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July 11, 1984

Ivan W. Smith, Esquire
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U.S. Nuclear Regulatory
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Dr. Richard F. Cole
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Dr. A. Dixon Callihan
Administrative Judge
Atomic Safety and Licensing Board
c/o Union Carbide Corporation
P.O. Box Y
Oak Ridge, Tennessee 37830

Re: In the Matter of Commonwealth Edison Company
(Byron Nuclear Power Station, Units 1 and 2)
Docket Nos. 50-454 and 50-455 OL

Gentlemen:

As promised in my letter of June 28, Commonwealth Edison Company is providing the Board and the parties with the typeset version of The Supplement to the Report on the Byron QC Inspector Reinspection Program, plus errata and addenda to the original report.

Please excuse our delay in providing this version, as it has only very recently become available.

Very truly yours,

Mark C. Furse

Mark C. Furse
One of the Attorneys for
Commonwealth Edison Company

MCF:reg
Enclosure
cc: Service List

Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
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RELATED CORRESPONDENCE

July 3, 1984

DOCKETED
USNRC

'84 JUL 16 A10:53

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

Mr. James G. Keppler
Regional Administrator
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: Byron Generating Station Units 1 and 2
Byron QC Inspector Reinspection Program
I&E Inspection Report Nos. 50-454/82-05 and
50-455/82-04

References (a): L. O. DelGeorge letter to J. G. Keppler
dated February 24, 1984

(b): L. O. DelGeorge letter to J. G. Keppler
dated June 27, 1984.

Dear Mr. Keppler:

Attached is the bound version of the supplement dated June, 1984 to the report on the Byron QC inspector reinspection program which was submitted in reference (a). This document provides the results of the supplemental inspections and evaluations to which we committed in the February final report. Aside from the printing and binding, it is identical to the version provided in reference (b).

Errata and addenda to the February report are also included. The errata and addenda are printed in a form suitable for replacement of pages in the February reinspection program report. They are otherwise identical to the version provided in reference (b). These changes are necessary to correct typographical errors and clerical errors introduced during the preparation of computerized weld inspection tabulations for the February report. These clerical errors resulted in the omission of reinspection results for a number of welds and overstatement of the number of weld discrepancies. Our review of the corrected data does not alter any of our conclusions regarding either the adequacy of QC inspections or the quality of construction at Byron. Minor additions to Appendix C are also being made to more accurately report the findings and conclusions regarding the Category Y engineering evaluations of Hatfield Electric and Pittsburgh Testing. Chapter VII is being revised to incorporate the results of the supplemental inspections and evaluations reported in the supplement. Any line which has been revised is marked with an "R1" in the margin.

One signed original and nineteen copies of this letter and the attachments are provided for NRC review.

Please direct any questions regarding this matter to this office.

Very truly yours,

L. O. DelGeorge
Assistant Vice President

lm

Attachment

cc: Mr. H. R. Denton (NRR) w/20 copies
Mr. R. C. DeYoung (IE Headquarters) w/20 copies

8788N

SUPPLEMENT

TO

REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

DOCKET NOS. 50-454 AND 50-455

June, 1984

SUPPLEMENT TO REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

CONTENTS

I. INTRODUCTION

The Byron QC Inspector Reinspection Program was established to verify the effectiveness of former certification practices and QC Inspector Qualification programs by reexamining, on a sampling basis, inspections performed by QC Inspectors certified prior to September, 1982. The Reinspection Program was completed and confirmed the adequacy of inspector activities at the Byron Station.

Although the Reinspection Program focused on an assessment of individual inspector qualifications and contractor certification practices, a significant amount of work quality data was accumulated. Observed discrepancies were evaluated for their significance to the design and the quality of construction work at Byron was determined to be adequate.

This supplement provides the results of supplemental inspections and evaluations which Commonwealth Edison committed to in the Report on the Byron QC Inspector Reinspection Program, Feburary 1984 (hereinafter referred to as the Reinspection Program Report). These supplemental inspections and evaluations covered subjective weld attributes for Hatfield Electric Company and Pittsburgh Testing Laboratory and objective attributes for Hatfield Electric Company.

II. SUPPLEMENTAL INSPECTIONS AND EVALUATIONS FOR SUBJECTIVE WELD ATTRIBUTES FOR HATFIELD ELECTRIC AND PITTSBURGH TESTING

A. INTRODUCTION

Appendix C to the Reinspection Program Report included commitments to perform supplemental inspections and evaluations (see Exhibit C-2, pages 10 and 13). These supplemental inspections included highly stressed welds for Hatfield Electric and Pittsburgh Testing and welds with overlap for welds inspected by Pittsburgh Testing. The engineering evaluation of weld discrepancies noted in these supplemental inspections and evaluations followed the same process described in Exhibit C-2 of Appendix C in the Reinspection Program Report.

B. HATFIELD ELECTRIC

Two sets of supplemental inspections were performed. One set of evaluations involved identifying highly stressed welds from the population of Hatfield Electric subjective weld discrepancies identified in the Reinspection Program. The other set of inspections involved highly stressed welds inspected by inspectors whose work was not reinspected in the Reinspection Program. The supplemental inspections and evaluations completed for Hatfield Electric show that the highly stressed welds are capable of carrying the design loads even with the presence of weld discrepancies.

1. Highly Stressed Welds Within Reinspection Program

This evaluation considered the highly stressed connection welds from the entire population of Hatfield Electric weld discrepancies in the Reinspection Program. The type of supports which have the highest stressed welds are cable tray supports. Cable tray support connections fall into four basic groups:

- auxiliary steel connections to in-place building steel,

- top connections for supports to auxiliary or in-place building steel,

- internal connections for support members to vertical members, and

- cable tray hold down connections to horizontal support members.

The cable tray supports associated with the discrepant welds shown in Table C-1 of Appendix C to the Reinspection Program Report were identified. The design margins for the connections in each group were then tabulated. Then at least 15 supports having highly stressed connections from each of the four groups were selected for weld mapping and evaluation. The weld maps were used to determine the reduction in weld strength based on the mapped weld discrepancy. The results of the engineering evaluation are shown in Table SCE-9.

Table SCE-9[1]

Results of AWS Weld Discrepancy Evaluation for Highly Stressed Cable Tray Welds - Hatfield Electric

		Weld Discrepancy Category[2]			
		A	B1	B2	C
Weld Type	No. of Weld Discrepancies	No Structural Impact	Weld Strength Reduced by < 10%	Weld Strength Reduced by ≥ 10%	Weld Rejected (Cracks)
Auxiliary steel connections	21	0	4	17	0
Top connections for supports	16	0	3	13	0
Internal connections for supports	17	0	4	13	0
Cable tray hold-down	15	0	8	7	0
TOTAL	69	0	19	50	0

Notes for Table SCE-9

1. The format of Table SCE-9 corresponds to Table CE-9 in Exhibit C-2 of Appendix C of the Reinspection Program Report.
2. For definition, refer to page 1 in Exhibit C-2 of Appendix C of the Reinspection Program Report.

The results of the engineering evaluation showed that each weld is capable of carrying the design loads; thus, structural integrity is not impaired. This evaluation demonstrates that 69 highly stressed cable tray connections with weld discrepancies are capable of carrying the design loads.

2. <u>Highly Stressed Welds Outside the Reinspection Program</u>

This inspection addressed highly stressed welds for the 10 Hatfield weld inspectors whose work was not reinspected during the Reinspection Program.

Approximately 60 highly stressed welded connections from the four groups of cable tray support welds were reinspected for the 10 Hatfield inspectors' work. A total of 187 welds were mapped. The types of weld discrepancies identified were similar to the discrepancies in the welds identified in the Reinspection Program.

The results of the engineering evaluation of these connections are shown in Table SCE-9A.

