U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-454/84-31(DRS);
50-455/84-24(DRS)

Docket No. 50-454; 50-455 License No. CPPR-130; CPPR-131

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

Facility Name: Byron Station, Units 1 and 2

Inspection At: Byron Site, Byron, Il
Sargent & Lundy Engineers, Chicago, IL

Inspction Conducted: June 27-28, July 5, July 16-20, August 2-3, 6-10, and September 7, 1984.

Inpsectors: for J. W. Muffett — 10/2/84 Date

for K. D. Ward — 10/2/84 Date

for J. M. Jacobson — 10/2/84 Date

Approved By: D. H. Danielson, Chief
Materials & Processes Section — 10/2/84 Date

Inspection Summary

Inspection on June 27-28, July 5, July 16-20, August 2-3, August 6-10, and Septemer 7, 1984 (Report No. 50-454/84-31(DRS); 50-455/84-24(DRS))
Areas Inspected: Special unannounced inspection of previous inspection findings; a 10 CFR 50.55(e) item; visual examination of various welds on cable trays, hangers and control boards; an allegation; and a review of detailed engineering evaluation of weld discrepancies on various components. The inspection involved a total of 88 inspector-hours by three NRC inspectors on site and 80 inspector-hours at the Regional Office.
Results: No items of noncompliance or deviations were identified.

DETAILS

1. Persons Contacted

Commonwealth Edison Company (CECo)

G. Sorenson, Construction Superintendent
*R. Tuetken, Startup Coordinator
R. Klinger, QC Supervisor
**T. Tramm, Licensing Administrator

Hatfield Electric Company (HECo)

J. Spangler, Lead Welding Inspector (PTL)
D. McCarty, Quality Control Engineer

Sargent & Lundy Engineers

R. W.Hooks, Assistant Head, Structural Engineer Division
K. T. Kostal, Partner

The inspectors also contacted and interviewed other licensee and contractor employees.

*Denotes those attending the final onsite exit interview on July 5, 1984.

**Denotes those attending the final exit concerning analysis on September 7, 1984.

2. Exit Interview

The inspectors met with applicant representatives denoted in Paragraph 1 at the conclusion of the inspection. The inspectors summarized the scope and findings of the inspection noted in this report.

3. Functional or Program Areas Inspected

The details of this inspection are documented in Sections I and II.

SECTION I

Prepared by: K. D. Ward
J. M. Jacobson

1. Licensee Action on 10 CFR 50.55(e) Item

(Closed) 50.55(e) 82-08 (455/82-08-EE): Inspection records do not exist for a significant quantity of high strength bolted connections in the auxiliary building. Also, establish that records do exist for Unit 1 and 2 Containment building connections. The inspector reviewed the final response dated January 14, 1983 and the statistical sampling plan.

During a review of structural steel bolting inspection records for the auxiliary building, fuel handling building, and the river screenhouse, it was determined that inspection records were not available for some of the high strength bolted connections. Specification requirements dictated testing a minimum of 10%, but not less than 2 of the bolts in each connection. Records are not available for inspection of 55.9% of the high strength bolted connections in the auxiliary building/fuel handling building and 49% of those connections in the river screenhouse. The lack of records was caused by a failure to establish an accountability system to indicate the status of inspection completed on the part of one contractor. Adequate records exist for inspection of the bolted structural connections in the containment buildings.

A statistical sampling plan was established to reinspect the high strength bolted connections. This reinspection was performed by the site independent testing contractor in accordance with an approved reinspection procedure.

Only one of 125 reinspected connections did not meet the inspection criteria. Per the sampling plan, reinspection of additional connections was not required.

The one connection which did not meet the inspection criteria was a ten bolt beam connection. One bolt was satisfactory, seven bolts were torqued to 96% of the required inspection torque and two bolts were in place, but were not torqued. This connection was reviewed against the original design loads and it was found that the connection was adequate to support the loads, in the condition that the connection was found at the time of the inspection.

Based on the results of the statistical sampling plan by CECo, it was concluded that the high strength bolted connections have been properly installed.

