U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-456/83-09(DE); 50-457/83-09(DE)

Docket Nos. 50-456; 50-457 Licenses No. CPPR-132; CPPR-133

Licensee: Commonwealth Edison Company
Post Office Box 767
Chicago, IL 60690

Facility Name: Braidwood - Units 1 and 2

Inspection At: Braidwood Site - Braidwood, IL

Enforcement Conferences At: Region III Office, Glen Ellyn, IL

Inspection Conducted: June 20-24, June 27-July 1, August 1-5, August 9, October 4-7, October 24, 1983, January 11-13, January 26, and February 9, 1984

Enforcement Conferences Conducted: December 20, 1983
March 7, 1984

Inspectors: R. D. Schulz — 3/26/84 Date

for I. T. Yin — 4/3/84 Date

T. E. Vandel — 3-26-'84 Date

D. E. Keating — 3/26/84 Date

Approved By: D. R. Hunter, Chief
Management Programs Section — 3/26/84 Date

Inspection and Enforcement Conference Summary

Inspection on June 20-24, June 27-July 1, August 1-5, August 9, October 4-7 October 24, 1983, and January 11-13, January 26, and February 9, 1984; and Enforcement Conferences on December 20, 1983, and March 7, 1984 (Report No. 50-456/83-09(DE); 50-457/83-09(DE))

Areas Inspected: Special, announced inspection of the piping contractor QA Program for training, large bore and Class 1 small bore piping design control, procurement control, document control, receipt inspection, special processes, inspections, measuring and test equipment, nonconformance and corrective action, audits, and small bore piping design; of the electrical contractor QA Program for staffing and qualifications, contractor auditing, document control, nonconformance control, equipment installation control, licensee auditing; and of the heating, ventilation, and air conditioning (HVAC) contractor QA Program for qualification and training, design control, drawing control, material inspection, installation, nonconformance/corrective action, and audits. Enforcement conferences were conducted on December 20, 1983, and March 7, 1984, to discuss the inspection findings. The inspection involved a total of 300 inspector-hours onsite by four NRC inspectors and the enforcement conferences involved a total of approximately 64 staff-hours.

Results: Six items of noncompliance were identified (failure to establish control for revisions to drawings - Section I, Paragraph 6.a; failure to follow procedures - Section I, Paragraphs 6.b, 7, 8.c and 9.b, Section II, Paragraph 3.c; failure to take adequate corrective action - Section I, Paragraph 11; inadequate control of small bore piping design - Section I, Paragraph 13; failure to execute a comprehensive audit plan - Section I, Paragraph 12, Section II, Paragraph 5.b, and Section III, Paragraph 9.a; and failure to provide design control which complies with the requirements - Section III, Paragraphs 7 and 8.a.).

Overview

1. Persons Contacted

   See Paragraph 1 of Section I, II and III of this report.

2. Piping

   See Section I of this report.

3. Electrical

   See Section II of this report.

4. HVAC

   See Section III of this report.

5. Unresolved Items

   Unresolved items are matters which require more information to make a determination whether it is an item of noncompliance, a deviation, or an acceptable matter. Unresolved items included in this report are located in Section I, Paragraphs 8.c and 9.a, and Section III, Paragraphs 7 and 9.b. Another unresolved item (456/83-09-04(A) and (B); 457/83-09-04(A) and (B)) located in Section I, Paragraph 9.a represents a violation but more information is needed to fully assess the significance of the matter and to determine the appropriate enforcement action.

6. Exit Interviews

   The inspectors summarized the results of the inspection with licensee representatives during exit meetings held on July 1, August 9, October 24, 1983, January 13, January 26, and February 9, 1984.

7. Enforcement Conferences

   The Region III staff met with licensee representatives for an enforcement conference on December 20, 1983. The Region III staff summarized the inspection findings and the licensee provided additional information related to those findings. Region III made a decision to review the additional information provided by the licensee before proceeding with further enforcement action. Region III representatives stated that another enforcement conference might be scheduled subsequent to the completion of the Region III review and inspection of the additional information.

   Following the Region III review and inspection of the additional information provided by the licensee, the Region III staff met with licensee representatives for a second enforcement conference on March 7, 1984. The Region III staff summarized all violations and discussed in more detail the findings in the areas of installed safety-related piping material traceability and

HVAC. The licensee discussed corrective actions taken and planned to ensure the quality of ongoing safety-related work and the verification of previously completed work, including the areas of piping material traceability and HVAC welding activities. The licensee stated that 100% verification of installed safety-related piping materials and correction of the deficiencies in the HVAC welding would be accomplished as well as verification of the acceptability of additional aspects of the HVAC installation. The licensee stated that the walkdown of the installed safety-related piping would include the verification of the as-built configuration. Additional matters discussed included CECo personnel and organizational changes to strengthen the construction project management team and to increase the emphasis on quality assurance.

SECTION I - PIPING

DETAILS

1. Persons Contacted

Commonwealth Edison Company (CECo)

M. J. Wallace, Assistant Manager Projects
D. Cosaro, Construction Superintendent
D. Brown, QA Supervisor
S. Hunsader, QA Supervisor
G. Groth, Lead Mechanical Engineer
T. Sommerfield, QA Superintendent
R. Kelm, Field Engineer
S. J. Reutke, QA Engineer
L. J. Tapella, QC Coordinator
R. J. Farr, Engineer
D. Farrar, Nuclear Licensing
M. A. Gorski, QA Engineer
E. D. Swartz, Nuclear Licensing
M. J. Morris, Field Project Engineer

Phillips, Getschow Company (PGCo)

K. J. Hamilton, Consultant
T. G. O'Connor, Site Manager
R. G. Meyers, Site Manager
J. Carlson, QC Supervisor
L. J. Butler, Assistant Site Manager
J. R. Stewart, Project Engineer
A. Rubino, QC Office Manager
K. McNeely, Field Engineering Supervisor
C. Rachke, QC Training Coordinator
M. Yenser, QC Technician
S. Giordano, Field Engineer
D. Petritis, Field Engineer
D. Sprague, QC Inspector
B. Roche, Material Control Supervisor
G. Cavalenes, QC Inspector
E. Ulrich, QC Inspector
W. Robinson, QC Technician
D. Casey, Calibration Technician
S. Forbes, Quality Assurance Coordinator
R. Adkins, QC Trainee
B. Brens, QC Trainee
R. Reitz, QC Trainee
T. Styx, QC Trainee

Sargent and Lundy

K. Fuss, Mechanical Field Coordinator
W. C. Cliff, Project Manager

Pittsburgh Testing Laboratory (PTL)

R. A. Vignocchi, Receipt Inspector

Hartford Steam Boiler

R. Rainey, ANI Supervisor
L. Parkey, ANI
K. Kilmer, ANI

2. Documents Reviewed

a. Commonwealth Edison Quality Assurance Manual, Revision 77.

b. Phillips, Getschow Quality Assurance Manual, Revision 13.

c. Commonwealth Edison Company FSAR, Volume 8.

d. Phillips, Getschow Procedures:

(i) QAP-QCT-20.15, Revision 9, "Training and Certification of Clerks, Trainees, Level I and II Quality Control Personnel."

(ii) QAP-105A, Revision 3, "Quality Assurance Indoctrination and Training Program."

(iii) PGCP-1.1, Revision 4, "Control of Engineering Change Notices and Field Change Requests."

(iv) PGCP-4, Revision 0, "Verification, Preparation and Transmittal of 'As Constructed' Drawings."

(v) QCP-B21, Revision 4, "Installation and/or Field Routing of Two Inch and Under Process Piping Systems - ASME Classes 1, 2, and 3."

(vi) QAP-33, Revision 6, "Receiving Inspection of Items, Material and Equipment."

(vii) QAP-5.1, Revision 0, "Item and Material Identification Monitoring."

(viii) BM-101, Revision 2, "Quality Assurance Interface for Requisitioning, Purchasing and Receiving Material."

(ix) PGCP-4, Revision 0, "Control of Rework of Component Supports."

(x) QCP-B23, Revision 3, "Installation and Inspection of Component Supports."

(xi) QAP-16, Revision 1, "Control of Installation of Nuclear or Safety Related Pipe Systems."

(xii) PGCP-11, Revision 5, "Cold Bending of 2" and Under Pipe and Tube."

(xiii) QAP-7, Revision 7, "Control of Inspection Equipment."

(xiv) QCP-B-26, Revision 0, "Calibration Check of Torque Wrenches."

(xv) QAP-7.6, Revision 2, "Calibration of Precision Dimensional Measuring Equipment."

(xvi) QAP-12, Revision 3, "Control of Nonconformity Reports."

(xvii) QAP-110, Revision 0, "Reporting of Defects and Noncompliance."

(xviii) QAP-12.1, Revision 0, "Control of Audit Nonconformities."

(xix) QCT-2.16, Revision 1, "Qualification of Audit Personnel."

3. Training

The training program for piping personnel was reviewed and found to be in conformance with commitments in the licensee's Quality Assurance Program, Phillips, Getschow (PGCo) Procedures, and Regulatory Guide 1.58, Revision 1.

Quality Control Personnel were trained and certified in accordance with PGCo Procedures and Regulatory Guide 1.58, Revision 1, which endorses ANSI N45.2.6-1978. Four quality control trainees were interviewed and all appeared knowledgeable in the applicable codes and standards specific to their inspection discipline. On-the-job training was documented and new personnel worked under the direction and guidance of qualified personnel until they were familiar with all the aspects of their related inspection activity. Indoctrination was given to craft, engineering, and quality control personnel when revisions were made to the Quality Assurance Manual, Quality Assurance Procedures, Quality Control Procedures, or Construction Procedures. The training program, established and implemented, was in accordance with 10 CFR 50, Appendix B, Criterion II which requires that suitable proficiency be achieved and maintained.

Qualification and training records for the following quality control inspection personnel were examined:

a. Employee Number 76

b. Employee Number 101

c. Employee Number 108

d. Employee Number 111

e. Employee Number 109

No items of noncompliance or deviations were identified.

4. Design Control

a. The design change piping program for large bore (over 2") piping and ASME Class 1 small bore piping was reviewed to ascertain that the licensee has established and implemented a program in accordance with the CECo Quality Assurance Manual. The review of documents included a verification of the following activities:

(i) Procedures to control design requests have been established.

(ii) Procedures and responsibilities for design control have been established.

(iii) Responsibilities and controls to assure that design changes were incorporated into drawings have been established.

(iv) Channels of communications between design organizations and responsible individuals have been established.

(v) Controls requiring that implementation of approved design changes in accordance with approved procedures have been established.

b. The following Field Change Requests were reviewed and found to be processed and dispositioned in accordance with licensee design control criteria:

(i) FCR #9988

(ii) FCR #L-9588

(iii) FCR #L-9194

(iv) FCR #L-9148

(v) FCR #L-9945

(vi) FCR #L-9189

No items of noncompliance or deviations were identified.

5. Procurement Control

Procurement documents were checked for technical adequacy, QA program requirements, 10 CFR 21 provisions, specific identification of items, and statements concerning access to the suppliers plant or records for purposes of audit. Procedures were reviewed to determine if responsibilities were assigned in writing for the initiation of procurement documents, the review and approval of procurement documents and making changes to procurement documents. The following procurement documents were checked along with the supplied materials documentation, including traceability to the item:

a. purchase order #272802, studs and nuts.

b. purchase order #501647 PCR 111, fittings.

c. purchase order #501796 PCR 1, flanges.

d. purchase order #272913, pipe and fittings.

e. purchase order #501794, pipe and fittings.

No items of noncompliance or deviations were identified.