Table SCE-9A

Results of AWS Weld Discrepancy Evaluation for Highly Stressed Cable Tray Welds Outside the Reinspection Program - Hatfield Electric

		Weld Discrepancy Category			
		A	B1	B2	C
Weld Type	No. of Weld Discrepancies	No Structural Impact	Weld Strength Reduced by < 10%	Weld Strength Reduced by ≥ 10%	Weld Rejected (Cracks)
Auxiliary steel connections	40	0	19	21	0
Top connections for supports	29	0	11	18	0
Internal connections for supports	30	0	12	18	0
Cable tray hold-down	88	0	48	39	1
TOTAL	187	0	90	96	1

In the case where a cracked cable tray hold-down weld was found during these additional inspections, the other welds in the connection were capable of carrying the load. The engineering evaluation of these highly stressed welds showed that each weldment is capable of carrying the design loads even with the presence of weld discrepancies.

3. Conclusion

The results of the supplementary evaluations complement the results of the Reinspection Program and give a total of 356 weld maps of discrepant welds which have been evaluated (50 randomly selected weld maps and 50 weld maps containing the most weld discrepancies from the Reinspection Program; 69 weld maps from highly stressed cable tray support welds; and 187 weld maps for highly stressed welds for weld inspectors not included in the Reinspection Program). These evaluations, which revealed no design significance, result in a reliability of better than 99% which is consistent with the previous conclusions reached concerning the quality of Hatfield Electric's work.

4. Additional Inspections and Evaluations

As noted previously, none of the weld discrepancies in the Reinspection Program or in the supplemental inspections and evaluations described herein impair the structural integrity of any structure or component. However, there were three types of discrepancies which resulted in a considerable reduction in load-carrying capacity. Even though these conditions were found to be acceptable for the highly stressed elements reviewed in the program, additional inspections and evaluations were performed to provide assurance of the adequacy of the entire plant. The three types of discrepancies for which additional inspections were undertaken are categorized as follows:

- Conduit support weldments
- Cable tray support connections with fit-up gap
- Cable tray support internal diagonal member connection

a. Conduit Support Weldment

The Reinspection Program identified two cases where a portion of the weld was omitted from a weldment for a conduit support connection. The weldment consisted of four individual welds of which two welds were omitted. In order to assess the effect of such an omission anywhere in the plant, a sampling plan was developed to inspect this type of weldment. A randomly selected sample of 489 of these weldments out of an approximate total population of 3,000 were examined to determine if all required welds had been made. In this examination, two supports were identified where the specified welds had been omitted. Based on the as-built conditions of these supports, an evaluation was made and it was determined that the conduit loads could be accommodated by the discrepant supports or by redistribution of loading to adjacent supports. Therefore, it has been demonstrated, with greater than 99% reliability at a 95% confidence level, that the structural integrity of the conduit system is adequate.

These favorable engineering evaluation results are due to the fact that the original conduit and conduit support design have design margins. Conduit supports are generally spaced closer than the maximum conduit span requirements because of physical limitations in the plant. Furthermore, the supports are initially selected from typical details. The typical details are designed using peak seismic responses for a given area of the plant. Support selection is also based on loads which assume maximum cable loads in each conduit. When individual supports are reviewed using actual cable loads and more exact seismic analysis, there is sufficient design margin available to accommodate the weld discrepancy.

b. Cable Tray Support Connections with Fit-Up Gap

The supplemental Hatfield Electric inspections identified recurring cases of welds with a fit-up gap. The engineering evaluations of these discrepancies conservatively assumed a considerable reduction in the load-carrying capacities of these connections. To assess the actual effect on weld capacity due to a fit-up gap, a supplemental test program was established. Ten fillet welded specimens with representative fit-up gap were prepared using the applicable Hatfield

Electric weld procedure. These specimens were strength tested, and the test results indicated that there was no reduction in strength of the weld due to the fit-up gap. Therefore, it was concluded that the fit-up gap that was identified in the Reinspection Program had no effect on the capacity of similar cable tray connections in the plant.

c. Cable Tray Support Internal Diagonal Member Connection

In the Reinspection Program and the supplemental Hatfield inspections, some of the connections for cable tray support diagonal member connections did not conform to the design configuration. In the worst case, a partial penetration weld was used instead of the specified fillet weld. The engineering evaluation of this case assumed that this diagonal did not carry any load and demonstrated that the support could still accommodate the design loads. Although the support was adequate, in order to address the effect of this type of discrepancy on the entire plant, the actual strength of this weld was investigated. The diagonal member with the welds in question was removed from the cable tray support and cross-sections of the welds were macroetched to determine the depth of weld penetration. Based on the results of this supplemental test, it was determined that the as-built welds had less than a 10% reduction in capacity from that calculated for the original fillet welds. Therefore, this type of discrepancy has no design significance and can be accepted for other such cases in the plant.

C. PITTSBURGH TESTING

The supplemental evaluations and inspections completed for Pittsburgh Testing show that: (1) highly stressed welds inspected by Pittsburgh Testing are capable of carrying the design loads and (2) weld discrepancies involving overlap do not mask other discontinuities or reduce the weld capacity.

1. Highly Stressed Welds

This evaluation considered the highly stressed connection welds from the entire population of welds inspected by Pittsburgh Testing with weld discrepancies in the Reinspection Program.

The design margin for each of the 905 welds shown in Table C-1 of Appendix C of the Reinspection Program Report was determined using the design loads and weld properties. Forty-three highly stressed welds were identified, and detailed weld map were prepared showing all weld discrepancies. The results of the evaluations for the discrepant welds in the highly stressed connections are shown in Table SCE-11.

Table SCE-11*

Results of AWS Weld Discrepancy Evaluation for Highly Stressed Welds Inspected by Pittsburgh Testing

	Weld Discrepancy Category			
	A	B1	B2	C
No. of Weld Discrepancies	No Structural Impact	Weld Strength Reduced by < 10%	Weld Strength Reduced by ≥ 10%	Weld Rejected (Cracks)
43	0	28	15	0

*Note: The format of this table corresponds to Table CE 11 in Exhibit C-2 of Appendix C of the Reinspection Program Report.

The results of the engineering evaluation showed that each weld is capable of carrying its design load. The results of this evaluation complement the results of the Reinspection Program and give a total of 107 weld maps of discrepant welds inspected by Pittsburgh Testing which have been evaluated (14 randomly selected weld maps and 50 weld maps containing the most weld discrepancies and 43 highly stressed welds). None of the discrepancies had design significance.

2. Welds with Overlap

These supplemental inspections were initiated to address Pittsburgh Testing's failure rate for the inspection of welds with overlap. The presence of overlap may make visual weld quality inspection more difficult since overlap can mask other discontinuities. The third-party inspector identified the 51 welds from the 905 weld discrepancies which had the most severe cases of overlap. The overlapped portion of these welds was removed by grinding and the weld was then reinspected. In all cases, the remaining weld was at least the size specified by the design. These welds revealed no other discrepancies.

Because it was found after grinding that no other discontinuities were masked by overlap and that the weld size remained within the specified limit, it is concluded that the amount of overlap present on welds inspected by Pittsburgh Testing has no impact on the capacity of the welds.

III. SUPPLEMENTAL INSPECTIONS AND EVALUATIONS FOR OBJECTIVE ATTRIBUTES FOR HATFIELD ELECTRIC

A. INTRODUCTION

Appendix D to the Reinspection Program Report included commitments to do additional inspections for Hatfield Electric objective attributes where the sample size was not statistically significant. These supplemental inspections are described in Note 5 to Table DE-5, in Exhibit D-1 of Appendix D of the Reinspection Program Report, and include equipment setting, equipment modifications, A325 bolting, and conduit support bolting.

B. EQUIPMENT SETTING

The work reinspected as part of the Reinspection Program did not include any reinspection of equipment setting. In order to complete the data base, the setting of 50 randomly selected pieces of safety-related electrical equipment from a total population of approximately 250 have been reinspected. A total of 778 items were inspected and 34 discrepancies were identified. An evaluation was made to determine whether or not the observed discrepancies have any design significance. The result of this evaluation is that none of the observed discrepancies has design significance. The majority of the discrepancies consist of equipment anchoring details with weld length and weld spacing deviations. The equipment anchoring details were determined to be adequate because of the conservatism which was used in the determination of design anchorage loads.