2. Visual Examination of Systems Control Corp. Welds

The NRC inspectors visually examined the following hanger welds comparing weld maps made by Sargent & Lundy (S&L) and verifying that all defects were correctly identified. It was found that all defects were identified and that the S&L inspectors were very conservative in making the maps and examining the welds.

Weld #	Hanger #	Traveler #	Drawing #	Item #	Random #	No. of Welds
85	14H7	51408	0-3022	109	570	6
86	14H7	51408	0-3022	109	570	6
87	14H7	51408	0-3022	109	570	6
88	14H7	51408	0-3022	109	570	6
89	14H7	51408	0-3022	109	570	6
6	H036	51377	0-3072	14	2099	1
7	H036	51377	0-3072	14	2099	1
8	H036	51377	0-3072	14	2099	6
9	H036	51377	0-3072	14	2099	6
10	H036	51377	0-3072	14	2099	2
11	H036	51377	0-3072	14	2099	6
17	H077	51450	2-3061	21	4429	2
18	H077	51450	2-3061	21	4429	2
19	H077	51450	2-3061	21	4429	6
20	H077	51450	2-3061	21	4429	6
21	H077	51450	2-3061	21	4429	6
4	H051	51376	1-3061	10	3202	8
5	H051	51376	1-3061	10	3202	8
31	H096	51432	0-3063	43	1794	8
32	H096	51432	0-3063	43	1794	8
33	H096	51432	0-3063	43	1794	5
34	H096	51432	0-3063	43	1794	5
35	H096	51432	0-3063	43	1794	4
36	H096	51432	0-3063	43	1794	4
81	H140	51378	0-3062	104	1646	14
82	H140	51378	0-3062	104	1646	1
83	H140	51378	0-3062	104	1646	4
84	H140	51378	0-3062	104	1646	4

The NRC inspectors also visually examined approximately 100 of the following welds which had minor porosity, undercut, surface irregularities, etc. It was determined that all the welds met the intent of the Code. They were shop welds (Systems Control) and field welds (Hatfield), pans welded to unistrut, channel to unistrut, etc.

Hanger #	Drawing #	Hanger #	Drawing #	Hanger #	Drawing #
H097	0-3063	H087	0-3063	H67	2-3061
H098	0-3063	H073	0-3063	H36	2-3061
H100	0-3063	H149	0-30162	H60	2-3061
H102	0-3063	H142	0-30162	H44	1-3061
H104	0-3063	H159	0-30162	H152	1-3061
H084	0-3063	H148	0-30162	H49	1-3061
H085	0-3063	H66	2-3061		

The NRC inspectors also visually examined the welds securing the main control boards in Unit 2 to the floor and found the welds to be acceptable. The welding was not completed and may be completed in the near future. The NRC inspectors also discussed the mounting of the Systems Control control boards with S&L and Hatfield personnel. S&L's

latest drawing, "Electrical Installation, Electrical Equipment - Mounting Details," Drawing No. 6E-0-3391AL, approved 4/3/84, was also reviewed. Hatfield welders were performing the welding.

The NRC inspector visually examined the inside welds of the following items welded by SCC and found them to be acceptable.

- Containment Isolation Panel #2PM11J
- Main Control Board - Generator and Auxiliary Power #2PM01J
- DC Fuse Panel #2DC10J
- Local Instrument Rack #2PL66J
- Local Instrument Rack #2PL75J
- Local Instrument Rack #2PL76J

The NRC inspector reviewed S&L Specification F-2815 "Cable Pans and Hangers",and selected various hanger and cable pan fitting details for inspection of weld quality. Approximately 300 welds were inspected, including welds in the following areas: elev. 439 (location 18-26 at L-Q), elev. 426 (cable spreading rooms), elev. 426 (location 12-16 at Q-V and 19-25 at Q-V) and elev. 414 and 426 (location R 18, inside containment). Weld quality in general appeared acceptable.

No items of noncompliance or deviations were identified.

3. Cable Tray Hanger Connections and 90° Cable Tray Fittings

The NRC inspector reviewed CECo's procedure, "Inspection of Cable Tray Hanger Connections and 90° Cable Tray Fittings". Hatfield visual welding inspection procedures, and training procedure, and several weld inspector qualifications were reviewed and found to be acceptable.

