MAY 16 1983

Docket No. 50-275

MEMORANDUM FOR: George Lear, Chief
Structural and Geotechnical Engineering Branch
Division of Engineering

THRU: Pao-Tsin Kuo, Leader
Structural Engineering Section B
Structural and Geotechnical Engineering Branch
Division of Engineering

FROM: Harold E. Polk, Structural Engineering Section B
Structural and Geotechnical Engineering Branch
Division of Engineering

SUBJECT: TRIP REPORT FOR IDVP/PG&E TECHNICAL INTERCHANGE MEETING MARCH 29 AND 30, 1983 FOR DIABLO CANYON REVERIFICATION

On March 29 and 30 two members of the staff, P. T. Kuo and Harold Polk of the SGEB and A. J. Philippacopoulos of Brookhaven National Laboratory attended a technical interchange meeting between the Independent Design Verification Program (IDVP) staff and PG&E Diablo Canyon Project (DCP) staff. Attendance lists for both days of the meetings are attached. The areas discussed were the DCP progress in the analysis of the Turbine Building and the Containment Annulus Steel Structure and the Auxiliary/Fuel Handling Building.

TURBINE BUILDING

The results of the Turbine Building seismic analysis was discussed by the DCP. Although the Turbine Building is a seismic Category II structure it contains seismic Category I equipment and systems, therefore, it must be demonstrated that the building will not impair the function of these systems during a seismic event. This requirement is satisfied by analyzing the structure and showing it will withstand the postulated earthquake without failure.

The Turbine Building is a combined steel frame and reinforced concrete structure. The reinforced concrete structure is below elevation 140 feet, the operating floor, and the steel frame structure is above the elevation 140 feet floor. The structure is approximately 400 by 140 feet in plan and is approximately 125 feet tall. The structure is founded on the underlying bed rock and is independent of the turbine pedestal.

The scope of work carried out by the DCP was to review the asbuilt drawings, perform onsite inspections, perform seismic analysis in 3 directions for the Hosgri earthquake, perform seismic analysis in 2 horizontal directions for the DE and DDE events, review structural members for loads and stresses and modify the structure where necessary. The provisions of the SEAOC 1974 and ACI 318-73 building codes were used for the review of the reinforced concrete portion of the structure. The AISC 7th edition building code, Part II was used for the structural steel portions of the structure. The review utilized the actual material properties for the HOSGRI event, while the code design material properties were used for the DE and DDE events.

For the horizontal seismic evaluations, earthquake input time histories were developed from both the Newmark and Blume ground response spectra. For the vertical seismic evaluations, only one time history based on the Newmark vertical ground response spectra was used. The reason for this is that the Newmark spectra envelopes the corresponding Blume spectra for the vertical direction. To account for accidental torsion the horizontal ground motion input acceleration values were increased by 10%.

The summation of the modal responses was based on the double algebraic sum method instead of the double absolute sum or the square root sum of the squares (SRSS) method. The DCP was informed by the staff that the double algebraic sum method is not recognized by the staff as an acceptable method to sum the modal responses.

The modifications to the Turbine Building consisted of stiffening a beam at column line 6, between column lines 4 and 5, elevation 119. This modification was made to reduce the floor response spectra to match the qualification response spectra for the 1.6 KV switch gear. The compression material that was used in the gap between the turbine pedestal and the turbine building at the north and south ends was removed to prevent pedestal to structure interaction. The pedestal to building separations are greater than the absolute sum of calculated maximum pedestal and building displacements. No modifications were required for the Turbine Building Crane.

Eight bolted connections in the lower chord bracing in the Turbine Building roof trusses exceed the allowable stresses in the AISC edition 7 and AISC edition 8 structural steel building code. The AISC edition 8 code allows higher stresses in bolted connections which are based on test data using finger tight bolts. If the clamping forces for torqued bolts is considered, the bolted joints are capable of withstanding the imposed loads. Furthermore, if the model used to predict the member forces is refined the forces would be reduced and thus could meet the AISC edition 8 allowables.

