DEC 1 1 1981



MEMORANDUM FOR: Chairman Palladino
Commissioner Gilinsky
Commissioner Bradford
Commissioner Ahearne
Commissioner Roberts

FROM: Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

SUBJECT: INFORMATION ITEM--POTENTIAL DEFICIENCY IN THE SEISMIC ANALYSIS OF EQUIPMENT AND COMPONENTS IN THE CONTAINMENT ANNULUS OF DIABLO CANYON UNIT 1 (BOARD NOTIFICATION NO. 81-47) 566 R04

In accordance with present NRC procedures regarding Board Notifications the enclosed information is being provided to the Commission.

By letter dated November 18, 1981, PG&E provided all parties of the Diablo Canyon proceeding a draft copy of the "Preliminary Report Seismic Reverification Program" prepared for PG&E by R. L. Cloud Associates, Inc. The Commissioners were provided copies of this report by a memorandum from W. J. Dircks dated November 25, 1981.

The NRC Staff has recently obtained copies of an earlier draft of this report. This earlier draft was provided to PG&E by letter dated October 21, 1981 from R. L. Cloud and copies were made and distributed within PG&E. Copies containing PG&E's comments (marked-up copies) were subsequently provided by PG&E to R. L. Cloud Associates for its consideration in developing the draft forwarded to all parties by PG&E on November 18.

Enclosed are copies of PG&E's mark-up (copies denoted #1, #3, #4, and #5 and a copy of a marked-up section) of the earlier draft. Personnel

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from PG&E and R. L. Cloud have stated that no other marked-up copies can now be located. This information is being provided in view of the Commission's interest in the degree of independence which R. L. Cloud Associates has in performing its independent audit and review responsibilities.

original signed by:

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

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October 21, 1981

Mr. Jim Rocca
Chief Mechanical Engineer
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Dear Jim,

Enclosed please find "A Preliminary Report on the Design Interface Review of the Seismic Reverification Program."

Yours truly,

R. L. Cloud

R. L. Cloud

DO NOT DUPLICATE

#1

RLC:ljs

Enclosure

# DRAFT COPY

A PRELIMINARY REPORT ON THE DESIGN
INTERFACE REVIEW OF THE SEISMIC
REVERIFICATION PROGRAM

October 1981

Project 105-4

Report of work performed for Pacific Gas &
Electric Co. by R. L. Cloud Associates, Inc.

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TABLE OF CONTENTS

APPENDICES

Appendix 1.0 Information Across Interface from PGandE to URS/Blume

1.1 Containment Structure

1.2 Intake Structure

1.3 Turbine Building

1.4 Auxiliary/Fuel Handling Buildings

1.5 Cranes

1.6 Outdoor Water Storage Tanks

Appendix 2.0 Information Across Interface from URS/Blume to PGandE

2.1 Containment Structure

2.2 Intake Structure

2.3 Turbine Building

2.4 Auxiliary/Fuel Handling Buildings

2.5 Cranes

2.6 Outdoor Water Storage Tanks

Appendix 3.0 Information Across Interface from PGandE to Equipment Suppliers and Qualifiers

3.1 Mechanical Equipment

3.2 Piping and Valves

3.3 HVAC - Compents and Ducting

3.4 Electrical Instrumentation and Control

Appendix 4.0 Civil Engineering - Central File Index

Appendix 5.0 Mechanical Engineering - Central File Index

Appendix 6.0 URS/Blume Supplier File at PGandE

Appendix 7.0 Design Verification Documentation of PGandE

# A PRELIMINARY REPORT ON THE DESIGN INTERFACE REVIEW OF THE SEISMIC REVERIFICATION PROGRAM

## 1.0 Introduction

As a result of the discovery of a misapplication of seismic floor spectra to the annulus area of the Diablo Canyon Power Plant Unit 1, a Seismic Reverification Program* was established to determine if further errors exist in seismic qualification of the plant for the Hosgri 7.5 M earthquake. This program was presented verbally to the U. S. Nuclear Regulatory Commission in a meeting at Bethesda, Maryland on October 9, 1981. The NRC felt the program was valuable, but requested a preliminary report on part of Task 3 of the Reverification Program on a priority basis.

Task 3 of the original program is titled "Design Interface Review" and consists of a review of seismic design and qualification information that was transmitted back and forth between PGandE and subcontractors during the evaluation of the plant for the Hosgri earthquake. The part of Task 3 requested in an early preliminary report was a review of the particular design interface that existed between PGandE and URS/Blume during the Hosgri re-evaluation.

This report has been prepared in response to the NRC request for a preliminary report on the URS/Blume - PGandE Seismic Design Interface. It has been completed on a priority basis and must be considered a preliminary report, as requested and as titled. Any omissions of significant information or other incompleteness will be addressed in the overall reverification program.

---

* "Seismic Verification Program, Robert L. Cloud Associates, Inc., Berkeley, California, October 12, 1981.

## 2.0 Objective and Scope

The objective of this preliminary part of the verification program was to examine Seismic Design and Qualification information of three categories:

(1) that transmitted from PGandE to URS/Blume
(2) that transmitted from URS/Blume to PGandE
(3) that received from URS/Blume by PGandE and subsequently distributed, by PGandE, to those qualifying equipment

The requirement was to perform an engineering review of this information in a selective manner, as described below. It was reviewed to establish that correct building and equipment configurations were transmitted for analysis; that analysis was performed using applicable drawings with the correct revision, applicable equipment weights, etc.

Design spectra, building loads and other output of URS/Blume as transmitted by URS/Blume and received by PGandE were scheduled for examination with the objective of checking to see that URS/Blume-generated information was properly applied. The methodology employed in this task is described in Section 3.2 herein.

The scope of the present effort is limited to the review of the Design Interface of PGandE with URS/Blume. Other design interfaces will be reviewed in the overall re-verification study. The buildings and equipment reviewed in the present effort are those required for safe cold shutdown, and were requalified in the Hosgri reanalysis.

## 3.0 Program Methodology

### 3.1 Definition of Seismic Qualification Interfaces

The seismic qualification interfaces of interest for the present effort are illustrated in Figure 3.1. As can be seen, there are three primary interfaces that are denoted by roman numerals. The word interface refers to the process or activity in which certain engineering work is done in one organization, then transmitted to another. In the receiving organization, the engineering work is used, and perhaps transformed or reduced, and transmitted on to other organizations.

Referring to Figure 3.1, The three primary interfaces are:

I. Development and assembly of structural configurations, equipment locations and masses, together with the description of the Hosgri earthquake. This basic plant engineering description and seismic loading are forwarded to URS/Blume for dynamic analysis.

II. URS/Blume receives the plant configuration description. From this information, URS/Blume develops analytical models of the civil structures, and performs the dynamic analysis of the structures to determine their response to the Hosgri earthquake. This response, in the form of amplified floor response spectra and building loads or building qualification reports, is then transmitted to PGandE.

III. PGandE receives the civil/structural seismic response information and organizes and/or reduces

it into suitable forms for transmittal to third parties for use in qualifying equipment, and in some cases, buildings. Equipment as used here refers to everything in the plant other than civil structures.

Figure 3.1, illustrating the interfaces, has additional flow paths that indicate feedback loops across the interfaces and dashed lines that indicate possible indirect interfaces. These additional communications paths are listed to complete all possible interface interaction activity.

## 3.2 Review Methodology

It was convenient to develop an organized approach to the review to minimize confusion, lost motion, and to ensure that a complete review was accomplished. The following paragraphs describe the methodology that was devised for use in the current preliminary effort.

The basic orientation of the review was to ensure that the applicable design and qualification information was used for building and equipment qualification by studying the engineering work itself. Although casual observations were made on QA/QC type questions such as independent checking, following of procedures, etc., the basic intent of the present effort was to determine if the applicable engineering data was used in the seismic qualification calculations, regardless of the formality with which it was handled.

A second tenet of this effort was to perform a review that was both broad and complete, but also had the requisite depth. In order to accomplish this objective, two goals were set. The first goal was to examine all the interface design information involving URS-Blume to verify consistency and general accuracy. The second goal was to review all the interface information involving URS/Blume for two selected buildings in complete and comprehensive detail. The two buildings selected were the Intake Structure and the Containment Building.

### 3.2.1 Listing

Having defined the design interfaces, the next step was to list the categories of information expected to flow across each of the 3 interfaces. These categories are listed in Figure 3.2.

### 3.2.2 Structures

To break the required information into more manageable packages, the design information was examined separately for each building. The buildings are listed in Figure 3.2.2-1 with cognizant responsibilities for major tasks. As indicated, there was a separate responsible PGandE building engineer for each structure.

The interface design information was studied separately for each building and is reported separately herein.

### 3.2.3 Equipment

The overall cognizant responsibilities for the Hosgri requalification of equipment was divided between PGandE and Westinghouse, as listed in Figure 3.2.3-1. PGandE performed this qualification in-house with PGandE engineers in some cases, and utilized subcontractors for others. Subcontractor interfaces on equipment qualification are described in the body of this report.

The general strategy regarding equipment qualification was straight forward. The flow of design spectra was traced from the URS/Blume report on the relevant building to the qualification document for the individual items or classes of safety related equipment. For this preliminary report, much of the specific seismic input for certain types of equipment required more time to track than was available. When

this occurred it is noted and the input will be reviewed in the overall report.

A sizeable portion of Hosgri required equipment was qualified by Westinghouse. The flow of seismic design information sent to Westinghouse by PGandE was partially documented (See Appendix 3.1.1).

The Intake Structure Hosgri spectra were sent to Westinghouse April 15, 1977. These spectra are identicle to the current Hosgri spectra, through Ammendment 83. The Auxiliary Structure Hosgri spectra and control room slab update, April 11, 1977 and March 25, 1980 respectively are also identical to the current Hosgri spectra, through Ammendment 83.

The spectra transmitted to Westinghouse for the Containment Structure on March 16 and 23, 1977 were superceded by the spectra issued June 5, 1977. Spectra could not be located in PGandE files. On August 9, 1977, PGandE transmitted vertical spectra for the Containment Structure to Westinghouse. These spectra were thought to be valid until October 1981.

No record was found of any Turbine Building spectra ever being sent to Westinghouse.

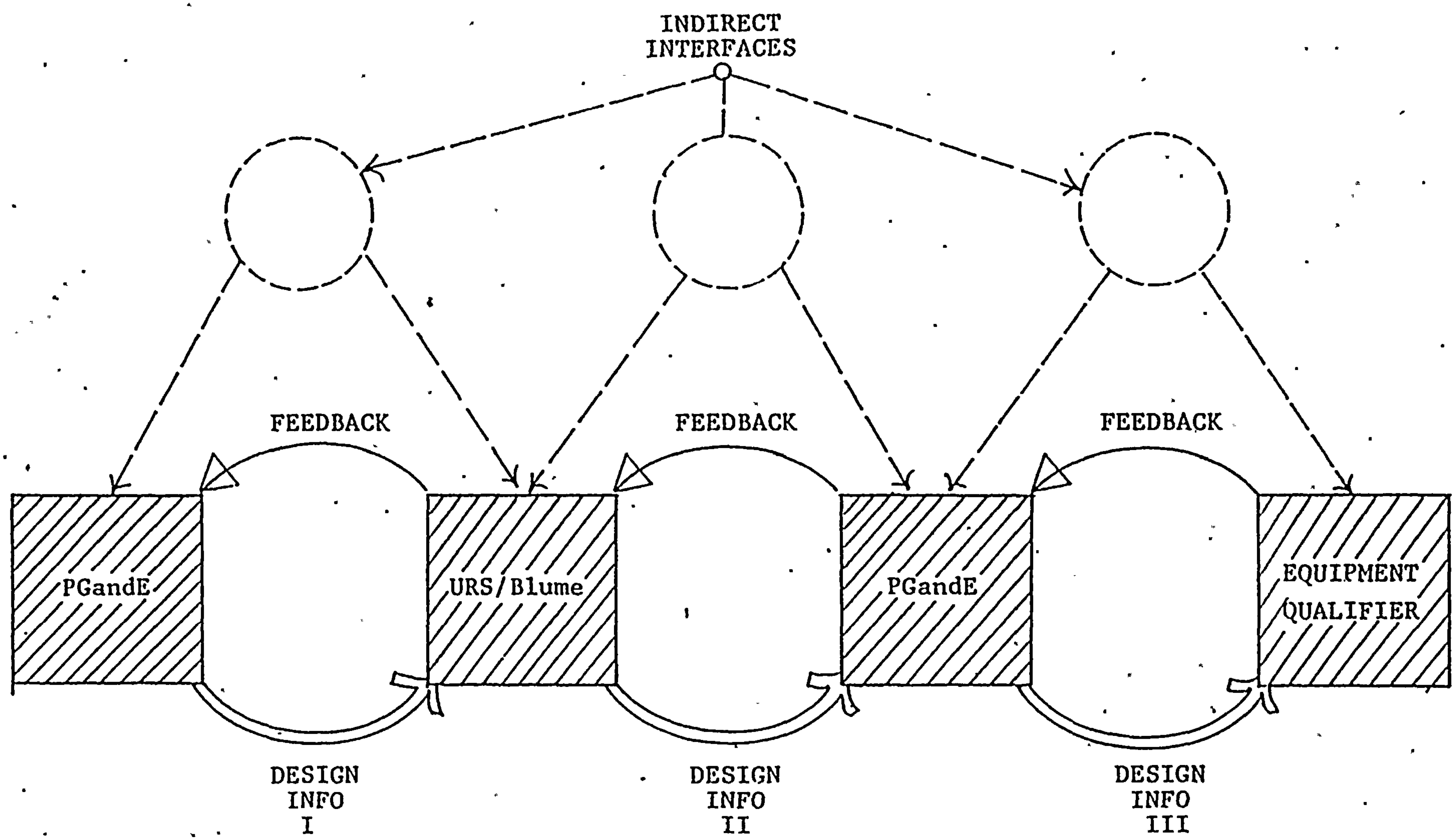


FIGURE 3.1: SEISMIC QUALIFICATION INTERFACES

| Interface I | Interface II | Interface III |
| --- | --- | --- |
| Building Drawings | Floor Response Spectra for all locations throughout plant | Envelope Floor Spectra |
| Equipment Weights and C. G. | Building Loads | Static g Loads |
| Documentation of Verbal Discussion | Dynamic Analysis Reports for all Buildings | Equipment Specifications |
| Definition of Ground Motion | | Test Specifications |
| | | Purchase Orders |

