TDH

Station: Byron/Braidwood Units 1 & 2 Project No.: 4391-09

Client: Commonwealth Edison Company

System Reviewed: Auxiliary Feedwater System

Revision: 0 Date: July 16, 1980

I have conducted a design review of the above-mentioned system in accordance with the approved checklist.*

P. L. Wattelet	[signature]	PMD
(Print Name)	(Signature)	(Review Chairman)
J. R. Meister	[signature]	PMD
(Print Name)	(Signature)	(Division)
C. B. Braeger	[signature]	CID
(Print Name)	(Signature)	(Division)
I. Wu	[signature]	EMD
(Print Name)	(Signature)	(Division)
C. S. Burton	[signature]	MDDD
(Print Name)	(Signature)	(Division)
D. A. Schroeder	[signature]	EPED
(Print Name)	(Signature)	(Division)

*Comments as of yet unresolved have been listed on pages 2 & 3. Byron project must resolve these comments to complete the design review.

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Rev. A (8-29-77)

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P PDR

MECHANICAL DEPARTMENT STANDARD

SYSTEM DESIGN REVIEW REPORT

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DRR-AF-0[illegible]-BB

Page 1 of 3

DESIGN REVIEW REPORT SUMMARY:

The following unresolved comments must be addressed by the Byron project:

1.) PMD Review Consideration 11, Comment 11:

FSAR Article 10.4.9.3.1 states that the AF pumps have been designed to start on either loss of offsite power, low-low level in any steam generator or safety injection signal. Westinghouse functional Diagram 108D685, Sheets 5 & 15 and Sargent & Lundy Diagrams M-4037-1AF01 do not show the auxiliary feedwater pumps starting on loss of offsite power.

Byron must resolve this conflict between FSAR statement and design.

2.) EPED Review Consideration 1, Comment 7:

The design criteria does not specify IEEE standards for Electrical Class 1E components as required by the Classification Criteria CC-ME-01-BB.

EPED Review Considerations 3 & 4, Comment 10:

Environmental conditions are not specified in F/L-2758C, Amendment 2.

4.) EPED Review Consideration 5, Comment 9:

The required equipment qualification documentation must be submitted, reviewed and accepted.

5.) EPED Review Considerations 6 & 14, Comment 2:

Solenoid operated Valves 1AF002A & B, and 1AF024 do not have control logics, schematics, or cabling identified in appropriate documents.

6.) EPED Review Consideration 6, Comment 3:

Solenoid valves 1AF004A & B shown on Logic Diagram M-4037-1AF02 and Master Diagram AF519 do not have schematics, nor are they identified on the P&ID.

7.) EPED Review Consideration 9, Comment 4:

Valves 1AF005A-H are located adjacent to each other providing insufficient separation, and the associated Automatic Flow Controls are in the same area.

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DESIGN REVIEW REPORT SUMMARY:

8.) EPED Review Consideration 12, Comment 1:

The design criteria requires automatic start of the pumps on loss of off-site power logic and the schematic diagrams do not implement this directly for Pump 1B.

9.) EPED Review Consideration 15, Comment 5:

Overloads of Valves 1AF013A-H, 1AF006A&B, and 1AF017A&B are not bypassed during ESF action per NRC Regulatory Guide 1.106.

10.) EPED Review Consideration 15, Comment 6:

Transfer to local control panel does not transfer control of 1AF006A&B and 1AF007A&B for emergency suction to auxiliary feedwater pumps.

11.) EPED Review Consideration 15, Comment 8:

Transfer to local control panel does not preclude shorts on the control circuit in the main control room lights, thus rendering the circuit inoperative for Auxiliary Oil Pumps 1AF01PA-A and 1AF01PB-A.

The Review Status of this system shall be indicated as Complete with Unresolved Comments (CU) until Byron project resolves these comments.

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ELECTRICAL DESIGN REVIEW CONSIDERATIONS	YES	NO	N/A	SEE COMMENT NUMBER
1. Is the classification of the electrical components of the system, as indicated in the project classification criteria, consistent with the safety function of the system?		X		7
2. Do the electrical documents (master diagrams, schematic diagrams, key diagrams, cable tabulations, etc.) for the system reflect the correct safety classification?	X			
3. Do the equipment specifications (both mechanical and electrical) establish the qualification requirements (environmental and seismic) for the electrical components in accordance with the project classification and design criteria?		X		10
4. Are the equipment qualification requirements specified in the equipment specifications up-to-date?		X		10
5. Has the required equipment qualification documentation been submitted, reviewed and accepted?		X		9
6. Do the electrical documents (master diagrams, key diagrams, cable tabulations, etc.) reflect the latest information with respect to equipment size, ratings, etc.?		X		2&3
7. Are the redundant safety-related components of the system identified?	X			
8. Are the redundant safety-related electrical components of the system assigned to redundant auxiliary power, control and instrument buses consistent with the divisional assignments?	X			
9. Are the redundant safety-related electrical components of the system separated and segregated or physically protected to minimize the probability of simultaneous failure of redundant components from the effects of a missile, pipe whipping, discharging fluid or a fire?		X		4

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RPT. NO. DRR- AF-001-BB DATE 6/27/80 TITLE: Auxiliary Feedwater REV: 0	MECHANICAL DEPARTMENT STANDARD DESIGN REVIEW CHECKLIST
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ELECTRICAL DESIGN REVIEW CONSIDERATIONS	YES	NO	N/A	SEE COMMENT NUMBER
10. Is the design of the electrical portion of the system such that the safety function of the system can be accomplished in the event of a single failure?	X			
11. Are the non-safety related electrical components of the system separated and segregated from the safety related components in accordance with the project design criteria?	X			
12. Do the system schematic diagrams implement the control functions specified in the system logic diagrams, functional descriptions or system descriptions?		X		1
13. Do the related electrical installation drawings (conduit, cable tray, cable tabulation, etc.) reflect the electrical design, e.g. cable types, sizes, segregation categories, separation requirements indicated on the associated system master diagrams?	X			
14. Can the safety system be tested in accordance with the requirements of IEEE Standard 338 or other project design criteria?		X		2
15. Do the instrumentation and control features of the System comply with the requirements of Sections 4.11 (Channel Bypass or Removal from Operation), 4.12 (Operating Bypasses) and 4.13 (Indication of Bypasses) of IEEE 279-1971?		X		5&6&8

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TITLE: Auxiliary Feedwater
REV: 0

MECHANICAL DEPARTMENT [illegible]

DESIGN REVIEW CHECKLIST

COMMENT NUMBER	REVIEWER'S COMMENTS NAME D. A. Schroeder	RESOLUTION
1.	Design Criteria requires auto start of pumps on loss of off site power logic and schematic diagrams do not implement this directly for Pump 1B.	
2.	Solenoid operated valves 1AF002A & B, and 1AF024 do not have control logics, schematics, or cabling identified in appropriate documents.	
3.	Solenoid valves 1AF004A & B shown on Logic Diagram M-4037-1AF02 and Master Diagram AF519 do not have schematics nor are they identified on the P&ID.	
4.	Valves 1AF005A-H are located adjacent to each other providing insufficient separation, and associated Automatic Flow Controls are in the same area.	
5.	Overloads of Valves 1AF013A-H, 1AF006A & B, and 1AF017A & B are not bypassed during ESF action for NRC Regualtory Guide 1.106.	
6.	Transfer to local control panel does not transfer control of 1AF006A & B and 1AF017A & B for emergency suction to auxiliary feedwater pumps.	
7.	Design Criteria does not specify IEEE standards for Electrical Class 1E components as required by the Classification Criteria CC-ME-01-BB.	
8.	Transfer to local control panel does not preclude shorts on the control cirucit in the main control room lights, thus rendering the circuit inoperative for Auxiliary Oil Pumps 1AF01PA-A & 1AF01PB-A.	

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TITLE Auxiliary Feedwater

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COMMENT NUMBER	REVIEWER'S COMMENTS NAME D. A. Schroeder	RESOLUTION
9.	Environmental Qualification not for F/L-2758, F/L-2891, F/L-2802, Seismic Qualification not accepted F/L-2819 or F/L-2802.	
10.	Environmental conditions not specified in F/L-2758C and Amendment 2.	

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DOCUMENTS REVIEWED AS PART OF DRL-AF-001-BB

1. Classification Criteria CC-AF-01-BB, Revision 5.

2. Design Criteria DC-AF-01-BB, Revision 1

3.	M-37		Revision M
4.	M-2037	Sheet 1	Revision D
5.	M-2037	Sheet 2	Revision C
6.	M-2037	Sheet 3	Revision B
7.	M-4037-1AF01	Sheet 1	Revision B
8.	M-4037-1AF01	Sheet 2	Revision C
9.	M-4037-1AF02		Revision C
10.	M-4037-1AF03		Revision A
11.	M-4037-1AF04		Revision A
12.	M-4037-1AF05		Revision B
13.	6/20E-1-3301		Revision C
14.	6/20E-1-3322		Revision D
15.	6/20E-1-3305		Revision E
16.	6/20E-1-4030	AF01	Revision B
17.	6/20E-1-4030	AF02	Revision A
18.	6/20E-1-4030	AF03	Revision D
19.	6/20E-1-4030	AF04	Revision A
20.	6/20E-1-4030	AF05	Revision A
21.	6/20E-1-4030	AF06	Revision A
22.	6/20E-1-4030	AF07	Revision A
23.	6/20E-1-4030	AF08	Revision A
24.	6/20E-1-4030	AF09	Revision A
25.	6/20E-1-4030	AF10	Revision A

26. 6/20E-1-4030 AF11 Revision A

27. 6/20E-1-4030 AF12 Revision A

28. 6/20E-1-4030 AF13 Revision A

29. A-229 Revision V

30. AF-503 Revision 5

31. AF-507 Revision 7

32. AF-511 Revision 9

33. AF-516 Revision 9

34. AF-517 Revision 7

35. AF-519 Revision 1

36. AF-532 Revision 5

37. Cable Tabulation - AF - June 9, 1980

38. Cable Tabulation - SX - June 9, 1980

39. Cable Tabulation - VA - June 9, 1980

PMD REVIEW CONSIDERATION	YES	NO	N/A	SEE COMMENT NUMBER
1. Have the Auxiliary Feedwater Pumps been provided with sufficient NPSH available? Where is this documented?	X			1
2. Has the Auxiliary Feedwater System been sized to provide minimum flow to unfaulted steam generators, as specified by Westinghouse, during a feedwater line break? Where is this documented?	X			2.
3. Do the AFW pumps have sufficient head to deliver their rated capacity at the steam generator safety valve set points?	X			3.
4. Have considerations been given to testing the AFW system periodically to insure operability?	X			4.
5. Have high energy portions of the AFW system been analyzed for proper support and restraint?			N/A	5.
6. Has adequate accessability been provided to perform the in-service inspection expected to be required during the plant life? Where is this documented?	X			6.
7. Is the AFW system properly classified? Are the boundaries clearly defined? Where is this documented?	X			7.
8. Have the seismic analyses required for SSE and OBE been performed? Where is this documented?	X			8.
9. Has the AFW system been designed to minimize water hammer in the steam generators and piping?	X			9.
10. Is the AFW system designed to perform its intended safety function while sustaining a single active failure and loss of offsite power?	X			10.
11. Have the AFW pumps been designed to start on either loss of offsite power, low-low level in any steam generator or safety injection signal? (FSAR 10.4.9.3.1)		X		11.