CONTAINMENT ANNULUS

The status of the seismic evaluations of the containment annulus structure in the horizontal, vertical directions as well as mass ratio studies were discussed. For the horizontal direction detailed uncoupled models of the three lower floors were being used to obtain mode shapes and frequencies. The objective of this analysis is to stiffen the floors in the horizontal direction so that structural frequencies higher than 20 Hz can be obtained.

The vertical evaluations have been completed. Floor response spectra were generated in this direction using two dimensional frame type models.

Mass ratio studies have been undertaken in order to assess the significance of coupling between the piping systems and the annulus structure. The approach used consists of adding single degree-of-freedom oscillators which represent the piping systems onto the two dimensional vertical frame models. Floor spectra are then generated with the masses in place. This procedure for developing floor spectra has as yet not been accepted by the staff. The current practice is a decoupled analysis including only the mass of the subsystems.

AUXILIARY/FUEL HANDLING BUILDING

Results of geotechnical studies were presented with particular emphasis on the upper and lower values of the shear wave velocity. DCP also presented sensitivity studies on soil springs which they claimed showed no effect on the response of the Auxiliary Building.

Several questions raised by the IDVP were brought up and discussed towards the end of the meeting. They dealt specifically with RFI questions pertaining to the Fuel Handling Building's sections given in the Phase I Final Report.

Harold E. Polk

Harold E. Polk, Structural Engineer
Structural Engineering Section B
Structural and Geotechnical
Engineering Branch
Division of Engineering

Attachment:
As noted

cc: R. Vollmer
D. Eisenhut
J. Knight
P. Kuo
M. Reich, BNL
A. Philippacopoulos, BNL
C. Miller, BNL
H. Schierling
B. Buckley
H. Polk

IDVP / DCP MEETING 3-29-83

ATTENDEES

P.F. MASON	DCP
Bimal Sarkar	DCP
Herman Minkowski	DCP
Stephen Kadysiewski	DCP
Chung Li	PG&E
Richard Orr	Westinghouse
Lincoln Malik	URS/Blume, DCP
SUNIL GUPTA	URS/BLUME, DCP
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J K McCall	DCP
DAVID SOKOLSKY	DCP
Ken Buchert	Bechtel
John R. Hoch	DCP
David Cooley	DCP
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C. G. MEYGRET	TES
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J. M. Biggs	HH&B
R. WRAY	TES
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Hans Schierling	NRC Licensing
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P.F. MASON
3-30-83
Job 15320-001

IDVP/NRC/DCP Meeting
STRUCTURAL REVIEW

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Bren Shicker	DCP
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INTERIM TECHNICAL REPORT 45
REVISION 0

ADDITIONAL VERIFICATION OF REDUNDANCY OF EQUIPMENT AND POWER SUPPLIES IN SHARED SAFETY-RELATED SYSTEMS

STONE & WEBSTER ENGINEERING CORPORATION

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May 20, 1983
J.O. No. 14296.30
DCS-436

Mr. H.R. Denton, Director
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Walnut Creek, Ca 94596

Docket No. 50-275
Diablo Canyon Unit 1
License No. DPR-76

SWEC INTERIM TECHNICAL REPORT

Gentlemen:

Attached is Interim Technical Report, Number 45, Revision 0, entitled "Additional Verification of Redundancy of Equipment and Power Supplies in Shared Safety-Related Systems."