6. Document Control

a. The document control program for small bore (2" and under) safety-related piping was reviewed for compliance to regulatory requirements. The inspector found that craft personnel were deviating from approved design drawings for ASME Section III Class 2 and 3 piping by re-routing lines, assigning weld numbers, and adding material in the field, PGCo engineering was unaware of these field changes made during the field installation activities, resulting in a lack of engineering control for approving the design and updating and releasing drawings. This practice was allowed regarding ASME Section III Class 2 and 3 piping by PGCo Procedure QCP-B21, Revision 4, "Installation and/or Field Routing of Two-Inch and Under Process Piping Systems - ASME Classes 1, 2, and 3." Decisions to re-route pipe which involve considerations such as ability to support, valve accessibility, maintenance accessibility, and piping contact/separation with other items important to safety were being made during the installation process by craft personnel not trained in engineering requirements. If material was to be added that did not appear on the drawing, craft personnel used the design piping tables as referenced on the drawing and selected the correct material from the design table; however, training of craft personnel in the use of piping design tables was not provided. Process piping installations deviating from approved drawings and involving craft decisions to revise the drawings during the installation process without engineering approval, update, or release was documented by craft personnel on the following drawings:

(i) M-2539C-21

(ii) M-2539C-40

(iii) M-2537A-32

(iv) M-2546C-31

(v) M-2546C-41

(vi) M-2546C-10

(vii) M-2542C-42

(viii) M-2539A-24

(ix) M-2539A-31

The installation described on Drawing M-2546C-10 was re-routed, resulting in a deletion of a ninety degree elbow; however, the bill of material on the drawing was not corrected to reflect the as-built condition. Drawings M-2539A-24 and 31 had similar inconsistencies. Phillips, Getschow Internal Audit #83-22, conducted in April 1983 stated: "Considering the amount of spools inspected (21), the amount of observations noted (13) and considering that 5 of the observations would have to be addressed on a Nonconformance Report if they had been found during a walk-down it would appear that PGCo may experience delays during the N-5 completion in order to research and resolve differences found between field walk-down information and reworked spool drawing information".

Craft personnel were documenting their field changes to drawings for Class 2 and 3, small bore safety-related piping; however, engineering personnel had no way of knowing whether these changes were in accordance with all the engineering and quality requirements or whether the craft documentation of changes was complete and accurate.

The failure to establish measures to control field changes to drawings is a violation of 10 CFR 50, Appendix B, Criterion VI, as implemented by CECo QA Manual, QR No. 6.0 (456/83-09-01; 457/83-09-01).

b. During the review of small bore safety-related drawings, it was determined that the following field drawings were not stamped with the field change requests that affected the installations:

(i) M-2539C-4, Revision D - Field Change Request #L-9194

(ii) M-2542C-121, Revision A, Field Change Request #9988

The failure to follow PGCo Procedure PGCP-1.1, Revision 4, "Control of Engineering Change Notices and Field Change Requests," Section 5.3, which required that Document Control stamp applicable design documents with the field change request is an example of a violation of 10 CFR 50, Appendix B, Criterion V (456/83-09-02(A), 457/83-09-02(A)).

7. Receipt Inspection

Receipt of piping components was reviewed to ascertain compliance with regulatory requirements and commitments in the Quality Assurance Program and implementing procedures. Responsibilities were assigned for receipt, acceptance, and release of items. Nonconforming items were reviewed for identification, segregation, control and release.

Receipt inspection reports were examined for applicable signatures, record of damage, and stipulated inspection criteria. The following receipt inspection reports were examined:

a. MRR#13473 - 20' 3" of 3" S/80, SA-106GR.B pipe

b. MRR#13310 - 17' 11" of 4", S/40, SA-312TP316 pipe

c. MRR#13354 - 1000' of 3/4", S/160, SA-376TP304 pipe

d. MRR#8788 - 206' 8" of 4", S/40, SA-312TP304 pipe

e. MRR#8788 - 508' 4" of 3", S/40, SA-312TP304 pipe

f. MRR#12618 - 2,265' of 1&1/2", S/40, SA-312TP304 pipe

g. MRR#12618 - 2,239' of 2", S/80, SA-312TP304 pipe

h. MRR#8873 - 322' of 3" S/40, SA-312TP304 pipe

i. MRR#12436 - (20) - 3" S/40, SA-403WP304, 90 degree elbows

The review of receipt inspection reports and interviews of PGCo and CECo inspection personnel revealed that neither CECo or PGCo were examining piping components for wall thickness or diameter compliance with the procurement specifications. CECo quality assurance personnel indicated that they were under the impression that PGCo was performing dimensional checks at receipt inspection. The licensee's failure to perform dimensional checks in accordance with the Quality Assurance Manual, Revision 77, Q.P. No. 7-1 is an example of a violation of 10 CFR 50, Appendix B, Criterion V (456/83-09-02(B), 457/83-09-02(B)). The licensee took immediate corrective action for future shipments and revised PGCo Procedure QAP-33 to require PGCo to verify a ten percent random sampling of dimensional requirements. Previously only CECo was required to verify dimensions on a sampling basis.

Code data reports were examined for Reactor Coolant Loop Piping, piece mark numbers LP3-CLI and LP4-CL1. The NPP-1 Data Reports were in accordance with the requirements established in Table 5.2.2., Volume 8, of the FSAR. In addition, the inspector examined NPV-1 Code Data Reports for the Reactor Coolant Drain Tank Pump and Reactor Water Make-Up Pump. The Data Reports were in accordance with Table 5.2.3, Volume 8, of the FSAR.

8. Special Processes

a. Welding Program

The welding program was reviewed to ascertain that controls have been implemented to assure compliance with the ASME Boiler and Pressure Vessel Code, Sections III and IX. The following Field Fabrication Process and Data Sheets were examined:

	Weld Map	Joint No.	System
(i)	FW-52-3	FW-5	Feedwater
(ii)	FW-78	FW-78	Feedwater
(iii)	FW-78	FW-2A	Feedwater
(iv)	FW-52-3	FW-3	Feedwater
(v)	RC-6	FW-1AP	Reactor Coolant
(vi)	RC-3	FW-3	Reactor Coolant

b. Welding Procedures

The welding procedures and welders were qualified in accordance with ASME Section IX and the feedwater welding procedures were impact test qualified in accordance with the Sargent and Lundy Piping Design Specification for the prevention of non-ductile failure. Quality Control hold points included:

(i) pre-weld

(ii) cleanliness

(iii) identification

(iv) alignment

(v) pre-heat

(vi) root pass

(vii) interpass temperature

(viii) final weld

c. Cold Bending

The cold bending program for small bore safety-related piping was reviewed to ascertain compliance with the ASME Boiler and Pressure Vessel Code, Section III. The following field bending data reports were examined:

(i) Drawing M-2546C-72, Revision A - Bend 1A
Bend 2A
Bend 3A
Bend 4A

(ii) Drawing M-2546C-44, Revision B - Bend 1

(iii) Drawing M-2546C-42, Revision D - Bend 1A
Bend 2A
Bend 3A
Bend 4A
Bend 5A

(iv) Drawing M-2546C-31, Revision C - Bend 1A
Bend 4A
Bend 5A

(v) Drawing M-2546C-27, Revision C - Bend 1A
Bend 2A

The inspection revealed that of the five drawings reviewed, only the bends on Drawing M-2546C-27 had a documented record of the use of calipers for measuring the ovality of the piping after the bend. The failure to maintain a record of the use of inspection equipment in accordance with PGCo Procedure QAP-7, Revision 7, "Control of Inspection Equipment" is an example of a violation of 10 CFR 50, Appendix B, Criterion V (456/83-09-02(C); 457/83-09-02(C)).

PGCo Procedure PGCP-11, Revision 5, "Cold Bending of 2" and under Pipe and Tube," did not require qualifying the bending procedure for wall thickness, because thinning allowances are incorporated into the wall thicknesses for piping specified in the design engineer's design tables. An analysis by the design engineer involved maximum thickness of pipe or tubing as received from the vendor as stipulated in Subsections NB-3642 and NC-3642 of the ASME Boiler and Pressure Vessel Code. Since measurements of wall thickness have not been made upon receipt of pipe to assure quality, as required by the CECo QA Manual, the design basis for not taking thickness measurements after bending requires further review (reference Paragraph 7). In addition, there was no record of the type of bender used in the field or that an acceptable bending process was employed. PGCo records did not indicate that bends were made in accordance with the ASME Code or PGCo Procedure PGCP-11. Pending review of the licensee evaluation of the bending process in relation to wall thickness requirements, this issue will remain unresolved (456/83-09-03; 457/83-09-03).

9. Piping Material and Component Supports

a. Piping Material

The verification program for the installation of safety-related piping materials was reviewed to ascertain compliance with regulatory requirements. The inspection revealed that PGCo did not have a documented inspection program for quality control inspectors to examine small bore piping components at installation to assure correct material usage. Therefore, quality control inspection records

verifying correct material installation for small bore piping did not exist. This is an example of a violation of 10 CFR 50, Appendix B, Criterion X. Since the NRC will need to review the results of the licensee's 100% verification efforts in order to fully assess the significance of the matter and to determine the appropriate enforcement action, this matter is classified as an unresolved item pending completion of the licensee's verification program and completion of the NRC's review of the results (456/83-09-04(A); 457/83-09-04(A)). The licensee revised PGCo procedure QCP-B21 subsequent to the inspector's findings requiring that quality control perform and document examinations on installed material, consisting of a check that the heat numbers on the drawing are the same as the heat numbers on the pipe.

An audit by PGCo in April 1983, Audit No. 83-BR3, "Installation and/or Field Routing of 2" and Under Process Piping Systems," had also identified the several findings related to material traceability. Thirteen field completed drawings withdrawn from the Quality Control Field for review, deficiencies were noted on eight, such as:

- Where stores requests indicated the withdrawal of two heat numbers for materials of the same size, type and design, it was noted that these heat numbers had not been entered on the drawing at the locations in the plan views where they were used, and

- Heat numbers that were indicated on the drawings were not in agreement with stores requests.

In addition, of approximately 160 pre-hydro small bore walkdown monitoring reports examined during the audit, about 60 of these reports identified inadequate heat number identification on drawings which should have been incorporated by Field Engineering in accordance with paragraph 5.4.3 after marked-up drawings were returned from the field. Examples of the deficiencies identified in the pre-hydro walkdown for small bore piping included:

- Drawing M-2538C-3, Revision A, no heat number on pipe between weld 12 and 13.

- Drawing M-2538C-1, Revision 0, no heat numbers on pipe.

- Drawing M-2539C-20, Revision 0, no heat number on pipe between weld 3 and 4.

- Drawing M-2539C-14, Revision A, no visible heat number on coupling.

The inspectors examined installed small bore piping lines identified on the following drawings:

M-2542C	Sheet 41
M-2556A	Sheet 14
M-2539A	Sheet 37
M-2539A	Sheet 24a
M-2539A	Sheet 31
M-2537A	Sheet 37
M-2537A	Sheet 53

These pipe runs included approximately 120 items, of which 107 were identified with heat or mark numbers on the component. The remaining 13 did not have a heat or mark number that was readable on the item production documentation, either on the drawing or the stores request was available that agreed with the certified material test report. The production documentation was initiated by craftsmen involved in the work.

In addition to the small bore piping programmatic problems, PGCo did not have a documented inspection program for quality control inspectors to verify correct material installation for large bore piping prior to Revision 12 of the PGCo QA Manual, dated November 19, 1982. Therefore, quality control inspection records verifying correct material installation for large bore piping did not exist prior to November 19, 1982. This is an example of a violation of 10 CFR 50, Appendix B, Criterion X. Since the NRC will need to review the results of the licensee's 100% verification efforts in order to fully assess the significance of the matter and to determine the appropriate enforcement action, this matter is classified as an unresolved item pending completion of the licensee's verification program and completion of the NRC's review of the results (456/83-09-04(B); 457/83-09-04(B)).

