

**CLINTON STATION**

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**INDEPENDENT DESIGN REVIEW  
FOR  
ILLINOIS POWER COMPANY**

**PROGRESS REPORT**

**JUNE — SEPTEMBER 1984**

**BECHTEL POWER CORPORATION**

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## Section 1

### SUMMARY

In June 1984, Bechtel Power Corporation (BPC) began work for the Clinton independent design review (IDR), in accordance with authorization from Illinois Power Company (IP). This involved preparation of a program plan, organization of the IDR team, and initial requests for information.

By September, work was well advanced. The Program Plan has been developed, comments incorporated, and has been approved by IP and the NRC. Accordingly the IDR now incorporates a change from the original scope of work planned; e.g., design-walkdowns have been added, design contractors are not limited to Sargent & Lundy (S&L), and modifications were made in the selection of the systems to be reviewed.

Approximately 13 meetings were held with S&L and others, covering virtually all areas of the IDR, and a large amount of requested information has been received. About 500 documents have been reviewed.

Organization and staffing of the IDR team was completed, with the exception of the walkdown teams. The walkdown teams are completing their organization and staffing, and will complete preparatory work by the end of September.

To date, the IDR has submitted one Observation Report (OR) to S&L. Also 7 Potential Observations are being processed internally by the IDR team. Some of these are likely to be issued as ORs.

## Section 2

### GENERAL

#### 2.1 INTRODUCTION

This is the first report covering the progress of each task as outlined in the proposed Program Plan and highlighting the activities which occurred during the IDR from June 1, 1984 through September 25, 1984.

#### 2.2 BACKGROUND

On June 15, 1984, BPC was requested by IP to undertake preliminary work to conduct an independent design review of specified activities related to the design of Unit 1 of the Clinton Power Station, beginning with preparation of a Program Plan.

The IDR will mainly cover work by Sargent & Lundy Engineers, but will also include Reactor Controls, Inc. (RCI). Work by other design contractors may also be evaluated when they have performed design which is part of the specified activities, and where there is evidence this could be important to results of the review.

The purpose of this design review will be to provide additional assurance that the design of the Clinton Power Station meets licensing requirements, through a review of the technical adequacy of selected systems and the design process (i.e., design system). Both vertical and horizontal-type reviews will be employed. The vertical review will comprise a review of the shutdown service water (SSW) system, and the Class 1E ac electrical distribution system. Also, a limited review of the high pressure core spray (HPCS) system will be performed to the extent needed to cover areas not present in the SSW system.

For the horizontal review, the adequacy of the design process on Clinton will be reviewed, using as a data base the results of review reports on Byron, LaSalle, and Fermi stations, and other information from previous reviews by IP and others.

From the vertical and horizontal reviews, an assessment will be made both of the adequacy of the systems reviewed and of areas of plant design which were not specifically reviewed, including positive aspects of the design work. Where appropriate, deficiencies identified will be evaluated for underlying, root causes.

The program for the review of each system is divided into the tasks listed below.

- Task 1: Design Requirements
- Task 2: Design Adequacy
- Task 3: Design Process
- Task 4: General Assessment

In addition, certain requirements, such as fire protection, high and moderate energy line breaks, and seismic II/I will be analyzed.

The relationship of tasks to subjects and design areas for review is shown in Table 1, based on a similar matrix in the Program Plan.

## 2.3 ACTIVITIES

The Program Plan was completed and issued as Revision 1 to IP for approval on July 19. It was further clarified on August 17, through responses to NRC comments. Included in the Program Plan are a formal protocol agreement, a QA program, a revised scope of systems covered, and other agreed-upon modifications to the original proposal by IP to the NRC. Formal NRC approval was provided on September 10, but the IDR team has been working on the basis of the provisions of the approved Program Plan except for the changes in the systems selected to be reviewed and other work yet to be performed.