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RPT. NO. DRR- AF-001-BB DATE 5-21-80 TITLE: Auxiliary Feedwater System REV:	MECHANICAL DEPARTMENT STANDARD DESIGN REVIEW CHECKLIST
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PMD REVIEW CONSIDERATION	YES	NO	N/A	SEE COMMENT NUMBER
12. Is the AFW system designed such that operator action is not required within the first 30 minutes following initiation?	X			12.
13. Has the AFW system been designed for use during start up and shutdown? If yes, what considerations have been given to the system design to operate in this mode?		X		N/C

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SARGENT & LUNDY ENGINEERS

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COMMENT NUMBER	REVIEWER'S COMMENTS NAME T. Hottle	RESOLUTION
1.	Byron AFJK-1 design calculation shows that with both pumps running and taking suction from the condensate storage tank that the suction losses are too great and that the valves will open for alignment to SX system. DRN P&ID-120 added extra 8" line 1CDC6A8 off of 14" line to reduce head loss to provide adequate available NPSH. Calculation AFJD-1 shows 23 feet NPSH required and 66 feet NPSH available with new routing.	None Required
2.	Byron Design Calculation AFJK-1 is the calculation to determine minimum flow required which agrees with Chapter 15 of the FSAR.	None Required
3.	Design Calculation AFJK-1 is performed with steam generator pressure at the safety valve set point plus 3% accumulation.	None Required
4.	The AFW system will be tested on a periodic basis, however, this is a requirement of the Commonwealth Edison Operating Department. A flanged connection is provided to test the system for flow and operability. (M-37) T. Hottle.	None Required
5.	Auxiliary feedwater system is a moderate energy system. (T. Hottle).	None Required
6.	Specification F/L-2907 requires the ISI contractor to perform a walk-thru of the plant to inspect for accessibility. Modification to the AF system will be made if required. (R. L. Johnson).	None Required

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COMMENT NUMBER	REVIEWER'S COMMENTS NAME J. [illegible]	RESOLUTION
7.	P&ID M-37 specifies all boundaries of AF system.	None Required
8.	As of May 15, 1980, 39 of 39 auxiliary feedwater subsystems have been analyzed. (B. Tatosian)	None Required
9.	Westinghouse has changed the design of the inlet piping to reduce water hammer problems. A.F. line connects into separate 6" line instead of feedwater line. This was a Westinghouse design modification for water hammer prevention. (T. Hottle).	None Required
10.	Two trains are provided, each with its own AFW pump which have diverse power sources - one being diesel to insure operation with loss of offsite power. (P&ID M-37)	None Required
11.	Westinghouse functional diagram 108D685 sheets 5 and 15 and Sargent & Lundy diagrams M-4037-1AF01 do not show the auxiliary feedwater pumps starting on loss of offsite power. (G. Sensmeier)	Byron project must resolve this conflict between design and FSAR statement. Either FSAR is wrong due to change in requirements or design must be checked and/or corrected.
12.	Automatic switchover to SX suction is provided in valves 017 A and B and 006 A and B (P&ID M-37). All other valves align automatically. No operator action intended for safe-shutdown of both units. (T. Hottle)	None Required

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CMD

REVIEW CONSIDERATION	YES	NO	N/A	SEE COMMENT NUMBER
1. Were analytical drawings signed, its information reviewed and approved by PMD?	X			
2. Were there any special modeling techniques used in the analysis for equipment, restraint, pipe, joint, etc.? Explain!	X			1
3. Were the thermal expansion modes, associated anchor movements and associated number of cycles, specified and documentary verified and approved by PMD?	X			
4. Were all the thermal expansion modes analyzed and found within Code allowables?	X			
5. Were the motor-operated valves, weight, and C.G. documentary reviewed and approved by MDDD/PMD before used in analyses?	X			
6. What was the acceptance criteria used for analyzing pipe under hydro loading, and were these loads transferred to SDDD?			X	
7. Were the pinned restraints under hydro testing specified and documented?			X	
8. Did the design specification state the peak pressure to be used for Upset, Emergency, and Faulted condition, and were these pressures used in the stress evaluation under these conditions?	X			
9. Has the dynamic interaction of nonseismic portion of the piping been considered on the seismic required piping subsystem? How is this documented?			X	
10. Did the number of modes extracted have sufficient frequency to exceed the cut-off frequency?	X			

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(Encl)

REVIEW CONSIDERATION	YES	NO	N/A	SEE COMMENT NUMBER
11. Were the correct response spectras with the correct damping factor enveloped for all points of excitation (anchors and restraints) before analyses (include the R. S. of steam generator)?	✓			
12. Was the interface information of NSSS vendor considered and used in the analysis?	✓			
13. How are the closely spaced modes combined?	✓			2
14. Table 3.7.3 of the PSAR states that under SSE, piping Group B of 8" and larger should remain functional; what was the method used to justify that?				3
15. What was the method adopted in analyzing the large continuous subsystem which exceeded the size limitations of the available programs (statically and dynamically)?			✓	
16. What was the methodology and criteria used in analyzing small pipe subsystem (instrumentation tubing) which is seismic qualification required?	✓			4
17. Did the maximum length between any two data points in the systems analytical model have a minimum frequency content larger than the 33 Hz?		✓		
18. Were the seismic differential anchor movements considered in the analyses? Were they furnished by SDDD?	✓			
19. How the differential anchor movement combines with the other loads, and what were the allowables used?	✓			5
20. Were the equipment reactions within the allowables provided by vendor?	✓			
21. Were the valves G level within the vendor's specified allowables?	✓			

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REVIEW CONSIDERATION	YES	NO	N/A	SEE COMMENT NUMBER
22. Was the snubber rating checked to verify that they can carry both Upset and Emergency conditions?		X		6
23. What was the methodology used to evaluate SSE response, and is it justifiable?	X			7
24. Were the pipe reactions on valves within the allowables, or sent to manufacturer for confirmation?	X			
25. Were the flanges within the systems checked against NC-3647?		X		8
26. Were branched piping reviewed, modeled properly, checked as per NC-3643.3, and results furnished to MDDD for implementation?	X			
27. Were there hydraulic analyses performed, and are the piping responses within allowables?			X	
28. Were there hydraulic transient analyses performed, and is the piping capable of withstanding the transient forces?			X	
29. Were the RV sized appropriately? Were the forces at the RV exits considered in the analyses? Were the supports designed for static, dynamic and/or wind loads reviewed?	X			[illegible]
30. What was the criteria used to account for the flexibility of the piping restraints for dynamic and static analyses?	X			9
31. Were the reactions at the penetrations (in and out) been tabulated, and documentary forwarded for use of penetration design under Upset, Emergency, as Faulted condition?	X			

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REVIEW CONSIDERATION	YES	NO	N/A	SEE COMMENT NUMBER
32. Is there piping in this system requiring pipe break or pipe whip analysis? (If not, continue question 33).	X			1[illegible]
a. Was the criteria used in postulating break location, break type and restraint location, proper and correct?				
b. Was the criteria used in designing pipe whip restraint proper and correct?				
c. Were the pipe break loads, pipe whip loads, and jet impingement loads calculated correct and proper and transmitted to the pertinent departments?				
33. Did all documents examined in the course of review appear consistent with each other?				

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COMMENT NUMBER	REVIEWER'S COMMENTS NAME [illegible]	RESOLUTION
1.	Flexible [illegible] were used in the system	Method of analysis were [illegible] similar to for experimental method
2.	SRSS METHOD WERE USED	method is acceptable
3.	NRC Functional Capability Requirements shall be complied	
4.	Small piping criteria shall be used	
5.	It will be combined by absolute sum. Equation 9 [illegible] B of ASME Sect III code is the allowable used.	
6.		Snubber rating will be checked where formal Analysis is performed.
7.	For SSE Response Spectra analysis, this method will be used. If EXCRE Spectra is conservative enough, the [illegible] SSE Spectra will be used	
8.		Flange will be checked against [illegible] on formal analysis stage
9.		Pipe restraint were considered as rigid
10.		Pipe whip analysis will be performed at the formal analysis stage

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Calcs. For	REVIEWED PIPING ANALYSIS DOCUMENTS
Safety-Related	Non-Safety-Related
Calc. No.	
Rev. 0	Date 5-2?-?
Page	of
Client	CECO
Project	BYRON / BRAIDWOOD
Proj. No.	4391-09
Equip. No.	
Prepared by	I. Wu
Date	5-20-?
Reviewed by	
Date	
Approved by	
Date	

DOCUMENT No.	TITLE	REV.	DATE	REMARKS
EMD-008417	AB-04	0	11-09-78	
008419	AB-07	0	07-07-77	
020026	AB-13	0	10-31-79	
009716	BR-09	0	09-16-77	
010450	BR-14	0	10-31-77	
010450	BR-16	0	10-31-77	
003143	CC-01	0	01-28-76	
017271	CC-11	1	03-22-79	
005074	CC-18	2	09-10-76	
013735	CC-40	1	06-28-78	
011204	CS-09	1	12-15-77	
015314	SX-08	1	11-29-78	
017437	SX-34	1	03-29-79	
016403	AF-04	1	03-02-79	
008658	AF-12	0	07-10-75	
009039	SD-23	0	08-08-77	
015538	DØ-09	0	10-30-78	
013281	ØG-08	0	05-11-78	
014125	WØ-11	0	07-21-78	
013404	VD-01	1	07-11-78	
013410	VD-02	1	05-18-78	
014587	WØ-09	0	08-23-78	
015813	ØG-02	0	12-20-78	
016676	DØ-10	0	02-05-79	
011013	SX-13	3	12-20-77	
005815	CS-08	1	11-05-76	
019342	FC-04	0	08-20-79	
P&ID				

PERSONS INTERVIEWED:

B. TATOSIAN ; J. J. KOLOGEROPOULOS ;
T. G. WHITE ; R. J. RAKOWSKI
A. J. DEBLER ;

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REVIEW CONSIDERATION (CID)	YES	NO	N/A	SEE COMMENT NUMBER
1. Have "in service" test requirement provisions been met, and access clearances and appurtenances been provided for test?	X			1
2. Have the seismically qualified instruments been seismically supported?	X			
3. Do instrument sensing lines penetrate the containment? If so, does the installation satisfy the requirements of 10 CFR 50 - Appendix A and Regulatory Guide 1.11?		X		
4. Have the sensing lines of nuclear safety-related instruments been provided with the identification tags as called for in the "Process Instrument Piping and Installation Design Criteria," DC-ME-02-BB?	X			2
5. Have redundant instruments and the respective sensing lines been provided with the necessary separation or barriers as called for in the "Process Instrument Piping and Installation Design Criteria," DC-ME-02-BB?	X			3
6. Have the instrument sensing lines been designed to accommodate the process pipe thermal expansion, the seismic vibration, and the thermal expansion of the sensing lines during blowdown?	X			
7. Have seismic qualified instruments been located such that the seismic response spectrum values are not exceeded during a Design Basis Earthquake?	X			
8. Do the equipment performance specifications (instrument data sheets) agree with the latest calculations (process parameters)?	X			
9. Is the equipment selected suitable to perform the intended function?	X			

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SARGENT & LUNDY ENGINEERS

REVIEW CONSIDERATION (CID)	YES	NO	N/A	SEE COMMENT NUMBER
10. Are the materials of construction compatible with the environment in which it must operate?	X			

Form VAS-4.1 Approved by [signature] Dept. Mgr.
Rev. A (8-22-77)

REF. NO. DRR-AF-001-EB DATE 5/23/80 TITLE: Auxiliary Feedwater System REV: 0	MECHANICAL DEPARTMENT STANDARD DESIGN REVIEW CHECKLIST
FOR OFFICE USE ONLY - NOT TO BE SENT OUTSIDE OF SARGENT & LUNDY	SARGENT & LUNDY REV. DATE Page 2 of 2

April 19, 1983

COMMONWEALTH EDISON COMPANY QUALITY ASSURANCE STATEMENT
REGARDING VERIFICATION OF ADEQUACY OF DESIGN AND CONSTRUCTION
OF BYRON NUCLEAR POWER STATION UNIT #1

The purpose of this statement to the United States Nuclear Regulatory Commission by the Manager of Quality Assurance of Commonwealth Edison Company is to describe the broad range of project design and construction quality activities which enables him to affirm the quality of the design and construction of the safety-related and ASME Code-related aspects of Byron Nuclear Power Station Unit 1 and its associated facilities.

