DUQUESNE LIGHT COMPANY
BEAVER VALLEY POWER STATION UNIT #2

DESIGN BASES ENDORSEMENT PROGRAM

Submitted as part of the
Duquesne Light Company
Engineering Confirmation Program
Reference 2NCD-03525

COPY

June 1984

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I. INTRODUCTION

A. Project Description

The Beaver Valley Power Station Unit No. 2 is an 888 MWe (nominal) nuclear fueled, steam turbine generator, pressurized water reactor power station. It is located in Shippingport Borough, Beaver County, Pennsylvania, on the south bank of the Ohio River. The site comprises about 500 acres at an elevation of 735 feet above mean sea level and is approximately 25 miles northwest of Pittsburgh.

B. Program Abstract

On October 21, 1983, the Nuclear Construction Division (NCD) of Duquesne Light Company (DLC) presented an Engineering Confirmation Program for BVPS-2 Plant Design to the Nuclear Regulatory Commission (NRC) Region I in King of Prussia, Pennsylvania. An objective of DLC, identified at that time, was to endorse the Plant Design Bases of BVPS-2. Specifically, DLC committed to:

1. Confirm that the evolved Design Basis Documents are acceptable.
2. Confirm that selected safety related systems' Design Output Documents reflect the Plant Design Bases through proper implementation.
3. Validate Key Attributes of the installed design of the selected safety-related systems.

To accomplish the above objectives, four major activites were identified:

Phase I - Endorsement of Stone & Webster Engineering Corporation (SWEC) Design Criteria Document

Phase II - Confirmation of the Implementation of SWEC Design Process and Control Document

Phase III - Review and Evaluation of Design Output Documents

Phase IV - Validation of Key Attributes of the Installed Design

To proceduralize the actions required to complete the Design Bases Endorsement (DBE) Program and identify the selected documents to be reviewed as part of this program, two NCD procedures were written:

NCDP 2.6 - BV-2 Design Bases Document Acceptance

NCDP 2.6.1 - Endorsement of Design Bases

These procedures are presented in Attachment A.

C. Personnel Involvement

Forty-eight DLC engineers expended approximately 11,000 hours in performance of the DBDA Program. Engineering experience of the participants includes structural, mechanical, electrical, metallurgical, nuclear, and licensing.

SWEC support involved approximately 50 engineers from their Boston Office.

D. Conclusion

The DLC Design Bases Endorsement (DBE) Program has demonstrated that the BVPS-2 Plant Design Bases, as defined in this report, have no significant unresolved concerns and are considered acceptable by DLC. The program enabled DLC to effectively identify specific design discrepancies. Each of these has been addressed and either resolved to DLC's satisfaction or included in a follow-on program which is expected to result in a satisfactory resolution.

II. PHASE I

A. SCOPE

In NCDP 2.6.1, "Endorsement of Design Basis", Section 6.0, 6.1, and 6.2 formally describe the review activities performed by DLC to endorse SWEC Design Criteria Documents. Briefly, DLC reviewed selected SWEC Project Manual Design Criteria Documents (DCD) and compared them to 10CFR50, Appendix A, the General Design Criteria and FSAR. The discrepancies discovered during the reviews were documented and submitted to SWEC for resolution. Based upon the specific resolution, the Design Criteria Document and/or the FSAR may have required revision to resolve the discrepancies. If the resolutions were acceptable to DLC and the required revisions were properly made, DLC endorsed the SWEC Design Criteria Document. This endorsement is identified by DLC Management approval signatures on the Design Bases Document Acceptance (DBDA) Sheet. If no revision was required to the DCD, the initially reviewed document was endorsed. Changes to the FSAR were tracked by the DLC Regulatory Affairs Department on the FSAR Amendment Item List. (See Attachment B.)

B. STATUS

Twenty-seven Design Criteria documents were reviewed for Phase I. As of June 30, 1984, twenty-two of these documents have been endorsed by DLC. Follow-on activities are identified in Section VII, Part A. Phase I documentation is in Attachment C.

III. PHASE II

A. SCOPE

For the Phase II Review, DLC's objective was to confirm that Design Process and Control (DP&C) Documents were implemented correctly by reviewing the documents addressed by the DP&C documents, (i.e., logics, flow diagrams, specifications, calculations, etc.). Design Process and Control Documents include SWEC Project Manual (2BVMs) and SWEC Engineering Assurance Procedures (EAPs). The procedure (DBDA) to confirm these documents is identical to that previously described for Phase I Documents.

B. STATUS

Thirty-six Design Process and Control Documents and other similar documents were reviewed for Phase II. As of June 30, 1984, twenty-seven of the documents were confirmed by DLC. Follow-on activities are identified in Section VII, Part B. Phase II documentation is in Attachment D.

IV. PHASE III

A. SCOPE

Samples of Design Output documents from two selected safety-related systems were reviewed for adequacy of implementation of Design Basis documents and other applicable design documents. An independent review was conducted by Electrical, Mechanical, and Structural Engineering groups for both the Residual Heat Removal System (RHS) and the Auxiliary Feedwater System (FWE). Design Verification Reports were prepared and transmitted to SWEC for resolution of DLC comments generated during the review. As a result of DLC review of SWEC resolutions, Design Output documents may be either acceptable without revision or may require revision.

B. STATUS

1. STRUCTURAL

Design Output documents reviewed by the Structural Engineering Department (SED) include piping support drawings, piping support calculations, and piping support purchase specifications. A total of 66 comments were generated in the areas listed below:

Design Review Item	Number of Comments FWE	RHS
Are the appropriate QA and QC requirements stated?	32	8
Is the design output reasonable when compared to the design inputs?	19	7
TOTAL	51	15

All 66 Structural comments have been resolved by SWEC to DLC's satisfaction.

Follow-on activities are described in Section VII, Part C. Phase III documentation is in Attachment E.

8. STATUS (Continued)

2. MECHANICAL

Design Output documents reviewed by the Mechanical Engineering Department (MED) include piping isometric drawings, piping arrangement drawings, instrument piping drawings, piping design packages, and component purchase specifications. A total of 63 comments were generated in the areas listed below.

Design Review Item	Number of Comments FWE	RHS
Were design inputs correctly selected and incorporated into design?	11	8
Are assumptions necessary to perform the design activity adequately described and reasonable?	2	1
Are the applicable codes, standards, and regulatory requirements, including issue and addenda, properly identified and are their requirements for design met?	12	3
Have the design interface requirements been satisfied?	8	12
Is the design output reasonable when compared to the design input(s)?	1	
Are the specified parts, equipment, and processes suitable as applied?	3	1
Are requirements for record preparation, review, approval, retention, etc. adequately specified?	1	—
TOTAL	38	25

SWEC has resolved all of the 63 Mechanical comments. Sixty-one are acceptable to DLC.

Follow-on activities are described in Section VII, Part C. Phase III documentation is in Attachment E.

B. STATUS

3. ELECTRICAL

Design Output documents reviewed by the Electrical Engineering Department (EED) include electrical elementaries and electrical one line-diagrams relating to cable and raceway identification and separation, cable philosophy, fire protection, essential system power supplier, grounding, and relaying. Equipment qualification documentation, restricted materials, and seismic classification were also considered. A total of 42 comments were generated in the areas listed below.

Design Review Item	Number of Comments FWE	RHS
Were design inputs correctly selected and incorporated into design? (General)	13	13
Does this design satisfy the 2BVM requirement? (Specific)	6	10
TOTAL	19	23

SWEC has resolved all of the 42 Electrical comments. Forty are acceptable to DLC.

Follow-on activities are described in Section VII, Part C. Phase III documentation is in Attachment E.

V. PHASE IV

A. SCOPE

Preliminary work for Phase IV involved establishing a list of significant key attributes in the two selected safety-related systems for validation by physical walkdown. Structural, Mechanical, and Electrical Engineering groups generated an inspection plan and conducted an independent walkdown of the Residual Heat Removal and the Auxiliary Feedwater Systems to identify potential inconsistencies between the design criteria and the installed configuration. These inconsistencies were transmitted to SWEC for resolution. As a result of acceptable resolutions, update of installed design via revision to design output documents is required.

B. STATUS

1. STRUCTURAL

The Structural Engineering Department (SED) identified ten key attributes for validation of the installed design of the RHS and FWE. The installed designs that were validated correspond to the Design Output documents in SED's Phase III review. The walkdown resulted in one comment for each of the two systems. Both comments have been resolved to DLC's satisfaction. Therefore, there are no follow-on activities required.

Phase IV documentation is in Attachment F.

2. MECHANICAL

The Mechanical Engineering Department (MED) identified 50 key attributes for validation of the installed design of the RHS and FWE. The installed designs that were validated correspond to the Design Output documents in MED's Phase III review. The walkdown resulted in five comments, all of which have been

2. MECHANICAL (Continued)

resolved by SWEC to DLC's satisfaction. Therefore, there are no follow-on activities required.

Phase IV documentation is in Attachment F.

3. ELECTRICAL

The Electrical Engineering Department (EED) identified 76 key attributes for validation of the installed design of the RHS and FWE. The installed designs that were validated correspond to the Design Output documents on EED's Phase III review. The walkdown resulted in 17 comments. Fifteen have been resolved by SWEC to DLC's satisfaction.

Follow-on activities are described in Section VII, Part D. Phase IV documentation is in Attachment F.

VI. SUMMARY OF DBE PROGRAM

PHASE I AND PHASE II

The Phase I and II reviews confirm that the Design Basis Documents identified in Attachment G are acceptable. This acceptance is based on the fact that DLC review comments have been satisfactorily resolved by SWEC. Typical comment items include the following:

- Inconsistent referencing of ASME Code Sections III and XI.
- Inconsistent presentation of information in the DBD, FSAR, and design input documents.
- Inconsistencies resulting from changes in code requirements.
- Omission of information from the DBD, FSAR, or design output documents.
- Inaccurate and/or lack of references.
- Editorial/typographical errors.

PHASE III

The Auxiliary Feedwater System (FWE) and Residual Heat Removal System (RHS) were two safety-related systems selected for this phase. The review of these systems' design output documents confirms that the design bases have been implemented satisfactorily. This confirmation is based on the comments/resolutions to specific design review items that were considered for each of 259 design outputs. The following review items were the basis for comments generated by DLC for SWEC resolution:

- Selection and incorporation of design inputs
- Adequate and reasonable assumptions
- Appropriate QA and QC requirements
- Identification of applicable codes, standards, and regulatory requirements
- Design interface requirements

PHASE III (Continued)

- Comparison between design inputs and design outputs
- Application of suitable parts, equipment, and processes
- Requirements for record preparation, review, approval, retention, etc.

The SED identified the following as their most significant comments:

- Absence of required signatures on pipe support calculations
- Incorrect transfer of design input information from the pipe support calculations to the pipe support drawings

The preceding comments are being resolved by SWEC as follows:

- Perform a reconciliation of the calculations to provide the required signatures
- Revise the drawings to include the correct input information

The MED identified the following as their most significant comments:

- ASME III code dates on specifications in conflict with the specification contract date
- Failure to perform ASME III pressure design of pipe flanges
- Application of class break criteria to ASME III instrument lines inconsistent with applicable codes and standards
- Incorrect or inadequate assumptions and operating modes in the pipe stress calculations and pipe stress data packages
- Incorrect or missing identification of parts on the pipe isometric drawings

The preceding comments are being resolved by SWEC, respectively, as follows:

- Prepare an "ASME Code Baseline Document" identifying the applicable ASME Section III and Section XI Code Edition, Addenda, and applicable Code Cases invoked for each component

PHASE III (Continued)

- Revise the piping design specification to meet the intent of the ASME code by taking credit for the use of ANSI standard flanges
- Revise class breaks on drawings as required based on guidance provided by DLC
- Revise the calculations and data packages to include correct assumptions and operating modes
- Revise the drawings to include the correct parts identification

The EED identified the following as their most significant comments:

- Incorrect calculations for sizing of power and grounding cables
- Missing protection and relay information on the electrical drawings

The preceding comments are being resolved by SWEC as follows:

- Revise the calculations to include correct sizing requirements
- Revise the drawings to include the missing information

PHASE IV

The Auxiliary Feedwater System (FWE) and the Residual Heat Removal System (RHS) were two safety-related systems selected for the phase. The objective of the walkdown of these systems is to validate that the key attributes of the installed design have been implemented satisfactorily. This validation is based on the comment/resolution to specific design review items considered for each installed design. The following review items were the bases for comments generated by DLC for SWEC resolution:

- Accuracy of nameplate data
- Accuracy of location and orientation
- Compliance with installation requirements

PHASE IV (Continued)

The SED made the following minor comments:

- Support 2RHS-PSR-005 did not comply with installation requirements.
- Support 2FE-PSSH-061 A&B had a discrepancy between the installed design elevations and that shown on the drawings.

Both of these comments have been resolved by SWEC to DLC's satisfaction.

The MED had no significant comments requiring SWEC resolution.

The EED identified the following as their most significant comments:

- Missing nameplate data for 2RHS*MOV 701B, 702A, 701A and 720A
- Location of 2RHS*MOV 750A and 750B and 2FWE*FI 100A2, 100B2, 100C1
- Ground cable "stranded" instead of "solid" (per 2BVM-38) on 4160V Emergency Switchgear 2DF

VII. FOLLOW-ON ACTIVITIES AND RECOMMENDATIONS

A. PHASE I FOLLOW-ON

1. DESIGN CRITERIA DOCUMENT NOT ENDORSED

Listed below are Phase I documents which have not been endorsed by DLC as of June 30, 1984. Follow-on activities for each listed document are identified.

2BVM-35 - Codes and Standards - Requirements for Category I Specification

SWEC has committed to revising this document by July 31, 1984. DLC will review the revision and, if acceptable, DLC will endorse it by August 31, 1984.

2BVM-42 - Cable Philosophy Power, Control and Instrumentation

Revision 6 dated May 31, 1984 incorporates comments noted by DLC in their initial review. SWEC also incorporated other changes to this document. Before endorsement of this document, DLC will review these additions to assure acceptability. This review will be completed by September 30, 1984.

2BVM-43 - Protection Relay and Device Settings

Section III "Electrical Protective Devices Philosphy Practices, Coordination, and Settings for 120VAC and 120VDC System" was scheduled by SWEC to be incorporated December 1, 1984 to coincide with the furnishing of additional vendor information. DLC will hold endorsements until this revision is reviewed. If acceptable, DLC will endorse it by January 1, 1985.

2BVM-116 - Seismic Classification for Structures Systems and Component

DLC requested SWEC to acknowledge, in 2BVM-116, that seismic classification is provided by both SWEC and the NSSS supplier. SWEC has agreed to this, but the revision has not yet been issued. SWEC expects to issue this revision by September 30, 1984. DLC will then review this revision and if acceptable will endorse it by October 31, 1984.

2BVM-118 - Criteria for Postulating Pipe Breaks and Analyzing the Dynamic and Environmental Effects (Outside Containment)

SWEC cancelled this document and incorporated the information into 2BVM-114, "Essential Systems, Components, and Instrumentation Required for Safety Functions" and 2BVM-85, "Criteria for Protection from the Dynamic Effects Associated with Postulated High Energy Pipe Breaks". These documents were checked to assure that the DLC concerns in 2BVM-118 were properly addressed. No follow-on activity is required.

A. PHASE I FOLLOW-ON (Continued)

2. DESIGN CRITERIA DOCUMENT ENDORSED BUT FOLLOW-ON REQUIRED

2BVM-32 - Instrument Connection on Vessels and Piping

Revision 2 dated March 3, 1982 has been endorsed by DLC. As a result of Phase III investigation, 2BVM-32 will again be revised. This document is scheduled to be issued July 15, 1984. DLC will review the revision at that time.

2BVM-107 - Design Consideration for In-Service Testing of Pumps ASME XI Subsection IWP

Revision 5 issued March 5, 1984 has been endorsed by DLC. At the DLC/SWEC Pump/Valve Workshop, several concerns applicable to the inservice testing of pumps were discussed. As a result, SWEC was requested to incorporate additional changes to 2BVM-107 by November 1984. DLC will review this revision at that time.

2BVM-109 - Design Consideration for Inservice Testing of Valves ASME XI Subsection AWV 10CFR50 (Appendix I)

Revision 3 issued February 21, 1984 has been endorsed by DLC. At the DLC/SWEC Pump/Valve Workshop, several concerns applicable to the inservice testing of valves were discussed. As a result, SWEC was requested to incorporate additional changes to 2BVM-109 by November 1984. DLC will review the revision at that time.

2BVM-149 - Fire Protection Evaluation Report

The resolution of several items are DLC responsibility. The issues involve operating procedures for BVPS-2 which have not yet been written. These items will be reviewed and resolved by responsible Fire Protection engineers.

B. PHASE II FOLLOW-ON

1. DESIGN PROCESS AND CONTROL DOCUMENTS NOT ENDORSED

Listed below are Phase II documents which have not been endorsed by DLC as of June 30, 1984. Follow-on activities for each listed document is identified.

2BVM-22 - Instructions for Nuclear Steam Supply Systems

SWEC 3VPS-2 project has requested their Engineering Assurance Division to grant them a deviation from EAP 3.4. All appropriate information from EAP 3.4 was to be incorporated into 2BVM-6, 16, 22, and 29. Since EAP 3.4 was part of the DRDA Program, confirmation to 2BVM-22 will be held until DLC is assured that applicable parts of EAP 3.4 are incorporated. 2BVM-22 revision has been issued. Revision to the other three documents are expected by July 16, 1984. If revisions are acceptable relative to EAP 3.4, 2BVM-22 will be confirmed by August 30, 1984.

2BVM-25 - Handling of Nonconformances and Disposition Reports (N&Ds)

The structure of Revision 10 dated June 14, 1984 is considerably different from the revision initially reviewed by DLC. Therefore, 2BVM-25 will be reviewed again for possible confirmation by September 30, 1984.

2BVM-56 - Instructions for Design Review Program

On May 18, 1984, a revision to 2BVM-56 was issued. The scope of the revision is quite different from the originally reviewed document. The new title is to 2BVM-56 is "Change Evaluation Committee". The revision will be reviewed similarly to the other Design Process and Control documents by September 30, 1984. Confirmation is expected by December 30, 1984.

2BVM-94 - Handling of Boston Generated Engineering and Design Coordination Reports

Structure of Revision 7 dated June 14, 1984 is considerbly different from the revision initially reviewed by DLC. Therefore, 2BVM-94 will be reviewed again for possible confirmation by September 30, 1984.

2BVM-129 - Guidelines for Internally Generated Missile Program

SWEC expects to issue the revision by September 1, 1984. At that time, DLC will review the revision to assure comments have been addressed. If acceptable, DLC will confirm this document by November 1, 1984.

B. PHASE II FOLLOW-ON (Continued)

1. DESIGN PROCESS AND CONTROL DOCUMENTS NOT ENDORSED (Continued)

EAP 2.9 - Preparation Review and Control of Licensing Reports

This is a SWEC corporate document issued by the Engineering Assurance Division (EAD). EAD has committed to revising EAP 2.9 by August 31, 1984. DLC will review the revision and, if acceptable, will confirm it by October 31, 1984.

EAP 2.10 - Handling of Changes to Licensing Documents

This is a SWEC corporate document issued by the Engineering Assurance Division (EAD). EAD has committed to revising EAP 2.10 by August 31, 1984. DLC will review the revision and, if acceptable, will confirm it by October 31, 1984.

EAP 2.11 - Project Compliance with SWEC Regulatory Guide Position and SWEC Branch Technical Position Policies

This is a SWEC corporate document issued by the Engineering Assurance Division (EAD). EAD has committed to revising EAP 2.11 by October 1, 1984. DLC will review the revision and, if acceptable, will confirm it by November 1, 1984.

EAP 3.4 - Nuclear Steam Supply System (NSSS) Supplier Design Interface with the Stone and Webster Design

SWEC SVPS-2 Project has requested their Engineering Assurance Division to grant them a deviation from EAP 3.4 because: 1) EAP 3.4 is designed to address the SWEC NSSS interface at the early stages of a nuclear project. SVPS-2 is in the latter stages; and 2) the majority of applicable requirements of EAP 3.4 are addressed in the project procedure. SVPS-2 applicable requirement from EAP 3.4 are being incorporated into 2SVM-6, 16, 22, and 29. These are all scheduled to be issued by July 16, 1984. No DLC action will be taken until the deviation request is approved. At this time, EAP 3.4 will be confirmed.

C. PHASE III FOLLOW-ON

1. AUXILIARY FEEDWATER SYSTEM (FWE)

CALCULATION NO. 12241-NP(N)-X16A-0 (See Attachment E, MED)

A note will be added on the calculation sheet to show that the values indicated as calculated loadings for flanges at points 250 and 284 are an envelope of the maximum loads of both flanges. This note will be on the issue of the calculation and is scheduled during the stress reconciliation program to be completed by June 1985.

All references in the calculation sheets to the 1980 ASME III Code will be deleted and reference to EMTR-605 will be added. This change will be made during the stress reconciliation program to be completed by June 1985.

DLC contends that this calculation should address the requirements of ASME III, NC-3672.6 and NC-3673.5. SWEC has taken the position that these code sections do not pertain to support load selection. Further discussion on this matter is required and the resolution will be closed prior to the completion of the pipe stress reconciliation program June 1985.

STRESS DATA PACKAGE SI-RM-45B (See Attachment E, MED)

The variation of zero to full by-pass flow are not identified in this stress data package. These variations will be addressed in the next issue of the stress data package by September 1, 1984.

Sources of temperature and pressure inputs are not adequately referenced to allow verifiction. The document will be revised per 2BVM-45 to indicate the sources by September 1, 1984.

SPEC. NO. 2BVS-920 (See Attachment E, MED)

This specification invokes the 71 ASME III through W72, but the contract date appears to indicate that the 1974 ASME III through W75 should be invoked. SWEC will issue the "ASME Code Baseline Document" (2BVM-179) by July 1984, and it will address clarifications to the ASME Code Edition and Addenda.

SPEC. NO. 2BVS-939 (See Attachment E, MED)

This specification will be revised to invoke ASME III 1977 Edition with Addenda through W78 for pressure design of flanges. This revision meets the intent of the 1971 baseline code because it allows credit to be taken for th use of ANSI standard flanges to satisfy the requirements for pressure design. This revision will be made by July 1985.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

SPEC. NO. 2BVS-977 (See Attachment E, MED)

This specification invokes the 1971 ASME III through W72, but the contract date appears to indicate that a later code should be invoked. SWEC contends that this specification is directly related to the baseline code (1971 W72) piping specifications. Further discussion on this matter is required and the resolution will be closed prior to completion of the pipe stress reconciliation program June 1985.

SWEC was advised that DLC will prepare a project licensing position for class breaks in ASME III instrument lines. When this position (R.G. 1.151) is finalized, SWEC will revise 2BVS-977.

Page 1 - 80 states that the engineers shall prepare isometric drawings for all impulse lines and pneumatic tubing over 1.5 inches in seismic areas. This should refer to lines under 1.5 inches. The revision will be made in the next revision of 2BVS-977 by August 1, 1984.

The correspondence section of the specification references the wrong names of DLC personnel to whom correspondence is to be sent. SWEC will correct these references in the next revision of 2BVS-977 by August 1, 1984.

2BVM-32 (See Section VII, Part A)

This design basis document will be reconciled by July 15, 1984 to include instrument connection drawings now found only in 2BVS-920 and 2BVS-939.

DWG 10080-RE-1F-4A (See Attachment E, EED)

Revise drawing to show that the supply breaker for 2FWE*P23A can be controlled from the Alternate Shutdown Panel. Issue date will be October 1, 1984.

DWG 10080-RE-1Y-5 (See Attachment E, EED)

Revise drawing to show valves 2FWF*HCV100C and E can be controlled from the Alternate Shutdown Panel. Issue date will be February 28, 1985. Also, revise to incorporate 2FWE*HCV100A, B. Issue date will be October 17, 1984.

DWG 10080-RE-1X-4 (See Attachment E, EED)

Revise drawing to delete 2FWE*HCV100A, B, C, D, E, F. Issue date by October 17, 1984.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

DWG 10080-RE-10AX-1B (See Attachment E, EED)

Revise to show proper train designation for 2MSS*SOV105B (should be "BP" not "AP"). Also show proper train designation for 2MSS*SOV105D (should be "AO" not "BO"). Issue date will be December 31, 1984.

CALCULATION E-20 Revision 2 (See Attachment E, EED)

Further discussion is required with SWEC to resolve the 5KV motor feeder cable size calculation for the 400 hp auxiliary feedwater pump. SWEC wants to use 550°C for the T_2 or T_{max} in the equation. DLC checked with the vendor who agrees that 250°C should be substituted into the equation for T_2.

CALCULATION E-66 dated October 12, 1983 (See Attachment E, EED)

Revise calculation to reflect a maximum allowable temperature of 250°C and a resultant minimum conductor size of 8AWG. Issue date will be December 1, 1984.

2BVM-114 dated January 13, 1982 (See Attachment E, EED)

Revise to show proper train designation for 2MSS*SOV105B (should be "BP" not "BO"). Also show proper train designation for 2MSS*SOV105D (should be "AO" not "AP"). Issue date will be December 31, 1984.

APCSB 9.5-1 Section 3.5 (See Attachment E, EED)

Revise to add description of instruments 2FWE*FT100AF. Revision will be issued by December 28, 1984. Also, delete instrument 2FWE-LI104F1 since it is no longer required on the ASP. Revision will be issued by December 28, 1984.

FSAR Table 3.11-1 (See Attachment E, EED)

Revise to add the following to Table 3.11-1 since they perform a 1E safety function: 2FWE*SOV100A, B and 2FWE*LSL104A3, A4 and 2FWE*LYL 104A3, A4. Revision will be issued by September 28, 1984. Also, revise to add the following to Table 3.11-1 since they perform a 1E safety function: 2MSS*SOV105A, B, C, D, E, and F. Revision will be issued by September 28, 1984.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

CALCULATION NO. 12241-NP(N)-Z-16A-118-2 (Support No. 2FWE-PSSH-016A&B (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-040-Y (Support No. 2FWE-PSR-043Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-041-4 (Support No. 2FWE-PSR-044Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-117-2 (Support No. 2FWE-PSSP-345A&B) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(T)-Z-16A-009-4 (Support No. 2FWE-PSA-009Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-004-3 (Support No. 2FWE-PSA-004Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(F)-Z-16A-011-6 (Support No. 2FWE-PSA-011Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

CALCULATION NO. 12241-NP(N)-Z-16A-005-4 (Support No. 2FWE-PSR-005Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-013-4 (Support No. 2FWE-PSR-013Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-006-4 (Support No. 2FWE-PSR-006Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-014-3 (Support No. 2FWE-PSA-014) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-017-4 (Support No. 2FWE-PSR-017Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-015-3 (Support No. 2FWE-PSR-015Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-109-0 (Support No. 2FWE-PSST-346X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

CALCULATION NO. 12241-NP(T)-Z-16A-119-0 (Support No. 2FWE-PSA-355X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-002-4 (Support No. 2FWE-PSR-002Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-003-3 (Support No. 2FWE-PSR-003Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

SWEC will provide a statement to the calculation describing that the over weld is adequate during the engineering confirmation update as described in 2BVM-122 by June 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-001-3 (Support No. 2FWE-PSR-001Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-010-4 (Support No. 2FWE-PSR-010Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-007-4 (Support No. 2FWE-PSR-007Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

CALCULATION NO. 12241-NP(N)-Z-16A-058-3 (Support No. 2FWE-PSR-062Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-018-4 (Support No. 2FWE-PSA-018Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-097-2 (Support No. 2FWE-PSR-334X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(T)-Z-16A-121-1 (Support No. 2FWE-PSA-357X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-112-0 (Support No. 2FWE-PSST-349X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(T)-Z-16A-120-0 (Support No. 2FWE-PSR-356X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-008-3 (Support No. 2FWE-PSA-008Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

1. AUXILIARY FEEDWATER SYSTEM (FWE) (Continued)

CALCULATION NO. 12241-NP(T)-Z-16A-047-4 (Support No. 2FWE-PSR-050Y) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-115-0 (Support No. 2FWE-PSST-352X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(N)-Z-16A-116-0 (Support No. 2FWE-PSR-353X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(T)-Z-16A-100-0 (Support No. 2FWE-PSR-337X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

CALCULATION NO. 12241-NP(T)-Z-16A-099-0 (Support No. 2FWE-PSR-336X) (See Attachment E, SED)

SWEC will provide the independent review and signature as part of the ASME III stress reconciliation program as described in 2BVM-156 by June of 1985.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS)

ISOMETRIC DRAWING NO. 107113-1B (See Attachment E, MED)

The Westinghouse symbol will be added next to Material Item No. 1 to indicate that it is a Westinghouse supplied component. Revision will be made by July 18, 1984.

ISOMETRIC DRAWING NO. 107115-1B (See Attachment E, MED)

Material Item No. 1 will be changed from 10-BM74 to 10-BA76D by July 16, 1984.

Material Item No. 2 will be changed from 2-RHS-FE600B(B-) to 2-RHS-FE607B(B-) by July 16, 1984.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS) (Continued)

ISOMETIC DRAWING NO. 107117-3A (See Attachment E, MED)

The Westinghouse symbol will be removed from Material Item No. 1 by July 15, 1984.

Piping Class 602 will be indicated for Material Item No. 3 by July 15, 1984.

ISOMETIC DRAWING NO. 110726-1C (See Attachment E, MED)

Piping Class 302 will be added to Material Item Nos. 2 and 8 by July 18, 1984.

The Westinghouse symbol will be added to Material Item Nos. 3 and 9 by July 18, 1984.

CALCULATION NO. 12241-NP(N)-X71B-0 (See Attachment E, MED)

The assumed dimensions and weights for valves HCV-750B, FCV-605B, and FE-600B will be reconciled during the Stress Reconciliation Program schedule for completion by April 1985.

All references in the calculation sheets to the 1980 ASME III Code will be deleted and reference to EMTR-605 will be added. This change will be made during the Stress Reconciliation Program to be completed by April 1985.

STRESS DATA PACKAGE SI-RM-76A (See Attachment E, MED)

Zero or full by-pass conditions with pump P21B in operation were not considered in this package. These conditions will be addressed in the next issue of the package by September 1, 1984.

Sources for line pressure and temperature are not adequately referenced to allow verification. SWEC will revise the package to include this information by July 23, 1984.

SPEC. NO. 2BVS-920 (See Attachment E, MED)

Page 1-42, Item 2, of the Specification states that insulation shall be removable for a minimum distance of 12 inches on either side of the circumferential weld center. SWEC STD-MP-1057-4-3 indicates a minimum distance of 14 inches required. 2BVS-920 will be reconciled to agree with the SWEC STD by July 15, 1984.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS)

DWG 10080-RE-34AL-8 (See Attachment E, EED)

Revise drawing Note 3 to read 1'6" instead of 16". Revision will be issued by December 31, 1984.

DWG 10080-RE-1F-4A (See Attachment E, EED)

Revise drawing to show 2RHS*P21A to be controlled from the Alternate Shutdown Panel. Revision will be issued by October 28, 1984.

DWG 10080-RE-IV-4 (See Attachment E, EED)

Revise drawing to agree with 12241-LSK-25-7B through 7E to show certain MOVs to be controlled at the Alternate Shutdown Panel. Revision will be issued by September 30, 1984. Also, revise to show breaker size F10 instead of D10 for MCC cubicles which feed MCC cubicles which feed MOVs 2RHS*MOV720A and 2RHS*MOV720B (2-E05/03C and 2-E06/02D). Revision will be issued by September 30, 1984.

DWG 10080-RE-32C-9C (See Attachment E, EED)

Revise drawing Section (65-65) to clarify that the specified 2/0 AWG ground cable is typical to jumpers (on cable tray) as well as the ground tie. Revision will be issued by December 31, 1984.

DWG 10080-RM-76A (See Attachment E, EED)

Revise the drawing to show 2RHS*FT605A to be "Blue(B)" channel color not "Red(R)." Revision will be issued by October 31, 1984.

CALCULATION E-66 dated October 12, 1983 (See Attachment E, EED)

Revise calculation to read 10.305 MCM. Revision will be issued by December 31, 1984. Also, revise calculation to reflect a maximum allowable temperature of 250°C and a resultant minimum conductor size of 8AWG. Revision will be issued December 1, 1984.

CALCULATION E-20, Revision 2 (See Attachment E, EED)

Further discussion is required with SWEC to resolve the 5KV motor feeder cable size calculation for the 400 hp auxiliary feedwater pump. SWEC wants to use 550°C for the T_2 or T_{max} in the equation. DLC checked with the vendor who agrees that 250°C should be substituted into the equation for T_2.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS) (Continued)

2BVM-114 (See Attachment E, EED)

Revise the 2BVM to show 2RHS*FT605A to be "Blue(B)" channel color not "Red(R)." Revision will be issued by December 31, 1984.

2BVM-42, Revision 1 (See Attachment E, EED)

Revise the 2BVM to show a cable ampacity derating factor for cables in a tray wrapped with a 1 hour fire rated material. SWEC is considering a derating factor of 0.85. Revision will be issued by March 1, 1985.

DWG 10080-RE-33H-5C (See Attachment E, EED)

Revise drawing (Detail D) to indicate the size of the grounding cable through the shake space to be 2/0 stranded per 2BVM-38. Revision will be issued by October 30, 1984. Also, revise drawing to indicate a fourth ground path for transformer TR-2C and TR-2D (Detail B). Revision will be issued by October 30, 1984.

FSAR, Page 8.3-66, Item 9 (See Attachment E, EED)

Revise to incorporate splicing of the ground conductor in trays at the electrical penetrations. Drawing 10080-35A-7E, Note 3, already states that Type IX penetration pigtails will be spliced in the tray.

DWG 10080-RE-4FA-5 (See Attachment D, EED)

Revise the drawing to show an asterisk instead of a dash for transmitter 2RHS*FT605A, B mark number to indicate that it is safety related. Revision will be issued by August 30, 1984. Also, revise the drawing to show the instrument channel colors for 2RHS*FT605 A-Blue(B) and 2RHS*FT605B Yellow(Y). Presently, they are shown as "no color"-(N). REvision will be issued by August 30, 1984.

DWG 10080-RE-36X-4 (See Attachment D, EED)

Revise the drawing to show the instrument channel colors for 2RHS*FT605A-Blue(B) and 2RHS*FT605B Yellow(Y). Presently, they are shown as "no color"-(N). Revision will be issued by August 30, 1984.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS) (Continued)

DWG 10080-RE-36Y-4 (See Attachment D, EED)

Revise the drawing to show the instrument channel colors for 2RHS*FT605A-Blue(B) and 2RHS*FT605B Yellow(Y). Presently, they are shown as "no color"-(N). Revision will be issued by August 30, 1984.

DWG 10080-RE-36BR-3 (See Attachment D, EED)

Revise the drawing to incorporate the Class 1E power supply for 2RHS*FT605A. Revision will be issued by October 30, 1984.

APCSB 9.5-1 (See Attachment D, EED)

The mark numbers shown as 2FWS*FT605A, B should be changed to show the mark numbers as 2RHS*FT605A, B. Revision will be issued by December 28, 1984.

FPER (See Attachment D, EED)

This document will be revised to add that a manually operated water deluge system is provided for each pump - 2RHS*P21A, B. Ionization and photo-electric smoke detectors are provided to alarm in the Control Room.

DWG 10080-RE-36BC (See Attachment D, EED)

Revise the drawing to incorporate the Class 1E power supply for 2RHS*FT605B. Revision will be issued by October 30, 1984.

