibility of cumulative affects on structural safety.

The review of findings are summarized as follows:

NCR NO.	NCR DATE	PROBLEM	DISPOSITIO
C-18	10/23/73	7 - # 11 bars missing. Improper spacing. (Pour placed 10/22/70)	Repair
135	7/15/74	Excessive cover.	As Is
143	7/30/74	Placed in wrong location.	Repair
158	8/20/74	12 - #8 bars missing. 42 - #6 bars missing. (Pour placed 7/17/74.)	Rework
168	9/5/74	Placed in wrong location. (Pour placed 7/5/74.)	Rework
172	9/12/74	35 - #11 bars missing. (Pour placed 6/13/74.)	Rework
QF-36	12/5/74	Improper spacing (Containment Building).	As Is
254	12/18/74	Excessive cover.	As Is
256	12/19/74	1 - #6 rebar was inadvertently cut.	Rework

NCR NO.	NCR DATE	PROBLEM	DISPOSITIO
260	12/23/74	52 to 64 #8 bars missing. (Pour placed 10/73 and 11/8/74.)	Rework
276	1/28/75	Containment Unit 2 8-#11 bundled haunch bars were cut off to make room for penetration.	As Is
290	2/21/75	8 - #11 bars missing. (Pour placed 11/8/74.)	Rework
295	2/28/75	116 - #6 ties omitted. (Pour placed 12/23/74.) Also, 2 - #8 bars and 4 - #6 bars omitted.	As Is
296	3/3/75	1 - #8 bar omitted. (Pour placed 8/30/74.)	Rework
298	3/10/75	3 - #9 rebar with incorrect embedment length.	As Is
326	8/11/75	42 - #6 ties omitted. (Pour placed 11/14/74.)	As Is
396	3/22/76	1 - #8 bar omitted. (Pour placed 2/9/76.)	As Is
398	3/23/76	20 - #11 bars omitted. (Pour placed 3/3/76.)	Rework
399	3/23/76	Same as NCR 398, except for opposite wall. Omission detected before pour completed.	--

Note: NCRs listed above concern omission or improper placement of reinforcement steel, and except for NCRs No. 276 and QF-36, all occurred in the Auxiliary Building.

4. In-depth QA Inspection

In view of the repeated rebar nonconformances reported subsequent to concrete placement and the past and the recent QA/QC deficiencies, an in-depth QA inspection was conducted.

The purpose of the inspection was two-fold: (1) to evaluate organizations, management policies and QA/QC provisions and practices relative to design, construction and inspection to identify underlying causes of continuing evidence of weakness in the Midland QA program implementation and (2) to verify that corrective action and other commitments made in the past by both CP and Bechtel have been implemented.

The results of the inspection are documented below.

a. Rework of Omitted Rebars

Most of the rebar omissions occurred in the Auxiliary Building, which is about 20% structurally completed. Total safety related rebar installed in the Auxiliary Building to date is approximately 2767 tons. An estimated 5.7 tons of rebar was omitted, but most have been replaced by corrective action. The rework on the concrete structure to replace omitted rebar includes (1) drill dowel holes (the embedment by this shall be in accordance with the approved table) (2) set dowels, and (3) fill holes with non-shrink grout (Embeco 636). In reviewing the NCRs and QC inspection records relative to rework the inspector identified the followings:

(1) No documented dowel drilling procedure was available, i.e., type of drill, type of bit, method of cleaning hole, precautions such as damage to other embedments, reinforcement steel or surrounding concrete, verification of hole diameter and depth, nor was there quality control involvement to verify any of the above. (As of April, 1976, instructions were made available for having dowel holes drilled, however, no actual drilling procedure had been established.)

(2) Specification C230 and C231 refer to grout and provide a list of acceptable grouting materials. In no case was specification C230 or C231 referenced on the NCR, however, an acceptable grout was referenced.

(3) A manufacturer's suggested grouting procedure is provided in each bag of "Embeco 636" grout and includes instructions for preparation, forming, temperature control, working time, recommended mixes, mixing, placing and curing. No checklists or other documents were available to show that all or any of the above instructions performed had been adhered to.

b. Design Control and Safety Evaluation of Rebar Omissions

Inspection was performed on May 3, 1976, at the BAPC office, Ann Arbor, Michigan to examine the A-E's design control of rebar placement and the results of their evaluation of the rebar included (1) review of Engineering Department Procedure (EDP) No. 4.61, titled, "Nonconformance Reports (NCRs)." Revision 1, dated June 20, 1974, (2) review of EDP-4.47, "Drawing Change Notice," Revision 1, dated February 4, 1975, (3) interviews with civil engineers and their group leaders relative to handling of Design Change Notices, Field Change Requests, engineering evaluations of NCRs, and QA training received in the past, (4) review of work interfaces and communication between design office and field engineering staff, and (5) discussions on safety evaluations concerning cumulative effects on Auxiliary Building due to rebar omissions. The inspection findings were as follows:

(1) It appears that only engineering group leaders receive formal QA training. Followup of this matter is planned.