A. GENERAL

Commonwealth Edison Company is ultimately responsible for the assurance of quality in all phases of the design, procurement, construction and preservice testing of the Byron plant. The Commonwealth Edison Company Quality Assurance Program, which has been approved by NRC and found acceptable by the American Society of Mechanical Engineers (ASME), addresses the requirements of the 18 Criteria of Appendix B to 10CFR50 and Section III of the ASME Boiler and Pressure Vessel Code as well as the applicable ANSI Quality Assurance Standards and NRC and other Federal and State Regulatory requirements.

The quality assurance programs of the various vendors and contractors, involved with ASME Code and safety-related items and activities, are also required to adhere to the requirements of the applicable Appendix B Criteria. Further, the Commonwealth Edison Company Program requires that its Quality Assurance personnel review and accept all such vendor and contractor quality assurance programs (including those of the Architect Engineer and the NSSS vendor) prior to award.

Commonwealth Edison Company's Manager of Quality Assurance directs the quality assurance activities related to the design, procurement, construction and operation of the Commonwealth Edison Company's nuclear plants. Commonwealth Edison Company's Quality Assurance organization is completely independent of the Engineering, Construction and Operating organizations, has freedom to identify quality problems and reports directly to senior management. Since the Commonwealth Edison Company Quality Assurance organization was established in 1973, the Manager of Quality Assurance has reported, successively, to an Executive Vice President, a former President and presently the Vice Chairman of the Company who all have given, and are giving, full support to the Quality Assurance Program

The people that formulate the Commonwealth Edison Company Quality Assurance organizations consist of graduate engineers of essentially all engineering disciplines related to nuclear and non-graduates with years of hands-on experience such as involving maintenance, construction, engineering, and operating Navy nuclear and other technical activities. Having qualified personnel is a

basic requirement for a Quality Assurance organization. To assure that qualified personnel have adequate knowledge to perform their work and maintain their proficiency with respect to such quality associated items and activities as Codes, Standards, materials testing, nondestructive examination, welding, auditing, inspection, coating, fire protection, etc., formal training and refresher training are routinely given. Generally, the training of Quality Assurance personnel is an extension of their formal education or work experience. In addition, the Commonwealth Edison Company Quality Assurance personnel are required to be qualified and, in turn, certified for specific functions involved with inspection, surveillance and audit activities such as covering the items listed above as examples for which training is provided, and are required to adequately demonstrate their qualification to perform specific functions before they are allowed to perform the quality assurance work activities for which they are qualified. Furthermore, Commonwealth Edison Company Quality Assurance personnel are required to be recertified on a two-to-three year cycle.

Qualified Quality Assurance personnel are assigned to all nuclear construction sites and operating stations and the Commonwealth Edison Company's nuclear testing and engineering organizations. A Quality Assurance Coordinator, who reports to the cognizant Director of Quality Assurance (Engineering-Construction), has been assigned full time, since 1975, to the Commonwealth Edison Company engineering organization which has overall design

responsibility for the nuclear stations. The Quality Assurance Coordinator reviews procurement documents, specifications and procedures and performs periodic audits and surveillances of project activities to verify compliance to the Commonwealth Edison Company Quality Assurance Program and applicable procedure requirements.

Each Commonwealth Edison Company corporate department having nuclear related responsibilities, such as involving engineering, purchasing and testing, is audited annually (Exhibit B) to the requirements of the Quality Assurance Program, their respective department procedures and other requirements by Corporate Quality Assurance using qualified and certified Lead Auditors and Auditor personnel who are not directly involved with the organization being audited. Also, the nuclear construction sites are audited by Corporate Quality Assurance on about a four-to-six month cycle. In addition, audits of the other construction site organizations and contractors are performed by Commonwealth Edison Company Site Quality Assurance in accordance with an approved schedule ranging from monthly to annually depending on need or established requirements. Identified deficiencies are required to be committed to be corrected or dispositioned in a timely manner. Audit deficiencies, involving Commonwealth Edison Company Departments, which are not corrected or dispositioned in a timely manner are referred to top corporate management for their handling. Where serious problems or inaction

to solve problems are identified, stop work action is initiated. The Manager of Quality Assurance has responsibility and authority to stop unsatisfactory work or stop further processing of unsatisfactory material during design and construction of the plant. Conditions found by quality personnel, which are adverse to quality and require prompt action and corrective action but cannot be resolved at the respective locations, are required to be promptly reported to the Manager of Quality Assurance or his designated alternate for action. Furthermore, resumption of work under a stop work order requires concurrence of the Manager Quality Assurance. There have been nine cases of stop work at Byron plus two at a vendor plant due to Quality Assurance Program implementation and welding problems (Exhibit C) ranging from a very short time to many weeks. The extended stop work cases, for the most part, involved administrative, training, inspection and/or procedure problems which had to be corrected before work activities could proceed.

Currently at the site, a stop work order is in effect against Reliable Sheet Metal, the HVAC contractor. All new work on safety-related systems and attachments to safety-related structures was stopped on September 17, 1982. The stop work was issued because of inadequate and incomplete inspections, inadequate procedures, lack of some procurement documents and open audit deficiencies. The stop work will remain in effect until these items have been corrected and the corrective actions have been accepted by the Commonwealth Edison Quality Assurance Manager.

At the construction sites, the Commonwealth Edison Company construction Quality Assurance organization functions independently of the Commonwealth Edison Company Construction site organizations under the direction of the site Quality Assurance Superintendent. He reports off-site to a Director of Quality Assurance (Engineering- Construction), who reports to the Manager of Quality Assurance. The Byron site construction Quality Assurance group has expanded over the years to keep pace with the construction activities and currently consists of about twenty qualified people augmented with an Independent Testing Agency contractor work force of qualified inspection and test technicians.

The site Quality Assurance group performs audits (Exhibit D) and surveillances (Exhibit E) of site construction activities. This group checks for implementation of contractor and Commonwealth Edison Company Quality Assurance Programs and procedures, and assures that on-site design functions are controlled and performed to applicable requirements and that the plant is constructed and tested in accordance with approved drawings, specifications and procedures. The Independent Testing Agency contractor, consisting of between forty-to-fifty qualified inspector type technicians, performs normal independent inspections, tests and examinations of contractor work at Byron under the control and direction of site Quality Assurance (Exhibit F). Site Quality Assurance also uses the Independent Testing Agency to perform special inspections as deemed prudent or necessary to check construction work performed and inspected by contractors.

Also, to cover plant operation activities at the Byron Station, the Commonwealth Edison operations Quality Assurance group was established early on. It has overall responsibility to ensure the activities and functions performed by the Station staff are carried out, as required, during the formulation, pre-operational testing and startup stages of the project as well as during plant operation after issuance of the plant operating license. The operations Quality Assurance group consists of seven to eight persons who perform inspections, surveillances and audits of plant operation activities covered by the Corporate Quality Assurance Program such as maintenance, procurement, pre-operational testing, plant start-up activities and associated administrative and other functions related to plant operations. Special emphases were placed on performing surveillances and audits of each system pre-operational test to ensure requirements were fulfilled.

In addition to the normal auditing performed by each site contractor (Exhibit G) and the surveillances and comprehensive audits performed by Commonwealth Edison Company site and operations Quality Assurance, site design, construction, testing and Quality Assurance activities were also audited by Commonwealth Edison Company Corporate Quality Assurance (Exhibit H) on a four-to-six month cycle throughout the course of the Byron Project. The Corporate Quality Assurance audits were performed to ensure that the Commonwealth Edison Company Quality Assurance and other organizations and the contractors on-site were performing their

responsibilities acceptably as required by the respective Quality Assurance Programs, design documents and procedures for the ASME Code- and safety-related aspects of the Byron Station Project.

Audits of architect-engineers' and NSSS vendors' corporate activities with respect to design are given special attention by Commonwealth Edison Company's corporate Quality Assurance management. All such audits are conducted under the immediate direction of either the Manager of Quality Assurance or the Director of Quality Assurance for Engineering and Construction. Furthermore, one of these individuals has participated with each audit team in almost all of these design audits. The audits covered all aspects of the Quality Assurance Program and in many cases went into considerable depth in specialized design areas. The methodology utilized by Commonwealth Edison Company Quality Assurance to achieve an appropriate confidence level regarding adequacy and accuracy of the design and construction includes inspections, surveillances and audits (Exhibits I & J). Although inspections, surveillances and audits do not in themselves result in specifically checking the design and construction of each and every item in the plant, the results from the implementation of the Commonwealth Edison Company Quality Assurance Program has proven to be sufficiently flexible and extensive to cover the various areas of design and construction. In addition, this technique has resulted in Commonwealth Edison Company Quality Assurance Engineers and

Inspectors examining, in great detail, a wide range of selected items and areas, including those reported to be of concern at other project sites such as troubles with vendors or contractors, construction, equipment and operating problems, failures relating to implementation of Quality Assurance Programs, design and design control problems, welding, nondestructive examination and inspection deficiencies, etc. In particular, special attention has been given to items reported as identified problems by other projects across the country and to items brought to our attention by NRC Region III Inspectors, particularly involving design and inspection activities. Nuclear industry and NRC reports of problems are reviewed by the Corporate Quality Assurance staff and pertinent problems are brought to the attention of our Quality Assurance personnel at all locations, by separate memoranda, who in turn are required to investigate whether similar problems exist in connection with any of our nuclear projects or operating stations. Furthermore, because of the comprehensive coverage achieved through this program, Quality Assurance Engineers and Inspectors have reviewed and verified the design and construction of a broad scope of items and components installed at Byron. These results are in addition to the reviews, checks, inspections and audits performed by in-line organizations responsible for design and construction.

Also, the NRC and ASME, starting in 1972 and 1974 respectively, have conducted inspections and surveys of Commonwealth Edison Company, to assure that the Commonwealth Edison

Company Program is correctly and properly implemented. ASME conducted surveys of the Commonwealth Edison Company corporate offices in 1974, 1977 and 1980 (Exhibit K) which resulted in ASME awarding Engineering Organization and "N" Certificates plus NA and NPT Certificates to Commonwealth Edison Company that grant it authority to design, fabricate and install items that must meet ASME Code requirements.

In all cases, the ASME Survey Teams reported that the procedures and management controls were sufficiently effective to implement the Commonwealth Edison Company Quality Assurance Program. Overall, not only did the Commonwealth Edison Company successfully pass all these corporate ASME surveys but as a further benefit all departments became more involved in Quality Assurance and gained significantly in the understanding and application of the Quality Assurance Program - a significant contribution to the overall quality effort.