Following the NRC inspection findings, on July 1, 1983, Commonwealth Edison submitted a 10 CFR 50.55(e) report identifying a potential deficiency concerning quality control verification and documentation of heat or mark numbers of installed piping system components. CECo believed that this verification was done by comparing the mark number documented on the stores request with the installed component mark number but had not been documented. Six piping inspectors interviewed stated that they had verified correct material installation but had not documented the verification. The licensee's project management believed that only a documentation problem existed.

The licensee stated in the July 1, 1983, 50.55(e) report that a sample inspection of installed large bore piping and installed small bore piping would be performed. The large bore sample would be selected from piping components installed prior to November 1982. The sample was divided into four areas:

- Small Bore Piping
- Phillips Getschow Stock Material, Large Bore Piping
- Southwest Fabricating Surplus Material, Large Bore Piping

- Piping Spools identified with Manufacturer's ASME Nameplates.

The independent sample verification was conducted by Phillips Getschow quality control personnel and revealed the following:

Small Bore Piping

Items in Sample (Represents 15%)	1415
Traceability by Markings on Hardware	1250
Traceability by Production Documentation	1383
Only Production Documentation/No Markings on Hardware	163
Items Missing Production Documentation (stores request)	32

The following small bore items were dispositioned to be removed:

Drawing	Installed Item	ASME Class	System
M-2534C Sheet 95	1" S/40 SA-376 TP 304 Pipe	2	Safety Injection
	(Drawing required 1" S/160 pipe)*		
M-2537C Sheet 40	Unknown 2" Pipe	3	Component Cooling
	(Lack of traceability of item - no markings or documentation.)		

*Subsequently, the licensee examined and measured the wall thickness of pipe installed on all additional drawings where more than one schedule or wall thickness of pipe was required. This was in addition to the 1415 item sample, and was done because the piping contractor could not verify through the stores request system correct wall thickness installations. The stores request system specified the drawing where the pipe was to be used but not the location on the drawing. Therefore, where two different wall thicknesses were required for one drawing assurance of correct placement could not be established. The licensee's efforts identified three pieces of pipe that were incorrectly placed resulting in schedules or wall thicknesses of pipe not in accordance with the drawing and Sargent and Lundy design. These pieces which are identified below were dispositioned to be removed.

Drawing	Installed Item	ASME Class	System
M-2546C Sheet 90	3/4" S/160 SA-312 TP304 Pipe	2	Chemical Feed and Volume Control
M-2546C Sheet 18	2" S/160 SA-312 TP304 Pipe	2	Chemical Feed and Volume Control

(Both items required S/40)

M-2539C Sheet 93	1" S/40 SA-312 TP304 Pipe	2	Safety Injection

(Drawing required 1" S/160)

Large Bore Piping (Phillips Getschow Stock)

Items in sample (represents 11%)	371
Traceability by Markings on Hardware	268
Traceability by Production Documentation	306
Only Production Documentation/No Markings on Hardware	100
Items Missing Production Documentation (stores request)	65

At the end of the NRC inspection the licensee indicated that the following three installed items appeared to require removal due to lack of hardware markings and documentation traceability:

Drawing	Installed Item	ASME Class	System
2A-AF-25-13	Unknown 4" Pipe Piece	3	Auxiliary Feedwater
2A-AF-23-4	Unknown 4" Pipe Piece	3	Auxiliary Feedwater
1A-SI-11-7	Unknown 4" Pipe Piece	2	Safety Injection

Large Bore Piping (Southwest Fabricating Surplus)

Items in Sample (represents 20%)	81
Traceability by Markings on Hardware	52
Traceability by Production Documentation	42
Only Production Documentation/No Markings on Hardware	28

Items Missing Production Documentation (stores request)	39

At the end of the NRC inspection the licensee indicated that one installed item appeared to require removal due to lack of hardware markings and documentation traceability as detailed below:

Drawing	Installed Item	ASME Class	System
1A-SX-93-1	Unknown 4" Pipe Piece	3	Essential Service Water

Large Bore Piping (Nameplates)

Items in Sample (represents 7%)	110
Traceability by Markings on Hardware	110
Traceability by Production Documentation	101
Items Missing Production Documentation (stores request)	9

In addition to not having established an inspection program requiring verification and documentation of correct material installed, the sample inspection performed by the licensee revealed additional information that heightened NRC concerns for the following reasons:

- Four small bore piping items were not the specified wall thickness and were examples of a failure to control material installation and execute an inspection program to assure the quality of installed items.

- The licensee stated that material was verified as being correct, although not documented, and the method the inspectors employed was checking the heat number or mark number against the stores request. Since numerous stores requests (based on the sample) cannot be found, the verification method (checking the stores request for all items) by all inspectors remains in question. Furthermore, retention of the stores request was a program requirement, documenting that the correct material was withdrawn and that it was withdrawn from a safety-related storage area.

- Numerous sample items did not have hardware identification markings, resulting in these items being of indeterminate quality, as independent inspection records verifying correct material at installtion did not exist. The indeterminate quality was a further example of a failure to control material installation and to execute an inspection program to assure the quality of installed items.

The licensee has decided to perform a 100% inspection of all installed piping components in order to:

- Comply with the ASME Code and 10 CFR 50 Appendix B.

- Verify correct material installation by hardware markings where available.

- Establish confidence in production documentation where no hardware markings exist by comparing production documentation against the hardware markings that do exist, thereby assuring that craftsmen were well trained and installed only acceptable material as reflected in their records.

The 100% inspection does not include large bore piping installed after November 19, 1982, where documented inspection records do exist for the items.

Additionally, the NRC inspection revealed that when a piping spool was cut the heat number markings were required to be transferred by craft personnel to maintain traceability. Quality control verified the transfer of heat numbers only on a sample basis. This sample basis, for assurance of correct transfer, was being reviewed by the licensee for possible corrective action and will remain an unresolved item. (456/83-09-06; 457/83-09-06)

A review of Phillips, Getschow Nonconformances #792 and #793 was performed and the inspector found that the nonconforming conditions were being adequately controlled. Nonconformance #792 resulted from a design change by Sargent & Lundy requiring an ultrasonic examination of numerous lengths of previously installed small bore pipe, and nonconformance report #793 resulted from a design change requiring a liquid penetrant examination of previously installed small bore fittings. These design changes were incorporated due to the possibility that the requirements of ASME Boiler and Pressure Vessel Code, Section III, NB-3673, Special Design Requirements would not be met. The disposition of the nonconformances was to cut out and replace some of the pipe and fittings and further analyze the remaining pipe and fittings for design acceptability to the requirements of NB-3673.

Certified material test reports were reviewed for installed piping components and were found to be in compliance with ASME Code requirements. Certified material test reports were reviewed for randomly selected ASME Boiler and Pressure Vessel Code, Section III, NB, Class 1 material in storage and for the installed material identified on the following reactor coolant drawings:

M-2542C Sheet 38
M-2542C Sheet 50
M-2542C Sheet 5

The test reports were in accordance with the piping design tables and the ASME Boiler and Pressure Vessel Code.

b. Component Supports

The component support program was reviewed to ascertain compliance with the ASME Boiler and Pressure Vessel Code, Section III, Subsection NF. The following component supports were reviewed:

System	Support Number
Component Cooling	M-1CC02007R, Revision E
Fire Protection	M-1FP16010R, Revision B
Residual Heat	M-1RH02017R, Revision E
Safety Injection	M-1SI16021X, Revision B
Residual Heat	M-1RH050035, Revision C
Chemical and Volume Control	M-1CV01039R, Revision D

Changes were identified on component support drawing M-1RH02017R from Revision D to Revision E and drawing M-1SI16021X from Revision A to Revision B. Both drawing changes involved ASME, NF welds. Rework of M-1RH0217R was completed on June 20, 1983, without a Field Change Order. Rework of M-1SI16021X was completed on May 9, 1983, without a Field Change Order. The failure to initiate a Field Change Order in accordance with PGCP-4, Revision 0, "Control of Rework of Component Supports," is an example of a violation of 10 CFR 50, Appendix B, Criterion V (456/83-09-02(D)).

The hanger check list traveler included quality control hold points for:

- location
- clamp condition
- locking devices
- torque
- plumb of cold position
- pin to pin distance
- welding
- condition of assembly

- proper material

- hanger number

- self aligning bushing free

- angle of strut or snubber in tolerance

ASME Section III NF welds were controlled with a Weld Data Traveler and each weld was assigned a unique number. The drawings categorized supports as "plate and shell" or "linear" for material requirements according to ASME, NF-2130; and "primary or secondary," and "plate and shell," "linear," or "component standard supports" for nondestructive examination requirements according to ASME, NF-5200. The drawings referenced the specific section of the NF code for nondestructive examination.

10. Measuring and Test Equipment

Procedures were reviewed to verify that controls have been established concerning measuring and test equipment which set forth the criteria and responsibility for assignment of calibration frequency; a formal requirement for marking or identifying calibration status for each piece of equipment; a system which assures that each piece of equipment was calibrated on or before the required date; a written requirement which prohibited the use of equipment beyond its calibration period; controls preventing use of out-of-calibration equipment; and controls for evaluating the status of equipment and items previously tested or measured using the equipment found to be out-of-calibration.

Calibrated equipment was certified in accordance with the National Bureau of Standards. Storage of calibrated equipment in the field was adequate for preventing damage due to temperature/humidity conditions or contact with other items. The following pieces of equipment were examined for acceptable storage, proper certifications, identification, and that calibration frequencies were being adhered to:

- Torque Wrench #TRW-8
- Inside Micrometer #1M-1
- Volt Ammeter Box #VA-PG-002
- Contact Pyrometer #CP-01
- Dial Indicator #PG6-MW
- Torqometer #TM22-MW
- Torque Wrench #8AMW

Torque Wrench #8AMW was found out of calibration on October 22, 1983, and an evaluation was done for items previously tested.

No items of noncompliance or deviations were identified.

11. Nonconformance/Corrective Action

The inspector reviewed this area to verify that measures have been established to identify and correct conditions adverse to quality. Corrective action taken to preclude repetition was also examined.

The following piping nonconformances were reviewed:

#841 - minimum wall violation
#849 - welding deviation
#852 - welding deviation
#870 - spool damage
#1031 - documentation error
#690 - procurement deviation
#693 - procurement deviation
#697 - procurement deviation
#796 - fit-up gaps
#816 - welding procedure error
#13 - undersized welds
#801 - filler metal deviation
#789 - inadequate records for small bore pipe

The nonconforming conditions, with the exception of Nonconformance #789, were properly identified and corrected. Measures were implemented to prevent recurrence of the nonconforming conditions where applicable.

Nonconformance #789, dated September 17, 1982, stipulated that 1/2" S/80, SA-312 Type 304, ASME Boiler and Pressure Vessel Code, Section III, NB pipe, heat number 745107, was discovered in Section III installations without material test reports or records of receiving and receipt inspections by either CECo or PGCo. The PGCo initial disposition was to cut out and replace this piping. The CECo final disposition stated, "Attached are CMTR's for 1/2" S/80 pipe. It may have been received as S/160". Records of receiving and receipt inspection existed for 2,662' 9" of 1/2" S/160 SA-376 Type 304, with the same heat number. The 1/2" S/80, SA-312 Type 304 was approved as an acceptable heat of material by CECo and PGCo without performing examinations for markings, damage, or dimensions, and there were no receiving records or receipt inspection record verifying quality or quantity. The certification for the 1/2" S/80 pipe was for 746' 7", but the licensee and PGCo were unaware of the amount of pipe received. Another nonconformance report, #1128, was written by PGCo on 6/28/83 for the 1/2" S/80 pipe, after the inspector identified the deficiencies. The failure to correct the nonconforming condition concerning the 1/2" S/80 pipe is an example of a violation of 10 CFR 50, Appendix B, Criteria XVI (456/83-09-07(A); 457/83-09-07(A)).