DWG 10080-RE-4BD-5 (See Attachment D, EED)

Cable 2RHS3BX001 is to replace cable 2RHS6NX001 shown on drawing 10080-RE-4BF-5. Cable 2RHS4YX002 is to replace Cable 2RHS8NX001 shown on drawing 10080-RE-4BH-5. Note: The channel color blue(B) as shown in Cable No. 2RHS3BX001 now conflicts with the 2BVM-114 which shows the cable to be red(R). Drawings 10080-RE-4FA, 36X, and 36Y should also be checked for the proper instrument channel color.

Drawings 10080-RE-36BR and 36BC will be revised by October 30, 1984.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS) (Continued)

CALCULATION NO. 12241-NP(N)-Z-71A-002-3 (Support No. 2RHS-PSSH-002A and B) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

SWEC will provide a statement to the calculation describing the adequacy of the rod and 2C4 x 5.4 during the ASME III Reconciliation Program as described in 2BVM-156 by April 1985.

CALCULATION NO. 12241-NP(N)-Z-71A-041-3 (Support No. 2RHS-PSSP-002) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

CALCULATION NO. 12241-NP(N)-Z-107A-141-5 (Support No. 2RHS-PSA-141) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

CALCULATION NO. 12241-NP(N)-Z-71A-004-4 (Support No. 2RHS-PSR-004) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

CALCULATION NO. 12241-NP(N)-Z-71A-040-3 (Support No. 2RHS-PSSP-001) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

CALCULATION NO. 12241-NP(N)-Z-71A-038-3 (Support No. 2RHS-PSSH-038X) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

SWEC will provide a statement to the calculation describing the adequacy of the weld which attaches the beam brakcet to the TS 6x6 during the ASME III Reconciliation Program as described in 2BVM-156 by April 1985.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS) (Continued)

CALCULATION NO. 12241-NP(N)-Z-71A-057-1 (Support No. 2RHS-PSSP-501X) (See Attachment E, SED)

SWEC will provide the independent review and signatures or part of the ASME III Stress Reconciliation Program as described in 2BVM-156 by April 1985.

D. PHASE IV FOLLOW-ON

1. AUXILIARY FEEDWATER SYSTEM (FWE)

CALCULATION E-66 (See Attachment F, EED)

Revise the calculation to indicate a maximum allowable conductor temperature of 250°C as recommended by IEEE-80, 1976. The revision will be issued by December 1, 1984.

Draft Environmental Qualification Submittal Table 3.11-1 (See Attachment F, EED)

Revise Table 3.11-1 to correct the elevation of flow transmitters 2FWE*FI100A2, B2, C1 from 735'6" to 707'6". The revision will be issued by September 28, 1984.

APSCB 9.5-1 Section 3.5 (See Attachment F, EED)

Add the description of 2FWE*FT100A, B, C to Section 3.5 of APSCB 9.5-1. Revision will be issued by December 28, 1984.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS)

DWG 10080-RE-IV-4 (See Attachment F, EED)

Revise the drawing to show the MCC breaker size for 2CCP*MOV112A as "B10" not "C10."

Also, revise the drawing to show the MCC breakers for 2RHS*MOV701A and 2RHS*MOV702A to be size "G10" not "J10."

DWG 10080-RE-1Y (See Attachment F, EED)

Revise the drawing to show the correct breaker size for 2RHS*MOV750A to be "D10" not "C10."

Electric Motor and Load List Report No. PES 400 dated April 16, 1984 (See Attachment F, EED)

Revise the Report PES 400 to show the locked rotor current of 5.5 amps for 2CCP*MOV112B. Also, revise the report to show the locked roto current of 12 amps for 2RHS*MOV750A.

2. RESIDUAL HEAT REMOVAL SYSTEM (RHS) (Continued)

2BVM-38 dated April 19, 1984 (See Attachment F, EED)

This 2BVM recommends 4/0 solid copper ground cable for the 4160V swgr. 2AE and 2DF. 4/0 stranded copper is actually installed. Also, one end of 2DF is grounded with stranded 500 MCM copper. SWEC is investigating the best solution for noted inconsistencies and will submit the resolution to DLC by July 6, 1984.

EFAR (Engineering Field Action Report) (See Attachment F, EED)

An EFAR will be issued by July 13, 1984 to install the proper nameplate for 2RHS*MOV701B on Compartment 9A of MCC*2-E06. The nameplate is presently blank.

Also, an EFAR will be issued by July 13, 1984 to install the proper nameplate for 2RHS*MOV702A on Compartment 8A of MCC*2-E05. The nameplate is presently blank.

FSAR Table 3.11-1 (See Attachment F, EED)

Revise Table 3.11-1 of the FSAR to show the elevation of 2RHS*MOV750A, B to 707'6" not 720'6".

E. RECOMMENDATIONS

Based on the results of the DBDA Program, the following recommendations have been generated:

1. The preceding follow-on items be tracked through to completion.

2. Endorsed DBDs that are revised be considered for re-endorsement or reconfirmation, as applicable.

3. New design basis documents be considered for DBDA endorsement or confirmation, including the following DBDs:

   a. 2BVM-122 Confirmation/Update Program (3-5-84)

   b. 2BVM-153 Guidelines for Qualification of Plate Embedded in Concrete

   c. 2BVM-156 ASME III Stress Reconciliation

   d. 2BVM-160 Tracking of Attachments to Structural Steel

   e. 2BVM-165 Hazards Analysis

   f. 2BVM-174 Seismic Raceway Qualification

   g. 2BVM-176 Seismic Task Group

   h. 2BVM-179 ASME Code Baseline Document

4. E&DCRs and addenda and revisions to Design Specifications affecting ASME III requirements be reviewed for DLC concurrence.

5. A selective sampling of additional electrical calculations (E-Series) be reviewed to investigate the possibility of generic deficiencies.

ENGINEERING ASSURANCE
AUDIT REPORT
BEAVER VALLEY UNIT 2 PROJECT
AUDIT NO. 44
NOVEMBER 28, 1983 - FEBRUARY 13, 1984

DUQUESNE LIGHT COMPANY

FEBRUARY 21, 1984

R.W. Twi
Audit Team Leader

W.M. Eifert
Chief Engineer
Engineering Assurance

TABLE OF CONTENTS

1.0 INTRODUCTION

An Engineering Assurance, in-depth, technical audit of the Beaver Valley Unit 2 Project was conducted during the period November 28, 1983 through February 13, 1984. The audit was performed by senior engineering personnel including senior staff personnel from Control Systems, Licensing, Materials Engineering, Nuclear Technology (Boston and CHOC), Engineering Mechanics (Boston and CHOC), Structural (CHOC), Power, Electrical (CHOC), Geotechnical, and Engineering Assurance divisions. The Fuel Pool Cooling and Cleanup System, plus pertinent portions of the Fuel Building, and various support systems were audited.

The audit team consisted of the following personnel:

AUDITOR	DIVISION	TITLE
WAWagner	Nuclear Technology (CHOC)	Supervisor Radiation Protection
KNKhanna	Electrical (CHOC)	Supervisor Electrical Engineering
FJRezendes	Control Systems	Supervisor Control Logic
FFChin	Engineering Assurance	Sr. Structural Engineer
GEThornes	Structural (CHOC)	Assistant Manager Structural Division
FSVetere	Geotechnical	Sr. Geotechnical Engineer
MPBerardi	Materials Engineering	Assistant Chief Engineer
WWang	Engineering Mechanics (CHOC)	Assistant Section Manager - Mechanics
BCDave	Engineering Mechanics (CHOC)	Senior Engineer
JLockaby	Engineering Mechanics	Staff Support Engineer
WTHotchkiss	Licensing	Supervisor Safety Engineering
DDavis	Nuclear Technology	Sr. Nuclear Technology Engineer
DHRogers	Engineering Assurance	Engineer
RWTwigg	Engineering Assurance	Audit Team Leader - Lead Engineer

OTHER PARTICIPANTS

JAMalloy	Duquesne Light Company	Quality Assurance Engineer
EKnapek	Duquesne Light Company	Engineer

An audit entrance meeting was held November 14, 1983 to present the purpose, scope, and conduct of the audit and to introduce the audit participants to each other. Attendees at this meeting are identified on Attachment 1.

A status meeting was held December 9, 1983 to discuss preliminary results and to identify areas requiring additional investigation and information. Attendees at this meeting are identified on Attachment 2.

During the period December 12, 1983 to February 9, 1984, audit results were finalized. A Post-Audit Conference was held on February 13, 1984. Attendees at this conference are identified on Attachment 3.

2.0 PURPOSE

The objective of the audit was to evaluate the technical adequacy of the engineering and design documents prepared by the Beaver Valley Unit 2 Project. The objective was achieved by reviewing portions of the Fuel Pool Cooling and Cleanup System as well as associated portions of the Fuel Building and equipment to determine if the system has the capability to provide adequate cooling as defined by the FSAR, NRC Standard Review Plans, and applicable Regulatory Guides and Codes.

3.0 SCOPE

In general, the audit sampled those engineering and design documents that describe, define, support, procure, construct, and evaluate the capability of the Fuel Pool Cooling and Cleanup System to provide adequate cooling to the spent fuel during normal, abnormal, and accident operating conditions. Considerations included, but were not limited to:

a. Quantity of fuel to be cooled.

b. Pool water: levels and make-up; radiation levels; temperature; corrosive products; impurities.

c. Alternate cooling capability.

d. Leak and/or failure detection and isolation.

e. Piping systems.

f. Instrumentation and controls.

g. Seismic and environmental qualification parameters.

h. Materials of construction.

i. Supporting and housing structures and systems.

j. Geotechnical inputs.

k. Electrical power distribution systems.

4.0 CONCLUSIONS AND SUMMARY OF RESULTS

Overall conclusions and results, major concerns and concerns of a general nature are presented in this section. Detailed discussions of results for each discipline audited are contained in Section 6. Audit Observations (AOs) have been written and are contained within Section 5.0 where specific Project or Division action is required.

Various inconsistencies were identified within the design process and may be grouped into the following general concerns:

1. Inconsistencies between design documents and the FSAR indicate a need for continued vigilance to maintain the FSAR and design documents in agreement.

2. Incomplete technical justification, or documentation thereof, was identified in most disciplines audited. The concerns range from no calculations available to justify information in design documents, through not all design conditions addressed within calculations, to the failure to present all assumptions or other rationale that forms the basis of the analysis.

3. Inconsistencies between interfacing discipline documents indicate a need for improved communications between disciplines. It was not always obvious to project personnel what information should be transmitted to other disciplines. For example, information found in some discipline calculations invalidate information contained in interfacing discipline documents.

4. Inconsistencies in documentation and errors within discipline documents indicate the need for increased emphasis on detailed document reviews.

The areas of major specific concern, which are addressed in the AOs contained in Section 5, are as follows:

1. Emphasis needs to be placed on the preparation of calculations to justify cable sizing and to clarify and supplement electrical design criteria. The lack of complete cable sizing calculations has resulted in undersized electrical cables being specified and released for installation.

2. Project reviews of vendor technical documents have not identified design analysis deficiencies or deviations from specification requirements. Some of these vendor deficiencies were caused by incomplete design specifications (which are presently being addressed in response to EDM 83-15). However, the deficiencies and deviations from specification requirements and the impact on interfacing disciplines are not being addressed.

3. Technical justification of the Fuel Pool Cooling Heat Exchanger's freely sliding support configuration has not been provided nor is the sliding support configuration consistent with that of a freely sliding support.

4. Operating restrictions for the protection of Fuel Pool Clean-up Pumps have not been included within the Fuel Pool Cooling and Purification System chapter of the Operating Manual.

5. The HVAC Installation specification and drawing do not include sufficient requirements for weld joint designs for rectangular welded ducts. Prompt action is required to resolve this concern to minimize any effect it may have on construction. A ROAP (EA task No. 1707) was submitted by the Millstone 3 project on a related problem which is presently being investigated.

The extent to which these general and major specific concerns are applicable to other systems is the responsibility of the Project.

These concerns reemphasize the need for an engineering confirmation program (as is presently under development by the Project) to document the technical adequacy of the final design.

In general, with the exceptions and inconsistencies identified above and based on the documents reviewed, the design of the Fuel Pool Cooling and Cleanup System is technically adequate, including analyses prepared to support the design; the system has the capability to perform its intended functions; and the design is in agreement with the project positions taken on the NRC Standard Review Plan.

5.0 AUDIT OBSERVATIONS

The Audit Observations (AOs) resulting from this audit are contained in this section. They are as follows:

Audit Observation Number	Subject	Action Party
12241-168	Materials	P. RaySircar
12241-169	Number Not Used	
12241-170	Electrical	P. RaySircar
12241-171	Nuclear Technology	P. RaySircar
12241-172	Structural	P. RaySircar
12241-173	Engineering Mechanics	P. RaySircar
12241-174	Geotechnical	P. RaySircar
12241-175	Control Systems	P. RaySircar
12241-176	Power	P. RaySircar
NT-012	Nuclear Technology	J. H. Fletcher

Reply forms associated with the above AOs have been provided to the appropriate action parties.

In accordance with SWEC policy, corrective action should be completed and preventive action implemented within 60 days of receipt of this report. If overriding factors preclude completion of actions within 60 days EAP 18.1 provides methods for obtaining management approval to extend the completion date.

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-168 PAGE 1 OF 1

ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Materials Engineering

AUDIT DATE 11/28 - 12/8/83 AUDITOR(S) MBerardi

PERSON(S) REPRESENTING AUDITED ORGANIZATION UVPatel REFERENCE(S)

REQUIRED REPLY DATE 3-19-84 ACTION ASSIGNED PRavSircar

DESCRIPTION OF CONDITION(S):

This audit observation identifies those items contained in the Materials Engineering section of the audit report that require a formal response. For complete details and recommendations, see the referenced report sections.

A. Specifications

Specifications are not always complete or consistent with other documents.

1. Specification 2BVS-19A does not include acceptance criteria for pressure boundary welds. (See Section 6.6.2.1, para. 4)

2. The definition and limitations of the essential variables associated with the bending process to assure final materials properties are not addressed in specifications 2BVS-58 and 2BVS-920. (See Section 6.6.2.1, para. 4)

3. The welding requirements in specification 2BVS-935 are not in compliance with the Project's position on Regulatory Guide 1.52. (See Section 6.6.2.4, para. 1)

4. Specification 2BVS-935 and drawing 2HVS*FN-204 A&B do not include sufficient requirements for weld joint designs for rectangular welded duct SXH/LL. (See Section 6.6.2.4, para. 2)

B. Supplier Technical Document Review

1. The Lead Materials Engineer is not indicating on Supplier documents which revision/addendum of the specification the document was reviewed to. (See Section 6.6.2.5. para. 3)

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-170 PAGE 1 OF 2

ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Electrical Engineering

AUDIT DATE 11/28 - 12/9/83 AUDITOR(S) KNKhanna

PERSON(S) REPRESENTING AUDITED ORGANIZATION RMatherwiez REFERENCE(S)

REQUIRED REPLY DATE 3-19-84 ACTION ASSIGNED PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the electrical section of the audit report that require a formal response. For complete details and recommendations, see the referenced report sections.

A. Calculations:

1. Calculations for sizing power cables are not adequate because voltage drop was not properly considered. (Section 6.2.2.1, item 2.c).

2. No formal calculations to verify adequacy of area or pool lighting were available. (Section 6.2.2.7, item 1).

B. One Line Diagrams:

1. The trip settings for the redundant fuel pool heat exchangers fed from MCC*2-E03 and MCC*2-E04 are C10 and B10, respectively. It is not clear why trip settings are different. (Section 6.2.2.3, item 1.a).

2. The designator for load 2HVR-FM-264D to MCC*2-E04(P) should be 1E, an asterisk is missing. (Section 6.2.2.3, item 1.b).

3. The Emergency Fire Booster Pump 2FPW-36 is shown without an asterisk (non 1E) on the One Line Diagram, but is shown with an asterisk (1E) in all other documents (e..g., Motor & Load Lists, etc). (Section 6.2.2.3, item 1.c).

C. Electrical Design Criteria are incomplete and are not always clear.

1. Applicable industry or regulatory documents are not listed in any of the design criteria. (Section 6.2.2.5, item 1.0).

2. In 2BVM-38, (Grounding Criteria) special grounding requirements for NSSS instruments are not included or referenced. (i.e., Isolated grounding for control and instrument panels in the Control Room is not addressed). (Section 6.2.2.5, item 2.a).

3. In installation specification 2BVM-931, the intent of the 30" vertical separation, 16" vertical separation, and 6" horizontal separation in item C is not clear. The basis of 48" in item D is not clear. (Section 6.2.2.5, item 3.b, 1&2)

4. Cable criteria, 2BVM-42, does not include a method for sizing 125V dc loads and power cables for safety related motor operated valves. (Section 6.2.2.5, item 4.a).

D. It is not clear why some grounding calculations and drawings are marked QA Category I/Nuclear Safety Related, when grounding is considered as Category III. (Section, 6.2.2.6, item 1).

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Nuclear Technology Division

AUDIT DATE 11/28 - 12/9/83 AUDITOR(S) WAWagner/WTHotchkiss

PERSON(S) REPRESENTING AUDITED ORGANIZATION PRAllen REFERENCE(S)

REQUIRED REPLY DATE 3-19-84 ACTION ASSIGNED PRaySircar

DESCRIPTION OF CONDITION(S):

This audit observation identifies those items contained in the Nuclear Technology Radiation Protection and Licensing sections of the audit report that require a formal response. For complete details and recommendations see the referenced report sections.

1. The review of radiation protection calculations indicates that additional calculations are required and some calculations are in need of revision to justify design parameters.

   a. To verify the adequacy of the shielding and designated radiation tolerance zone levels associated with the fuel building. These calculations do not take into consideration PWR operational data for activated corrosion products and any difference between the BV-1 design such as the use of high density fuel storage racks. (Section 6.7.2.1 item 1.a. & b.)

   b. To verify that the fuel handling accidents or other design basis events do not exceed the limiting case for control room habitability which is presently defined as a loss of coolant accident (LOCA). (Section 6.7.2.3 item 1.)

   c. Calculation #12241-UR(B)-265-0 uses the results of a Millstone 3 calculation which contained outdated source term data developed from a superseded version of computer program RADIOISOTOPE. As required by a memo from the program sponsor (KIandolo to all RADIOSOTOPE code users dated June 26, 1981) fission product source terms decayed from greater than 24 hours using the old revision were not re-evaluated. (Section 6.7.2.1 item 2.b.)

   d. Calculation #12241-UR(B)-208-0 contains the following concerns: (Section 6.7.2.2 item 2.b.)

      1. Calculation is marked QA Category II in lieu of QA Category I even though the results support Category I equipment qualification.

2. Calculation is not marked confirmation required even though the data is based on an IOC which states that data is preliminary and needs to be confirmed.

3. Calculation addresses the fuel pool filters and they are not contained within the fuel building scope.

4. Calculation does not address piping integrated dose.

e. Calculation 12241-UR(B)-183-1 incorrectly indicates the multiplier to be used for a semi-infinite cloud. (Section 6.7.2.2 item 2.c.).

2. The following inconsistency with the FSAR was identified: (Section 6.7.2.1 item 3.b.).

FSAR table 12.3.1 states that zone II is an unrestricted area maintained at less than 2.5 mrem/hour. By definition, per 10CFR20, an unrestricted area is less than 2 mrem/hour.

3. The following inconsistencies with 2BVM-119, Rev. 3, "Environmental Conditions for Equipment Qualification Requirements", were identified. (Section 6.7.2.2 item 1.a., b., & c.)

a. Table III does not list the fuel handling accident as a design basis for environment conditions.

b. Appendix C does not contain calculation #12241-UR(B)-242-0, the basis for the post-LOCA gamma values.

c. The accident beta values in 2BVM-119 are based on 6-month post-LOCA conditions instead of one year post-LOCA conditions.

4. A detailed review of radiation monitors associated with the fuel building indicated many inconsistencies within the specification and with other documents. (Section 6.7.2.5 item 1.a. & b. and item 2.a. through f.).

5. The scope of the ALARA program is limited and consideration should be given to expand the program to include more extensive review of system related items, design changes and additional operational data gathering. (See Section 6.7.2.7 item 1.a., b., c. & item 2).

6. A review of the Failure Mode and Effects Analysis (FMEA) revealed:

a. Various failures in motor operated valve control circuits are shown on the FMEA as causing valve closure although the actual failure effect is to prevent valve opening. (Section 6.5.2 item 1).

b. There is no procedure that requires the FMEA analyst to be informed of design changes that might affect the validity of the FMEA. (See Section 6.5.2 item 2).

c. A list of current pages of the report does not exist. (See Section 6.5.2 item 3).

EA-038

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Structural Engineering

AUDIT DATE 11/28 - 12/8/83 AUDITOR(S) FFChin/GThornes

PERSON(S) REPRESENTING AUDITED ORGANIZATION PCTalbot/APlizga REFERENCE(S)

REQUIRED REPLY DATE 3-19-84 ACTION ASSIGNED PRaySircar

DESCRIPTION OF CONDITION(S):

This audit observation identifies those items contained in the structural section of the audit report that require a formal response. For complete details and recommendations see the referenced report sections.

1. Design Criteria/FSAR

1.1 The Structural Design Criteria do not include explicit instructions for the analysis and design of unique conduit and cable tray supports. (Paragraph 6.9.2.1, item 5)

1.2 The Structural Design Criteria are not consistent with the FSAR regarding revisions and supplements of design codes. (Paragraph 6.9.2.1, item 4)

1.3 Table SRP No. 3.8.4 in Section 1.9 of the FSAR identifies that load combinations criteria are not in complete agreement with SRP 3.8.4 but the remarks do not adequately address the difference. (Paragraph 6.9.2.1, item 2).

1.4 There is no evidence that the Structural Design Criteria have been approved by the Chief Structural Engineer as required by SDM 81-14. (Paragraph 6.9.2.1, item 7)

1.5 Note 3 at the top of page 3.8.35 of the FSAR indicates equations 3.8-1 through 3.8-9 instead of equations 3.8-10 through 3.8-16. (Paragraph 6.9.2.1, item 8)

2. Calculations

Technical justification in the form of new or revised calculation is required in the following areas:

2.1 It does not appear that the floor slab opening between supports for the fuel pool heat exchanger has been accounted for in the slab analysis as the opening interrupts the continuity of the slab. (Paragraph 6.9.2.2, item 1)

2.2 No calculation could be identified that justifies the sliding support for the fuel pool heat exchangers based on the interface materials. (Paragraph 6.9.2.2, item 2)

2.3 No calculations could be identified or located to justify the end reactions of filter and ion-exchanger supports within the supporting cubicle walls. Calculations that substantiated the cubicle wall design could not be located during the audit. (Paragraph 6.9.2.2, items 5)

2.4 Moment distribution method and assumption are improperly applied in calculation C38-620 to 628. (Paragraph 6.9.2.2, item 3)

2.5 Calculation S36.188 has not been updated to reflect the latest seismic g-values. The calculation references a deleted seismic analysis document. (Paragraph 6.9.2.2, item 4)

2.6 There is no evidence to indicate that calculations C38.444 to .450, C38.437 to .443, C38.496 to .514 were Independently Reviewed. (Paragraph 6.9.2.2, item 7)

3. Specifications

3.1 Specification 2BVS-407 and 2BVS-904 refer to applicable documents of different issue than shown in the FSAR. (Paragraph 6.9.2.3, item 1)

4. Drawings

Drawings are inconsistent with both the FSAR and Structural Design Criteria.

4.1 The difference between structural drawings including RM-7A-8C/RV-3J-3B and both the FSAR (Pg. 3.8-39) and the Structural Design Criteria (Pg 3-13) in regards to the size of the opening for transferring fuel elements between the pool and the cask area needs to be resolved. (Paragraph 6.9.2.4, item 2)

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Engineering Mechanics Division

AUDIT DATE 11/28 - 12/9/83 AUDITOR(S) WWang/BCDave/JLockaby

PERSON(S) REPRESENTING AUDITED ORGANIZATION RALoranger REFERENCE(S)

REQUIRED REPLY DATE 3-19-84 ACTION ASSIGNED PRayGircar

DESCRIPTION OF CONDITION(S):

This audit observation identifies those items contained in the Engineering Mechanics section of the audit report that require a formal response. For complete details and recommendations see the referenced report sections.

PIPE STRESS

1. Project Specifications are not consistent with requirements established in the FSAR or other documents. (See Section 6.3.2.2.3, item 1a through d - page 6.3-2)

2. Calculations contain various discrepancies or lack clarity. (See Section 6.3.2.2.4, item 1 a through e - page 6.3-3)

PIPE SUPPORTS

Project Procedures

Project Procedures contain various discrepancies:

2BVM-102

1. The applicability and implementation information contained on the cover of this project procedure is not clear. (See section 6.3.3.2.1, item 1a).

2. There is no minimum effective throat requirements listed for partial penetration welds. (See section 6.3.3.2.1, item 1 b).

2BVM-103

1. Two referenced specifications contain conflicting information on allowable weld shear stress. The allowable weld shear stress stated in 2BVM-103 is correct only if welding electrodes of 70ksi are used. This fact is not explicitly called out in 2BVS-920, but is clearly called out in 2BVS-059. (See Section 6.3.3.2.1, item 3a and b)

2. Procedure 2BVM-102 gives different allowable weld shear stress than the one stated in 2BVM-103, (See Section 6.3.3.2.1 item 3b)

Specifications/ESSOWs

2BVS-059

1. The environmental conditions contained in specification 2BVS-059 are inconsistent with either the FSAR, Section 3.11 or 2BVM-119 (See section 6.3.3.2.2. item 2a).

2BVS-979

1. The section dealing with the design of base plates and anchor bolts for pipe supports is not clear whether the criteria established by NRC IE Bulletin, 79-02 is to be used or the more stringent SWEC criteria. (Section 6.3.3.2.2, item 3b)

Calculations

For the calculations reviewed, it appears that the supports are capable of supporting the piping during all the loading conditions stipulated in the pipe stress calculations and are within the allowable stresses contained in the governing code. However, two of the support calculations contain departure from procedure 2BVM-102 and the governing code (AISC 1.17.5) dealing with minimum weld size. (Section 6.3.3.2.3 item 1)

The pipe support calculations reviewed also contained other inconsistencies that should have been found in the calculations review process. (Section 6.3.3.2.3, item 2)

MECHANICAL:

1. The distribution of ARS results to the Lead Electrical Engineer has not occurred nor is the distribution process, as stated in 2BVM-125, in agreement with current project practices. (See Section 6.3.4.2.1, item a)

2. The Seismic Data Index is not being maintained and Seismic Data Transmittal Forms are not being used. (See Section 6.3.4.2.1 item 1b)

3. The project dropped the ARS curves vertically after spreading the peak, a technique that is different from Reg. Guide 1.122 and justification has not been documented. (Section 6.3.4.2.1, item 1b)

4. The zero period acceleration values used by the Mechanical section differ from those generated by the Structural section. The values used by the Mechanical group were lower by 30%. (Section 6.3.4.2.1, item 2)

5. There are unclear areas in procurement specifications.

- Specification 2BVS-3 (Spent Fuel Pool Heat Exchanger) was used and certified as a design specification with ASME code requirements missing. Further, this specification does not specify how to apply nozzle loads nor were the latest seismic data used. (Section 6.3.4.2.2, item 1a, b&c)

- Specification 2BVS-40 (Spent Fuel Racks) did not define allowable embedment interface loads during a fuel assembly drop accident. (Section 6.3.4.2.3)

6. In service report TM-114, orthogonal nozzle loads were applied separately instead of simultaneously. Further, local nozzle analysis omitted shell side loading and the inconsistencies among the models used throughout the report are not explained. Finally, the allowable stress used to accept shell-nozzle design differed from that shown in the spec. (Section 6.3.4.2.2, item 2)

7. In mechanical calculations - NM(E)-244-CZ, rev. 0, nozzle loads were improperly identified and incorrectly translated to the centerline of the vessel. (Section 6.3.4.2.2, item 3)

8. In structural analysis report 81A0980, the rack-pool embedment interface load reported was larger than that allowed by the specification. (Section 6.3.4.2.3)

Vendor drawings 80C7662, rev. 1 and 80E7653, rev. 0 do not show how the requirements for remote underwater installation/removal and remote leveling of the racks are met. (Section 6.3.4.2.3)

9. Specification 2BVS-40 does not contain all the necessary design criteria for the Spent Fuel Storage Rack.

The allowable loads at embedment interface during a fuel assembly shop accident are not specified.

The structural acceptance criteria in the specification does not the meet the criteria of SRP 3.8.4 (though the vendor has complied with the SRP criteria). (Section 6.3.4.2.3)

10. Design changes are not completely controlled.

- The load change reported by the vendor in report 81A0980 was not brought to the attention of the Structural Group (Section 6.3.4.2.3).

- The change from the use of low density racks to high density racks has not been incorporated into liner embedment design (Section 6.3.4.2.3).

- The change deleting a high energy line from the Fuel Building has not been incorporated into the project procedure for postulating high energy line breaks, 2BVM-118. (Section 6.3.4.2.4, item 1)

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-174 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley 2 Project

ACTIVITY AUDITED: Geotechnical

AUDIT DATE: 11/28 - 12/9/83 AUDITOR(S): Frank Vetere

PERSON(S) REPRESENTING AUDITED ORGANIZATION: DDHunt REFERENCE(S):

REQUIRED REPLY DATE: 3-19-84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the geotechnical section of the audit report that requires a formal response. For complete details and recommendations, see the referenced report sections.

1. Water levels used in the SHAKE calculations that determined strain-dependent soil properties are not consistent with those used in other Project calculations. (Section 6.4.2.2, item 1).

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ORGANIZATION AUDITED: Beaver Valley 2 Project

ACTIVITY AUDITED: Control Systems

AUDIT DATE: 11/28 - 12/83 AUDITOR(S): FRezendes

PERSON(S) REPRESENTING AUDITED ORGANIZATION: JFHarkins REFERENCE(S):

REQUIRED REPLY DATE: 3-19-84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This audit observation identifies those items contained in the Control Systems section of the audit report that require a formal response. For complete details and recommendations. See the referenced report sections.

1. An inconsistency exists between the FSAR (page 9-1.13), which states that the fuel pool purification pumps are manually operated, and the logic diagram which shows them to have an autostart feature as a result of an auto trip of the running pump. (See Section 6.1.2.1 item 3).

2. An inconsistency exists between specification 2BVS-636, Add. 1 for the operating temperature for TE 103A&B (30°F) and the actual fuel pool temperatures. (See Section 6.1.2.2 item 2).

3. Operating ranges for flow element 2FNC*FE100 and flow indicator 2FNC*FI-100 (indicated in specification 2BVS-602 Rev. 1) are not consistent with maximum flow conditions for two pump operation indicated by power calculations. Subsequent to power group action to define new operating ranges for the instruments in question, specification 2BVS-602 should be revised to reflect the new operating range. (See Section 6.1.2.2 item 3).

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-176 PAGE 1 OF 2

ORGANIZATION AUDITED: Beaver Valley 2 Project

ACTIVITY AUDITED: Power Division

AUDIT DATE: 11/28 - 12/8/83 AUDITOR(S): SFrank/DDavis

PERSON(S) REPRESENTING AUDITED ORGANIZATION: AFiorente REFERENCE(S):

REQUIRED REPLY DATE: 3-19-84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This audit observation identifies those items contained in the Power and the Nuclear Technology Process Group section of the audit report that require a formal response. For complete details, see the referenced report sections.

1. There are inconsistencies between the FSAR and other design documents. (See Section 6.8.2.1)

2. Calculations contain various discrepancies or lack clarity. (See Section 6.8.2.2)

3. The elevation of the normal fuel pool water level, as noted on several drawings, is inconsistent with present requirements. (See Section 6.8.2.3)

4. There are inconsistencies between the Specification for Fuel Cooling Pump Heat Exchanger and Orifice Plates and the supporting calculation and vendor documents. (See Section 6.8.2.4)

A review of the Fuel Pool Cleanup System revealed:

5. Calculations indicate that clean-up pump flows have to be limited to protect the motors form overload. However, administrative provision have not been established to limit pump operation or to resize the motors to handle all operating conditions. (Section 6.10.2, item 1).

6. Flow restriction is required to prevent pump cavitation during refueling cavity clean-up. However administrative provisions have not been established to require the operator to limit flow to 250GPM. (Section 6.10.2, item 2).

7. Technical justification is lacking that verifies the adequacy of the Refueling Cooling Pumps for RWST clean-up. (Section 6.10.2, item 3).

8. There is no evidence that provision has been made to order and install "under drains" for the demineralizer. (Section 6.10.2, item 4).

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9. The draft operating manual design data list indicates 5 cubic feet of resin in lieu of 15 cubic feet. (Section 6.10.2, item 5.a).

10. The FSAR does not list the Fuel Pool Demineralizer as a component designed to ASME section VIII. (Section 6.10.2, item 5.b).

11. Stress Design Data Packages (SI-RM/RB packages) prepared in accordance with 2BVM-45 do not have total page accountability. (Section 6.3.2.2.2, item 2)

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Nuclear Technology

AUDIT DATE 11/28 - 12/9/83 AUDITOR(S) SFrank/WTHotchkiss

PERSON(S) REPRESENTING AUDITED ORGANIZATION PRAllen REFERENCE(S)

REQUIRED REPLY DATE 3-19-84 ACTION ASSIGNED JHFletcher

DESCRIPTION OF CONDITION(S):

This audit observation describes those portions of the report requiring a response of the Nuclear Technology Division. For additional details, see the referenced report section.

1. The Nuclear Technology Division has not issued formal guidance for the preparation and control of Failure Modes and Effect Analysis (FMEA) (Consideration should be given to the inclusion of Figure 6.5.1 attached). (Section 6.5.2, Item 4)

2. The Nuclear Technology Division has not issued Technical Procedure (NTTP) 2.4.1 "Decay Heat from Fission Products". This procedure was previously PTP 7.3.1 (Power Division) but has since been cancelled and is still referenced by valid calculations. (See Section 6.8.2.2., item 2)

FIG. 6.5.1. POWER OPERATED VALVES

INITIAL POSITION		SAFETY POSITION		FAULT TREE			
				FAIL TO		INADVERTENT	
OPEN	CLSD	OPEN	CLSD	OPEN	CLOSE	OPENING	CLOSING
●		●					●
	●		●			●	
●			●		●	●	
	●	●		●			●

[●] = CONDITION TO BE REVIEWED

TABLE OF REQUIRED RESPONSES

6.1 CONTROL SYSTEMS

6.1.1 General

6.1.2 Detailed Results

6.1.2.1 Engineering Diagrams

para. 3 Response required AO 12241-175

6.1.2.2 Equipment Specifications

para. 2 Response required AO 12241-175
para. 3 Response required AO 12241-175

6.1.2.3 Vendor Documents

6.1.2.4 Instrument Installation Drawings

6.1 CONTROL SYSTEMS

6.1.1 General

The audit for instruments and controls consisted of a review of the licensing commitments and engineering drawings for consistency and accuracy. Other documents reviewed included specifications, vendor drawings and instrumentation installation drawings.

Results of the audit indicate that the system instrumentation and controls adequately provide the required monitoring and control functions committed to in the FSAR during normal and abnormal operating conditions.

An inconsistency was identified, between the FSAR and a logic diagram for the controls of a non safety-related pump. This inconsistency does not affect the safety of the plant. Inconsistencies were identified within purchase specification 2BVS-602 Orifice Plates, Rev. 1 with respect to the specified measurement range for flow element 2FNC*FE100 and the related flow indicator 2FNC*FI-100 and the related Power back-up calculations for two pump operation; and within purchase specification 2BVS-636, RTDs, Rev. 3, Add. 1 for temperature element TE 103A & B relative to actual fuel pool operating temperatures.