Very truly yours,

John E. Krechting

J.E. Krechting
Project Engineer, Diablo Canyon Nuclear Power Plant

Enclosure

cc: RRFray (45)
RFReedy
ETDenison
WECooper (10)
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PACIFIC GAS & ELECTRIC COMPANY

DIABLO CANYON NUCLEAR POWER PLANT

INDEPENDENT DESIGN VERIFICATION PROGRAM

INTERIM TECHNICAL REPORT NO. 45

REVISION 0

ADDITIONAL VERIFICATION OF REDUNDANCY OF EQUIPMENT AND POWER SUPPLIES IN SHARED SAFETY-RELATED SYSTEMS

PERFORMED BY

STONE & WEBSTER ENGINEERING CORPORATION

DOCKET NO. 50-275

LICENSE NO. DPR-76

PROJECT MANAGER Frank Sestak Jr. DATE 5-17-83

F. Sestak, Jr.

PROGRAM MANAGER'S PREFACE

DIABLO CANYON NUCLEAR POWER PLANT - UNIT 1

INDEPENDENT DESIGN VERIFICATION PROGRAM

INTERIM TECHNICAL REPORT

ADDITIONAL VERIFICATION OF REDUNDANCY OF
EQUIPMENT AND POWER SUPPLIES IN
SHARED SAFETY-RELATED SYSTEMS

This is the forty-fifth of a series of Interim Technical Reports prepared by the DCNPP-IDVP for the purpose of providing a conclusion of the program.

This report provides a description of the work done, summary and evaluation of the results, and conclusions of the IDVP with respect to the concern of redundancy of equipment and power supplies in shared safety-related systems.

As IDVP Program Manager, Teledyne Engineering Services has approved this ITR. The methodology followed by TES in performing this review and verification is described by Appendix A to this report.

ITR Reviewed and Approved
IDVP Program Manager
Teledyne Engineering Services

D. C. Stratouly
Assistant Project Manager

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

Interim Technical Report (ITR) No. 34, Revision 1, describes all additional verification work required to be performed based on the initial sample. This ITR describes work performed in one of the areas of concern, specifically, redundancy of equipment and power supplies in shared safety-related systems and presents the results of the Independent Design Verification Program (IDVP) verification of the DCP analysis.

The IDVP initial sample review of the Control Room Ventilation and Pressurization (CRVP) System Class IE electrical power supplies identified that adequate electrical power redundancy was not provided to satisfy the single failure criteria identified in Final Safety Analysis Report (FSAR) Section 9.4.1.

The CRVP System is a Design Class I (safety-related) ventilation system for the control room with equipment shared by and powered from both Unit 1 and Unit 2. PG&E agreed to make modifications to the electrical system to assure that the single failure criteria would be met. The IDVP recommended additional verification to assure similar concerns did not exist for other shared safety-related systems. This concern was described in ITR No. 34. As a result, PG&E performed a review of all safety-related systems to verify the FSAR statement that the Diesel Fuel Oil Transfer (DFOT) System was the only other shared safety system. PG&E then performed a review of the DFOT System to determine if FSAR commitments concerning equipment and power supply redundancy were met. The IDVP verified the results of the DCP review.

SECTION 2

SUMMARY

PG&E performed an analysis on the DFOT System. This analysis was made to ensure a problem did not exist similar to that found in the CRVP System. The analysis was performed to show proper operation of the DFOT System, whether or not Unit 2 power supplies are available.

PG&E identified all electrical and control equipment required for operation of the system and the Unit 1 or Unit 2 power source for each. Based on this information, a single failure analysis was performed for each electrical and control component to demonstrate the system will meet its design bases described in the DCNPP-1 FSAR, Section 9.5.4, whether or not Unit 2 power supplies are available. PG&E concluded that the DFOT System power supplies are designed to ensure the availability of the redundant transfer train during any single failure condition.

The IDVP reviewed the PG&E analysis and performed an independent verification using DCNPP-1 design documentation supplied by PG&E. The IDVP found:

- Concurrence with the PG&E analysis.

- The DFOT System satisfies the DCNPP-1 FSAR, Section 9.5.4, single failure criteria and the FSAR, Section 8.3, commitments for electrical bus failure with either Unit 1 only operational or Unit 1 and 2 operational.