12. Audits

The licensee's audit program of the piping contractor and the piping contractor's audit program was reviewed to ascertain compliance with ANSI N45.2.12, ANSI N45.2.23, and implementing procedures.

The following piping contractor audits were reviewed:

- Process Control, Small Bore Piping, 4/12/83 - 4/20/83
- Welding Controls, 3/29/83 - 3/31/83
- Documentation Control, 5/10-83 - 5/18/83
- Process Control, Large Bore Piping, 2/22/83 - 3/11/83

The following licensee audits of the piping contractor were reviewed:

- QA-20, 82-15 - Instrumentation Design and Installation, 2" and Under Pipe Design and Installation, June 1982.

- QA-20, 82-25 - PGCo Q.A. Manual Sections 10, 11, 12, 14, 15, 16, 17 and Applicable Procedures, October 1982.

- QA-20, 82-12 - Pipe Supports/Whip Restraints, April 1982.

- QA-20, 83-25 - Large Bore Pipe Installation, Personnel Qualifications, Weld Rod Control, Storage Control, PGCo Q. A. Manual Sections 12, 13, 14, May 1983.

The audits performed were in accordance with a pre-determined schedule included pre-established questionnaires for depth and continuity, and contained objective evidence and evaluation statements concerning the audits. Pre and post audit conferences were held. The certifications for the PGCo lead auditor were examined and found to be in compliance with ANSI N45.2.23. Responsibilities for corrective action were assigned to specific individuals and findings were followed up for correction of the concerns.

After review of the PGCo audit schedule and discussions with the PGCo lead auditor, the inspector learned that PGCo had not established and executed a plan for auditing the implementing procedures of the quality assurance program on a periodic basis to determine the effectiveness of the program. PGCo was required by Section 16 of its QA Manual to audit the entire QA manual annually, but no requirement existed to audit the implementing procedures such as the Quality Assurance Procedures, Quality Control Procedures, or Construction Procedures in a specified time period. These procedures were being audited on a random basis, without regard to complete coverage in any period of time. For example, a review of audits in the welding area revealed the following audits not performed:

- QCP-B7, Ferrite Control of Stainless Steel Field Welds
- QCP-B20, General Repair Procedure
- P QCP-2, Reforming of Pipe Ends and Welds
- P QCP-13, Preparation of Welds for In-Service Inspection

Failure to establish and execute a comprehensive audit plan is an example of a violation of 10 CFR 50, Appendix B, Criterion XVIII (456/83-09-08(A); 457/83-09-08(A)).

13. Small Bore Piping Design

The inspector reviewed site design control measures for safety related process and instrumentation small bore piping (2" and under). Process systems installation started in July 1981. Instrumentation systems installation started in March 1981.

a. Review of Procedures and Specifications

To assess the overall program adequacy, the inspector reviewed the following documentations:

- Phillips, Getchow Co. (PG) Quality Control Procedure (QCP) B21, "Installation and/or Field Routing of Two Inch and Under Process Piping Systems - ASME Classes 1, 2, and 3", Rev. 4, dated December 3, 1982, including "Supplement For Contract," dated July 22, 1983.

- PG Construction Procedure (CP) 22, "2" and Under and 2½"-4" Process and Instrument Line Supports in Category I Buildings," Rev. 7, dated April 16, 1983.

- PG QCP B23, "Installation and Inspection of Component Supports," Rev. 4, dated May 11, 1983, including "Supplement For Contract," dated May 11, 1983.

- PG CP 40, "Verification, Preparation and Transmittal of 'As Constructed' Drawings," Rev. 0, dated May 31, 1983.

- Pertinent portions of S&L Specification F/L-2739, "Piping System Installation (Section III and Non-Section III) Byron Station - Under 1 and 2, Braidwood Station Units 1 and 2," Amendment 4, dated July 22, 1982.

Findings:

(i) Per PG Procedure CP 22, PG was authorized to construct Category I (safety related) 2" and under process and instrumentation piping with a maximum operating temperature of 150°F, as directed by S&L design guides. Design tasks of: (1) pipe support location and type and routing analysis, (2) documentation of design on routing and structural drawings, (3) hanger detail drawings/material documentation, and (4) design review/documentation of design acceptability were performed. In view of the many program and computation deficiencies and errors identified during the inspection, it became apparent that neither the licensee nor the AE had performed sufficient assessments and verifications to determine the adequacy of PG design capabilities, program provisions, or effective procedure implementation.

(ii) The "field running" of Class 2 and 3 small bore piping allowed field engineering to change the design pipe routing without prior concurrence from the AE. The AE would not assess the design adequacy of the systems until near turnover for system testing. At that time, PG would prepare "as constructed" field routing drawings and "as built" pipe restraint drawings which would then be reviewed by S&L. These design provisions and control measures are contrary to the licensee QA program which required: (1) installation and inspection to be in accordance with the reviewed and approved up-to-date design drawings, (2) utilization of the Field Change Request (FCR) system to minimize the risk of drastic alterations or modifications after system component installation, and (3) timely identification of any nonconformances, and implementation of swift and effective corrective or preventative measures.

Items (i) and (ii) are examples of a violation of 10 CFR 50, Appendix B, Criteria II and III (456/83-09-09(A); 457/83-09-09(A)).

(iii) S&L Specification F/L-2739, Paragraph 301.11, "Installation of 2" and Under Piping", states:

"For two inch and under piping, Sargent & Lundy drawing numbers M-2535A through M-2616C, released under an alpha revision except an alpha revision released for 'Record Revision Only':

(1) "All dimensions and configurations are conceptual to provide the basic routing of each specific 2 inch and under piping system. Should conflicts or interferences occur, the piping may be rerouted using care and judgment, so as to provide sufficient clearance around electrical switchgear, instrument panels and other equipment, structural features, etc., to facilitate good routing practice, (i.e., valve accessibility, interference elimination, maintenance accessibility, the ability to properly support, etc.); and to provide a minimum of 3 inch clearance from other process piping and instrument sensing lines. The original dimensioned routing and configuration shall be followed throughout the pipeline except in the area required to clear the conflict or interference."

In review of the PG QCPs and CPs, the inspector determined there was a lack of specific quantitative acceptance criteria to provide small bore Class 2 and 3 piping with sufficient clearance or separation from electrical switchgear, instrument panels, etc., as delineated in the S&L specification. This is an example of a violation of 10 CFR 50, Appendix B, Criterion III (456/83-09-09(B); 457/83-09-09(B)).

b. Review of PG Calculations

The inspector reviewed the following PG small bore Class B, C, and H, (ASME 2, 3 and instrumentation), piping with maximum operation temperature of 150°F:

(i) Lines 1CCE3AA-½" and 1CCE3BA-½", a Class H instrumentation line connecting to 1CCA2A-3" at Fl. El. 394'-7".

Findings:

- The design pipe weights and spans were per S&L ECN 4566. However, valve weights and component weights were not documented in the calculation.

- Root valve (isolation valve) weights were not taken into consideration per verbal instructions. The designer was not aware that verbal exceptions to the procedure were not acceptable.

- Restraint IFIS CC063-H5A-6 showed a calculated load of 23 lbs. The type H5A support data from S&L Drawing M-5010, "Instrument Line Supports Typical Details," Rev. D, dated August 29, 1983, showed:

Cantilever Length (L) (ft)	Maximum Load (P) (lbs)
1.5	25
2.0	16

The designer did not use the above design data and incorrectly selected L of 2.0 feet based on PG Hanger Drawing No. H5A, Rev. 1, dated April 14, 1980, where it stated:

L (ft) max.	P (lbs)
2.0	40

(ii) Line 1D0D8BC-2", Diesel Oil in Auxiliary Building at Fl. El. 383'-0".

Findings:

- The design was based on S&L ECN 2715, dated July 2, 1982, which was subsequently incorporated in S&L Specification F/L-2739, Amendment S, dated February 18, 1983. Since the calculation was performed after May 1983, ECN 4566, "Providing Installation and Support Selection Guidelines

for Process Piping, Instrumentation Piping and Tubing in Category I Building, Rev. 2," dated May 14, 1983, including Table IV, "Span Length (Ls) and Weight Data, Uninsulated Pipe", should have been used.

- The pipe coupling weight was not considered in the calculation based on PG Information Request (IR) No. 2101, dated October 21, 1982, which requested that coupling weights should not be considered in small bore support calculation. The IR was approved by S&L on October 21, 1982. The inspector stated that the use of an IR in lieu of an FCR to change design requirements was not in accordance with licensee QA program provisions, requiring final design deviation review and approval, and update of affected drawings.

(iii) Line 1DOD8BA-01, shown on Drawing No. PG 2556A-15, the calculation was signed on July 14, 1983, and was reviewed and approved on July 19, 1983.

Findings:

- The lack of a documented step-by-step pipe span measurement and dead weight load determination. The latest calculation which was performed during the inspection showed the following discrepancies between calculations based on as-built drawings and previous calculation dated July 14, 1983.

Hanger No.	Calculation dated July 14, 1983	Calculation dated October 6, 1983 (date of RIII inspection)
1D003AB-	Span/Load (ft) (lbs)	Span/Load (ft) (lbs)
01	6 /64	5.5 /40
02	6.9/36.5	6.75/58.5
03	12 /38.1	8.65/53
04	8.7/39	6.8 /30
05	7.2/31	6.85/30.2

The failure to include the correct component weight in the pipe span mass calculation was largely contributed to the fact that the valve weight proportionment design methods described in PG CP 22 had not been followed by the designer. This is an example of a violation of 10 CFR 50, Appendix B, Criterion III. (456/83-09-09(C); 457/83-09-09(C)).

- In view of the many errors observed during review of the calculation, and the absence of PG design checking and verification procedures, the inspector requested to interview the individual (with initial RS) who reviewed and approved the apparent erroneous calculations on October 6, 1983. The PG management informed the inspector that the reviewer had called in and resigned the same morning.

c. PG Personnel Authorities, Duties, and Qualifications

Findings:

(i) The inspector reviewed PG Site QA Manual, Rev. 0, dated August 26, 1983. Section 1.19, "Field Engineer," (FE) states that "The FE shall have no design responsibilities...." The statement is contrary to the PG procedures listed in Paragraph 13.a above. PG QCPs and CPs assign the FE responsibility for the design of small bore pipe routing and some calculation responsibility for safety-related small bore pipe supports. Furthermore, qualification and training requirements commensurate with the FEs' authorities and duties had not been established in procedures. This is an example of a violation of 10 CFR 50, Appendix B, Criterion II (456/83-09-09(D); 457/83-09-09(D)).