6.1.2 Detailed Results

6.1.2.1 Engineering Diagrams

1. Various engineering diagrams including flow, logic, loop, elementary and HVAC functional control diagrams were reviewed. The review concentrated on verifying that design commitments of the FSAR and applicable regulatory guides were incorporated into the system design. Logic diagrams were reviewed for compliance with FSAR commitments regarding instruments and controls for both safety and non-safety related equipment including the fuel building HVAC system. The flow diagram was reviewed for agreement with the logic and loop diagrams regarding location and identification of system instrumentation. Elementary diagrams were reviewed for agreement with the logic diagrams regarding control schemes, electrical, hardware, redundancy and electrical separation where applicable to safety related equipment. The HVAC system functional diagram and elementary drawings were also reviewed. All engineering drawings were in agreement with each other and the system requirements.

2. Engineering calculations for flow measurement devices are required for orifice sizing and instrument rangeability. Vendors performed these calculations for the Project's review and approval. One of these calculations was reviewed for this audit. No discrepancies were noted. No other controls calculations were performed for this system.

3. A relatively minor discrepancy was identified in the two non-safety related fuel pool purification pumps. The FSAR states, on page 9-1.13, that these pumps are manually operated, whereas the logic diagram shows them as having an autostart feature as a result of an autotrip of the running pump.

RESPONSE REQUIRED AO 12241-175

6.1.2.2 Equipment Specifications

1. Category I specifications for instrumentation associated with the fuel pool cooling system were reviewed. Parameters reviewed included materials, dimensions, process requirements, accuracy, and environmental conditions for equipment qualification requirements.

2. A minor discrepancy was noted in specification 2BVS-636 Add. 1 relative to the fuel pool operating temperature. The temperature specified was much lower (30°F) than the actual temperature, but this does not affect the temperature element type or model number because of the wide capacity of the temperature sensor. The specification should be revised to reflect the correct value.

RESPONSE REQUIRED AO 12241-175

3. Operating ranges for flow element 2FNC*FE-100 and flow indicator 2FNC*FI-100 indicated in specification 2BVS-602, Rev. 1 are not consistent with or meet the maximum flow conditions indicated for two pump operation contained within power calculations. Subsequent to power group action to define new operating ranges, 2BVS-602 should be revised to reflect the new operating range.

RESPONSE REQUIRED AO 12241-175

6.1.2.3 Vendor Documents

Various vendor documents were reviewed for compliance with specification requirements. These documents included correspondence and equipment drawings. The review did not include vendor environmental qualification test reports. Vendor documents were reviewed for compliance with such specification requirements as material, physical size, and electrical characteristics. The results of the review indicate that vendor documents are in agreement with specifications requirements and are technically adequate.

6.1.2.4 Instrumentation Installation Drawings

Various instrument installation drawings were reviewed for tubing installation between the process piping and the instrument. The results of the review indicate that instrument isolation and drain valves are included and located in appropriate areas, and that physical separation of redundant instruments and connecting process tubing has been maintained.

F. Rezendes (Control Systems)

R.W. Twigg (Audit Team Leader)

TABLE OF REQUIRED RESPONSES

6.2 ELECTRICAL

6.2.1 General

6.2.2 Detailed Results

6.2.2.1 Calculations

para. 2c AO 12241-170

6.2.2.2 Purchase Specifications

6.2.2.3 One Line Diagrams

Para. 1.a	AO 12241-170
Para. 1.b	AO 12241-170
Para. 1.c	AO 12241-170

6.2.2.4 Motor & Load List

6.2.2.5 Electrical Design Criteria

para. 1	AO 12241-170
para. 2.a	AO 12241-170
para. 3.b 1&2	AO 12241-170
para. 4.a	AO 12241-170

6.2.2.6 Grounding

para. 1 AO 12241-170

6.2.2.7 Lighting

para. 1 AO 12241-170

6.2.2.8 Electrical Drawings

6.2.2.9 Environmental Qualification of Equipment

6.2 ELECTRICAL

6.2.1 General

The scope of the audit involved reviewing the technical adequacy of the electrical system to meet the electrical power requirements of the Fuel Pool Cooling System (FPC) and other electrical requirements within the Fuel Building. The review primarily concentrated on the class 1E portion of the FPC system and the interaction with non class 1E systems.

The following areas were reviewed:

1. Calculations
2. Purchase Specifications
3. One Line Diagram
4. Electric Motor & Load List
5. Electrical Design Criteria
6. Grounding
7. Lighting
8. Electrical Drawings
9. Equipment Qualification

The results of the audit indicate that additional emphasis needs to be placed on the preparation of calculations to justify cable sizes and light intensities and to clarify and supplement electrical design criteria. The details of these concerns and other inconsistencies are identified in the Detailed Results.

6.2.2 Detailed Results

6.2.2.1 Calculations

The following calculations were reviewed:

1. Electrical Heat Release - Fuel & Decont. Bldg. Calc. No. E1

   a. The calculation was found technically adequate. All input data have been taken from the vendors submitted documents or ETG XIII-6 (Heat Release Electrical Equipment). The Power Group, the user of this calculation's data, was included in the distribution.

2. Cable Sizing Calculations

   a. There was no evidence that cable sizes for large, 4.16KV loads were based on approved calculations. Calculations are underway to check the adequacy of these cables

   b. For sizing cables for 460V loads, document number 2BVM-42 (cable philosophy, power, control and instrument cables) is used.

c. The Power cables feeding the Class 1E fuel pool pump motors and Motor Control Centers were checked and found to be inadequate because of voltage drop considerations. See the following table (Table 6.2.2.1) for specific details. The project immediately notified the field to put these cables on "Hold", changed the cable's status in the computer, and set about resizing the cables.

RESPONSE REQUIRED AO 12241-170

Table 6.2.2.1 Voltage Drop Considerations

Source	Load	HP	Cable #	Cable Size Per ECO	Maximum Permissible Length Per 2BVM42	Actual Est. Length Per ECO
MCC*2E03	2FNC*P21A	25HP	2FNCA0L001	3/C#8	201	268
MCC*2E04	2FNC*P21B	25HP	2FNCP0PL001	3/C#8	201	393
US*2-8	MCC*2E03	80A	2EHSA0L245	3/C#250MCM	278	471
US*2-9	MCC*2E04	85A	2EHSBPL201	3/C#250MCM	266	343

3. System Short Circuit and Voltage Drop Study

a. Per direction from the Electrical Division Chief, all system calculations should be redone using EPRI's Load Flow Program, recently acquired by SWEC. Since the project is in the midst of revising the calculations , no review was done.

6.2.2.2 Purchase Specifications

The following specifications were reviewed:

a. 2BVS-310 (Rev. 7, Add. 1) 480V Motor Control Centers (MCC)
b. 2BVS-828 (Rev. 3, Add. 1) 600V Power Cable
c. 2BVS-816 (Rev. 1, Add. 2) 600V Control Cable
d. 2BVS-324 (Rev. 2) Instrument Cable

1. The Motor Control Centers (MCC) specification, 2BVS-310, Rev. 7, was reviewed for it s technical adequacy. The interrupting capacity of the circuit breakers, specified as 25,000 amperes symetrical, was consistent with the calculations. All starters specified were rated as per ANSI C19.7 and applicable codes and standards. This specification was also reviewed for Class 1E environmental qualification requirements, and was found acceptable. It contained the appropriate qualification insert, environmental conditions (normal, abnormal and accident), and documentation requirements.

2. All cable specifications were reviewed to see if the environmental qualification tests specified are in accordance with IEEE-383 and were found in conformance.

6.2.2.3 One Line Diagrams

One line diagrams for Motor Control Centers (MCC) E03(0) and E04(P) were reviewed to verify that:

a. all loads, their ID No., hp, starter size and bus assignments are consistent with the latest motor and load list.

b. the trip settings of redundant loads are identical.

c. any non-safety related loads connected to the Class 1E buses are tripped by a LOCA signal to ensure that Class 1E buses are not degraded under accident conditions.

The one line diagrams have met the above requirements with the following comments and minor exceptions.

1. Dwg No. RE-1U 480V MCC One Line Diagram - Sh10, Rev. 4

a. The trip setting of fuel pool heat exchanger 21A supply per ISO V/V 2CCP*MOV128A, fed from MCC*2-E03 in compartment "5A", is shown as C10. The trip setting of it's redundant counterpart fed from MCC*2-E04 in compartment "5F" is shown as B10.

RESPONSE REQUIRED AO 12241-170.

b. MCC*2-E04(P) Compartment D
Load 2HVR-FN-264D is shown as non 1E.
(Asterisk missing)

RESPONSE REQUIRED AO 12241-170.

c. MCC*2-E04(P) Compartment 9A
Emergency Fire Booster Pump 2FPW-P36 is shown as non 1E, and is not tripped on LOCA. The same load appears as 2FPW*P36 (with asterisk) in all other documents (e.g., Motor and Load List, EC-0 Report, Qualification Check List).

Inconsistent use of the asterisk (*) may be an oversight or may reflect inconsistent classification. The Project should review the cause of this occurrence as well as the classification criteria used by the project. For example, is the safety related classification required or is non-safety related classification with appropriate design criteria and separation from safety related power appropriate in this case? The motor has been purchased as 1E qualified equipment. If it was also installed as 1E equipment and instruction provided to ensure that maintenance of this equipment by plant staff is 1E qualified, it may be appropriate to classify it 1E to ensure protection of the class 1E power source.

RESPONSE REQUIRED AO 12241-170.

2. Dwg No. RE-1J 480V US (unit substation) One Line Diagram - Sh3, Rev. 4

   a. Six non 1E loads (CRDM shroud fans 2HVR-FN202A1 through -FN202C2) are connected to the two 1E buses US*2-08 and US*2-09. ESK's indicated, however, that they are tripped on LOCA. The cables feeding these loads are color coded to ensure their independence from each other. Thus integrity of the 1E buses is maintained.

6.2.2.4 Motor and Load List

All loads associated with the Fuel Pool Cooling System are properly listed and their power sources are adequately identified.

6.2.2.5 Electrical Design Criteria

The following design criteria were reviewed for technical adequacy and compliance with industry and regulatory requirements.

1. Applicable industry or regulatory documents are not listed in any of the design criteria.

   RESPONSE REQUIRED AO 12241-170

2. Grounding Criteria 2BVM-38

   a. The grounding criteria does not include or reference special grounding requirements for NSSS instruments (i.e., Isolated grounding for control and instrument panels in the Control Room is not addressed).

   RESPONSE REQUIRED AO 12241-170

   b. The adequacy of ground cable (size 4/0) was reviewed (per calculation No. EC67) and found adequate.

3. Separation Criteria 2BVM-41

   a. The project is committed to IEEE-384-1974 and Reg. Guide 1.75 Rev. 2. Although the current design does not fully meet these standards, the project is in the process of adding wraps/barriers to adequately separate the divisional, safety related/non-safety related systems in accordance with 1EEE-384-1974. As a program is in effect to resolve this condition, no additional detailed review was performed in this area during the audit.

   b. In the related area of installation specification 2BVM-931, Add-1, dated 10/20/83 (section 3.1.1.6, pages 3-3 and 3-4) the following concerns were noted:

1. Item C. The applicability of the 30" vertical separation, 16" vertical separation, and 6" horizontal separation is not clear.

   RESPONSE REQUIRED AO 12241-170.

2. Item D. The basis of 48" is not clear.

   RESPONSE REQUIRED AO 12241-170.

These areas should be clarified, removed or justified.

4. Cable Criteria 2BVM-42

   a. The criteria does not include the method for sizing 125V dc loads and 600V power cables for safety related Motor Operated Valves.

      RESPONSE REQUIRED AO 12241-170.

   B. Typographical omission: '0' on pages 11 and 12.

6.2.2.6 Grounding

The review of various grounding related documents revealed inconsistencies in the QA Category and Safety Related markings.

1. Grounding Calculation No. E66 is marked QA Category I; and, similarly, numerous grounding plan drawings are identified as "Nuclear Safety Related". Grounding is by definition a Category III system.

   RESPONSE REQUIRED AO 12241-170

6.2.2.7 Lighting

Lighting design was reviewed to ensure that only incandescent lights are used in the building, and that proper lumen values are assumed in accordance with ETG XIII 6-1 to ensure adequate intensity.

1. It was noted that no formal calculations for area or pool lighting were performed. If lighting design is based on Unit-1, it should be so documented.

   RESPONSE REQUIRED AO 12241-170.

6.2.2.8 Electrical Drawings

The following drawings were reviewed:

Drawing Number	Title
RE-27	Arrangement Drawing
RE-34	Cable Tray Layout
RE-50A,B&C	Conduit Plan

1. The following were noted:

   a. Physical drawings were found to be technically adequate. Adequate working space is provided around electrical equipment, raceway design meets the separation requirement and appropriate cross references are indicated on the drawings.

   b. The project has a system of uniquely identifying each conduit and tray support so that their loading adequacy can be traced back to the structural calculations.

   c. Floor and wall openings are currently being assigned unique numbers by the project.

   d. All pre-engineered supports are shown on the electrical drawings under the Lead Electrical Engineer's signature, approval and PE stamp and initialed by the Lead Structural Engineer as required by SDM 83-5. Since all special conduit supports and cable tray supports are primarily qualified by the Lead Structural Engineer, consideration should be given to have the structural PE stamp (as a second stamp) be added to these drawings. Similar concerns on PE stamping are currently being addressed by Engineering Assurance by other means and need not be addressed by the Project.

6.2.2.9 Environmental Qualification of Equipment

1. Motor Control Center, cable, regulating transformer, and instrument rack equipment environmental qualification documents were reviewed. While the project's review of these reports is ongoing, it was concluded that a satisfactory system for such review is in place. The environmental qualification requirements and environment data (normal, abnormal and accident) are included in the specifications.

K.N. Khanna (Electrical Division)

R.W. Twigg (Audit Team Leader)

TABLE OF REQUIRED RESPONSES

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6.3.1 General

6.3.2 Pipe Stress

6.3.2.1 General

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6.3.2.2.1 FSAR

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6.3.3 Pipe Supports

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para. 1a & b Response required AO 12241-173
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para. 2a Response required AO 12241-173
para. 3b Response required AO 12241-173

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6.3.4 Mechanical

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para. 1a, b, & c Response required AO 12241-173
para. 2a & b Response required AO 12241-173
para. 3 Response required AO 12241-173

6.3.4.2.2 Seismic Qualification of Heat Exchanger

para. 1a, b & c Response required AO 12241-173
para. 2a thru e Response required AO 12241-173
para. 3a thru d Response required AO 12241-173

6.3.4.2.3 Seismic Qualification of Fuel Racks

para. 1 Response required AO 12241-173
para. 2 Response required AO 12241-173
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para. 4 Response required AO 12241-173

6.3.4.2.4 Design for Pipe Rupture

para. 1 Response required AO 12241-173

6.3 ENGINEERING MECHANICS DIVISION

6.3.1 General

The audit of the Fuel Pool Cooling System included a review of the design documents as well as governing procedures for Stress Analysis, Pipe Support Design, seismic qualification of components, and other mechanical engineering specialty activities. It was observed generally that some inconsistencies exist where design requirements are sourced from a large number of documents. This situation will be alleviated to a large degree by planned actions including FSAR revisions and issuance of a Pipe Stress and Supports Design Criteria.

The details of these concerns and other inconsistencies are identified in the Detailed Results.

6.3.2 Pipe Stress

6.3.2.1 General

A review of the specific design criteria established in the project specification and procedures was performed. Inconsistencies were found between some Specifications/ESSOWs and the FSAR, and between calculations and design documents. The specifics are described as follows.

The following classes of documents were reviewed to ascertain that adequate explicit written instructions and design criteria are provided to personnel performing stress analysis. Implementation was also reviewed.

1. FSAR

2. Project Procedures

3. Project Specifications/Engineering Services Scopes of Work (ESSOW)

4. Pipe Stress Calculations

The specific documents reviewed included:

a. FSAR Sections 1.8, 3.2, 3.7. 3.9, 9.1
b. 2BVM-45 System Design Information Required for Pipe Stress Analysis, Rev. 6/6/83
c. 2BVM-106 Engineering Mechanics Division Technical Reference Documents, Rev. 5/17/83
d. 2BVM-139 Large Bore Isometric Verification, Rev. 1/28/82
e. 2BVS-939 Piping Engineering and Design, Rev. 3, Add. 4
f. 2BVS-978 ESSOW for Pipe, Rev. 3
g. 2BVS-979 ESSOW for Small Bore Pipe Support, Rev. 5
h. 12241-NP(T)-X77L, Rev. 0
i. 12241-NP(T)-X77H, Rev. 0
j. 12241-NP(T)-X77J, Rev. 0

6.3.2.2 Detailed Results

6.3.2.2.1 FSAR

FSAR was reviewed for applicable criteria and specific project commitments. These commitments were then compared to the other design documents and the results are contained as follows:

6.3.2.2.2 Project Procedures

1. Pipe stress analysis criteria and procedures are scattered between various project specifications and project procedures. Not all requirements have been covered in existing documents. The project has recognized this shortcoming and has already initiated project procedure 2BVM-157 (Criteria Document) which will combine all criteria into one document.

2. The pages of the Power prepared Stress Design Data Packages (SI-RM/RB packages) prepared in accordance with 2BVM-45 are not numbered sequentially nor do packages contain an index of the contents. This shortcoming can lead to inappropriate use of SI-RM/RB information.

   RESPONSE REQUIRED AO 12241-176

6.3.2.2.3 Project Specifications/ESSOW

1. The following concerns were observed:

   a. Specification No. 939 does not permit simplified (static) analysis of small bore Category I piping, but ESSOW No. 979 permits it as the vendor's option.

   b. Specification No. 939 does not impose FSAR requirements regarding mass-point spacing. Change Request No. 385 dated 12/19/83 has been initiated to resolve this concern.

   c. ESSOW No. 979 does not specify the FSAR requirements that seismic support loads for small bore piping analyzed by simplified analysis must be multiplied by a factor of 1.5 if the piping frequency is less than 33 CPS.

   d. ESSOW No. 979 allows specified anchor movements for small bore piping at junction with large bore piping. The ESSOW requires the project to advise the vendor if these movements are exceeded. No project procedure exists to implement this requirement.

   RESPONSE REQUIRED AO 12241-173

6.3.2.2.4 Calculations

1. Calculations No. 12241-NP(T)-X77 L,J,H Rev. 0 were reviewed. These calculations are generally adequate and complete with the following exceptions:

a. These calculations indicate that no emergency condition analysis is required. As the ASME III code requires analysis for emergency conditions, this is a misleading statement. The calculation actually has been analyzed for design parameters greater than that occurring in emergency conditions. Thus, the emergency condition is enveloped by these governing conditions.

RESPONSE REQUIRED AO 12241-173

b. Calculation No. 12241-NP(T)-X77L-0

Assumption 5, which addresses N&D 6166, should be deleted and, more appropriately, be included in the objective of the calculation. The stress calculation does not note that the N&D applies to Node 114. This shortcoming makes it difficult to isolate just how N&D 6166 was resolved.

RESPONSE REQUIRED AO 12241-173

c. Calculation No. 12241-NP(T)-X77L-0

Thermal Mode 2 has been analyzed for 110°F. However, based on stress input package SI-RM-82A-0, the temperature should have been 118°F. Pipe stress analysis and support loads will not be appreciably impacted by this discrepancy. This temperature difference is very small and maximum stress in the piping is 13,805 psi against an allowable of 27,425 psi.

RESPONSE REQUIRED AO 12241-173

d. Calculation No. 12241-NP(T)-X77H-0

Expansion joint deflections noted in the calculation exceed deflections specified by the vendor as follows:

Deflections	Actual	Specified Allowable
Lateral	0.355 in.	0.25 in.
Angular	0.092 deg.	0.0057 deg.

However, considering the size of the expansion joint, actual deflections should be accommodated. Nevertheless, vendor approval is required. It apparently was not being solicited. Accordingly, the calculation should be marked Confirmation Required.

RESPONSE REQUIRED AO 12241-173

e. Calculations: 12241-NP(T)-X77J, H, L-0

Thermal conditions analyzed are listed as an assumption. Since these conditions have been selected from the stress analysis data package as those conditions which will envelop

all other conditions, the thermal condition used can not be an assumption. Selection and justification of particular conditions must be detailed in the calculation.

RESPONSE REQUIRED AO 12241-173

f. Nozzle Loads

Calculations X77L and X77H contain departures from the stiffness requirements of EMD 80-02 (the stiffness of the first support after equipment must be greater than or equal to the stiffnesses of all other supports in the system). The intent of this requirement was discussed with EMD Headquarters personnel during the audit. It is apparent that engineers may use actual stiffness (as done in the calculations) in accordance with EMD 80-02. Even though the allowable nozzle loads for the equipment in the calculations reviewed are available, a large amount of equipment does not have allowable loads available from the vendor nor is resolution available in cases where actual loads exceed allowable loads. The Project is in the process of instituting a nozzle load verification program. The procedures of this program are in the preliminary stage.

6.3.3 PIPE SUPPORTS

6.3.3.1 General

The audit was divided into two elements:

1. Review of Project documents applicable to pipe supports.

2. Review of pipe support calculations.

The following document types were reviewed to determine if adequate criteria and instructions were available to personnel performing pipe supports design.

1. FSAR

2. Project Procedures

3. Project Specifications

4. Project Calculations

The specific documents included:

a. FSAR sections 1.8, 3.2, 3.7, 3.9, 3.11, Rev. 1.

b. 2BVM-106: Applicability of EMD Technical Guidelines, Rev. 5-17-82

c. 2BVM-103: Methods and Procedures for Design and Analysis of Pipe Supports. Rev. 2-25-82.

d. 2BVM-102: Pipe Supports Welding Design Guide, Rev. 3-18-82.

e. 2BVM-115: Identification and Scheduling Changes to Pipe Supports. Rev. 3-26-82

f. 2BVM-139: Large Bore Isometric Verification Procedure for Pipe Stress and Pipe Supports, Rev. 1-28-82.

g. 2BVM-153: Qualification of Plates Embedded in Concrete. Rev 10-18-82.

h. 2BVM-148: Filing, Filming and Maintenance of Pipe Support Calculations, Rev. 3-3-82.

i. 2BVM-45: Preparation of System Design Info. required for Pipe Stress Analysis, Rev. 6-6-83

j. 2BVS-059: Design and Fabrication of Power Plant Pipe Supports. Rev. 2, Add. 5.

k. 2BVS-979: ESSOW for Pipe Stress and Design of Small Bore Pipe Supports. Rev. 5

l. 2BVS-978: ESSOW for Pipe Stress Analysis and Pipe Support Analysis and Design (SWCL), Rev. 3.

m. 2BVS-920: Field Fabrication and Erection of Piping for ASME III and B31.1, Rev. 7, Add. 1.

n. 2BVS-939: Piping Engineering and Design, Rev. 3, Add. 2.

o. 2BVS-939A: Stone & Webster Pipe Classes, Rev. 3.

p. 2BVM-113: Pipe Hanger Information System, Rev. 7-29-83.

The review of the project documents revealed the following generic items:

a. The number of procedures on the subject of pipe supports is confusing. As a minimum, the main procedure 2BVM-103, the project criteria document, should reference all the other procedures and provide a "road map" to define the overall interface between them.

b. Although some phases of pipe support design are covered in relatively great detail, there is a large amount of information needed for design (e.g., load combinations for terminal anchors) that is available only through an informally controlled document known as "The Beaver Valley Unit 2 Design Book for Pipe Supports".

The Project is aware of these shortcomings and is in the process of developing a controlled criteria document to encompass all the phases of design.

6.3.3.2 Detailed Results

6.3.3.2.1 Project Procedures

1. 2BVM-102:

a. The applicability and implementation information contained on the cover is not clear. It is recommended that the wording be revised to clearly state which revision of the document applies to each situation.

RESPONSE REQUIRED AO 12241-173.

b. There is no minimum effective throat requirement listed for partial penetration welds. The minimum weld size for fillet welds has been established; similarly this AISC criteria should be established for partial penetration welds. It is noted that Materials performs a review of all pipe support drawings which would prohibit any weld discrepancy from being issued to the field.

RESPONSE REQUIRED AO 12241-173

2. 2BVM-148:

a. The attachments were left off of Rev. 1 when it was issued. These missing attachments have been distributed subsequent to the audit.

3. 2BVM-103: Methods and Procedures for Design and analysis of Pipe Supports.

a. The allowable weld shear stress listed is only correct if welding electrodes of at least 70ksi are used. It is not explicitly called out in 2BVS-920 that this is the case. However, the 2BVS-920 references 2BVS-059 (where it is explicitly called out). This inconsistency could be misleading. It is therefore suggested that this explicit requirement be added to 2BVS-920. This does not impact previous construction if only 70ksi electrodes have been used.

b. In addition, 2BVM-102 gives a different weld shear stress allowable. This inconsistency should be eliminated.

RESPONSE REQUIRED AO 12241-173

6.3.3.2.2 Project Specifications

1. 2BVS-978:

The sample work transfer authorizations shown do not list all the procedures applicable to pipe supports. It is suggested that these be added. In the future, a reference to the design criteria could suffice.

2. 2BVS-059:

a. The environmental conditions shown are not in accordance with either Sect. 3.11 of the FSAR or 2BVM-119, "Environmental Conditions for Equipment Qualification Requirements". It is recommended that the conditions in 2BVS-059 be brought in accordance with the governing documents.

RESPONSE REQUIRED AO 12241-173.

b. The tolerances listed for fabricated pipe supports are considered to be redundant. They are the same as industry standards. It would be simpler and more cost effective to just reference the industry standards.

c. The tolerances listed on pg. 1-37 are not considered to serve a purpose. It is suggested that they be deleted.

3. 2BVS-979:

a. The standard supports shown in the ESSOW are considered to be overly conservative (as shown by a review of the back up calculation 12241-NP(T)-2-979-0), especially in the area of the welds specified.

b. The section dealing with the design of base plates and anchor bolts (pg. 3-7) for pipe supports is not clear whether the criteria established by NRC I&E Bulletin, 79-02 is to be used, or whether the more stringent SWEC criteria listed applies. It is recommended that this section be clarified.

RESPONSE REQUIRED AO 12241-173

6.3.3.2.3 Calculations

The following large bore pipe support drawings and calculations for the fuel pool cooling system were reviewed:

Support No.	Calc. No. & Rev.	Stress Calc. No.	Dwg. No & Rev.
2CCP-PSR312	77A-008-1	77G	77A-6-2E
PSR306	77A-002-2	77D	77A-130-0B
PSR308	77A-004-2	77E	77A-129-0B
PSR310	77A-006-2	77F	77A-128-0B
2FNC-PSSP176A&B	77A-027-1	77J	77A-25-1D
2FNC-PSSP179A&B	77A-029-1	77J	77A-27-1C

1. A detailed review check list for each support was completed delineating the results of the review. The overall conclusion is that the supports are capable of supporting the piping during all the loading conditions stipulated in the pipe stress calculations within the allowable stresses contained in the governing code. However, two of the supports (2FNCPSSP176A&B and 179A&B) contain departure from the procedure (2BVM-102) and section of governing code (AISC 1.17.5) dealing with minimum weld size. The weld between the embedded plate and a flat plate is 1/16" under the minimum requirement. However, the weld is adequate from a strength standpoint and the deviation does not appear to be technically significant. A procedure for dealing with this type of deviation is recommended. This should only be done for existing supports with violations up to 1/16" maximum.

RESPONSE REQUIRED AO 12241-173.

2. The pipe support calculations reviewed all contain some shortcomings that should have been identified in the calculation review process. Examples of these are:

   a. Input errors in the computer programs used. (e.g., Cal. #12241-NP(T)-Z-77A-008-1)

   b. Use of the inappropriate allowables. (e.g., Calc. #12241-NP(T)-Z-77A-008-1)

   c. Deviations from division guidelines without documentation as to the acceptability or a confirmation statement. (e.g., Calc. #12241-NP(T)-Z-77A-008-1)

   d. Parts of the support not qualified in the calculation. (e.g., Calc. #12241-NP(T)-Z-77A-027-1)

   e. Incomplete (or lack of) referencing. (Gang supports loads not referenced from other applicable calcs. e.g., Calc. #12241-NP(T)-Z-77A-008-1)

   RESPONSE REQUIRED AO 12241-173

6.3.4 ENGINEERING MECHANICS - MECHANICAL

6.3.4.1 General

The scope of the audit for the Mechanical Group included the following:

1. Generation and Control of Amplified Response Spectra (ARS)

2. Seismic qualification of Spent Fuel pool heat exchangers.

3. Seismic qualification of high density spent fuel storage rack.

4. High energy line design for pipe rupture.

The following document types were reviewed to determine if adequate instructions and criteria were available to personnel performing the work.

1. FSAR
2. Project Procedures
3. Project Specifications
4. Project Calculations

The specific documents included:

a. 2BVM-125 Generation and Control of Amplified Response Spectra (ARS).

b. 2BVM-118 Criteria for Postulating Pipe Breaks and Cracks and Analyzing
Dynamic and Environmental Effects (outside containment).

c. 80C7662 MFG Dwg, Spent Fuel Storage Rack, Rev. 1
d. 80E7653 MFG Dwg, Spend Fuel Storage Rack, Rev. 0

e. 2BVS-40 High Density Fuel Storage Rack, Rev. 3
f. 2BVS-3 Spent Fuel Pool Heat Exchanger, Rev. 3

g. TM-114, Rev. 1 Joseph Oat Seismic Report, Spent Fuel Pool Heat Exchanger, Rev. 1

h. 12241-NP(N)-2004-Rev. 0 MECH ARS
i. 12241-SM-012, Rev. 0 STRUCT ARS
j. 12241-NM(B)-244-ZZ, Rev. 0 Spent Fuel Pool Heat Exchanger
k. 12241-NM(B) 202-FB, Rev. 2 Spent Fuel Pool Liner

6.3.4.2 Detailed Results

6.3.4.2.1 Generation & Control of Amplified Response Spectra (ARS)

1. The project procedure 2BVM-125 and the technique to generate the ARS were audited. The project group has followed the project procedure with minor deviations, however, there are three minor observations related to the generation of ARS that should be resolved.

a. 2BVM-125 "Generation, Control and Use of Seismic Acceleration Data" requires the ARS results be sent to the Lead Engineer - Electrical (Section 5.2.2, PP. 7). A review of the calculation 12241-NP(N)-2004 "ARS for Fuel and Decontamination Building" indicated that this was not done. Instead the results were sent to the Lead Structural Engineer. Since these results would be used to qualify the cable tray and its support, this does not pose a technical concern, but only an administrative one. However, either the distribution process should be changed to comply with the current 2BVM-125 or the current project procedure should be revised.

RESPONSE REQUIRED AO 12241-173.

b. 2BVM-125 requires the project group to maintain a Mechanical Seismic Data Index and use the Mechanical Seismic data transmittal form (Section 5.2.2, PP. 8). This was not followed. The Mechanical group is now in the process of developing a scheme to implement this requirement.

RESPONSE REQUIRED AO 12241-173.

c. The BV-2 project used an enveloping technique that is different from that defined by NRC Reg. Guide 1.122. This variance has not been identified in the FSAR section that indicates the degree of Reg. Guide compliance. Further investigation has indicated that a FSAR change request (#217) has been drafted (initiated 9/83) to address this concern; however, it has not as yet been incorporated. BV-2 dropped the ARS curves vertically after spreading the peak, a technique that is different from the Regulatory Guide 1.122. The Project has not demonstrated that this method is conservative. This peak spreading technique was achieved by using an option within the computer code "PSPECTRA" (ME-164, V1 L9).

RESPONSE REQUIRED AO 12241-173.

2. The design interface between the structural and the mechanical groups was audited by examining the following calculations:

12241-SM-012, Rev. 0, STRUCT ARS from structural group and
12241-NP(N)-2004, Rev. 0, MECH ARS from mechanical group.

There were two inconsistencies noted:

a. The same floor elevation was referred to as elevation 733.50 ft in the structural calculation, but elevation 733.75 ft in the mechanical calculation.

b. The zero period acceleration (ZPA) values in the seismic data sheet of the mechanical calculation were different from those in the floor acceleration profile in the structural calculation.

EL'	OBE Horz	OBE Vert	SSE Horz	SSE Vert	Notes
798'	0.477	0.179	0.872	0.366	Structural Calc
798'	0.389	0.141	0.576	0.285	Mechanical Calc
					Units = g

The values used by the mechanical group were lower by about 30%. The (ZPA) values from mechanical's seismic data sheet may be used in the specification for the intensity of the seismic test motion for equipment qualifications. This inconsistency should be evaluated.

RESPONSE REQUIRED AO 12241-173.

3. The content of calculation 12241-NP(N)-2004, Rev. 0, MECH ARS, is incomplete. The seismic data sheet has not been generated for damping values other than one set of values (0.5% for OBE and 1.0% for SSE). Since most of the work was done, the effort required to complete the calculation would be minimum. This action will simplify or eliminate the need for additional calculations to be performed to justify other damping values that are used, such as 4% (OBE) and 7% (SSE) for bolted structure.

6.3.4.2.2 Seismic Qualification of Spent Fuel Pool Heat Exchanger

The procurement specification (2BVS-3), the seismic report from the vendor (TM-114), and the qualification calculation by SWEC (12241-NM(B)-244-CZ, Rev. 0) were reviewed to determined the adequacy of contract administration and technical design. It was observed that there were some unclear areas in the procurement specification. This led to some technical errors made by the vendor. There were also other areas of technical analysis where both the vendor and the mechanical group made the same error. The following provides a detailed description.

1. Procurement Specification (2BVS-3)

   a. The procurement specification was used and certified as a design specification (May 25, 1982) to satisfy the ASME code requirement. However, much of this required information was not provided. As a minimum a design specification should define the load magnitudes, load combination method, and the allowable values for normal, upset, emergency, and faulted conditions. This information was not clearly defined, nor was the code jurisdictional boundary identified.

   b. The method of applying the allowable nozzle loads was not specified (PP 1-13) although the magnitudes of the allowable nozzle loads were defined.

c. The seismic requirements section (PP 1-17,) did not reflect the latest seismic data from calculation 12241-NP(N)-2004, Rev. 0.

	Specification Value	Latest Calculated Value
Horizontal	.34g	.319g
Vertical	.18g	.315g

Since there can be cases where the new seismic value is higher than the specification value (such as the case for the vertical acceleration in the example above), a review of all the specifications is needed in order to determine project impact.

RESPONSE REQUIRED AO 12241-173.

2. Seismic Report from the Vendor (TM-114, Rev. 1)

a. A report "Seismic Analysis of the Fuel Pool Cooler" was prepared by the vendor (Joseph Oat) and was approved by SWEC (1/76), but the following interface and technical issues were not identified nor justified.

b. The nozzle loads were applied incorrectly (PP. 7). The vendor applied the nozzle loads in two orthogonal planes separately, rather than simultaneously in one application which was SWEC's standard practice. The vendor method would result in an underestimate of loading severity. This was not noticed in the mechanical group's review. It is recommended that a full review of any specifications that are required to state the method for applying nozzle loads should occur, and ensure all vendor reports submitted for SWEC review contain the appropriate loading applications.

c. The local nozzle analysis was done incorrectly (Appendix IV). The vendor omitted the loading contribution from shell side due to seismic vibration. The omission was never justified nor even mentioned in the report.

d. The structural models used to calculate support loads needed justification. Throughout the report many models were used to represent the same sliding support for reaction forces. There was no mention of the reasons why different models were used when indeed a consistent model with force release in vessel axial direction would suffice. This issue was not identified by the reviewer.

e. The allowable stress used to accept the shell-nozzle design was different and higher than what was in the procurement specification (PP IV-3).