Systems Control Company (SCC) provided cable tray hanger assemblies at Byron. Hatfield installed the components supplied to the site by SCC. In order to address the general concern for weld quality covered in NCRs 850 and 885, a random sample of 80 hangers from the population of 5,717 Systems Control hangers at Byron was identified by Sargent and Lundy for weld inspection. The sample was selected from the population of hangers using a list of random numbers. This selection process ensured that the sample was unbiased and representative of all hangers in the plant. The sample captured all commonly used connection types, including 44 connections that, based on the original design, were deemed to be highly stressed.

The inspections [illegible]ected hangers were performed by Hatfield with verification t[illegible] inspections by CECo's third party inspectors (Sargent & Lundy [illegible] inspectors on loan to Commonwealth Edison). The 80 hangers included 358 Systems Control shop-welded connections. Of the 358 connections inspected from the sample 80 hangers, 252 connections had no discrepancies, and 106 were found to have some form of discrepancies such as underlength, undersize, overlap, undercut, craters, and two connections with missing portions of welds. None of the welds had cracks.

Inspections of cable tray fittings were performed in 1977 pursuant to Commonwealth Edison's Byron NCR 105. NCR 105 was issued in response to the fact that Systems Control did not have approved welder qualifications and procedures. As part of the overall response to the nonconformance, 99 fittings out of approximately 1,200 which were at the Byron site at that time, were inspected by Industrial Contract Services for the purpose of determining SCC weld quality. Both stiffener welds and side channel welds were inspected with no discrepancies found in the stiffener welds. Four fittings were found to have side channel weld discrepancies. These discrepancies included lack of fusion, porosity, and a missing weld attaching a corner bent plate to the cable tray side channel. None of these discrepancies had design significance.

In June 1984 Sargent & Lundy performed an engineering evaluation in order to confirm that the fitting welds are not required to meet structural load-carrying requirements due to the presence of alternate load paths able to carry the cable loading. The evaluation confirmed that the fitting welds are not required to enable fittings to meet load requirements due to the existence of redundant load paths.

However, the evaluation determined that in one configuration, involving the outside fitting weld of a 90 degree fitting, only one load-bearing redundancy exists, the fitting stiffener. The fitting weld therefore is required if the stiffener weld in that corner of the fitting is missing. The condition of a missing stiffener weld at the outside corner of a 90 degree fitting has not been found in any inspection. In order to assure that this condition does not exist, all 90 degree fittings will be inspected and repaired as required.

Approximately 962 90°tray fittings and approximately 3,000 hanger connections were visually examined by CECo's Level IIs, contracted by Daniels. The unacceptable welds found by the Level IIs were reinspected by an S&L Level III who was involved in the reinspection program.

The NRC inspector observed the reinspection of the following Systems Control welds and basically agreed with the interpretation.

90° Tray Fittings Welds	Drawing Number
11516M P2E	6E-1-3061 Rev. V
11516L P2E	6E-1-3061 Rev. V
11491T P2B	6E-1-3061 Rev. V
11610J C2E	6E-1-3061 Rev. V
11612J K2B	6E-1-3061 Rev. V
11647J C2E	6E-1-3061 Rev. V
11659S K2B	6E-1-3061 Rev. V
11588F P1B	6E-1-3061 Rev. V
11588E P1B	6E-1-3061 Rev. V
11683S K2B	6E-1-3061 Rev. V
21693F P1B	6E-1-3061 Rev. V
21693E P1B	6E-1-3061 Rev. V
2P2B (EL. 421'-")	6E-0-3032 Rev. T

2C2B (EL. 420')	6E-0-3032 Rev. T
2P1B (EL. 411'10")	6E-0-3033 Rev. Y
1K1B (EL. 418'11")	6E-0-3031 Rev. AA
1P1E (EL. 420'3")	6E-0-3031 Rev. AA
1C1E (EL. 418'11")	6E-0-3031 Rev. AA