FIGURE 3.2 INFORMATION CATEGORIES OF INTERFACE

| | INTAKE BUILDING | CONTAINMENT BUILDING | AUXILIARY BUILDING | TURBINE BUILDING | CRANES | FIELD ERECTED TANKS |
|---|---|---|---|---|---|---|
| MODELING & DYNAMIC ANALYSIS | URS/Blume | URS/Blume | PGandE,<br>URS/Blume | URS/Blume | W* - 3<br>URS/B - 4 | URS/Blume |
| DEVELOP SPECTRA | | URS/Blume | URS/Blume | URS/Blume | | |
| SEISMIC QUALIFICATIONS | URS/Blume | PGandE | PGandE | URS/Blume | W - 3<br>URS/B - 4 | URS/Blume |

* Westinghouse

Diablo Canyon Nuclear Power Plant Unit 1

SEISMIC ANALYSIS AND QUALIFICATION OF BUILDINGS - COGNIZANT RESPONSIBILITIES

Figure 3.2.2-1

| EQUIPMENT | RESPONSIBILITY |
|---|---|
| Reactor Coolant System and Equipment | W* |
| Piping Systems 6" and over connected to Reactor Coolant System | W |
| Secondary Systems | PGandE & Subcontractors |
| Safety Related Conduit & Raceways | PGandE |
| Safety Related Mechanical Equipment | PGandE |
| HVAC | PGandE |
| Instrumentation and Control Equipment | PGandE |

* Westinghouse

FIGURE 3.2.3-1 RESPONSIBILITY OF EQUIPMENT QUALIFICATION

## 3.3 Reveiw of Structures and Equipment

The review of interface information for structures and equipment was performed using the methodology described in Section 3.2. To break the required information into more managable packages, the design information was examined for the following categories:

1. Containment Structure
2. Intake Structure
3. Turbine Building
4. Auxiliary and Fuel Handling Building
5. Cranes
6. Outdoor Water Storage Tanks
7. General Equipment and Systems

Sections 3.3.1 through Sections 3.3.7 discuss in detail the interface information for the above mentioned categories.

### 3.3.1 Containment Structure

The Containment Structure was originally investigated for the Double Design Earthquake (DDE) by URS/Blume. Results of this investigation are given in the URS/Blume report dated July 1970, "Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis", (Reference 1). To comply with the 7.5 M Hosgri specification, the Containment Structure was re-evaluated. This re-evaluation is presented in the URS/BLume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Containment Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake", May 1979 (Reference 11).

The following sections describe the transfer of information between PGandE and URS/Blume for the Containment Structure

and five major pieces of equipment. Generic equipment, such as cranes, piping, heating, ventilating and air conditioning, etc. are covered in Sections 3.3.5 through Sections 3.3.7.

3.3.1.1 Design Information from PGandE to URS/Blume

The close and informal relationship between PGandE and URS/Blume engineers resulted in sparse documentation of design information, drawings, equipment weights, pipe loads, etc. from PGandE to URS/Blume. Appendix 1.1 contains all the transmittal documentation for the period 1969 through 1981 for the Containment Structure. The documentation in Appendix 1.1 was obtained from Central Files in the Mechanical Engineering Department (Appendix 5) and Civil Engineering department (Appendix 4) and various personal files of engineers at PGandE. In addition part of the information was obtained from URS/Blume's project file. The document supporting this informal interface process contains the personal recollections of the PGandE engineer responsible for the Containment (Appendix 1.1, item #16).

For the Hosgri re-evaluation (Reference 11) the dynamic model used was the same as for the double design earthquake (DDE) analysis (Reference 1), with additional annulus information provided by PGandE and field visits (Appendix 1.1, item #16).

To verify that the documents used by URS/Blume to develop the original dynamic model (used subsequently for the Hosgri ev-evaluation) were correct, a list of drawings was checked. This list, given in Appendix 1.1, item #14, was obtained from the July 1970 report on the Containment Structure(Reference 1).

The criteria established to check the referenced drawings are tabulated as follows:

1. These are Containment Structure - Unit 1 drawings.

2. Since the reference drawings had no revision numbers, it was assumed that the drawings were current in July 1970.

3. When the drawings had no revisions dated later than July 1970, they were marked "O.K." If revisions were made, these were so noted.

A review of the above mentioned drawings was performed, and it was found that revisions made after 1970 were minor (Appendix 1.1, item #14), and would not affect the model in the horizontal direction.

In the case of the annulus, the only drawing documentation available are the four sketches sent to URS/Blume from PGandE (Appendix 1.1, item #5), and the calculation sketch at URS/Blume (Appendix 1.1, item #17). These sketches are for Unit 2 annulus and not for Unit 1. Unit 2 drawings, as provided by PGand E, were used by URS/Blume to formulate the seismic model because they were clearer and more easily read.

Thus, for the Hosgri ev-evaluation report (Reference 11) the containment dynamic model used was a Unit 1 interior and exterior and a Unit 2 annulus. According to URS/Blume this posed no problem as they were under the impression the Unit 1 and Unit 2 were identical. This is identified in

Appendix 1.1, item #18. Use of Unit 2 annulus and Unit 1 interior should have no affect on the shape of the annulus spectra, because of the axisymetric interior, as discussed in Appendix 1.1, item #18. The only change in the annulus regions covered by the 5 referenced frames will be affected due to Unit 1 being mirror image opposite hand configuration from the Unit 2 model.

3.3.1.2 Design Information from URS/Blume to PGandE

Unlike the informal transmittal documentation from PGandE to URS/Blume, the documentation from URS/Blume to PGandE was more formal. This is verified by reviewing the transmittal documents listed in Appendix 2.1.1. This Appendix contains transmittal documents sent to PGandE from February 1977 to the present. These documents were obtained from URS/Blume during the week of October 13, 1981. The contents of the transmittal documents marked with an asterisk are in Appendix 2.1.2.

3.3.1.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

For the purpose of this interface review, the seismic input information for the following equipment was evaluated:

1. Reactor Coolant System
2. Hydrogen Recombiner
3. Containment Purge Valves
4. Regenerative Heat Exchanger
5. Containment Cooling Fans

It was found that most of the design information for the above equipment was transmitted to Westinghouse (Appendix 3.1). The accuracy of this information is discussed in the next section.

3.3.1.4 Qualification of Containment Structure and Equipment

3.3.1.4.1 Containment Structure

A comprehensive design review of the Containment Structure was originally completed on 2/28/77. This review had one outstanding item - pipe rupture restraints. This item was cleared, and an amendment issued on 1/16/78. The original review and the amendment were performed by PGandE and are given in Appendix 7.

Another design review of the Containment Structure was completed by PGandE on 1/22/79. This design review addressed the structural adequacy of the Containment Structure for the postulated 7.5 M Hosgri seismic event (Appendix 2.1).

Because of the recent development due to the discovery of an error in the annulus spectra, no conclusion can be drawn on the structural adequacy of the annulus. As this structure supports many equipment and piping systems, further in-depth review is necessary in the overall reverification program.

3.3.1.4.2 Equipment

A detailed review of equipment is given in Appendix 3.1. A summary is given below:

1. Reactor Coolant System
   Westinghouse (W) seismically qualified the Reactor Coolant vessel for the Hosgri requirement as discussed in the W report, "Summary Report, Seismic Evaluation of Westinghouse Equipment for Postulated 7.5 M Hosgri Earthquake, Diable Canyon Units 1 and 2, August 1979 (Appendix 3.1.2). The seismic spectra used for qualification envelope the current Hosgri spectra for the interior concrete, and thus the seismic qualification is valid.

2. Hydrogen Recombiner
   Westinghouse (W) originally qualified the Hydrogen Recombiner in the annulus region by test. These were transmitted to PGandE as discussed in Appendix 3.1.2. Due to the conservative nature of the test spectra utilized in the original qualification, it was confirmed that the Hydrogen Combiners qualify to the new enveloped annulus spectra.

3. Continment Purge Valves
   The Containment Purge Valves were reviewed by T. N. Crawford as stated in the memo-to-file dated 6/11/79 (Appendix 3.1.2). The zero period accelerations used in analysis

are more conservative than the current Hosgri spectra. Considering that the computations were correct, the containment purge valves are qualified to the 7.5 M Hosgri earthquake.

4. Regenerative Heat Exchangers
Westinghouse (W) performed the seismic qualification of the Regenerative Heat Exchangers using the Hosgri spectra as discussed in Appendix 3.1.2.

This qualification will require close scrutiny to properly evaluate the conclusion of the review.

5. Containment Cooling Fans
A detailed discussion of the qualification and review process for the containment cooling fans is given in Appendix 3.1.2. The end result of this check shows that superceded spectra were utilized for qualification. In this particular case, the conclusions are still valid because the spectra that were used envelope the current spectra.

Besides the equipment reviewed above, other equipment in the Containment Structure has not been reviewed for the current effort, but will be done in the Reverification Program.

### 3.3.2 INTAKE STRUCTURE

#### 3.3.2.1 Design Information from PGandE to URS/Blume

PGandE's Civil Engineering file was searched for the design information transmitted from PGandE to URS/Blume on the Intake Structure during and prior to the Hosgri studies (Appendix 4). No such information was found. The following information was taken from the file of the lead PGandE engineer responsible for the Intake Structure.

The seismic analysis of the Intake Structure for the Hosgri criteria was initiated on April 26, 1976. (Appendix 1.2). The relevant information such as civil/mechanical drawings and equipment weights were found to be transmitted from PGandE to URS/Blume from April 26 to June 22, 1976 (See Appendix 1.2).

#### 3.3.2.2 Design Information from URS/Blume to PGandE

A two-phase work scope of the seismic analysis of the Intake Structure for the Hosgri criteria was found in a memorandum dated 5/6/76 from URS/Blume to PGandE (Appendix 2.2.1). Some weekly progress reports from URS/Blume were found in the PGandE civil engineering file (Appendix 4).

A preliminary report on the seismic analysis of the Intake Structure was issued by URS/Blume to PGandE on April 6, 1977. Modifications of this report were made on 5/9/77 and 2/14/78, and the final report was issued on 5/16/79. An additional report entitled "Diablo Canyon Intake Structure -

Factor of Safety Against Overturning, Foundation Bearing Pressures", was issued on 11/13/78 (Appendix 2.2.2).

The design drawings used by URS/Blume to develop the mathematical model for the seismic analysis were reported in "DCNPP - Intake Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Criteria", May 9, 1977 (See Appendix 2.2.2). These drawings were compared with the Intake Structure drawings in the PGandE file (Appendix 1.2). A list of Intake Structure drawings currently in URS/Blume files is also given in Appendix 1.2. It was found by comparing the drawings used in developing the mathematical model of the Intake Structure with those in the PGandE file, that the PGandE file has later revision drawings. The revisions are based on spot checks. These minor changes will not affect the mathematical model used in the seismic analysis.

3.3.2.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

No information was found to be given to equipment suppliers.

3.3.2.4 Qualification of Intake Structure and Equipment

3.3.2.4.1 Intake Structure

According to the lead PGandE engineer responsible for the Intake Structure, the building was qualified by using seismic response output produced in the URS/Blume 5/9/77 report (Appendix 1.2). The URS/Blume 5/16/79 report

gave smaller building response. Therefore, the building does not need to be requalified. However, the design review of the Intake Structure (Appendix 7) was dated September 1976, and has not reflected the Hosgri seismic requirement. Further investigation will be performed to determine the process of building qualification in the overall reverification program.

3.3.2.4.2 Auxiliary Salt Water Pumps

The safety-related Class 1 equipment inside the Intake Structure are the auxiliary salt water pumps. They were qualified by PGandE using the site design spectra (Hosgri criteria, see Appendix 2.2) for the reason that the building is essentially rigid. Although the 5/9/77 and 5/16/79 reports by URS/Blume differ in seismic structural responses, there is no need to requalify the auxiliary salt water pumps if the building is truly rigid since the site seismic design spectra were used to qualify these pumps. Rigidity of the building appears to be a good assumption based upon a cursory examination of the drawings, but this assumption will be verified in an engineering sense in the reverification study.

3.3.2.4.3 Buried Pipelines

The buried pipelines connecting the Intake Structure to the Turbine Building were qualified by PGandE with input from URS/

Blume. PGandE's qualification work was independently checked by Harding-Lawson Associates, using input from URS/Blume (See Appendix 7). The input used in the above two studies will be verified in the overall reverification program.

### 3.3.3 Turbine Building

The Turbine Building was originally designated a seismic Design Class II structure and designed on the basis of a minimum horizontal seismic coefficient of 0.2 g. The structure was later analyzed for the double design earthquake (DDE) and was found to require minor structural mofification. This is presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Earthquake Analysis Turbine Building, Unit 1", dated July, 1970 (Reference 2).

Because the building contains some design Class I equipment and because it is in close proximity to the Class I Auxiliary Building, it was necessary to show that under the postulated 7.5 M Hosgri motions the building would not have a failure which would impair either the Class I equipment contained in the Turbine Building or the Class I Auxiliary Building. For this reason, the Turbine Building was investigated for the Hosgri inputs. This resulted in major strucutral modifications, which are given in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Turbine Building Evaluation and Structural Modification for the 7.5 M. Hosgri EArthquake", March, 1980 (Refernece 3).