- The specific concerns addressed in EOI Files 8012 and 8016 for the CRVP System did not occur in the other DCNPP-1 identified shared safety-related system.

Based on the satisfactory results of the independent verification and the statement by PG&E that the DFOT System was the only other shared safety-related system, no further additional verification is required in this area.

SECTION 3

BASIS OF CONCERN

A single failure analysis was performed by the IDVP for the shared safety-related CRVP System. The Class IE electrical power supplies to system components were reviewed for two conditions. One condition considered only the Class IE Unit 1 electrical power supply available. The second condition considered both Unit 1 and Unit 2 Class IE electrical power supplies available, and assumed a single failure of an electrical bus in each unit consistent with the FSAR, Section 8.3, commitment.

3.1 EOI FILES

This review of the Class IE electrical power supplies demonstrated that adequate electrical power redundancy was not supplied to the CRVP System to meet the single failure criteria identified in FSAR Section 9.4.1. The first concern was that portions of the CRVP System required to maintain the Unit 1 control room habitability are shared between Units 1 and 2 and are provided safety-related power from the Unit 2 diesel generators and Class IE electrical system. If the Unit 2 Class IE electrical system is not available, the CRVP System does not meet the single failure criteria. The Unit 1 Technical Specifications, Section 3.8.2, permit operation in Modes 1, 2, 3, and 4 with only Unit 1 vital electrical buses energized. EOI File 8012 was issued addressing this concern.

The second concern was that portions of the Class I CRVP System are shared by Units 1 and 2 and, as such, are provided electrical power from both Units 1 and 2 safety-related electrical systems. The FSAR, Page 8.3-4, states that for a postulated loss-of-coolant accident (LOCA) in one unit and a shutdown in the other unit, each unit can withstand an assumed failure of a vital bus. Thus, in addition to loss of off-site power required to be assumed during the LOCA, each unit must be assumed to lose a vital bus. These assumed failures would result in the LOCA unit having two vital buses available due to the alignment of the swing diesel and the non-LOCA unit having one vital bus available. Evaluation of these failures indicated inadequate electrical power redundancy in the shared CRVP System to meet the single failure criteria. A single failure could result in failure of the CRVP System to isolate, pressurize, and/or select pressurization air from the least contaminated intake, or to provide adequate air-conditioning to remove heat generated from the vital electrical equipment located in the safeguards room. EOI File 8016 was issued addressing this concern.

3.2 SCOPE OF ADDITIONAL VERIFICATION

The IDVP developed a Scope of Work to determine if the concerns identified in EOI Files 8012 and 8016 were present in other safety-related systems shared between Units 1 and 2. PG&E determined that the DFOT System was the only other shared safety-related system required to operate to mitigate the effects of accidents described in the FSAR, Chapter 15 (other than the CRVP and electrical power distribution systems).

To determine the acceptability of the DFOT System, the following items were reviewed:

- The PG&E analysis identifying the redundancy of electrical power supplies, and

- The DFOT system power supplies to determine if the DCNPP-1 single failure criteria were met.

SECTION 4

ANALYSIS

The DFOT System supplies fuel from the underground storage tanks to the 550-gallon diesel fuel oil day tanks (2 1/2-hour supply) located at each diesel generator. The FSAR, Section 9.5.4, states that the system is designed to Class I criteria and that the design incorporates sufficient redundancy so that a malfunction or failure of either an active or passive component will not impair the ability of the system to supply fuel oil.

The IDVP performed a single failure analysis of the DFOT system power supplies. This was accomplished by reviewing the DCNPP-1 design documents submitted to the IDVP as part of the results of the PG&E additional verification and single failure analysis.