	Member	Member and Bending
Vendor Used Allowable	1.5S	2.25S
Specification Allowable	1.5S	1.95S (Ks = 1.3)

The vendor used a higher allowable stress for acceptance without providing justification.

RESPONSE REQUIRED AO 12241-173.

3. Mechanical calculation (12241-NM(B)-244-CZ, Rev. 0) -

   a. A SWEC calculation was prepared by the Mechanical group to evaluate the nozzle loads that were generated (10/77) from pipe stress analysis.

   b. The same vendor methodology (TM-114) was used. Consequently the same type of errors (noted in 6.3.4.2.2 1b above) were made, except that the nozzle loads and the allowable stress were used correctly.

   c. The translation of nozzle loads to the center line of the vessel was done incorrectly. The moment effect was omitted without any justification. For example, the two nozzle forces 612 lb and 262 lb would result in an unbalanced overall moment whose value was about 13,000 in-lb (PP 2.5) This moment would generate reaction forces at the heat exchanger supports, but this was not addressed throughout the calculation.

   d. Subsequent to the 10/77 nozzle loads, a new set of nozzle loads was available through pipe stress calculation 12241-NP(T)-NL421, Rev. 1 (9/82). These new loads should be evaluated.

   The reaction forces based on mechanical calculation were transmitted to the Structural group (11/79) for the floor design. Since these reaction forces may be questionable, based on above observations the adequacy of floor design should be re-examined. It is recommended a review of the technical methodology be performed to establish an acceptable method, and then a revised calculation be initiated using the 9/82 nozzle loads.

   RESPONSE REQUIRED AO 12241-173.

6.3.4.2.3 Seismic Qualification of High Density Spent Fuel Storage Rack

The procurement specification for the spent fuel racks (2BVS-40, 1/18/83) and the vendor report "Structural Analysis and Design Report" (81A0980, dated 8/23/83) were audited. The following describes the details.

1. The specification requirement for the allowable embedment loads at the rack-pool interface was not clear (PP 1-19, 2BVS-40). The specification did not define what would be the allowable loads at embedment interface during a fuel assembly drop accident, which is required by the specification. A comparison was made of the vendor defined embedment load and the specification required load for earthquake environment. This comparison shows that the vendor load is higher than that specified in the contractural document. No justification for this deviation was requested nor made as a result of the review process (PP 45, Table 5.5).

	Vendor Generated Load	Specification Allowable Load
SSE	320.42 KIP	180 KIP
OBE	281.18 KIP	180 KIP

The interface embedment loads in the specification are the basis of SWEC floor design. An increase of the embedment load as a result of the vendor loads must be reviewed and approved by the structural group. The adequacy of the floor design must be verified.

RESPONSE REQUIRED AO 12241-173.

2. The structural acceptance criteria (PP 1-25) in the specification should be revised to reflect the S.R.P. 3.8.4 (7/81), which the vendor has complied with and SWEC has approved.

RESPONSE REQUIRED AO 12241-173

3. The specification defined the basis of rack design. One of the requirements was that the rack be designed to allow for remote, underwater installation and/or removal (PP 1-5). It was not obvious how this contractual requirement was incorporated into the rack design after reviewing two vendor drawings (80C7662 Rev. 1, 80E7653, Rev. 0). The current rack design linked many rack modules into one piece by bolting each module down to a subbase steel frame system. This subbase system was then rested against the floor embedment plates. The capability to level the rack remotely does not appear possible.

RESPONSE REQUIRED AO 12241-173

4. The embedment design calculation for the liner (12241-NM(B)-20-FB, Rev. 2, 4/80) was based on low density rack, and should be revised to incorporate the new loads.

RESPONSE REQUIRED AO 12241-173

6.3.4.2.4 High Energy Line Design for Pipe Rupture

The project procedure 2BVM-118 "Criteria For Postulating Pipe Breaks and Cracks and Analyzing the Dynamic and Environmental Effects (Outside Containment)" (3/26/80) identified a high energy line inside the Fuel Building (Table 5). The presence of this high energy line could have significant impact to the design in the area of:

a. pipe rupture analysis, restraint design, procurement, installation.

b. jet impingement evaluation, analysis, and design.

c. environmental qualification of equipment.

d. structural design.

1. The project responsible engineer for this 2BVM-118 indicated the present design does not have any high energy line inside the fuel building. It was the understanding of the auditor also that there was no effort underway to incorporate any high energy line breaks inside the fuel building. A review should be initiated to resolve the discrepancy and the result should be properly incorporated into the 2BVM-118.

RESPONSE REQUIRED AO 12241-173.

B.C. Dave (EMD - Stress)

R.W. Twigg (Audit Team Leader)

J. Lockaby (EMD - Supports)

W. Wang (EMD - Mechanical) 2/17/84

TABLE OF REQUIRED RESPONSES

6.4 GEOTECHNICAL

6.4.1 General

6.4.2 Detailed Results

6.4.2.1 Defining Soil Profile and Properties

6.4.2.2 SHAKE Analysis

Para. 1 Response required AO 12241-174

6.4 GEOTECHNICAL

6.4.1 General

A technical review of geotechnical input to the soil-structure interaction (SSI) analysis was performed as part of the audit. The soil-structure interaction analysis is used to determine amplified response spectra (ARS) at each floor slab level in the structure in order to seismically design plant components. The Geotechnical Engineer determines the soil profile to be used by the Structural Engineer in modeling the subsurface under the building. An estimate of shear strain induced by the seismic loading must also be calculated by means of the computer program SHAKE throughout the profile to determine the strain-compatible values of shear modulus and damping.

This task was selected for the audit because it is representative of the many different activities required of the Geotechnical Engineer during plant design and construction. The audit reviewed the derivation of dynamic soil properties from the site investigation stage, through the design criteria preparation, to the actual calculation of shear modulus and damping and the use of the data in structural calculations.

Based on observations made during this audit of the fuel building soil-structure interaction analysis, the geotechnical project personnel are producing well documented and technically adequate calculations and reports. An inconsistency of ground water level was identified between the SHAKE analysis for the fuel building and other analyses requiring ground water levels. The details of this inconsistency is identified in the Detailed Results.

6.4.2 Detailed Results

6.4.2.1 Defining Soil Profile and Properties

1. The Geotechnical design criteria (2BVM-80) and all relevant documents used as input to the design criteria were reviewed. Soil parameters listed in 2BVM-80 and applicable to the fuel building analysis were adequately documented in calculation 12241-211K-G(B)-206. The soil profile selected for the SHAKE analysis was consistent with profiles presented in the BVPS-2 FSAR, Section 2.5.4. The concrete drawings (RC-38 series) were also checked to compare the modeling of the structure and found satisfactory. Shear wave velocity data from two geophysical surveys was used correctly to define low strain shear modulus.

6.4.2.2 SHAKE Analysis

1. Strain-dependent soil properties were calculated in the free-field and under the fuel building. The methodology used was similar to that previously used for Unit 1. The input into the SHAKE

calculations were correctly determined and the output was consistent and reasonable. The low strain shear modulus was bracketed by a 50 percent variation, resulting in a conservative range of corrected soil properties. The groundwater level was selected at El 675 (Ordinary High Water) to be consistent with the water level used in the BVPS-1 SSI analysis (Ref. 1). The choice of the water level, however, was not consistent with other dynamic analyses performed by the project where groundwater was required as input. Typically, when performing a dynamic analysis with a seismic loading condition corresponding to the SSE, a groundwater level coincident with the 25-year flood was assumed. No adverse effects on structural design are expected, since the results of the SHAKE analysis were used as input to confirmatory calculations only. The project should consider, however, performing a confirmatory SHAKE run with the groundwater level at elevation 690 ft (25 year flood level) to determine the impact on shear modulus resulting from fluctuating water levels. The Lead Geotechnical Engineer has agreed to this approach.

RESPONSE REQUIRED AO 12241-174.

2. Structural calculations were also reviewed to verify that data supplied by the Geotechnical engineer was correctly used. The actual design was performed in Calculation 12241-SM-012 using lumped mass analysis, with the subsoil modeled as a homogeneous mass. The soil properties were modeled in a simplified manner that was consistent with the detailed profile obtained from SHAKE. This method was verified using a finite element SSI analysis (FLUSH). The soil profile used in this calculation, (12241-NSB-086J) was the same profile provided by the Geotechnical Engineer.

Reference 1 - SWEC Soil Structure Interaction in the Development of Amplified Response Spectra for Beaver Valley Power Station, Unit 1, June 11, 1979.

F. Vetere (Geotechnical Division)

R.W. Twigg (Audit Team Leader)

TABLE OF REQUIRED RESPONSES

6.5 LICENSING

6.5.1 GENERAL

6.5.2 DETAILED RESULTS

para. 1 Response required AO 12241-171

para. 2 Response required AO 12241-171

para. 3 Response required AO 12241-171

para. 4 Response required AO NT-012

6.5 LICENSING

6.5.1 General

The scope of the Licensing audit consisted of a technical evaluation of the Failure Mode and Effects Analysis for the Fuel Pool Cooling and cleanup system. Each line entry to the FMEA was checked for consistency with respect to input documents and for the accuracy of the resulting failure and effects. The flow diagram and the corresponding draft operating manual were examined to determine if all safety related active components are included in the analysis.

The results of the audit confirm the conclusions reached in the FMEA that the system meets the single active failure criterion. However, the effects of the individual postulated failures and the detectability of these failures are not accurately described. The details of these concerns and inconsistencies are identified in the Detailed Results.

The following documents were reviewed within the evaluation of the FMEA.

a. FSAR (various sections)

b. Draft Operating Manual dated 6/21/83

c. Logic Diagrams

12241-LSK-29-8A Rev. 4
12241-SK-27-30S Rev. 1

d. Elementary Diagrams

12241-E-6ND Rev. 7
12241-E-6RJ Rev. 4
12241-E-3J Rev. 7
12241-E-3B Rev. 9

e. FMEA

12241-FMEA-29-8 Rev. 2 (4 pgs)

f. Flow Diagram

12241-RM-82A Rev. 15

g. Fault Tree Diagram

12241-FTSK-29-8 Rev. 2 (pgs A-G)

h. Standard Review Plan 9.1.3 Rev. 1

i. Regulatory Guide 1.13 Rev. 1

j. Project Manual Section

2BVM-147 Rev. 1-17-83
2BVM-147 Draft Rev.

k. FMEA Book Introductory Matter Draft Rev. 1 (6-21-83)

6.5.2. Detailed Results

The FMEA for the Fuel Pool Cooling Systems is limited to 46 line entries consisting of control actions for the two Fuel Pool Cooling pump and motor operated valves located in the component cooling water system. All lines were included in the evaluation.

1. Various failures in motor operated valve (MOV 128A&B) control circuits are shown incorrectly on the FMEA as causing the valves to close. The effects of these failures is to prevent powered opening of the valves. Motor operated valves 128 A & B, when closed, isolate component cooling water from the fuel pool cooling heat exchangers. These valves are open during normal operation.

   This error in analysis is conservative in direction and does not affect the design nor the determination that the design meets the single failure criterion. See Figure 6.5.1.

   RESPONSE REQUIRED AO 12241-171

2. The current issue of the ESK is different from the issue used for the analysis. (In this particular case no changes to the ESK affected the validity of the analysis). However, there is no procedure that requires the FMEA analyst to be informed of design changes that might affect the validity of the FMEA

   RESPONSE REQUIRED AO 12241-171

3. The FMEA does not have a list of current pages. Therefore, the holder cannot determine that the volume is up to date.

   RESPONSE REQUIRED AO 12241-171

4. Use of the handout from a FMEA training session (included in this report as Figure 6.5.1) which covers the analysis of MOV circuits, might have prevented the inconsistencies noted above. The Nuclear Technology Division is requested to formalize this guidance for the preparation and control of FMEA within division technical procedures. Consideration should also be given to including the information presented in Figure 6.5.1.

   RESPONSE REQUIRED AO NTD-012.

Wells T. Hotchkiss (Licensing)

Richard W. Twigg (Audit Team Leader)

FIG. 6.5.1. POWER OPERATED VALVES

INITIAL POSITION		SAFETY POSITION		FAULT TREE			
				FAIL TO		INADVERTENT	
OPEN	CLSD	OPEN	CLSD	OPEN	CLOSE	OPENING	CLOSING
●		●					●
	●		●			●	
●			●		●	●	
	●	●		●			●

[●] = CONDITION TO BE REVIEWED

TABLE OF REQUIRED RESPONSES

6.6 MATERIALS

6.6.1 General

6.6.2 Detailed Results

6.6.2.1 Fluid Systems

para. 4 Response required AO 12241-168
para. 5 Response required AO 12241-168

6.6.2.2 Liner

6.6.2.3 Pipe Supports

6.6.2.4 HVAC

para. 1 Response required AO 12241-168
para. 2 Response required AO 12241-168

6.6.2.5 Supplier Technical Documents

para. 1 Response required AO 12241-168
para. 3 Response required AO 12241-168

6.6 MATERIALS ENGINEERING

6.6.1 General

Materials Engineering involvement in the Fuel Pool Cooling and Cleanup System Audit included the evaluation of the following:

Materials adequacy in the fluid system, fuel pool liner, pipe supports, HVAC, and review of supplier technical documents.

The evaluation of the adequacy of the materials in contact with the system fluid was determined from the review of Component/Equipment Specifications and drawings. In general, the materials were found to be acceptable. Two concerns were uncovered; namely, unspecified acceptance criteria for pressure boundary welds and incomplete pipe bending requirements.

The evaluation of the adequacy of the material integrity of the fuel pool liner was determined from the review of the liner specification and related drawings. The material requirements for the liner were found to be acceptable.

The evaluation of the adequacy of the material requirements for pipe supports was determined from the review of the pipe support specifications/ESSOW and associated drawings. The material requirements for the pipe supports were found to be acceptable.

The evaluation of the adequacy of the material requirements for the HVAC system was determined from the review of the HVAC Specification, drawings and associated vendor procedures. The material requirements were found to be unacceptable in two areas, namely, lack of compliance to project position on Regulatory Guide 1.52 and the lack of definition of weld joint details.

The evaluation of the technical adequacy of the review of supplier procedures was determined from the review of dispositioned supplier procedures and associated comments. In general, the reviews were found to be acceptable. Two concerns were uncovered, namely, lack of information on the completed project review forms as to which specific specification revision/addenda the procedure is to be reviewed against, and the lack of acknowledgement in the procedure disposition stamp block of the specification revision/addenda.

The details of these concerns and inconsistencies are identified in the Detailed Results.

6.6.2 Detailed Results

6.6.2.1 Materials for Fluid System

The attributes that were evaluated to determine the adequacy of the materials in contact with the system fluid included; corrosion allowance, galvanic corrosion, non-metallics in radiation environments,

material processing requirements (i.e., heat input control, welding bending, etc.), dissimilar welds, in-service inspection requirements, cleanliness control, and expendable products.

1. In general, all materials in contact with the system fluid were stainless steel which requires no corrosion allowance. The corrosion allowance specified for the carbon steel shell of the Fuel Pool Heat Exchanger (Specification 2BVS-3) was acceptable.

2. Resistance to galvanic corrosion is acceptable. This has been adequately addressed in Specifications 2BVS-3 Rev. 2, 2BVS-11 Rev. 2 Add.4, 2BVS-19A Rev. 2 and 2BVS-50 Rev. 3 in cases where dissimilar metals come in direct contact with system fluid and to the external environments of the system.

3. The non-metallics in Specifications 2BVS-3, 2BVS-19A and 2BVS-50 were found to be acceptable for use in the radiation environments specified in these specifications.

4. In general, the material processing requirements have been adequately addressed. In the case of the piping specifications (2BVS-58 and 2BVS-920) the bending requirements were found to be inadequate. The definition and limitations of the essential variables associated with the bending process (e.g., pipe size, material type, mandrels, etc.) have not been addressed. Specification 2BVS-19A does not appear to include requirements for pressure boundary welding, but has requirements for non-pressure boundary welding. This appears to be technically inconsistent and should be clarified. The project should establish specific and complete requirements for pipe bending (see master piping specification) and invoke these requirements in Specifications 2BVS-58 and 2BVS-920. Also, the project should ascertain the acceptability of the pressure boundary welds of Specification 2BVS-19A and modify the specification appropriately.

   RESPONSE REQUIRED AO 12241-168.

5. Adequate requirements have been included in Specifications 2BVS-3, 2BVS-58 and 2BVS-920 for welding dissimilar metals. Supplier welding procedures were also reviewed and found to conform to these requirements invoked in the implementing procedures.

6. Sufficient design considerations have been included in Specifications 2BVS-3, 2BVS-11, 2BVS-19A, 2BVS-50, 2BVS-58 and 2BVS-920 such that visual inspections required for class 3 components and systems can readily be performed. Specifications 2BVS-3, 2BVS-11, 2BVS-19A, 2BVS-50, 2BVS-58 and 2BVS-58A specify cleaning requirements capable of achieving the final cleanliness desired for final system performance considering that the installed system will be final cleaned by flushing only.

7. The requirements for controlling the use of expendable products enumerated in Category I Specifications (2BVS-3, 2BVS-11, 2BVS-58, 2BVS-58A and 2BVS-920) were acceptable and comply with the packaging requirements of the project position on Regulatory Guide 1.38.

6.6.2.2 Materials for Liner

The attributes that were evaluated to determine the adequacy of the materials and fabrication design of the liner included; welding details, dissimilar welds, surface finish, and expendable products.

1. The welding requirements of Specification 2BVS-25 and the associated fabrication/design drawing for the liner included adequate requirements for dissimilar metal welds. The surface finish requirements for the liner were adequate and assured the elimination of a high lustre finish on the finished liner surface.

2. The project position for controlling the use of expendable products in shop specifications was limited to Category I components/equipment specifications. This is considered adequate and is reflected appropriately in specification 2BVS-25 by virtue of the fact that this specification is silent on this matter.

6.6.2.3 Pipe Supports

The attributes that were evaluated to determine the adequacy of the material/fabrication requirements for pipe supports included; weld details, coating requirements and/or corrosion allowance.

1. Specifications 2BVS-59A, 2BVS-920 and 2BVS-979 and BZ drawing Series 77A (Eleven drawings were reviewed) contained sufficient requirements to adequately define the weld joint designs. The pipe support materials are coated and adequate requirements have been included in the specifications. Therefore, corrosion allowances are not required. The requirement for recoating after welding has been adequately addressed in these specifications.

6.6.2.4 HVAC

The attributes that were evaluated to determine the adequacy of the material/fabrication requirements for the HVAC included; compliance with the project position on Regulatory Guide 1.52, weld joint designs, and recoating over welds.

1. The welding requirements in specification 2BVS-935 Rev.4 Add. 2 are not in compliance with the latest issued project position on Regulatory Guide 1.52. The responsible engineer, however, has indicated that a change to this position is being prepared and will address this matter. Regulatory Guide 1.52 invokes ANSI N509. The Project position on this regulatory guide takes exception to certain portions of this guide. The degree to which

the requirements from this ANSI document have been invoked in specification 2BVS-935 is not apparent. Recommend that the project ascertain the extent to which the requirements from ANSI N509 have been invoked in the specification before the final position on Regulatory Guide 1.52 is established.

RESPONSE REQUIRED AO 12241-168.

2. Specification 2BVS-935 and associated drawings 2HVS*FN 204 A&B do not include sufficient requirements for weld joint designs for the SXH/LL rectangular welded duct utilized for the leak collection filtration system. The contractor's document which covers this work (Schneider Sheet Metal Document No. SM-STD-1, Rev. 6 dated 10/3/83) was reviewed. It indicates options for weld joints (i.e., full, partial, or seal weld). A ROAP (EA Task No. 1707) has been submitted by the Millstone 3 project on this subject and is being evaluated. Recommend that project evaluate required weld joints needed for these welds fabrications and impose complete requirements to assure compliance.

RESPONSE REQUIRED AO 12241-168.

3. The requirements for recoating welds on galvanized materials have been adequately addressed in Specification 2BVS-935.

6.6.2.5 Review of Supplier Technical Documents

The attributes evaluated to determine technical adequacy of supplier technical document reviews included; completeness of information provided to the reviewer, consistency and completeness of review, quality and clarity of comments, correctness of dispositions.

1. Ten procedures were reviewed. Five procedures (WP-SC-A30, Specification 2BVS-57; WS1-46-A, Rev. 2 and WS1-34A, Rev. 0; Specification 2BVS-59; WPS-1021 A,B,C,D,E&F Rev. 7; Specification 2BVS-59A; and WP-S-300-F-2, Rev. 2; Specification 2BVS-100) did not include the specific specification revision/addenda numbers to which the procedures were to be reviewed (EAP 9.2 requires the responsible engineer to identify this information).

RESPONSE REQUIRED AO 12241-168.

2. In all cases, a check sheet was used which provides assurance that the reviews were complete and consistent. In all cases the comments, noted dispositions, technical adequacy and approvals were clear, concise and correct.

3. In six cases the specific revision/addenda numbers of the specification were not specified in the disposition block stamped on the procedure by the reviewer. (QC-900, Rev. 1; Specification 2BVS-3; 1041, Rev. 2; Specification 2BVS-37; WP-SC-A30; Specification 2BVS-57; WS-1-34A, Rev. 0; Specification 2BVS-59; WPS-1021 A,B,C,D,E&D, Rev. 7; Specification 2BVS-59A; and QCP-101M, Rev. 2; Specification 2BVS-11). This information is

required by METP 7.1. Recommend that the project review the methodology of assuring that supplier technical documents are reviewed to the appropriate specification revision/addenda and the procedure disposition note the specification revision/addenda numbers.

RESPONSE REQUIRED AO 12241-168.

M.P. Berardi (Materials Engineering)

R.W. Twigg (Audit Team Leader)

TABLE OF REQUIRED RESPONSES

6.7 NUCLEAR TECHNOLOGY

6.7.1 General

6.7.2 Detailed Results

6.7.2.1 Radiation Shielding

para. 1.a. and b. Response Required AO 12241-171
para. 2.b. Response Required AO 12241-171
para. 3.b. Response Required AO 12241-171

6.7.2.2 Radiological Environmental Qualification

para. 1.a, b., c. Response Required AO 12241-171
para. 2.b.1,2,3 & 2.c Response Required AO 12241-171

6.7.2.3 Accident Analysis

para. 1 Response Required AO 12241-171

6.7.2.4 Fuel Storage Rack Design

6.7.2.5 Radiation Monitoring

para. 1.a. and b. Response Required AO 12241-171
para. 2.a. thru f. Response Required AO 12241-171

6.7.2.6 Airborne Radioactivity

6.7.2.7 ALARA Design Reviews

para. 1a thru c Response Required AO 12241-171
para. 2 Response Required AO 12241-171

6.7. Nuclear Technology - Radiation Protection

6.7.1 General

The audit of the fuel building and associated systems was performed in the following subject areas:

1. Radiation Shielding
2. Radiological Environmental Qualification
3. Accident Analysis
4. Fuel Storage Rack Design/Criticality Analysis
5. Radiation Monitoring
6. Airborne Radioactivity
7. ALARA Design Reviews

The results of concerns and inconsistencies are identified in the Detailed Results.

6.7.2 Detailed Results

6.7.2.1 Radiation Shielding

The shielding design approach for the fuel building was reviewed including radiation zone maps, radiation source term development bases, and radiation shielding analysis. With the exception of two calculations that relate to spent fuel handling, no evaluations have been performed to verify the adequacy of the shielding and designated radiation zone levels associated with the fuel building. As part of the audit, operational data from Beaver Valley Unit 1 (BV1) were gathered to aid in evaluating the specified zone levels. The data suggest that higher radiation zone levels may need to be specified, however more information is required.

1. In light of the above the following tasks are recommended to provide a complete design basis evaluation for the fuel building:

   a. PWR operational data should be gathered to quantify the effect on component dose rates due to the buildup of activated corrosion products and applied to support the existing radiation zone levels or to establish new ones. In addition, the applicability of the above information to other PWRs should be investigated by the Nuclear Technology Division.

b. Shielding evaluations should be performed to verify that the analysis performed for BV1 or RP-8a are appropriate for BV2. The evaluations should include an assessment from a shielding standpoint for any design differences, such as the use of high density fuel storage racks.

RESPONSE REQUIRED AO 12241-171

2. Two radiation shielding analyses that relate to spent fuel handling were reviewed in detail.

a. Calculation #12241-UR(B)-080-1 was found to be technically accurate and the results were consistent with the design as shown in the FSAR Figures 12.3-9 and 12.3-18 and the design drawings, RC-38H-2S and RC-49G-5A.

b. Calculation #12241-UR(B)-265-0 requires revision because of the use of results from a Millstone 3 calculation which contained old source term data for a fuel assembly at 100 hours decay that was developed from a superseded version of the RADIOISOTOPE computer code.

NOTE: Per a memo from KIandolo to all RADIOISOTOPES code users, June 26, 1981; any source term decayed for greater than 24 hours should be reevaluated due to revisions in the computer code.

RESPONSE REQUIRED AO 12241-171

3. The FSAR was reviewed for radiation shielding items and found to be complete and accurate except for the following minor items:

a. FSAR Section 9.1.4.3.4 states that during all phases of spent fuel transfer the dose rate at the surface of the water is less than 2.5 mrem/hour and is accomplished by ten feet of water. Two and one-half mrem/hour should be changed to 5 mrem/hour to be consistent with the supporting calculation. The project has issued a change to the FSAR (Amendment 4) to correct this inconsistency, therefore no audit observation was written.

b. FSAR Table 12.3-1 states that Zone II is an unrestricted area maintained at less than 2.5 mrem/hour. By definition per 10CFR20 an unrestricted area is less than 2 mrem/hour, therefore unrestricted should be changed to restricted.

RESPONSE REQUIRED AO 12241-171

6.7.2.2 Radiological Environmental Qualification

1. 2BVM-119, Rev. 3, "Environmental Conditions for Equipment Qualification Requirements", was reviewed in general with respect to radiation environment definition and in detail for the fuel building and was found to be complete and accurate except for the following items, which should be addressed in a revision:

a. Table III should add the fuel handling accident as a design basis for environmental conditions.

b. Appendix C should add Calculation #12241-UR(B)-242-0 as a basis for the post-LOCA gamma values.

c. The accident beta values should be evaluated for the specified one year post-LOCA conditions; the values currently in 2BVM-119 are based on 6-month post-LOCA conditions.

RESPONSE REQUIRED AO 12241-171

2. Three calculations that support the radiation environmental conditions specified within 2BVM-119 were reviewed as follows:

a. Calculation #12241-UR(B)-153-3 was reviewed for the areas that relate to the fuel building and was found to be complete and accurate.

b. Calculation #12241-UR(B)-208-0 was reviewed in detail and requires revision because of the following:

(1) Calculation should be QA Category I, not QA Category II, since the results support Category I equipment qualifications. It should also, therefore, be independently reviewed.

(2) Calculation should not address the fuel pool filters (as they are not contained within the fuel building) and should be expanded to address piping integrated doses.

(3) Confirmation required should be added in light of the data on which the calculation is based. (Data is based on an IOC which implies that the data is preliminary and should be confirmed). Additional data should be gathered as soon as reasonably possible.

RESPONSE REQUIRED AO 12241-171

c. Calculation #12241-UR(B)-183-1 was reviewed in detail and requires revision due to an error with regard to the multiple to be used for a semi infinite cloud. The calculation is currently being revised as a result of the audit. Project Procedure 2BVM-119 should be changed accordingly to reflect the revised results.

RESPONSE REQUIRED AO 12241-171.

3. FSAR Tables 3.11-1 and 3.11-2 were reviewed with respect to the fuel building and the data were found not to be in agreement with 2BVM-119. A FSAR amendment has been issued and addressed this item but was not reviewed as part of the audit.

6.7.2.3 Accident Analysis

1. Evaluations of events within the fuel building that could result in significant offsite radiological releases, e.g., fuel handling accident and heavy load drop accidents, were reviewed and found to be complete and accurate. FSAR Sections 6.4, 9.1.5, and 15.7.4 were reviewed and verified as consistent with the design basis evaluations, except for the area of control room habitability. An evaluation is required to ensure control room habitability for a fuel handling accident or other design basis events and to verify that the LOCA is the limiting case for control room doses as stated in FSAR Section 6.4.2.5.

   RESPONSE RESPONSE AO 12241-171.

2. Calculation #12241-UR(B)-189-1 addresses the radiological consequences of a fuel handling accident and was reviewed in detail and found to be complete and accurate from a radiation protection standpoint.

6.7.2.4 Fuel Storage Rack Design/Criticality Analysis

Due to time limitations only a cursory review of this subject area was performed. No obvious problems or inconsistencies were noted.

6.7.2.5 Radiation Monitoring

1. Specification #2BVS-509A, 5/16/83 and Addendum A, 7/22/83 were reviewed to assure that the applicable guides, standards and regulatory guidance have been addressed in the design of the digital radiation monitoring system. General requirements have been adequately addressed except for the following:

   a. A review should be performed to determine if the requirements of ANSI N13.1-1969 are met as far as location of the sample probes in relation to ventilation duct bends and effluent points. If not, the need for flow conditioning should be addressed. In addition, sample line routing should be reviewed to assure the absence of excessive line lengths and small radius bends.

   b. A calculation should be performed to verify that the airborne radiation monitors have the capability to detect 10MPC-hours of radioactivity in any compartment which has a possibility of containing airborne radioactivity as stated in FSAR Section 12.3.4.1.

   RESPONSE REQUIRED AO 12241-171.

2. A detailed review of the bid specification for five radiation monitors associated with the fuel building was performed and revealed many inconsistencies within the specification and with other documents, such as the FSAR, design drawings, etc. A detailed review should be performed to rectify this situation.

Many of the problems noted below are being addressed as part of issuing the purchase specification, which is now is progress, however, the following should be verified:

a. Accident environmental conditions are specified inappropriately for QA Category II monitors, since they are not required to operate during or after an accident.

b. Figure 11, page 2-14 of the specification, is missing the fuel building monitor. This should be checked for completeness.

c. Data sheets do not agree with Table 2-1 of the specification.

d. Monitors are not always shown on the referenced drawings.

e. Special background radiation levels are inconsistent with each other and with the radiation zone maps.

f. FSAR Figures 11.5-1 to 11.5-3 are not in agreement with the specification.

RESPONSE REQUIRED AO 12241-171.

6.7.2.6 Airborne Radioactivity

1. A review was performed to assure that airborne radioactivity concerns have been factored into the design of the fuel building. The ALARA design review included this area within its scope. Calculation #12241-UR(B)-238-0 was performed to determine the airborne concentrations in the fuel building. This calculation was reviewed in detail and was found to be complete and accurate and in agreement with the data presented in FSAR Section 12.2.2.4.

6.7.2.7 ALARA Design Reviews

1. A review was performed to determine if the guidance of Regulatory Guide 8.8 is being implemented by the BV2 project. It was determined that an ALARA review was done but that it is of limited scope and does not address all licensing commitments and all areas of Regulatory Guide 8.8 and PTG-106. Therefore, it is recommended that the scope of the ALARA program be expanded and formalized by means of a project procedure to provide a controlled, documented process, which shows interface with the appropriate disciplines and most importantly with DLC. In particular, the following areas should be addressed to meet existing commitments:

   a. The review should address all the considerations of Regulatory Guide 8.8, including review of system related items and review of small bore piping.

   b. Changes in the drawings which were used for the existing ALARA review should also be reviewed.

c. 2BVM-122, "Engineering Confirmation/Update Program", should be expanded to address ALARA.

RESPONSE REQUIRED AO 12241-171

2. As discussed within the radiation shielding subject areas, operational data from BV1 was obtained as part of the audit. The data revealed contamination problems in the fuel pool leakage monitoring area and higher than expected radiation levels. Additional operational data should be gathered to address ALARA concerns and factored into the fuel building ALARA review. In particular, the ALARA review should assure that components carrying fuel pool water can be shielded in the future without construction interferences, if radiation problems develop during plant operation.

RESPONSE REQUIRED AO 12241-171

W.A. Wagner (Nuclear Technology Division)

R.W. Twigg (Audit Team Leader

TABLE OF REQUIRED RESPONSES

6.8 POWER

6.8.1 General

6.8.2 Detailed Results

6.8.2.1 FSAR

Para. 1 Response required AO 12241-176.
Para. 2 Response required AO 12241-176.
Para. 3 Response required AO 12241-176.

6.8.2.2 Calculations Review Comments

Para. 2. Response required AO NT-012.
Para. 4. Response required AO 12241-176.
Para. 5. Response required AO 12241-176.

6.8.2.3 Drawings

Para. 1. Response required AO 12241-176.

6.8.2.4 Specifications

Para. 1 Response required AO 12241-176.
Para. 2 Response required AO 12241-176.

6.8 POWER (including Engineered Safety Systems and Analysis)

6.8.1 General

The scope of the Power Division portion of the audit included the fuel pool cooling system; the fuel building heating, ventilating, and air conditioning (HVAC) system; and the fuel pool suction/discharge piping of the fuel pool purification system. The documents reviewed included the FSAR (through Amendment 4), NRC regulatory guides and Standard Review Plans, diagrams, calculations, drawings, specifications, and other applicable documents.

The review of documents indicates that the Fuel Pool Cooling System and the Fuel Building HVAC system are adequately designed to achieve their specified functions. No major shortcomings were uncovered during the audit. Some concerns and inconsistencies were observed and identified in the Detailed Results.

6.8.2 Detailed Results

6.8.2.1 FSAR

The review of the FSAR with respect to other project design documents revealed these inconsistencies.

1. FSAR tables 1.9-1 and 1.9-2 incorrectly take exception to the decay heat rates basis of design indicated by SRP 9.1.3 and in lieu of this refer to Westinghouse generated curves. However, the design basis calculations are, in fact, based on BTP ASB 9-2 as referenced by SRP 9.1.3.

   RESPONSE REQUIRED AO 12241-176.

2. FSAR section 9.4.2.1 lists the design basis for the Fuel Building HVAC air temperature as between 74°F and 90°F whereas calculation 12241-B-24A specifies the air temperature of the Fuel Building must be maintained at 96°F.

   RESPONSE REQUIRED AO 12241-176.

3. The next to the last sentence in the second paragraph of FSAR Section 9.1.3.3 is not clear because two decay heat load cases, other than the two required by SRP 9.1.3, are referred to but are incompletely defined. The FSAR should be clarified by deleting this sentence or be revised to clearly describe the additional design cases.

   RESPONSE REQUIRED AO 12241-176.

6.8.2.2 Calculation Review Comments

1. Calculation 211-N-317, which confirms that the Fuel Pool will not exceed the "maximum normal" temperature as indicated by SRP 9.1.3 (140°F), relies, in part, on room ambient air as a heat sink to avoid exceeding the 140°F limit. However, calculation 12241-B-24A which justifies the adequacy of the Fuel Building HVAC system assumes a pool temperature of only 129°F. Subsequent to the audit, the Project has indicated that a new calculation has been completed which shows the air conditioning equipment to be adequately sized based on the higher fuel pool temperature.

2. Calculation 211-N-317 references a cancelled Power Technical Procedure PTP 7.3.1 (cancelled 12/1/82). As this procedure has not been reissued or otherwise addressed by the Nuclear Technology Division (NTD), the NTD is requested to evaluate whether the use of this cancelled PTP is still valid and to take appropriate action to maintain this reference or a superseding reference.