The Commonwealth Edison Company Quality Assurance efforts during the course of the Byron Project have been actively, energetically and intensely performed to ferret out problems, obtain corrective action, prevent recurrence of problems and assure that the proper engineering information was used in generating the design documents; the proper design documents were used in the construction of the plant; the construction was performed to approved procedures and is in accordance with the design documents; and the inspection and testing of the facilities was performed,

reviewed and accepted by qualified personnel. These verification efforts have been carried out with multiple tiers of inspections, surveillances and audits by contractors and Commonwealth Edison Company Quality Assurance and other outside organizations such as NRC and ASME plus consultants, such as Energy Inc., who have performed management audits (Exhibit L) of Commonwealth Edison Company Quality Assurance every other year as to the implementation and effectiveness of the Quality Assurance Program in Commonwealth Edison Company.

Also, top corporate management of Commonwealth Edison Company has been kept fully informed by Corporate Quality Assurance about the quality aspects of the Byron Project as well as of the other nuclear construction projects and the operating nuclear stations on our system.

A copy of each Commonwealth Edison Company Quality Assurance audit report is sent to the Manager of Quality Assurance and to other corporate management having responsibilities involving the Byron Project. In addition, detailed monthly reports covering the Commonwealth Edison Company Quality Assurance activities, audits and problems are provided to top corporate management in order to keep them informed. Also, items that need upper management attention are identified in this monthly Quality Assurance activities report for their corrective action. When such identification has been deemed necessary by the Manager of Quality Assurance, prompt action is required by senior management.

Finally, an annual Quality Assurance assessment report covering quality assurance activities and problems involving all Commonwealth Edison Company organizations and locations checked by Quality Assurance during the year is provided to top management having nuclear related responsibilities. This report provides a candid overall assessment regarding the implementation of the Commonwealth Edison Company Quality Assurance Program including contractor construction activities. Problems experienced during the year are addressed and where more attention is deemed needed by upper Commonwealth Edison Company management, usually relative to attitudes, approaches and resistants; such problems also are presented in the report for corrective action and disposition.

The reporting concept is similar to that used with financial audits; that is, bring problems to the attention of the responsible manager for correction. A difference under the Commonwealth Edison Company Quality Assurance Program, however, is that stop work action by the Manager of Quality Assurance is exercised where a serious problem needs immediate attention.

In addition to the above verification activities which have been performed regularly throughout the course of the construction project, a special intensive evaluation of the Byron project was performed in late October, 1982. The basis for the evaluation was the Institute of Nuclear Power Operations Performance Objectives and Criteria. Commonwealth Edison Quality Assurance coordinated a self-initiated evaluation which was

carried out by a twenty-man team. The team consisted of senior management personnel with broad backgrounds in construction, engineering and operating along with five consultants. The team looked, in depth, at the plant facilities, work under construction, construction practices, design input, design output and design review. The Byron project was found to measure up well against the INPO Criteria. Corrective action for the deficiencies identified by the Team were readily undertaken. It is felt that this industry evaluation adds considerable credibility to the view that the Byron Unit One facilities are adequately designed and constructed and are of good quality.

B. DESIGN VERIFICATION

Commonwealth Edison has placed heavy emphasis on the evaluation and verification of design. Engineers qualified in specific design disciplines are used in these design verification audit efforts. This is accomplished in two ways. Engineers from consulting firms are hired to perform independent design verifications and Commonwealth Edison Quality Assurance performs its own verification of design with audit teams of Edison design engineers.

1. Verification by Consultants

Energy Incorporated has been involved in three recent technical assessments of Sargent & Lundy (S&L) for Commonwealth Edison involving design control and design verification. In June of 1982, Energy Incorporated participated in a design audit of S&L, the architect

Engineer, and did a thorough assessment in the design control area involving the Byron Project. Again, in October 1982, Energy Incorporated participated in the INPO Self-Initiated Evaluation of the Byron Nuclear Station Construction Project. In this Evaluation, Energy Incorporated was responsible for assessing the effectiveness of the design control covering design input, design output and design review. In both efforts, Energy Incorporated found that S&L is doing an effective and thorough job in the design of the plants and has an effective design document control system.

During these two efforts, Energy Incorporated's assessment covered the following specific areas:

Engineering administrative procedures
Design criteria
Drawing
Equipment & System specifications
Stress analysis reports
Design document control system
Design interface controls (internal & external)
Class 1E equipment qualification program
Design review and verification program
Computer program verification

The approach used for the assessment was to review the S&L Quality Assurance Manual, various Department Standards, and the Project Instructions covering the design process to determine if these documents were thorough and, if properly implemented, could result in a well controlled design

process. The specific areas named above were then evaluated through document review, personnel interviews and observations to determine if the engineering procedures were effectively implemented. It was found that the S&L design control program is very thorough, well understood by the engineering staff, and effectively implemented.

Energy Inc. found that S&L's Quality Assurance Manual gives the overall direction for the design process quality program and requires the development of Project Instructions to provide additional direction to the staff members assigned to each project. These instructions contained design interface and review requirements and contained tracking requirements to assure the various design interfaces occurred. It should be noted that all the project instructions reviewed during the evaluations contained the level of detail necessary to assure continuity throughout the program. It was found through interviews by Energy Inc. that the project design staff was very familiar with these instructions.

In addition to the Quality Assurance Manual and Project Instructions, it was found that each department within S&L has its own department standards. These standards contain instructions covering the engineering work being done by the given department. Again, the

department standards reviewed during the course of the evaluations were found to be excellent training and instructional documents well understood by the department staffs.

Also, to aid the staff members in applying the correct design criteria, the projects had developed general project design criteria documents. These documents were not necessarily a program require- ment but were generated to aid the staff during the design and analysis activities. These documents are excellent reference documents and will be invaluable during the life of the plant for future reference.

In addition, the engineering documents (drawings, specifications, analysis reports, and criteria) were well done and cross referenced. Specifically the stress analysis reports were found to thoroughly reference the drawings and criteria documents by both number and revision. This thoroughness seemed to be consistent in all documents reviewed.

At the conclusion of the evaluations it was Energy Incorporated's opinion that S&L has a very thorough program in the Design Control area. They found the program to be well documented, understood by the staff, and effectively implemented. (See Exhibit P)

In the third and most recent audit of Sargent and Lundy in March 1983 by Energy Incorporate, a five man team of experienced design consulting engineers performed an independent design verification audit of the Byron/Braidwood projects with particular emphasis placed on design of Byron Unit 1. The review included, but was not limited to review of stress analysis reports for proper input and use of output, compatibility with design drawings, completeness of the model, adherence to codes and standards; review of pipe whip analysis for modeling methodology; review of fluid system thermal-hydraulic analysis for modeling; review of a fluid system for classification, operating modes, thermal-hydrauulic operational analysis and safety analysis which establish design input values; P&ID's for proper regulatory and code requirements; control requirements for operational and safety considerations, design drawings for proper carry-through of P&ID and functional requirements, control loop diagrams, completeness of drawing package and design specification.

Energy Incorporated, as part of this independent design analysis type review, similarly verified that Sargent & Lundy is doing an effective and complete job in the design of these plants.

2. Verification by Commonwealth Edison

During the course of the Byron project, extensive audits of the organizations having design and construction responsibilities, have been and are being performed by Commonwealth Edison Company's Quality Assurance Organization. Quality Assurance has conducted audits, surveillances and closeout surveillances of audit deficiencies of our principal Architect-Engineer, Sargent & Lundy, Westinghouse Electric Corporation, and of other organizations performing design work involving the Byron Project.

Sargent & Lundy has responsibility for the overall control of the design, and of the distribution of design information and documents, which is controlled by distribution lists and memoranda. Two methods are used to verify calculations. In the case of design calculations performed by computer, the computer programs are verified by Sargent & Lundy for adequacy and accuracy of the design process for safety-related and ASME Code-related structures, systems and components prior to permitting their use; and thus, sample calculations of subsequent computer runs are not required. Calculations involving design not performed completely by computer are documented and their review, including verification of sample calculations, must be documented.

Audits were performed by Commonwealth Edison Company of both Architect Engineer firms' corporate and on-site design activities for Byron. Examples of some of the technical deficiencies which were identified and corrected as a result of these audits are: calculations for cable pan loading did not properly reflect FSAR requirements; field changes were not properly translated into design drawings; provisions were not made for local annunciation and alarm for fire protection in the battery room; insufficient accountability for concrete test data and reinforcement bar damage data; calculations for electrical conduit supports did not consider the eccentricity of the applied load due to the width of the tube steel; improper horizontal acceleration factor was used in electrical conduit support calculation; a horizontal force component was omitted from an electrical conduit support calculation and calculations for pipe rupture jet forces were not properly documented.

In addition, the Architect Engineers perform audits of their assigned design responsibilities, which Commonwealth Edison Company Quality Assurance reviews and assures are performed acceptably and, when deficiencies are identified, are corrected satisfactorily. These audit and surveillance activities will continue until completion of the design of the two units at Byron.

System design at Sargent & Lundy for the Byron Project was initiated in 1971. A majority of the system design was conducted between 1973-1976, with many revisions being made since then as a result of changing design requirements, changing NRC requirements, TMI lessons learned, design improvements by Sargent & Lundy and design changes suggested by Commonwealth Edison Company Operating and Engineering Departments. Commonwealth Edison Company Quality Assurance has assured by audits and surveillances that systems design was performed in accordance with procedures in place at the time of the design work. Early in the 1970's, an approved Sargent & Lundy Quality Assurance Program was not in effect, but formal design control procedures were in effect which required independent review of design work. Design work since the implementation of the Sargent & Lundy Quality Assurance Program in about early 1974 was performed to procedures in effect at the time of the actual work performed, which ensured that design work was independently reviewed and approved. All of this design work was audited by the Quality Assurance organizations of Sargent & Lundy and Commonwealth Edison Company and by independent consultants for Commonwealth Edison Company. In addition, Sargent & Lundy further reviewed the design of the various systems as a result of

the NRC review of the system descriptions within the FSAR, which adds further assurance of proper system design. Finally, as to final design verification, Sargent & Lundy is required to do independent design reviews. System and structure design reviews are performed in accordance with Sargent & Lundy approved Quality Assurance Procedures and Project Instructions to verify the design of the Byron Station Project. Design review teams of qualified Sargent & Lundy design people, not involved with the project design, were used. In addition, an overall integrated design review of the total design of the Byron Project is being performed by independent senior Sargent & Lundy design people in accordance with the Project Instruction. In the case of both types of review to independently verify the design, documented design review reports setting forth the results of these reviews are issued by Sargent & Lundy and are reviewed by audit for acceptability by Commonwealth Edison Company Quality Assurance.

C. QUALITY ASSURANCE COVERAGE

The scope of audits conducted over the years by Commonwealth Edison Company Quality Assurance covers the various aspects of design. The questions contained in the approved checklists for the design audits are comprehensive and cover not

only the 10CFR50 Appendix B, 18 Criteria basic requirements such as design control, document control, auditing, corrective action, training, personnel qualification, etc., but also the complex and intricate aspects of the plant electrical, mechanical and structural design. The checklist questions for each audit are developed from established requirements such as those contained in procedures, applicable design documents, National Standards, the ASME Code, the FSAR, NRC regulations, and the applicable Quality Assurance Program and its implementing procedures.

In addition, more extensive design analysis audits were performed in selected areas. Some of the areas were selected on the basis of reports of problems at nuclear construction sites not on the Commonwealth Edison Company system. Some of the design areas covered with special "analysis type" audits were pipe supports, whip restraints, environmental qualification of electrical equipment and cable tray loading. These special design audits were performed by senior Commonwealth Edison Company Quality Assurance engineering people with design experience in the related area. In addition, audits were performed of architect engineer organizations which are located at the Byron Site (Exhibit M).