The only deviation which resulted in a significant reduction of strength was a hold-down weld detail for 4160 volt switchgear. In this detail, welds on the two short sides of a four-sided weld were omitted. In order to evaluate the overall effect of this discrepancy it was assumed that all of the 4160 volt switchgear had this discrepancy. Because of the conservatism in the original equipment anchorage loads, it was determined that the as-built condition was adequate to support the required loads.

A few discrepancies involved discontinuities in the equipment grounding connection. The discontinuities were determined to be acceptable because of the presence of an alternate grounding connection in each case.

C. EQUIPMENT MODIFICATION

The work reinspected as part of the Reinspection Program included reinspection of 27 items associated with equipment modification. This sample was too small to permit meaningful reliability calculations. In order to expand the data base, an additional random sample of 50 pieces of safety-related electrical equipment out of a total population of 250 have been reinspected. Equipment modification work is, in large part, not recreatable. Several modifications may be made to the same equipment. A subsequent modification may alter a previous modification. Modifications may be made by the electrical contractor, the equipment supplier, Commonwealth Edison Operational Analysis Department, or Commonwealth Edison Byron Station personnel.

To accomplish the supplemental reinspection of equipment modification, a 100% wiring inspection was made. A total of 1,850 items covering a considerably larger number of inspection points were inspected and 44 discrepancies were identified. An evaluation was made to determine whether or not the observed discrepancies had any design significance. The result of the evaluation is that none of the observed discrepancies has design significance. The discrepancies are primarily minor wiring variations that do not affect the functioning of the equipment.

D. A325 BOLTING

In the Reinspection Program only eight cases of A325 bolting in electrical supports were reinspected. In order to expand this data base, an additional random sample of 51 supports out of a total population of 169 supports using A325 bolted connections were reinspected. The engineering evaluation established an acceptance criteria taking into account bolt relaxation and measurement accuracy. Of the 295 bolts which were reinspected on these supports, 46 bolts did not meet this acceptance criteria. The design of the associated connections was reviewed, and it was determined that these connections are adequate as bearing rather than friction type connections. Although these discrepancies have no design significance, because of the number of discrepancies found, a retorquing of all Hatfield A325 bolting installation has been initiated. Any discrepant conditions will be corrected.

E. CONDUIT SUPPORT BOLTING

The work reinspected as part of the Reinspection Program did not include checking the torque level of conduit support bolting. Conduit support bolt torque was deemed not recreatable because it could not be associated with an individual inspector. In order to resolve questions concerning conduit support bolting, 305 randomly selected supports were reinspected from a total of approximately 25,000. A total of 1,008 bolts were inspected. Torque values were recorded for any bolt with torque less than the minimum installation criteria. The engineering evaluation established an acceptance criteria taking into account bolt relaxation and measurement accuracy. Thirty-four bolts did not meet this acceptance criteria. These conditions were evaluated and found to have no design significance because the loads would be carried by the adjacent supports.

In this process of inspecting conduit support bolt torques, two clamps with four bolts were found missing. Based on our concern for missing clamps and bolts, a walkdown of the critical clamps was undertaken. A critical clamp is typically located where a conduit terminates. There were 8,532 cases included in this initial walkdown and ten cases were found with missing bolts or clamps. The walkdown of the remaining accessible conduit is continuing to ensure that conduit clamps and bolts are in place. Any missing bolts or clamps will be restored.

F. CONCLUSION

The supplemental inspections and evaluations which have been conducted for Hatfield Electric objective attributes confirm the adequacy of the quality of work.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Insert the following page behind the first title page.

ERRATA AND ADDENDA

TO

REPORT ON THE BYRON

QC INSPECTOR

REINSPECTION PROGRAM

The following pages contain errata and/or addenda:

<u>Page Numbers</u>

ES-4, 6
VI-5, 6
VII-2, 9, 10, 11, 12, 13
Exhibit VII-1 page 3, 5
A-6
B-6
C-1, 2, 4,
Exhibit C-1 page 3, 4
Exhibit C-2 page 2, 7, 8, 9, 11
F-6

June, 1984

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page ES-4

Table ES-1
Reinspection Program Summary
Line Indicating Revision
Change 26,660 to 27,538
Change 92.0% to 92.8%
Change 86,905 to 87,783

Line Indicating Revision
Change 44,980 to 45,858
Change 201,906 to 202,784

(The revised page for the Reinspection Program Report follows.)

D. BYRON REINSPECTION PROGRAM RESULTS

The results of the Reinspection Program are summarized by contractor in Table ES-1. This table also delineates the number of reinspections performed as part of the Program.

Table ES-1
Reinspection Program Summary

Contractor	No. of Objective Inspections*	Objective Inspection Results Acceptable[1]	No. of Subjective Inspections**	Subjective Inspection Results Acceptable[2,3]	Total Objective and Subjective Inspections	
Blount Brothers	2,390	98.8%	NA	NA	2,390	
Johnson Controls	7,812	99.4%[4]	1,459	95.5%[4]	9,271	
Hunter	69,624	99.0%	3,725	97.0%	73,349	
NISCo	2,792	99.6%	229	100.0%	3,021	
Hatfield Electric	60,245	96.5%	27,538	92.8%	87,783	R1
Powers-Azco-Pope	8,047	96.3%[4]	6,607	86.2%[4]	14,654	
Pittsburgh Testing	6,016	98.9%	6,137	85.3%[4]	12,153	
Peabody Testing	0	NA	163	75.5%[5]	163	
TOTAL	156,926		45,858		202,784	R1

* From Appendix D, Table D-1.
** From Appendix C, Table C-1.

Notes for Table ES-1:

1. Program acceptance criterion is 95%.
2. Program acceptance criterion is 90%.
3. Includes concurrence by third-party inspector.
4. 100% of inspectors sampled; 100% of accessible work for inspectors not meeting acceptance criterion reinspected.
5. 100% of inspectors sampled; 100% of accessible work reinspected.

As can be seen from Table ES-1, over 200,000 reinspections were performed as part of the Byron Reinspection Program. All seven contractors performing objective inspections exceeded the acceptance criterion. Four of seven

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page ES-6

Section 3. - Plant Quality Inferred From the Reinspection Program
Line Indicating Revision
Change 44,980 to 45,858
Change 4,132 to 4,001

(The revised page for the Reinspection Program Report follows.)

surveillances, and evaluations implemented as part of this quality program further assure us that the results of the Reinspection Program are representative of the overall plant quality.

2. Plant Quality Inferred From Inspector Qualification

The Reinspection Program validates the adequacy of the inspector training and certification programs in use prior to September 1982 for six out of eight contractors reviewed. These contractors are responsible for 88% of the total work at Byron. This ensures that all work performed by these contractors was adequately inspected, from which it can be inferred that the contractors' construction work is of good quality.

3. Plant Quality Inferred From the Reinspection Program

For the objective inspections, a total of 156,926 items were reinspected, and 3,247 discrepancies were noted. For the subjective inspections, a total of 45,858 items were reinspected, and 4,001 discrepancies were noted. The R1
evaluation of these subjective and objective discrepancies showed that many of the discrepancies are insignificant or do not affect the design (e.g., chipped paint, documentation, measured dimensions different than those of the original inspector but still within design tolerance, etc.). The remaining discrepancies which had potential for affecting the design were evaluated further. This engineering evaluation showed that these discrepancies had no design significance. This provides direct evidence of the quality work at the Byron Station.

F. CONCLUSIONS

1. The Byron Reinspection Program has been completed in accordance with the agreement reached with the NRC staff.

2. The Program verified that the vast majority of inspectors whose work was reinspected passed the established acceptance criteria and were qualified (see Table ES-2).

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page VI-5

Line Indicating Revision
Change 2,117 to 1,986
Change 11 to 8
Change 2,064 to 1,936

Line indicating Revision
Change 1 to 10
Change 887 to 878

Line Indicating Revision
Change 4,132 to 4,001
Change 253 to 259
Change 3074 to 2937

Line Indicating Revision
Change 253 to 259

(The revised page for the Reinspection Program Report follows.)

C. RESULTS OF ENGINEERING EVALUATION

1. Subjective Discrepancy Evaluation

The results of the subjective discrepancy evaluations for each contractor are summarized in Table VI-1.