(2) The use of condensed design criteria such as Midland Civil Group Standards No. 7220-C-501 and No. -502 by the design engineers to replace or supplement for EDP and PSAR was questionable. Subsequently, Bechtel indicated that they will abandon the use of these standards. Further review of this matter is planned.

(3) In the case of Bechtel NCR 260, the drawing was revised after the concrete placement had been completed, and in other cases last minute drawing revisions may have contributed to rebar omissions. Improvement of design and field communication and drawing revision control is needed.

(4) The Bechtel management and the licensee representative were informed by the inspector that the IE:HQ technical group has been requested by IE:III to review the safety evaluations concerning the rebar omissions and placement problems. The primary concern is possible cumulative effects on the structural integrity of the Auxiliary Building.

c. Deficiencies In QC Inspection of Rebar Placements

The causes of the rebar omission and related placement problems involved different design and construction organizations. It is considered a serious problem at the site, when the QCEs, whose main job function is to inspect to assure correct

installations, continue to fail to identify rebar deficiencies prior to concrete placement. The IE:III inspection efforts included: (1) interviews with the Project Field QC Engineer, Lead Civil QC Engineer, and Civil QC Engineer, (2) review of NCRs for causes of the rebar deficiencies, (3) review of Field Inspection Procedures (FIPs) for adequacy and implementation, and (4) review of QC personnel qualifications and training records. The inspection findings are as follows:

(1) Where NCR disposition calls for rework, the work result is to be verified by a QCE, a written statement on the NCR such as "work completed to Inspection Plan C-231-244B, Revision 2" is signed and dated by the QCE. In the case of both Quality Control Inspection Plans and Nonconformance Reports, no documented dowel embedment measurements or any adverse observations were included. All inspection requirements are listed in a standard format and verified correct by evidence of the inspector's signature.

(2) No documentation was available to show that provisions of Section 4.10 of FIP G-3 had been implemented. Section 4.10 provides that the organization responsible for control of the activity which apparently caused the NCR: (a) evaluate the information provided by the NCR, and (b) initiate whatever corrective action may be warranted to prevent recurrence.

(3) FIP G-3, Processing of Nonconforming Items, Section 4.1.3 stated: "Engineering changes which affect completed work shall require the initiation of an NCR." The use of NCRs to record design change, field change request, or deficiencies caused by design changes subsequent to the work completion appears to be inconsistent with requirements. Subsequent to the inspection, the licensee stated that this practice would be discontinued and that Bechtel would revise FIP G-3. This is considered an unresolved matter pending future inspection resolution.

(4) The inspector reviewed the QCE qualification records based on FIP G-8 requirements. The review included personnel certificate, indoctrination, training, and physical examination. No deficiencies were identified. Training in the areas of rebar placement inspection has been stepped up.

(5) In regard to the review of NCRs for QC's contribution to the causes of rebar deficiencies, the following items were identified:

(a) In some cases all applicable referencing drawings were not listed on the inspection plan.

(b) In some cases the QCE failed to identify rebar requirements listed in the drawings.

(c) In some cases applicable Design Change Notices had not been included on the inspection plan.

(d) Use of incorrect field sketches for rebar inspection occurred in some cases.

(e) The QCE sometimes failed to use the latest design drawings for inspections.

(f) In some cases incorrect rebar fabrication drawing instead of design drawings were used for inspection.

(g) Misinterpretation of drawing or specification requirements occurred on occasion.

(h) In one case failure to follow the inspection through by different QCEs occurred.

d. Absence of QA Trend Analysis on Rebar Placement Problems

It is stated in Bechtel FIP G-3, Processing of Nonconforming Items, Revision 6, dated May 17, 1974, Section 4.10.1, and 4.10.3, that, "The PFQCE (Project Field Quality Control Engineer) shall notify the site QAE of any nonconformances which may be reportable in accordance with article 50.55(e) of 10 CFR Part 50 or are of such magnitude or quantity that an MCAR may be required," and "The PFQCE shall also route a copy of the completed NCR to the site QAE for his evaluation and use in determining the need for corrective action to prevent recurrence."

In the case of Bechtel NCR 260 both the site QAE and the QCE failed to determine the significance of the problem based on 50.55(e) requirements. In the case of MCAR-10, which was generated because of the tiebar omission problems identified in Bechtel

NCR 295, no trend analyses were performed to determine the root cause of rebar placement problems and thus corrective actions and measure to prevent future recurrence. Subsequently, additional rebar omission problems occurred as identified in Bechtel NCRs 396, 398, and 399. Upon reviewing all the NCRs related to rebar omission and placement deficiencies, the inspector determined that (1) construction audits were not effective in detecting unsatisfactory QC rebar inspection performance, and (2) trend analysis relative to rebar problems had not been performed and corrective measures taken to preclude recurrence.