Cable Tray	Connection Welds	Drawing Number
H005/DV8	2 welds	6E-0-3062H
H006/DV8	2 welds	6E-0-3062H
H007/DV8	2 welds	6E-0-3062H
H008/DV8	2 welds	6E-0-3062H
H009/DV8	2 welds	6E-0-3062H
H011/DV8	2 welds	6E-0-3062H
H017/DV8	2 welds	6E-0-3062H
H019/DV8	2 welds	6E-0-3062H
H021/DV8	2 welds	6E-0-3062H
H024/DV8	2 welds	6E-0-3062H
H041/DV8	2 welds	6E-0-3062H
H109/DV8	2 welds	6E-0-3062H
H064/DV8	4 welds	6E-0-3062H
H044/DV8	4 welds	6E-0-3062H
H045/DV8	2 welds	6E-0-3062H
H046/DV8	2 welds	6E-0-3062H
H043/DV8	2 welds	6E-0-3062H
H051/DV8	2 welds	6E-0-3062H
12H5/DV8	2 welds	6E-0-3031 Rev. 8A

No items of noncompliance or deviations were identified.

4. Cable Tray Hanger Connection - Walkdown Training

The NRC inspector reviewed CECo's "Instruction for Walkdown Cable Tray Hanger Connection Welds" and attended the class for the training in accordance with the instruction.

Approximately 100 walkdown personnel (S&L Designers and Engineers) and 7 certified AWS weld inspectors (Daniels personnel) received formal classroom training and practical test using actual mockups which the NRC inspector observed. The practical test consisted of 25 weld details with acceptable welds and welds missing. Records of this training and testing for walkdown personnel are maintained by the S&L overall field coordinator. Records of this training and testing for weld inspectors are maintained by the CECo QC Supervisor.

All accessible Systems Control shop cable tray hanger connections in safety related areas as issued by Sargent & Lundy and directed by CECo were walked down. Any walkdown findings or missing welds were inspected or mapped by certified AWS weld inspectors.

Fireproofing or blockwalls were not a cause for classifying DV-8 or DV-8A connections inaccessible. Where this condition existed, the fireproofing

or blockwall section was removed to establish accessability after review of the condition by CECo.

12H4/DV8	2 welds	6E-0-3031 Rev. 8A
17H1/DV8	2 welds	6E-0-3031 Rev. 8A
12H2/DV8	2 welds	6E-0-3031 Rev. 8A
12H2/DV8	2 welds	6E-0-3031 Rev. 8A
13H20/DV8	2 welds	6E-0-3032H Rev. T
13H15/DV8	2 welds	6E-1-3032H Rev. T

"T" Fitting

1852N P13 (EL. 411'7")	6E-1-3042 Rev. S

No items of noncompliance or deviations were identified.

5. Allegation

Excessive heat input and violation of maximum interpass temperature for automatic welding of 30" primary coolant piping causing ferrite depletion.

NRC Findings

Ferrite is the magnetic phase found in many grades of otherwise non-magnetic austenitic stainless steel weld metals. Ferrite is desirable in weld metal to the extent that it helps prevent cracking and micro fissuring. The cracking of concern here is generally longitudinal centerline cracking or crater cracking, both of which occur during the final stages of solidification. Regarding fissuring, the consensus of experts is that it occurs in welds during the reheating process when an additional bead is deposited next to or over an existing bead. Except in very severe cases, the great bulk of fissures are microscopic in size. In a very notch tough material such as austenitic stainless steel, it would require very unusual service conditions to adversely affect the service life of the structure. From a practical viewpoint, millions of pounds of multipass fully austenitic weld metal have been used in production weldments with virtually no failures attributable to fissures (The Welding Journal, July 1974). It is generally recognized that a weld metal ferrite content of as little as 3FN is sufficient to prevent cracking or fissuring. Weld metal ferrite content is determined primarily by three factors in descending order of importance: weld electrode chemistry, nitrogen pick up during welding and heat input or cooling rate. The ASME B&PV Code, Section III, Subsection NB, requires that welding electrode and filler metal be capable of depositing weld metal with a minimum ferrite of 5FN. The alleger contends that the heat input of the welds was too high and that the welds do not contain adequate ferrite.

Beginning with the welding electrode chemistry, the inspector reviewed 23 Certified Material Test Reports and found all to meet or exceed ASME Code requirements, 7 out of the 23 were for use with automatic welders. These 7 CMTRs represented the automatic welding of approximately 65 welds.