TABLE 1  
REVIEW SUBJECTS vs. TASKS

REVIEW (1) SUBJECTS	TASKS							
	Licensing Require- ments	Design Adequacy	Design Process	Design Interface w/GE & Other	Design Change Control	S&L Design Reviews	Common(2) Require- ments	As-Built Control Walkdown
SSW System								
Mech. Systems	x	x	x	x	x	x	x	x
Mech. Components	x	x	x	x	x	x	x	x
Civil - Structural	x	x	x	x	x	x	x	x
Electrical Power	x	x	x	x	x	x	x	x
Inst. & Control	x	x	x	x	x	x	x	x
Design System	x	x	-	x	x	x	x	x
Design Standards	x	x	-	-	-	-	x	x
Electrical System (1-E, ac)								
Electrical Systems	x	x	x	x	x	x	x	x
Electrical Components	x	x	x	x	x	x	x	x
Civil - Structural	x	x	x	x	x	x	x	x
Inst. & Control	x	x	x	x	x	x	x	x
Design System	x	x	-	x	x	x	x	x
Design Standards	x	x	-	-	-	-	x	x
Other Reviews								
Observations	x	x	x	x	x	x	x	-
Corrective actions	x	x	x	x	x	x	x	-
Root cause analysis	x	x	x	x	x	x	x	-

In preparing the Program Plan, a public meeting was held with the NRC on June 28, in which special attention was given to matters of IDR scope and level of detail of the review. As a result of this and further consideration, the systems reviewed were changed to include the Class 1E ac distribution system, the shutdown service water system, and parts of other systems, such as the high pressure core spray system, as needed, to provide a sampling of different phases of design. Also, a walkdown program was added to review adequacy of design communicated to construction, and the scope of design contractors was expanded beyond S&L.

Organization and staffing of the IDR team proceeded on the basis of the approved Program Plan and at a rate consistent with the needs of the Clinton IDR. Of significance, has been the appointment of an experienced Bechtel manager as the Liaison Manager for S&L and for the walkdown activities. This is Mr. E. M. Hughes, who is now completing his assignment as Project Manager for the Byron Station independent design review.

Understandings were reached that S&L was to respond to the IDR requests by providing heavy support commensurate with the needs of the IDR. It was agreed that all parties would significantly increase their level of effort for the IDR from that originally planned. The IDR team reviewed the schedule and provided IP with best estimates for optional means of issuing the Final Report.

## 2.4 OBSERVATIONS

There are several areas on which potential observations have been issued. These are summarized in Appendix A.

Only one Observation Report (OR File No. 01) has been issued on the subject of control system schematics for SSW pumps. There are discrepancies noted between implementing design criteria (DC-SX-01-CP, FPR#1673) onto logic diagrams (M15-1052) and transferring the information to schematic diagrams (E02-1SX99-001-002-003). This Observation Report is included in Appendix B along with a Resolution Report which requests additional information from S&L.

## Section 3

### PROGRAM STATUS

For this period, the Bechtel IDR has been actively addressing the designated tasks. The status of each task is given below.

#### 3.1 TASK 1: DESIGN REQUIREMENTS

##### 3.1.1 Checklists/Procedures/Commitment Lists

Checklists have been established for each system to be reviewed to perform Task 1. A work plan has also been prepared for performing the horizontal review.

Procedures on communications, review process, processing of observations, and walkdown have been prepared and implemented for IDR project team use.

The Clinton FSAR and SER have been reviewed to identify safety-related design criteria or other safety-related commitments and design requirements. This included IP responses to NRC questions. A preliminary commitment list has been prepared and distributed to the IDR team members to assist in the selection of commitments to be reviewed for the IDR under Tasks 1, 2, and 3. The commitment list has been separated according to the area to be reviewed, i.e., shutdown service water, high pressure core spray, Class 1E ac-power, and high energy line break analysis (includes moderate energy) within the scope of the Clinton IDR.

##### 3.1.2 Piping Engineering

Major effort has been directed at identifying commitments. Eighteen documents were reviewed including calculations, design specifications, design criteria, piping fabrication specifications, valve specifications, P&IDs, S&L piping standards, and valve drawings for design requirements.

### 3.1.3 Plant Design Layout

Design requirements were identified. Review of the draft commitment list was started. Mechanical engineering standards and layout requirements were reviewed.