   RESPONSE REQUIRED AO NT-012.

3. Assumptions and methods used in Calculation 211-N-331 were reviewed and found to be appropriate with the exception that the 110°F temperature which was used for calculating the NPSH should have been 165°F to agree with design requirements. However, there is ample margin (NPSHa = 52') above the required NPSH (NPSHr = 7.5' @ 750 GPM).

4. The normal flow rate for 2 - pump operation is calculated to be 1575 GPM (calculation 211-N-331). However, Specification 2BVS-602 Revision 1 - Orifice Plates - indicates a maximum flow of 1400 GPM for orifice plate 2FNC*FE100. This discrepancy will cause the flow meter (2FNC*FI-100) to peg at full scale (400 in. of H_2O) during 2-pump operation, and therefore the meter will not accurately indicate the flow.

   RESPONSE REQUIRED AO 12241-176.

5. The transient calculation of pool temperature performed with the CONSBA code (SWEC Computer Program No. NU-169) which is referenced within calculation 211-N-317 could not be located either in the project files or upon request to SWEC-NY during the audit period. This information should be located and be maintained for historical purposes.

   RESPONSE REQUIRED AO 12241-176.

6. In the pressure drop calculation for the fuel pool cooling pumps (211-N-331), the assumptions and methods used were reviewed and found to be appropriate. A minor shortcoming is that a reference for the flow coefficients of the 6 and 10-inch ball valves used in the piping system is not provided; however, based on suppliers log information provided to the auditor by the Project, the valves used are correct.

6.8.2.3 Drawings

Numerous piping, isometric, flow schematic, machine location, facilities, and vendor drawings were reviewed and were found to be generally consistent and technically adequate. Some exceptions were noted, however.

1. The elevation of the normal fuel pool water level, as noted on several drawings, was found to be incorrect for the current design according to verbal information from the project.

   RESPONSE REQUIRED AO 12241-176.

2. The existence of high energy lines within the fuel building was reviewed. One line in particular was investigated at the request of the EMD auditor and found to pass around the outside of the fuel building and to enter the decontamination building. No high energy lines were found to enter the fuel building.

3. Piping drawings were reviewed to confirm that all piping penetrates the fuel pool at a level at least 10 feet above the top of the active fuel, thereby eliminating a flow path that could permit inadvertent draining of the fuel pool. However, this determination was complicated because the elevation of the top of the active fuel to be stored in the BV-2 fuel pool is not documented and had to be calculated from vendor drawings of the BV-2 fuel storage rack and BV-1 fuel.

   The stack-up of dimensions of embedment plates, subbases and fuel rack modules and BV-1 fuel elements, as calculated by the project during the audit, indicates that the top of the active fuel is at elevation 740'- 6". The lowest penetration elevation is 750' - 10". Therefore all penetrations meet this requirement.

6.8.2.4 Specifications

Specifications for the Fuel Pool Cooling Pumps, Fuel Pool Heat Exchangers, and orifice plates were reviewed for the adequacy of flow conditions with respect to system calculations and design conditions, and were found to be appropriate with these exceptions.

1. Specification 2BVS-11 - Revision 3 - Fuel Pool Cooling Pumps - lists in the technical data section the shutoff head as 80 feet. However, the vendor pump curves indicate the shutoff head as 89 feet. This inconsistency should be resolved.

   RESPONSE REQUIRED AO 12241-176

2. In specification 2BVS-602-Revision 1 - Orifice Plates - design flow for orifice plate 2FNC*FE-100 is not consistent with system calculations for two-pump operation (See Section 6.8.2.2).

   RESPONSE REQUIRED AO 12241-176.

6.8.2.5 Interfaces

Interfaces with other systems and other disciplines were examined during the audit. The interface with the component cooling water system, which receives heat from the fuel pool heat exchangers, is consistent with regard to heat transfer rate, component cooling water flow rate and inlet temperature.

S. Frank (Power Division)

R.W. Twigg (Audit Team Leader)

TABLE OF REQUIRED RESPONSES

6.9 STRUCTURAL

6.9.1 General

6.9.2 Detailed Results

6.9.2.1 Design Criteria

Para. 2. Response required AO 12241-172.
Para. 4. Response required AO 12241-172.
Para. 5. Response required AO 12241-172.
Para. 7. Response required AO 12241-172.
Para. 8. Response required AO 12241-172.

6.9.2.2 Calculations

Para. 1. Response required AO 12241-172.
Para. 2. Response required AO 12241-172.
Para. 3. Response required AO 12241-172.
Para. 4. Response required AO 12241-172.
Para. 5. Response required AO 12241-172.
Para. 7. Response required AO 12241-172.

6.9.2.3 Specifications

Para. 1. Response required AO 12241-172.

6.9.2.4 Drawings

Para. 2. Response required AO 12241-172.

6.9 STRUCTURAL

6.9.1 General

The scope of the audit consisted of reviewing documents developed by the structural discipline for the fuel pool cooling and purification system. Documents reviewed are mainly in support of the system in the Fuel Building and part of the Auxiliary Building. It included the following categories:

1. Design Criteria
2. Calculations
3. Specifications
4. Drawings

Results of the review indicate that documents prepared by the structural discipline are generally adequate to provide the required functions for the system. The structural engineering and design are consistent with the licensing commitments. No adverse impact on the fuel pool cooling and purification system is evident from the material reviewed. However, some inconsistencies were identified and are described in the detailed results.

6.9.2 Detailed Results

6.9.2.1 Design Criteria

The Structural Design Criteria, 2BVM-5 revised July 1, 1982, was reviewed for its technical adequacy and compliance with the FSAR, applicable codes, and consistency with the Standard Review Plan (SRP). The result of the review indicates that the Structural Design Criteria is generally consistent with the requirements of governing documents and is technically adequate for its intended use. However, some inconsistencies were noted.

1. A review of the licensing commitments shows that 14 load combinations are required to be reviewed for concrete design and five load combinations are required to be reviewed for structural steel design. These load combinations are consistent with 2BVM-5 with nine additional combinations for concrete and 11 additional combinations for structural steel. One additional loading combination (b(ii)d) is identified in the SRP which is not included in the FSAR or design criteria; however, this loading combination is considered to be a typographical error within the SRP.

2. It is noted that the SRP limits the acceptance criteria of 1.6 and 1.7 times the allowable stress(s) for loading combinations 2(c)(ii)(a)(4) and 2(c)(ii)(a)(5) respectively. The design criteria and FSAR indicate allowable stresses of 1.8S and 2.0S for the above corresponding load combinations. Table SRP No. 3.8.4 in Section 1.9 of the FSAR identifies that loads, load combinations and structural acceptance criteria are not in complete agreement with SRP 3.8.4. However, the remarks for the above disagreement is not adequately addressed under FSAR table SRP No. 3.8.4

RESPONSE REQUIRED AO 12241-172

3. It is cumbersome to identify which of the 39 possible load combinations are applicable to a certain design in any calculation. A procedure or technique should be established which provides guidance to the designers for selecting which loading combination will govern the design. Furthermore, it is important to document what loadings such as pressure, temperature, or pipe rupture are not applicable to a design. This guidance could be in the form of a standard calculation (referenced in the body of calculations) to show which load combination will govern for typical designs. This guidance while not mandatory, will facilitate the performance of the engineering confirmation program.

4. An inconsistency was noted in the referenced code application between FSAR and the Design Criteria. Section 3.8.1.2.1.3 of the FSAR states that structural design, materials, and fabrication conform to American Institute of Steel Construction (AISC) Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings (February 12, 1969), Supplement No. 1 (Nov. 1, 1970), and Supplement No. 2 (December 8, 1971) whereas the Design Criteria only specifies AISC 1969 as applicable. Supplements No. 1 and 2 identify changes to plate girder, connections and shear connector designs. Inconsistencies between the FSAR and the design criteria should be resolved, and existing designs should be verified as complying with the resulting requirements.

   RESPONSE REQUIRED AO 12241-172.

5. The Structural Design Criteria does not contain explicit instructions for the design of conduit and cable tray supports. The project has compiled a four-page document (B4-12241-3768) titled "Design of Electrical Conduit and Cable Tray Supports" which references EMTG 3-A for conduit supports and EMTG 4-A for cable tray supports. Both of these documents enable a designer to select generic type supports but offer little guidance as to the design criteria of unique supports. Furthermore, it is not clear that the project has demonstrated the adequacy of the static design used in the analysis of raceway supports. This can be demonstrated by performing a dynamic analysis of typical raceway runs and comparing its results with that of the static design. The $20h_z$ cutoff frequency stated in B4-12241-3768 is above the fundamental frequency for some conduit sizes (and materials) for the usual spans of eight feet. It is not clear whether the component or support design is to include the system frequency or just the support frequency in the amplification factor.

   RESPONSE REQUIRED AO 12241-172.

6. It is recommended that the capability of the clamps used to transfer loads and the torsional capacity of the unistrut (or power strut) members be investigated and published. (See River Bend tests (TP19.4.2) for "C" clamps and Millstone tests (TP19.4.1) for split clamps).

7. There is no evidence that the Structural Design Criteria had been reviewed and approved by the Chief Structural Engineer as required by SDM 81-14.

RESPONSE REQUIRED AO 12241-172.

8. Note 3 on top of page 3.8-35 of the FSAR should be revised to indicate equations 3.8-10 through 3.8-16 in lieu of 3.8-1 through 3.8-9.

RESPONSE REQUIRED AO 12241-172.

6.9.2.2 Calculations

Seven calculations (six concrete and one structural steel) associated with the fuel pool cooling and purification system in the Fuel and Auxiliary Building were reviewed in part or in total. Generally, the assumptions, methods, input and results are reasonable and correct. The calculations reviewed are technically adequate for their intended use with the exception of some items as described below.

1. It does not appear that the slab opening for the heat exchanger has been accounted for in the slab analysis as the opening interrupts the continuity of the slab. The calculation (C38-496) should be reviewed and revised to incorporate the effect of this opening.

RESPONSE REQUIRED AO 12241-172.

2. No calculations could be identified that justify the sliding support pedestal for the Fuel Pool heat exchangers. A check on the vertical reinforcing should be made to justify the capability of the pedestal to sustain frictional resistance to sliding. Further, both the vendor calculation (Joseph Oats) and the subsequent project calculation assume a freely sliding support at one pedestal. This will not be obtainable with a carbon steel interface and a bolt preload of approximately 1200 lbs.

RESPONSE REQUIRED AO 12241-172.

3. Errors were noted in the application of the moment distribution method utilized in calculation C38-620 to 628 which should have been identified by the checker. These have no impact on the design. This same calculation assumes a pinned end at the connection to the south wall at the fuel building as shown in Section 33-33 of RC 38B and RC-38E which should be considered fixed based on the current concrete drawings. This will decrease the positive moment and eliminate the apparent overstressed condition explained on C38-624.

RESPONSE REQUIRED AO 12241-172.

4. The result of reviewing the design of structural steel framing (S36.188) for supporting the filters and ion exchanger indicates that the assumption of applying one quarter of loading at mid-span as a cantilevered beam is conservative. The size of the member was first chosen based on stiffness requirement and then checked for stress level. This approach is reasonable. However, the allowable stress load factor of 1.6S for the load combination analyzed is not identified or used in accordance with the design criteria. However, both Safe Shutdown Earthquake (SSE) and 1/2 SSE conditions were analyzed and the results were well below the 1.6S allowable stress. This calculation has not been updated to reflect the latest seismic g-values and the calculation still references the deleted document 2BVM-70. However, the new "g" values will not invalidate the result of the calculation.

   RESPONSE REQUIRED AO 12241-172.

5. No calculations could be identified or located to justify the end reactions of these filter and ion exchanger supports within the supporting cubicle walls. No calculations were located during the audit that substantiate the design of the cubicle walls themselves. Although it appears that the cubicle walls could take the end reactions in this particular case, no statement has been made in this or similar calculations to document the preparers and checkers judgements for the adequacy of the cubicle walls to sustain the beam reactions.

   RESPONSE REQUIRED AO 12241-172.

6. The calculation for the dynamic water pressure in the fuel pool for the North-South direction was reviewed and found to be satisfactory. The calculation is based on a method contained in Chapter 6, Nuclear Reactor and Earthquake, U.S. Department of Commerce, assuming the fuel pool as a rigid container. The convective and impulsive forces are properly calculated and are inputed into the structural analysis. The top water level, used in the calculation is at El.765-10", 14" lower than the level required as indicated by preliminary Nuclear Technology calculation SP-2FNC-3 (10/14/83). It is not expected that the resolution of this difference will invalidate the result of the fuel pool design. As this Nuclear Technology calculation is still in the review process no project responses is required.

7. There was no evidence that three of the six Category I calculations audited had been reviewed by an independent reviewer.

   RESPONSE REQUIRED AO 12241-172.

6.9.2.3 SPECIFICATIONS

Three specifications (reinforcing steel, concrete, and placing of rebars and concrete) were reviewed for their compliance with the FSAR. The materials such as rebars, cement, fly ash and concrete density for biological shielding and maximum concrete slump are consistent with the FSAR requirements. The test frequency of cadwell splices for rebars is in compliance with Reg. Guide 1.10.

1. An inconsistency needing resolution exists in the applicable date of issue for some ASTM references between two of the three specifications reviewed and the FSAR. Examples are ASTM A-29, A-184 and A-615 for specification 2BVS-407 and ASTM C-109, D-1752 and D-2842 for specification 2BVS-904.

   RESPONSE REQUIRED AO 12241-172.

6.9.2.4 Drawings

The structural RC38 and RS38 series drawings including RS-36D-8E were reviewed with emphasis on the slab at El 739"-7 1/4" which supports the Fuel Pool Cooling Heater Exchangers, the fuel pool reinforcing, and the structural steel framing supports at El 718"-6" for the filters and ion exchanger. The result of the review indicates that the size of structural members and reinforcing bars are consistent with that shown in the applicable calculations. General notes and references are adequate for construction. However, some inconsistencies were noted.

1. The design live loads are not shown on the plan for the roof and the 12" slab at El 739'-7 1/4" of the Fuel Building. It appears these are isolated cases. The Project has marked up the stick files to specify these loads in the next drawing revision; therefore, no audit observation is written.

2. Both the FSAR (P3.8-39) and the Structural Design Criteria (P3-13) identify an opening of 3'-0" X 25'-9" for transferring fuel elements between the spent fuel pool and the cask area. However, all structural drawings reviewed including RM-7A-8C and RV-3J-3B show an opening of 2'-0" X 25'-9". The project should resolve this inconsistency. It does not appear that this item would affect the result of design and the intended use of the plant.

   RESPONSE REQUIRED AO 12241-172.

George Thornes (Structural Division)

Richard W. Twigg (Audit Team Leader)

Frank F. Chin (Engineering Assurance Division)

TABLE OF REQUIRED RESPONSES

6.10 NUCLEAR TECHNOLOGY/PROCESS GROUP

6.10.1 General

6.10.2 Detailed Results

1. Response required AO 12241-176

2. Response required AO 12241-176

3. Response required AO 12241-176

4. Response required AO 12241-176

5a&b Response required AO 12241-176

6.10 NUCLEAR TECHNOLOGY/PROCESS GROUP

6.10.1 General

The scope of the Process Group (Nuclear Technology) audit included an evaluation of the Fuel Pool Cleanup System including clarification (filteration) and purification (demineralization) for the water in the fuel pool refueling cavity transfer canal and the reserve water storage tank (RWST).

The evaluation of design inputs, capacity of the system, back-up calculations, and a review of NRC and code requirements indicated the system is adequate to accomplish its designed functions and satisfy regulatory guidelines and requirements.

Some concerns requiring project action were uncovered, however. These concerns (pump, pump motor, and line sizing; component purchases; and minor document discrepancies) are identified in the Detailed Results.

The documents included within the evaluation are as follows:

a. FSAR commitments.

b. Regulatory Guide 1.13 "Spent Fuel Pool Facility Design Basis" Rev. 1, 1975

c. Standard Review Plan 9.1.3 NUREG 0800 July 1981

d. Flow Diagrams: for Fuel Pool Cooling and Purification Piping, Containment Depressurization Piping

e. Machine Location Auxiliary Building Sheet 2

f. Arrangement Fuel and Decontamination Building Sheet 1

g. Specifications: for Miscellaneous Cartridge Type Liquid Filters, Demineralizers and Ion Exchangers, Steam Generator Blowdown Waste and Miscellaneous pumps

h. Calculations: No. 211-N-330 Spent Fuel Pool Purification System Pressure drop, NPSH Calculations and Orifice Plate Requirements, No. 211-N-180 Skiming Depth Range for Flows of 5 to 50 GPM

i. Operating Manual, Fuel Pool Cooling and Purification System, 6-21-83, Issue No. 1

6.10.2 Detail Results

The results of this review indicates that the Fuel Pool Cleanup System conforms to the requirements of governing documents with the following exceptions:

1. Calculation No. 211-N-330 indicates that the clean-up pumps flows have to be limited to 450 GPM to protect the motors from overload. The pump motors should be sized to handle all operating conditions or additional provision, either physical or administrative, be established to protect the motors from overload.

   RESPONSE REQUIRED AO 12241-176.

2. Under one operating mode of the purification pumps (suction from the refueling cavity is below the upper suction level) the pump discharge must be throttled to 250 GPM to prevent flow ΔP from exceeding the NPSH. There is no evidence to indicate that administrative action has been specified to prevent damage to the pump.

   RESPONSE REQUIRED AO 12241-176.

3. When using the fuel pool filter and/or the demineralizer for purification of the RWST, as mentioned in the FSAR, the flow path from the Refueling Cooling Pumps to the purification system is 2" diameter which will restrict the flow to approximately 142 GPM. This is considered to be a small clean-up rate for a 850,000 gallon tank. Also the pump head is only 70' TDH. A calculation should be performed to document the adequacy of the pump for this mode of operation.

   RESPONSE REQUIRED AO 12241-176.

4. The demineralizer specification requires the project to supply "under drains" (VOP Johnson Well Screens). However there is no evidence that provision had been made to purchase or to provide installation documents for these "under drains".

   RESPONSE REQUIRED AO 12241-176.

5. The following inconsistencies between documents were identified:

   a. The draft operating manual design data list should be revised to indicate 15 cubic feet of resin in lieu of 5 cubic feet.

   b. The FSAR should be revised to include the fuel pool demineralizer in the list of components designed to ASME VIII.

   RESPONSE REQUIRED AO 12241-176

   Subsequent to this audit the client informed SWEC that, during refueling, the capacity of the filters in Unit 1 (of which Unit 2 is a direct copy), is restrictive in clearing the reactor cavity. The client installs an additional temporary pump and filter during refueling at Unit 1 to increase the rate of clean-up. The project has been requested to provide an estimate for revising the present BV2 design to increase the filter flow rate.

D. H. Davis — D.H. Davis (Nuclear Technology Division)

R. W. Twigg Jr — R.W. Twigg (Audit Team Leader)

ATTACHMENT 1

AUDIT ENTRANCE MEETING ATTENDEES

NAME	TITLE/DISCIPLINE
J. Lockaby	Auditor - Engineering Mechanics
S. Frank	Auditor - Power
P.R. Allen	Lead Nuclear Technology
F. Vetere	Auditor - Geotechnical
D.D. Hunt	Lead Geotechnical
F.F. Chin	Auditor - Engineering Assurance
W.T. Hotchkiss	Auditor - Licensing
U.V. Patel	Lead Materials Engineering
A. Fiorente	Lead Power
M.P. Berardi	Auditor - Materials Engineering
S.H. Kampanellas	Electrical
R.M. Sibulkin	Principal Electrical
J.D. Sutton	Lead Licensing
J.F. Harkins	Lead Control Systems
K.M. Bendiksen	Assistant Project Engineer
A.W. Plizga	Structural Design Supervisor
A.P. Capozzi	Assistant Chief - Engineering Assurance
R.W. Twigg	Audit Team Leader - Engineering Assurance
D.H. Rogers	Audit Coordinator - Engineering Assurance

ATTACHMENT 2

AUDIT STATUS MEETING ATTENDEES

NAME	DISCIPLINE	TITLE
J.O. Webb, Jr.	Engineering Assurance	Project Engineering Assurance Engineer
J. Lockaby	Engineering Mechanics	Auditor - Staff Support Engineer
A.W. Plizga	Structural	Design Supervisor
P.C. Talbot	Structural	Lead Structural Engineer
D.D. Hunt	Geotechnical	Lead Geotechnical Engineer
F. Vetere	Geotechnical	Auditor - Sr. Geotechnical Engineer
G.E. Thornes	Structural (CHOC)	Auditor - Assistant Division Manager
F.F. Chin	Engineering Assurance	Auditor - Sr. Structural Engineer
P. RaySircar	Project	Project Engineer
W. Wang	Engineering Mechanics (CHOC)	Auditor - Assistant Section Manager
P.R. Allen	Nuclear Technology	Lead Nuclear Technology Engineer
T.G. Carson	Operations Services	Lead Operations Services Engineer
J. Camobreco	Power	Principal Nuclear Engineer
A. Fiorente	Power	Lead Power Engineer
F. . Morrissey	Quality Assurance	QA Program Administrator
K.L. Polk	Engineering Mechanics	Principal Pipe Stress & Supports Engineer
J. Busa	Engineering Mechanics	Principal Pipe Stress & Supports Engineer
R.J. Spahl	Engineering Mechanics	Principal Mechanics Engineer
J.D. Sutton	Licensing	Lead Licensing Engineer
W.H. Bohlke	Project Management	Project Manager
M.P. Berardi	Materials Engineering	Assistant Chief Engineer
H.K. Krafft	Materials Engineering	Lead Materials Engineer
W.T. Hotchkiss	Licensing	Auditor - Supervisor Safety Engineering

ATTACHMENT 2

AUDIT STATUS MEETING ATTENDEES

NAME	DISCIPLINE	TITLE
S. Frank	Power	Auditor - Consultant
W.A. Wagner	Nuclear Technology (CHOC)	Auditor - Supervisor Radiation Protection
D.H. Rogers	Engineering Assurance	Audit Coordinator - Engineer
R.W. Twigg	Engineering Assurance	Audit Team Leader - Lead Engineer

ATTACHMENT 3

POST AUDIT CONFERENCE ATTENDEES

NAME	DISCIPLINE	TITLE
F.N. Morrissey	Quality Assurance	QA Program Administrator
A.P. Capozzi	Engineering Assurance	Assistant Chief Engineer
J.G. Dolan	Electrical	Chief Engineer
W.H. Bohlke	Project Management	Project Manager
R.E. Bowker	Power	Assistant Chief Engineer
F. Sestak, Jr.	Power	Chief Engineer
A.L. VanSickel	Engineering Mechanics	Chief Engineer
C.A. Norcross	A.S.H.	Assistant Manager
A.S. Lucks	Geotechnical	Chief Engineer
R.B. Bradbury	Licensing	Chief Engineer
W.M. Eifert	Engineering Assurance	Chief Engineer
P. RaySircar	BVPS-2	Project Engineer
C. Richardson	Engineering	Engineering Manager
J.H. Fletcher	Nuclear Technology	Chief Engineer
M.P. Berardi	Materials Engineering	Assistant Chief Engineer
M.B. Stetson	Structural	Assistant Cheif Engineer
P.F. McHale	Structural	Supervisor
J.O. Webb, Jr.	Engineering Assurance	Engineering Assurance Engineer - BV2
D.H. Rogers	Engineering Assurance	Audit Coordinator - Engineer
R.W. Twigg	Engineering Assurance	Audit Team Leader - Lead Engineer

ENGINEERING ASSURANCE
AUDIT REPORT
BEAVER VALLEY UNIT 2
SITE ENGINEERING GROUP AUDIT

APRIL 23 - JUNE 20, 1984

DUQUESNE LIGHT COMPANY

JULY 20, 1984

D.H. Rogers
Audit Team Leader

W.M. Eifert
Chief Engineer
Engineering Assurance

TABLE OF CONTENTS

1.0 INTRODUCTION

An Engineering Assurance (EA) Technical Audit of the Beaver Valley Unit 2 Site Engineering Group (SEG) was conducted during the period April 23 through May 4, 1984. In order to provide additional scope and technical depth to the audit, technical support was provided by SWEC engineering divisions. Duquesne Light Company (DLC) personnel also assisted in the audit. The audit focussed mainly on the engineering activities at the site. However, selected construction and other department interfaces were also explored. The audit team consisted of the following personnel:

AUDITOR	DIVISION/DEPARTMENT	TITLE
CEKirschner	DLC/QA	Senior QA Engineer
ABektore	Engineering Mechanics	Sr. Engineering Mechanics Engineer
MBerardi	Materials Engineering	Assistant Division Chief
FFChin	Engineering Assurance	Sr. Structural Engineer
CJHo	Engineering Mechanics	Sr. Engineering Mechanics Engineer
HWMooncai	Engineering Assurance	Electrical Engineer
CMorrell	Power	Lead Nuclear Engineer
FJRezendes	Control Systems	Supervisor Control Systems
TWLeague	Engineering Assurance	Audit Coordinator
DHRogers	Engineering Assurance	Audit Team Leader

An audit entrance meeting was held April 23, 1984 to present the purpose, scope, and approach of the audit. Attendees at this meeting are identified on Attachment 1.

The audit on site covered the period April 23, 1984 to May 4, 1984. A status meeting was held May 4, 1984 to identify results to date and to identify areas requiring additional investigation and information. Attendees at this meeting are identified on Attachment 2.

During the period May 7, 1984 to June 20, 1984, audit results were finalized. A post audit conference was held on June 20, 1984. Attendees at the post-audit conference are identified on Attachment 3.

2.0 PURPOSE

The purpose of the audit was to evaluate the design process by assessing the technical adequacy of designs/design changes accomplished by the SEG. The objectives were to determine if:

- Designs/design changes are consistent with design and licensing bases, licensing requirements, technical procedures, associated documents; reflect good judgement and practice, are inspectable; and constructable.

- Analyses performed to support designs/design changes are complete, clear and technically adequate.

- The requirements and acceptance criteria for installation of material/equipment are consistent with the technical requirements and are sufficiently clear and complete to permit appropriate inspections.

- Design methods and procedures reflect division technical guidelines.

- Technical documentation to support designs/design changes (e.g., calculations) is complete prior to issuing designs/design changes.

- Field generated purchase orders reflect appropriate requirements.

3.0 SCOPE

The engineering activities performed by the SEG were evaluated. The major activities evaluated involved designs/design changes generated by the SEG to resolve installation problems and the resolution of non-conformances. Below are the subjects/activities that were audited.

Control Systems

Instrumentation Installation and Tubing Diagrams
E&DCRs
N&Ds
Specification Changes
Field Walkdown

Materials Engineering

Processing Procedures
Supplier Documents
Field Procurement
Specification Changes
Drawing Review
E&DCRs
N&Ds
Pre-Engineered List (PEL)

Engineering Mechanics

Qualifying Temporary Erection Spans
Instrument Tubing and Instrument Tubing Supports
Manual and Computerized Support Calculations for Large Bore Piping
Support Calculations for Instrumentation Tubing
BZ (Pipe Supports) Interim Issue Drawings
N&Ds
E&DCRs
Field Walkdown

Structural

Calculations
E&DCRs
N&Ds
Interim Issue Drawings
Cutting of Embedded Steel
Revisions to Specifications

Electrical

E&DCRs
N&Ds
Specification Changes
Interim Issue Drawings
Vendor Drawings
Electrical Separation
Field Walkdown

Power

E&DCRs
N&Ds
Interim Issue Drawings
Specification Changes
Calculations
Field Procurement
Vendor Documents
Field Walkdown

4.0 CONCLUSIONS AND SUMMARY OF RESULTS

Overall conclusions and results, major concerns, and concerns of a general nature are presented in this section. Detailed discussions of the results of each discipline audited are contained in Section 6.0. Audit Observations (AOs), contained within Section 5.0, have been written where specific action is required.

Based on the material audited, the audit results indicate that, in general, the design process is adequate. The designs and design changes performed at the SEG, as well as the analyses prepared by the SEG to support these designs and design changes, are technically adequate. Site personnel were found to be technically competent, conducting themselves in a professional manner. The promptness and depth of investigation by the SEG during the audit in responding to auditor concerns, assured mutual understanding while indicating a genuine interest in resolving problems.

Concerns (as represented by AOs in Section 5) identified during this audit appear to be varied and do not indicate any general weakness within the SEG. The one area that could use general improvement is the preparation of E&DCR problem descriptions and problem solutions. Although problem descriptions and solutions reviewed were not discrepant, clarity could be improved; training is recommended.

5.0 AUDIT OBSERVATIONS

The Audit Observations (AOs) resulting from this audit are contained in this section. They are as follows:

Audit Observation Number	Subject	Action Party
12241-182	Materials	PRaySircar
12241-183	Engineering Mechanics	PRaySircar
12241-184	Electrical	PRaySircar
12241-185	Power	PRaySircar
12241-186	Control Systems	PRaySircar
12241-187	Structural	PRaySircar

Reply forms associated with the above AOs have been provided to the Project.

In general, AOs have been written and categorized by discipline because the conditions were observed while auditing that discipline. However, this should not be construed that the cause of the condition necessarily rests with the discipline audited. It is the Project's responsibility to determine the cause of the condition including the disciplines that must be involved in resolving the condition. The Project's response to an AO should reflect input from the disciplines involved.

In accordance with SWEC policy, corrective action should be complete and corrective action implemented within 60 days of receipt of this report. If overriding factors preclude completion of actions within 60 days, EAP 18.1 provides methods for obtaining management approval to extend the completion date.

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-182 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley Unit 2 SEG

ACTIVITY AUDITED: 6.4 Materials Engineering

AUDIT DATE: 4/23 - 5/4/84 AUDITOR(S): MPBerardi

PERSON(S) REPRESENTING AUDITED ORGANIZATION: RDHarris REFERENCE(S): EAP 4.1

REQUIRED REPLY DATE: 8/6/84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the Materials Engineering Section of the report that requires a formal response. For complete details see the referenced report sections.

1. MATERIAL PROCESSING PROCEDURE DISTRIBUTION

   Material Process Procedures are not being receipt acknowledged nor being distributed to site personnel in a timely manner. There was approximately a 3 month period from the time Material Processing Procedure Rev. 13 was distributed from Boston to the time of receipt acknowledgement at the Site, and approximately 1 month period of time for Rev. 14. As of 5/1/84 site distribution has not been accomplished; therefore, the site subcontractors are not receiving documents in a reasonable time to implement the procedures. (Section 6.4.2.1)

2. E&DCRs

   E&DCRs are issued calling for a more restrictive acceptance criteria than previously required by the Specification but the acceptability of previous work was not stated, nor was the extent of applicability of change noted (e.g., E&DCR 2PS-3272). (Section 6.4.2.7)

3. PEL

   The QA requirements for E60XX Electrodes are not addressed in the Pre-Engineered List (PEL). Since these electrodes have been specified for Category I applications and they are non ASME III material, the PEL should contain the applicable Category I QA requirements from 10CFR50 Appendix B. (Section 6.4.2.2)

EA-318 Disc EA159

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-183 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley Unit 2 SEG

ACTIVITY AUDITED: 6.3 Engineering Mechanics

AUDIT DATE: 4/23 - 5/4/84 AUDITOR(S): CJHo/ABektore

PERSON(S) REPRESENTING AUDITED ORGANIZATION: CDHoumiller REFERENCE(S): EMTG-16-A, 2BVS-920

REQUIRED REPLY DATE: 8/6/84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the Engineering Mechanics Section of the audit report that require a formal response. For complete details see the referenced report sections.

1. Instrument Tubing

   Span spacing of supports for 3/8" tubing is increased in excess of technical guideline (EMTG) values, but there are no calculations or other documentation to justify this increase. (Section 6.3.1.2.2)

2. Instrument Tubing Supports

   The loading sheet used in 1/2" tubing support design calculations with the printed wording "Based on loads from EMTG-16-A Table 6" is not applicable. The loading used in 1/2" tubing support design is based on the analysis performed in calculation 599-470.1 NP(B)-067-XM-2. (Section 6.3.1.2.3)

3. Pipe Stress

   The SEG-EMD is evaluating N&Ds, which report spans of piping not supported per 2BVS-920, using an unissued procedure, 2BVM-233 "Qualifying Erection Spans Not Supported per 2BVS-920". (Section 6.3.1.2.1)

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-184 PAGE 1 OF 2

ORGANIZATION AUDITED: Beaver Valley 2 - SEG

ACTIVITY AUDITED: 6.2 Electrical

AUDIT DATE: 4/23 - 5/4/84 AUDITOR(S): HWMooncai/CKirschner

PERSON(S) REPRESENTING AUDITED ORGANIZATION: EFarino REFERENCE(S): 2BVM-212, 2BVS-931 STD-ME-27-11-1

REQUIRED REPLY DATE: 8/6/84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the Electrical Section of the audit report that require a formal response. For complete details see the referenced report sections.

1. Configurations exist (cable tray/sleeves) that have or could result in unsupported cable in excess of specification requirements. For example, an unsupported length of triplex cable leaving safety related tray 2TL6240 and entering sleeve 2WL340036 located in the Service Building El 730' measured approximately six feet. The subject tray and sleeve each belong to an associated bank of trays and sleeves which have a configuration that may lead to similar nonconformance when cables are pulled. Other banks of trays and sleeves with similar configurations were located nearby. (See Section 6.2.2.3)

2. Environmentally qualified electrical equipment was apparently modified at installation but there was no documentation available to demonstrate the modifications were approved and would not affect seismic qualification. Some safety related electrical cabinets are installed with a field fabricated and installed top section. These top sections are not specified in the associated equipment specifications. There is no evidence that these top sections were seismically qualified as a unit with their associated cabinets. Some examples include: PNL*REL252P, BAT-BKR*2-2P and PNL*DC2-06. (See Section 6.2.5).

3. The reasons for changes on revisions to some interim issue drawings issued by the SEG Electrical Group are inadequate. Revisions to interim drawings prepared by the SEG electrical group which incorporate additional raceway information transmitted by unnumbered E&DCRs from the Boston electrical design group do not describe the reason for change. Typically, the reason for change is indicated as "per Boston information". (See Section 6.2.2.1)

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-184
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4. Sectional view detail on interim issue, electrical installation drawings showing exothermic welding of cable is misleading. Electrical design standard STD-ME-27-11-1 requires that ground cable be attached to the containment liner by exothermically welding the cable to a vendor-attached angle or double plate only, not to the containment liner. Drawing No. 12241-RE-33D-3B section 1-1 is not accurate and depicts the exothermic weld to be in physical contact with the containment liner as well as the intended vendor-attached angle. (See Section 6.2.2.4).

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-185 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley Unit 2 - SEG

ACTIVITY AUDITED: 6.5 Power

AUDIT DATE: 4/23 - 5/4/84 AUDITOR(S): CMorrell

PERSON(S) REPRESENTING AUDITED ORGANIZATION: RTBurgas REFERENCE(S): EAP 5.3

REQUIRED REPLY DATE: 8/6/84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the Power Section of the report that require formal response. For complete details see the referenced report sections.