The following sections address the interface issue between PGandE, URS/Blume, and Equipment Suppliers and Qualifiers for the Turbine Building.

#### 3.3.3.1 Design Information from PGandE to URS/Blume

The original design and analysis, including the generation of drawings of the Turbine Building, were done by URS/Blume. Following the Hosgri requirement to re-evaluate the Turbine Building in 1977, URS/Blume performed the analysis and reevaluation. Design changes and drawings were

generated by PGandE from URS/Blume input. These were then checked and verified by URS/Blume. (This is documented in Section 4, Appendix 1.3.)

In the case of the Turbine Building, a large number of transmittals were documented. Appendix 1.3 contains transmittal documentation for the period 1974 to 1979. Relevant design information transmitted is given in Appendix 1.3.

3.3.3.2 Design Information from URS/Blume to PGandE

Appendix 2.3.1 contains transmittal documents from URS/Blume to PGandE. They reference various spectra, design, analysis and test reports and other correspondence of technical nature.

The detail transmittals themselves have not been reviewed and will be a part of the overall reverification work.

3.3.3.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

In the Turbine Building, the major safety related mechanical equipment system, per Hosgri requirement, is the Diesel Generator System. Since PGandE was its own qualifier, no interface between equipment vendor or suppliers was required.

The Diesel Generator System consists of six major components:

1. Diesel Generators
2. Starting Air Receivers
3. Fuel Oil Filter
4. Fuel Oil Priming Tank
5. Fuel Oil Strainer
6. Fuel Oil Transfer Pump

The Mechanical Engineering Central File Index (Appendix 5) was reviewed to check for correct and current seismic inputs in the qualifying documents for the above mentioned components. The specific details of each component is discussed at length in Appendix 3.1.5.

Results of this review show that the Diesel Generator System was conservatively qualified to correct Hosgri seismic input.

3.3.3.4 Qualification of Building and Components

The Turbine Building design qualification responsibilities were divided between URS/Blume and PGandE.

The qualification of major seismic resistant components of the building for the Hosgri evaluation was performed by URS/Blume and specific drawings which reflect the modifications are included in the report entitled "DCNPP, Unit 1 - Turbine Building Evaluation and Structural Modifications for the 7.5 M Hosgri Earthquake", March 1980 (Appendix 2.3.2). PGandE implemented modifications to qualiby the building frames, interior block and concrete walls and anchorage that were not qualified by URS/ Blume. Tables 3.3.1 and 3.3.2 contain the list of

PGandE drawings for these modifications, obtained from conferring with the responsible lead engineer.

The PGandE design review is presented in the report "Hosgri Design Verification - Turbine Building", February, 1980 (Appendix 7).

Since the design review did not verify the interface procedures between URS/Blume, PGandE and the field. (Figure 4-10-2, URS/Blume Report on Design Review, Appendix 7), these will be investigated in the overall reverification program.

TABLE 3.3.1

Drawings prepared by PGandE containing modification information for Structural Frames, Beams and Columns per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463684 | 465135 |
| 465127 | 465136 |
| 465128 | 465137 |
| 465129 | 465138 |
| 465130 | 465139 |
| 465131 | 465140 |
| 465132 | 465141 |
| 465133 | 465142 |
| 465134 | 465143 |

TABLE 3.3.2

Drawings containing modification information for Equipment Anchorage per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463671 | 463677 |
| 463672 | 463678 |
| 463673 | 463679 |
| 463674 | 463680 |
| 463675 | 463681 |
| 463676 | 463682 |
| | 463683 |

### 3.3.4 Auxiliary/Fuel Handling Buildings

#### 3.3.4.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file (Appendix 4) was searched for the design information transmitted from PGandE to URS/Blume on the Auxiliary/Fuel Handling Buildings during and prior to the Hosgri studies. Specifically, Civil/Structure files No. 9.3, Auxiliary Building, and No. 9.31, Seismic Analysis, were searched thoroughly (Appendix 4). One transmittal issued by PGandE to URS/Blume dated April 16, 1971 was found. In this memo, the steam anchorage drawings of the Auxiliary Building were discussed (Appendix I.4).

After discussions with the lead engineer of PGandE who was responsible for the seismic analyses of Auxiliary/Fuel Handling Buildings, it was learned that during the DDE analysis, PGandE developed, with the assistance of URS/Blume, computer programs "Dybox-2" and "Shewal-4" to compute the mass and stiffness properties of the mathematical model for the Auxiliary/Fuel Handling Building (Appendix 1.4). The computations by computer were done at PGandE and the output was given to URS/Blume as input to compute the seismic response of the buildings (Appendices 1.4 and 2.4.2 - May 9, 1977, pp. 8 and 9).

The lead engineer of PGandE also stated that for the Hosgri criteria, the original data (for DDE analysis) used as an input for Dybox-2 was checked against the as-built conditions. The results of this check confirmed that there were no changes in the concrete dimensions. Consequently, the DDE model was used

in the Hosgri study (Appendix 1.4). The same statements were found in the URS/Blume Report of May 9, 1977 (Appendix 2.4.2).

However, an examination of some telecon records (from 3/9/77 to 3/24/77, Appendix 1.4) kept in URS/Blume's file reveals that there were discussions on discrepancy of weights computed by PGandE in the E-W and N-S directions for the DDE model, and a difference of 35% in the weight at Elevation 140', computed by PGandE for the DDE model and URS/Blume's computation in March 1977.

An average weight of weights in the E-W and N-S directions and the weight of DDE model at Elevation 140' were finally used in the Hosgri analysis, with no explanations as to how the weight difference was resolved. A detailed examination of the above will be performed in the overall reverification program.

3.3.4.2 Design Information from URS/Blume to PGandE

The flow of information from URS/Blume to PGandE on the Auxiliary Building is documented in Appendix 2.4.

Preliminary Hosgri spectra were issued by URS/Blume prior to the issuance of the May 9, 1977 (May 11, 1977 transmittal) Hosgri Final Report (Appendix 2.4.2).

During the qualification of the Auxiliary Building it was decided to make a separate more detailed finite element model of the control room due to its importance. This model is the basis for the control room qualification (Appendix 2.4.2). Since the final control room spectra are higher than the preliminary

spectra, a detailed review of equipment qualification will be performed in the final program to be sure the preliminary spectra were not used.

Spectra transmittals after May 11, 1977 provide additional, but not different, information.

3.3.4.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

Seismic qualification of major mechanical equipment is addressed in Section 3.3.4.4.2. Seismic qualification of other equipment and systems is addressed in Section 3.3.7.

3.3.4.4 Qualification of Buildings and Equipment

3.3.4.4.1 Buildings

The statement by the responsible engineer at PGandE in Appendix 1.4 confirmed that the structural evaluation of the Auxiliary Building was done based on the output from URS/Blume's 7.5 M Hosgri seismic analysis. No effort has been spent, because of time constraints, to spot-check the building qualification details. In the full length verification study, seismic input loads used for building verification report dated 1974, of the Auxiliary Building is in PGandE's Civil Engineering file (Appendix 7). The design verification report has an attached note indicating revision for Hosgri. This will be investigated further in the Reverification Program.

3.3.4.4.2 Equipment

The major equipment of the Auxiliary Building was qualified either by Westinghouse and PGandE or reviewed by Westinghouse. Table 3.3.5.4 summarizes the qualification of mechanical equipment in the Auxiliary Building. The detailed information on this equipment qualification is given in Appendix 3.1.4.

### 3.3.5 Cranes

#### 3.3.5.1 Containment Structure Cranes

There are two cranes in the Containment Structure that required seismic evaluation per 7.5 M Hosgri specification. These are the Polar crane and the Dome Crane. A brief discussion of the two cranes is given in the following sections.

##### 3.3.5.1.1 Containment Polar Crane

The Containment Polar Crane is a gantry crane with trolleys and consists primarily of welded structural steel members and full moment resisting bolted connection. Results of a 3-D nonlinear seismic analysis are presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Containment Polar Cranes Evaluation for the 7.5 M Hosgri Earthquake", dated Jly 1979 (Appendix 2.5.2).

The drawings and other design information utilized for the modeling of the cranes are not referenced in the report. Nor are there any transmittals documenting the transfer of these from PGandE to URS/Blume.

At present the only documentation that substantiates the above mentioned report are the calculations (Appendix 2.5.2). These documents basically reflect that the design review was completed by URS/Blume and that the results concluced are valid. The drawings included in the Appendix of the July 1979 report were checked against the

model in the report (Appendix 2.5.2). This preliminary review shows that the information was transformed correctly from the drawings to the model.

3.3.5.1.2 Dome Crane

The dome service crane is a maintenance crane located on top of the polar crane. PGandE was in the process of designing modification to comply with the 7.5 M Hosgri Evaluation. As of May 5, 1981, PGandE halted this process and is presently considering retaining a consultant to evaluate the consequences of assumed failure. This is documented in the letter dated May 5, 1981 given in Appendix 1.5. The documentation of seismic qualification of this crane for the Hosgri requirement was not found in the current effort. It will be verified in the overall re-verification program.

3.3.5.2 Intake Structure Crane

3.3.5.2.1 Design Information from PGandE to URS/Blume

Some design information for the seismic analysis of Intake Structure Crane was transmitted from PGandE to URS/Blume on 1/18/79, More design information for crane, trolley assembly and frames were respectively transmitted on 12/21/78 and 1/24/79. In February 1979, field measurement of Intake Structure crane was performed (Appendix 1.5).

3.3.5.2.2 Design Information from URS/Blume to PGandE

URS/Blume requested field measurement and transmitted SK-1-12-9 on 1/23/79. The crane hoist engineering drawings were found to be transmitted on 3/5/79. The final seismic analyses report entitled "DCNPP - Intake Structure Crane Evaluation for the 7.5 M Hosgri Earthquake", November 1979, was transmitted on 11/28/79 and documents the seismic design qualification information for this crane (Appendix 2.5).

3.3.5.2.3 Qualification of Intake Structure Crane

A quick review of the final report listed in Section 3.3.5.2.2 found many suggested design modifications. They are: the installation of a seismic hold-down and lateral restraint mechanism, and minor structural modifications to transmit horizontal forces from crane legs to truck and then to the rail. These modifications to design drawings were made by URS/Blume and were also reported in the above report. The modifications to construction drawings were jointly made by PGandE and URS/Blume. However, spot checks need to be made to insure that modifications to construction drawings were properly done.

3.3.5.3 Turbine Building Crane

3.3.5.3.1 Design Information from PGandE to URS/Blume

In the case of the Turbine Building Crane, a formal transmittal of drawings and equipment weights was done on 7/22/75: The transmittal documentation giving the drawing number is listed in Section 1 of Appendix 1.5. Besides this design information, no other transmittals were found.

3.3.5.3.2 Design Information from URS/Blume to PGandE

The final report entitled "Diablo Canyon Nuclear Power Plant - Turbine Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)", November 1979, presents the design information required to modify the crane for the Hosgri criteria (Reference 3).

3.3.5.3.3 Qualification of Turbine Building Crane

The qualification of Turbine Building crane was jointly performed by PGandE and URS/Blume. Based upon design information presented in 3.3.5.3.2 above, URS/Blume modified the crane design to provdie tiedown of the crane trolley to the bridge girder and lateral seismic restraint to distribute the lateral seismic loads to both horizontal crane support girders (described in the Hosgri report given in 3.3.5.3.2 above). PGandE and URS/Blume subsequently jointly revised the crane construction drawings. However, spot checks need to be made to insure that modifications to construction drawings were properly implemented.

3.3.5.4 Fuel Handling Building Crane

3.3.5.4.1 Design Information from PGandE to URS/Blume

Very little documentation was found in PGandE's file on design information transmitted to URS/Blume. Based upon the recollection of the lead engineer for the seismic analysis of fuel handling crane (Appendix 1.5), the latest revisions of crane manufacturer's drawings, original calculations, and material properties of crane were transmitted to URS/Blume. As is the case for some of the other structures, the information was passed on in an informal basis. However, there is no record of URS/Blume's correspondence file on crane which shows that URS/Blume received such information. Some spot checks need to be made to check the accuracy of design information transmitted.

3.3.5.4.2 Design Information from URS/Blume to PGandE

The final report entitled "Diablo Canyon Nuclear Power Plant - Fuel Handling Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)" was issued on 9/6/79 (Reference 4). Several minor structural modifications to the existing crane structural system were reported in order to prevent eccentric loading of the crane runway and excessive loading on the trolley axis.

3.3.5.4.3 Qualification of Fuel-Handling Building Crane

The qualification of fuel-handling building crane to satisfy Hosgri criteria was jointly performed by PGandE and URS/Blume. URS/Blume prepared design modifications per Hosgri report for this crane. PGandE and URS/Blume jointly revised the

subject crane construction drawings. Some spot checks will be made to insure that these modifications were properly done.

### 3.3.6 Outdoor Water Storage Tanks

#### 3.3.6.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file was searched for the design information transmitted from PGandE to URS/Blume (Appendix 4). No relevant transmittals were found.

After talking to the lead engineer of PGandE who was responsible for the seismic analysis of outdoor water storage tanks, it was learned that the seismic analyses of these tanks started in March 1977. PGandE and URS/Blume engineers worked closely as a team and the information between PGandE and URS/Blume was exchanged on a person to person basis in meetings, telephone calls, etc. (Appendix 1.6.)

An examination of telecon records kept in URS/Blume's file (Appendix 1.6) confirms the statement described above by the lead engineer of PGandE. Some design information transmitted between URS/Blume and Harding-Lawson on soil data and stability of tanks was also found in URS/Blume's telecon records. The design information was found to be transmitted informally. Some checks are required in the overall reverification program to insure its accuracy.