### 3.1.4 Civil/Structural

Pertinent sections of the FSAR were reviewed. Pertinent NRC questions and responses were reviewed and open items noted. Several responses are still under discussion with S&L personnel. The SER and its three supplements were reviewed. Open items were noted and are being discussed with S&L. Seismic analysis and pool dynamic loads analysis review have progressed. Reviews of structural steel design and reinforced concrete design of the circulating water screen structure and parts of the auxiliary, control, and diesel-generator buildings are in progress. Sample calculations have been selected for review.

### 3.1.5 Stress

Review of stress calculations for the HPCS system inside containment is being completed. Most of the stress calculations of the SSW system piping have been obtained for review. Most of the backup documentation identified and requested have been received for review.

### 3.1.6 Mechanical

Commitments were defined and review initiated. SSW design criteria were reviewed, as well as contract specifications for SSW equipment, project instructions, design calculations, and related contract specifications.

### 3.1.7 Equipment Qualification

Review of design requirements is complete for the ac distribution, SSW, and HPCS systems. Ten procurement specifications were reviewed for seismic qualification requirements. A total of 31 commitments were identified and reviewed.

### 3.1.8 Instrumentation & Control

The review checklist for the HPCS system has been completed. The FSAR, SER, and SSER were reviewed for commitments. For the SSW system, the review checklist was completed. The FSAR, SER, SSER were reviewed for commitments. Design criteria were reviewed. Twenty-eight design documents were reviewed.

### 3.1.9 Electrical Systems

Documents were reviewed to identify and list design criteria, commitments and design requirements including the FSAR, NRC Questions and Responses, SER, General Design Criteria (GDC), NRC Regulatory Guides, and Industry Codes and Standards (IEEE Standards). The following design documents were reviewed for design requirements: design criteria, single line, meter and relay, and key diagrams, design calculations, and purchase specifications.

### 3.1.10 HELB/MELB

The draft commitment list for HELB/MELB analysis was reviewed and revised. Determination of compliance with the design requirements given by these commitments, as evidenced by review of S&L documentation, was started.

### 3.1.11 Fire Protection

A review of the FSAR was made and licensing commitments were listed. The Clinton Station "Safe Shutdown Analysis" and Fire Protection Evaluation Report" were reviewed to establish the design basis and criteria for the fire protection systems. A meeting was held with S&L engineers to discuss these documents.

### 3.1.12 Seismic II/I

A review of the FSAR was made and licensing commitments were determined. The Clinton project instruction and design criteria for potential interactions between safety related components and other plant components were reviewed.

### 3.1.13 Observations

One Observation (OR File No. 01) has been identified resulting from design requirements review.

## 3.2 TASK 2: DESIGN ADEQUACY

### 3.2.1 Piping Engineering

Fourteen documents were reviewed including P&IDs, calculations, valve specifications, piping specifications, and valve operability documents for design adequacy.

### 3.2.2 Plant Design Layout

Design criteria review was initiated with request for documents. S&L composite drawings have been received and review started.

### 3.2.3 Civil/Structural

Commitment items were reviewed for design adequacy for capacity of ultimate heat sink (UHS) pond, seepage through UHS submerged dam, soil engineering parameters, tornado design parameters, screen house flood protection and fire rating of structural walls and architectural doors.

### 3.2.4 Stress

Design adequacy assessment is pending completion of review of stress analyses and supporting documentation.

### 3.2.5 Mechanical

P&IDs, calculations, and contract specifications were reviewed for design adequacy.

### 3.2.6 Equipment Qualification

Six equipment packages, twelve binders, and ten purchase specifications have been reviewed for seismic qualification. Review of operability qualification (PVORT) design is complete. Three binders have been reviewed for pump and valve operability qualification and seventeen binders were reviewed for environmental qualification.

### 3.2.7 Electrical Systems

The following design documents were reviewed for design adequacy: design criteria, single line, meter and relay, and key diagrams, design calculations, and purchase specifications.

### 3.2.8 HELB/MELB

Copies of Clinton Project design criteria, applicable GE design specifications, and completed S&L jet impingement and MELB calculations were received for review. Review of jet effects from postulated breaks in large (greater than 6") lines inside the drywell to confirm adequacy of calculation OIME07, "Jet Impingement on ECCS Large Lines Inside Drywell" has begun. Review was started of the color-coded composite drawing outside containment to confirm separation. Also, review was started of pressure transient analyses and moderate energy flooding and spray effects.