1. E&DCRs

   Instrument sample lines were installed without regard to possible condensate problems. The installation of new containment atmosphere sampling lines for measuring post accident hydrogen concentration does not prevent the possible loss of sample flow due to condensed liquid entrapment. (See Section 6.5.2.1)

2. CALCULATIONS

   Calculations exhibited a lack of attention to detail in that of 15 audited:

   a. Five used outdated input data (See Section 6.5.2.3.1)

   b. Seven had reference discrepancies (See Section 6.5.2.3.2 and 6.5.2.3.3)

   c. Eight used inappropriate assumptions (See Section 6.5.2.3.4)

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STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-186 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley Unit 2 - SEG

ACTIVITY AUDITED: 6.1 Control Systems

AUDIT DATE: 4/23 - 5/4/84 AUDITOR(S): FJRezendes

PERSON(S) REPRESENTING AUDITED ORGANIZATION: JGRosen, Jr. REFERENCE(S): MK-1022-1-2

REQUIRED REPLY DATE: 8/6/84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in the Control Systems Section of the report that require formal response. For complete details see the referenced report section.

Instrument Installation Drawings

There is no evidence that the Control Systems instrument specialist was consulted when the project deviated from SWEC standard MK-1022-1-2 by changing the vent valve size from 3/4" to 2" on the standpipes on water boxes 2VPS-TK24H and 2VPS-TK24F. (See Section 6.1.2.1)

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. 12241-187 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley Unit 2 - SEG

ACTIVITY AUDITED: 6.6 Structural

AUDIT DATE: 4/23 - 5/4/84 AUDITOR(S): FFChin

PERSON(S) REPRESENTING AUDITED ORGANIZATION: RMCharles, SKumar, RJFaust REFERENCE(S): EAP 5.3

REQUIRED REPLY DATE: 8/6/84 ACTION ASSIGNED: PRaySircar

DESCRIPTION OF CONDITION(S):

This Audit Observation identifies those items contained in Structural Engineering Section of the report that requires a formal response. For complete details see the referenced report sections.

Calculations

Structural calculations exhibit technical inconsistencies. Five out of the twelve calculations audited exhibited such inconsistencies. (See Sections 6.6.2.1.2 a, b, c, d, e).

6.1 CONTROL SYSTEMS

6.1.1 General

The audit consisted of a review of construction/installation documents that are originated and/or revised by the Site Engineering Group (SEG). The documents audited, on a sample basis, included specifications, E&DCR's, N&D's, and instrument installation and tubing (RK's) diagrams. In addition, a field walkdown was made for the main purpose of determining if installed instrumentation is protected from ongoing construction activities. The general quality and the technical design of the installation was also observed during the walkdown.

Based upon the sample of documents reviewed, in addition to technical discussions, it appears that the Control System Division (CSD) personnel of the SEG are performing their functions in a conscientious, efficient manner. Audit details, as well as discrepancies identified as a result of the audit, are discussed below.

6.1.2 Detailed Results

6.1.2.1 Instrument Installation Drawings (Interim Issues)

Approximately 15 instrument installation drawings (RKs) were reviewed at the site during the audit. The drawings were reviewed for conformance to SWEC standards and revisions required by site-originated E&DCRs.

The overall quality, legibility, neatness, and accuracy are considered very good. Designs conformed to SWEC standards except in two instances.

Two instrumentation standpipes on water boxes 2VPS-TK24H and 2VPS-TK24F were revised to change the vent valve size from 3/4" to 2 inch, as shown on RM-59A-11. SWEC power industry group standard MK-1022-1-2 requires a 3/4" vent valve for all standpipes. The project revised this vent size to permit the standpipe to be used as a condenser waterbox vent for maintenance purposes. Opening this vent may have an impact on the operation of the level instrumentation associated with the standpipe. It is recommended that the project review this matter with the responsible instrument specialist to ensure that this deviation from the SWEC standard does not impact the proper operation of the level instrumentation.

RESPONSE REQUIRED, see AO 12241-186.

6.1.2.2 E&DCR's

Twenty two E&DCRs were reviewed during the audit. In general, the clarity of the problem descriptions and solutions were acceptable. All of the sampled E&DCRs had been reviewed and approved by the appropriate project personnel. Seven of the sampled E&DCRs were revisions to original E&DCRs.

Instrument installation specification 2BVS-977 was reviewed to ensure that changes required by several E&DCR's were accurately incorporated into the specification. The specification had been revised to incorporate the E&DCR changes as required.

Two relatively minor discrepancies were noted in regard to revising instrument tubing (RK) drawings in compliance with site originated E&DCRs. In one instance an instrument support shown on RK-325A-1-2 was not at the elevation required on E&DCR 2PS-2685. The 1" difference was determined to be a drafting error. In the other instance the standpipe, top flange elevation and overall length as shown on RK-6H-2E and RK-6K-2B was not the same as required on E&DCR 2PS-3140A. The difference was construction clearance added as the E&DCR was being incorporated into the drawing. The site has issued revised E&DCRs to correct these discrepancies. Discrepancies of this type are relatively scarce and have no impact on safety or operation. Thus, no further response is required of the SEG.

6.1.2.3 N&Ds

Twenty-one N&Ds identifying nonconformances in instrumentation installation and procurement were reviewed. The dispositions were technically adequate. Some required a revision to the instrument installation specification, 2BVS-977.

6.1.2.4 Specifications

The only instrumentation specification that was revised by the site is the instrumentation installation specification, 2BVS-977. The specification, through addendum 3, was reviewed to determine that changes required by E&DCRs and N&Ds had been accurately incorporated.

As previously discussed, mandated changes had been accurately made. Other specification revisions were reviewed and found to be satisfactory. Addenda were reviewed and approved by the appropriate personnel.

6.1.2.5 Field Walkdown

A field walkdown of some instrument installations in the Containment, Auxiliary Building, and Fuel Pool Building was made to determine if adequate protection of instruments is provided. Also, the installation of some instruments was inspected for required valving and proper tubing configurations. Installed instrumentation, that was observed, was adequately installed and protected from construction activities by suitable, temporary metallic covers.

F.J. Rezendes (Control Systems)

D.H Rogers (Audit Team Leader)

6.2 ELECTRICAL

6.2.1 General

The objective of the audit was to evaluate the technical adequacy and design consistency of the electrical designs and changes accomplished at the SEG by the electrical group.

There were no advance change E&DCRs nor calculations issued by the SEG electrical group. The majority of purchase orders written for equipment required in the field are written by construction with no involvement of the SEG electrical group.

The areas audited included the following:

1. Design changes. Such changes mainly dealt with cable or conduit routing and installation by supplying information needed to complete the electrical installation:

   - o E&DCRs
   - o N&Ds
   - o Specifications
   - o Interim Drawings

2. Vendor Drawings

3. Electrical Separation

4. Other Considerations

Overall design consistency and technical adequacy exist among the audited electrical design and change documents produced by the SEG electrical group. Some concerns regarding unsupported cables, details for containment liner grounding, and seismic qualification of field additions to class 1E equipment were observed.

6.2.2 Detailed Results

6.2.2.1 E&DCRs

Forty-one E&DCRs were reviewed in detail. Most of the E&DCRs reviewed were concerned with incorporating field run conduits into SEG prepared interim drawings. Other E&DCRs concerned specification changes. The solutions were consistent with the appropriate drawings, electrical installation specification, applicable standards and good engineering practice.

The problem descriptions and problem solutions were clear although oversimplified. The person answering the problem solution is usually the same person initiating the problem description. Many problem descriptions concerning the electrical installation specification were written as a statement of fact rather than a problem seeking a solution. The associated problem solution becomes an act of

concurrence to change the interim drawing or the electrical installation specification. It is recommended that the SEG retrain their personnel in the preparation of E&DCRs.

Solutions to most E&DCRs audited required specialist expertise or affected other disciplines. Appropriate specialists and other disciplines had provided input to and concurrence with the dispositions.

Unnumbered E&DCRs were observed at the SEG electrical group. The Boston project electrical design group has been using the E&DCR form, intentionally unnumbered and unsigned, to transmit drawing change information to the SEG Electrical group. According to the SEG electrical group, this information consists of additional raceways that had been inputted into the computer at Boston, however, the computer generated ticket could not be issued by the ticket office for construction until the accompanying interim drawing was also issued incorporating this raceway addition. It was not the intent of the Boston project electrical design group that the use of these E&DCRs be subject to the requirements of 2BVM-203, section 9.0. The E&DCR form was used as a convenient method to transmit information to the SEG electrical group only. Henceforth, an IOC should be used in lieu of the unnumbered E&DCR to transmit this type of information from the Boston project electrical design group to the SEG electrical group.

During the review of revisions to the interim drawings which incorporated the additional raceway information transmitted by unnumbered E&DCRs from the Boston electrical design group, it was noted that the reasons for change on safety related drawings are not described (2BVM-212 Interim Drawing Control). Typically, the reason for change is indicated as "per Boston information".

RESPONSE REQUIRED, SEE AO 12241-184

6.2.2.2 N&Ds

Forty-five N&Ds were reviewed in detail. Most of the N&Ds issued were concerned with inaccurate conduit support locations and separation criteria violations between raceways and/or cables. The dispositions were clear, technically adequate, and incorporated in the associated specifications.

Most N&Ds audited required specialist or discipline expertise or affected other disciplines. Appropriate specialists and other disciplines had provided input and concurrence with the dispositions.

6.2.2.3 Specifications

The SEG electrical group has responsibility for one specification, "2BVS-931 Electrical Installation". The six E&DCRs with changes to the electrical installation specification were reviewed for content and checked for incorporation into the specification. The changes were clear and they were accurately incorporated into the specification.

Electrical installation specification 2BVS-931 and E&DCR 2PS-3346 state that the maximum unsupported length of cables running outside of raceways shall not exceed 4 1/2 feet. During a plant walkdown, it was observed that an unsupported length of triplex cable leaving safety related tray 2TL6240 and entering sleeve 2WL340036 in the Service Building, El 730' exceeded the maximum unsupported length and was measured at approximately 6 feet. The subject tray and sleeve each belong to an associated bank of trays and sleeves. The configuration of this bank of trays and sleeves may lead to similar nonconformances when cables are pulled. Other banks of trays and sleeves with similar configurations are located nearby.

RESPONSE REQUIRED, SEE AO 12241-184

6.2.2.4 Interim Drawings

E&DCRs and N&Ds requiring incorporation in the Interim Drawings were reviewed for content and checked for incorporation in the drawings. Thirty E&DCRs with changes to be incorporated into the interim drawings consisted of conduit additions. Four N&Ds with changes to be incorporated into the drawings consisted of three N&Ds with inaccurate location dimensions and one N&D with a grounding cable location change. They were clear in content and accurately incorporated in the drawings.

Electrical design standard STD-ME-27-11-1 requires that ground cables be exothermically welded on to six angles attached to the containment liner by the containment liner vendor/fabricator. There should be no exothermic weld contact to the containment liner by anyone other than the containment liner vendor.

Drawing No. 12241-RE-33D-3B, section 1-1 is not accurate. It depicts the exothermic weld of the ground cable to the containment liner to be in physical contact with the containment liner as well as the intended vendor - attached angle. Further observation during a field walk indicated that the exothermic welding of the ground cables to the six vendor - attached angles have not been performed. When this exothermic welding is performed, care must be exercised to avoid contact of this weld with the containment liner. Otherwise, possible metallurgical effects of this exothermic welding process on the containment liner may jeopardize its integrity as a pressure boundary membrane. The drawing does not show accurately the location of this exothermic weld on the vendor - attached angle to minimize the possibility of misinterpretation.

RESPONSE REQUIRED, SEE AO 12241-184

6.2.3 Vendor Drawings

Vendor drawings associated with installation of equipment were reviewed. Field implementation of the instructions included in eight drawings for fastening equipment to its mounting sills by methods of bolting, plug or fillet welding were verified as adequate by observation during a field walkdown of safety related switchgear, load centers, battery racks, battery chargers and dc switch board.

6.2.4 Electrical Separation

During field walkdowns and as indicated on raceway drawings, many inconsistencies with the separation criteria (2BVS-931) were observed in the separation space between non safety related cables/raceways/sleeves and safety related cables/raceways/sleeves. Further investigation indicated that this condition was previously identified by the Project and the Project has established the Electrical Separation Task Group to determine the extent and corrective action required to rectify this situation. Hence, no further review by EA was conducted on electrical separation.

6.2.5 Other Considerations

During field walkdowns, some safety related cabinets were observed to include a field fabricated top section. These top sections are used to facilitate conduit and cable entry into the cabinet. There is no evidence that these top sections were included in the seismic qualification of their associated cabinets. Some typical examples include PNL*REL252P, BAT-BKR*2-2P and PNL*DC2-06.

RESPONSE REQUIRED, SEE AO 12241-184

H.W. Mooncai (Electrical)

D.H. Rogers (Audit Team Leader)

6.3 ENGINEERING MECHANICS

6.3.1 PIPE STRESS

6.3.1.1 General

The following design work performed by the SEG-EMD Group was evaluated during the Pipe Stress portion of the audit:

1) Qualifying temporary erection spans not supported per 2BVS-920.

2) Instrument tubing and instrument tubing supports.

Pipe stress analyses, seismic qualification of electrical equipment and duct support analyses/design, performed by the Boston Project and anticipated by the audit plan for the SEG-EMD, are not performed by SEG-EMD. Therefore, this area was not audited.

In general, the work reviewed was found to be acceptable. The proficiency of EMD personnel at the SEG was apparent. However, some concerns were identified during the audit and are discussed.

6.3.1.2 Detailed Results

6.3.1.2.1 Qualifying Temporary Erection Spans not Supported 2BVS-920

A concern identified during the EMD portion of the audit is the use by the SEG-EMD of an unissued procedure (2BVM-233) to substantiate the "accept-as-is" disposition of N&Ds reporting spans of piping not supported per 2BVS-920.

Specification 2BVS-920 requires the temporary support of piping during erection. The maximum temporary pipe support spacing is given in Sketch No. 2BVS-920-17-3. To date SQC (Site Quality Control) has issued over 200 Nonconformance and Disposition reports (N&Ds) against the present criteria.

The general problem was identified in NRC Infraction Notice 83-04-01 on April 22, 1983. The Infraction Notice stated "Quality requirements for temporary supports were not included in specification 2BVS-920 or Field Construction Procedures FCP-207". Temporary piping supports are of concern because the integrity of penetrations, equipment, nozzles, piping and permanent pipe supports may be compromised if associated piping and in-line devices are not properly supported during any phase of construction.

Sixty-seven (67) N&D evaluations by SEG-EMD were reviewed. Proposed Procedure 2BVM-233, "Procedure for Qualifying Temporary Erection Spans Not Supported per 2BVS-920", is the basis of these N & D evaluations. 2BVM-233 was modified during the audit by the SEG-EMD to address auditor concerns re allowable stress (Sy) and the time frame pipe could be unsupported (perhaps several months). 2BVM-233 is currently in the review/issue process pending the approval of EMD and issuance by the Project.

RESPONSE REQUIRED, see AO 12241-183.

There are two minor comments on the calculations associated with the above N&D dispositions:

a. Calculations 12241-NP(F)-395 & -383 have the same calculation title. Calculation title duplication should be avoided. The SEG-EMD group agreed during the audit that all future work will have individual titles. No further response is required of the SEG.

b. The preprinted calculation sheet for hydrotest condition did not use the formula addressed in the specification. However, the computations involved reflect the fact that the right formula was used; their results are correct. It is recommended that the SEG-EMD correct this printing error in these calculations.

6.3.1.2.2 Instrument Tubing

Six tubing packages were reviewed, including applicable E&DCRs.

The system established by specification 2BVS-977, "Installation of Instruments ASME CODE SECTION III Class 2&3, and ANSI CODE B31.1 Class 4", has been implemented. The span spacing of tubing supports for 1/2" tubing deviates from EMTG-16A; and the deviation is justified by EMD Calculation No. 599-470.1 NP(B)-067-XM Rev. 2. The 3/8" tubing's span spacing is increased by engineering judgement over EMTG values. This judgement needs to be substantiated by calculation or other means and confirmed by the EMD staff stress specialist.

RESPONSE REQUIRED AO 12241-183

The instrument tubing isometric drawings were created by the Control Systems Group, then reviewed and approved by SEG-EMD. A stress check list was used to justify that the tubing is adequately supported per specification 2BVS-977. Any calculation associated with this stress check for a package was included in the support calculation for that package. It is recommended that those computations associated with stress check (such as thermal offset length or a reference like the aforementioned EMD calculation) should be included with the stress check rather than included in support calculations. SEG-EMD was aware of these conditions and stated that instrument tubing stress calculation is going to go into greater detail about the acceptability of the tubing configuration and will include any necessary calculations and references. The implementation of this program will be evaluated during a future audit.

6.3.1.2.3 Instrument Tubing Supports

The loading used in tubing support design is that recommended in an IOC by J. Doyon to C. Houmiller dated 2/1/82 and is based on the analysis performed in calculation 599-470.1-NP(B)-067-XM-2. Therefore, the loading reference on the loading sheet used in tubing support design calculations, which states "Based on Loads from EMTG-16.A TABLE 6", is incorrect. (Refer to section 6.3.2.2.2 below).

RESPONSE REQUIRED AO 12241-183

The following minor comment has been discussed with SEG-EMD who have taken the suggestion under advisement.

a) The storage ATS Name for a computer program run should be traceable and unique to avoid confusion. Even though the microfiche of a run are stored, it is recommended that the standard format for the ATS Name not use a designer's initials. Calculation 12241-NP-(F)-Z900N-077 includes an "Anchor Problem Evaluation" (APE) computer program run whose ATS storage name is coded JEG.APE.7A. JEG are the initials of the designer. A better ATS Name format would have been Z900N.077.APE.

6.3.2 PIPE SUPPORTS

6.3.2.1 General

The scope of the Pipe Supports portion of the audit of SEG-EMD covered engineering/design changes in the following areas that were initiated in the last 12 months.

(1) Manual and Computerized support calculations for large bore piping.

(2) Support calculations for instrumentation tubing.

(3) BZ (Pipe Support) interim issue drawings.

(4) N&Ds

(5) Advance Change E&DCRs

The audit process consisted of examination of calculations, drawings and documents followed by a visit to the plant areas for confirmation that actual conditions agreed with those indicated by the above calculations, drawings and documents. Although the prime scope of the audit was technical, nevertheless, attention was also given to the documentation of reviewed items.

Generally it was observed that calculation methods and assumptions, as well as the designs verified by these calculations, were adequate. No computation errors were found in the manual and computerized design calculations. However, some inconsistencies were observed in the documentation of calculations and are described in detail in the following paragraphs.

6.3.2.2 Detailed Results

6.3.2.2.1 Pipe Supports Manual and Computerized Calculations

Three pipe support calculations were reviewed for technical adequacy and extent of documentation. Two contained computer analyses. In all calculation packages a preprinted "boiler plate" format was used for as much of the contents as possible. For generic objectives, methods, sources, and conclusions; reference was made to the "Master Calculation". Review of the manual and computerized calculations for

accuracy of results indicated they were adequate. However, documentation review indicated some minor inconsistencies: wrong attachments and references, limited revision comments and not enough description in the body of the calculation to readily follow the calculation's development.

6.3.2.2.2 Calculations for Instrumentation Tubing Supports

Calc. No. 12241-NP(F)-Z900U-897, for Support No's 2HVP-TSA897 & -TSA 898, was selected and reviewed. Details of the supports were shown on Drawing 12241-BZ-900U-355-1. Qualification of stress and supports was based on EMTG-16A. The support design loads used were those recommended in the IOC to C. Houmiller from J. C. Doyon dated 2-1-82 and reported above in Section 6.3.1.2.3.

In the same calculation, it was further observed that acceptability of the support was not based on comparison of the calculated loads imposed on the support's structural components (consisting of uni-struts and TS members) to allowable or acceptable loads; but, rather, reference was made to generic calculations which qualified these structural components. During the audit the SEG-EMD agreed that a load comparison will be contained in all future calculations. The implementation of this change will be verified during a future audit.

6.3.2.2.3 BZ-Pipe Support Interim Issue "Drawings"

Approximately 100 BZ Support Drawings were reviewed for consistency, clarity, design changes, technical adequacy, and timely inclusion of Advance Change E&DCRs. The review showed Advance Change E&DCR solutions and the resulting drawing changes in agreement. Further, Advance Change E&DCRs were incorporated within the time limits indicated by 2BVM-203. In addition, it was observed that no more than two Advance Change E&DCRs were incorporated into one drawing. The other attributes indicated above were found to be satisfactory.

6.3.2.2.4 N&Ds

Ten N&Ds were reviewed. Condition Details and Dispositions were found to be acceptable. However, one N&D disposition raised a question.

N&D 2941, written against Support 2SIS-PSR-008, stated that the total installed cold lateral clearance for the support was 0.137" while 0.135" clearance was the maximum allowed. This N&D was dispositioned by calling for a 0.125" shim to be added to the support to reduce the clearance to .012", a repair necessitated by a 0.002" non-conformance. When questioned, the SEG-EMD responded that recent discussions with EDM-Boston have lead to a more practical disposition of this type of N&D. It is understood that minor clearance deviations (0.015" or less) will now be accepted provided this excess clearance does not affect the functional integrity of the support. No further action is required of the SEG.

6.3.2.2.5 Advance Change E&DCRs Issued Within Last 6 Months

Approximately 100 Advance Change E&DCRs were reviewed. The results are as follows:

a) Advance Change E&DCRs were approved by authorized personnel assigned by SEG to Advance Change E&DCR program.

b) Clarity, completeness of problem descriptions and solutions were satisfactory.

c) Review and approvals and incorporation of information into BZ-Support drawings were made within time limits set by 2BVM-203.

d) No more than two Advance Change E&DCRs were incorporated into a drawing.

C.J. Ho (EMD -Stress)

D.H. Rogers (Audit Team Leader)

A. Bektore (EMD - Supports)

6.4 MATERIALS ENGINEERING

6.4.1 General

Materials Engineering (MED) involvement in the BV2 SEG Technical Audit included the evaluation of the following subjects:

a. SWEC issued Material Processing Procedures completeness and timely issuance/distribution.

b. Materials Pre-Engineered List (PEL).

c. Supplier technical document reviews.

d. Materials field purchase requisition/purchase orders.

e. Drawing reviews.

f. Specification revisions.

g. E&DCRs

h. N&Ds

6.4.1.1 The evaluation of the adequacy of the following subjects determined them to be acceptable with no discrepancies noted:

a. material field purchase requisitions/purchase orders

b. drawing reviews

c. specification revisions

6.4.1.2 The evaluation of the adequacy of the following subjects determined them to be acceptable with only minor discrepancies noted.

a. supplier technical document reviews

b. N&Ds

6.4.1.3 The evaluation of the adequacy of the following subjects revealed specific areas of concern:

a. Material Processing Procedures - The distribution cycle appears to be delayed and needs some attention.

b. PEL - Insufficient QA requirements to satisfy 10CFR50 Appendix B and lack of review/approval of Specialist.

c. E&DCRs - Applicability of change to more restrictive acceptance criteria for existing welds not specified.

6.4.2 Detailed Results

6.4.2.1 Material Processing Procedures

The attributes that were evaluated to determine the adequacy of the SWEC issued materials processing procedures included: correctness of latest revision in site distributed procedures, comparison of manuals to the latest distributed manual index, and timely distribution of procedures by site.

The latest manual index from the Boston office was Revision 14 issued March 8, 1984. As of May 1, 1984, the site still had not distributed this revision package.

A procedure manual was checked for completeness against Revision 13, the latest site distributed procedure package. The manual was intact except that one technique sheet, W101A was included in the manual under W600A, Rev. 8 but not listed on the index. In a discussion with the Lead Materials Engineer in Boston it was indicated that the technique sheet was issued with Index Revision 13 of W600A, but was neglected to be listed on the index. This error was in the process of being corrected.

The distribution cycle for the last three material processing procedure indices (Manual Revisions 12, 13 and 14) were evaluated. Revision 12 was issued from Boston on January 6, 1983 and the date of receipt acknowledgement (from Site Document Distribution Center) was January 21, 1983. Revision 13 was issued from Boston on June 14, 1983 and the date of receipt acknowledgement (from Site Document Distribution Center) was September 7, 1983. If should be noted that a reminder notice was sent to the site at the beginning of July and the site responded on July 8, 1983. The latest package Revision 14, was issued from Boston on March 8, 1984. As of May 1, 1984, the recipients at the site had not received this package from the Site Document Distribution Center. In a discussion with personnel from the Document Control Center, it was learned that part of the problem in this latter distribution was due to a mix-up of these procedures with the Q-1 forms transmitted at the same time. The two packages were inadvertently put together and were distributed as a Q-1 package, only. This error was in the process of being corrected during the audit. However, based on the last two revisions there appears to be some unnecessary delay in distributing Materials Processing Procedures at the site. The project should investigate the cause for these apparent delays and implement measures to distribute these procedures in a reasonable time period.

RESPONSE REQUIRED, see AO 12241-182

6.4.2.2 Materials Pre-Engineered List (PEL)

The attributes that were evaluated to determine the adequacy of the materials pre-engineered items included: acceptability of adding new materials to PEL based on scope of the PEL, appropriate approvals, and completeness of technical and quality assurance requirements.

The weld filler metals on the PEL fall within the scope of the PEL and are included on the list. A total of 15 pre-engineered items (weld filler metal/electrodes) were reviewed.

In all cases the materials added to the PEL fall within the defined scope of these documents. In all cases, except one, adequate approvals were obtained, the ASME III quality assurance requirements were included, and these requirements were considered to be adequate for both ASME III and 10CFR50, Appendix B. The exception was E60XX electrodes. E60XX are not ASME III acceptable electrodes, but can be used for other QA Category I applications. However, none of the quality assurance requirements to satisfy 10CFR50, Appendix B were included in the PEL. (PEL No. 301- page 609). The PEL indicated QA Categories I, II, and III applicability. In addition, the specialist's approval was not obtained for this entry on the PEL; the review/approval form was annotated "N/R".

The Project should determine whether E60XX electrodes, utilized for Category I applications, meet the Project's Category I Quality Assurance Program requirements. Further, the Project should obtain the proper approvals for the cited PEL.

RESPONSE REQUIRED, see AO 12241-182

6.4.2.3 Supplier Technical Document Reviews

The attributes that were evaluated to determine the adequacy of the supplier technical document reviews by materials engineering included: completeness of review form, proper utilization of check sheets, clarity of comments, disposition status, reviewer's signature noted, and indication of specification numbers in disposition stamp block.

A total of eight suppliers' welding procedures were reviewed. In two of eight cases the specification to which the procedure was to be reviewed against was not noted on the document review form (PS-232 Rev. 0, Northern Steel Corporation and SPBV 1252 Rev. 3 Schneider Power). For this latter procedure, several specifications were noted in the disposition block whereas only one was noted on the document review form.

In all cases examined, check sheets were being utilized. In two out of eight cases the procedures were dispositioned as acceptable, however, notation of any comments was not provided on the review form. Generally, "No Comment" notation should be provided in these cases. (SPBV-409G Rev. 0, Schneider Power and SPBV 126 Rev. 0, Schneider Power).

In one out of eight cases the disposition stamp was not affixed to the procedure. (PS-232 Rev. 0.-Northern Steel Corp.) This would lead to a nonconforming condition when utilized for production work since there would be no obvious evidence to the Shop Inspector that SWEC approval of the procedure was obtained.

In all cases, the reviews/approvals were adequate and properly noted in the review forms. In two out of eight cases the specification number was not noted on the procedure (PS-232, Rev. 0, Northern Steel Corp. -

no disposition stamp was affixed to the procedure and WPS-No. 8-8GT-52 Rev. 1, Westinghouse). This could lead to some confusion as to the acceptability for the use of the procedure for specific work to which it is applicable. These latter documents were judged to be technically adequate and in the opinion of the auditor no significant finding was noted.

The project should reemphasize, to the respective personnel involved, the importance of meeting all aspects of procedure reviews (EAP 9.2 and METP 7.1) to satisfy a complete and adequate review of supplier technical documents. In addition, all above discrepancies should be resolved by the project on the documents affected.

6.4.2.4 Materials Field Purchase Requisitions/Purchase Orders

The attributes that were evaluated to determine the adequacy of the field purchase requisitions/purchase orders for materials included: adequacy of technical and quality assurance requirements, adequacy of reviews/approvals, and specification/purchase order agreement.

Four field purchase requisitions/purchase orders were examined and were found to be acceptable for these attributes. The technical and quality assurance requirements in each case examined were invoked by reference to the ME document numbers included on the applicable PEL. Although only ASME III quality assurance requirements have been invoked, it was the auditor's opinion that these also satisfied 10CFR50, Appendix B requirements for procurement of weld filler metal utilized for Category I work. This opinion was concurred with by telephone communication with SWEC's Quality Assurance Department in Boston.

6.4.2.5 Drawing Reviews

The attributes that were evaluated to determine the adequacy of the materials drawing reviews included: completeness of weld fabrication details, technical adequacy of materials, adequacy of special fabrication notes, and compliance with specification requirements.

A total of 10 pipe support drawings (BZ series) were examined. All attributes were satisfied in an acceptable manner, except in one instance. In one out of 10 cases, the weld fabrication detail indicated a penetration weld size that was thicker than the metal to be welded (lug to pipe weld) (BZ-19A-49-0B). Since a full penetration weld was implied, this discrepancy would only result in a technical problem if a thicker lug material is needed to satisfy the design requirements. This one occurrence appeared to be an oversight on the preparer's part; and, therefore, no corrective action is recommended for the project other than resolving this discrepancy on the engineering documents affected.

6.4.2.6 Specification Revisions

The attributes that were evaluated to determine the adequacy of the specification revisions included: compliance with project procedure for updating, clarity and identification of changes, technical adequacy of changes, and acceptable reviews.

There are only two material specifications issued on this project; namely, 2BVS-901 and 2BVS-975, and both were examined. In both cases all of the above attributes were satisfied and considered acceptable.

In the process of examining Specification 2BVS-975, it was noted that the SEG central files contained the incorrect revision of Specification 2BVS 975 (Revision 3 rather than Revision 4 the latest issued revision). It was determined that the SEG received Revision 4 (Signed copy of the receipt acknowledgment was obtained from the Document Distribution Center). Although Addenda Nos. 1, 2, and 3 written against Revision 4 were included in the folder, the replacement pages from these addenda were filed with Revision 3 of the specification. This discrepancy was brought to the attention of the SEG and they indicated that it will be corrected. Because of the small sample size the auditor could not ascertain whether this was a unique case and/or a general problem. It is recommended that the project check a few folders in the SEG central specification files for correctness.

6.4.2.7 E&DCRs

The attributes that were examined to determine the adequacy of the E&DCRs included: clarity of problem description, clarity of solution details, technical adequacy of solutions, correctness of reviews/approvals, related activities properly coded, and compliance with MED technical guidance.

A total of eleven E&DCRs were examined. In four out of eleven cases the problem descriptions were not readily discernable without additional investigations (2PS-649, 2PS-767, 2PS-831, 2PS-3272).

In two out of eleven cases, all reviews/approvals were not apparently obtained. On E&DCR 2PS-1284 there was no evidence that Materials Engineering had reviewed the change even though the change related to weld fabrication details. E&DCR 2PS-2437 did not obtain reviews/approvals from a second discipline reviewer.

In all cases the related code activities required by Project Procedures were adequately complied with, and compliance with MED technical guidance was acceptable.

The above discrepancies appear to be primarily on earlier issued E&DCRs and it was the opinion of the auditor that, in general, the current E&DCRs are being handled in a technically adequate manner.

In one out of eleven cases the solution was considered inadequate (2PS-3272). This E&DCR invoked a more restrictive change to the acceptance criteria for unistrut welds. However, the extent of applicability of this change to past work was not noted in the E&DCR. It was unclear whether there was any previous work accepted to the original criteria and, if so, whether this work was now technically acceptable. The Project should ascertain the acceptability of unistrut welds and establish a formal procedure which clearly delineates the methodology used for dispositioning previous work when changes are made.

RESPONSE REQUIRED, see AO 12241-182

6.4.2.8 N&Ds

The attributes that were evaluated to determine the adequacy of N&Ds included: clarity of condition details, clarity of dispostion, technical adequacy of disposition, appropriateness of reviews/approval, and compliance with MED technical guidance.

A total of 18 N&Ds were evaluated. The results of the evaluation indicated that in two out of 18 cases the condition details were not clear (N&D Nos. 2280 and 2280A, revision to the former). In all cases examined, the disposition details were clearly presented. In one out of 18 cases the disposition details appeared to be incorrect and a revision to the original N&D was required (N&Ds 2280 and 2280A, respectively). The original disposition indicated a rework, but the actual condition required a repair. In three out of 18 cases examined, the reviews/approvals were not correct. N&D 1246A did not have the appropriate equipment specialist's review/approval. N&Ds 1844 and 2280A did not have two different engineers from the same discipline reviewing/approving in the Dispositioned By and Lead Engineer's blocks, a requirement of EAP 15.2. In all cases there was acceptable compliance to MED technical guidance.

The above discrepancies appear to exist on earlier issued N&Ds. In the more recent N&Ds (i.e., eight out of the 18) examined all of the above attributes considered were acceptable. Therefore, specific corrective measures are not recommended for nor is any further action required of the project since there were no technical problems remaining and/or resulting from the earlier dispositions. In addition, the procedures being currently followed are consistent with prescribed policies and have not resulted in any problems from the more recent N&D dispositions.

M.P. Berardi (Materials Engineering)

D.H. Rogers (Audit Team Leader)

6.5 POWER

6.5.1 General

The scope of the Technical Audit consisted of a review of design documents generated by the Site Engineering Group (SEG) to determine if they are consistent with the associated design documents and requirements. A sample of the following documents were reviewed during the audit:

1. E&DCRs
2. N&Ds
3. Calculations
4. Interim Issue Drawings
5. Site Purchase Requisitions/Purchase Orders
6. Vendor Documents
7. Specification Changes

The model shops interface with design/constructability of design changes was also evaluated during the audit. The evaluation indicated that the plant model is consulted frequently by the SEG personnel and represents a good tool in verifying constructability of designs prior to actual construction.

The results of the audit indicate that the design documents issued by the Power Division SEG are adequately prepared and consistent with the associated design requirements. Some discrepancies were uncovered during the audit, however; and they are detailed below.

6.5.2 Detailed Results

6.5.2.1 E&DCR's

Fifteen E&DCR's were reviewed in detail to ensure that the appropriate personnel have reviewed and approved the change request; that the problem descriptions and solutions were clear and complete; the design changes were consistent with the associated design documents and requirements; and the problem solutions were technically adequate. In all cases the E&DCR's received the correct review and approval signatures. The problem descriptions and solutions were sufficiently clear and consistent with the design requirements.

One E&DCR and its subsequent revisions (2PS-3091, 3091A and 3091B) were technically deficient in one area of design. This E&DCR revised a Boston issued E&DCR (2P-4173) installing new containment atomospheric sampling lines for measuring the post accident hydrogen concentration. The supply lines to the hydrogen analyzers did not provide for sloping or heat tracing to prevent loss of sample flow due to water entrapment. Since the analyzers draw a saturated air sample from the post LOCA containment atmosphere, liquid will condense out and flow to the low points of the sample lines causing a water seal.

Recommendation

The Project should revise the flow diagram (RM-110A) to indicate that the sample supply lines are sloped or heat traced. Either method is acceptable, however, each has its drawback. Continuous sloping requires an interference free routing whereas the heat tracing must be class IE with seismic Category I insulation to support its safety function.