#### 3.3.6.2 Design Information from URS/Blume to PGandE

The final seismic analyses were completed in March 1979 and the design information transmitted on March 26, 1979 (Reference 5). Because the tank modifications were being carried out in the field at the same time as the analyses were being performed, nu-

merous revisions were made to PGandE drawings to incorporate URS/Blume's findings. The above report, therefore, reflects the actual configuration and field condition of the tanks (Appendix 1.6). Although a team effort existed between PGandE and URS/Blume in transmitting the design information, some checks need to be made to determine the accuracy of the information transferred.

3.3.6.3 Qualification of Tanks

The tanks were qualified jointly by URS/Blume and PGandE, using Hosgri criteria as they worked together. URS/Blume's Hosgri report (March 1979) documents the modifications (Reference 5). The outdoor water storage tanks and components were subsequently concluded to meet the Hosgri seismic requirement (PGandE's design verification report for outdoor water storage tanks, dated 9/21/79 (Appendix 7).

### 3.3.7 General Equipment and Systems

A significant portion of the scope of this report is to review the interfaces between PGandE and various equipment suppliers and qualifiers. For most equipment, the practical way to check this interface is to examine the end result, the actual seismic qualification and note whether the current applicable Hosgri response spectra curves were used.

The mechanical equipment seismic qualifications are reviewed in the section addressing the individual buildings and will be not included here. This section will deal primarily with the review of seismic qualification of the following equipment and systems.

1. Piping Systems
2. Valves
3. HVAC Components
4. HVAC Ducting
5. Electrical Equipment & Instrumentation
6. Electrical Systems - Raceways and Conduits

3.3.7.1 Piping Systems

This section of the report will address the transmittal of seismic design information from PGandE to consultants engaged in analysis of piping systems and supports.

As was noted in a summary by the PGandE Piping Group, the piping analysis was assigned to consultants URS/Blume and Earthquake Engineering Systems (EES). Similarly for support evaluation, URS/Blume, EES, and EDS Nuclear, Inc. were used as the primary consultants.

For support evaluation the seismic design input consists of either a spacing table with seismic factors or the actual support force output from a piping analysis computer model. PGandE uses a design guide for the seismic factors which they transmit to the consultants. This will be a significant interface to examine. For instances where piping computer analysis output is used for design, then the valve qualification is totally dependent on the design input to the piping analysis.

The transmittals for piping analyses appear to be in complete form for documents sent to EES. The only problem is that the transmittal cover sheet does not list the contents of the entire attachment. The transmittal might only read problem number and "appropriate spectra attached". To trace the flow of information it will be necessary to find the contents of the transmittals. This task may be accomplished by further examination of PGandE files or perhaps by examining EES files.

For the scope of piping assigned to URS/Blume, very little correspondence was located during the time frame

of Unit 1 piping analyses. However, URS/Blume has not yet been contacted to provide any transmittals they may have sent or received. This will be implemented for the long term reverification effort.

### 3.3.7.2 VALVES

A preliminary review was performed on seismic design information transferred across interfaces between PGandE and valve qualifiers. This review addresses the safety related valves that required seismic requalification to meet the Hosgri requirements.

The valves reviewed consist of the minimum required active valves for hot shutdown and/or cold shutdown and the valves required in case of a single failure. The containment purge valves are addressed in Section 3.3.1.3.

The valves reviewed are listed in Tables 7-3A,B and 7-7, 7-7A of the Hosgri Seismic Re-evaluation Report (Reference 6). Copies of these tables are contained in Appendix 3.2.

#### 3.3.7.2.1 Definition of Interfaces

A number of PGandE and contractor interfaces existed. Review of available documentation to date shows that the primary interfaces for valve requalification were:

PGandE → EES → PGandE for piping analysis
PGandE → EDS → PGandE for valve qualification
PGandE → Westinghouse → PGandE for valve qualification

where EES ---- Earthquake Engineering Systems, Inc.
EDS ---- EDS Nuclear Inc.
Westinghouse -- Westinghouse Electric Corp..

EES, using data proveded by PGandE, produced computer models of piping systems. Computer analyses were then performed to determine the dynamic characteristics of the piping system under earthquake loading. Results were then returned to PGandE.

Earthquake loading was determined from acceleration response spectra provided by PGandE to EES.

PGandE transferred the relavant results of the completed piping analyses, valve accelerations, and pipe loading to EDS and Westinghouse. EDS and Westinghouse then proved that the valve meets certain criteria under the given loading conditions. This was done by either analysis or testing. Results were then returned to PGandE.

3.3.7.2.2 Transmittals Between EES and PGandE

No documentation has been found concerning transmittals of information from PGandE to EES at this point in time. A search for this documentation is being continued.

Some records of EES transmittals to PGandE have been found to date. A complete set of EES transmittals to PGandE has not been compiled yet.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.3 Transmittals Between EDS and PGandE

A limited amount of documentation of information transfer from PGandE to EDS has been found to date. Complete documentation of requalification information for the valves being reviewed here has not been compiled at this point in time.

Some records of results sent by EDS to PGandE have been located. A complete set of EDS transmittals to PGandE for the valves being reviewed has not been compiled as of this date.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.4 Transmittals Between Westinghouse and PGandE

Some information on PGandE transmittals to Westinghouse has been located in PGandE files. However, insufficient records have been found to fully document information flow from PGandE to Westinghouse.

The only evidence of information returned from Westinghouse to PGandE found to date is a Westinghouse document containing valve seismic qualification forms submitted to the NRC. A copy of this document was sent to PGandE.

Documentation of transmittals between Westinghouse and PGandE located to date are contained in Appendix 3.2.2.

### 3.3.7.2.5 Reverification Effort

For valves on flexible piping systems, the acceleration response of the pipe must be known in order to obtain the valve accelerations, and to derive the pipe loadings on the valves. This is a result obtained from the piping analyses. Therefore, the validity of a valve qualification depends on information transferred two steps earlier: from PGandE to the piping analyst and from the return of the analysis results from the piping analyst to PGandE.

With the documentation available to date, no evidence was found to indicate whether the valve accelerations have ever been verified as being correct before being transmitted to the valve qualifiers.

To perform a thorough review of the information transferred across interfaces, the following procedure will be followed:

1. Locate and examine documentation of correct Hosgri spectra transmitted to piping analysts.

2. Locate and review transmittals of piping analysis results to PGandE, particularly valve accelerations. The accuracy of the piping model is also to be checked.

3. Locate and review transmittals of valve accelerations from PGandE to valve qualifiers.

4. Cross check data returned to PGandE from piping analysts with data transmitted out of PGandE to the valve qualifiers.

3.3.7.3 HVAC Components

An independent engineering review of the seismic qualification was performed for the Safety Related HVAC equipment (References 7 and 8) by EDS Nuclear, Inc.

This EDS review concluded that the majority of the HVAC equipment is seismically qualified to the Hosgri requirement, and that with minor modifications, the remainder will also be.

As part of this interface review, the seismic accelerations that were used as input was checked for correctness. Out of 5 inputs checked, one of them was incorrect.

The field work is given in Appendix 3.3.1. Since the qualification accelerations are larger than the Hosgri accelerations, these particular errors were not of consequence.

3.3.7.4 Heating, Ventilating and Air Conditioning Duct

3.3.7.4.1 The majority of HVAC ducts required for cold shutdown has been qualified by PGandE, with the remainder of the engineering being done by EDS Nuclear. PGandE architects, HVAC engineers, and civil engineers all collaborated on the duct design. Information flow between these groups is documented in Appendix 3.3.2.1.

3.3.7.4.2 The HVAC information in Appendix 3.3.2 was supplied by the responsible PGandE engineer. Containment duct computations could be easily be found. This will be reviewed at a later date.

3.3.7.4.3 A random sampling of the duct qualification calculations was checked for seismic input (Appendix 3.3.2). Six of the twenty-seven HVAC details listed in Appendix 3.2.2.2 were chosen at random. In contrast to the random sampling shown above, all seismic inputs to the Fireproof Ducts were checked against current Hosgri Spectra (Appendix 3.3.2).

3.3.7.4.4 Five HVAC Details have Hosgri accelerations correctly used and one (Detail 4, Drawing 504566) has Hosgri accelerations greater than the value in the calculations. All spectra for the Fireprorfed Ducts were found to be correctly used (Appendix 3.3.2.3).

3.3.7.4.5 One HVAC Detail (Detail 4, Drawing 504566) will be analyzed at a later date.

3.3.7.5 Electrical Equipment and Instrumentation

A preliminary review was performed on seismic design information transferred between PGandE and electrical equipment and instrumentation vendors and qualifiers. This review focuses strictly on design information used in requalifying safety related electrical equipment and instrumentation to meet the Hosgri seismic requirements.

The Hosgri Seismic Re-evaluation Report (Reference 6) was used to derive the list of safety related electrical equipment and instrumentation. A copy of Table 10-1 from the Hosgri Report is included in Appendix 3.4.1. Table 10-1 is a complete list of the safety related electrical equipment and instrumentation.

Although the cable trays are included in Table 10-1, they are reviewed separately and are addressed in Section 3.3.7.6.

3.3.7.5.1 Definition of Interfaces

The responsibility for electrical equipment and instrumentation seismic qualification was divided between PGandE and Westinghouse. Westinghouse was responsible for qualifying Westinghouse supplied NSSS equipment. The remaining electrical equipment and instrumentation was qualified by PGandE.

The interface between PGandE and Westinghouse allowed PGandE to send Hosgri spectra information to Westinghouse, and for Westinghouse to send the results back to PGandE.

Of the PGandE qualified equipment, it was qualified either by analysis or by testing at Wyle Laboratories.

The Wyle Labs and PGandE interface allowed PGandE and Wyle Labs to exchange information regarding Hosgri spectra, test spectra and test procedures. Also, Wyle transmitted test results back to PGandE across this interface.

3.3.7.5.2 Transmittals from PGandE to Westinghouse

No documentation has been found in the current work regarding the transmittal of information from PGandE to Westinghouse.

3.3.7.5.3 Transmittals from Westinghouse to PGandE

The only evidence of transmittals from Westinghouse to PGandE encountered to date is the existence in the PGandE files of the Westinghouse report "Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri". (Reference 9).

3.3.7.5.4 Transmittals from PGandE to Wyle Labs

No documentation has been found to date regarding the transmittal of spectra or test procedure information from PGandE to Wyle Labs.

3.3.7.5.5 Transmittals from Wyle Labs to PGandE

The only transmittals from Wyle Labs to PGandE found thus far are Wyle Labs test reports and test procedures. Two of these that were examined are Wyle Labs Test Procedure No. 3642 and Test Report No. 58255 (Reference 10).

3.3.7.5.6 Transmittals Regarding Requalification by Analysis

No documentation has been found to date regarding requalification of electrical equipment or instrumentation by analysis, by either PGandE or other Parties.

3.3.7.5.7 Westinghouse Requalification

Review of the Westinghouse report, "Summary Report on Seismic Evaluation for Postulated 7.5 M. Hosgri", (Reference 9) showed that Westinghouse electrical equipment and instrumentation was requalified for Hosgri requirements by applying certain criteria to previously performed tests and analyses.

The test spectra used in the previous tests are included in Appendix 3.4. These are identical to Figures 10-2 to 10-12 in the Hosgri report. The Westinghouse report states that the 5-9-77 spectra were used and that the Blume and Newmark spectra were enveloped.

The report also states that the vertical spectra used were taken as 2/3 of the horizontal spectra. However, in a conversation with the cognizant engineer from Westinghouse, he states that specific vertical Hosgri spectra were used in the requalification of each item of equipment. The engineer also stated that the vertical spectra for control room equipment were selected with consideration for the node point closest to the equipment location.

Requalification was performed by Westinghouse by

comparing the applicable Hosgri spectra to test spectra used in the initial pre-Hosgri qualification. The positive results of this comparison were communicated to PGandE by Westinghouse in Westinghouse Project Letter PGE-4231, Revision 1, dated September 5, 1980 sent to D. V. Kelly (Reference 12).

3.3.7.5.8 Wyle Requalification Tests

Though no documented transmittals from PGandE to Wyle have been found to date, there is evidence that Wyle test procedures were reviewed and approved by PGandE personnel:

1. A PGandE memo, dated 11-9-77, from O. Steinhardt contains comments on test spectra contained in Wyle Test Report No. 26286.

2. Wyle Test Procedure No. 3642, dated 11-30-77, is signed and approved by PGandE personnel.

Documentation on these two items is contained in Appendix 3.4.

PGandE internal memorandum indicate that General Electric was involved in Wyle Labs requalification tests of the 4.16kV Vital Switchgear (Appendix 3.4). Further investigation will be required to determine General Electric's role on requalification. If necessary, information transmittals across that interface will be examined.

3.3.7.5.9 Requalification by Analysis

For equipment requalified by analysis, as indicated by note 5 in Table 10-1 of the Hosgri report, no information has been found to date as to who had performed these analyses. Investigation in this area will be continued.

3.3.7.5.10 Preliminary Review of Electrical Equipment

A preliminary review of requalification of electrical equipment and instrumentation was conducted by checking a 50% sample of Zero Period Accelerations (ZPA's) from the Hosgri Evaluation listed in Table 10-1 of the Hosgri report.

The Hosgri ZPA's listed were cross checked against the ZPA's of the applicable up-to-date Hosgri spectra. The Hosgri ZPA's in Table 10-1 were found to be correct.

In each case, the ZPA levels used to qualify each item of equipment, as listed in Table 10-1, were greater than the Hosgri required ZPA's.