### 3.2.9 Fire Protection

Review of fire protection reports, layout drawings, P&IDs and vendor drawings has commenced to determine that design is adequate to meet fire protection criteria.

### 3.2.10 Observations

No Observations resulting from design adequacy review were identified.

## 3.3 TASK 3: DESIGN PROCESS

### 3.3.1 Piping Engineering

Approximately nineteen documents were reviewed for design process.

### 3.3.2 Plant Design Layout

Review of design process was initiated.

### 3.3.3 Civil/Structural

Approximately thirty-one design standards, twenty-eight calculations, sixty drawings, and three specifications were received for review design process.

### 3.3.4 Stress

Twelve stress analyses and one nuclear Class 1 stress report are being reviewed, together with supporting documentation. This review is approximately 60 percent complete.

### 3.3.5 Mechanical

Procedures and documents identified in Tasks 1 and 2 were reviewed for design process.

### 3.3.6 Equipment Qualification

Ten equipment packages were reviewed for design adequacy of seismic qualifications.

### 3.3.7 Electrical Systems

The following design documents were reviewed for design process: design criteria, single line, meter and relay, and key diagrams, design calculations, and purchase specifications.

S&L's office and the Clinton jobsite were visited to determine design process and obtain existing documentation. At the jobsite, pertinent personnel were met to discuss the status of construction, interface with S&L, IP, and various contractors.

GE and other vendor documents were reviewed for design interface with balance of plant (BOP) portion of the Class 1E electrical system. S&L internal system design review report for the Class 1E electrical system was also reviewed.

### 3.3.8 HELB/MELB

Review of project procedures and documentation was started to determine the design process followed by each S&L department and division.

### 3.3.9 Quality Engineering

Quality engineering has reviewed S&L's QA manual, comments to 10CFR50 Appendix B, and ANSI N45.2-11. In addition, nine general QA procedures and seven project instructions have been reviewed.

### 3.3.10 Seismic II/I

Review of project procedures and documents was started to determine how S&L incorporates Seismic II/I considerations into the design process. These considerations include both the in-place movement and the potential falling of components during a seismic event.

### 3.3.11 Observations

One Observation (OR File No. 01) resulting from design process review has been identified.

### 3.4 TASK 4: GENERAL ASSESSMENT

For this task, the results of Tasks 1, 2, and 3 will be assembled and analyzed for conclusions. No conclusions have been made to date.

### 3.5 Horizontal Review

The horizontal review effort has been initiated. Review of the following has begun: of the Cygna Energy Services Independent Design Verification (IDV) of Fermi, Teledyne Engineering Services Independent Design Review (IDR) of LaSalle, NRC Integrated Design Inspection (IDI) of Byron, Bechtel IDR of Byron, and Institute of Nuclear Power Operations (INPO) Review of Clinton. A total of 114 report items have been reviewed. Of these, 53 have been closed because they did not indicate that a discrepancy existed, were not applicable to design process or to the Clinton IDR scope, or were a repeat of other items being reviewed. The remaining 61 items have been provided to the various systems groups for further review and analysis.

### 3.6 Walkdowns

For environmental qualification, a walkdown checklist has been completed and walkdown packages are being prepared. For seismic qualification, approximately 30 pieces of equipment have been selected for walkdown verification. Preparations are in progress to support HELB/MELB field walkdowns. Outside containment, the walkdown will test the effectiveness of separation. Inside containment, the effects of individual pipe breaks will be compared with the calculational results.

Worksheets for the fire protection walkdowns have been prepared and walkdown packages for nine fire zones are being prepared.

A procedure for the Seismic II/I walkdown was prepared. This procedure includes a checklist to be used for each area being reviewed. Approximately twenty walkdown areas have been selected and approximately twenty more will be selected based on site conditions and insight gained during the initial walkdown phases.

Preparations were made for verification of the SSW mechanical process as well as the diesel generators by field walkdown. For stress analyses, walkdown guidance has been completed. A plan and list of package drawings of civil/structural items for field walkdown verification were prepared. Documents were gathered in preparation of field walkdown to verify plant design mechanical layout.