In view of the many errors that were observed during the review of PG calculations, the inspector reviewed the designers' (Hanger Selectors) qualification and past training.
The inspector reviewed PG CP 29, "Qualifying and Training Procedure for Hanger Selection Personnel," Rev. 5, dated June 22, 1983. PG CP 29 considers that personnel with a high school education or one year in hanger work to be qualified. Training includes familiarization with design documents and receiving documented training of PG CP 22 requirements.
The inspector reviewed resumes of all six Hanger Selectors (initials: LG, WH, JL, EG, SC, and WS) and noticed that they were all high school graduates, but had no prior hanger or restraint design work experience. Based on the many calculation errors, the inspector's interview with some of the designers discussions with licensee and PG management, and observation of the site design control activities, the inspector determined that the training program for the Hanger Selectors did not assure that the individuals had achieved and maintained suitable proficiency. This is an example of a violation of 10 CFR 50, Appendix B, Criterion II (456/83-09-09(E); 457/83-09-09(E)).

d. Review of PG Information Request (IR) System

As discussed in Paragraph 13.b(ii) above, pipe coupling weight was not taken into consideration due to incorrect utilization of the IR system. The specific IR involved was No. 2101, dated October 21, 1982. During further investigation of the problem, the inspector revealed that approximately 5300 IRs had been issued prior to PG management's decision to better control the system, and to provide better distribution of these IRs by developing a new system format. The inspector reviewed the 68 new IRs with revised format, starting on September 1, 1983, and determined that some problems still existed. The specific case observed was IR No. 6 issued on September 8, 1983, and approved on the same date. On this IR PG requested and S&L approved substituting A-155 CM65 material for A-155 CM70 material. The use of the IR in lieu of the FCR system is contrary to the licensee's QA design control program and compromised final design change acceptance review and approval. This is an example of a violation of 10 CFR 50, Appendix B, Criterion III (456/83-09-09(F); 457/83-09-09(F)).

e. Review of Licensee Site Design Control Audits

The inspector reviewed the pertinent portions of the following CECo QA Audit Reports:

- No. QA-20-83-33, July 5-12, 1983
  "Instrumentation Installation 2" and Under Piping Installation, Material Traceability, Design Change"
  (5 findings; 3 observations)

- No. QA-20-82-15, June 24-29, 1982
  "Instrumentation and Small Bore Pipe Installation"
  (3 findings; 3 observations)

- No. QA-20-82-12, April 20-23, 1982
  "Hanger Installation: 2" and Under Pipe Installaton"
  (no finding; 1 observation)

- No. QA-20-81-30, February 29 through October 1, 1981,
  "Instrumentation System Layout Activities"
  (7 findings; 3 observations)

Findings similar to those discussed in Paragraph 13.b were also uncovered by the CECo audit team. Finding No. 5 in report QA-20-83-33 states:

> "Contrary to 10 CFR 50 Appendix B Criterion III, Support Loading calculations are being performed to a procedure that does not clearly define the step by step approach for performing the calculation. Furthermore, the current ECN utilized for the calculation activity has not been incorporated into PGCo's Procedure PGCP-22. Also, the drawings from which rated loads are obtained are not referenced on the calculation sheets.

Discussion:

1. The following calculation sheets are used to document the results of hanger selection calculations:

   - Instruments: "Restraint Calculation Sheet"
   - 2" and Under: "Support Calculation Sheet"

   Procedure PGCP-22 states that these forms will be used to document the results of the calculations. The procedure did not give the actual step by step method for performing the calculations to arrive at the results written on the calculation sheets.

2. ECN 45 6 is the current document to be followed for the support selection activity. PGCP-22, Rev. 4, currently references ECN 2715 only.

3. The typical hanger used is listed on the calculation sheet by hanger number. The revision of the drawing from which the rated load is taken is not referenced. As a result it is difficult to determine which revision was used to establish the rated load for the load calculations.

   Also, the references for the weights of fittings, valves, instruments, etc. are not shown on the calculation sheets. As a result it is difficult to determine the origin of the load values listed."

The site installation of small bore instrumentation piping began before March 1981, and the small bore process piping before July 1981. Two years had passed prior to the CECo design audit findings. Based on the above findings the inspector concluded that the site design control deficiencies had not been identified and corrected in a timely manner. Inadequate audits is an example of a violation of 10 CFR 50, Appendix B, Criterion XVIII (456/83-09-08(D); 457/83-09-08(D)).

Based on the many programmatic and implementation deficiencies described above the inspector concluded that the licensee control over the site small bore piping design activities was inadequate and ineffective.

Subsequent to the inspection, PG management suspended the Engineering Department Support Selection Program for process piping and instrument piping and tubing in Category I Buildings on October 10, 1983, until the program could be evaluated for compliance to S&L Specification L-2739 and PG Procedure CP-22. CECo letter, BRD No. 9627, "PG Co Letter B-B-531, dated 10/10/83," dated October 11, 1983, concurred with PG's decision, and requested PG to maintain this suspension until written concurrence to resume this activity was obtained from CECo.

An exit meeting was held at the site on October 24, 1983, during which CECo presented corrective actions for the design, installation, and inspection of the small bore Class B, C, and H safety related piping systems with operation temperature less than 150°F. Program improvements include: (1) more specific installation tolerance and acceptance requirements, (2) upgrading of PG procedures to provide better feedback to the A-E, (3) improvements in the PG hanger selection calculation format and review verification, and (4) expanding the A-E and CECo engineers' role in field pipe routing design changes and overview of PG support selections. Region III management representatives requested licensee representatives to: (1) conduct comprehensive QA/technical audits prior to the lifting of the stop work order and (2) perform a detailed evaluation by the A-E to determine effectiveness of PG improved design program, and adequacy of the A-E design guidance and control.

SECTION II

Electrical Contractor

1. Persons Contacted

CECo Personnel

D. Brown, QA Coordinator, Electrical
D. Cosaro, Construction Manager
C. Mennecke, Project Construction Lead Electrical
T. Sommerfield, QA Superintendent
L. Tapella, Project QC Coordinator

Electrical Contractor Personnel

B. Brown, Lead Inspector, Level II, L. K. Comstock Engineering Company (LKCEI)
T. Corcoran, QC Manager, LKCEI
J. Facchina, File Clerk, LKCEI
W. Gardner, Manager, QA/QC Services, LKCEI
N. Kimble, Level II Inspector, LKCEI
M. Lechner, Inspector Trainee, LKCEI
P. Pysell, Assistant QC Manager, LKCEI
T. Rolan, QC Analyst, LKCEI
C. Tyler, Level II Inspector, LKCEI
J. Barnes, Engineer, L. K. Comstock Company (LKC)
J. Blanchette, Document Control Supervisor, LKC
K. Easton, Document Control, LKC
J. Hii, Project Engineer, LKC
V. Kilgove, Area Foreman, LKC
R. Koslowski, Document Control, LKC
M. Mangra, Area Engineer, LKC
F. Rolan, Project Manager, LKC
R. Thompson, Area Manager, LKC

2. Quality Assurance Program

A review was performed of the Electrical Contractor's QA Program Manual as follows:

a. Licensee Approvals

The inspector reviewed the licensee's acceptance of the LKC/LKCEI QA Program documented in the following letters of acceptance.

- February 8, 1979, accepting the submitted manual for use at the Braidwood site.

- August 13, 1980, accepting the program as revised effective May 1, 1980.

- May 26, 1982, accepting the revised program effective May 12, 1982.

b. Program Manual Review

The inspector reviewed the latest revision of the QA Manual sections, numbered and titled as follows.

- 3.0 QA Program
- 4.0 QC Program
- 4.1 Site QC Organization
- 4.2 Drawing and Specification Control
- 4.3 Work Instructions
- 4.4 Procurement Document Control
- 4.5 Supplier Evaluation
- 4.6 Control and Identification of Equipment and Components
- 4.7 Control of Special Processes
- 4.8 Inspection and Tests
- 4.9 Control of Measuring and Test Equipment
- 4.10 Handling, Storage, and Shipping
- 4.11 Nonconforming Items and Corrective Action
- 4.12 Test Control
- 4.13 QC Records
- 4.14 Audits

c. Items Discussed

The inspector requested clarification of certain items reviewed in the QA Manual.

(i) It was noted that in Section 4.8 a Sampling Plan was included and that several of the detailed inspection procedures included a sampling plan to a "not less than" minimum (i.e., 4.8.1, Inspection of Class 1E Safety Related Conduit Installation", not less than 35% of installed conduit).

In response to the inspector's concern, the CEI QA Coordinator Electrical stated that the contractor has been elevated to a 100% inspection coverage for all activities, and that it was considered unnecessary to revise the procedures since 100% inspection was compliant to the procedures as written.

(ii) It was noted that several procedures indicated that inspection was to be done by a Level I or Level II inspector, it was explained that Level I and/or Level II Inspectors could perform inspection coverage as necessary; however, it was explained that when Level I inspectors perform the inspection activity, it is necessary for a Level I inspector to review the inspection coverage and report,and sign as approved.

No items of noncompliance or deviations were identified.

3. Implementation Program by the Electrical Contractor

Program activities currently in progress by the electrical contractor, were reviewed by the inspector as follows:

a. Staffing and Qualifications of Inspection Staff

(i) The inspector was informed that the LKC inspection staff was at authorized levels and that the staff, as broken down below, was considered to be adequate to perform adequate and timely inspection coverage.

(1) Total Staff (approx.). 37

(2) Level III Inspectors 1

(3) Level II Inspectors. 25

(4) Level I Inspectors 5

(5) Clerical 4

The above staff represented a 1/10 ratio of inspection staff to total construction work force, which the contractor considered normal.

(ii) The inspector qualification program was reviewed by the inspector with the following results.

(1) The master qualification list was reviewed which showed the areas of qualification of all inspectors, the recertification due date for each area or discipline and certification completion date.

(2) The inspector selected a sample of one inspector per performance level (including trainee) from the qualification list, for a total of four inspectors. A review of their qualification, training and certification records (as depicted on the mas er list) was performed. Those selected were as follows:

- Level III QC Inspector
- Level II QC Inspector
- Level I QC Inspector
- Trainee

The records were complete and up-to-date for each sample reviewed. In the case of the trainee selected, the file folder was in place and those training/qualifications activities accomplished to date (i.e., eye test and self-reading log) were present in the folder.

(3) The inspector observed a field-conducted on-the-job training session. A one-on-one training activity was being conducted. A Level II QC Inspector accompanying a trainee while the trainee performed inspection activity of cable terminations. The instruction by the Level II included such parameters as: (a) how to locate terminal blocks involved, and (b) inspection of terminations for crimp, tightness, and location of conductor in crimp ferrel. A good exchange of information appeared to be taking place.

b. Auditing Performance

(i) The LKCEI corporate auditing activity is performed on a quarterly basis to accomplish a complete program verification on an annual basis. The 1983 approved corporate office audit schedule for the Braidwood site was reviewed. The schedule, issued as a memo on March 18, 1983, listed four audits to be performed as follows:

Date of Audit	Criteria to be Covered
March 15, 1983	III, VI, XIV, XV
June 28, 1983	IX, XVIII
September 20, 1983	X, XII, XVII
December 6, 1983	I, II, V, XIII

The first scheduled audit was performed on April 12-14, 1983 (report number CQA-313) and covered Criteria III, VI, XIII, XIV, and XV with no adverse findings being identified. The inspector also observed a memo which provide notice of the second audit, scheduled for June 28-30, 1983, covering Criteria IX and XVIII (delayed until a later date because of the inspection coverage in progress during that period of time at the site).

The inspector requested the corporate audit reports for the last half of 1982 for review. The reports and criteria covered by the audits were reviewed by the inspector as follows.

Audit Report Number	Date of Audit	Criteria Covered
CQA-250	December 16-17, 1982	XIV & XVIII
CQA-182	September 21-22, 1982	III, VI, & XII

Neither the auditing coverage performed and/or scheduled from mid-year 1982 through mid-year 1983 nor the audit schedule established for the year 1983 would provide complete program verification coverage as prescribed by the QA manual.

(ii) The LKCEI internal auditing activity for Braidwood, beginning with audit report I-001, was reviewed by the inspector.