RESPONSE REQUIRED, see AO 12241-185

6.5.2.2 N&Ds

Twenty one N&Ds were audited at the SEG. Evaluation of the N&Ds indicates that the problem descriptions and dispositions are generally clear and complete, are technically adequate and supported by appropriate documentation. The appropriate review and approval of each N&D was obtained except for "Headquarters Lead Engineers" concurrence for six of the Category I "Accept as is/Repair" N&Ds per requirements of 2BVM-218. Five of the six N&Ds (6437, 6440, 6446, 6459, and 6471) occurred prior to the February 1984 revision of 2BVM-218 and one subsequent (7230) which appears to be an isolated occurrence, therefore, no further action is required of the project.

All N&Ds audited which affected other disciplines or required specialist input indicated concurrence of those affected disciplines or specialists in the disposition.

The technical assessments for Report of a Problem, 10CFR50.55(e) evaluations, and affected licensing documents were correctly performed for the Category I N&Ds reviewed.

6.5.2.3 Calculations

Fifteen minimum wall thickness calculations were reviewed for assumptions, methodology, inputs, references, and conclusions (minimum wall calculations were the only type prepared by the power group). The results of the review were that the calculations methodology and conclusions were valid. However, the following problem areas were identified:

1. Calculations performed prior to the time when the line designation tables (LDT) became controlled documents utilized input data (temperature and pressures) from the pipe stress data transmittal which are inconsistent with the current issue of the LDT (revision 31, 1/3/84). The Project evaluated the audited calculations (P1004, P1010, P1012A, P1019, and P1047) against the current data and determined that the conclusions remained unchanged. The Project agreed to reconcile all calculations to the latest issue of the line designation table.

   RESPONSE REQUIRED, see AO 12241-185

2. The reference section of the calculations reviewed does not sufficiently identify the sources of data utilized. Calculations

P1002A, P1004, P1008, P1009 and P1010 did not identify the line designation table as source for pipe class, schedule, and fluid. The remaining calculations reviewed listed the LDT, however, the applicable job number and issue date for traceability were missing. Also, all calculations reviewed did not identify the source for piping material type (Piping Design Spec. 2BVS-939). The project agreed to revise all calculations to include the LDT and 2BVS-939 specification including job number, revision, and date of issue.

RESPONSE REQUIRED, see AO 12241-185

3. Two calculations reviewed (P1012A and P1069) concerning ASME III Code Class 1 piping referred to ASME III Article NC3641.1 instead of NB3641.1. Both articles have similar minimum wall thickness formulas, but they differ on the applicable stress allowables. The stress values used in both calculations, however, were obtained correctly. The Project agreed to revise calculations P1012A and P1069 to refer to NB3641.1 of ASME III.

Recommendation

Revise the standard check-off list of references utilized for minimum wall calculations to include ASME III, NB3641.1.

RESPONSE REQUIRED, see AO 12241-185

4. Calculations for carbon steel pipe (P1004, P1009, P1019, P1020, P1047, P1071, P1073, P1077) assumed a corrosion/erosion allowance of 0.04 inches. The calculations should use a referenced input value that is traceable to the Materials Division since corrosion/erosion is "outside" Power Division's area of responsibility.

The Project agreed to incorporate a reference of the shop fabricated piping specification 2BVS-58 which has a 0.04 inch corrosion allowance in the pipe bending section and has been approved by Materials Division.

Recommendation

The Project should consider including the corrosion/erosion allowance into the piping design specification 2BVS-939.

RESPONSE REQUIRED, see AO 12241-185

6.5.2.4 Interim Issue Drawings

Six interim issue drawings were audited. Five drawings were revisions to piping drawings and the sixth was a revision to a flow diagram. The basis for changes were mainly E&DCRs and Boston requested changes. All changes were technically adequate, consistent with project documents, and clearly identified on each drawing with a circle and revision symbol.

The record of change sheet for the Category I drawings reviewed correctly identified all changes with the appropriate reasons listed. Boston requested changes via an IOC were described with reference to a

controlled source document (e.g., RP-72D-7B relocated relief valves per IOC and a "controlled" SWEC setpoint calculation). The referenced Boston initiated IOCs, however, are not a project controlled document. Although all drawings reviewed for the audit did not require the referenced IOC to document the reason for change, it is recommended that the SEG establish a project file for Boston IOCs requesting interim issue drawing changes.

The review and approval of all drawings reviewed, except for flow diagrams, were performed by the appropriate personnel. The interim issuance of flow diagrams (RMs) by the SEG apparently does not comply with 2BVM-203 section 6.1.2 where only MINOR changes are allowed to be made by the SEG nor does it satisfy EAP 5.9 section 1.3 where the project Lead Controls Engineer's review and an Operational Design Review by Advisory Operations Division of each issue of flow diagrams is required. The Project stated "Since flow diagrams are issued as interim series drawings, section 1.5 of EAP 5.4 applies. (This EAP applies because flow diagrams are considered as production drawing on BV2). Section 1.3 of EAP 5.9 and Section 1.4 of EAP 5.4 pertain to Boston issued drawings only. The review and approval requirements of interim issued drawings are described in Design Procedure DP-P-11.1 which does not specifically require the Lead Controls Engineer or ODR review."

The Project statement is inconsistent with SWEC's objective of obtaining the same level of review for interim issued drawings as would be obtained by the Boston issued drawings. A similar concern was raised during a previous audit of the Boston Project (see AO 12241-181). The resolution of the concern reported here will be tracked as part of AO 12241-181.

6.5.2.5 Site Purchase Requisitions/Purchase Orders

Three purchase orders and one memo-of-change to an existing order were reviewed during the audit. The four purchase orders reviewed were for equipment from the Pre-Engineered Material List (PEL) which provides approved engineering requirements for the product. The information from the PEL was correctly incorporated into the Purchase Orders reviewed. The technical information and quality requirements were sufficiently delineated to provide an acceptable product, the descriptions of items to be purchased were clear and complete, and submittal of key vendor documents (stress reports, hydro test reports, and certificate of compliance) were correctly specified.

6.5.2.6 Vendor Documents

The following vendor documents were reviewed during the audit: a ventilation damper assembly drawing, a component stress report, and a certificate-of-compliance. The documents reviewed are consistent with specified requirements, are technically adequate for the associated system design requirements and received the appropriate level of review and approval.

6.5.2.7 Specification Changes

Three addenda to site controlled specifications were reviewed for design consistency and found acceptable. The changes were addenda 3 and 4 to revision 7 of specification 2BVS-920 (Fabrication and Erection Piping) and addendum 1 to revision 3 of 2BVS-934 (Installation of Heating and Cooling System). The specification changes reviewed were clearly identified in the text and listed on the reason for change sheets. The majority of the changes to the specifications were to incorporate N&Ds and E&DCRs.

Calvin D Morrell, Jr.
C. Morrell (Power)

David H Rogers
D.H Rogers (Audit Team Leader)

6.6 STRUCTURAL

6.6.1 General

The audit consisted of reviewing documents developed by the structural discipline of the Site Engineering Group (SEG). The major effort of the Structural SEG has been and is devoted to the analysis and design of electrical conduit supports in providing assistance to Sargent Electric Company (SECO), the electrical contractor, for conduits and cable trays. In addition, other activities include designs and design changes to resolve installation problems and the resolution of non-conformances. Documents reviewed include calculations, E&DCRs, N&Ds, revisions to specifications, interim issue drawings, and requests for cutting embedded steel.

Results of the review indicate that structural engineering and design work performed by SEG is generally consistent with governing procedures. Documents prepared by the structural discipline are technically adequate and provide the required details for construction. However, instances of procedural non-conformances and minor technical errors in calculations were identified. None of the above items invalidate the results of the work performed.

6.6.2 Details

6.6.2.1 Calculations

The calculations performed by the Structural group of the SEG are, for the most part, those required for the analysis and design of unique conduit and cable tray supports. The generic designs for support of these systems have been done at the Boston office and are identified on the electrical drawing series RE-52 for conduit and RE-34 for cable tray. Twelve calculations (conduit and cable tray supports, equipment and tank anchors, steel plate and concrete manhole designs) were reviewed. Generally, the assumptions, methods, inputs are reasonable and correct. The calculations reviewed are technically adequate, and complete; resulting designs are constructable and generally conservative. However, some technical inconsistencies as well as shortcoming in documentation which had no adverse impact on the results of calculations were identified and they are discussed below.

1. The Design Criteria for Electrical Conduit and Cable Tray Supports, Part IV of 2BVM-5, Structural Design Criteria, was just issued prior to this audit in response to the previous BV-2 technical audit at Boston (AO 12241-172). These criteria document the requirements and provide direction in allowable design stresses, load combinations, materials and general analytical procedures for designing supports. Based on the calculations reviewed during this audit, the stresses for the conduit supports are within the limits set forth by this design criteria. However, during the reconciliation program support calculations should be reviewed and, where necessary, reconciled to comply with Part IV of 2BVM-5.

2. Instances of minor technical discrepancies which do not affect hardware were found in some calculations as follows:

   a. The overturning moment for the vertical seismic uplift had not been taken into account for the filters in qualifying the anchor bolts or studs in calculation No. 5CA-175(F).

   b. Incorrect section modulus (P1001B instead of P1001A) for unistrut was used in bending stress computation in calculation No. 5SED(F)130. This would be an overstressed condition if correct value was used. However, the support was requalified during the audit utilizing lower up-to-date seismic "g" values.

   c. There was no evidence that the capacity for the weak axis of structural tubing 6 x 2 x 3/8 for cable tray support R-825 had been evaluated for added conduits attachment in calculation No. 5SEB(F)200. Although the weak axis of the supporting tube steel is the strong axis of the frame, its adequacy to carry additional conduits loading should be documented.

   d. Calculation No. 5SEC(F)204 has not been updated to reflect the latest applicable seismic "g" values. In addition, the horizontal SSE "g" values transmitted from Boston to SEG via IOC dated 7/26/83 and used in calculation 5CA-169(F) are approximately 25% less than the correct values referenced in calculation NM(B)-276-CF. Since the stresses are low in these two calculations, the use of correct seismic "g" values will not invalidate the conclusion of the calculations. Project indicated that these calculations will be revised during the reconciliation program.

   e. All designs reviewed reference AISC allowable stresses for light gage cold formed open sections when the proper reference should be AISI allowable. The only major difference in these two specifications is in the allowable column loads which rarely govern the design of the support. However, a calculation has been initiated in the Boston office to provide stress comparisons and documentation of the above reference.

   All of the discrepancies cited above, with the exception of those dealing with "g" values were resolved during the audit. These corrections do not affect the final results of the calculations; however, the SEG should take action to improve the quality of their calculations.

   RESPONSE REQUIRED, SEE AO 12241-187

3. The calculations reviewed did not include the Record of Confirmation Sheet. STP 11.5 requires that the above sheet be included in calculations even though there is no unconfirmed data required. A deviation request for the above non-compliance was initiated by the Project during the audit.

4. 2BVM-205, Site Engineering Group Organization Chart, does not define all levels of responsibility identifying immediate supervisors within the Structural Group. As a result, it is difficult to determine whether personnel who perform independent reviews of calculations are qualified as independent reviewers under EAP 5.3. It is recommended that a detailed organization chart be published to document all levels of responsibility within the Structural discipline.

6.6.2.2 E&DCRs

Ten E&DCRs were reviewed. Eight of the ten E&DCRs involve various specification changes ranging from coating of concrete surfaces to material substitution. The problem descriptions and solutions were clear and technically adequate. The review and approval of the E&DCRs had been performed by the appropriate personnel.

It was noted that the Structural discipline had issued very few E&DCRs. However, Requests for Information (RIs) have been extensively used to initiate design revisions, proposed as-built changes because of interferences, and specification revisions. Examples are RI-AS-0139, RI-2872-DC and RI-2549-SW. There is concern that a contractor would be encouraged to react to the RI response without waiting for the applicable revised document (For example, RI-2549-SW was answered 4/2/84 changing the time requirement for presoaking of concrete prior to grouting. The answer was needed 4/1/84; however, the specification was not changed until 4/23/84). If the final disposition incorporated in the applicable document differs from that suggested in the RI, how is the work performed at risk by the contractor reconciled? It is recommended that the SEG change the wording used in RI responses from that implying approval to that indicating which engineering document will be affected.

6.6.2.3 N&Ds

Twelve N&Ds were reviewed. Nine of them involved materials (concrete aggregates, air and moisture contents) non-compliance with specifications and they were "accepted as is". One of the N&Ds specified rework and two others specified repairs. The descriptions of non-conformances and dispositions were clear and the dispositions were technically adequate. The review and approval of the N&Ds had been performed by the appropriate personnel.

It was noted that deleterious substances (material finer than 200 sieve) for the fine and No. 8 aggregates used in concrete mix exceeded the maximum values allowed by the specification. However, the concrete aggregates were accepted on the basis that concrete will not be subject to abrasion in the future and referenced to ACI C-33(77). Examples are N&Ds 4352, 4454 and 4460. The above acceptance criteria was not apparent in the DLC Form SQCF-626 (081177) used for the above N&Ds. It is recommended that this form be annotated or modified to reflect the actual acceptance criteria.

6.6.2.4 Revisions to Specifications

Five specifications (Drilled-in Expansion Type Concrete Anchors, Reactor Containment Liner and Mat Embedments, Placing Concrete and Reinforcing Steel, Field Applied Studs and Studs Welding and Reinforcing Steel) were reviewed for the latest changes. These changes were made to incorporate E&DCRs and RIs. The revisions in the specifications were described clearly, completely and accurately. The changes were technically adequate and supported with technical justification and they had been reviewed and approved by the appropriate personnel.

6.6.2.5 Interim Issue Drawings

Interim issue drawings for concrete and structural steel were reviewed. Most of the drawing changes resulted from responses to RIs. The details of revisions were adequately documented. Drawing changes were technically adequate and, where needed, substantiated with calculations. In addition, these drawings were reviewed and approved by the appropriate personnel.

The reason for change on drawings RC-50L-7J, RC-51D-6A, RS-15B-2B, and RC-33E-11C was unclear, not specific. The reason for change given was "Design Improvement". This seems to be a minor concern since it occurred on only 4 out of approximately 50 drawings reviewed. As this situation has been discussed with the SEG and they agreed that a more descriptive reason for change will be used in the future, no further action is required.

6.6.2.6 Cutting of Embedded Steel

There is a basic system in effect to account for cutting of embedded steel as detailed in 2BVM-219 (Handling of Rebar Cut Requests). Rebar can not be cut unless an approved form for request to cut embedded steel is issued. Fourteen requests to cut embedded steel were reviewed. They were technically justified and approved by the appropriate personnel. The applicable drawings were marked up to identify the rebars that had been cut. However, the master file for logging the cut requests was not complete or up-to-date. This concern was corrected during the audit.

F.F. Chin (Structural)

D.H. Rogers (Audit Team Leader)

AUDIT ENTRANCE MEETING ATTENDEES

L.E. Arch	Senior Project Engineer (DLC)
A. Bektore	Senior Engineering Mechanics Engineer
P.J. Bienick	Assistant Superintendent of Engineering (SEG)
W.W. Chaisson	Engineering and Design Coordinator (SEG)
F.F. Chin	Senior Structural Engineer (Engineering Assurance)
J.L. Cooper	Power Engineer (SEG)
R.J. Faust	Principal Structural Engineer (SEG)
E. Farino	Principal Electrical Engineer (SEG)
R.D. Harris	Materials Engineer (SEG)
C.J. Ho	Senior Engineering Mechanics Engineer
E.J. Horvath	Senior Project Engineer (DLC/SEG)
C.D. Houmiller	Principal Engineering Mechanics Engineer (SEG)
R.F. Jones	Instrumentation and Controls Engineer (SEG)
N.F. Kokot	ASME Coordinator (SEG)
T.W. League	Audit Coordinator (Engineering Assurance)
A.C. McIntyre	Superintendent of Engineering (SEG)
H.W. Mooncai	Electrical Engineer (Engineering Assurance)
C.G. Morrell	Lead Nuclear Power Engineer
C.R. Paull	Senior Purchasing Agent (SEG)
F.J. Rezendes	Supervisor Control Systems
D.H. Rogers	Audit Team Leader (Engineering Assurance)

AUDIT STATUS MEETING ATTENDEES

A. Bektore	Senior Engineering Mechanics Engineer
P.J. Bienick	Assistant Superintendent of Engineering (SEG)
R.T. Burgas	Principal Power Engineer (SEG)
F.F. Chin	Senior Structural Engineer (Engineering Assurance)
G. Dean	Structural Engineer (SEG)
E. Farino	Principal Electrical Engineer (SEG)
R.J. Faust	Principal Structural Engineer (SEG)
R.D. Harris	Materials Engineer (SEG)
M.B. Herdzik	Assistant Office Supervisor (SEG)
C.J. Ho	Senior Engineering Mechanics Engineer
E.J. Horvath	Senior Project Engineer (DLC/SEG)
N.R. Keen	EMD - Instrumentation Engineer (SEG)
C.E. Kirschner	Senior QA Engineer (DLC/QA)
N.F. Kokot	ASME Coordinator (SEG)
T.W. League	Audit Coordinator (Engineering Assurance)
A.C. McIntyre	Superintendent of Engineering (SEG)
H.W. Mooncai	Electrical Engineer (Engineering Assurance)
C.G. Morrell	Lead Nuclear Power Engineer
C.R. Paull	Senior Purchasing Agent (SEG)
J. Raines	PSAS Engineer
F.J. Rezendes	Supervisor Control Systems
D.H. Rogers	Audit Team Leader (Engineering Assurance)
J.G. Rosen, Jr.	Principal Control Systems Engineer (SEG)
V.R. Shah	EMD Responsible Engineer (SEG)
R.W. Twigg, Jr.	Lead Engineer (Engineering Assurance)
J.O. Webb, Jr.	Engineering Assurance Engineer

POST-AUDIT CONFERENCE ATTENDEES

L.E. Arch	Senior Project Engineer (DLC)
W.H. Bohlke	Project Manager
L.A. Budlong	Supervisor Pipe Stress
R.T. Burgas	Principal Power Engineer (SEG)
W.W. Chaisson	Engineering and Design Coordinator (SEG)
A.F. Champagne	Assistant Superintendent of Engineering (SEG)
G. Dean	Structural Engineer (SEG)
D.M. DeSanzo	Receiving Supervisor (SEG)
W.M. Eifert	Chief Engineer - Engineering Assurance
R.J. Fausc	Principal Structural Engineer (SEG)
E. Farino	Principal Electrical Engineer (SEG)
R.D. Harris	Materials Engineer (SEG)
C.D. Houmiller	Principal Engineering Mechanics Engineer (SEG)
C.E. Kirschner	Senior QA Engineer (DLC)
N.F. Kokot	ASME Coordinator (SEG)
J.B. MacKay	Assistant Chief Engineer - Electrical
D.L. Malone	Supervisor Engineering Assurance
A.C. McIntyre	Superintendent of Engineering (SEG)
F.N. Morrissey	QA Program Administrator
P. RaySircar	Project Engineer
D.H. Rogers	Audit Team Leader (Engineering Assurance)
J.G. Rosen, Jr.	Principal Control Systems Engineer (SEG)
J.O. Webb, Jr.	Project Engineering Assurance Engineer
R.J. Washabaugh	Project Manager (DLC)
H.M. Siegel	Manager of Engineering (DLC)

ENGINEERING ASSURANCE
TECHNICAL AUDIT REPORT
HAZARDS ANALYSIS PROGRAM
BEAVER VALLEY UNIT 2 PROJECT
AUDIT NO. 50
NOVEMBER 12, 1985 - JANUARY 31, 1986

DUQUESNE LIGHT COMPANY
APRIL 7, 1986

G. Bushnell, Auditor

R.M. Simonetti, Auditor

R.A. Terry, Auditor

D.A. Shaw
Audit Team Leader

W.M. Eifert
Chief Engineer
Engineering Assurance

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of the In-Depth Technical Audit performed on the Beaver Valley 2 Project during the period November 1985 through January 1986. The audit covered the project's Hazards Analysis Program, a program established to evaluate the effects of high energy pipe rupture (breaks and cracks), internal flooding, internally generated missiles, harsh environmental conditions, and seismically induced interaction between nuclear safety related equipment and non-seismic equipment. The purpose of the program is to assure that the plant can be safely shutdown following the occurrence of such events coincident with the most limiting single active failure and loss of offsite power.

This audit is part of an ongoing series of In-Depth Technical Audits, the purpose of which is to provide a basis for an overall assessment of the adequacy and implementation of the design process applied by SWEC on the Beaver Valley 2 Project.

The audit was conducted principally at project headquarters in SWEC's Boston Office, but also included a two day visit to the plant site to review activities associated with the hazards analysis program. A team of four SWEC engineers performed the audit, with two engineers from Duquesne Light Company also participating in Boston and at the plant site on a part time basis. The team members are identified below.

Name	Organization	Discipline	Title
GBushnell	SWEC	Engineering Mechanics	Supervisor
CKirschner	DLC	Quality Assurance	Supervisor QA ENG/MOD
DAShaw	SWEC	Engineering Assurance	Supervisor Audit Team Leader
RMSimonetti	SWEC	Power	Sr. Power Engineer
RATerry	SWEC	Engineering Mechanics	Sr. Mechanical Engineer
LWUrda	DLC	Quality Assurance	Senior QA Specialist

The audit commenced with a pre-audit meeting November 12, 1985, and concluded with a post-audit conference January 31, 1986. Attendees at each of these meetings are identified in Appendix 1 and Appendix 2, respectively.

Personnel contacted by the audit team during the audit are identified in Appendix 3.

2.0 PURPOSE

The purpose of this audit was to evaluate the project's design control process applied to the analysis of those hazards postulated to occur within the plant. It evaluated the technical and procedural adequacy of the Hazards Analysis Program to verify that it is prescribed by appropriate procedures and criteria, that these procedures and criteria are being followed correctly, and that the process is producing results which are technically acceptable and in compliance with governing NRC requirements.

3.0 SCOPE AND APPROACH

This audit covered the Beaver Valley 2 project's program for analyzing and resolving those hazards postulated to occur within the plant structures. It encompassed the entire process from an engineering and design perspective, beginning with commitments to NRC regulations and guidelines and proceeding through to the completion of analyses to verify that the plant can be shutdown following the occurrence of any of these hazards, coincident with a single active failure and loss of off-site power. It also included a review of the process for developing hardware designs necessary to mitigate the consequences of the hazards.

The approach used in conducting the audit is briefly described in this section. Additional details on the audit approach are provided in the Summary of Results section.

The audit commenced with a review of the Beaver Valley 2 FSAR for conformance with NRC requirements such as Standard Review Plans and General Design Criteria.

Project Procedures pertinent to the hazards analysis activities were also reviewed to verify that they adequately reflect FSAR commitments, effectively prescribe the implementation methods and criteria needed for analysis of hazards, and clearly specify responsibilities of personnel participating in the hazards analysis program.

The project's implementation of the hazards analysis program was then reviewed by selecting two areas in the plant and reviewing the project's analyses of the potential hazards in these areas. The two areas selected were the Main Steam Valve House and Cable Vault which is outside the Reactor Containment and the cubicle for Steam Generator 2RCS*SG21B which is inside the Reactor Containment. They were chosen because they have a considerable quantity and variety of the types of potential hazards which are required to be evaluated. The types of hazards are:

- o High Energy Line Breaks (HELB)
- o Internally Generated Missiles (IGM)
- o Internal Flooding
- o Harsh Environment
- o Seismically Induced Safety/Non-Seismic Interactions

For each of these hazards, a sampling of the project's analyses was selected from these areas and reviewed for:

- o Determination of potential hazards sources.
- o Determination of zones of influence of hazards.
- o Identification of equipment (targets) which are affected either directly or indirectly by the hazards.
- o Determination of the effects of the hazards upon the targets and upon the

capability to shutdown the plant coincident with the most limiting single active failure and loss of offsite power.

- Determination of the need for the addition of hardware to mitigate the effects of the hazards.

- Suitability of the design of mitigating hardware.

The project's methods for assuring that design changes are reviewed for impact on completed hazards analyses were also evaluated in this audit to verify that the hazards analysis documentation is kept current with:

- Additions/relocations of systems and components.

- Revisions to system conditions.

- Revisions to pipe stress analysis results.

Finally, in order to draw overall conclusions with regard to the design control process and technical acceptability of the work performed by the project on hazards analysis, the results of the audit were analyzed by the audit team. Both positive results and discrepancies observed during the audit were evaluated to determine whether any systematic shortcomings were evident in the program.

Concerns and questions which arose during the audit were identified to the project on Action Item forms. The project responded to these actions items by citing the cause and extent of the identified condition and describing their intended actions, if any, to correct the condition and prevent recurrence and a schedule for doing so. The audit team then followed up by evaluating the project's response and remedial actions. For cases where the reported condition had not been totally resolved and verified by the audit team prior to the conclusion of the audit, Audit Observations (AOs) were written. These are attached to this report. The Action items are not included in this report but are all identified in the list of Action Items located in Section 4 of this report.

4.0 OVERALL CONCLUSIONS

The BVPS-2 project's program for postulating, analyzing, and resolving potential hazards internal to the power plant structures was found by this audit to be generally satisfactory, though some items of concern were observed which require project attention. It was also observed that the program has not yet been fully implemented. The program for analysis of High Energy Line Breaks was well underway at the time of the audit, but those for Internally Generated Missiles, Internal Flooding, and Safety/Non-Seismic Interactions have not yet been fully implemented.

The audit commenced with a review of the FSAR to verify conformance with NRC requirements. It was found that the FSAR complies with essentially all of these requirements with one exception observed. It related to the postulation of non-mechanistic line breaks in the break exclusion zone (Main Steam Valve House), which is required for the purpose of establishing postulated harsh environment and flooding conditions. The project approach is considered technically justifiable, but the FSAR should be reviewed and clarified, as necessary.

The project procedures pertinent to hazards analyses were also reviewed. Although these procedures were found to be generally quite detailed and comprehensive, several weaknesses were observed which appear to have contributed to some of the shortcomings found in the project's hazards analysis activities. The principal weaknesses were in the areas of criteria for evaluating potential hazards and defining interfaces between groups working on hazards analyses.

The audit team reviewed the project's efforts in postulating, evaluating, and resolving potential hazards. It found that these activities are being carried out in compliance with the FSAR and applicable project procedures. It also showed that the project is developing and maintaining adequate documentation for these activities. However, as mentioned above, shortcomings were observed which are attributed to weaknesses in the project procedures. The project needs to review the audit team's concerns and the related project procedures and take the necessary corrective and preventive measures to resolve these concerns.

The project's methods for keeping abreast of design changes which affect hazards analyses, and assuring that such changes are appropriately factored into the hazards analyses, were also reviewed in the audit and found to be satisfactory. However, the plant model which was an essential tool used by the Hazards Analysis Task Group in identifying plant configuration changes was "frozen", per client direction, after this audit was concluded. Since the model will no longer be kept up-to-date, the Hazards Analysis Task Group will have to revise their methods for tracking changes in plant configuration.

Although the audit results show that the project's hazards analysis program is functioning in a generally satisfactory manner, the project has to resolve the several items of concern reflected in the Audit Observations included in this report. The audit team will follow up on these items to verify that they are satisfactorily resolved. Also, since much of the program was not yet fully implemented at the time of this audit, additional auditing will be scheduled in the future. The project's method of tracking plant configuration changes will have to be looked at again by the audit team, now that the model has been "frozen".

TABLE 4-1 ACTION ITEM IDENTIFICATION AND CLASSIFICATION

ACTION ITEM NUMBER	SUBJECT	TYPE	RESULTANT	AUDIT OBSERVATION NUMBER
1.	Internally Generated Missiles - Postulation Criteria.	A,0	D	EMD-027
2.	FSAR Exceptions to SRP 3.11	A	L	———
3.	Internally Generated Missiles - Identification and Evaluation	A,0	T	12241-221
4.	Flooding Analysis Main Steam Valve House	*	—	———
5.	Flooding - Effects on Essential Equipment	A,0	T	12241-220
6.	Flooding Analysis	0	T	12241-220
7.	Process Flood Postulation	A,0	P, T	12241-220
8.	Flooding Analysis	A,0	D	12241-222
9.	Hazards Analysis Program	0	T	12241-220
10.	High Energy Line Breaks	A,0	L,T	12241-221
11.	Hazards - Seismic Interaction	A,0	P	12241-220
12.	List of Equipment Subject to Flooding	0	T	12241-220
13.	High Energy Line Break - Jet Impingement	B	NA	———
14.	High Energy Line Break - Temperature Effects	A,0	T	12241-220
15.	Pipe Rupture	0	T	12241-224
16.	Pipe Rupture	A,0	T	12241-223

DEFINITIONS

TYPE CODES

A - Corrective and/or Preventive Action is/was required

B - Information provided by the project resulted in closing the Action Item with no need for any project action.

O - Open issue to be resolved between the project and the audit team.

* - The subject of this Action Item is enveloped by the subject of Action Item #7; therefore it has been closed.

RESULTANT CODES

L - FSAR change is required
D - Design document change is required, no hardware impact
P - Procedure change is required
H - Hardware impact
C - Administrative control
T - To be determined after resolution between the project and the audit team.
NA - Not applicable.

5.0 SUMMARY OF RESULTS

5.1 Consistency Between the FSAR and NRC Regulations

The BVPS 2 FSAR was reviewed for conformance with NRC regulations and guidelines which apply to hazards analyses. The following NRC documents were used in this review:

Standard Review Plans

3.4.1	Flood Protection
3.5.1.1	Internally Generated Missiles (Outside containment)
3.5.1.2	Internally Generated Missiles (Inside containment)
3.6.1	Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment
3.6.2	Determination of Rupture Locations and Dynamic Effects Associated with the Postulated Rupture of Piping
3.11	Environmental Qualification of Mechanical and Electrical Equipment
9.3.3	Equipment and Floor Drainage System

Branch Technical Positions:

ASB 3-1	Protection Against Postulated Piping Failures in Fluid Systems Outside Containment
MEB 3-1	Postulated Rupture Locations in Fluid System Piping Inside and Outside Containment

Regulatory Guides

1.29	Seismic Design Classification

General Design Criteria

4	Environmental and Missile Design Bases

The audit showed that the BVPS 2 FSAR generally complies with the requirements of the above documents, or wherever exceptions are taken, they are clearly described and justified in the FSAR. There was, however, one case observed where the FSAR does not totally conform to these requirements and no exception was contained in Section 1.9 of the FSAR. It is briefly described below.

Standard Review Plan 3.6.1, and the accompanying Branch Technical Position ASB 3-1, address pipe breaks and invoke differing requirements depending on the date when an application for a construction permit is tendered. In the case of BVPS2, the subject date places the project under the jurisdiction of the "Giambusso Letters". However, the project does not totally meet the requirements contained in these letters; they have alternatively utilized some of the requirements from the "O'Leary letter" and the current SRP criteria for newer plants. The differences relate to treatment of piping failure in the main steam piping and feedwater piping in the Main Steam Valve House which is a break exclusion zone; i.e., an area where high energy line breaks need not be postulated, as long as certain limitations regarding piping stress levels are met. The project's approach to this subject is considered technically acceptable and justifiable. The licensing documentation should be clarified to support this approach. (Action Item 10) (AO 12241-221, Item 1)

In addition to the foregoing concern, two other items associated with the FSAR which require project attention were observed during this part of the audit, as described below.

FSAR Section 3.5.1.1 and 3.5.1.2 (including in-process Change Notice 1209) address Internally Generated Missiles (IGM). They contain statements regarding the identification and evaluation of IGM originating from rotating machinery and pressurized components, and discuss various potential sources of missiles, and state whether the subject components or parts of components represent credible missile sources. Also discussed are the potential effects which those missile sources which are deemed credible have upon potential targets. No documentation could be found to support many of these statements on IGM. (Action Item #3) (AO 12241-221, Item 2)

The second item is relatively minor and relates to Environmental Qualification and Standard Review Plan 3.11. In FSAR Section 1.9, "Standard Review Plan Conformance Evaluation", Table 1.9-1 specifies that exceptions have been taken to SRP 3.11. However, a review of Table 1.9-2, in which exceptions are discussed and justified, shows that one of the three items identified therein as differences from SRP 3.11 is not actually a difference, but a case where an exception did indeed exist at one time but doesn't any longer. This was reported on Action Item #2 and has been determined by the project to be the responsibility of Duquesne Light Company (DLC). The project has advised DLC of the need to update the FSAR. Thus, this Action Item has been satisfactorily resolved.

5.2 Adequacy of Procedures

The project hazards analysis program is prescribed principally by two project procedures: 2BVM-165 for High Energy Line Breaks, Internally Generated Missiles, and Safety/Nonseismic Interaction, and 2BVM-114 for Internal Flooding and Harsh Environment. Several other procedures are also associated with the hazards program; they are: 2BVM-85 for postulating High Energy Line Breaks and analysis; 2BVM-129 for Internally Generated Missiles; 2BVM-116 for seismic classification of structures, systems, and components; 2BVM-128 for environmental qualification of equipment; and 2BVM-201 for developing and maintaining the engineering model.

All of these procedures were reviewed during the course of this audit to determine whether they are compatible with FSAR commitments, and adequately prescribe the activities associated with hazards analysis and responsibilities of personnel involved in those activities. The review also assessed the procedures for consistency with related Engineering Assurance Procedures and Division procedures, guidelines, and standards, and for proper approvals in accordance with SWEC requirements.

This audit found the governing project procedures to be generally satisfactory. They are, for the most part, comprehensive and clearly prescribe criteria, implementation requirements and responsibilities.

The audit review did uncover some shortcomings in the procedures which appear to be a cause of some of the items of concern observed in this audit.

The following listing summarizes the items observed which require resolution. Further details for each of these items are provided in the program implementation section 5.3, of this report. Related Action Items and Audit Observations are also identified there.

a. Internal Flooding analyses do not consider the effects of flow from one area to another, e.g., under doors which are not sealed.

b. Internal Flooding analysis excludes from consideration as flooding sources piping which contains subcooled liquid whose temperature exceeds 212 F.

c. Hazards Analysis Group on the project handles High Energy Line Breaks, Internally Generated Missiles and Safety/Non-Seismic Interactions. Other hazards such as Internal Flooding and Harsh Environment are handled by separate groups. An apparent consequence of this arrangement is that compatibility between the various hazards efforts is sometimes lacking.

d. Safety/Non-Seismic Interaction evaluation criteria are not being interpreted consistently by the project groups involved.

e. Identification and documentation of Nuclear Safety Related equipment affected by flooding is not prescribed by a project procedure, and it cannot be determined whether all types of Nuclear Safety Related equipment which could be adversely affected by flooding were considered in preparing the list.

f. Project procedures state that temperature effects resulting from High Energy Line Breaks are to be addressed independent of break postulation for dynamic effects. However, it has not been demonstrated that local temperatures within the jet impingement zone do not result in a more severe condition for jet impingement targets.

5.3 Program Implementation

The project's implementation of the Hazards Analysis program was reviewed by selecting two areas in the plant and verifying that the project had adequately evaluated the potential hazards in these areas. The two areas selected were: (1) Steam Generator Cubicle for 2RCS*SG21B at Elev. 767'-10" (Hazards Zone CS-403) and (2) Main Steam Valve House and Cable Vault (Hazards Zone VC-405). A description of the review and results for each type of hazard is given below.

a. High Energy Line Breaks

For this part of the audit the audit team selected two high energy pipe lines for review, the 32" Main Steam line and the 16" Main Feedwater line associated with Steam Generator 2RCS*SG 21B The review covered all of this piping inside the Reactor Containment and inside the Main Steam Valve House up to the first restraint beyond the break exclusion zone. It included a review of the related pipe stress analyses to verify that the project had correctly selected the locations for postulated breaks and cracks based on configuration, stress levels and usage factors, and where applicable, that criteria to qualify piping as break excluded were satisfied. The review then proceeded on to the project's determination of postulated pipe whip and jet impingement and the identification of potential targets. The next step in the process was to verify that these targets and the mechanistic effects upon them were correctly identified to the disciplines responsible for evaluating the consequence of the postulated interactions. Evaluations of five targets by the respective disciplines were then reviewed to see whether these evaluations correctly determined the effects of the interactions upon the ability to safely shut down the plant and mitigate the effects of the

initiating event, coincident with loss of off-site power and the most limiting single failure. The design and analysis of hardware needed to mitigate the consequences of postulated pipe breaks were also reviewed in the audit.