Table VI-1
Summary of Subjective Discrepancy Evaluation Results

Contractor	No. of Discrepancy Evaluations	Category X No. Within Parameters	Category Y No. Acceptable by Judgment	Category Z No. Acceptable by Calculation	No. with Design Significance	
Blount Brothers*	0	N/A	N/A	N/A	N/A	
Johnson Controls	65	15	12	38	0	
Hunter	109	25	23	61	0	
NISCo	0	N/A	N/A	N/A	N/A	
Hatfield Electric	1,986	8	1,936	42	0	R1
Powers-Azco-Pope	914	201	77	636	0	
Pittsburgh Testing	905	10	878	17	0	R1
Peabody Testing	22	0	11	11	0	
TOTAL	4,001	259	2,937	805	0	R1

*Inspection of Blount Brothers was performed by Pittsburgh Testing. Inspection results are reported under Pittsburgh Testing.

Table VI-1 shows that 259 of the discrepancies (6%) identified in the Reinspection Program are not "valid" discrepancies and represent work that is within current design parameters. The Category X discrepancies result primarily from design parameters that have been expanded since the time of the original inspection. Therefore, the observed discrepancies are actually within current design limits. R1

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page VI-6

Line Indicating Revision
Change 3,074 to 2,937

Line Indicating Revision
Change 19% to 20%

(The revised page for the Reinspection Program Report follows.)

The Category Y evaluation covered 2,937 of the weld discrepancies (74%) wherein weld capacity was reduced by approximately 10% after accounting for the weld discrepancy. In all cases the margin remained within the specified design limits. R1

The Category Z evaluation covered 805 of the weld discrepancies (20%). The reduction in weld capacity varied after accounting for the weld discrepancy. However, in all cases the design margin remained within the specified design limits. R1

The engineering evaluation of subjective discrepancies has shown that none have design significance.

A detailed presentation of subjective discrepancy evaluation is contained in Appendix C.

2. Objective Discrepancy Evaluation

The results of the objective discrepancy evaluations for each contractor are summarized in Table VI-2.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page VII-2

Line Indicating Revision
Added phrase and changed 156,926 to 160,857
Line Indicating Revision
Change 44,980 to 47,676
Line Indicating Revision
Added word "objective"
Line Indicating Revision
Added sentence
Line Indicating Revision
Added footnote

Add Page VII-2A

(The revised pages for the Reinspection Program Report follow.)

uniformly effective, performed most of his work after September 1982. The vast majority of the work performed prior to September 1982 was reinspectable, and 100% of that reinspectable work for all inspectors failing to pass the Program acceptance criteria was reinspected. Because no discrepancy of design significance was identified, the quality of work was shown to be good. Peabody Testing had too little reinspectable work from which conclusions on certification program effectiveness could be drawn. However, this contractor had a very limited scope of work (0.2% of the site total), most of which was overinspection of other contractors or inspections overseen by Commonwealth Edison personnel. Inasmuch as 100% of this contractor's reinspectable work was reinspected and no discrepancy with design significance was found, the good quality of this contractor's work can be inferred.

3. The Reinspection Program and supplemental inspections* subsequent to the Reinspection Program resulted in a total of 160,857 objective inspections and a total of 47,676 subjective inspections being repeated by currently qualified inspectors. These reinspections ranged over a wide variety of plant work items. Engineering evaluation of all observed objective discrepancies showed that none had design significance. Engineering evaluation of all subjective discrepancies for six contractors and a representative sample of discrepancies for Hatfield Electric and Pittsburgh Testing Laboratories showed that none had design significance. This data supports the inference that the quality of work for all eight contractors in the Reinspection Program was good. R1 R1 R1 R1

The remainder of this chapter elaborates upon and substantiates these points.

B. MANAGEMENT APPROACH TO ENSURE QUALITY OF CONSTRUCTION

Commonwealth Edison has implemented a comprehensive quality program to assure that the Byron Station is constructed properly and is of high quality. The program begins prior to award of contracts by requiring that procurement documents include commitments to specific quality requirements and it continues

* These supplemental inspections were performed as a result of comm[illegible]s to the NRC staff. R1

throughout the construction phase. The essence of the approach is the provision of many independent layers of inspection and review of field installations to assure compliance with requirements and, thereby, to ensure quality construction.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page VII-9

Lines Indicating Revision
Added and modified sentences

(The revised page for the Reinspection Program Report follows.)

acceptance criteria, and no observed discrepancies were determined to have design significance. The quality of their work is inferred from the reliability calcualtion presented in Section D below.

D. INFERENCE OF WORK QUALITY FROM THE REINSPECTION RESULTS R1

In this section, the detailed reinspection data given in Appendix B and, the engineering evaluation data given in Appendixes C and D ana the supplemental inspections and evaluations presented in Section II and III of the Supplement to the Reinspection Program are combined to obtain reliability estimates for each of the eight contractors' work. These reliabilities are intended to address the quality levels for work that was not reinspected. R1

1. Applicability of Data to Plant Quality Inferences R1

The data from the Reinspection Program and the supplemental data provide a reasonable basis for estimating plant quality when samples are adequate in size and scope, and the entire Reinspection Program is of sufficient technical scope. R1

The question of sample size and adequacy of representation for sampled inspectors in the overall inspector population is discussed in section C above. The sampling of inspectors' work was not entirely random in that it concentrates entirely on each inspector's first 3 months of work. However, the selection of the inspectors was random, and thus the work reinspected was largely random from a plant quality viewpoint. It should be noted that the calculation of the reliabilities presented below is based on a formal statistical methodology which assumes random selection of samples. However, the biases introduced by the sample selection procedure are conservative and the results of the formal calculation are thus justified in that they are underestimates of the true reliabilities. R1 R1

The sufficiency of technical scope is an engineering judgment that relates to the relevance of inspected attributes to work quality. Based on the QC procedures and their associated checklists used in the Reinspecion Program, it is our conclusion that the Reinspection Program did have suffiecient technical scope to yield informatior on construction quality.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page VII-10

Evaluation of Reliabilities
Line Indicating Revision
Change Sentence
Line Indicating Revision
Change 44,980 to 45,858
Line Indicating Revision
Change 4,132 to 4,001
Change Paragraph

Add Page VII-10A

(The revised pages for the Reinspection Program Report follow)

2. Evaluation of Reliabilities

In the Reinspection Program, for objective inspections, a total of 156,926 R1
items were reinspected and 3,247 discrepancies were noted (Appendix D).
For the subjective inspections, a total of 45,858 items were reinspected, R1
and 4,001 discrepancies were noted (Appendix C). All the objective R1
discrepancies which had potential for affecting the design were evaluated. This engineering evaluation showed that none of these discrepancies had design significance. Engineering evaluation of all subjective discrepancies for six contractors and a representative
sample of discrepancies for Hatfield Electric and Pittsburgh Testing R1
Laboratory showed that none had design significance. Subsequent to the Reinspection Program, objective inspections for an additional 3,931 items and subjective inspections for an additional 1818 welds were performed. All the discrepancies which had a potential for affecting design were evaluated. This evaluation showed that none of these discrepancies had design significance. These evaluations demonstrate the good quality of the work performed by the contractors reviewed at the Byron Station.

Tables VIIE-1 through VIIE-8 of Exhibit VII-1 list the number of inspected items, the number of discrepancies of design significance, and calculated reliabilities for each of the eight contractors. Objective and subjective attributes are listed separately.

The reliability for each attribute can be defined as the proportion of work items in the total population of work for that attribute which have no discrepancies with design significance. Statistical estimates of the reliability can be made from inspections and engineering analyses of random samples from the population. The precision of these estimates, of course, increases with the sample size.