3.3.7.5.11 Reverification Approach

Should further investigation fail to uncover records that satisfactorily document the transfer of seismic requalification information between PGandE and qualifiers, the following procedure will be undertaken:

1. Actual test spectra used in requalification tests will be examined. They will be checked

to see if they envelop the applicable Hosgri spectra.

2. Requalification analyses will be examined to check if the applicable seismic information was applied. In addition, the analysis criteria used for qualification, if applicable, will be examined.

3.3.7.6 Electrical Raceways

3.3.7.6.1 The supports for the Electrical Raceways are found indiscriminately throughout the main buildings. With in excess of six hundred unique types of support details.

The PGandE Civil Engineer responsible for electrical Raceways provided the qualification documentation. Each support detail is qualified to the Hosgri by simplified computation. Each Detail is assumed to span a maximum of eight feet.

3.3.7.6.2 With such a large volume of material, a random sampling approach was employed. The Hosgri seismic accelerations were checked for ten support details (Appendix 3.4.2.3). In addition the program employed in September 1981 by PGandE to requalify the raceways in the Annulus section of Containment was checked. The Annulus region was closely examined for the following three reasons:

No transmittals of Annulus drawings from PGandE to URS/Blume were located and URS/Blume does not, at present, have the drawings. Preliminary spectra differing from the 5/9/77 spectra was issued for Containment. Different spectra (7/21/77) superceding the 5/9/77 Hosgri Report was issued (Appendix 2.1.2).

Seven of the ten calculations checked (S86, S93, S166, S251, S370, S415, S432) did not use correct seismic accelerations for 4% damping.

The bolted cable trays can take advantage of 7% damping for the Safe Shutdown Earthquake (Regu-

latory Guide 161, Appendix 3.4.2.3). The Hosgri spectra for most locations lists only 2%, 3%, and 4% damping. Possibly the incorrect accelerations resulted from interpolations of the 4% Hosgri spectra. Detail S415 used Hosgri spectra issued before May 9, 1977.

PGandE's Electrical Raceway Seismic Requalification Program for Unit 1 (Appendices 3.4.2.2, Item 1) was also checked (Appendix 3.4.2.3, Item 2) using the same Raceway Details as above. Four of the ten calculations examined were incorrectly noted on the check list (Appendix 3.4.2.2, Item 1).

3.3.7.6.3 In summary, two of the ten Raceway Details (S414, S432) were stressed above the allowable factor of safety (Appendix 3.4.2.3, Item 3). Two additional Raceway Details (S93, S147) show no requalification after the Hosgri spectra were issued on May 9, 1977.

## SUMMARY AND CONCLUSIONS

This report has been prepared in response to the NRC request for a preliminary report on the PGandE Hosgri Reverification Program. As requested, it covers a review of the applicability of seismic design and qualification information for the Hosgri earthquake that may be considered to be associated with design interface between PGandE and URS Blume. As illustrated in Figure 3.1, the design applicability was reviewed for the entire seismic chain beginning with basic plant design information developed at PGandE, through the URS/Blume interface, then back to PGandE and on to the equipment qualifiers.

In this preliminary report, the goal was to review applicability of all major design issues and identify all detailed equipment qualifications for later review, although a certain level of sample checking was performed. To accomplish the basic objective, the review was performed on a building by building basis. The findings by building are reported below.

### Containment

The Hosgri evaluation was performed using the original models for the DDE evaluation based upon 1970 drawings. These drawings were reviewed against current revisions. No changes were sufficient to require re-modeling. There were few formal transmittals from PGandE to URS/Blume in the early time period, because engineers from the two organizations were working together as though in one organization.

The annulus area lacked formal transmittals and was found to have been modeled using the Unit 2 configuration, as was known.

With the exception of the annulus, the containment building models were based upon applicable drawings.

URS/Blume performed the seismic analysis of the containment building and supplied several well documented reports to PGandE.

PGandE received the well documented seismic results from URS/Blume. Building response spectra were supplied to equipment suppliers to permit equipment qualification. The applicability of the design information for the following major equipment was verified:

- Reactor Coolant System (RV, SG, PCP, Piping)
- Hydrogen Recombiner
- Containment Purge Valves
- Regenerative Heat Exchangers
- Containment Fan Coolers

Other equipment is discussed subsequently.

Intake Structure

The seismic analysis of the Intake Structure was based upon information contained in a transmittal from PGandE in 1976. This transmittal was examined. URS/Blume issued a report on the seismic analysis of the Intake Structure in April 1977. After modifications, it was finalized in 1979. The drawings used to prepare the model were outdated, but building revisions were minor and did not affect the analysis.

The qualification of auxiliary salt water pumps was based upon the ground level motion, which considers the building to be rigid. Dur to the low elevation of

pumps within the building itself, this is considered a sound assumption. Nevertheless, it will be checked in the reverification effort.

Turbine Building

There was no design interface between PGandE and URS/Blume in the initial aspect of the design and qualification because URS/Blume had design responsibility for the building. Although URS/Blume designed the building, the drawings were prepared by PGandE Design Drafting.

The building had to be modified to qualify it for the Hosgri earthquake. All relevant drawings have been obtained, and a complete design verification effort completed by PGandE was documented. The in-depth verification was left to the final program since this building is less important than certain others.

The diesel generator, including the fuel system and starting air reviewers, was reviewed. The correct seismic input information was used for this safety related equipment.

Auxiliary/Fuel Handling Building

The Hosgri requalification of the Auxiliary Building was performed with the same models used in the earlier DDE analysis. This model was developed jointly by PGandE and URS/Blume using specialized computer programs for computing building properties. Reports of reviews of building properties and configurations were noted prior to initiation of the Hosgri analysis. The applicable drawings were used and referenced in the building analysis. Records of discussions on model properties, however, suggests that limited checks on

mass and stiffness should be made in the verification study.

In addition, a separate refined finite element analysis was used for the control room. Spectra from this refined analysis which were higher than the preliminary spectra were used for qualification (mainly by Westinghouse) of control room equipment.

Cranes

For most of the cranes, the design information was provided to URS/Blume on an informal basis. For each of the major cranes in the plant, URS/Blume issued a complete design report. In addition, a design review was completed by URS/Blume for the Containment Polar Crane. These are positive findings, however, in some cases the qualification report does not have a complete record of drawings upon which models were based.

Also during the Hosgri requalification, some of the cranes were modified wiht the addition of holddowns, lateral restraints, etc. Additional checks to ensure analysis reflected the as modified drawings would be beneficial.

Outdoor Water Storage Tanks

The information transmittal from PGandE to URS/Blume for qualification of the outdoor tanks was done on an informal basis since the two organizations were working together as a team. Substantial modifications were made to these tanks in the course of the Hosgri requalifications. Indirect interfaces existed in the analysis of these tanks via Harding-Lawson, soil consultants,

since one of the modifications was to dig out under the tank foundation and strengthen this structure. Communications were informal in many cases. Based upon the information that has been reviewed, there is no reason for concern. However, this area will be reviewed in much more detail in the final program because there was an indirect interface and because of information communications.

## CONCLUSION

In the course of this preliminary work a great deal of material has been examined. A certain amount of assurance has been established that there are no additional explicit errors, and several areas have been found that suggest more detailed review in the reverification effort.

As discussed at the outset, this review was conducted on the engineering material itself. The present findings and conclusions are independent of the normal convolutions of the design process, and whether work was done formally or informally, with the exception of course that informal transmittals, etc. require additional verification of the end product.

The analysis of the major buildings in the plant were based upon drawings that represent the correct building configuration, even though in many cases drawings were revised after the analysis was complete. The major items of safety related equipment in the Containment Building were qualified with correct response spectra. The Containment Building and Intake Structure were scrutinized in more depth than the other buildings. The Inlet Structure and the safety related auxiliary pumps were qualified using applicable drawings and

spectra.

As with any review of any design project, some errors and some mistakes real or apparent will be found. In the present limited effort certain such findings arose. In one case, an item of HVAC equipment was qualified with the wrong spectra. The reviewer compared it to the correct spectra and found it was satisfactory in view of a large safety factor.

The documentation on the unistrut design details were misleading to the reviewer and one or two conduit supports appeared to be qualified with the wrong spectra. There will be reviewed thoroughly in the final report, but it is expected that resolutions will result, since deeper inquiry did produce resolutions in other cases.

In conclusion, the limited review performed to date showed explicitly that the reactor coolant system and other major equipment were qualified using correct design information and no information has come to light thus far that calls the safety of the plant into question. Some areas have been found where further review is indicated, primarily because of a lack of ready documentation of the applicability of the design information.

# REFERENCE LIST

1. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis (URS/Blume, July 1970)

2. Diablo Canyon Nuclear Power Plant, Earthquake Analysis, Turbine Building, Unit 1 (URS/Blume, July 1970)

3. Diablo Canyon Nuclear Power Plant - Turbine Building crane evaluation for the 7.5 M Hosgri Earthquake (revised) November 1979.

4. Diablo Canyon Nuclear Power Plant - Fuel Handling Building crane Evaluation for the 7.5 M Hosgri Earthquake (revised) September 6, 1979.

5. Diablo Canyon Nuclear Power Plant - Units 1 and 2 - Outdoor Water Storage Tanks - Dynamic Seismic Analyses for the 7.5 M Hosgri criteria (revised), March 1979.

6. Seismic Evaluation for Postulated 7.5 Hosgri Earthquake - Units 1 and 2 - Diablo Canyon Site - PGandE.

7. "Engineering Review of Hosgri Seismic Qualification of Design Class 1 HVAC Equipment", EDS Nuclear Inc. February 22, 1979.

8. "Diablo Canyon Nuclear Plant, Seismic Qualification of HVAC Equipment", EDS Nuclear Inc., August 24, 1979.

9. Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri.

10. Wyle Labs Test Procedures No. 3642, and Test Report No. 58255.

11. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure, Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake, (URS/Blume, May 1979).

12. Westinghouse Project Letter PGE-4231, Revision 1, September 5, 1980 to D. V. Kelly.

No request has been made ~~of~~ the piping group to provide documentation. Therefore, we would like to be given the opportunity to provide info now deemed missing or inadequate. Is the audit going to cover equip loads?
MKT

3.3.7.1 Piping Systems

This section of the report will address the transmittal of seismic design information from PGandE to consultants engaged in analysis of piping systems and supports.

As was noted in a summary by the PGandE Piping Group, the piping analysis was assigned to consultants URS/Blume and Earthquake Engineering Systems (EES). Similarly for support evaluation, URS/Blume, EES, and EDS Nuclear, Inc. were used as the primary consultants.

For support evaluation the seismic design input consists of either a spacing table with seismic factors or the actual support force output from a piping analysis computer model. PGandE uses a design guide for the seismic factors which they transmit to the consultants. This will be a significant interface to examine. For instances where piping computer analysis output is used for design, then the valve qualification is totally dependent on the design input to the piping analysis.

true?

The transmittals for piping analyses appear to be in complete form for documents sent to EES. The only problem is that the transmittal cover sheet does not list the contents of the entire attachment. The transmittal might only read problem number and "appropriate spectra attached". To trace the flow of information it will be necessary to find the contents of the transmittals. This task may be accomplished by further examination of PGandE files or perhaps by examining EES files.

How thorough

For the scope of piping assigned to URS/Blume, very little correspondence was located during the time frame

of Unit 1 piping analyses. However, URS/Blume has not yet been contacted to provide any transmittals they may have sent or received. This will be implemented for the long term reverification effort.

### 3.3.7.2 VALVES

A preliminary review was performed on seismic design information transferred across interfaces between PGandE and valve qualifiers. This review addresses the safety related valves that required seismic requalification to meet the Hosgri requirements.

The valves reviewed consist of the minimum required active valves for hot shutdown and/or cold shutdown and the valves required in case of a single failure. The containment purge valves are addressed in Section 3.3.1.3. true?

The valves reviewed are listed in Tables 7-3A,B and 7-7, 7-7A of the Hosgri Seismic Re-evaluation Report (Reference 6). Copies of these tables are contained in Appendix 3.2.

#### 3.3.7.2.1 Definition of Interfaces

A number of PGandE and contractor interfaces existed. Review of available documentation to date shows that the primary interfaces for valve requalification were:

PGandE → EES → PGandE for piping analysis
PGandE → EDS → PGandE for valve qualification
PGandE → Westinghouse → PGandE for valve qualification

where EES ---- Earthquake Engineering Systems, Inc.
EDS ---- EDS Nuclear Inc.
Westinghouse -- Westinghouse Electric Corp.

EES, using data proveded by PGandE, produced computer models of piping systems. Computer analyses were then performed to determine the dynamic characteristics of the piping system under earthquake loading. Results were then returned to PGandE.

Earthquake loading was determined from acceleration response spectra provided by PGandE to EES.

PGandE transferred the relavant results of the completed piping analyses, valve accelerations, and pipe loading to EDS and Westinghouse. EDS and Westinghouse then proved that the valve meets certain criteria under the given loading conditions. This was done by either analysis or testing. Results were then returned to PGandE. ?

3.3.7.2.2 Transmittals Between EES and PGandE

No documentation has been found concerning transmittals of information from PGandE to EES at this point in time. A search for this documentation is being continued.

Some records of EES transmittals to PGandE have been found to date. A complete set of EES transmittals to PGandE has not been compiled yet.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.3 Transmittals Between EDS and PGandE

A limited amount of documentation of information transfer from PGandE to EDS has been found to date. Complete documentation of requalification information for the valves being reviewed here has not been compiled at this point in time.

Some records of results sent by EDS to PGandE have been located. A complete set of EDS transmittals to PGandE for the valves being reviewed has not been compiled as of this date.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.4 Transmittals Between Westinghouse and PGandE

Some information on PGandE transmittals to Westinghouse has been located in PGandE files. However, insufficient records have been found to fully document information flow from PGandE to Westinghouse.