In addition to the basic Quality Assurance 10CFR50, Appendix B Criteria requirements and the verification of implementation of the Quality Assurance procedures and controls, the scope of design audits of our architect engineering organizations (Exhibit N)

by Commonwealth Edison also covered such items as: (1) technical review and evaluation of calculations; (2) performance of work; (3) computer program validation and usage; (4) piping design and analysis; (5) controlling and processing design changes; (6) stress analysis; (7) design support activities by other design organizations; (8) verification of qualification and ability of design and engineering personnel; (9) incorporation of design criteria and parameters into design documents; (10) design interface and data control with other design organizations; (11) technical aspects of electrical, mechanical and structural design including instrumentation and control; (12) design of supports, hangers, snubbers and restraints including applications of loadings; (13) seismic and environmental qualification requirements; (14) effectiveness of design control and design review including data verification; and (15) overall design review, all to assure such items are being performed correctly by the Architect Engineers.

A sample of some of the technical questions from our design audit checklists, which ranged from ten to as many as 233 questions per audit, are listed in Exhibit A and are provided to demonstrate the comprehensive, complex and in-depth nature to which these audits were performed to review and analyze the adequacy and accuracy of the designs.

As can be determined from the listing of items covered above and the sample questions from our design audit checklists listed in Exhibit A, some of the design items being checked are highly

technical and require the use of an engineer with substantial design experience. Thus, when it was deemed necessary to augment our audit teams' technical capability and credibility, independent design personnel with technical expertise in a particular design activity were assigned to the audit team as consultants. Examples of technical items for which consultants were used to assist audit teams involving design were (1) evaluation of calculations; (2) design of hangers and snubbers; (3) computer program validation; (4) application of loadings, etc. The technical audits performed by Commonwealth Edison Company with outside consultants has proven to be very effective in identifying problems and verifying design acceptability.

D. On-Site Quality Assurance

The Commonwealth Edison construction Quality Assurance group at Byron monitors quality related construction activities through audits and surveillances. The staffing of the group has increased as construction activity has increased to its present number of approximately twenty-eight (28). This number includes qualified technical personnel from the Independent Testing Agency who supplement the activities performed by the twenty (20) Commonwealth Edison Quality Assurance Engineers and Quality Assurance Inspectors. This site group is composed of a site QA Superintendent, and two (2) QA Supervisors, with the remainder of the personnel assigned under several lead people who report to the supervisors. In addition to the site Construction Quality Assurance group, an Operations Quality Assurance group is also in place. Prior to receipt of the operating

license this group consisting of 7-8 qualified Quality Assurance people under the direction of a Station Quality Assurance Supervisor, is continually involved in performing surveillances and audits of the preoperational test program leading up to plant start-up as well as the other operating station activities covered by the corporate Quality Assurance Program.

During the course of the project, the site construction QA organization has performed extensive audits of the contractors performing safety related work at Byron. In accordance with approved audit schedules and to approved checklists. The scope of the audits conducted through the course of the project cover not only the eighteen criteria of 10CFR50, Appendix B such as design control, document control, inspections, tests, personnel qualification, corrective action and audits, but other areas such as ANSI Standards, ASME Code, applicable NRC and other governmental regulations, the requirements of the Commonwealth Edison Quality Assurance Program and the respective contractors' Qualicy Assurance Programs, procedures, and plant installation adherence to specifications, drawings and procedures requirements.

As of December 31, 1982 the site QA group has performed 409 audits of contractor activities at an average interval of each three months (see Exhibit D). Where additional coverage was warranted, the frequency of audits was increased.

The audit process provides for identification of problems, obtaining appropriate corrective action including action to prevent

recurrence, follow-up and close-out by the Quality Assurance groups. This audit program has been effectively executed during the course of the project and has been instrumental in the identification of problems at Byron.

In addition to audits, the Commonwealth Edison site Quality Assurance performs regular surveillances of construction activities. Surveillances are less formal than audits in that they are generally not conducted in accordance with approved checklists but instead are conducted to verify adherance to procedures, codes, standards, etc. Documented surveillances are performed at a greater frequency and independent of audits although they cover the same types of activities as audits. Deficiencies identified during surveillances must be corrected in a timely manner or they will be elevated to audit deficiencies. To date 4107 surveillances have been performed by the site QA group (see Exhibit E).

Each site contractor also performs audits and inspections of their work activities in accordance with their own Quality Assurance Programs which are approved by Commonwealth Edison Company. To date the site contractors have performed approximately 1080 audits of their construction and quality control inspection activities (see Exhibit G). The performance of such activities are monitored by Commonwealth Edison Quality Assurance to assure adequate implementation by each contractor. Contractor Quality Control (QC) inspection personnel are required to be qualified in accordance with ANSI N45.2.6. This requirement has been in place since the beginning

of the project and has been monitored by Commonwealth Edison. Due to changes to interpretation to the ANSI standard, it was required to periodically review and upgrade site contractors inspector qualification requirements mainly after TMI.

In addition to the audits and surveillances conducted by Commonwealth Edison and site contractor Quality Assurance groups, the Independent Testing Agency performs over-inspections of construction activities. The Independent Testing Agency has performed, on a sampling basis, over-inspections of welds previously inspected by contractor QC inspectors as a check of the inspection and to assure compliance to requirements. This group has also performed surveillances of many contractor activities in the Structural, Mechanical and Electrical disciplines. Since September 1982, another group consisting of 5-7 Independent Testing Agency qualified inspection personnel has been established. This group known as the "Unit Concept Inspection" team conducts in-depth inspections of work performed by site contractors to the basic design drawings. The unit concept inspections are in addition to the normally assigned inspections and the specific overinspections performed by the testing agency as directed by site Quality Assurance.

The inspection performed by this group is an independent reinspection of work and inspections performed by the contractors during plant construction and a verification of the quality of manufactured equipment installed in the plant. The purpose of the Unit Concept Inspection is to perform complete check and reinspection

of all items of an element of the plant each week, such as all items in a volumetric space within four columns and the floor and ceiling of the plant, a specific item, etc. against the final basic design and vendor drawings to provide the Commonwealth Edison Company an additional level of assurance of the construction quality of the facilities and equipment in the plant.at the essentially completed stage of installation.

In addition to the audits performed by the Site and Station Quality Assurance groups at Byron, extensive and comprehensive audits are performed by General Office Quality Assurance using qualified Quality Assurance auditors not directly involved with the Byron Project quality assurance activities. These off-site audits are performed two or three times each year. Such audits provide an independent check of the Quality Assurance implementation of all organizations on site as well as provide an evaluation and assessment of the adequacy and effectiveness of the Commonwealth Edison Quality Assurance groups at Byron for the Manager Quality Assurance and the other involved top management of the Company.

Also, a management audit is performed every other year of the implementation of the Quality Assurance Program and other requirements, by an independent outside the Company consultant organization, covering all nuclear associated activities in Commonwealth Edison all of which provides additional assurance that the construction quality is good.

As a result of the most recent Management Audit and Assessment performed in 1981, it was the assessment of the Energy Incorporated Audit team that Commonwealth Edison Company's Quality Assurance Department and the other Edison organizations and contractors, demonstrated a high level of capability and had a good attitude toward implementing the Edison Quality Assurance Program. This Program was comprehensive and therefore, more than just adequate. It was current with respect to the applicable regulatory requirements and codes and effective as evidenced by its implementation such as: the timely responses and corrective actions taken by the audited organizations, as well as the recognition and understanding of the program requirements by personnel outside the Quality Assurance Department.

E. QUALITY ASSURANCE COVERAGE OF ON-SITE DESIGN

Three organizations, Sargent & Lundy, Westinghouse and Nuclear Power Services perform design activities at Byron Site under the direction of Commonwealth Edison Company Project Engineering Department. Sargent & Lundy, our principal Architect/Engineer, is involved on-site in piping support design, electrical design, resolution of field problems and gathering of field information to be used by their Chicago office in design activities. On-site design activities are performed utilizing engineering standards and hand calculations. Resulting changes to design documents are controlled through the use of field change requests, engineering change notices and subsequent drawing revisions.

Nuclear Power Services (NPS) is basically an engineering adjunct to Sargent & Lundy's piping and support design activities on site. Work procedures developed by NPS are reviewed by Sargent & Lundy to ensure they have adequate design and design control provisions. Sargent & Lundy maintains a vigilance over NPS activities through on-site management, site visits and periodic audits.

NPS activities include field walk downs, analysis of installed piping, design of piping supports and issuance of approved design drawings. To accomplish their design, NPS utilizes standards and hand calculations, or if applicable, computer analysis is performed. "STRUDL" and "BASE PLATE" are the computer programs widely used to analyze complex structures and resolve complex problems.

The piping analysis and piping support design work being performed by Westinghouse is a continuation of the design effort initially performed by Sargent & Lundy. Westinghouse's site activities also include resolution of field problems.

The piping analysis performed by Westinghouse is done using automatic interactive graphics piping analysis methods. Piping models are developed from fabrication isometric drawings, checked by an independent engineer and then transmitted to computers in Pittsburgh for analysis. The results of this analysis provide piping stress levels and piping support loads to the support designers for incorporation into their analysis. The piping supports previously designed by Sargent & Lundy are verified to assure they are capable

of supporting the loads generated by the piping analysis. If so, the drawings are released for fabrication. If not, the piping support drawings are modified to reflect needed design changes. In the event that new support designs are required, these are made by the piping design group and original support drawings are prepared, reviewed, approved and distributed.

In the design of new supports or resolution of field problems, simple calculations are performed, where applicable, by hand with computer analysis utilized on the more complex structural frames and baseplates subjected to multidirectional loading.

To augment Westinghouse's manpower, NPS personnel aid in performing design tasks. Westinghouse maintains overall responsibility for the work performed by NPS personnel, and all the work is performed in accordance with the approved Westinghouse QA Program and applicable procedures.

On-site design activities are delineated in appropriate interface documents, instructions and procedures. These interface documents are reviewed and approved by the involved engineering organizations including Commonwealth Edison Company Project Engineering Department. Procedures are reviewed and approved by the applicable engineering organizations and Commonwealth Edison Company Site QA.

At the Byron Site, design activities performed on site are being reviewed and monitored by site Quality Assurance on a continuing basis by scheduled surveillances; also, design activities

are being audited to formally approved checklists in accordance with an approved audit schedule. Through the end of 1982, sixteen (16) audits and eighty-four (84) surveillances have been conducted by site Quality Assurance. These audits have contained numerous questions covering the following general areas:

Organizations
Indoctrination and Training
Design Control including Design Changes
Control and Approval of Design Inputs
Design Interfaces
Design Status Control
Design Reviews and Verification
Reviews of Design Calculations
Document Control
Instructions, Procedures and Drawings
Corrective Action
Records
Audits

Specific design areas examined during these audits have included such elements as:

1. Review, approval and updating of design input by the responsible design organization.
2. Documentation of design input, objectives and assumptions used on specific calculations.
3. Verification that field walkdown information and calculations are correct.

4. Verification that penetrations and attachments on safety-related walls have been properly documented.
5. Verification that design calculations are being performed to acceptable methods and results conform to acceptable criteria.
6. Verification that approved as-built conditions are supported by design calculations consistent with design criteria.
7. Verification that systems have been checked for thermal expansion using the appropriate flexibility check rules.
8. Verification that supports and restraints are designed to an emergency loading condition and that the emergency condition includes: (a) pipe weight, (b) self excitation emergency dynamic load, (c) weight of restraint, (d) thermal expansion pipe loads and (e) frictional loads.
9. Verification that resultant deflection or deformation of the aux steel piping anchor due to weight, thermal and dynamic loads does not exceed .25 inch at the centerline of the pipe.
10. Verification that only current design standards and design drawings are used during the design process.