(1) The 1982 audit activity and results are tabulated as follows:

Number	Date of Report	Coverage	Results	Remarks
I-001	7-12-82	Storage, Issue & Control of Welding Material	1 finding	
I-002	7-12-82	Housekeeping & Protection of Safety-Related Class 1E Cable	2 findings 1 concern	
I-003	7-15-82	Control of Measuring & Testing Equipment & Calibration of Torque Wrenches		
I-004	10-14-82	Cable Installation & Inspection	3 findings	
I-005	7-22-82	Safety related cable pen installation & inspection procedures		
I-006	7-12-82	Nonconforming Items	2 findings 2 concerns	
I-007	8-6-82	Inspection of Class 1E safety-related conduit installations		
I-008	8-25-82	Design Control	1 concern	
I-009	9-1-82	Corrective Action	2 findings 2 concerns	

Number	Date of Report	Coverage	Results	Remarks
I-010	8-30-82	Welding inspection		
I-011	9-10-82	Receiving, storage, handling	2 findings	
I-012	9-17-82	Installation of Class 1E equipment	2 findings	
I-013	10-22-82	Electrical termination installation inspection	1 finding	
I-014	11-29-82	QA Manual Dist. & Control	2 concerns	
I-015		Revision work requests of safety related equipment	LKC to schedule for 1983	
I-016	10-22-82	Stop Work		
I-017	10-22-82	Electrical penetrations installation, terminations and maintenance	1 finding	
I-018	11-3-82	Welding procedure for structural attachments & weld inspection	6 findings	
I-019	11-9-82	Concrete expansion anchor installation Inspection of safety-related CEA installations	1 finding	

Number	Date of Report	Coverage	Results	Remarks
I-020	11-9-82	Powder actuated fastener installations & inspections of actuated fastener installations		
I-021	12-6-82	Safety related cable pan installation & inspection		
I-022	To Be Scheduled in 1983			
I-023	12-2-82	Housekeeping receipt inspection & storage		
I-024	12-3-82	Pointing release notice		
I-025		Qualification, calibration, training of QC personnel & QC records	Not performed in 1982	

These audits varied in duration from one day audits to one that extended over a period from September 24, 1982, to October 21, 1982 (I-013). Report findings were determined to be corrected and closed in a reasonable time. The worse case was report I-018, "Welding Procedures for Structural Attachments, and Weld Inspection". It contained six findings and two concerns requiring five months to close. The audit was done on November 3, 1982, with the concerns being closed out on April 4, 1983.

(2) The 1983 auditing activity began on January 2-6, 1983, with report number I-027. The audit activity and results, for the year 1983, are tabulated below.

Report No.	Dates	Coverage	Results	Remarks
I-025	- -	Qualification & Classification		Report not in file.
I-026	1/5-7/83	Control of Special Processes	1 finding	

Report No.	Dates	Coverage	Results	Remarks
I-027	1/2-6/83	DC Storage Batteries & Racks	3 findings	
I-028	1/5-7/83	SMAW Welding of Stainless Steel & Inspection	no findings	
I-029	1/25-28/83	Stud Welding & Inspection	3 findings	
I-030	1/19 thru 2/8/83	Installation of Class 1E Embedded Electrical Items & Inspection	2 findings	
I-031	1/21/83	Inspection of MIG Welding of Aluminum		Report Notes no aluminum welding having been performed.
I-032	- -	Drawings & Specs. Document Control Inspection Procedure		Report not in file.
I-033	- -	Heat tracing system Installation & Inspection		Rescheduled, no procedure
I-034	- -	- - - - - - - - -		Voided, to be scheduled later

(iii) The approved, issued audit schedule for the year 1983 provided for audits to be performed as follows: (1) four audits for January, (2) three audits for February, (3) three audits for March, (4) two audits for April, (5) two for May, and (6) three audits for June. Of the seventeen audits scheduled to be performed during January through June of 1983, only five could be determined to have been completed with all five audits having been performed in January of 1983, and with no further auditing activity performed.

The auditing activity performed by LKCEI failed to conform with the requirements established by the QA Program for a comprehensive system of planned and periodic audits. This is an example of a violation of 10 CFR Part 50, Appendix B, Criterion XVIII (456/83-09-08(B), 457/83-09-08(B)).

c. Document Control

The LKC document control activities were reviewed by the inspector. The QA Program Procedure 4.2.1 was being implemented with the transmittal form 4.2.1 utilized as provided for the control of issuance of new revisions to documents and for the control of return and disposal of obsolete documents. It was noted that the applicable ECNs and FCRs were listed on the new revision drawings when issued. A document master card was maintained for each drawing issued and was maintained in current revision status (including ECNs and FCRs).

A survey was conducted of several document stations located throughout the plant construction area with the following results:

(i) Main Station: Auxiliary Building elevation 451 adjacent to the control room areas. Review of drawings and discussions with personnel working out of that station established that wiring diagrams of the control room wiring terminations drawings, both the current revision and all old voided revisions were maintained and marked appropriately. The inspector was informed that the as-built condition of terminations were marked on the prints, therefore, old drawings need be maintained to provide a complete as-built history. In addition obsolete drawings (voided drawings) were stamped as such and were maintained separately in temporary file cartons. The system appeared to be functioning adequately with sample drawings of the current revisions found to be the latest issued revision (Drawings 20E-1-3785 Rev. K, -0-4491D Rev. K, -0-4631C Rev. F).

(ii) Station 5: Located in a lower level of Unit 2 containment; however, it was reportedly being used by electricians performing work in Unit 1 containment.

The inspector, during a review of the racks of drawings located in the station, selected sample drawing numbers at random to be checked for status. The results are as follows:

Drawing -1-3513, Rev. AF 6-22-83, Current
Drawing -1-3515, Rev. N 9-17-82, Current Revision is S

Additionally, Station 5 notebooks (maintained for copies of the current FCRs and ECNs) failed to include numerous of the listed current FCRs and ECNs for the above listed drawings.

In discussions with the document control personnel, it was learned that the document center records for Station 5 showed that Revision N of drawing had not been returned. In addition, a general memo dated April 9, 1983, was provided, regarding missing (unreturned) voided prints, now considered to be lost or missing. Four revisions old drawings remain available for construction activity in the stick file of Station 5 without any marking as to void status is contrary to the document control procedure.

Prior to the completion of the inspection, the inspector was informed by the LKC Project Engineer that a complete audit of Station 5 had been performed. Sixteen additional voided drawings were identified in the current stick files out of a total of 528 drawings located at the station (15 safety related drawings). The inspector was further informed that corrective action was being taken to assure that all 44 stations are maintained in a current status.

This item is an example of a violation of 10 CFR 50, Appendix B, Criterion V and the L. K. Comstock QA Manual, Section 4.2 for failing to assure that only approved current revision documents were available for use at the location where the activity is performed (456/83-09-02(E); 457/83-09-02(E)).

d. Nonconformance Control

The LKCEI nonconformance control activities were reviewed by the inspector. The QA Program Manual Procedure 4.11.1, 4.11.2, and 4.11.3 provide the procedural instructions for this program control. The control provided in two strata: 4.11.1 covered nonconformance reports (NCRs) control of material so designated, while 4.11.2 covered inspection correction reports (ICRs) for those in-process items where further work or processing was needed to complete the hardware in an acceptable condition to established design requirements. The results of the review follows.

(i) Nonconformance Reports (NCR)

NCRs were prepared by the QC Inspection department and were signed by the QC Manager. A log being maintained for all issued NCRs by number and by hold tag numbers.

A review of the log established that the first nonconformance report, NCR#1, was issued by the predecessor electrical contractor (E. C. Ernst) on October 21, 1976. NCR#47 of that era remained open regarding "Lack of documentation for concrete expansion anchors." The latest dispostion for the open NCR was provided by CECo on November 18, 1982.

Current era activities and status included: (1) three old (1981) NCRs showing that CECo has issued NCRs regarding this problem, (2) 36 NCRs that are more than one year old with 13 not yet dispositioned by CECo, and (3) of the more recent open items, a majority appeared to be awaiting CECo dispositions.

NCR hold tag control appeared to have been a problem in the past with most of the tags being issued and being used on nonconforming equipment having not been returned when the NCRs were closed. Currently the problem of unreturned tags has been improved, however, in discussions with the Assistant QC Manager,

it was learned that an improved (more durable) type tag was being considered along with a change in the procedure to further improve this control.

(ii) Inspection Correction Report (ICR) Control

ICRs (Form 30) were used to control those less than complete deficiencies that could be brought to design conformance. QC Inspection also maintained a status log of these items. The results of a review of the log revealed: (1) two 2-year old ICRs, 784 and 920, cover hangers within Unit 1 containment, loop 4, that have rejectable welding and both have been reissued at least twice, in 1982 and 1983, and appear to be items that should have been converted to NCRs; (2) ICR #1287 was an old item related to electrical cable pan fill which remained open and was carried in the log with a note that it cannot be closed (this is a concern discussed later in this paragraph); and (3) 50 items were in excess of 1 year old.

The inspector expressed concern regarding the practice of using ICRs to report electrical separation deficiencies. The inspector was informed by licensee personnel that this concern had been identified at Byron Station and that it had been discussed with Region III personnel. It now was an agreed practice, to be reviewed further in the future, that the ICR system was to be used to identify each and every electrical cable problem such as separation of cable in air and in cabinets, metal to metal separation, cable tray fill, minimum bend radius of cables, and pull tension concerns. The designer, Sargent & Lundy (S&L) had reserved the right to review and evaluate each and every instance of apparent violation and to make a separate determination in each case as to its acceptability on a violation to be reworked. The inspector indicated that the previous agreement should stand and that the results should be equally applicable to Braidwood.

e. Equipment Installation Control

The inspector conducted a review of electrical equipment installation to determine the adequacy of adherence to drawings during installation and control of problems during installation.

Unit 2 control room main control panels numbered 2PM05J and 2PM06J were selected for review. The inspector was accompanied by: (1) the Area Manager, (2) an engineer, (3) the responsible foreman, and (4) the QC Inspector involved. The inspector reviewed the following documents relative to the installation:

- Drawing 0-3372, B, Rev. L, Electrical Installation of Equipment Main Control Room

- Drawing 0-3391, K, Rev. H, Electrical Installation Section and Details

- Drawing 0-3391C, Rev. AB, Electrical Installation of Equipment Manufacturing Details Sheet 1

- Drawing 0-3391 AC, Rev. A, Electrical Installation of Equipment Miscellaneous Mounting and Shim Plate Details

The inspector determined by direct measurements that the equipment was placed on location as dimensioned on the drawings. It was also determined that the interface fit between the equipment mounting base plate and the floor embeds had considerable attachment welding problems. The LKC Engineer had performed an engineering evaluation and prepared a set of 18 FCRs that depicted an engineered resolution of each of the installation problems for all the equipment on drawing 0-3372-B (including panels 2PM05J and 2PM06J). The QC inspector had prepared an NCR-677 related to the two panels under consideration, identifying attachment welds staggering problems and dimensional problems and had attached three of the FCRs (6288, 6291, and 6292) prepared by the engineer to resolve the problem.

Although the NCR was still open, most of the repair welding work was done according to the new drawing 0-3391 AC which was issued to incorporate all of the FCRs previously mentioned.

The contractor had not completed its final acceptance inspections of the equipment installation, however, the inspector believed that the activities have been conducted in a controlled acceptable manner.

4. Licensee Auditing of the Electrical Contractor

The inspector reviewed the CECo QAM procedures QR-18 and QP-18-1 and conducted a review of the licensee auditing activity of the electrical contractor. The review covered one General Office (GO) audit performed September 13-21, 1982, and four on-site scheduled audits as follows:

- QA-20-82-53 September 29, 1982
- QA-20-83-06 February 9-16, 1983
- QA-20-83-09 February 25, 1983
- QA-20-83-20 April 18-21, 1983

Only one of the above five audits contained no findings. The inspector also reviewed a May 16, 1983 (BRD #8715) letter covering CECo immediate concerns. In addition, the onsite unscheduled auditing and surveillance activity was selectively reviewed as follows:

- Audits No. 82-37
  No. 82-43
  No. 83-06

- Surveillances No. 2727 February 8, 1983, Storage of Cable
  No. 2794 March 24, 1983, Conduit Installation
  No. 2887, May 25, 1983, Storage and Protection of Diesel Generator
  No. 2920, June 12, 1983, Storage of Cable on Reels

It was noted that on an average, approximately 6 surveillances were being performed per month in addition to the scheduled and unscheduled audits. Emphasis appeared to be and needed to be on the storage and protection of installed equipment. More emphasis also needed to be placed on this subject by the station personnel.