Pipe support engineering has completed selection of items and prepared a checklist in support of field walkdowns.

For electrical layout, in preparation for walkdowns, procedures were gathered. The status of construction and turnover was investigated to determine the areas and equipment to be inspected during walkdowns.

## Section 4

### MEETINGS

During the reporting period the following meetings have taken place.

June 1	Decatur	Initial meeting with IP on IDR scope and approach
June 6	Chicago	Initial IDR kickoff meeting with S&L
June 28	Bethesda	Meeting with NRC on Program Plan
July 12	Chicago	IDR program work with S&L
July 24	Chicago/Clinton jobsite	IDR program work
Aug. 9	Chicago	HELB/MELB orientation meeting at S&L
Aug. 22	Chicago	Working meeting with S&L engineers on fire protection
Aug. 28	Chicago/Clinton jobsite	IDR program work
Aug. 30	Clinton jobsite	IDR program work
Sept. 11	Chicago	Working meeting with S&L engineers
Sept. 12	Chicago	Meeting with S&L on level of support and schedule review
Sept. 17	Chicago	Working meeting with S&L engineers
Sept. 19	Chicago	Working meeting with S&L engineers

Appendix A

Potential Observation Report Summary

APPENDIX A  
POTENTIAL OBSERVATION REPORT SUMMARY

File #	Title	Description of Concern	Classification Valid? Significant?	Status	Description of Resolution
1	SSW Pumps	SSW pumps 1A & 1B do not satisfy design criteria to operate whenever diesel generators operate. Logic diagram for pump 1C does not implement the criteria.	Yes	S&L	
2	Time Delay Relay Coil	Time delay relay coil, shown connected across the 125 vdc control power bus, does not satisfy intent of FPR #1673.		Closed	Concern of inconsistency between design criteria, logic diagrams, and schematic diagrams incorporated into OR-1.
3	Penetration Impact Testing	Possible inconsistency between penetration fitting design spec and piping spec with regard to impact test requirements for Class 2 piping forming part of containment pressure boundary.		RFI	
4	Hydrodynamic Loads	Hydrodynamic load effects on components in D.G./Control Building may not be fully considered. Discrepancy may exist in SRV responses between Aux. Bldg. and D.G. Bldg. even though on same mat.		Level-1	
5	Valve Operability	Design documentation of Posi-Seal and Xomox valve operability might be incomplete.		Level-1	

APPENDIX A  
POTENTIAL OBSERVATION REPORT SUMMARY

File #	Title	Description of Concern	Classification		Status	Description of Resolution
			Valid?	Significant?		
6	460v Motors	Calculations may be needed to ensure that 460v motors and MOV operators required to function upon actuation of safety signal will perform their safety related function			Level-1	
7	Mechanical Eqpt.	Possible discrepancy between FSAR and S&L procedures on testing mechanical equipment when resonant frequency is less than 33 Hz. for seismic loads and 60 Hz. for hydrodynamic loads.			Level-1	

Appendix B

Observation Reports and Resolutions

CLINTON POWER STATION  
Job 15478-003

OBSERVATION REPORT

File No. 01  
File Revision No. 0  
Date 9-18-84

1. Level 1 classification of Observation:

- ☐ Not significant to safety  
☒ Additional information required \*see 5, "Recommendation for resolution"  
☐ Significant to safety, send to Level 2 Committee

2. Structure(s), system(s), or component(s) involved:

SSW Pumps 1A, 1B, 1C

Time Delay Relay Coils (2-SX1PA, 2-SX1PB)

NOTE: This OR combines the concern which was noted on POR File No. 2,  
Rev. O.

3. Description of Observation.

There are discrepancies between implementing design criteria (DC-SX-01-CP, FPR #1673) onto logic diagrams (M15-1052, Sheet 3 Rev. C, Sheet 6 Rev. B) and transferring the information to schematic diagrams (E02-1SX99-001 Rev. P, -002 Rev. R, -003 Rev. L). Several examples found are:

(See continuation sheet)

4. Significance of Observation:

There is the potential that certain design criteria, logic diagrams, and schematic diagrams have not been properly coordinated.