These audits and surveillances have been effective at identifying and resolving deficiencies promptly with the involved site design organization. While there have been minor problems noted and resolved, these audits and

surveillances have shown that no significant design problems exist in design activities at the Byron Site. These actions and results add to our confidence that Byron Unit #1 design is acceptable.

F. NRC Inspections

The NRC has performed many inspections of the Byron Project. Since 1974 approximately 120 inspections have been performed of essentially ASME Code and safety-related construction and design activities. The scope of the inspections concentrated on implementation of both Commonwealth Edison and site contractor Quality Assurance programs relative to procedures, performance of inspections, qualifications of inspection personnel, and documentation verifying acceptance of installations and materials in the plant. During the course of these inspections, approximately 208 items have been identified by NRC inspectors; approximately 123 infractions and 85 unresolved items (Exhibit O). The items identified are tracked by Commonwealth Edison site Quality Assurance to verify completion of corrective actions. The corrective actions in many cases have resulted in improvements to the quality programs being implemented at Byron through more comprehensive procedures, additional audit and surveillance activities and more detailed inspections, for example. Presently some items remain open, though for most NRC items the corrective actions have been completed. It is anticipated that most of the open items will be closed shortly.

G. CONCLUSIONS

To the best of my knowledge and belief and based on the overall results of: (1) the comprehensive auditing and surveillance activities including resultant corrective actions of deficiencies covering design and construction; (2) the quality control inspections and audits performed by each site contractor; (3) the additional assurance inspections of the contractors performed by the Independent Testing Contractor at Byron under the control and direction of Commonwealth Edison Company site Quality Assurance; (4) the comprehensive inspections performed by NRC; and (5) the various ASME surveys of ASME Code certified contractors and Commonwealth Edison Company that were performed during the construction of the plant, involving both design and construction, Commonwealth Edison Company's Quality Assurance is quite confident the ASME Code-related and safety-related aspects of Byron Nuclear Power Station Unit 1 are acceptably designed and built.

W. J. Shewski
Manager of Quality Assurance

1779Q

BYRON STATION
STATEMENT ON ADEQUACY OF DESIGN AND CONSTRUCTION

INDEX OF EXHIBITS

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B. Corporate QA Audits - (Edison Departments)
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K. ASME Surveys of Edison
L. Management Audits - By Independent Consultants
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N. Corporate QA Audits of Sargent & Lundy
O. NRC Inspection
P. Independent Assessment of Design by Energy Incorpoated

March 29, 1983

EXHIBIT A

BYRON PROJECT
COMMONWEALTH EDISON DESIGN ANALYSIS AUDITS
SAMPLE QUESTIONS

NUCLEAR POWER SERVICES AUDIT
June 4, 1982

Question 1 Verify that supports and restraints are designed to an upset loading condition and that the upset condition includes:

a. pipe weight load
b. upset pipe dynamic load
c. self excitation upset dynamic load
d. weight of restraint structure
e. thermal expansion pipe loads (if applicable)
f. frictional load (if applicable)
(Ref: Consultant Spec. #109, Section 302.12)

Question 3 Verify that resultant deflection or deformation of the auxiliary steel piping anchor due to weight, thermal and dynamic loads does not exceed .25 inch at the centerline of the pipe.
(Ref: Consultant Spec. #109, Section 302.12)

SARGENT & LUNDY
June 11, 1982

Question 9 Verify that for each amendment or revision to the Safety Analysis Report an abbreviated internal division of responsibility has been prepared.
(Procedure GQ-3.05, Rev. 3, para. 4.0, pg. 6)

Question 64 Do the mechanical piping and design groups interface so that when revisions are made to piping, the corresponding hangers are also revised. Is the field notified of such upcoming hanger changes?
(Criterion III)

Question 82 — Have all non-conforming cylinder breaks for Byron/Braidwood been acounted for in the mix design. (Criterion III)

Question 84 — Verify that electrical valve operators located inside the containment have been tested in accordance with IEEE 382-1972. (FSAR pg. 8.1-12, para. 8.1.13)

Question 85 — Verify that calculations were performed to demonstrate that there will be no failure of cable insulation of the bottom layers of cable due to compacting (plastic flow) over to design life of the plant. (FSAR pg. 8.3-11, para. 8.3.1.4.1.1)

Question 86 — Verify that the electrical penetrations for Division 11 cables are physically separated from Division 12 cables. (FSAR pg. 8.3-12, para. 8.3.1.4.1.1)

Question 87 — Verify that the two groups of electrical penetrations of the same ESF division are spaced approximately 40 feet apart. (FSAR pg. 8.3-12, para. 8.3.1.4.1.1)

Question 88 — Verify that the electrical penetrations meet the design requirements of IEEE 317-1972. (FSAR pg. 8.3-13, para. 8.3.1.4.1.1)

Question 89 — Verify that nuclear instrumentation signal (triaxial) cables are run in steel conduit that is limited to 25% fill. (FSAR pg. 8.3-18, para. 8.3.1.4.2)

Question 90 — Verify that for nuclear instrumentation signal (triaxial) cables the following criteria has been met: (FSAR pg. 8.3-18 para. 8.3.1.4.2.2)

a. The maximum straight run of conduit is 100 feet, or
b. where a 90° bend occurs that straight run is 10 feet maximum.

Question 91 — Verify that the battery charger for DC Bus 111 is rated to supply its associated DC loads while fully recharging the battery within a 24 hr. period. (FSAR pg. 8.3-24, para. 8.3.2.1.1)

Question 92 — Verify that the 125-VDC batteries are sized to carry the loads shown in Table 8.3-5 for the indicated time period. (FSAR pg. 8.3-24, para. 8.3.2.1.1)

Question 93 — Verify that redundancy within the inverter equipment is established by a normal 480-volt, 3 phase, 60Hz input feed from a Class IE motor-control center, and a reserve 125-VDC feed from the respective ESF division's 125-VDC distribution bus. (FSAR pg. 8.3-7, para. 8.3.1.2)

Question 94 — Verify that a reserve d-c feeder is provided to each ESF control bus so that, in the event of a d-c feed cable failure, the control power can be manually transferred to the reserve feeder. (FSAR pg. 8.3-26 para. 8.3.2.2)

Question 95 — Verify that control power for each 4160-volt ESF bus is taken from the respective ESF division's 125-VDC distribution bus. (FSAR pg. 8.3-4, para. 8.3.1.1.1)

Question 96 — Verify that power circuits fed by the 4160-volt switchgear are protected from phase-to-phase and phase-to-ground faults by relays within the switchgear. (FSAR pg. 8.3-4, para. 8.3.1.1.1)

Question 97 — Verify that the 4160 volt ESF switchgear has been adequately sized to serve the safety a-c loads. (FSAR pg. 8.3-3 para. 8.3.1.1.1)

Question 98 — Verify that a diesel generator is automatically started by any one of the following:

a. Automatic safety injection signal

b. Manual safety injection actuation by push buttons, or

c. undervoltage on the 4160 volt ESF bus served by the diesel generator.

Question 99 — Verify that physical separation of redundant Class 1E circuits and devices has been provided within the Main Control Boards. (FSAR 8.3-20 para. 8.3.1.4.3 & IEEE 420-1973 para. 4.2.1)

Question 100 Verify that the fire suppression for the upper cable spreading room consists of: (Fire Protecion Report pg. A5.2-3)

a. Automatic Halon 1301 system

b. Manual carbon dioxide system, and

c. Manual water hose stations

Question 101 Verify that fire stops have been provided whenever cables penetrate fire barrier walls or floors. (Fire Protection Report pg. A5.2-3)

Question 102 Verify that ionization detectors are provided in the battery room which annunciate and alarm locally and in the control room. (Fire Protection Report pg. 2.3-57)

Question 103 Verify that motor assemblies located inside the containment have been qualified in accordance with IEEE 334-1971. (FSAR pg. 8.1-12, para. 8.1.7)

a. Which specs need this requirement?

b. Did the specs include this requirement?

c. Did S&L verify that the requirements were met

Question 104 Verify that Class IE cables comply with the testing requirements of IEEE 383-1974. (FSAR pg. 8.3-14, para. 8.3.1.4.1.2)

a. Which specs need this requirement?

b. Did the specs include this requirement?

c. Did S&L verify that the requirements were met.

Question 109 For piping analysis, verify that the modal response of the piping system in each direction are combined by the double sum method. (BY/BR FSAR Sec. 3.7.3.8.2, 3.7.3.7 and 3.7.3.6)

Question 110 For piping analysis, verify that the stresses are determined by taking the square root of the sum of the squares of the individual responses in the three directions. (BY/BR FSAR Sec. 3.7.3.8.2, 3.3.7.3.7 and 3.7.3.6)

<u>Question 111</u> Verify, that when equipment or components are supported at points at different elevations, the envelope of these elevation response spectra is used for the seismic qualification of the equipment. (BY/BR FSAR Sec. 3.7.3.9)

<u>Question 112</u> Verify for piping analysis, that the torsional effects of eccentric masses such as valves and valve operators are accounted for by the following modeling technique: (BY/BR FSAR Sec. 3.7.3.11)

a. Items are modeled as massless members with the mass of the item concentrated at the center of gravity.

b. A rigid member is modeled connecting the center of gravity to the piping.

<u>Question 113</u> Verify that ASME Section III Classs 1 piping has been analyzed for loading combinations shown in the table 3.9-11 in the BY/BR FSAR. (BY/BR FSAR Sec. 3.9.3.1.1)

<u>Question 114</u> Verify that the stresses developed in ASME Section III Class 1 piping do not exceed the values listed in BY/BR FSAR table 3.9-12 (NB-3600). (BY/BR FSAR Sec. 3.9.1.2.1?)

<u>Question 115</u> Verify that design loading combinations used for ASME Section III Class 2 & 3 components and supports are in accordance with those combinations listed in BY/BR FSAR Table 3.9-5. (BY/BR FSAR Sec. 3.9.3.1.1)

<u>Question 116</u> Verify that the stress levels for ASME Class 2 & 3 active and inactive valves are in compliance with the stress criteria given in BY/BR FSAR Table 3.9-9. (BY/BR FSAR Sec. 3.9.3.1.2.2)

<u>Question 117</u> Verify that, for active valves, a seismic analysis of extended structures (i.e. valve operators) is performed and that the resulting stresses and deflections demonstrate operability and structural integrity of the valve. (BY/BR FSAR Sec. 3.9.3.2.2)

Question 118 Verify that, if the natural frequency of a valve operator is less than 33Hz, the operator stiffness is included in the piping analysis. (10CFR50 App. B, Criterion III)

Question 119 Verify that the loading combinations for structural steel elastic design are in accordance with BY/BR FSAR TAble 3.8-9. (BY/BR FSAR Sec. 3.8.4.3)

Question 120 Verify that the loading combinations for reinforced concrete ultimate strength design are in accordance with BY/BR FSAR Table 3.8-10. (BY/BR FSAR Sec. 3.8.4.3)

Question 121 Verify that stresses and strains for reinforced concrete design are in accordance with the ultimate strength design provisions of ACI-318-71. (BY/BR FSAR Sec. 3.8.4.5.1)

Question 122 Verify that stresses and strains for structural steel design are in accordance with the 1969 AISC Specification except for specified abnormal loading conditions where 1.6 times the AISC allowable loads are used. (BY/BR FSAR Sec. 8.4.5.2)

Question 123 Verify that the ASME Class 2 & 3 piping (except piping at containment penetrations) breaks are postulated at the following locations: (BY/BR FSAR Sec. 3.6.2.1.2.1.1)

a. At terminal ends of the run

b. At each location where the stresses under the loadings resulting from normal and upset plant conditions and an OBE event as calculated by equations (9) and (10) in Paragraph NC-3652 of ASME Section III exceed 0.8 ($1.2S_h + S_a$).