The inspector concluded that good emphasis was being placed on installed equipment by the auditors, and that the QA activity had been effective in gaining contractor control improvement.

No items of noncompliance or deviations were identified.

SECTION III - HVAC

DETAILS

1. Persons Contacted

Commonwealth Edison Company (CECo)

M. J. Wallace, Project Manager
D. Cosaro, Construction Superintendent
W. Shewski, Manager of Quality Assurance (Corporate)
T. Sommerfield, QA Superintendent
G. Groth, Lead Mechanical Engineer
D. Brown, QA Supervisor
L. Tapella, Project Coordinator
J. Hawkinson, Construction HVAC Engineer
S. Reece, QA Engineer
J. Walters, QA Engineer
C. Hayes, QA Welding Engineer

Pittsburgh Testing Laboratory (PTL)

A. Fraizer, NDE Supervisor
F. Forrest, Project Manager

Pullman Construction Industries, Inc.

M. Jarigese, QA Manager (Corporate)
D. Grant, QA Manager (Site)
R. Waterfield, QA Supervisor (Site)
D. Lawler, Project Manager
R. Ewald, Engineering Supervisor

2. Documents Reviewed

a. Commonwealth Edison Company Quality Assurance Manual, Revision 77.

b. Pullman Construction Industries, Inc., Quality Assurance Manual, Revision 1.

c. Sargent and Lundy Specification F/L-2782, HVAC Work, Amendment 7.

d. Pullman Construction Industries, Inc., Procedures:

(i) B2.1.F, QA/QC Qualifications, Revision 1

(ii) B3.1.F, Design Control, Revision 3

(iii) B5.1.F, HVAC Repair/Adjustment, Revision 2

(iv) B6.1.F, Document Control, Revision 1

(v) B8.1.F, Indentification and Control of Parts and Components, Revision 0

(vi) B9.1.F, Welder Qualification, Revision 2

(vii) B9.2.F, Control of Welding Filler Metal, Revision 0

(viii) B9.3.F, Expansion Anchor Installation, Revision 7

(ix) B9.4.F, Instllation Procedure, Revision 2

(x) B.10.1.F, Field Receiving Inspections, Revision 2

(xi) B.10.2.F, Visual Weld Inspection, Revision 1

(xii) B.10.3.F, Installation Inspection, Revision 3

(xiii) B10.4.F, Final Inspection, Revision 1

(xiv) B12.1.F, Equipment Calibration/Verification, Revision 3

(xv) B13.1.F, Storage and Handling, Revision 0

(xvi) B16.1.F, Non-Conformance/Corrective Action, Revision 1

(xvii) B17.1.F, Q. A. Records, Revision 0

(xviii) FWP-300, Gas Metal Arc Welding, Revision 8

(xix) FWP-300B, Gas Metal Arc Welding, Revision 2

(xx) FWP-301, Shielded Metal Arc Welding, Revision 5

(xxi) FWO-301C, Shielded Metal Arc Welding of Galvanized Steel to Galvanzıaed Steel or Carbon Steel, Revision 4

(xxii) FWP-304, Gas Metal Arc Welding of Stainless Steel, Revision 4

(xxiii) FWP-403A, Shielded Metal Arc of Stainless Steel, Revision 4

(xxiv) FWP-304B, Semi-automatic and Machine Gas Metal Arc Welding, Revision 1

(xxv) WP-305A, Gas Shielded Flux-cored Arc Welding, Revision 1

(xxvi) FWP-306, Carbon Arc Brazing, Revision 8

3. Qualification and Training

Welders were given general training in welding and brazing procedures. The inspector reviewed one of the nine procedures for the following attributes:

a. material specification
b. welding process
c. position
d. filler metal classification
e. single or multiple pass
f. welding current
g. polarity
h. welding progression
i. preheat and interpass
j. electrode size
k. amperage
l. voltage
m. type of joint detail

The following welders' qualification records were reviewed and found to be in compliance with AWS D1.1-1977, Section 5, Tables 5.23 and 5.26.1:

Welder I. D. #

39
44
50
66
36

The Pullman welders were qualified for one or more processes including Shielded Metal Arc Welding, Gas Metal Arc Welding, Flux-Cored Arc Welding, and Carbon Arc Brazing. Nine welding and brazing procedures had been qualified for the Braidwood Site, subdivided into over seventy procedure specification sheets.

Quality control personnel were trained and certified in accordance with approved procedures and Regulatory Guide 1.58, Revision 1. Documented records included training in applicable codes and standards, on-the-job training, examinations including mock inspections, and eye tests. Certification was divided into disciplines such as mechanical inspection, material control inspection, and documents.

No items of noncompliance or deviations were identified.

4. Design Control

The design change HVAC Program was reviewed to ascertain that the licensee has established and is implementing a program in accordance with regulatory requirements and the CECo Quality Assurance Manual. The review of documents included a verification of the following activities:

a. Procedure to control design requests have been established.

b. Procedures and responsibilities for design control have been established.

c. Responsibilities and controls to assure that design changes will be incorporated into drawings have been established.

d. Channels of communications between design organizations and responsible individuals have been established.

e. Controls requiring that implementation of approved design changes be in accordance with approved procedures have been established.

f. The following Field Change Requests and Engineering Change Notices were reviewed and found to be processed and dispositioned in accordance with proper design control criteria:

(i) FCR #L10649
(ii) FCR #L10135
(iii) FCR #L-9861
(iv) FCR #L-9717
(v) FCR #L-9687
(vi) FCR #L-9752
(vii) FCR #L-9724
(viii) ECN #4315
(ix) ECN #4259
(x) ECN #4619
(xi) FCR #L-10575
(xii) FCR #L-10115
(xiii) FCR #L-10563
(xiv) FCR #L-10134
(xv) FCR #L-10159

No items of noncompliance or deviations were identified.

5. Drawing Control

Drawings were reviewed for current revisions, distribution lists, and responsibilities assigned for implementation. Drawings, both in the field and in the office were checked, including posting Field Change Requests, as detailed below:

Office Drawings	Field Drawings
M-1314-8	M-1277-1
M-1267-9	M-1283-2
M-1274-2	M-1283-1
M-1274-1	M-1281-3
M-1273-4	M-1274-2
M-1275-1	M-1270-1
M-1276-1	M-1326-6
M-1311-10	M-1326-5
M-1312-1	M-1326-3
M-1311-11	M-1326-2
M-1283-2	M-1326-1
	M-1322-1
	M-1313-3
	M-1313-2
	M-1319-2

Field Drawings

M-1314-4
M-1323-1
M-1323-6
M-1323-7
M-1314-3
M-1314-8
M-1323-1
M-1314-3

A control system had been established for issuing and returning drawings.

No items of noncompliance or deviations were identified.

6. Material Inspection

The welding issue station was inspected and the E7018 and stainless steel welding rod was found to be stored in the ovens within acceptable temperature parameters. The issue station was only open at designated times of the day and only the E7018, E308, and E309 rod was issued by means of a requisition system. The E7018, E308, and E309 requisition log indicated the welder to whom the rod was issued to, the amount issued, and the amount returned, but not where the rod was to be used. With the issue station open on a limited basis, a strain is placed on planning, taking into consideration the amount of filler metal required and the assignment of joints requiring the same filler metal type. Without a requisition system, for other than E7018, E308, and E309 rod controls for quantity issued is absent for filler metal such as carbon wire, stainless wire, and E6013. Since quality control does not inspect filler metal type during the welding process, nor are welding procedures which specify type of filler metal documented prior to welding for each HVAC installation, weld material control at issue and lack of the traceability to the item takes on added significance (reference Paragraph 7).

The following welding material certifications were reviewed and found to be in compliance with AWS D1.1:

- .035 wire - ER70S-2, Heat No. 27403
- 1/8" - E309-16, Heat No. X37712
- 3/32" - E7018, Heat No. 411T0411
- 3/32" - E7018, Heat No. 431P2321

Receipt inspection reports were reviewed for the following material types:

Report No.	Material Type
202	Duct, plate, nuts, bolts, angle
203	Auxiliary steel, screens, seal angles
210	E7018 weld rod
214	Auxiliary steel, angle

270	E71T wire, flex connections, tube steel
298	Plate
297	Angle, plate, tube

Attributes including identification, cleanness, coating, dimensions, workmanship, damage, and documentation were checked.

The inspector randomly selected two ducts, attached stiffeners, and one hanger in the control room vent system and found the material and the certifications in accordance with the design requirements including yield stress.

No items of noncompliance or deviations were identified.

7. Installation

The installation program was reviewed to ascertain that the licensee has established and is implementing a program in accordance with 10 CFR 50, Appendix B, and AWS D1.1 1977. The inspector determined that the HVAC QA Program did not have adequate policies, procedures, or instructions for controlling fit-up and welding during the installation of HVAC components. Quality control personnel were required to examine the final weld for compliance to AWS D1.1 1977, but the only mandatory in-process verification required by Pullman Procedure B10.2.F, "Visual Weld Inspection", involved checking amperage, voltage, interpass temperature, travel speed, and preheat temperature for compliance with the welding procedure specification sheets. This was being done on three welds per week, the minimum required by Procedure B10.2.F. Fit-up was required to be checked after welding was completed per B10.2.F. No requirement existed in the QA Program for the welding procedure to be specified for each specific HVAC installation before welding commenced.

The HVAC QA program was deficient in the following areas:

Instructions were not adequate in that welding procedures to be used for each specific HVAC installation were not stipulated on drawings, travelers, or predetermined by any documentation form. The selection of welding procedures had been performed by the craftsmen. The weld procedure selected was not documented and there were nine welding procedures divided into over seventy detail sheets. The craftsmen were required to select the welding procedure detail sheet. Additionally, during the installation process quality control did not verify welding position or polarity for electrode classification, nor verify that acceptable welding procedures were employed for each HVAC installation or inspect on a frequency adequate to assure by an acceptable confidence level that the welders were complying with the welding procedure essential variables. This is an example of a violation of 10 CFR 50, Appendix B, Criteria II and IX (456/83-09-10(A); 457/83-09-10(A)).

Quality control did not inspect HVAC components for fit-up prior to welding on components. Fit-up tolerances cannot be determined after welding certain components, such as all-around fillet welds and full penetration welds. Furthermore, documented instructions to the quality control inspectors of

fillet weld gaps after welding was inadequate as the HVAC contractor procedure "Visual Weld Inspection Procedure", B10.2.F, stated that a 3/16" gap was acceptable, while AWS D1.1-1977, Section 3.3, states that a 3/16" gap is allowed only if the leg of the fillet weld is increased by the amount of the separation or the contractor demonstrates that the required effective throat has been obtained. This is an example of a violation of 10 CFR 50, Appendix B, Criteria II and IX (456/83-09-10(A); 457/83-09-10(B)).

Quality Control was not required to examine the base metal prior to welding to assure that surfaces and edges were free of discontinuities. This is an example of a violation of 10 CFR 50, Appendix B, Criteria II and IX (456/83-09-10(C); 457/83-09-10(C)).

Records were inadequate for the following quality activities as a result of a lack of controls and inspections:

(i) Welding procedures employed during the installation process were not specified and after October 1982 there was no documented evidence available of the welding procedures used for each HVAC component installation. Prior to October 1982 quality control listed the welding procedure used on the final weld inspection form presumed to be used after examining the completed weld. The Pullman Quality Assurance Site Supervisor stated that by examining the final weld, in most cases, the welding procedure that was used could be determined. Of course, if the weld was ground down, determination would become increasingly difficult. In addition, examination of the final weld did not provide assurance that the welding procedure essential variables were complied with during the in-process welding.

(ii) Fit-up inspection for full penetration welds, all around fillet welds, and other welds inaccessible for fit-up inspection after welding.