The only evidence of information returned from Westinghouse to PGandE found to date is a Westinghouse document containing valve seismic qualification forms submitted to the NRC. A copy of this document was sent to PGandE.

Documentation of transmittals between Westinghouse and PGandE located to date are contained in Appendix 3.2.2.

3.3.7.2.5 Reverification Effort

For valves on flexible piping systems, the acceleration response of the pipe must be known in order to obtain the valve accelerations, and to derive the pipe loadings on the valves. This is a result obtained from the piping analyses. Therefore, the validity of a valve qualification depends on information transferred two steps earlier: from PGandE to the piping analyst and from the return of the analysis results from the piping analyst to PGandE.

With the documentation available to date, no evidence was found to indicate whether the valve accelerations have ever been verified as being correct before being transmitted to the valve qualifiers.

To perform a thorough review of the information transferred across interfaces, the following procedure will be followed:

1. Locate and examine documentation of correct Hosgri spectra transmitted to piping analysts.

2. Locate and review transmittals of piping analysis results to PGandE, particularly valve accelerations. The accuracy of the piping model is also to be checked.

3. Locate and review transmittals of valve accelerations from PGandE to valve qualifiers.

4. Cross check data returned to PGandE from piping analysts with data transmitted out of PGandE to the valve qualifiers.

ROBERT L. CLOUD ASSOCIATES, INC.
2972 ADELINE STREET
BERKELEY, CALIFORNIA 94703
(415) 841-9296

October 21, 1981

Mr. Jim Rocca
Chief Mechanical Engineer
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Dear Jim,

Enclosed please find "A Preliminary Report on the Design Interface Review of the Seismic Reverification Program."

Yours truly,

R L Cloud

R. L. Cloud

DO NOT DUPLCATE

#3

RLC:ljs

Enclosure

PACIFIC GAS AND ELECTRIC COMPANY 62-6224

COPY

MECHANICAL AND NUCLEAR ENGINEERING

Interim Report to NRC - Cloud Associates
Diablo Canyon Unit 1

October 21, 1981

MESSRS. D. A. BRAND
R. V. BETTINGER

Attached is one copy of "Report on the Design Interface Review of the Seismic Reverification Program" for your review and comments.

To maintain our schedule, comments will be returned to Dr. Cloud by 5 p.m. Thursday, October 22, 1981.

Please have any comments to J. J. McCracken by 3 p.m., October 22, 1981.

JVRocca

J. V. ROCCA

JVR(3381):sal

cc: JJMcCracken

Attachment

Ales - VJG

DRAFT COPY

# A PRELIMINARY REPORT ON THE DESIGN INTERFACE REVIEW OF THE SEISMIC REVERIFICATION PROGRAM

October 1981

Project 105-4

Report of work performed for Pacific Gas & Electric Go. by R. L. Cloud Associates, Inc.

Robert L. Cloud Associates, Inc.

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West Falmouth, MA 02574
(617) 540-5381

TABLE OF CONTENTS

## APPENDICES

Rcd - VJG



A PRELIMINARY REPORT ON THE DESIGN INTERFACE REVIEW OF THE SEISMIC REVERIFICATION PROGRAM

## 1.0 Introduction

As a result of the discovery of a misapplication of seismic floor spectra to the annulus area of the Diablo Canyon Power Plant Unit 1, a Seismic Reverification Program* was established to determine if further errors exist in seismic qualification of the plant for the Hosgri 7.5 M earthquake. This program was presented verbally to the U. S. Nuclear Regulatory Commission in a meeting at Bethesda, Maryland on October 9, 1981. The NRC felt the program was valuable, but requested a preliminary report on part of Task 3 of the Reverification Program on a priority basis.

Use Re verification throughout

Task 3 of the original program is titled "Design Interface Review" and consists of a review of seismic design and qualification information that was transmitted back and forth between PGandE and subcontractors during the evaluation of the plant for the Hosgri earthquake. The part of Task 3 requested in an early preliminary report was a review of the particular design interface that existed between PGandE and URS/Blume during the Hosgri re-evaluation.

This report has been prepared in response to the NRC request for a preliminary report on the URS/Blume - PGandE Seismic Design Interface. It has been completed on a priority basis and must be considered a preliminary report, as requested and as titled. Any omissions of significant information or other incompleteness will be addressed in the overall reverification program.

---

* "Seismic Verification Program, Robert L. Cloud Associates, Inc., Berkeley, California, October 12, 1981.

Rd VJG



## 2.0 Objective and Scope

The objective of this preliminary part of the verification program was to examine Seismic Design and Qualification information of three categories:

(1) that transmitted from PGandE to URS/Blume
(2) that transmitted from URS/Blume to PGandE
(3) that received from URS/Blume by PGandE and subsequently distributed, by PGandE, to those qualifying equipment or conduit systems,

The requirement was to perform an engineering review of this information in a selective manner, as described below. It was reviewed to establish that correct building and equipment configurations were transmitted for analysis; that analysis was performed using applicable drawings with the correct revision, applicable equipment weights, etc.

Design spectra, building loads and other output of URS/Blume as transmitted by URS/Blume and received by PGandE were scheduled for examination with the objective of checking to see that URS/Blume-generated information was properly applied. The methodology employed in this task is described in Section 3.2 herein.

The scope of the present effort is limited to the review of the Design Interface of PGandE with URS/Blume. Other design interfaces will be reviewed in the overall re-verification study. The buildings and equipment reviewed in the present effort are those required for safe cold shutdown, and were requalified in the Hosgri reanalysis.

Reed VJB



## 3.0 Program Methodology

### 3.1 Definition of Seismic Qualification Interfaces

The seismic qualification interfaces of interest for the present effort are illustrated in Figure 3.1. As can be seen, there are three primary interfaces that are denoted by roman numerals. The word interface refers to the process or activity in which certain engineering work is done in one organization, then transmitted to another. In the receiving organization, the engineering work is used, and perhaps transformed or reduced, and transmitted on to other organizations.

Referring to Figure 3.1, The three primary interfaces are: this DID

I. Development and assembly of structural configurations, equipment locations and masses, together with the description of the Hosgri 3.4B earthquake. This basic plant engineering description ~~and seismic loadings are~~ static is forwarded to URS/Blume for dynamic analysis.

II. URS/Blume receives the plant configuration description. From this information, URS/Blume develops analytical models of the ~~civil~~ structures, and performs the dynamic analysis of the structures to determine their response to the Hosgri earthquake. This response, in the form of amplified floor response spectra and building loads or building qualification reports, is then transmitted to PGandE. & ?

III. PGandE receives the ~~civil/structural~~ seismic response information and organizes and/or reduces

it into suitable forms for transmittal to third parties for use in qualifying equipment, and in some cases, buildings. Equipment as used here refers to everything in the plant other than civil structures.

Figure 3.1, illustrating the interfaces, has additional flow paths that indicate feedback loops across the interfaces and dashed lines that indicate possible indirect interfaces. These additional communications paths are listed to complete all possible interface interaction activity.

Blume did both the dynamic analysis of all bldgs & structural qualification of the turbine & intake bldgs. PG&E did structural qualification of containment & aux. bldgs.

## 3.2 Review Methodology

It was convenient to develop an organized approach to the review to minimize confusion, lost motion, and to ensure that a complete review was accomplished. The following paragraphs describe the methodology that was devised for use in the current preliminary effort.

The basic orientation of the review was to ensure that the applicable design and qualification information was used for building and equipment qualification by studying the engineering work itself. Although casual observations were made on QA/QC type questions such as independent checking, following of procedures, etc., the basic intent of the present effort was to determine if the applicable engineering data was used in the seismic qualification calculations, regardless of the formality with which it was handled.

A second ~~tenet~~ thrust of this effort was to perform a review that was both broad and complete, but also had the requisite depth. In order to accomplish this objective, two goals were set. The first goal was to examine all the interface design information involving URS-Blume to verify consistency and general accuracy. The second goal was to review all the interface information involving URS/Blume for two selected buildings in complete and comprehensive detail. The two buildings selected were the Intake Structure and the Containment Building.

### 3.2.1 Listing

Having defined the design interfaces, the next step was to list the categories of information expected to flow across each of the 3 interfaces. These categories are listed in Figure 3.2.

### 3.2.2 Structures

To break the required information into more manageable packages, the design information was examined separately for each building. The buildings are listed in Figure 3.2.2-1 with cognizant responsibilities for major tasks. As indicated, there was a separate responsible PGandE building engineer for each structure.

Its not indicated in Fig 3.2.2-1

The interface design information was studied separately for each building and is reported separately herein.

### 3.2.3 Equipment

The overall cognizant responsibilities for the Hosgri requalification of equipment was divided between PGandE and Westinghouse, as listed in Figure 3.2.3-1. PGandE performed this qualification in-house with PGandE engineers in some cases, and utilized subcontractors for others. Subcontractor interfaces on equipment qualification are described in the body of this report.

The general strategy regarding equipment qualification was straight-forward. The flow of design spectra was traced from the URS/Blume report on the relevant building to the qualification document for the individual items or classes of safety related equipment. For this preliminary report, much of the specific seismic input for certain types of equipment required more time to track than was available. When

this occurred it is noted and the input will be reviewed in the overall report.

A sizeable portion of Hosgri required equipment was qualified by Westinghouse. The flow of seismic design information sent to Westinghouse by PGandE was partially documented (See Appendix 3.1.1).

The Intake Structure Hosgri spectra were sent to Westinghouse April 15, 1977. These spectra are ~~identicle~~ identical to the current Hosgri spectra, through ~~Ammendment~~ Amendment 83. The Auxiliary ~~Structure~~ Building Hosgri ? spectra and control room slab update, April 11, 1977 and March 25, 1980 respectively are also identical to the current Hosgri spectra, through ~~Ammendment~~ Amendment 83.

I told Clond people to look in M+NE file 9.73

The spectra transmitted to Westinghouse for the Containment Structure on March 16 and 23, 1977 were superseded by the spectra issued June 5, 1977. Spectra could not be located in PGandE files. On August 9, 1977, PGandE transmitted vertical spectra for the Containment Structure to Westinghouse. ~~These spectra were thought to be valid until October 1981.~~

No record was found of any Turbine Building spectra ever being sent to Westinghouse.

That's because W didn't have to qualify anything in the turbine bldg

Did W need to qualify any equipt. in T.B.?

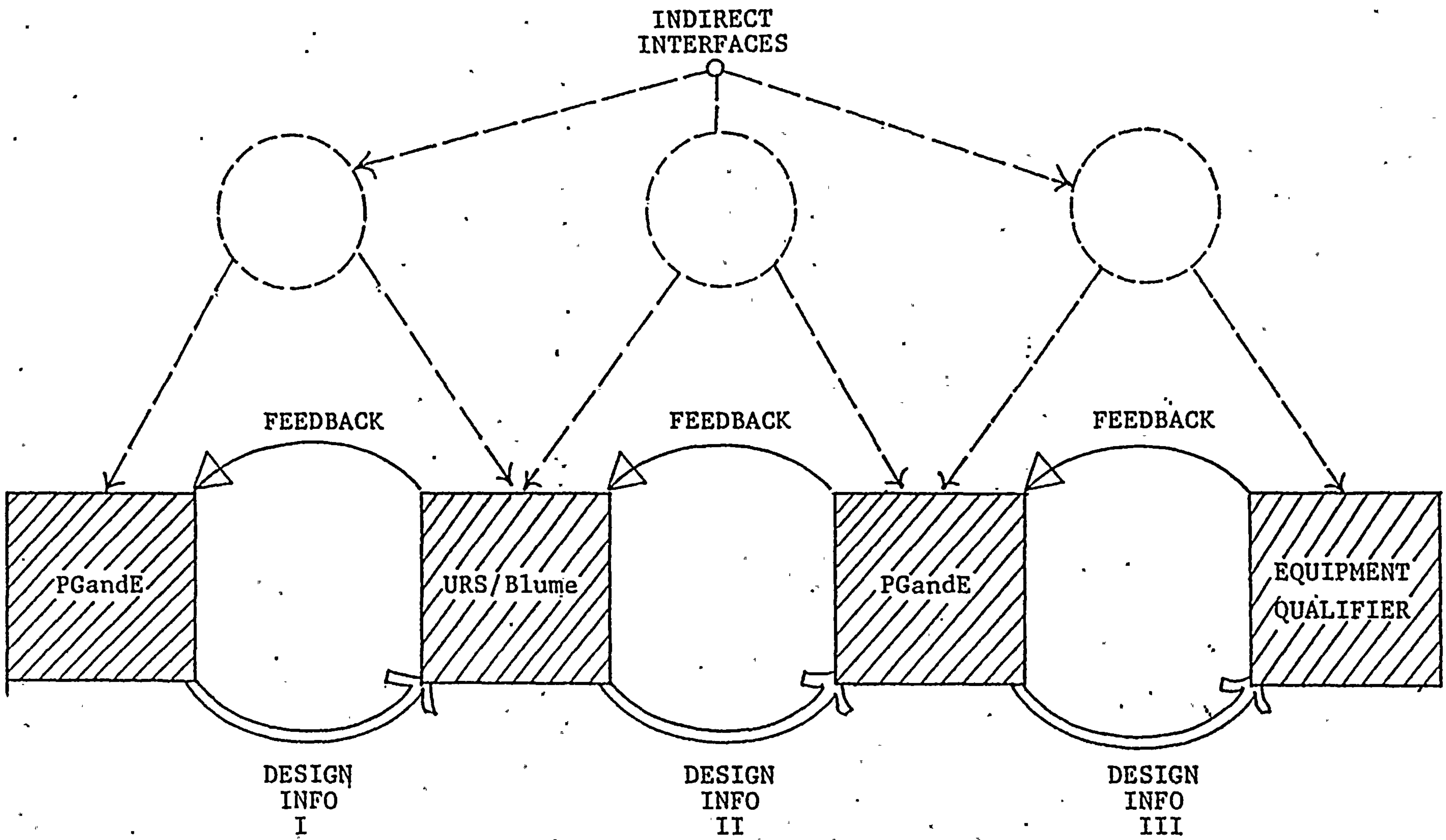


FIGURE 3.1: SEISMIC QUALIFICATION INTERFACES

| Interface I | Interface II | Interface III |
|---|---|---|
| Building Drawings<br><br>Equipment Weights and C. G.<br><br>Documentation of Verbal Discussion<br><br>Definition of Ground Motion | Floor Response Spectra for all locations throughout plant<br><br>Building Loads<br><br>Dynamic Analysis Reports for all Buildings | Envelope Floor Spectra<br><br>Static g Loads<br><br>Equipment Specifications<br><br>Test Specifications<br><br>Purchase Orders |