NUCLEAR POWER SERVICES AUDIT
September 20, 1982

Question 3 Verify that Class C systems with an operating temperature greater than 150°F have been checked for thermal expansion using the appropriate flexibility check rule.
(Ref: Bid Spec. 109, pages 25-29)

<u>Question 4</u> Verify that design input for concrete expansion anchor work is to the latest revision of BY/BR/CEA. (Ref: Bid Spec. 109 std. specification for CEA work, page 1)

<u>Question 5</u> Are small piping systems designed using the seismically qualified small piping restraint rule for horizontal runs with axial restraint? (Ref: Spec. 109, page 16 of 62, Small Piping and Tubing Procedure)

<u>Question 9</u> Is the piping subsystem field verified for conformance to isometric routing, line number, valve identification(s) and locations of previous supports installed and for selection of preliminary support locations? (Ref: Work Procedure 3.0.4, Section 4.4.1)

WESTINGHOUSE ELECTRIC CORPORATION AUDIT
<u>February 15, 1983</u>

<u>Question 13</u> Are "as-built" drawings incorporated into the pipe support loading analysis? (Ref: WCAP 9625, Section 2.5.1.3)

<u>Question 14</u> Has a Design Report been prepared to show that applicable stress limitations are satisfied with the component is subject to the loading conditions specified in the Design Specifications and ASME Section III? (Ref: ASME Section III Summer 1982 addenda NCA 3350, WCAP 9625, 2.5)

<u>Question 16</u> Do Load Capacity Data Sheets state the load capacity of the component support and identify the tests and calculations used to establish the load capacity? (Ref: ASME Section III Summer 1982 Addenda NCA 3551.20

SARGENT & LUNDY AUDIT
<u>March 11, 1983</u>

<u>Question 8</u> Can hand prepared design calculations be easily reconstructed (i.e. can the purpose or objective be determined, data and assumptions listed, all calculation steps recorded, and source(s) of formulae or equations not in common engineering usage referenced)?

Ref: Procedure GQ-3.08 Rev. 4
Para. 3.0.B.1 Criterion III

<u>Question 10</u> Do the design criteria and procurement specifications contain the requirements for environmental design and qualification to assure the capability of performing design safety functions under all normal, abnormal, accident, and post accident environments and for the length of time for which its function is required?

Ref: Procedure GQ-3.04 Rev. 6 & GQ-4.01 Rev. 9 NUREG-0800 (formally NUREG-75/087) Section 3.11 Subsection II Criteria III & IV

<u>Question 14</u> Is a review of computer-aided design calculations made to determine if input data is consistent with design input, it correctly defines the problem for the program, and is sufficiently accurate to produce results within the numerical limitation of the program?

Ref: Procedure GQ-3.08 Rev. 4 Para 3.0B.2 Criterion III

<u>Question 16</u> Verify that ASME Design Specifications have been certified to be correct and complete and to be in compliance with the requirements of NA-3250.

Ref: Criteris III & XVII

<u>Question 40</u> Verify S & L reviews as-built drawings and reconciles those modifications with the stress report calculations.

Ref: 10CFR50 Appendix B Criterion III

<u>Question 41</u> Verify that S & L is re-analyzing structural integrity as complete support as-built data is furnished by Westinghouse and NPS.

Ref: 10CFR50 Appendix B Criterion III

<u>Question 42</u> How does S & L incorporate final loads in their structural analysis?

Ref: 10CFR50 Appendix B Criterion III

<u>Question 43</u> How is support as-built information transmitted from Westinghouse & NPS to S & L for final structural analysis, and once received how is it processed?

Ref: 10CFR50 Appendix B Criterion III

<u>Question 69</u> Verify that as-built information has been evaluated for system safety function. (Ref. 10CFR50, Appendix B Criterion III)

<u>Question 72</u> Verify that PMD has identified high energy lines based on the following:

a. Regulatory Guide 1.46
b. Byron/Braidwood FSAR Section 3.6.1.1.1.

(Ref.: Regulatory Guide 1.46)
(Byron/Braidwood FSAR Section 3.6.1)
(S&L PI-BB-38)

<u>Question 73</u> Verify that EMD checks high energy lines determined by PMD for postulated breaks using the criteria of Regulatory Guide 1.46 and Byron/Braidwood FSAR Section 3.6.2.1 for the following areas:

a. Reactor coolant loop piping

b. High Energy Piping other than Reactor Coolant Loop Piping.

(Ref.: Regulatory Guide 1.46)
(Byron/Braidwood FSAR Section 3.6.2.1)
(S&L PI-BB-38)

<u>Question 74</u> Verify that piping in the containment penetration area meets the requirements of FSAR Section 3.6.2.1.2.1.2.2 for "no break" conditions.
(Ref.: Byron/Brdwd FSAR Section 3.6.2.1.2.1.2.2)

<u>Question 75</u> Verify that pipe whip restraint design includes a check of ring to pipe gap in the cold position.
(Ref.: 10CFR50 Appendix B Criterion III)
(Byron/Braidwood FSAR Section 3.6.2.2.2.2)

Question 76 — Verify that the design of pipe whip restraints includes a check of the pipe to ring gap in the hot position using the most significant thermal movements from the piping analysis.
(Ref.: 10CFR50 Appendix B, Criterion III)
(Byron/Braidwood FSAR Section 3.6..2.3.1.2)

Question 77 — Verify that the blowdown forces on primary loop components are computed from equation 3.6.1 in the Byron/Braidwood FSAR.
(Ref.: Byron/Braidwood FSAR Section 3.6.2.2.1.2)

Question 78 — Verify that the impinging jet force for piping other than reactor coolant piping is determined in accordance with Section 3.6.2.2.2.1.4 of the Byron/Braidwood FSAR.
(Ref.: Byron/Braidwood FSAR Section 3.6.2.2.2.1.4)

Question 79 — For blowdown calculations, outside the reactor coolant boundary, were the most significant pressure-temperature conditions utilized by EMD?
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 80 — Verify that the structural design of reactor coolant whip restraints is adequate for the postulated load based upon the values for working stress allowable stresses in the 1969 AISC specification increased by 50%.
(Ref.: Byron/Braidwood FSAR Section 3.6.2.3.1.1.3)

Question 81 — Verify that the structural design of whip restraints (for other than R. C. lines) is adequate for the postulated loads based upon the criteria listed in Sections 3.6.2.3.2.4 and 3.6.2.3.2.5 of the Byron/Braidwood FSAR.
(Ref.: Byron/Braidwood FSAR Section 3.6.2.3.2.4 and 3.6.2.3.2.5)

Question 82 — Do the embedments and supporting structures have sufficient strength to accommodate the design forces of the whip restraints as well as any non-pipe whip related loads?
(Ref.: 10CFR50 Appendix B, Criterion III)
(Byron/Braidwood FSAR Section 3.6.1.3)

Question 83 Verify that structural items important to safety that may be impacted by unrestrained pipe whips have sufficient strength to withstand the impact loading.
(Ref.: 10CFR50 Appendix B, Criterion III)
(Byron/Braidwood FSAR Section 3.6.1.3)
(Regulatory Guide 1.46 Section 4.6)

Question 84 Verify that the design of pipe whip restraints has included the proper selection of energy absorbing materials in accordance with established guidelines based on testing.
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 85 Verify that an analysis of the performance of absorbing material has been made considering both the solid state and plastic deformation modes.
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 86 Verify that when primary loading forces are applied to energy absorbing material in a direction other than normal to the primary face, the effect of the angle of the force has been accounted for in the determination of the energy absorbing material performance.
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 87 Verify that criteria for acceptance of damaged energy absorbing material has been justified by test or analysis.
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 88 Verify that field installation tolerances for pipe whip restraints have been justified based upon the original design.
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 89 Are "as-built" conditions reviewed and analyzed by S&L and reconciled with the original whip restraint design.
(Ref.: 10CFR50 Appendix B, Criterion III)

Question 90 Verify that design calculations for whip restraints are properly documented in accordance with S&L Standards.
(Ref.: 10CFR50 Appendix B, Criterion III)
(Sargent & Lundy GQ 3.08 Section 3)

<u>Question 91</u> Verify that drawings and calculations have received independent and documented review.

(Ref.: 10CFR50 Appendix B, Criterion III)
(Sargent & Lundy GQ 3.08 Section 3B.2)

<u>Question 92</u> Verify that procedures have been written and established for the interdepartment control of whip restraint design.
(Ref.: 10CFR50 Appendix B, Criterion V)
(Sargent & Lundy GQ 5.01 Section 3)

<u>Question 93</u> Verify that design changes for whip restraints are subject to the same control, review and approval as the original design.
(Ref.: 10CFR50 Appendix B, Criterion III)
(Sargent & Lundy GQ 3.08 Section 4)

EXHIBIT B

CORPORATE QUALITY ASSURANCE DEPARTMENT
AUDITS OF
COMMONWEALTH EDISON DEPARTMENTS

CECo Departments	Deficiencies Identified In the Annual Audit									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	Total
SNED/PED (Engineering)	17	11	14	8	15	4	1	2	1	73
OAD (Testing)	5	5	1	7	4	5	0	1	1	29
Purchasing	7	2	1	2	1	3	0	0	1	17
Nuclear Licensing	-	-	-	-	-	-	0	-	0	0
Total	29	18	16	17	20	12	1	3	3	119

EXHIBIT C

BYRON STATION
STOP WORK ACTIONS
INITIATED BY COMMONWEALTH EDISON COMPANY

1. 1977 - May 6, 1977 concrete placement stopped due to improper placement of reinforcing. Corrective action was completed and work resumed 5/11/77. (NRC #2C)

2. 1977 - System Control Corporation - May 23 to June 10. System Control Corporation work on cable pans and hangers was stopped as a result of deficiencies noted during a CECo-QA audit of their plant activities in Iron Mountain, Michigan.

3. 1978 - Ceramic cooling tower - stopped 7/28/78 due to unsatisfactory implementation of QA program. Inadequate documentation was received prior to the release of materials for construction. Work resumed 7/31/78.

4. 1979 - System Control Corporation - June 7 to June 28. Commonwealth Edison Company Station Construction Department conducted an in-plant inspection on containment isolation panels, cable pans and hanger welding. Welding was unsatisfactory and work was stopped. Work was resumed after an inspector from Pittsburgh Testing Laboratories was assigned to the shop to inspect equipment prior to shipping.

5. 1979 - Blount Bros./Inryco - stopped post tensioning on 11/27/79 after anchorhead failures. Subsequent distressing and replacement of Unit I anchorheads. Work resumed in spring of 1980.

6. 1980 - Hunter Corporation - stopped installation of safety related component supports on 3/27/80 due to design and inspection inconsistencies. Work was resumed on 4/3/82 after procedures were revised.

7. 1981 - Hatfield Electric - stopped all safety related cable pulling activities on January 10, 1981 due to programmatic inconsistencies. Work was restarted completely on March 16, 1981.

8. 1981 - Johnson Controls - stopped all safety related welding activities due to procedural deficiencies on March 6, 1981. Work was resumed on March 9, 1981 after corrective action was taken.

9. 1982 - Reliable Sheet Metal - stopped all new installation activity on safety related H.V.A.C. Systems and HVAC attachments to safety related structures on 9/17/82. Stop work caused by inadequate and incomplete inspection and inadequate procedures. Stop work is still in affect as of 3/30/83.