The inspector then reviewed Hunter Corp.'s (the welding organization) Quality Control Surveillance Reports dating 1/74 through 7/80. Ferrite determinations were made with a Severn gage on most of the welds. Thirty welds were picked at random, and were reviewed for ferrite determinations. All welds were reported to have adequate ferrite content.

Eleven welds in the plant were selected by the inspector to physically measure ferrite range with a Severn gage. Of these 11 welds, 6 were chosen to verify the Quality Control Surveillance effort. All welds were found to contain adequate ferrite and the results agreed with those reported by the surveillance documentation.

This allegation could not be substantiated and is considered closed.

SECTION II

Prepared By: J. W. Muffett

1. Review of Engineering Analysis of Various System Control Corporation (SCC) Supplied Equipment and Components

Certain SCC supplied equipment was identified as having discrepant welds per AWS D1.1. The details concerning the history of these problems are contained in Inspection Report 50-454/84-32(DRP).

The equipment addressed by the detailed engineering analysis are:

- Main Control Boards
- DC Fuse Panels
- Local Instrument Racks
- Solid Bottom Cable Trays
- Solid Bottom Cable Tray Fittings
- Ladder Trays and Fittings
- Cable Tray Hangers

These analyses address either specific discrepancies identified in inspections or whether types of welds which were found to be discrepant were required for structural adequacy.

a. Main Control Boards-Open Item 454/84-32-01; 455/84-25-01 (Closed)

Westinghouse reports WCAP-10390, "Service Qualification of the Byron/Braidwood Main control Board", and WCAP-10412, "Seismic Qualification of the Byron/Braidwood Main Control Room Control Panels and Remote Shutdown Panels", were reviewed. These reports demonstrate the structural adequacy of these components in their "as-built" condition. This closes open item 454/84-32-01; 455/84-25-01.

b. DC Fuse Panels (1DC10J, 1DC11J, 2DC10J, 2DC11J)

The Sargent & Lundy document "Seismic Qualification of DC Fuse Panels" was reviewed along with the weld maps of the DC fuse panels. Also, the Wyle seismic test report of DC fuse panel 1DC10J was reviewed. During the course of the Sargent & Lundy inspections it was discovered that panel 2DC10J was discrepant enough so that the results of the test of panel 1DC10J did not apply. Therefore a detailed engineering analysis of panel 2DC10J was performed. This analysis was also reviewed. All stresses in the members and in the welds are within Code allowables. The highest stress in a weld is only 38% of the Code allowable. These analyses demonstrate that all the DC fuse panels are adequate to perform their design functions.

No items of noncompliance or deviations were identified.

c. Local Instrument Racks

A number of Sargent and Lundy documents and analyses concerning the

local instrument racks have been reviewed: "Evaluation of 17 Local Instrument Panels Inspected by Sargent and Lundy", "Determination of Total Weld Length, Area, and Discrepancies for SCC Panels 1PL54J, 1PL71J, 1PL78JA, and 1PL60JA", "Seismic Qualification of Local Instrument Panels", and Wyle Laboratories "Seismic Qualification Test Report of a Local Instrument Rack."

These analyses use two methods to demonstrate the adequacy of these panels. The first is comparison of the panels with a panel which was subjected to a qualification test (the Wyle lab test). The second is a detailed engineering evaluation. Both of these methods demonstrate the adequacy of the panels. The most highly stressed weld was stressed to 10% of the Code allowable.

No items of noncompliance or deviations were identified.

d.

Solid Bottom Cable Trays-Open Item 454/84-32-05; 455/84-25-05 (Closed)

The Sargent & Lundy calculation 98.20.1-3, "Effect of Missing Stiffeners on Cable Tray Design" was reviewed. This calculation demonstrates that the stiffener is not required for the cable trays to perform their design function. This effectively addresses the question of the effect of missing or discrepant welds on the cable tray stiffeners. Therefore the structural adequacy of the solid bottom cable trays has been shown. This closes open item 454/84-32-05; 455/84-25-05.

e.