(iii) Base metal surfaces and edges prior to welding.

(iv) Welders that performed the welding on the joints identified in Pullman Nonconformance Report #BR-08, dated 6/15/81.

(v) Welding position and polarity.

Failure to implement an adequate quality assurance program with regard to installation activities of HVAC components in accordance with CECo QA Program, Topical Report CE-1-A Section 2, Sargent and Lundy HVAC Specification F/L-2782, and AWS D1.1-1977 as evidenced by the above identified deficiencies is in violation of 10 CFR 50, Appendix B, Criteria II and IX.

After the inspector identified these deficiencies, a stop work order was issued for all safety-related HVAC welding on August 3, 1983, by Pullman Construction Industries, Inc.

The inspector verified that the three weekly in-process surveillances of amperage, voltage, interpass temperature, travel speed, and pre-heat temperature were being done. Record reviews included surveillances on the following days: 3/11/83, 3/18/83, 4/28/83, and 5/5/83. Prior to November 30, 1982, the surveillances were less than three per week, only required by procedure to be done on a random basis.

Final quality control weld inspection reports were reviewed as follows and found to be in compliance with Pullman Procedure B10.2.F.

Piece Number	Date	Drawing	Drawing Title
S-3981, Hanger	8/2/83	M-1326-6	Auxiliary Bldg. Control Room Vent
Duct Patch #2133c	7/29/83	M-1281-1	Diesel Generator Vent Floor Plan
Duct Patch #2133a	7/29/83	M-1281-1	Diesel Generator Vent Floor Plan
Duct Patch #2131c	7/29/83	M-1281-1	Diesel Generator Vent Floor Plan
Duct #2582 to Stiffener	3/1/83	M-1314-1	Auxiliary Building Vent
S-1339, Hanger	8/1/83	M-1281-3	Diesel Generator Vent Floor Plan
AS-1189, Auxiliary Steel	7/14/83	M-1281-3	Diesel Generator Vent Floor Plan
Duct #2664 to Stiffener	3/1/83	M-1314-3	Auxiliary Building Vent Floor Plan
Duct #3155	10/27/82	M-1314-4	Auxiliary Building Vent Floor Plan
Duct #470	10/9/82	M-1309-3	Auxiliary Building Vent Partial Floor Plan
Duct to Hanger Rings #3511A, 3512A	10/1/82	M-1274-2	Containment Purge Vent System
Ceiling Panels	9/21/82	M-1317-1	Auxiliary Building Equipment Room
Hanger #1425 & Hanger # 1424	9/18/82	M-1314-4	Auxiliary Building Vent Floor Plan

HEPA Filter Frames	8/30/82	M-1317-1	Auxiliary Building Equipment Room
Attachments for Charcoal Canister	10/6/82	M-1317-2 M-1317-1	Auxiliary Building Equipment Room
Duct #2582 to Stiffeners	3/1/83	M-1314-10	Auxiliary Building Vent

Final quality control Type A installation reports were reviewed as follows and found to be in compliance with Pullman Procedure B10.3.F, Installation Inspection:

Piece No.	Date	Drawing	Drawing Title
S-3220-Hanger	7/30/83	M-1326-4	Auxiliary Building Control Room Vent
Duct #2174	8/1/83	M-1281-1	Diesel Generator Room Vent Floor Plan
Auxiliary Steel AS-1189	8/1/83	M-1281-3	Diesel Generator Room Vent Floor Plan
Duct Patch #2173A	7/29/83	M-1281-1	Diesel Generator Room Vent Floor Plan

Safety-related control room HVAC ducts #4927 and #4928 were examined. The companion angle flanged joints were installed in accordance with Sargent and Lundy Specification F/L-2782, with regard to 1" stitch-welds being on 9-inch centers and flanges bolted together on not less than 6-inch centers.

On August 4, 1983, a region-based inspector reviewed the physical condition of the hanger and stiffener welds, the angle frame to duct brazing, and the appropriate welding procedures. An inspection of hanger, stiffener, and brazing welds was performed in the upper cable spreading rooms of Units 1 & 2 and the HEPA filters of Unit #2. In addition, the inspector witnessed a qualification and break test (preliminary) for a prequalified procedure covering square butt, full penetration welding of sheet to sheet to AWS Code D1.3-1977. Approximately six (6) hangers on each of three (3) duct runs plus four (4) sections of duct per run were inspected. This represented an approximate total of 450 welds inspected. These included areas that had not been inspected as yet; areas that had been inspected but not yet repaired, reworked, and areas which had been accepted and had final visual inspection by Pittsburgh Testing Laboratories. Of the in-process inspected welds, Pullman QC had identified twelve (12) that had rejectable defects. The region based inspector identified approximately twelve (12) of the same type defects in the in-process, uninspected welds. These additional defects were located on welds which were within the planned inspection program and would likely be identified during the inspection of these welds by Pullman.

During the examination of the accepted welds, the following four conditions were identified which the inspector indicated warranted further investigation and/or evaluation by the licensee.

- Hanger No. 2219 (Sargent and Lundy No. S-3881, Drawing No. M-1323, Sheet 10) - North Leg, East side, had possible lack of fusion at end of weld.

- Hanger No. 2221 (Sargent and Lundy No. S-3883, Drawing No. M-1323, Sheet 10) Southwest corner, had possible slag inclusion.

- Duct to flange connection Pc No. 9 (Sheet 4033) - east side of duct. Outside corner weld at top of duct - crater and possible surface crack in weldment.

  These three conditions were in duct run in Unit 2 at El. 469'0, approximate Col. L-25.

- Upper cable spreading room, El. 463'5", Col. L. 23 (approx.) Actuator motor hanger bracket, east side of duct between HEPA filters and main supply duct - possible crater in corner. This item had been modified from the standard mounting bracket and an FCR had been written.

The licensee was pursuing these items as a result of the inspection findings. These matters are considered an unresolved item and will be reviewed during a future inspection (456/83-09-11; 457/83-09-11).

8. Nonconformance/Corrective Action

The HVAC contractor divided deficiencies, deviations or defects into Nonconformances and Correction Notices. Correction Notices were written instead of nonconformances, if a nonconforming item could be made conforming by approved procedures or other corrective means.

Forty-two Nonconformances had been written since April 18, 1978, while through August 4, 1978, 2513 Correction Notices had been written by Pullman for deficiencies and deviations, but their QA program did not require that Correction Notices be analyzed for significance. These Correction Notices identified approximately 6,000 welding deficiencies and deviations, including incomplete fusion, craters, cracks, insufficient throat, weld length, undercut, undersize and weld placement. These deficiencies in the welds were identified by the HVAC contractor's quality control personnel and either had been repaired or were in-process of being repaired. Pullman Construction Industries, Inc., had not established a corrective action program to assure conditions adverse to quality such as deficiencies and deviation were identified for significance and subsequently that the cause of the significant condition was determined and corrective action taken to preclude repetition with regard to the root causes of the 2513 Correction Notices. In November 1982 CECo performed a 100% inspection of safety-related installed components, including all

components installed prior to November 1982, as a sample program was all that was originally required. The reinspection effort included approximately 1,950 items and as a result of numerous deficiencies, Pullman Construction Industries, Inc., issued a Stop Work Order on June 28, 1983, for all new work, except for the diesel oil storage rooms and diesel generator rooms, in an effort to correct past work.

Despite the numerous deficiencies identified, the licensee failed to institute quality controls prior to commencement of welding. The NRC expressed a concern to the licensee that a contributing factor to the welding deficiencies may be attributable to the failure to specify the welding procedure that the craftsmen were to use, stipulating such factors as current and travel speed.

The following five Nonconformances were reviewed for corrective action:

NCR #	Date
BR-11	8/24/81
BR-40	4/25/83
BR-28	7/3/82
BR-08	6/15/81
BR-07	3/3/81

Corrective actions on all except BR-08, dated June 15, 1981, were satisfactory. This nonconformance concerned fifty-five welds for which the welder was unknown.

The program, approved by the licensee, required quality control to verify the welder stamp numbers affixed near the completed weld against the welder qualification listing. The program did not require performing in-process inspections on a frequency to assure that a qualified welder was, in fact, being employed for the specific welding joint for which he was pre-qualified. The welders had failed to stamp their identification numbers adjacent to the fifty-five welds identified and this condition resulted in indeterminate welder qualifications associated with the fifty-five welds.

The corrective action accepted by Commonwealth Edison QA was to examine the welds visually and, if acceptable, approve the weld. The AWS D1.1 Code requires that visual examination is the basis for acceptance only if a qualified welder performed the welding. A visual surface examination of a weld, based on the fact that an unqualified welder may have performed the welding, does not provide assurance of weld acceptability. Therefore, corrective action was inadequate. The failure to establish a corrective action program for the 2513 deficiencies and take adequate corrective action for nonconformance report BR-08 is in noncompliance with 10 CFR 50, Appendix B, Criterion XVI (456/83-09-07(B); 457/83-09-07(B)).

9. Audits

a. Contractor Audits

The HVAC contractor's yearly audit program, as established by its QA manual, for 1982 was not completed until April 4, 1983. This deficiency was identified and documented by Commonwealth Edison Quality Assurance. The audits, which are to cover all aspects of the Quality Assurance Program as stated in 10 CFR 50, Appendix B, Criterion XVIII, were conducted in three days by one lead auditor.

The audits dated April 4, 1983, and April 28-29, 1982, were limited in scope and failed to cover the following implementing procedures:

B3.1.F, Design Control
B5.1.F, HVAC Repair Adjustment
B9.3.F, Expansion Anchor Installation
B9.4.F, Installation Procedure
B10.2.F, Visual Weld Inspection

This is an example of a violation of 10 CFR 50, Appendix B, Criterion XVIII (456/83-09-08(C); 457/83-09-08(C)).

b. Licensee Audits

The following Commonwealth Edison audits of the HVAC contractor were reviewed:

Audit No.	Areas Reviewed
83-31	Qualification Q.C., Weld Material Control, Welder Qualifications, Installation, Inspection Status, and Design Change
82-06	The NRC inspectors' review was limited to Material Traceability and Component Identification.
83-12	Design Document Control, Procurement Control, Storage and Handling, Housekeeping, Q. C. Inspections, Calibration Control, Equipment Installation, Inspector Qualifications, Nonconforming Items, Auditing
82-56	Timeliness of Inspections
82-51	Material Traceability, Drawing Control, Component Documentation, Fabrication

The audits met the requirement of 10 CFR 50, Appendix B, Criterion XVIII, which states, "A comprehensive system of planned and periodic audits shall be carried out to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program"; however, as described in Paragraph 7 the Quality Assurance Program did not meet the requirements of 10 CFR 50, Appendix B. It appeared that a technically qualified, experienced auditor would have identified some of the deficiencies listed in Paragraph 7. For example, one of the questions from Audit 82-06 stated, "Verify that Pullman provides for traceability of safety related materials?". The answer documented by the auditor stated, "Fab tickets contain heat code (MTR) numbers for material and heat numbers for shop welding material. Onsite welding material is traced based upon duct installation date. Welding material distribution log has heat numbers of rod issued to welders on a given day. Only one heat of welding material is kept in oven at one time providing heat traceability". This answer failed to address:

(1) Welding material other than E7018, E308 and E309 rod which was the only filler metal documented in the distribution log and kept in the ovens.

(2) Welding material heat traceability was maintained to the component in the shop but was not being maintained to the component in the field.

(3) Assurance that the correct filler metal type was used and traceable to a specific component. (The duct installation date did not provide assurance.)

The answer demonstrated that the auditor was not fully knowledgeable in AWS D1.1-1977, Section 6, requirements. The qualification, knowledge level, and certification of auditors is considered an unresolved item and will be reviewed further in a subsequent inspection (456/83-09-05; 457/83-09-05).