A generally accepted statistical method for calculating such reliabilities is to compute reliabilities at 95% confidence level from the sampled data. Such a reliability represents a conservative estimate of the true reliability. It is conservative in the sense that there is a 95% chance that the true reliability is greater than the estimate. In the case where no discrepant items are observed in a random sample from a large population, the reliability at 95% confidence level can be calculated from the formula*

*Reference 1: Miller, I., and Freund, J.E., "Probability and Statistics for Engineers," Prentice Hall, Inc., 1977, Chapter 9.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

<u>Page VII-11</u>

Line Indicate Revision
Change 25 to 29
Line Indicating Revision
Change 30 to 31
Change 21 to 24
Line Indicating Revision
Change four to five
Line Indicating Revision
Change five to two
Line Indicating Revision
Change five to two

<u>Page VII-12</u>

Line Indicating Revision
Change 5 to 6
Deletes part of a sentence

<u>Page VII-13</u>

Line Indicating Revision
Change sentence

(The revised pages for the Reinspection Program Report follow.)

$$R = 1 - \frac{2.9955}{n} \qquad \text{Eq. VII-1}$$

where

R = Reliability at 95% confidence level

n = number of inspections in the random sample

In Exhibit VII-1 and Tables VIIE-1 (Blount), VIIE-2 (Johnson Controls), VIIE-3 (Hunter), VIIE-4 (NISCo), VIIE-5 (Hatfield), VIIE-6 (Powers-Azco-Pope), VIIE-7 (Pittsburgh Testing), VIIE-8 (Peabody Testing), which follow, the reliabilities presented are based on Eq. VII-1, i.e., they represent reliabilities at 95% confidence level based on samples which contained no discrepancies of design significance. It should be emphasized that, when a sample size is small, the true reliability is likely to be much greater than indicated.

Tables VIIE-1 through VIIE-8 show better than 95% reliability for 29 of the R1
31 attributes reinspected. In 24 of these cases, the calculated reliabilities R1
are better than 99%. For five cases, the reliabilities are computed in the R1
96% to 99% range. For the remaining two cases, in these tables no R1
reliability estimate at 95% confidence level is projected because Equation
VII-1 requires at least 60 observations to provide 95% reliability. For
these two cases, the sample sizes were too small to obtain meaningful R1
reliabilities based on Equation VII-1. This does not prevent us from concluding, on the basis of calculated reliabilities, that all contractors performed good work. This conclusion remains valid because all inpectors within a contractor organization were qualified under the same program and good reliability demonstrated in one objective attribute provides a valid basis for inferring the reliability in another objective attribute where

sampling was limited. In Table VIIE-6, three out of five attributes have better than 95% reliability, therefore it is inferred that the reliabilities not listed in the tables would also be better than 95%. Note that for attributes where the number of items reinspected is large (>300), the computed reliabilities are better than 99%. This is indicative of good quality work. R1

The above discussion of reliabilities indicates that better than 95% reliability is expected for the work of all eight contractors. This component level reliability is considered to be high enough to conclude that work quality is good.

E. CONCLUSIONS

The evaluation of Commonwealth Edison management approach to ensure quality of construction and the successful completion of the Reinspection Program leads us to conclude that:

1. The good quality of construction at Byron is ensured because of the comprehensive quality program implemented by Commonwealth Edison management. The many layers of inspections, overinspections, audits, surveillances, and evaluations implemented as part of this quality program further assure us that the results of the Reinspection Program are representative of the overall plant quality.

2. With limited exceptions, the Reinspection Program verified the effectiveness of QC inspector certification programs prior to September 1982. This ensures that work performed by the contractors whose programs were effective was adequately inspected, from which it can be inferred that the contractor's construction work is of good quality. The quality of work for the contractors whose QC inspector programs were not verified has been confirmed through additional reinspection and evaluation.

3. The adequacy of construction quality for all eight contractors is supported by the Reinspection Program results, the results of the supplemental inspections subsequent to the Reinspection Program, and by inferences drawn from these results. R1

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Exhibit VII-1 Page 3 of 5

Item A. - Objective Attributes
Line Indicating Revision
Change 0 to 778 and add 99.6
Line Indicating Revision
Change 8 to 295 and add 98.9
Line Indicating Revision
Change 27 to 1850 and add 99.8
Line Indicating Revision
Added item 9
Line Indicating Revision
Change footnote

Item B. - Subjective Attributes
Line Indicating Revision
Change 26,660 to 27,538 and 99.9 to >99
Line Indicating Revision
Added Footnote

(The revised page for the Reinspection Program Report follows.)

Table VIII-5
Calculated Reliabilities for Work of
Hatfield

	No. of Inspected Items	No. of Discrepancies with Design Significance	Reliability % at 95% Confidence Level	
A. Objective Attributes				
1. Conduit	2,793	0	99.9	
2. Terminations	7,784	0	>99.9	
3. Equipment setting*	778	0	99.6	R1
4. A325 bolting*	295	0	98.9	R1
5. Equipment modification*	1850	0	99.8	R1
6. Conduits as-built	44,777	0	>99.9	
7. Pan hangers	4,776	0	>99.9	
8. Pan	80	0	96.3	
9. Conduit support bolting*	1,008	0	99.7	R1
B. Subjective Attributes				
1. Visual welds	27,538	0**	>99**	R1

* Supplemental inspections subsequent to the Reinspection Program. R1

** Inferred from the engineering evaluation presented in Appendix C. R1

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Exhibit VII-1 Page 5 of 5

Line Indicating Revision
Added "Work Inspected By"
Line Indicating Revision
Changed 99.9 to >99**
Line Indicating Revision
Added Footnote

(The revised page for the Reinspection Program Report follows.)

Table VIIE-7
Calculated Reliabilities for Work Inspected by Pittsburgh Testing R1

	No. of Inspected Items	No. of Discrepancies with Design Significance	Reliability % at 95% Confidence Level	
A. Objective Attributes				
1. Concrete expansion anchor	6,016	0	>99.9	
B. Subjective Attributes				
1. Visual welding	6,137	0**	>99**	R1

** Inferred from the engineering evaluation presented in Appendix C. R1

Table VIIE-8
Calculated Reliabilities for Work of Peabody

	No. of Inspected Items	No. of Discrepancies with Design Significance	Reliabilty % at 95% Confidence Level
A. Objective Attributes			
None			
B. Subjective Attributes			
1. Visual welding*	163	0	98.2

* 100% of accessible and recreatable work was reinspected.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page A-6

Item A. - Results by Inspection Type
Line Indicating Revision
Change 89.9% to 88.6%
Change 92.1% to 92.8%
Line Indicating Revision
Change (23,978/26,660) to (24,402/27,538)
Change (24,543/26,660) to (25,552/27,538)

Under Item B. - Results by Inspection Attribute
Line Indicating Revision
Change 92.1% to 92.8%

Line Indicating Revision
Change 2,682 to 3,136

(The revised page for the Reinspection Program Report follows.)

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page A-6

Item A. - Results by Inspection Type
Line Indicating Revision
Change 89.9% to 88.6%
Change 92.1% to 92.8%
Line Indicating Revision
Change (23,978/26,660) to (24,402/27,538)
Change (24,543/26,660) to (25,552/27,538)

Under Item B. - Results by Inspection Attribute
Line Indicating Revision
Change 92.1% to 92.8%

Line Indicating Revision
Change 2,682 to 3,136

(The revised page for the Reinspection Program Report follows.)

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page A-6

Item A. - Results by Inspection Type
Line Indicating Revision
Change 89.9% to 88.6%
Change 92.1% to 92.8%
Line Indicating Revision
Change (23,978/26,660) to (24,402/27,538)
Change (24,543/26,660) to (25,552/27,538)

Under Item B. - Results by Inspection Attribute
Line Indicating Revision
Change 92.1% to 92.8%

Line Indicating Revision
Change 2,682 to 3,136

(The revised page for the Reinspection Program Report follows.)

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page A-6

Item A. - Results by Inspection Type
Line Indicating Revision
Change 89.9% to 88.6%
Change 92.1% to 92.8%
Line Indicating Revision
Change (23,978/26,660) to (24,402/27,538)
Change (24,543/26,660) to (25,552/27,538)

Under Item B. - Results by Inspection Attribute
Line Indicating Revision
Change 92.1% to 92.8%

Line Indicating Revision
Change 2,682 to 3,136

(The revised page for the Reinspection Program Report follows.)