Solid Bottom Cable Tray Fittings-Open Item 454/84-32-06; 455/84-25-06 (Closed)

The Sargent & Lundy calculation "Cable Tray Fittings" (12.2.139) was reviewed. This analysis of cable tray tees, crosses, and elbows shows that with one qualification, fitting welds are not required to carry design loads. The qualification pertains to 90° fittings. On the outside of those fittings only two load paths exist; the fitting weld and the fitting stiffener weld. Therefore, if either weld is missing or otherwise incapable of carrying the requisite load (i.e. cracked) the other weld must be capable of carrying the design load. To provide assurance that there is no 90° fitting with two inoperative load paths, all 90° fittings have been inspected for missing fitting welds. No fittings were discovered which were incapable of carrying their design loads. This closes open item 454/84-83-06; 455/84-25-06.

f.

Ladder Trays and Ladder Tray Fittings-Open Item 454/84-32-07; 455/84-25-07 (Closed)

The Sargent & Lundy calculation "Ladder Type Cable Tray Weldment Evaluation" was reviewed and found acceptable. Two conclusions are drawn by this analysis. They are: (1) the worst strength

reduction found in the sample of straight ladder trays could be applied to any connection on the straight ladder trays and these components could still carry their design loads; (2) the worst strength reduction found in the sample of ladder fittings could be applied to any connection or any ladder fitting and these components could still carry their design loads. Therefore this analysis demonstates the structural adequacy of the ladder trays and the ladder tray fittings. This closes open item 454/84-32-07; 455/84-25-07.

g. Cable Tray Hangers-Noncompliance 454/84-32-08; 455/84-25-08 (Open)

In a number of cases deficiencies were identified in the welds associated with the cable tray hangers. These deficiencies lead to a series of inspection programs dealing with this issue.

(1) CECo and Sargent & Lundy initially inspected and evaluated approximately 300 welded connections. None of these connections exceeded applicable Code allowables for stress. Nevertheless some large strength reductions were apparent in this sample (53% strength reduction). The deficiencies causing these large strength reductions were of a nature that they could not be tolerated by all connections. Therefore, a second inspection program was started, based on the largest strength reduction found in the initial sample (53% strength reduction).

(2) The second program inspected and evaluated all connections which could not tolerate a 53% strength reduction. During this inspection a connection was found which had a significantly larger strength reduction (92% strength reduction). This was evidence that the 53% strength reduction was not the worst case. This lead to a much more comprehensive inspection program.

(3) In the third inspection program all connection types DV-8 and DV-8A were inspected for missing welds and all other accessible connections were inspected for missing welds. Under the provisions of this program, if a connection type was found to have a strength reduction greater than 53% then all of that connection type would be inspected for missing welds. At this time approximately 30,000 connections have been inspected. Approximately 550 connections classified as inaccessible now require inspection and remain to be completed. This noncompliance remains open (Reference 454/84-32-08; 455/84-25-08).

These inspection programs have been reviewed in all stages by the inspectors. These reviews included review of weld maps, weld evaluations, program plans, personnel testing, training and actual observation of welds. No noncompliances or deviations from commitments have been identified in these cable tray hanger inspection programs.

h. Observations

A number of observations were made during the review of these analyses. They are as follows:

1. Ladder Tray Fittings - In some configurations the pipe rung of a ladder tee or cross intersects the sidechannel at an angle of 45°. The original analysis for determining the strength of this connection did not take into account the reduction in effective throat at the 45° intersection. Sargent & Lundy was notified of this problem and performed a reanalysis which has been reviewed and found acceptable. Therefore, this observation has no effect on the conclusions drawn relative to ladder tray fittings.

2. Solid Bottom Cable Trays - In the original calculation "Effect of Missing Stiffeners on Cable Tray Design" the methodology of combining seismic response did not adhere to the methodology to which the Byron Plant is committed in the FSAR. Sargent & Lundy was notified of the problem and performed a reanalysis using the proper combination methodology. The reanalysis has been reviewed and found acceptable. Therefore, this observation has no effect on the conclusions drawn relative to solid bottom cable trays.

i. Conclusion

No items of noncompliance or deviations were identified. The inspection of the final analyses revealed no violation of FSAR commitments as they pertain to design and analysis. Also, the procedures dealing with the performance of these analyses were functioning properly. Therefore, the structural adequacy of the SCC supplied components covered in this report has been demonstrated.