JAB provided on basis of NRC - PG&E - JAB Mtg. to establish Criteria for Hosgri Evaluation

FIGURE 3.2 INFORMATION CATEGORIES OF INTERFACE

"Definition" of ground motion means ground response spectra it was based on the combined efforts of Blume for PG&E [illegible]

However, Magnitude of 7.5 EQ was dictated [illegible] 1965 [illegible] to them

| | INTAKE BUILDING | CONTAINMENT BUILDING | AUXILIARY BUILDING | TURBINE BUILDING | CRANES | ~~FIELD ERECTED~~ TANKS OUTDOOR |
|---|---|---|---|---|---|---|
| MODELING & DYNAMIC ANALYSIS | URS/Blume | URS/Blume | PGandE, URS/Blume | URS/Blume | W* - 3<br>URS/B - 4 | URS/Blume |
| DEVELOP SPECTRA | NONE | URS/Blume | URS/Blume | URS/Blume | ** URS/Blume | NONE |
| SEISMIC QUALIFICATIONS | URS/Blume | PGandE | PGandE | URS/Blume | W - 3<br>URS/B - 4 | URS/Blume |

* Westinghouse

Diablo Canyon Nuclear Power Plant Unit 1

SEISMIC ANALYSIS AND QUALIFICATION OF BUILDINGS Cranes and Outdoor Tanks.. - COGNIZANT RESPONSIBILITIES

Figure 3.2.2-1

** For polar crane only.

| EQUIPMENT | RESPONSIBILITY |
|---|---|
| Reactor Coolant System and Equipment | W* |
| Piping Systems 6" and over connected to Reactor Coolant System | W |
| other Seismic Category I Piping | PG&E |
| Secondary Systems | PGandE & Subcontractors |
| Safety Related Conduit & Raceways | PGandE |
| Safety Related Mechanical Equipment | PGandE |
| HVAC | PGandE |
| Instrumentation and Control Equipment | PGandE |

* Westinghouse

FIGURE 3.2.3-1 RESPONSIBILITY OF EQUIPMENT QUALIFICATION

How is piping qualified by PG&E?

## 3.3 Review of Structures and Equipment

The review of interface information for structures and equipment was performed using the methodology described in Section 3.2. To break the required information into more manag e able packages, the design information was examined for the following categories:

1. Containment Structure
2. Intake Structure
3. Turbine Building
4. Auxiliary and Fuel Handling Building
5. Cranes
6. Outdoor Water Storage Tanks
7. General Equipment and Systems

Sections 3.3.1 through Sections 3.3.7 discuss in detail the interface information for the above mentioned categories.

### 3.3.1 Containment Structure

The Containment Structure was originally ~~investigated~~ analyzed for the Double Design Earthquake (DDE) by URS/Blume. Results of this ~~investigation~~ analysis are given in the URS/Blume report dated July 1970, "Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis", (Reference 1). To comply with the 7.5 M Hosgri specification, the Containment Structure was re-~~evaluated~~ analyzed. This re-~~evaluation~~ analysis is presented in the URS/BLume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Containment Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake", May 1979 (Reference 11).

The following sections describe the transfer of information between PGandE and URS/Blume for the Containment Structure

and five major pieces of equipment. Generic equipment, such as cranes, piping, heating, ventilating and air conditioning, etc. are covered in Sections 3.3.5 through Sections 3.3.7.

### 3.3.1.1 Design Information from PGandE to URS/Blume

The close and informal relationship between PGandE and URS/Blume engineers resulted in sparse documentation of design information, drawings, equipment weights, pipe loads, etc. from PGandE to URS/Blume. Appendix 1.1 contains all the transmittal documentation for the period 1969 through 1981 for the Containment Structure. The documentation in Appendix 1.1 was obtained from Central Files in the Mechanical Engineering Department (Appendix 5) and Civil Engineering Department (Appendix 4) and various personal files of engineers at PGandE. In addition part of the information was obtained from URS/Blume's project file. The document supporting this informal interface process contains the personal recollections of the PGandE engineer responsible for the Containment (Appendix 1.1, item #16).

For the Hosgri re-evaluation (Reference 11) the dynamic model used was the same as for the double design earthquake (DDE) analysis (Reference 1), with additional annulus information provided by PGandE and field visits (Appendix 1.1, item #16).

To verify that the documents used by URS/Blume to develop the original dynamic model (used subsequently for the Hosgri ev-evaluation) were correct, a list of drawings was checked. This list, given in Appendix 1.1, item #14, was obtained from the July 1970 report on the Containment Structure (Reference 1).

The criteria established to check the referenced drawings are tabulated as follows:

1. These are Containment Structure - Unit 1 drawings. ?

2. Since the reference drawings had no revision numbers, it was assumed that the drawings were current in July 1970.

3. When the drawings had no revisions dated later than July 1970, they were marked "O.K." If revisions were made, these were so noted.

A review of the above mentioned drawings was performed, and it was found that revisions made after 1970 were minor (Appendix 1.1, item #14), and would not affect the model in the horizontal direction.

In the case of the annulus, the only drawing documentation available are the four sketches sent to URS/Blume from PGandE (Appendix 1.1, item #5), and the calculation sketch at URS/Blume (Appendix 1.1, item #17). These sketches are for Unit 2 annulus and not for Unit 1. Unit 2 drawings, as provided by PGand E, were used by URS/Blume to formulate the seismic model because they were clearer and more easily read.

Thus, for the Hosgri ~~er~~re-evaluation report (Reference 11) the containment dynamic model used was a Unit 1 interior and exterior and a Unit 2 annulus. According to URS/Blume this posed no problem as they were under the impression the Unit 1 and Unit 2 were identical. This is identified in

This discussion of the orientation error is not too clear — I suggest extracting something from the attached material prepared for PG+E Technical Report.

Appendix 1.1, item #18. Use of Unit 2 annulus and Unit 1 interior should have no effect on the shape of the annulus spectra, because of the axisymmetric interior, as discussed in Appendix 1.1, item #18. The only change in the annulus regions covered by the 5 referenced frames will be affected due to Unit 1 being mirror image opposite hand configuration from the Unit 2 model. ?

3.3.1.2 Design Information from URS/Blume to PGandE

Unlike the informal transmittal documentation from PGandE to URS/Blume, the documentation from URS/Blume to PGandE was more formal. This is verified by reviewing the transmittal documents listed in Appendix 2.1.1. This Appendix contains transmittal documents sent to PGandE from February 1977 to the present. These documents were obtained from URS/Blume during the week of October 13, 1981. The contents of the transmittal documents marked with an asterisk are in Appendix 2.1.2.

3.3.1.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

For the purpose of this interface review, the seismic input information for the following equipment was evaluated:

1. Reactor Coolant System
2. Hydrogen Recombiner
3. Containment Purge Valves
4. Regenerative Heat Exchanger
5. Containment ~~Cooling Fans~~

Fan Coolers.

It was found that most of the design information for the above equipment was transmitted to Westinghouse (Appendix 3.1). The accuracy of this information is discussed in the next section.

### 3.3.1.4 Qualification of Containment Structure and Equipment

#### 3.3.1.4.1 Containment Structure

A comprehensive design review of the Containment Structure was originally completed on 2/28/77. This review had one outstanding item - pipe rupture restraints. This item was cleared, and an amendment issued on 1/16/78. The original review and the amendment were performed by PGandE and are given in Appendix 7.

Another design review of the Containment Structure was completed by PGandE on 1/22/79. This design review addressed the structural adequacy of the Containment Structure for the postulated 7.5 M Hosgri seismic event (Appendix 2.1).

Because of the recent development due to the discovery of an error in the annulus spectra, no conclusion can be drawn on the structural adequacy of the annulus. As this structure supports many equipment and piping systems, further in-depth review is necessary in the overall reverification program.

See material provided by Hanusiak — Think annulus structure is qualified subject only to look at [illegible] pipe [illegible] [illegible] implemented [illegible]

A conclusion, slightly qualified, can be drawn.

### 3.3.1.4.2 Equipment

A detailed review of equipment is given in Appendix 3.1. A summary is given below:

1. Reactor Coolant System
   Westinghouse (W) seismically qualified the Reactor Coolant ~~vessel~~ system for the Hosgri requirement as discussed in the W report, "Summary Report, Seismic Evaluation of Westinghouse Equipment for Postulated 7.5 M Hosgri Earthquake, Diabl~~e~~o Canyon Units 1 and 2, August 1979 (Appendix 3.1.2). The seismic spectra used for qualification envelope the current Hosgri spectra for the interior concrete, and thus the seismic qualification is valid.

2. Hydrogen Recombiner
   Westinghouse (W) originally qualified the Hydrogen Recombiner in the annulus region by test. These were transmitted to PGandE as discussed in Appendix 3.1.2. Due to the conservative nature of the test spectra utilized in the original qualification, it was confirmed that the Hydrogen Combiners qualify to the new enveloped annulus spectra.

3. Continment Purge Valves
   The Containment Purge Valves were reviewed by T. N. Crawford as stated in the memo-to-file dated 6/11/79 (Appendix 3.1.2). The zero period accelerations used in analysis

are more conservative than the current Hosgri spectra. Considering that the computations were correct, the containment purge valves are qualified to the 7.5 M Hosgri earthquake.

4. Regenerative Heat Exchangers
Westinghouse (W) performed the seismic qualification of the Regenerative Heat Exchangers using the Hosgri spectra as discussed in Appendix 3.1.2.

This qualification will require close scrutiny to properly evaluate the conclusion of the review.

5. Containment Fan Coolers ~~Cooling Fans~~
A detailed discussion of the qualification and review process for the containment fan coolers ~~cooling fans~~ is given in Appendix 3.1.2. The end result of this check shows that superseded spectra were utilized for qualification. In this particular case, the conclusions are still valid because the spectra that were used envelope the current spectra.

This seems to imply there was an earlier seismic spectra that was higher than Hosgri. I'm not aware of such. Please inform [illegible]

Besides the equipment reviewed above, other equipment in the Containment Structure has not been reviewed for the current effort, but will be done in the Reverification Program.

### 3.3.2 INTAKE STRUCTURE

#### 3.3.2.1 Design Information from PGandE to URS/Blume

PGandE's Civil Engineering file was searched for the design information transmitted from PGandE to URS/Blume on the Intake Structure during and prior to the Hosgri studies (Appendix 4). No such information was found. The following information was taken from the file of the lead PGandE engineer responsible for the Intake Structure.

The seismic analysis of the Intake Structure for the Hosgri criteria was initiated on April 26, 1976. (Appendix 1.2). The relevant information such as civil/mechanical drawings and equipment weights were found to be transmitted from PGandE to URS/Blume from April 26 to June 22, 1976 (See Appendix 1.2).

#### 3.3.2.2 Design Information from URS/Blume to PGandE

A two-phase work scope of the seismic analysis of the Intake Structure for the Hosgri criteria was found in a memorandum dated 5/6/76 from URS/Blume to PGandE (Appendix 2.2.1). Some weekly progress reports from URS/Blume were found in the PGandE civil engineering file (Appendix 4).

A preliminary report on the seismic analysis of the Intake Structure was issued by URS/Blume to PGandE on April 6, 1977. Modifications of this report were made on 5/9/77 and 2/14/78, and the final report was issued on 5/16/79. An additional report entitled "Diablo Canyon Intake Structure -

Factor of Safety Against Overturning, Foundation Bearing Pressures", was issued on 11/13/78 (Appendix 2.2.2).

The design drawings used by URS/Blume to develop the mathematical model for the seismic analysis were reported in "DCNPP - Intake Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Criteria", May 9, 1977 (See Appendix 2.2.2). These drawings were compared with the Intake Structure drawings in the PGandE file (Appendix 1.2). A list of Intake Structure drawings currently in URS/Blume files is also given in Appendix 1.2. It was found by comparing the drawings used in developing the mathematical model of the Intake Structure with those in the PGandE file, that the PGandE file has later revision drawings. The revisions are minor ~~based on spot checks.~~ and do ~~These minor changes will~~ not affect the mathematical model used in the seismic analysis. ?

3.3.2.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

No information was found to be given to equipment suppliers.

3.3.2.4 Qualification of Intake Structure and Equipment

3.3.2.4.1 Intake Structure

According to the lead PGandE engineer responsible for the Intake Structure, the building was qualified by using seismic response output produced in the URS/Blume 5/9/77 report (Appendix 1.2). The URS/Blume 5/16/79 report

gave smaller building response. Therefore, the building does not need to be requalified. However, the design review of the Intake Structure (Appendix 7) was dated September 1976, and has not reflected the Hosgri seismic requirement. Further investigation will be performed to determine the process of building qualification in the overall reverification program.

~~Please check with Ed Kahler of PG+E: ERG Dept to see if currently Hosgri des. review is available (we think so).~~

Design Review for Hosgri was performed by URS/Blume as they reanalyzed the Intake for the Hosgri.