Table A-5
Reinspection Results
Hatfield Electric

A. **Results by Inspection Type**

Type	Reinspection Results (Acceptable/Total) Level II Reinspection	Third-Party Review	
Subjective	88.6% (24,402/27,538)	92.8% (25,552/27,538)	R1 R1
Objective	96.5%	(2)	

B. **Results by Inspection Attribute**

Attribute	Initial Sample Period No. of People Reinspected	Initial Sample Period Final % Acceptable	Expansion Sample Period No. of People Reinspected	Expansion Sample Period Final % Acceptable	
1. Visual weld (Subjective)	8	92.8%	(1)	(1)	R1
2. Conduit	6	97.6%	(1)	(1)	
3. Terminations (Objective)	5	99.9%	(1)	(1)	
4. Equipment setting (Objective)	0	0%	(1)	(1)	
5. A325 bolting (Objective)	1	100.0%	(1)	(1)	
6. Equipment modification (Objective)	3	100.0%	(1)	(1)	
7. Conduit as-built (Objective)	8	95.9%	(1)	(1)	
8. Cable Pan hangers (Objective)	2	95.5%	(1)	(1)	
9. Cable Pan (Objective)	1	100.0%	(1)	(1)	

Notes for Table A-5:

*Results are cumulative. 3,136 observed discrepancies were reinspected by third-party inspectors. R1

(1) Not required

(2) Not applicable

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page B-6

All entries under Table B-5 Detailed Inspector Results Hatfield Electric - Attributes
All items under Attribute No. 1 have been revised.

Change Item A 828/865 to 833/863
Change Item C 608/698 to 630/712
Change Item E 10221/11312 to 10554/11501
Change Item G 724/771 to 1132/1211
Change Item I 4233/4489 to 4462/4701
Change Item N 3309/3404 to 3381/3489
Change Item O 51/51 to 50/50
Change Item W 4569/5070(3) to 4510/5011(3)
Change total 24543/26660 to 25552/27538

(The revised page for the Reinspection Program Report follows.)

Table B-5
Detailed Inspector Results
Hatfield Electric

Inspector	Attributes No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	
A	833/863	-	-	-	-	-	-	-	-	R1
B	-	-	-	-	-	-	4795/4974	-	-	
C	630/712	-	-	-	-	-	-	-	-	R1
D	-	80/80	638/638	(1)	8/8	-	-	-	-	
E	10554/11501	187/188	48/48	-	-	-	-	-	-	R1
F	-	178/179	72/72	-	-	2/2	-	-	-	
G	1132/1211	386/401	544/546	-	-	1/1	-	-	-	R1
H	-	-	-	-	-	-	3985/4112	-	-	
I	4462/4701	-	-	-	-	-	-	-	-	R1
J	-	639/661	-	-	-	-	-	-	-	
K	-	1256/1284	-	-	-	-	-	-	-	
L	-	-	-	-	-	-	-	705/742	-	
M	-	-	-	-	-	-	10952/11457	-	-	
N	3381/3489	-	-	-	-	-	-	-	-	R1
O	50/50	-	-	-	-	-	-	-	-	R1
P	-	-	-	-	-	-	2001/2081	-	-	
Q	-	-	-	-	-	-	4818/5055	-	-	
R	-	-	-	-	-	-	11734/12205	-	-	
S	-	-	-	-	-	-	2753/2879	-	-	
T	-	-	-	-	-	-	1917/2014	-	-	
U	-	-	6473/6480	(2)	-	24/24(2)	-	-	-	
V	-	-	-	-	-	-	-	3854/4034	80/80	
W	4510/5011(3)	-	-	-	-	-	-	-	-	R1
TOTAL	25552/27538	2726/2793	7775/7784	-	8/8	27/27	42955/44777	4559/4776	80/80	R1

Notes for Table B-5:

No expanded sampling was required; a substitution (W) was made for (C) in Attribute No. 1 because (C) failed the first 3-month period but had no further inspections to reinspect.

Attribute 1 - Visual weld
Attribute 2 - Conduit
Attribute 3 - Terminations
Attribute 4 - Equipment setting
Attribute 5 - A325 bolting
Attribute 6 - Equipment modification
Attribute 7 - Conduit as-built
Attribute 8 - Pan hangers
Attribute 9 - Pan

(Notes for Table B-5: Continued on the following page)

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

<u>Page C-1</u>

<u>Appendix C Engineering Evaluation of Subjective Discrepancies</u>

Item B. - <u>Quantity of Subjective (Weld) Inspection Discrepancies</u>
Line Indicating Revision
Change 4,132 to 4,001
Line Indicating Revision
Change 44,980 to 45,858

<u>Table C-1 - Summary of Weld Discrepancies by Contractor</u>

Line Indicating Revision
Change 26,660 to 27,538
Change 2,117 to 1,986

Line Indicating Revision
Change 44,980 to 45,858
Change 4,132 to 4,001

(The revised page for the Reinspection Program Report follows.)

APPENDIX C
ENGINEERING EVALUATION OF SUBJECTIVE DISCREPANCIES

A. INTRODUCTION

This appendix has been reformatted from the Appendix C submitted with the January 12, 1984, Interim Report. A sample of the subjective (weld) discrepancies was evaluated for the Interim Report. All weld discrepancies have been evaluated and tabulated for this report. The tables which form part of this appendix tabulate discrepancies by type and by method of engineering evaluation.

B. QUANTITY OF SUBJECTIVE (WELD) INSPECTION DISCREPANCIES

The Reinspection Program identified 4,001 weld discrepancies associated with R1
visual weld quality inspection out of 45,858 welds inspected. Table C-1 R1
summarizes the number of welds inspected and weld discrepancies for each contractor.

Table C-1
Summary of Weld Discrepancies by Contractor

Contractor	No. of Welds Inspected	No. of Weld Discrepancies	
Blount Brothers	0*	N/A	
Johnson Controls	1,459	65	
Hunter	3,725	109	
NISCo	229	0	
Hatfield Electric	27,538	1,986	R1
Powers-Azco-Pope	6,607	914	
Pittsburgh Testing	6,137	905	
Peabody Testing	163	22**	
TOTALS	45,858	4,001	R1

* Inspection of Blount Brothers was performed by Pittsburgh Testing. The inspection results are reported under Pittsburgh Testing.

** 40 discrepancies were identified; 18 were located in non-safety related structures.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

Page C-2

Category Y

Delete last sentence in paragraph

(The revised page for the Reinspection Program Report follows.)

C. CATEGORIZATION OF SUBJECTIVE DISCREPANCIES

An engineering evaluation has been performed for each observed subjective (weld) discrepancy. The evaluation methods used can be divided into three categories. These three categories are related to the acceptance criteria for visual weld inspection. The acceptance criteria consists of inspecting welds for arc strike, spatter, convexity, crater, incomplete fusion, overlap, porosity, undercut, underrun, and cracks. The presence of these weld inspection items are considered as weld discrepancies. These weld discrepancies vary in degree as to their effect on weld capacity.

Category X - Evaluation by comparison with current design parameters and tolerances.

Category X contains weld discrepancies that do not reduce the weld capacity. Arc strikes and spatter are cosmetic indications that relate only to appearance. Convexity relates to weld metal on the face of a weld in excess of the weld metal necessary for the required weld size. Convexity has no effect on weld capacity (see Exhibit C-2 Section C.1).

Category Y - Evaluation based on engineering judgment by comparison of the discrepancy with design margins.

Category Y contains some of the following weld discrepancies: crater, incomplete fusion, overlap, porosity, undercut, or underrun. Portions of the weld with these discrepancies are considered ineffective, and weld capacity is based on a reduced weld length. Engineering judgment is used to evaluate the weld discrepancies based on the available design margin in the weld and the reduced weld length, which accounts for the assumed ineffective portions.

Page C-4

Table C-2 - Summary of Subjective Discrepancy Evaluation Results

Line Indicating Revision
Change 2,117 to 1,986
Change 11 to 8
Change 2064 to 1936

Line Indicating Revision
Change 1 to 10
Change 887 to 878

Line Indicating Revision
Change 4,132 to 4,001
Change 253 to 259
Change 3074 to 2937

Lines Indicating Revision
- This paragraph has been revised.

Add Page C-4A

Line Indicating Revision
Change 19% to 20%

(The revised page for the Reinspection Program Report follows.)