5. Recommendation for resolution (optional):

S&L should provide an explanation of why these discrepancies occurred, and an assessment of their safety significance. S&L should identify and verify that the design process for preparing logic and schematic diagrams ensures that the design criteria are implemented in the design.

6. Signatures:

*W. Parkinson* 9/19/85  
Level 1 Review Committee

*Robert S. Cahn*  
*Bob Jordan*

*R. S. Lawell*  
*DB Aardoe*

CLINTON POWER STATION  
Job 15478-003

OBSERVATION REPORT  
(continuation sheet)

File No. 01  
File Revision No. 0  
Date 9-18-84

- 
- 3.(a) The design criteria DC-SX-01-CP, which specifies the SSW pumps 1A and 1B to operate whenever the diesel generators operate is not satisfied. The logic (M15-1052, Sheet 3 Rev. C, Sheet 6 Rev. B) and schematic (E02-1SX99-001 Rev. P, -002 Rev. R) diagrams for these pumps do not show this criteria being implemented.
- (b) The logic diagram (M15-1052, Sheet 3 Rev. C) for SSW pump 1C does not implement the above mentioned design criteria, although the schematic diagram (E02-1SX-99-003 Rev. L) for pump 1C does.
- (c) Time delay relay coils (2-SX1PA and 2-SX1PB), shown connected across the 125 v dc control power bus in schematics E02-1SX99-001 Rev. P and E02-1SX99-002 Rev. R, do not satisfy the intent of FPR #1673 and are inconsistent with logic diagrams M15-1052, Sheet 3 Rev. C and M15-1052, Sheet 6 Rev. B. A 10 second timer was added in the start circuit of SSW pumps 1A and 1B to prevent spurious starts of the SSW pumps resulting from short term (less than 10 sec.) closures of low SSW header pressure, reactor level or drywell high pressure sensor contacts. As shown on the schematics, the time delay relays will not perform as intended.

CLINTON POWER STATION  
Job 15478-003

RESOLUTION REPORT

File No. 01  
File Revision No. 0  
Date 9-18-84

1. Resolution by Level 1 Internal Review Committee

2. Classification of Observation:

- a.      Not valid (see continuation sheet)
- b.      Not significant to safety
- c.   x   Additional information required
- d.      Significant to safety

3. Program resolution is:

- a.      Closed item
- b.   x   Action to be taken by Reviewee -- Provide additional information

4. Review Committee signatures:

Robert S. Cahn  
W. J. Parkinson

B. W. Jordan  
A. J. Powell  
D. B. Aasby

5. Reviewee proposed resolution:

a. Description of proposed resolution:

b. Basis of proposed resolution:

6. Reviewee response report signed by

\_\_\_\_\_  
Engineer Date \_\_\_\_\_

\_\_\_\_\_  
Manager Date \_\_\_\_\_

7. Illinois Power Co. concurrence: \_\_\_\_\_ Date \_\_\_\_\_

CLINTON POWER STATION  
Job 15478-003

RESOLUTION REPORT

File No. 02  
File Revision No. 0  
Date 9-18-84

1. Resolution by Level 1 Internal Review Committee

2. Classification of Observation:

- a. ☐ Not valid (see continuation sheet)
- b. ☐ Not significant to safety
- c. ☐ Additional information required
- d. ☐ Significant to safety

3. Program resolution is:

- a. ☒ Closed item
- b. ☐ Action to be taken by Reviewee

NOTE: The concern of this POR is the same as that expressed in OR File No. 1, Rev. 0; therefore the two observations have been combined in OR File No. 1. See Completion Report.

4. Review Committee signatures:

D. B. Harshbarger  
R. S. Cahn

R. S. Powell  
W. J. [unclear]  
[unclear]

5. Reviewee proposed resolution:

a. Description of proposed resolution:

b. Basis of proposed resolution:

6. Reviewee response report signed by

\_\_\_\_\_  
Engineer Date \_\_\_\_\_

\_\_\_\_\_  
Manager Date \_\_\_\_\_

7. Illinois Power Co. concurrence: \_\_\_\_\_ Date \_\_\_\_\_