In response to the inspector's inquiry on May 3, 1975, at the Bechtel Ann Arbor office, as to the existence of trend analyses performed in other areas of work activities, the Bechtel PQAE presented to the inspector two trend analyses written in 1975. However, the inspector was told that no formal criteria and procedural requirement had been established until recent months after the significance of the rebar omission problem had been identified by the NRC. During the NRC site inspection on May 6-7, and 13-14, 1974, similar question on the existence of trend analyses performed by QAE in other areas was raised by a different group of inspectors but no QAE appeared to have any knowledge of trend analyses. Subsequent to the management information exchange meeting, a list of trend analysis reports were presented to the inspectors. A followup review of these reports is planned for a future inspection.

e. Field Engineering Control of Rebar Placements

In the past, the rebar fabrication drawings made by Inland-Ryerson (Inryco) were reviewed by the Field Engineers and Project Engineers. This review responsibility was formally transfered to the field engineers at the site through a memo from the Project Engineer to the site Project Superintendent, dated May 6, 1975, subject: "Engineering Review of Rebar Detail Drawings." The memo stated, in part, that, "Engineering has checked adequate numbers of such drawings in appropriate critical areas of the plant to be assumed that continuation of such checking is not necessary. We are confident that the intents of our structural designs are being properly interpreted

by Field Engineers both in the preparation and review of drawings they generate and in review of I-R drawings."

At present, the field engineering control of the documentation and review of Inryco rebar drawings are as follows:

(1) Inryco makes fabrication drawings based on the design drawings.

(2) Inryco forwards detail drawings to site Document Control.

(3) Site document control logs them and sends the Inryco drawings to Field Engineer for review and approval. The Field Engineer also maintains a copy of Inryco up-to-date drawings.

(4) The Field Engineer returns the Inryco drawing to Document Control after review.

    (a) If approved, drawings are to be distributed to work areas for construction.

    (b) If further details are required, and not approved drawings are to be returned to Inryco.

    (c) A copy of Inryco drawing is forwarded to Ann Arbor for information only.

(5) For checking the rebar placements before the concrete pour, the Field Engineer is to use design drawings with the fabrication drawings and approved field sketches used only as references.

In regard to review of NCRs for Field Engineer's (FE) contribution to the causes of the rebar deficiencies, the following items were identified:

(1) In checking rebar placement, FEs in some cases failed to review all applicable references drawings.

(2) Checkout based on detail drawings rather than design drawings sometimes occurred.

(3) In some cases misinterpretation of design drawings or specifications occurred.

(4) In some cases checkout was based on outdated documents.

f. Implementation of Licensee Commitments

Significant CP commitments relative to Quality Assurance, rebar placement, enforcement, 50.55(e) reports, and correspondences were reviewed for implementation during this inspection. The effectiveness of implementation was also assessed. The documentation records included:

(1) Memorandum and Order (ALAB-106), dated March 26, 1973, issued by Atomic Safety and Licensing Appeal Board (ASLAB).

(2) Prepared testimony by S. H. Howell, dated July 17, 1974, presented to ASLAB.

(3) Consumers Power Company (CP), Bechtel Power Corporation, and Bechtel Associates Professional Corporation (BAPC) Proposed Findings of Facts and Conclusions of Law, issued by CP and Bechtel attorneys on August 13, 1974, before the Atomic Safety and Licensing Board (ASLB).

(4) CP 50.55(e) Report on Unit No. 2 Containment Rebar Spacing Deviation - report forwarded to IE:HQ, dated January 28, 1975.

(5) IE:III Regional Director's letter to CP, dated April 16, 1975, regarding rebar spacing problem.

(6) CP 50.55(e) Interim Report on Auxiliary Building rebars omissions - Report forwarded to IE:HQ, dated April 21, 1976.

(7) CP's response letter to IE:III, dated March 5, 1976, on Items of Noncompliance Identified in IE:III Inspection Report No. 76-01.

(8) CP former Director of Project QA Services Department (PQASD), Mr. G. S. Keeley, prepared testimony before ASLB, dated July 17, 1974.

Implementation of licensee commitments has been and will continue to be examined during each inspection. The results of the in-depth review during the current inspection indicate that, with the exception of the items identified in the Summary of Findings section of this report (under Enforcement

Items and Deviations) commitments in the areas reviewed are being satisfactorily implemented.

Licensee corrective action in regard to the items identified will be examined during subsequent inspections.

g. Personnel Interview

As a part of the in-depth QA inspection effort to identify the underlying causes of continuing evidence of weakness in the Midland QA program implementation, various levels of CP and Bechtel QA/QC and Bechtel field engineers were interviewed by IE:III inspectors and an IE:III investigator. The responses of the personnel interviewed were considered informative and cooperative and helped verify the report findings and resolutions.