Table C-2
Summary of Subjective Discrepancy Evaluation Results

Contractor	No. of Discrepancy Evaluations	Category X No. Within Parameters	Category Y No. Acceptable by Judgment	Category Z No. Acceptable by Calculation	No. with Design Significance	
Blount Brothers*	N/A	N/A	N/A	N/A	0	
Johnson Controls	65	15	12	38	0	
Hunter	109	25	23	61	0	
NISCo	0	0	0	0	0	
Hatfield Electric	1,986	8	1,936	42	0	R1
Powers-Azco-Pope	914	201	77	636	0	
Pittsburgh Testing	905	10	878	17	0	R1
Peabody Testing	22	0	11	11	0	
TOTAL	4,001	259	2,937	805	0	R1

*Inspection of Blount Brothers was performed by Pittsburgh Testing. Inspection results are reported under Pittsburgh Testing.

Table C-2 shows that 6% of the discrepancies identified in the Reinspection Program as Category X are not "valid" discrepancies and represent work that is within current design parameters. The Category X discrepancies result primarily from design parameters that have been expanded since the time of the original inspection and therefore are within current design limits.

The Category Y evaluation in Table C-2 indicates that 74% of the observed weld discrepancies, wherein for Johnson Controls, Hunter, Powers-Azco- Pope and Peabody, the weld capacity was reduced by approximately 10% after accounting for the weld discrepancy, are acceptable. In all cases, the design margin remained within design limits. For Hatfield Electric and Pittsburgh Testing, the remaining weld discrepancies, beyond the 100 weld discrepancies mapped for Hatfield Electric and 64 for Pittsburgh Testing, were judged to be acceptable by comparison of the number and types of weld discrepancies. It was found that the weld discrepancies in the mapped set of welds are representative of the entire group of weld discrepancies for Hatfield Electric and Pittsburgh Testing. R1

The Category Z evaluation in Table C-2 indicates that 20% of the observed weld discrepancies are acceptable. The reduction in weld capacity varied after accounting for the weld discrepancy. However, in all cases, the design margin remained within the specified design limits. R1

Table CE-3
Summary of Subjective Discrepancy Evaluation
Hatfield Electric

Type of Discrepancy By Attribute	Total Quantity	Category X No. Within Parameters	Category Y No. Acceptable by Judgment	Category Z No. Acceptable by Calculation	No. with Design Significance
Visual weld	1986	8	1936	42	0

R1

Note for Table CE-3:

1. Categories X, Y, and Z are defined in Section C of Appendix C.

Table CE-4
Summary of Subjective Discrepancy Evaluation
Powers-Azco-Pope

Type of Discrepancy By Attribute	Total Quantity	Category X No. Within Parameters	Category Y No. Acceptable by Judgment	Category Z No. Acceptable by Calculation	No. with Design Significance
Visual weld					
1. Instrument tubing supports	608	167	77	364	0
2. Socket welds (NC)	44	1	0	43	0
3. Socket welds (ND)	24	11	0	13	0
4. Support welds (NF)	34	0	0	34	0
5. Socket welds (B31.1)	204	22	0	182	0
TOTAL	914	201	77	636	0

Note for Table CE-4:

1. Categories X, Y, and Z are defined in Section C of Appendix C.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

EXHIBIT C-1, Page 3 of 4

Line Indicating Revision
Change 2117 to 1986
Change 11 to 8
Change 2046 to 1936

(The revised page for the Reinspection Program Report follows.)

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

EXHIBIT C-1, Page 4 of 4

Line Indicating Revision
Change 1 to 10
Change 887 to 878

(The revised page for the Reinspection Program Report follows.)

Table CE-5
Summary of Subjective Discrepancy Evaluation
Pittsburgh Testing

Type of Discrepancy By Attribute	Total Quantity	Category X No. Within Parameters	Category Y No. Acceptable by Judgment	Category Z No. Acceptable by Calculation	No. with Design Significance
Visual weld	905	10	878	17	0

R

Note for Table CE-5:

1. Categories X, Y, and Z are defined in Section C of Appendix C.

Table CE-6
Summary of Subjective Discrepancy Evaluation
Peabody Testing

Type of Discrepancy By Attribute	Total Quantity	Category X No. Within Parameters	Category Y No. Acceptable by Judgment	Category Z No. Acceptable by Calculation	No. with Design Significance
Visual weld	22	0	11	11	0

Note for Table CE-6:

1. Categories X, Y, and Z are defined in Section C of Appendix C.

ERRATA AND ADDENDA TO THE REPORT ON THE BYRON QC INSPECTOR REINSPECTION PROGRAM

EXHIBIT C-2, Page 2 of 15

Paragraph Indicating Revision
This paragraph has been revised

Add Exhibit C-2, Page 2A of 15

(The revised page for the Reinspection Program Report follows.)

therefore have no design significance. These are limited to arc strike, convexity, and spatter.

Category B — Weld discrepancies that result in a reduction of the size, length, or capacity of the weld. These include craters, incomplete fusion, overlap, porosity, undercut, and underrun. Category B weld discrepancies are further subdivided into Categories B1 and B2 to qualify the significance of these weld discrepancies as follows:

Category B1 — Weld discrepancies that have capacity reductions of less than 10%.

Category B2 — Weld discrepancies that have capacity reductions of equal to or greater than 10%.

Category C — Weld discrepancies that are assumed unsuitable for load transfer and result in total weld rejection. Cracks are the only case for this category.

According to the American Welding Society, a weld discrepancy is defined as "An interruption of the typical structure of a weldment, such as a lack of homogeneity in the mechanical, metallurgical or physical characteristics of the material or weldment. A discontinuity is not necessarily a defect" (Reference C2).

The terms Category X, Category Y, and Category Z have been used to categorize the evaluation methods used for the AWS weld discrepancies in Chapter VI and in this appendix. Categories A, B, and C have been used to categorize the significance of the weld discrepancy. The evaluation methods and weld discrepancy significance are related. Category X is equivalent to Category A, and Category Z is equivalent to Categories B2 and C. Category Y is equivalent to Category B1 for Johnson Controls, Hunter, Powers-Azco-Pope, and Peabody. For Hatfield Electric and Pittsburgh Testing, the results of the engineering evaluation of 100 mapped weld discrepancies for Hatfield Electric and 64 for Pittsburgh Testing indicated no design significance. The mapped welds for Hatfield Electric and Pittsburgh Testing were biased by including at least 50 welds that the third-party inspector identified as having the most weld-quality discrepancies. This was done by reviewing all the reinspection records for discrepant welds which were previously examined in the field by the same third- R1 therefore have no design significance. These are limited to arc strike, convexity, and spatter.

Category B — Weld discrepancies that result in a reduction of the size, length, or capacity of the weld. These include craters, incomplete fusion, overlap, porosity, undercut, and underrun. Category B weld discrepancies are further subdivided into Categories B1 and B2 to qualify the significance of these weld discrepancies as follows:

Category B1 — Weld discrepancies that have capacity reductions of less than 10%.

Category B2 — Weld discrepancies that have capacity reductions of equal to or greater than 10%.

Category C — Weld discrepancies that are assumed unsuitable for load transfer and result in total weld rejection. Cracks are the only case for this category.

According to the American Welding Society, a weld discrepancy is defined as "An interruption of the typical structure of a weldment, such as a lack of homogeneity in the mechanical, metallurgical or physical characteristics of the material or weldment. A discontinuity is not necessarily a defect" (Reference C2).