4.1 SINGLE FAILURE ANALYSIS

The PG&E analysis of the DFOT System to determine redundancy of power supplies was reviewed. Electrical and instrument schematics detailing the power and control circuits to DFOT components were reviewed to determine the capability of the DFOT System to meet single failure criteria either with only Unit 1 Class IE electrical power supply available or with both Unit 1 and Unit 2 Class IE electrical power supplies available. Single failures were postulated, including vital bus failures or individual electrical or control component failures. The effects on the DFOT System were evaluated. Loss of off-site power was assumed to occur simultaneously with the postulated failure in all cases.

The DFOT System consists of two mechanical trains, each with its own transfer pump and associated valves and electrical circuits. For each pump, the power and control circuits have a common power source (through MPHTSB for Pump No. 01 and through MPGTS for Pump No. 02). The normal power source for transfer switch MPHTSB is vital Bus 1H, with vital Bus 2H as an alternative power source. The normal power source for transfer switch MPGTS is vital Bus 1G, with vital Bus 2G as an alternative power source. There are no interconnections between the circuits for DFOT Pump No. 01 and DFOT Pump No. 02. A single failure of one vital bus or any component powered from this vital bus will result in the loss of only one train. The redundant pump and its associated control circuits will remain available. The review verified that the DFOT System has adequate electrical redundancy to meet single failure criteria and to perform its intended safety function.

4.2 ACCEPTANCE CRITERIA

The acceptance criteria for satisfactory verification of the DFOT System are that the system must satisfy the DCNPP-1 single failure criteria including the licensing commitments for vital bus failure with either:

- Unit 1 operational, or
- Unit 1 and 2 both operational.

4.3 DOCUMENTATION USED

The following documents were used by the IDVP in the evaluation of the DFOT System:

- PG&E Analysis and Single Failure Study
- DFOT System Electrical Schematic
- DFOT System Instrument Schematic
- DFOT System Piping Schematic
- FSAR
- PG&E List of Safety-Related Equipment in the DFOT System
- PG&E List of Shared Safety-Related Systems.

SECTION 5

CONCLUSIONS

The conclusions concerning the additional verification of redundancy of equipment and power supplies in shared safety-related systems follow:

- The IDVP concurs with the PG&E analysis of the DFOT System.

- Based on the PG&E review, there are no other shared safety-related fluid systems required to operate to mitigate the effects of accidents addressed in the FSAR, Chapter 15.

- The DFOT System satisfies single failure criteria defined in the DCNPP-1 licensing commitments for Class IE electrical bus failure with either Unit 1 only operational or Units 1 and 2 both operational.

- The specific concerns addressed in EOI Files 8012 and 8016 for the CRVP System did not occur in the other DCNPP-1 identified shared safety-related system.

- No further additional verification is required in this area based on the satisfactory results of the independent verification and the statement by PG&E that the DFOT System was the only other shared safety-related system.

APPENDIX A

PROGRAM MANAGER'S ASSESSMENT

APPENDIX A

PROGRAM MANAGER'S ASSESSMENT

Independent review by TES of the tasks performed by SWEC to verify the Diablo Canyon Project (DCP) efforts was done in accordance with the IDVP Phase II Program Management Plan and ITR-34.

ITR-34, Revision 1, issued on March 24, 1983, identified five (5) areas of concern which required additional verification. The additional verification was performed by the DCP and their conclusions were verified by SWEC.

This ITR describes the work performed by the DCP for the concern of redundancy of equipment and power supplies in shared safety-related systems. The results are reported herein. The DCP performed a review of all safety-related systems and identified the Diesel Fuel Oil Transfer (DFOT) system as being the only other shared safety system. The DCP then performed a review of the DFOT system to determine if the FSAR commitments concerning equipment and power supply redundancy were met. The IDVP verified the review results of the DCP.

The verification of the DFOT system results revealed that the system does have adequate electrical redundancy to meet single failure criteria and perform its safety function. No EOI files were issued.

The IDVP concluded that the concern of redundancy of equipment and power supplies in shared safety-related systems is satisfactory.

Accordingly, no further additional verification is required.