The audit results show that the project's program for evaluation of pipe break hazards is functioning in a generally satisfactory manner. Piping system parameters are contained in the stress analysis data packages from which high energy lines are identified. Methods for postulating break locations and types are technically adequate, pipe whip and jet impingement analyses are being performed correctly, zones of influence are properly established, targets are being identified thoroughly, and the evaluation of the effects of hazard source interaction with targets is being controlled and tracked adequately to assure that the interactions are resolved acceptably. However, many interactions have not yet been resolved due to anticipated changes in the program which are discussed further along in the report.

Also, some aspects of the program were found to be in need of improvement. These are discussed in the summary which follows. Since numerous documents were reviewed during this part of the audit, they are generally not included in the text of this summary, but are listed at the end.

Project activities regarding pipe break postulation, assessment, and mitigation are governed by 2BVM-85 and are incorporated into the Hazards Analysis program by 2BVM-165. The basic criteria stated for postulation of, and protection against, pipe breaks and cracks meet the project licensing commitments reflected in the FSAR.

The audit of pipe break activities commenced with a review of the piping arrangement drawings and pipe stress analysis calculations associated with the selected piping. This review showed that the project has correctly postulated locations and types of breaks for the piping inside the Reactor Containment. The main feedwater piping in the Main Steam Valve House (MSVH) is break excluded; i.e., breaks need not be postulated provided the limitations on pipe stresses and cumulative usage factors specified in SRP 3.6.2 are met. The audit showed that the project has correctly established that these requirements are satisfied, thereby qualifying this piping for break exclusion per criteria stated in the FSAR.

During this part of the review it was observed that the project's procedures on this subject do not totally comply with SRP's 3.6.1 and 3.6.2 with regard to postulation of piping failures in the break exclusion zone. This has been described in section 5.1 of this report, which addresses the FSAR.

The audit review then assessed the EMD Mechanical discipline's analyses which establish the pipe whip, jet impingement and environmental effects resulting from pipe breaks in the selected lines; determine the zones of influence for the resultant hazards; and quantify interaction effects with structures, systems, and components within the zones of influence. These analyses were found to be generally acceptable. However, one item of concern was observed which require project attention; it is described below.

The review of calculation 12241-NM(B)-309-DTA disclosed that the ultimate strain values (Euu) were based on in-house guidance document EMTR-400,

revision A, the version in effect when the subject calculation was prepared. However, the EMTR was subsequently revised as the ultimate strain values were determined to be unconservative. Although the change is not likely to adversely impact the results in the affected calculations, the observation raised a concern regarding the project's methodology for identifying and tracking the effects of changes to design input criteria. (Action Item #15) (AO 12241-224, Item 1.b). This calculation also contained an inconsistency in that the maximum moment is specified as one value in the "Summary of Results" and a different value in the "Analysis Section". (Action Item #15) (AO 12241-224, Item 2).

The next phase of the audit entailed a review of the project's process for designing hardware needed to mitigate the consequences of pipe breaks. Calculation 12241-NM(B)-292-JDB, prepared for a pipe rupture restraint on the main feedwater line, was reviewed and found to be technically acceptable and in conformance with applicable criteria. However, the review did generate some concerns regarding the project's methods for controlling and transmitting calculation results to interfacing disciplines. (Action Item #16) (AO 12241-223)

Once the EMD-Mechanical discipline has established zones of influence for the postulated pipe break hazards, the project's Hazards Analysis Task Group (HATG) then identifies all essential targets which are located in each zone of influence and initiates the process for evaluating the effect of each postulated interaction on safe shutdown capability. The audit showed that the HATG is identifying and tracking the evaluation of essential targets in a thorough manner and in compliance with the governing project procedure, 2BVM-165. However, this process is being carried out independently of consideration of related hazards which are analyzed by other project groups. For example, flooding is a potential consequence of the pipe breaks which are evaluated by the HATG, but flooding analyses are conducted by the Power discipline without any interface with the HATG's pipe break analyses. The Power discipline bases their flooding evaluation on the assumption of failure of the worst single source of flooding in an area under consideration. If only a single source of flooding need be considered, the two efforts would be compatible. However, since the HATG only evaluates those targets which are deemed essential to the safe shutdown of the plant, or to the mitigation of the consequences of the pipe break, there is the possibility that non-essential components or pipes which would contribute to flooding could also be damaged by the effects of a pipe break. Thus, flooding could be produced by more than one source simultaneously. (Action Item #9) (AO 12241-220, Item 3)

The final step in this part of the audit was to review the project's evaluation of identified pipe whip/jet impingement targets. Five targets within the zones of influence of the Main Steam and Main Feedwater line breaks were selected for review by the audit team. The review showed that the targets have been correctly identified and entered into the HATGs evaluation and tracking system.

The five interactions consisted of four cases of jet impingement and one pipe whip. Two have been resolved by providing pipe rupture restraints. Resolution of the remaining three, all cases of jet impingement, require evaluation of the effects of the jet impingement loads on the targets. In two cases, the loads have been provided to the disciplines responsible for the evaluations, and in the other the loads have not yet been transmitted.

For the cases where the loads have been transmitted, no further action with respect to analysis of safe shutdown capability has taken place, however, because of two pending issues on the project. One is the project's proposed intention to utilize the alternate two-phase flow jet model found in NUREG CR/2913 which has the potential to significantly alter the jet impingement targets identified for each break point, as well as modify the magnitudes of the resulting interaction loads. The other issue is implementation of the project WHIPJET Program which is intended to significantly reduce the number of HELB based upon the "leak before break" concept. This is pending NRC approval.

One other pending change was also observed during the audit, which will resolve what appeared to be a discrepancy between the project practice regarding arbitrary intermediate breaks (AIB) and the FSAR. The audit disclosed that the project is not postulating AlB as is required by FSAR Section 3.6.B.2.1.1.2. The project basis for this is NRC letter for Docket No. 50-412 dated May 21, 1985 deleting the requirement for AIB based on the break locations and system conditions stated in DLC letter number 2NRC-5042 dated March 12, 1985. This departure from the FSAR is being resolved by FSAR Change Notice 1355 which was in-process prior to this audit.

The project design documents reviewed in this part of the audit are identified below:

Physical Arrangement Drawings:	12241-RP-17-8A 12241-RM-41A 12241-RM-45A
Stress Analysis Data Packages:	SI-RM-41A SI-RM-45A
EMD Pipe Stress and Supports Calculations:	12241-NP(N)-X17B 12241-NP(B)-258-F1A 12241-NP(N)-X2A 12241-NP(N)-X17H 12241-NP(N)-Z2A-001 12241-NP(N)-Z2A-010
EMD-Mechanical Section Calculations: (pipe break postulation, fluid forcing functions, restraint analysis, etc.)	12241-NM(B)-361-DE 12241-NM(B)-361-DE-001 12241-NM(B)-449-DL 12241-NM(B)-318-DE 12241-NM(B)-318-DE-002 12241-NM(B)-318-DE-003 12241-NM(B)-335-DL

b. Internally Generated Missiles

The audit of the project's program for evaluating Internally Generated Missiles (IGM) produced by postulated failure in rotating machinery and pressurized components was limited to verifying FSAR compliance with regulations and the adequacy of governing project procedures. The review of implementation of the program revealed that no evaluations have yet been conducted by the project.

It was also observed in reviewing the FSAR that statements made therein regarding identification and evaluation of IGM are not supported by documented technical rationale. This item of concern has been described further in Section 5.1, which addresses the FSAR.

Review of the project procedure for IGM (2BVM-129) raised a question with regard to postulating of Diesel Generator (DG) originated IGM. The project procedure states that DG IGM need not be postulated since the DGs are housed in structures designed for tornado missiles and redundant trains are adequately separated. It is based on Engineering Mechanics Division guidance document EMTR-416 which appears to assume that DGs are individually housed in separate structures, not the case on BVPS-2. This concern was reported on Action Item #1 and has been satisfactorily resolved on the project by performing an analysis which showed that the walls separating the DGs will withstand tornado missiles. However, EMTR-416 should be clarified. (AO EMD-027)

c. Flooding From Internal Sources

The audit team selected the Main Steam Valve House and Cable Vault for review to assess the project program for evaluating the effects of flooding from internal sources (i.e., pipe breaks and cracks, failures of vessels and tanks, etc.). Project documentation was reviewed to determine whether all areas in the building and nuclear safety related equipment contained in them were analyzed. The audit team also reviewed project selection of postulated flooding sources for each area to determine whether the selections were appropriate. The calculation (12241-Power-N-211-N-265) for determining flood levels in each area was reviewed to verify that correct input data, assumptions, and analytical methods were used and that the results were reasonable. This part of the audit concluded with a review of the project's program for identifying essential equipment subject to flooding and for evaluating the effects which flooding of this equipment would have on safe-shutdown capability.

The audit showed that flood levels have been calculated for all the areas of the Main Steam Valve House and Cable Vault Structure.

These calculations have been performed on an area basis, the areas being those already established as "fire areas" for fire protection design purposes. This provides areas which are clearly defined and which have boundaries to contain the water flowing from a failed pipe or component in each area.

The flooding sources postulated for each area were reviewed. It was determined that in all cases the most conservative single source was chosen. However, postulating a single source for flooding is questioned, since this approach does not consider the possibility of one line rupture resulting in impact upon another line and subsequent additional flooding should this second line suffer a loss of pressure integrity as a result of this impact. This item of concern has also been described in Section 5.3.a of this report.

In addition, some discrepancies were found in the calculations during the audit, such as an incorrect assumption of a thermodynamic phenomenon, some instances where calculations require updating. and a case where no explanation was provided for the use of two different sets of temperature and pressure conditions for the same line in two different areas.

The incorrect assumption, which is prescribed by Project Procedure 2BVM-114, is that high energy line breaks in systems normally above 212F will have neglible flooding effects, since the majority of released steam will escape from the immediate area via whatever venting is provided. As a result, another pipe in the area was chosen as the flood source. (Action Item #7) (AO 12241-220, Item 2.) It is noted that this only affects flooding outside the Reactor Containment, since the analysis of flooding inside the Reactor Containment is based on the assumption of subcooled liquids remaining totally liquid.

The calculations for six areas require updating, four of them because they use design or operating conditions which do not agree with the conditions given in the latest Line Designation Tables or pipe stress input documentation; and two because hypothetical rather than specific actual lines were postulated as flood sources, and the design and operating conditions used in the analysis do not agree with current design and operating conditions. The current Line Designation Tables contain design and/or maximum operating conditions for all of the lines in question, so the calculations should be reviewed and updated accordingly. It is recognized that the change to the conditions is slight so that the effect on the calculated flood levels will be minor. (Action Item #8) (AO 12241-222, Items 1 & 2)

The third discrepancy is the situation where a particular line passes through two areas and in both cases is the most conservative flooding source. However the calculations to determine the resulting flood level use design conditions for one area and the maximum operating conditions for the other area. The calculation criteria allows the use of either design or maximum operating conditions for any particular line, however, the use of different conditions for the same line without explaining the reason(s) for doing so is questioned. (Action Item #8) (AO 12241-222, Item 3)

The audit of the calculations verified that, except for the above discrepancies, correct input data, assumptions and analytical methods were used and that the results were reasonable.

It was observed during the audit that the calculations for determining flood levels do not consider the effects of accumulation of flow from one area to another, such as would occur where the flooded area has a door which is not sealed so that the flood water flows out of the area through the gap under and around the door into other areas. (Action Item #6) (AO 12241-220, Item 1)

The project has not yet performed an evaluation of nuclear safety related equipment subject to flooding in order to determine the effects on safe shutdown capability. They have prepared a list of this equipment which was reviewed by the audit team. Two items of concern arose in this review. First, the preparer of the list is not identified on the list and there is no documented evidence that the list has been reviewed by a second engineer; and second, it cannot be determined from the list itself, or from other available documentation, whether all types of nuclear safety related equipment which could be adversely affected by flooding were considered in developing the list. (Action Item #12) (AO 12241-220, Item 5)

d. Harsh Environment

This part of the audit entailed verifying that the environmental conditions resulting from pipe breaks postulated by the Hazards Analysis Group would be

no more severe than those which the Nuclear Technology discipline postulated for use in the environmental qualification of equipment. Two Nuclear Technology calculations (12241-128-6 and 12241-US(B)-188-0) for the Main Steam Valve House and Cable Vault structure were reviewed by the audit team.

The review showed that Nuclear Technology postulates a break in the pipe which would result in the most severe environmental conditions in an area. The piping from which the single pipe is selected includes all piping regardless of whether or not it is Nuclear Safety Related. This assures that any single line break postulated by hazards analysis will not produce environmental conditions which are more severe than those postulated by Nuclear Technology. However, postulating only a single pipe break may not be appropriate since it does not consider the fact that one line rupture and the attendant pipe whip may cause other pipe breaks which would thereby exacerbate the environmental conditions already created by the single pipe break. This relates to the interface concern described in Section 5.3.a of this report.

The audit also revealed another concern with the interface between High Energy Line Break activities and the Harsh Environment area. In postulating Harsh Environmental conditions, the project has not considered the fact that local temperature effects within a jet impingement zone may be more severe than the overall, or average, temperature effects resulting from a break. (Action Item #14) (AO 12241-220, Item 6).

e. Seismically Induced Safety/Non-Seismic Interactions

Project activities regarding assessments of seismically induced failure of non-nuclear safety related (NNS) systems/components with nuclear safety related (NSR) components are generally defined by 2BVM-165. As defined by 2BVM-116, NNS systems/components whose seismically induced failure might compromise the integrity of NSR components are classified as Seismic Category II. Procedurally, this designation requires maintenance of anchorage and structural integrity of the NNS item under earthquake loadings. In implementation, however, item specific interactions may be resolved by fragility considerations of the NSR target, addition of intervening structure, etc, in addition to demonstrating/ensuring structural integrity.

The scope of the safety/non-seismic concern covers each NNS structure/system/component located within a Seismic Category I structure, as defined by 2BVM-116. Uniquely identifiable zones within these structures, developed by the project Hazards Analysis Coordinator per 2BVM-165, are utilized to identify and locate potential interactions.

The basic interaction identification process, established by 2BVM-165, is at a system level within each zone, with specific item by item interaction identification and assessment indicated where safe-shutdown capability cannot be maintained. This philosophy was found by the review to be inappropriate for seismically induced interactions. Reviews of in-process work verified that the existing procedural guidance led to numerous component-level assessments without adequate consideration of generic topics such as credible failure modes, equipment similitude characteristics, etc. (Audit Observation 12241-220, Item 4).

Current project activities for this hazard-related topic area are involved with programmatic changes to the original approach. Adequate assessment of implementation of the modified program cannot be made until completion of significant project activity. However, project personnel awareness of the issue involved indicates that a more appropriate methodology will evolve.

5.4 Change Control

The engineering model, located at the BVPS-2 site, is the primary design tool used to identify and assess effects of additions and modifications on hazards analyses.

Model generation activities are controlled under Project Procedure 2BVM-201 with contractor inputs to the model coordinator controlled by BV-2 Field Construction Procedure FCP-37. The model is currently in "Phase III" (per 2BVM-201, final stage) which is essentially maintenance of the model after basic designs have been incorporated, and use of the model as a construction tool (i.e., checking for clearances, interferences, etc, prior to installation of new systems/components). The model is built on a 3/4" to 1' scale with a tolerance of $\pm$ 1/16" which yields a full scale accuracy of $\pm$ 1". Components down to 1/2" conduit, 3/8" instrument tubing, and 4"x4" electrical junction/pull boxes are included.

Engineering changes reflected on design drawings, and manufacturer/contractor drawings are sent to the model coordinator via controlled distribution for incorporation into the model. Proposed changes/additions are cleared through the model prior to implementation to ensure adequate clear space is available with no interferences and that adequate clearances are in accordance with engineering requirements. Hazards analysis evaluations are based on interactions identified by site walkdown (accomplished on approximately a monthly basis) as highlighted by changes to the model (pending and incorporated) since the previous walkdown. To assess the adequacy of use of the model, and its control procedures, to evaluate the potential impact of additions/changes on the status of the hazards evaluation program, a portion of the review was conducted at the site.

The review indicated that configuration control procedures employed to maintain currency of the model regarding plant as-built conditions function independent of the Hazards Program. As a service to the Hazards Analysis Task Group defined in 2BVM-165, duplicate change record logs are maintained to facilitate HATG tracking of assessed/resolved interactions. The review indicated that the model coordinator's activities adequately identified and tracked all changes intended to be incorporated into the model, and that such changes were being adequately identified by site engineering and construction activities. (As the model is also used to check/verify adequate installation provisions prior to construction activities, it was found to dictate the basic geometry of a proposed addition/change, e.g., small bore piping run layout/support locations, with "as-builts" from the actual installation fed back into the model changes.) To evaluate the accuracy of employing the model to identify potential hazards interactions, a sampling was taken in the main steam valve house area, centering on hazard zone VC-405 (located on model table A4). The primary set of indicated potential interactions evaluated by the review concerned valve V43 on line 2SVS-004-2 at approximately El 800'. The model indicated a potential for seismic interaction (II/I) between V43 and junction box JB3682 and duct DSA-173. (For

review purposes, no distinction was made between nuclear safety related and non-nuclear safety related systems/components, as the sole intent was to verify model accuracy). It was also noted that junction box JB3681 was modeled as indicating no seismic interaction potential with valve V44 mounted in line 2SVS-010-173-2, in an adjoining area.

A site walkdown by the review team verified the relative positioning of the junction box and ductwork with respect to valve V43, and also verified the absence of seismic interaction potential between JB-3681 and V44 as the model indicated.

Additional potential interactions indicated by the model involved unit heater 2HVR-VHE-303 over several lines (and their valves) at approximately El 785'. During the site walkdown the review team found physical/visual access to 2HVR-VHE-303 extremely restricted (largely by the presence of temporary scaffolding), thus hampering normal line of sight for interaction identification. In this particular instance, the model proved superior to the actual plant for identification of the conditions noted, and the walkdown activity served to verify observations made from the model. The conclusion of the review is that use of the model as the primary design tool to identify/assess the effects of additions/modifications on the hazards analyses is justified, and adequately and accurately represents the as-built condition of the plant; and that adequate processes and controls are in effect to permit accurate model maintenance.

Subsequent to the site portion of the review and assessment of the engineering model, the review team was notified by the project of a modification to the change control procedures utilized by the HATG. Beginning approximately February 1, 1986, the engineering model will no longer be utilized as a construction tool, and change control documents to maintain model currency will no longer be generated.

This means that the Hazards Analysis Task Group's system for tracking changes will have to be revised, with a stronger emphasis placed on site walkdown activities.

In addition to changes in plant configuration, changes in stress levels in piping and changes in system conditions (i.e., temperature, pressure, etc.) also have an effect on hazards analyses. To assure that such changes are factored into the hazards analyses, all revisions to the document which contain this information are issued on a controlled distribution to the Hazards Analyses Group. Stress levels are contained in pipe stress calculations and system conditions are contained in project procedure 2BVM-121 for Code Class 1 piping systems and in Stress Analysis Data Packages for non-Code Class 1 systems.

6.0 AUDIT OBSERVATIONS

The Audit Observations (AOs) listed below and contained in this section describe conditions observed during the audit which require project actions. The persons assigned the action on these AOs have been provided with response forms which are to be completed and returned to Engineering Assurance by April 23, 1986.

AO NO.	SUBJECT	ACTION ASSIGNED
12241-220	Hazards Analysis - Project Procedures	CORichardson
12241-221	Hazards Analysis - FSAR	CORichardson
12241-222	Hazards Analyis - Flooding Calculations	CORichardson
12241-223	Hazards Analysis - Design Control	CORichardson
12241-224	Hazards Analysis - Pipe Rupture Calculations	CORichardson
EMD-027	Hazards Analysis - Division Procedures	DCFoster

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Hazards Analysis - Project Procedures

AUDIT DATE November 1985 - January 86 AUDITOR(S) GBushnell, DAShaw, RMSimonetti, RATerry

PERSON(S) REPRESENTING AUDITED ORGANIZATION JSpizuoco REFERENCE(S)

REQUIRED REPLY DATE April 23, 1986 ACTION ASSIGNED CORichardson

DESCRIPTION OF CONDITION(S):

The project procedures governing hazards analysis activities on the Beaver Valley 2 project were found by the audit team to be generally satisfactory. They are, for the most part, comprehensive and clearly prescribe criteria, implementation requirements, and responsibilities.

However some shortcomings were observed in the program which appear to be the result of weaknesses in the procedures. Examples are described below:

1. The procedures do not specify that flooding analyses consider the effects of flow from one area to another such as would occur under doorways which are not sealed. Consequently, the flooding analyses have not considered this phenomenon. (Action Item #6)

2. Project Procedure 2BVM-114 contains non-conservative criteria regarding the postulation of flooding from piping containing subcooled liquid. Paragraphs 4.4.1.1.3 and 4.4.1.2.3 exclude from consideration as flood sources piping which contains subcooled liquid whose temperature exceeds 212F.

   The procedure's basis for this is that the escaping effluent will totally flash to vapor which will then escape from the area via vent paths. This assumption that the liquid will flash to 100% vapor is erroneous. As a result, no subcooled lines are considered flood sources, thereby underestimating flood levels in some areas. (Action Item #7)

3. The activities of the Hazards Analysis Group are governed by project procedure 2BVM-165. The scope of this procedure is limited to three types of hazards- High Energy Line Breaks, Internally Generated Missiles, and Safety/Non-Seismic Interactions. Other hazards such as Internal Flooding and Harsh Environment are covered by separate procedures and handled by separate groups. An apparent consequence of this arrangement is that compatibility between the various hazards efforts is sometimes lacking. For example, the

Power group determines the postulated flood level in an area by assuming a failure in the single source which would produce the highest flood level. This is done independently of the pipe break analyses performed by the Hazards Analysis Group. The analyses by the Hazards Analysis Group identify for further evaluation only targets which are Nuclear Safety Related. As a result, flooding analyses do not consider the possibility that a high energy line break may in turn cause a pressure boundary failure in a target pipe or component which is not Nuclear Safety Related. This would cause additional flooding sources and sources of fluids contributing to Harsh Environments not accounted for or enveloped by the analyses performed by others. (Action Item #9)

4. Criteria governing identification of Safety/Non-Seismic Interactions contained in 2BVM-165, Section 7.1 and 8.2, are not being interpreted consistently by the project groups involved. Lack of definition of credible failure modes of Non-Nuclear Safety Related components under seismic loading allows for application of overly conservative criteria. This approach is resulting in an excessively large number of Safety/Non-Seismic Interactions being identified and evaluated on an individual item basis in lieu of handling them by a more generic approach. (Action Item #11)

5. The process for identifying and documenting the identity of Nuclear Safety Related equipment affected by flooding is not prescribed by a project procedure. In addition, the list of equipment developed by the project for flooding analyses purposes has not been reviewed by a second engineer. Also, one cannot determine from this list of equipment, or other available documentation, whether all types of Nuclear Safety Related equipment, which could be adversely affected by flooding, were considered in preparing the list. For example, there are no junction boxes on the list, but it is not evident whether this is because they were not considered or because none are located below flood levels. (Action Items #5, #12)

6. 2BVM-85 states that temperature effects resulting from pipe ruptures will be addressed independent of break postulation for dynamic effects. Although this approach is adequate for overall environmental concerns, no justification exists to demonstrate that local temperature within the jet impingement zone does not result in a more severe condition for jet impingement targets. (Both ANSI-58.2-1980 and EMTR-3 require consideration of jet temperature effects on the safety related targets). (Action Item #14)

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Hazards Analysis - FSAR

AUDIT DATE November 1985-January 1986 AUDITOR(S) GBushnell, DAShaw, RMSimonetti

PERSON(S) REPRESENTING AUDITED ORGANIZATION JSpizuoco REFERENCE(S) FSAR

REQUIRED REPLY DATE April 23, 1986 ACTION ASSIGNED CORichardson

DESCRIPTION OF CONDITION(S):

During this audit some items associated with the FSAR were observed which require project attention. They are:

1. The FSAR was reviewed for conformance with applicable NRC requirements such as are contained in Standard Review Plans, Branch Technical Positions, General Design Criteria, and Regulatory Guides.

   The audit results show that, in general, the FSAR does comply with these requirements. There was, however, one instance observed where the FSAR and/or the project practices are not totally in agreement with the requirements, nor is there any explanation provided in Section 1.9 of the FSAR for the exceptions. The BVPS-2 docket #50-412 dated 10/20/72 places the project under jurisdiction of the "Giambusso Letters" per SRP 3.6.1 (BTP ASB 3-1, para. B.4.c).

   FSAR 3.6B.1.3.3.1 states that no mechanistic effects (i.e., jet impingement) are considered within Main Steam or Feedwater Line break-exclusion zones. This is in agreement with para. 6.1.2 and 6.1.3 of 2BVM-85 which limits evaluation of breaks in these zones to environmental conditions only, based on the "O'Leary Letter".

   FSAR 3.6B.2.1.2.1 defines the extent of the break exclusion zone as extending beyond the isolation valve to the first restraint, in compliance with the "O'Leary Letter" (also NUREG-75/087, para. 3.6.1.B.2.c.(3)). However, terminal end breaks are not postulated at the restraints as required by the "O'Leary Letter" para. A.4 and NUREG-75/087. This criterion appears to be based on the requirements stated in NUREG-0800 SRP 3.6.1 ASB 3-1, B.2.c which, per SRP 3.6.2 MEB 3-1, B.1.b, are applicable to break exclusion zone boundaries terminating at the outboard isolation valve.

   FSAR Table 1.9-1 indicates conformance to NUREG-0800 SRP 3.6.1, Rev. 1 and ASB 3-1 Rev. 1, with no deviation/exception.

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The licensing bases being employed by the project design processes governing HELB are not readily apparent/adequately identified. (Action Item #10).

2. The FSAR, in Section 3.5.1.1 and 3.5.1.2 (including in-process FSAR change notice 1209) address Internally Generated Missiles (IGM) and describes the project's identification and evaluation of IGM caused by rotating machinery and pressurized component failures. No documentation could be found during the audit which supports the statements made in the FSAR with regard to the project's identification and evaluation of IGM. (Action Item #3).

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Hazards Analysis - Flooding Calculations

AUDIT DATE November 1985-January 1986 AUDITOR(S) DAShaw, RMSimonetti

PERSON(S) REPRESENTING AUDITED ORGANIZATION KConnery REFERENCE(S) 2BVM-114

REQUIRED REPLY DATE April 23, 1986 ACTION ASSIGNED CORichardson

DESCRIPTION OF CONDITION(S):

Flooding Analysis calculation (12241-Power-N-24-N-265, Rev. 4) for the Cable Vault and Main Steam Valve House structure was reviewed in the audit. The calculation divides this structure into ten distinct areas based on the fire areas established for fire protection design purposes. It contains a calculation of flood level for each of these ten areas. The audit review shows that six are in need of updating as described below: (Action Item #8)

1. Four of them are out of date because they use design or operating conditions which do not agree with the conditions given in the latest line designation tables or pipe stress input documentation; they are: (1) cable vault-fire area PT-1, #2 encl., elev. 718' - 6"; (2) cable vault-fire area CV-1, elev. 735' 6"; (3) cable vault-fire area PT-1, open floor, elev. 718' - 6"; and (4) cable vault-fire area DV-4, elev. 773' - 6".

2. Two need updating because hypothetical rather than specific actual lines were postulated as flood sources and the design and operating conditions used in the analysis do not agree with current design and operating conditions; they are: (1) cable vault-fire area CV-5, elev. 773' - 6" and (2) cable vault-fire area ASP, Alt. shutdown cubicle, elev. 755' - 6".

3. The review also showed that the calculations for two adjoining areas use the same pipe line for sources of flooding, but use system design conditions in one case and system maximum operating conditions in the other case, without providing an explanation for this approach. The calculations are: (1) cable vault-fire area CV-4, elev. 773' - 6"; and (2) main steam valve house, fire area MS-1, elev. 773' - 6".

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Hazards Analysis - Design Control

AUDIT DATE November 1985 - January 1986 AUDITOR(S) GBushnell, RATerry

PERSON(S) REPRESENTING AUDITED ORGANIZATION JSpizuco REFERENCE(S)

REQUIRED REPLY DATE April 23, 1986 ACTION ASSIGNED CORichardson

DESCRIPTION OF CONDITION(S):

The audit review of pipe rupture calculation 12241-NM(B)-292-JDB revealed some items of a design control nature which require project evaluation. They are:

1. The calculation notes in its conclusion that changes to drawing RV-56A are required and the calculation is marked "Confirmation Required" as the means of assuring that the necessary changes are made. Use of the "Confirmation Required" box to track the need to make changes in documents affected by the calculation results is not the correct method for doing this. (Action Item #16)

2. The calculation does not clearly identify the embedment loads required for evaluation by Structural discipline, nor does it indicate compatibility with a pre-established design load set utilized by Structural. (Action Item #16)

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ORGANIZATION AUDITED Beaver Valley 2 Project

ACTIVITY AUDITED Hazards Analysis - Pipe Rupture Calculations

AUDIT DATE November 1985-January 1986 AUDITOR(S) GBushnell, RATerry

PERSON(S) REPRESENTING AUDITED ORGANIZATION JSpizuoco REFERENCE(S)

REQUIRED REPLY DATE April 23, 1986 ACTION ASSIGNED CORichardson

DESCRIPTION OF CONDITION(S):

The audit review of Pipe Rupture calculations performed by Engineering Mechanics revealed some items requiring project attention. They are described below:

1. Calculation 12241-NM(B)-309-DFA establishes the plastic hinge limit moment (Mp) using the methods and parameters of EMTR-400-A. The ultimate strain values (Euu) previously reported in EMTR-400-A have been found unconservative and have been corrected in EMTR-400-B (issued 7/5/85). Use of the corrected strain valves would:

   - Increase plastic modulus (Ep) by a factor of $\sim$ 2.
   - Decrease plastic moment (Mp) by $\sim$ 5%.

   The small resulting changes along with the large margins of safety in the calculation make any immediate revisions unnecessary. However, this calculation and others associated with break exclusion zone evaluations, should incorporate the corrected strain parameters in future revisions. More importantly, however, this item raises a concern over the projects methodology for identifying and tracking the effects of changes to design input criteria. (Action Item #15)

2. Calculation 12241-NM(B)-309-DFA also contained the following inconsistency (Action Item #15):

   P. 43, "Summary of Results", gives M_{max} = .306 x 10^7 in # from penetration to isolation valve, but P. 134, "Analysis Section", give this same maximum moment value as M_{max} = .370 x 10^7 in #.

STONE & WEBSTER ENGINEERING CORPORATION ENGINEERING ASSURANCE DIVISION AUDIT OBSERVATION	AO. NO. EMD-027 PAGE 1 OF 1

ORGANIZATION AUDITED: Beaver Valley 2 Project

ACTIVITY AUDITED: Hazards Analysis - Division Procedures

AUDIT DATE: November 1985 - January 1986 AUDITOR(S): GBushnell

PERSON(S) REPRESENTING AUDITED ORGANIZATION: JSpizuoco REFERENCE(S): 2BVM-114, EMTR-416

REQUIRED REPLY DATE: April 23, 1986 ACTION ASSIGNED: DCFoster

DESCRIPTION OF CONDITION(S):

Project Procedure 2BVM-129, Section 5.4, states that Diesel Generator (DG) Internally Generated Missiles (IGM) need not be postulated as they are located in structures designed for tornado missiles, and redundant trains are adequately separated. This is based on an Engineering Mechanics guidance document (EMTR-416, Section 4.2.5) which appears to assume that each DG is housed in a separate structure, thus having no interior walls or floors which would have to be designed to withstand IGM. The Beaver Valley 2 DGs, 2EGS*EG2-1&2, are located in a common structure with interior floors and walls which have not been demonstrated as being capable of withstanding tornado missiles. (Action Item #1). It is recommended that the EMTR be revised to clarify this area. The project has already resolved this concern from a project standpoint. Therefore, no further action is required of the BV2 project.

APPENDIX 1
PRE-AUDIT MEETING NOVEMBER 12, 1985
ATTENDEES

NAME	ORGANIZATION	TITLE
KFConnery	SWEC	Support Engineer, Power
NAGoldstein	SWEC	Lead Engineer Engineering Mechanics
VLechpammer	SWEC	Coordinating Engineer
DLMalone	SWEC	Supervisor Engineering Assurance
FNMorrissey	SWEC	Quality Assurance Program Administrator
DAShaw	SWEC	Supervisor Engineering Assurance (Audit Team Leader)
MESheridan	SWEC	Support Engineer Engineering Mechanics
RMSimonetti	SWEC	Senior Engineer Power
JMSpizuoco	SWEC	Principal Engineer Engineering Mechanics

APPENDIX 2
POST AUDIT CONFERENCE JANUARY 31, 1986
ATTENDEES

NAME	ORGANIZATION	TITLE
GBushnell	SWEC	Supervisor Engineering Mechanics
APCapozzi	SWEC	Asst. Chief Engineer Engineering Assurance
AJFiorente	SWEC	Lead Engineer - Power
DCFoster	SWEC	Chief Engineer Engineering Mechanics
NAGoldstein	SWEC	Lead Engineer Engineering Mechanics
BFJones	SWEC	Asst. to Chief Engineer Power
CEKirschner	DLC	Supervisor QA ENG/MOD
FEKnapek	DLC	Senior QA Specialist
FNMorrissey	SWEC	Quality Assurance Program Administrator

APPENDIX 2
POST AUDIT CONFERENCE JANUARY 31, 1986
ATTENDEES

NAME	ORGANIZATION	TITLE
WJParker	SWEC	Asst. Project Engineer
CORichardson	SWEC	Project Engineer
REROemer	SWEC	Asst. Project Engineer
DAShaw	SWEC	Supervisor Engineering Assurance
RMSimonetti	SWEC	Senior Engineer Power
JMSpizuoco	SWEC	Principal Engineer Engineering Mechanics
KFConnery	SWEC	Support Engineer - Power
WNKennedy	SWEC	Principal Engineer Engineering Mechanics
JOWebb	SWEC	Project Engineering Assurance Engineer

APPENDIX 3
PROJECT PERSONNEL CONTACTED DURING AUDIT

NAME	TITLE
DBennett	Supervisor, Model Shop, Site
RBenson	Responsible Engineer, Engineering Mechanics
FACollins	Support Engineer, Power
*KFConnery	Support Engineer, Power
CWEarle	Support Engineer, Electrical
KFitzgerald	Support Engineer, Power
NAGoldstein	Lead Engineer, Engineering Mechanics
*DEGraves	Principal Engineer, Nuclear Technology
HHStidstone	Support Engineer, Power
NKokot	Engineering Assurance Engineer, Site
JAPizzi	Lead Engineer, Electrical
*MESheridan	Support Engineer, Engineering Mechanics
WKSherman	Principal Engineer, Power
*JMSpizuoco	Principal Engineer, Power

* Hazards Analysis Task Group member