The terms Category X, Category Y, and Category Z have been used to categorize the evaluation methods used for the AWS weld discrepancies in Chapter VI and in this appendix. Categories A, B, and C have been used to categorize the significance of the weld discrepancy. The evaluation methods and weld discrepancy significance are related. Category X is equivalent to Category A, and Category Z is equivalent to Categories B2 and C. Category Y is equivalent to Category B1 for Johnson Controls, Hunter, Powers-Azco-Pope, and Peabody. For Hatfield Electric and Pittsburgh Testing, the results of the engineering evaluation of 100 mapped weld discrepancies for Hatfield Electric and 64 for Pittsburgh Testing indicated no design significance. The mapped welds for Hatfield Electric and Pittsburgh Testing were biased by including at least 50 welds that the third-party inspector identified as having the most weld-quality discrepancies. This was done by reviewing all the reinspection records for discrepant welds which were previously examined in the field by the same third-party inspectors. For the remainder of the weld discrepancies for Hatfield Electric and Pittsburgh Testing, a detailed review of the reinspection records was made to assure that the number and types of discrepancies in the mapped welds were representative of the entire group. Based upon the results of the engineering calculations for the mapped welds, the review of the reinspection records including discussions with the third-party inspectors, and the knowledge of the conservative design process, it was inferred that the remaining population of weld discrepancies is acceptable. On this basis, the remaining Hatfield Electric and Pittsburgh Testing weld discrepancies were placed in Category Y.

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Paragraph 3 - Hatfield Electric Evaluation Results - AWS Weld Discrepancies
Line Indicating Revision
Change 26,660 to 27,538
Change 2,117 to 1,986
Line Indicating Revision
Change 2,117 to 1,986

(The revised page for the Reinspection Program Report follows.)

Table CE-8
Results of AWS Weld Discrepancy Evaluation
Hunter

		Weld Discrepancy Category			
		A	B1	B2	C
Weld Type	No. of Weld Discrepancies	No Structural Impact	Weld Strength Reduced by < 10%	Weld Strength Reduced by ≥ 10%	Weld Rejected (Cracks)
Pipe supports and pipe whip restraints	60	19	18	23	0

The results of the engineering evaluation of Hunter AWS welds indicate that each of the components are adequate to carry the design loads with the observed discrepancies present.

Based on the small number of discrepancies and the evaluation which determined that no discrepancy had design significance, the AWS welding performed by Hunter has been determined to be of good quality.

3. Hatfield Electric Evaluation Results - AWS Weld Discrepancies

The inspection work performed by Hatfield included conduit supports, junction box supports, cable tray supports, cable tray hold-down welds and auxiliary steel for electrical supports. A total of 27,538 welds were reinspected and 1,986 weld discrepancies were identified. R

A detailed review of the reinspection records for all 1,986 discrepancies was made. This review indicated that there were only two cracked welds. In order to achieve 95% reliability with 95% confidence, a statistical sampling plan was chosen in accordance with Military Standard 105D. The resulting sample size for the engineering evaluation was 100 welds. The sample was conservatively biased by including the 50 welds that the third-party inspector identified as having the most weld quality discrepancies. The two welds with cracks were part of that group. The remaining 50 welds were randomly selected. R

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Line Indicating Revision
Change 35 to 36
Change 15 to 16
Line Indicating Revision
Change 36 to 34
Change 17 to 16
Change 18 to 17
Line Indicating Revision
Change 29 to 30
Change 19 to 20

(The revised page for the Reinspection Program Report follows.)

The results of the engineering evaluation for the sample of 100 Hatfield welds are shown in Table CE-9.

Table CE-9
Results of AWS Weld Discrepancy Evaluation
Hatfield Electric

Weld Discrepancy Category

Weld Type	No. of Weld Discrepancies	A No Structural Impact	B1 Weld Strength Reduced by < 10%	B2 Weld Strength Reduced by ≥ 10%	C Rejected (Cracks)	
a. Conduit/ junction box supports and associated auxiliary steel	36	2	17	16	1**	R1
b. Cable tray supports and associated auxiliary steel	34	1	16	17	0	R1
c. Cable tray hold-down	30	2	20	7	1*	R1
TOTAL	100	5	53	40	2***	

* One of the two hold-down welds attaching the cable tray to its support was cracked. It was found that, after subtracting the entire length of the cracked weld, the other weld was sufficient to transfer the design loading.

** Temporary tack weld used to aid construction was cracked. The tack weld is not required by design. There is no crack in the design weld.

*** The potential of crack propagation into the base metal was evaluated. For the two reported cases, based on the fracture toughness of the materials, it was determined that the cracks will not propagate into the base metal under the maximum design loading and minimum plant operating temperatures.

Design margins exist in conduit and junction box supports and associated auxiliary steel because the initial design conservatively assumed maximum

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Line Indicating Revision
Change 36 to 34
Line Indicating Revision
Change 13% to 14%
Line Indicating Revision
Change 29 to 30

(The revised page for the Reinspection Program Report follows.)

cable weight in each conduit. In addition, the supports and auxiliary steel are conservatively designed for peak seismic acceleration. When a more exact calculation was performed using actual cable loads and actual seismic acceleration, the design margin exceeded a 1.5 factor. This design margin is representative of the highly stressed conduit and junction box supports and associated auxiliary steel in the plant. The weld strength reduction for all but the two lowest quality welds was applied to all of the components with weld discrepancies and the weld stresses remained within design basis allowables. The two lowest quality welds were evaluated and those supports have a design margin greater than one.

A design margin exists in welded connections for cable tray supports and cable tray support auxiliary steel because the initial design was conservatively based on a maximum uniform cable load. In addition, the components are generally designed using simplified, yet conservative, techniques. By using actual cable tray loadings and more exacting methods of analysis, it was shown that the actual stresses are lower than the stresses from the original design. For the 34 cases where a detailed R1
engineering evaluation of the weld discrepancy was performed, the welds are adequate to carry the loads. The average value of the weld strength reduction for cable tray supports and auxiliary steel is approximately 14%. This reduction is not significant to the overall behavior of the R1
support system.

A design margin exists for cable tray hold-down welds because the initial design conservatively assumed maximum cable weight, maximum cable tray span and peak seismic acceleration. When a more detailed calculation is performed for any particular cable tray hold-down weld using the seismic values for that particular location, actual cable tray loads and actual cable tray spans, there is additional design margin. There is additional design margin for the 30 cases where a detailed engineering R1
evaluation was performed, and the welds are adequate to carry the design loads.

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Line Indicating Revision
Change Twenty-eight to Thirty-one

(The revised page for the Reinspection Program Report follows.)

An engineering evaluation of all 608 AWS weld discrepancies was completed. In all cases, the design of the component was acceptable with the observed discrepancy present. The results are categorized in the Table CE-10.

Table CE-10
Results of AWS Weld Discrepancy Evaluation
Powers-Azco-Pope

		Weld Discrepancy Category			
		A	B1	B2	C
Weld Type	No. of Weld Discrepancies	No Structural Impact	Weld Strength Reduced by < 10%	Weld Strength Reduced by ≥ 10%	Rejected (Cracks)
Instrument tubing supports	608	167	77	364	0

The supports installed by Powers-Azco-Pope typically have a large design margin. The supports are designed for peak seismic accelerations. These supports are selected from generic design tables which envelope the various design considerations and use standard member sizes. Thirty-one of the supports associated with the 608 discrepancies had a design margin of 1.1 or less. This is representative of the highly stressed supports installed by Powers-Azco-Pope. The maximum weld strength reduction based on the lowest quality weld was applied to all of the supports associated with the 608 discrepancies. In all cases, after performing a more exact analysis, the design margin remained greater than one and had no design significance. R

The results of the engineering evaluation of Powers-Azco-Pope AWS weld discrepancies indicate that the Reinspection Program has captured a representative sample of highly stressed elements with lowest quality welds and that there is no design significance.

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Page F-6

Paragraph deleted

(The revised page for the Reinspection Program Report follows.)

Evaluation of fifty welds from the entire population of discrepant welds with the lowest factor of safety. Another method would be to select the worst weld in each category and the weld with the lowest factor of safety in each category. Then perform a detailed engineering evaluation to determine if the worst weld would meet the design intent for the weld with the lowest factor of safety."

Response:

As stated in the response to Q4, all weld discrepancies have been evaluated. Refer to Exhibit C-2, Sections D.1 through D.6, for the engineering evaluation of highly stressed welds and their compliance with design criteria.

Q8. "Provide a summary regarding the number and type code (ASME) and AWS) rejectable items found during the reinspection for each contractor. Further, with regard to the number of rejectable ASME Code items, please explain how you are going to assure that the items that have not been repaired are acceptable. This includes both items that have and have not been reinspected."

R1