EXHIBIT D

SITE QUALITY ASSURANCE DEPARTMENT
AUDITS OF
BYRON CONSTRUCTION ACTIVITIES

Year	Number of Audits	Deficiencies Findings	Deficiencies Observations	Totals
1974	4	0	5	5
1975	1	20	0	20
1976	37	102	99	201
1977	50	108	120	228
1978	68	113	83	196
1979	68	76	77	153
1980	56	89	72	161
1981	66	90	74	164
1982	59	55	56	111
TOTALS	409	653	586	1239

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SITE QUALITY ASSURANCE DEPARTMENT
SURVEILLANCES OF BYRON
SITE CONSTRUCTION ACTIVITIES

Year	Number of Surveillances
1976	44
1977	486
1978	550
1979	576
1980	703
1981	945
1982	803
Total thru 12/31/82	4107

EXHIBIT F

BYRON STATION
INDEPENDENT TESTING AGENCY
TESTS AND INSPECTIONS

Test and Inspection Area	
Concrete Aggregate Grout Cadwelds Concrete Expansion Anchors Bolting Welding	36,500 Inspection Reports (approx.)

Non-Destructive Examinations	
Magnetic Particle Liquid Penetrant Radiography Ultrasonic	36,800 Inspection Reports (approx.)

EXHIBIT G

BYRON STATION
AUDITS BY
MAJOR SITE CONTRACTORS
THRU 12/31/82

Contractor	Number of Audits
Hunter	88
Blount Bros.	561
Hatfield	97
Powers-Azco-Pope	79
Reliable Sheet Metal	7
Johnson Controls	3
PTL	245
TOTAL	1080

EXHIBIT H

COMMONWEALTH EDISON CORPORATE QUALITY ASSURANCE

AUDITS OF BYRON SITE

Year	Number of Audits	Deficiencies: Findings	Deficiencies: Observations	Totals
1975	1	20	6	26
1976	3	26	4	30
1977	2	17	10	27
1978	2	10	12	22
1979	2	13	6	19
1980	2	20	5	25
1981	2	9	7	16
1982	3	23	29	52
Totals	17	138	79	217

EXHIBIT I

Quality Assurance Coverage of Commonwealth Edison Company Construction Projects

Construction Sites

1. Contractors
   - Inspections (QC)
   - Audits (QA)

2. CECo Quality Assurance

   Site QA
   - Inspections
     - Independent Testing Agency
   - Surveillances (Documented)
     - Continuously (800/yr)
   - Audits

   Corporate
   - Audits - By Corporate QA
     - Of all site organizations
   - Management Audit -
     - By outside Consultants

Design Activities

1. Architect Engineers
   - Audits (QA)
   - Other

   Independent Review
   - System Design
   - Overall Design

2. CECo Quality Assurance

   Site Design Activities
   - Site QA
     - Surveillances (Documented)
       - Continuously
     - Audits

   Corporate
   - Audits
   - Management Audit -
     - Outside Consultant

   Outside Design Activities
   - Corporate QA
     - Audits of AE Organizations (Supplemented Team with design Engineers having Special design expertise)

Other

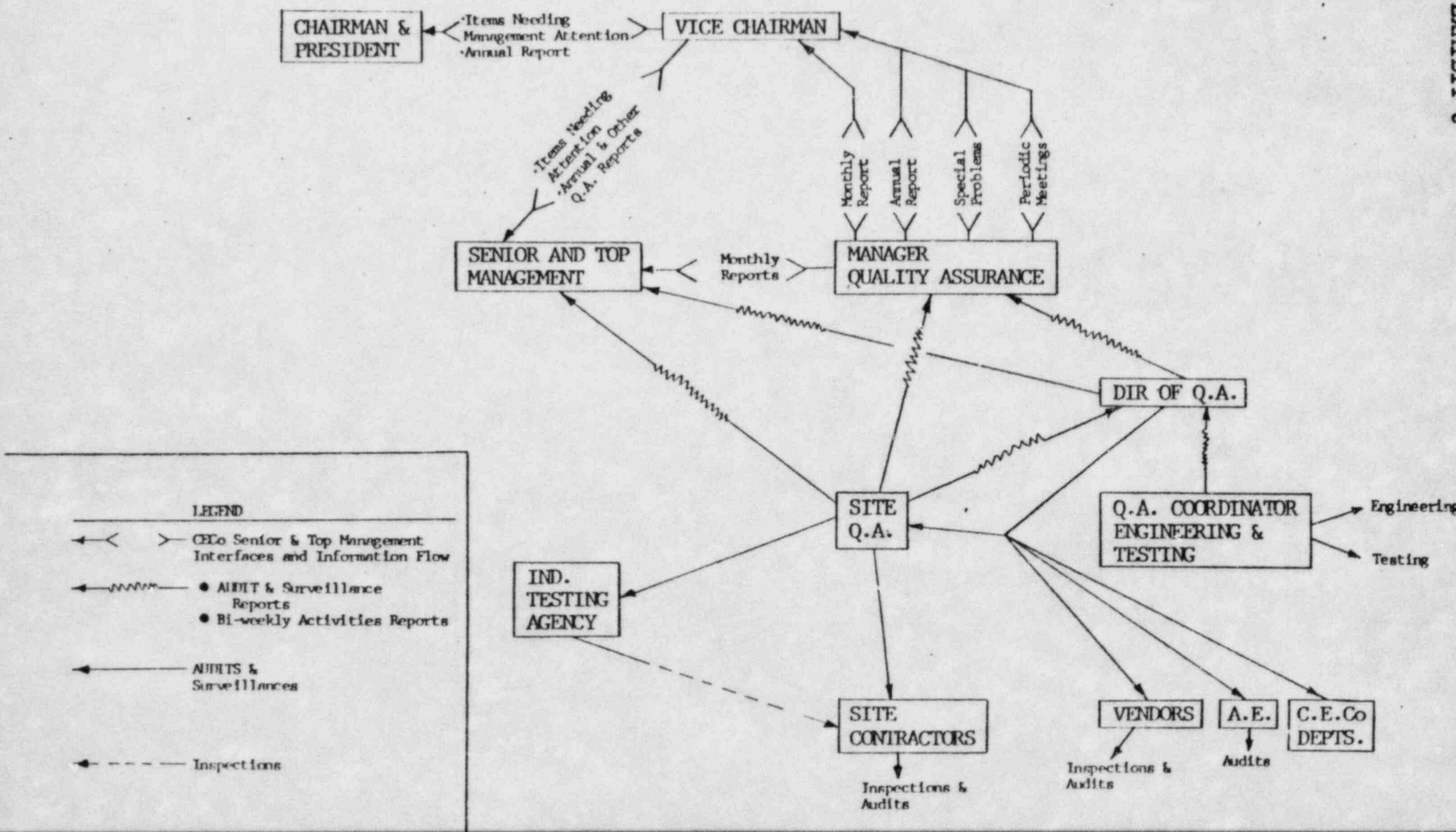
1. Corporate QA
   - Vendors Audits
   - Other CECo Orgs.
     - Surveillances
     - Audits

2. QA Coordinator
   - Engrg. & Tstng.
     - Surveillances
     - Audits

QA Reports to Commonwealth Edison Company Corporate Management

1. Copies of all CECo surveillance and audit reports are sent to Manager Quality Assurance and Director Quality Assurance for Engineering-Construction.
2. Audit reports are sent to responsible corporate management.
3. Monthly composite reports are prepared and provided to responsible top management by QA.
4. Annually an assessment activities and objectives report is provided to senior management.
5. Annually ... l presentation about QA activities and problems is presented to senior management for

Quality Assurance
Surveillance Audit & Information
Interface Flow Diagram
For Commonwealth Edison Construction Projects



ASME SURVEY
OF
COMMONWEALTH EDISON CORPORATE OFFICE

Year	Citations
1974	None
1977	None
1980	None

MANAGEMENT AUDITS
OF
COMMONWEALTH EDISON COMPANY

Year	Byron Deficiencies Findings	Byron Deficiencies Observations
1977	1	1
1979	(General Comments Only)	
1981	1	7
Total	2	8

EXHIBIT M

BYRON STATION
CECO QUALITY ASSURANCE
AUDITS OF SITE ARCHITECT ENGINEER ORGANIZATIONS

Architect Engineer	Number of Audits	Deficiencies Findings	Observations	Total
Sargent and Lundy	7	3	10	13
Nuclear Power Services	8	4	11	15
Westinghouse SAMU	4	0	3	3
Total	19	7	24	31

CECO QUALITY ASSURANCE
DESIGN AUDITS

Architect Engineer	Number of Audits	Deficiencies: Findings	Deficiencies: Observations	Deficiencies: Total
Sargent & Lundy	15	113	38	151
Westinghouse (NSSS)	11	29	22	51
Total	26	142	60	202

COMMONWEALTH EDISON CORPORATE QA AUDITS OF SARGENT & LUNDY DESIGN ACTIVITIES

(BYRON PROJECT)

Date	Major Areas Audited	Number of Question
2/20/74	- Organization - Design Control - Procurement Document Control - Instruction, Procedures & Drawings - Control of Purchased Material - Corrective action - QA Records - Audits	136
2/25/75	- Organization - Design Control - Procurement Document Control - Instructions, Procedures & Drawings - Document Control - QA Records - Corrective Action - Audits	164
2/17/76	- Organization - QA Program - Design Control - Procurement Document Control - Instructions, Procedures & Drawings - Document Control - Control of Puchased Material, Equipment and Services	137
3/7/77	- Design Activities - Approval and Control of Documents/Design	132
9/7/77	- Implementation of QA Program - Compliance w/10CFR50 Appendix B - Follow-up of March Audit - Design/Document Control	1111

COMMONWEALTH EDISON CORPORATE
QA AUDITS OF SARGENT & LUNDY
DESIGN ACTIVITIES

(BYRON PROJECT)

Date	Major Areas Audited	Number of Questions
3/1/78	- Design Modifications - Field Change Requests - Engineering Change Notices - Nonconformance Reports - Drawing Changes	233
10/30/78	- CECo Field Change Request Procedure - Follow-up of 3/78 Audit - Internal Audits - Audit Checklists	16
2/21/79	- Pipe Support Design - Field Change Requests - Cable Tray Loading - Overall Design Review	46
2/27/80	- Oper. Design Change Requests	41
2/11/81	- Design Spec. Requirements (NCA-3250) - Interface with Other Design Groups - Cable Tray Occupancy - Vendor Drawing Control - Design Review	46
5/11/81	- Design Personnel Qualifications - and Training - Computer Program Validation - Generic Industry Design Problems Reviewed	16
9/29/81	- Environmental Qualification of Electrical Equipment: NU-REG.0588	11
1/18/82	- Nonconformance Reporting - Field Changes - "As-Built" Drawing Processing - Cable Pan Design - Overpressurization Design - Block Wall Design - Post Tensioning - System Design Review and Calculations	74

EXHIBIT N

COMMONWEALTH EDISON CORPORATE
QA AUDITS OF SARGENT & LUNDY
DESIGN ACTIVITIES

(BYRON PROJECT)

Date	Major Areas Audited	Number of Questions
6/7/82	- Stress Analysis - Mode Combination Technique - Load Base Combinations - Seismic Analysis (More than one Response Spectra) - Valve Modeling - Equipment Qualification - Structural Steel Design - Reinforced Concrete Design	146
3/7/83	- Equipment Qualification - Design Criteria - Design Speciications - Review of Calculations - Field Changes - As-Built Drawing Reconciliation - Design Change Control - Whip Restraint Design	93

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