3.3.2.4.2 Auxiliary Salt Water Pumps

The safety-related Class 1 equipment inside the Intake Structure are the auxiliary salt water pumps. They were qualified by PGandE using the site design spectra (Hosgri criteria, see Appendix 2.2) for the reason that the building is essentially rigid. Although the 5/9/77 and 5/16/79 reports by URS/Blume differ in seismic structural responses, there is no need to requalify the auxiliary salt water pumps if the building is truly rigid since the site seismic design spectra were used to qualify these pumps. Rigidity of the building appears to be a good assumption based upon a cursory examination of the drawings, but this assumption will be verified in an engineering sense in the reverification study.

This is not an assumption. It was proven by Blume analyses & is documented in their report.

3.3.2.4.3 Buried Pipelines

The buried pipelines connecting the Intake Structure to the Turbine Building were qualified by PGandE with input from URS/

Blume. PGandE's qualification work was independently checked by Harding-Lawson Associates, using input from URS/Blume (See Appendix 7). The input used in the above two studies will be verified in the overall reverification program.

### 3.3.3 Turbine Building

The Turbine Building was originally designated a seismic Design Class II structure and designed on the basis of a minimum horizontal seismic coefficient of 0.2 g. The structure was later analyzed for the double design earthquake (DDE) and was found to require minor structural modification. This is presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Earthquake Analysis Turbine Building, Unit 1", dated July, 1970 (Reference 2).

Because the building contains some design Class I equipment and because it is in close proximity to the Class I Auxiliary Building, it was necessary to show that under the postulated 7.5 M Hosgri motions the building would not have a failure which would impair either the Class I equipment contained in the Turbine Building or the Class I Auxiliary Building. For this reason, the Turbine Building was investigated for the Hosgri inputs. This resulted in major structural modifications, which are given in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Turbine Building Evaluation and Structural Modification for the 7.5 M. Hosgri EArthquake", March, 1980 (Refernece 3).

The following sections address the interface issue between PGandE, URS/Blume, and Equipment Suppliers and Qualifiers for the Turbine Building.

#### 3.3.3.1 Design Information from PGandE to URS/Blume

The original design and analysis, including the generation of drawings of the Turbine Building, were done by URS/Blume. Following the Hosgri requirement to re-evaluate the Turbine Building in 1977, URS/Blume performed the analysis and re-evaluation. Design changes and drawings were

generated by PGandE from URS/Blume input. These were then checked and verified by URS/Blume. (This is documented in Section 4, Appendix 1.3.)

In the case of the Turbine Building, a large number of transmittals were documented. Appendix 1.3 contains transmittal documentation for the period 1974 to 1979. Relevant design information transmitted is given in Appendix 1.3.

3.3.3.2 Design Information from URS/Blume to PGandE

Appendix 2.3.1 contains transmittal documents from URS/Blume to PGandE. They reference various spectra, design, analysis and test reports and other correspondence of technical nature.

The detail transmittals themselves have not been reviewed and will be a part of the overall reverification work.

3.3.3.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

In the Turbine Building, the major safety related mechanical equipment system, ~~per Hosgri requirement,~~ is the Diesel Generator System. Since PGandE was its own qualifier, no interface between equipment vendor or suppliers was required.

The Diesel Generator System consists of six major components:

1. Diesel Generators
2. Starting Air Receivers
3. Fuel Oil Filter
4. Fuel Oil Priming Tank
5. Fuel Oil Strainer
6. Fuel Oil Transfer Pump

The Mechanical Engineering Central File Index (Appendix 5) was reviewed to check for correct and current seismic inputs in the qualifying documents for the above mentioned components. The specific details of each component is discussed at length in Appendix 3.1.5.

Results of this review show that the Diesel Generator System was conservatively qualified to correct Hosgri seismic input.

3.3.3.4 Qualification of Building and Components

The Turbine Building design qualification responsibilities were divided between URS/Blume and PGandE.

The qualification of major seismic resistant components of the building for the Hosgri evaluation was performed by URS/Blume and specific drawings which reflect the modifications are included in the report entitled "DCNPP, Unit 1 - Turbine Building Evaluation and Structural Modifications for the 7.5 M Hosgri Earthquake", March 1980 (Appendix 2.3.2). PGandE implemented modifications to quali-fy the interior ~~building~~ framing system, interior block and concrete walls and anchorage that were not qualified by URS/Blume. Tables 3.3.1 and 3.3.2 contain the list of

PGandE drawings for these modifications, obtained from conferring with the responsible lead engineer.

The PGandE design review is presented in the report "Hosgri Design Verification - Turbine Building", February, 1980 (Appendix 7).

Since the design review did not verify the interface procedures between URS/Blume, PGandE and the field (Figure 4-10-2, URS/Blume Report on Design Review, Appendix 7), these will be investigated in the overall reverification program.

TABLE 3.3.1

Drawings prepared by PGandE containing modification information for Structural Frames, Beams and Columns per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463684 | 465135 |
| 465127 | 465136 |
| 465128 | 465137 |
| 465129 | 465138 |
| 465130 | 465139 |
| 465131 | 465140 |
| 465132 | 465141 |
| 465133 | 465142 |
| 465134 | 465143 |

TABLE 3.3.2

Drawings containing modification information for Equipment Anchorage per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463671 | 463677 |
| 463672 | 463678 |
| 463673 | 463679 |
| 463674 | 463680 |
| 463675 | 463681 |
| 463676 | 463682 |
| | 463683 |

3.3.4 Auxiliary/Fuel Handling Buildings

3.3.4.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file (Appendix 4) was searched for the design information transmitted from PGandE to URS/Blume on the Auxiliary/Fuel Handling Buildings during and prior to the Hosgri studies. Specifically, Civil/Structure files No. 9.3, Auxiliary Building, and No. 9.31, Seismic Analysis, were searched thoroughly (Appendix 4). One transmittal issued by PGandE to URS/Blume dated April 16, 1971 was found. In this memo, the main steam line anchorage drawings for the G-line of the Auxiliary Building were discussed (Appendix 1.4).

After discussions with the lead engineer of PGandE who was responsible for the seismic analyses of Auxiliary/Fuel Handling Buildings, it was learned that during the DDE analysis, PGandE developed, with the assistance of URS/Blume, computer programs "Dybox-2" and "Sherwal-4" to compute the mass and stiffness properties of the mathematical model for the Auxiliary/Fuel Handling Building (Appendix 1.4). The computations by computer were done at PGandE and the output was given to URS/Blume as input to compute the seismic response of the buildings (Appendices 1.4 and 2.4.2 - May 9, 1977, pp. 8 and 9).

The lead engineer of PGandE also stated that for the Hosgri criteria, the original data (for DDE analysis) used as an input for Dybox-2 was checked against the as-built conditions. The results of this check confirmed that there were no changes in the concrete dimensions. Consequently, the DDE model was used

in the Hosgri study (Appendix 1.4). The same statements were found in the URS/Blume Report of May 9, 1977 (Appendix 2.4.2).

However, an examination of some telecon records (from 3/9/77 to 3/24/77, Appendix 1.4) kept in URS/Blume's file reveals that there were discussions on discrepancy of weights computed by PGandE in the E-W and N-S directions for the DDE model, and a small difference of 35% in the weight at Elevation 140', computed by PGandE for the DDE model and URS/Blume's computation in March 1977.

An average weight of weights in the E-W and N-S directions and the weight of DDE model at Elevation 140' were finally used in the Hosgri analysis, with no written explanations as to how the weight difference was resolved. A detailed examination of the above will be performed in the overall reverification program.

5-1/6

3.3.4.2 Design Information from URS/Blume to PGandE

The flow of information from URS/Blume to PGandE on the Auxiliary Building is documented in Appendix 2.4.

Preliminary Hosgri spectra were issued by URS/Blume prior to the issuance of the May 9, 1977 (May 11, 1977 transmittal) Hosgri Final Report (Appendix 2.4.2).

During the qualification of the Auxiliary Building it was decided to make a separate more detailed finite element model for determining the vertical response of the control room floor due to its ~~importance~~ relative flexibility. This model is the basis for ~~the control room~~ vertical seismic qualification of equipment located on the control room floor (Appendix 2.4.2). ~~Since the final control room vertical spectra are higher than the preliminary~~ The vertical spectra determined from this model were used for the qualification of control room equipment —

~~spectra, a detailed review of equipment qualification will be performed in the final program to be sure the preliminary spectra were not used.~~

Spectra transmittals after May 11, 1977 provide additional, but not different, information.

3.3.4.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

Seismic qualification of major mechanical equipment is addressed in Section 3.3.4.4.2. Seismic qualification of other equipment and systems is addressed in Section 3.3.7.

3.3.4.4 Qualification of Buildings and Equipment

3.3.4.4.1 Buildings

The statement by the responsible engineer at PGandE in Appendix 1.4 confirmed that the structural evaluation of the Auxiliary Building was done based on the output from URS/Blume's 7.5 M Hosgri seismic analysis. No effort has been spent, because of time constraints, to spot-check the building qualification details. In the full length verification study, seismic input loads used for building verification report dated 1974, of the Auxiliary Building is in PGandE's Civil Engineering file (Appendix 7). The design verification report has an attached note indicating revision for Hosgri. This will be investigated further in the Reverification Program.

garbled

3.3.4.4.2 Equipment

The major equipment of the Auxiliary Building was qualified either by Westinghouse and PGandE or reviewed by Westinghouse. Table 3.3.5.4 summarizes the qualification of mechanical equipment in the Auxiliary Building. The detailed information on this equipment qualification is given in Appendix 3.1.4.

Cannot find

Rel-VJG



## 3.3.5 Cranes

### 3.3.5.1 Containment Structure Cranes

There are two cranes in the Containment Structure that required seismic evaluation per 7.5 M Hosgri specification. These are the Polar crane and the Dome Crane. A brief discussion of the two cranes is given in the following sections.

#### 3.3.5.1.1 Containment Polar Crane

The Containment Polar Crane is a gantry crane with trolleys and consists primarily of welded structural steel members and full moment resisting bolted connection. Results of a 3-D non-linear seismic analysis are presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Containment Polar Cranes Evaluation for the 7.5 M Hosgri Earthquake", dated July 1979 (Appendix 2.5.2).

Remove this. The orig. 2D analysis are our qualifying analysis for Hosgri req.

The drawings and other design information utilized for the modeling of the cranes are not referenced in the report. Nor are there any transmittals documenting the transfer of these from PGandE to URS/Blume.

At present the only documentation that substantiates the above mentioned report are the calculations (Appendix 2.5.2). These documents basically reflect that the design review was completed by URS/Blume and that the results concluded are valid. The drawings included in the Appendix of the July 1979 report were checked against the

conflicting statement

model in the report (Appendix 2.5.2). This preliminary review shows that the information was transformed correctly from the drawings to the model.

3.3.5.1.2 Dome Crane

~~The dome~~ service crane is a maintenance crane located on top of the polar crane. PGandE was in the process of performing physical modifications ~~designing modification~~ to comply with the 7.5 M Hosgri Evaluation. ~~As of May 5, 1981, PGandE halted this process and is presently considering retaining a consultant to evaluate the consequences of assumed failure. This is documented in the letter dated May 5, 1981 given in Appendix I.5.~~ The documentation of seismic qualification of this crane for the Hosgri requirement was not found in the current effort. It will be verified in the overall re-verification program.

Please see Hanusiak [illegible] thanks. We have completed Hosgri qualification of Dome service crane and it is documented (Hanusiak)

insert B

3.3.5.2 Intake Structure Crane

3.3.5.2.1 Design Information from PGandE to URS/Blume
Some design information for the seismic analysis of Intake Structure Crane was transmitted from PGandE to URS/Blume on 1/18/79. More design information for crane, trolley assembly and frames were respectively transmitted on 12/21/78 and 1/24/79. In February 1979, field measurement of Intake Structure crane was performed (Appendix 1.5).

3.3.5.2.2 Design Information from URS/Blume to PGandE
URS/Blume requested field measurement and transmitted SK-1-12-9 on 1/23/79. The crane hoist engineering drawings were found to be transmitted on 3/5/79. The final seismic analyses report entitled "DCNPP - Intake Structure Crane Evaluation for the 7.5 M Hosgri Earthquake", November 1979, was transmitted on 11/28/79 and documents the seismic design qualification information for this crane (Appendix 2.5).

3.3.5.2.3 Qualification of Intake Structure Crane
A quick review of the final report listed in Section 3.3.5.2.2 found many suggested design modifications. They are: the installation of a seismic hold-down and lateral restraint mechanism, and minor structural modifications to transmit horizontal forces from crane legs to truck and then to the rail. These modifications to design drawings were made by URS/Blume and were also reported in the above report. The modifications to construction drawings were jointly made by PGandE and URS/Blume. However, spot checks need to be made to insure that modifications to construction drawings were properly done. The modifications have been completed in the field

3.3.5.3 Turbine Building Crane

3.3.5.3.1 Design Information from PGandE to URS/Blume
In the case of the Turbine Building Crane, a formal transmittal of drawings and equipment weights was done on 7/22/75. The transmittal documentation giving the drawing number is listed in Section 1 of Appendix 1.5. Besides this design information, no other transmittals were found.

3.3.5.3.2 Design Information from URS/Blume to PGandE
The final report entitled "Diablo Canyon Nuclear Power Plant - Turbine Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)", November 1979, presents the design information required to modify the crane for the Hosgri criteria (Reference 3).

3.3.5.3.3 Qualification of Turbine Building Crane
The qualification of Turbine Building crane was jointly performed by PGandE and URS/Blume. Based upon design information presented in 3.3.5.3.2 above, URS/Blume modified the crane design to provide tiedown of the crane trolley to the bridge girder and lateral seismic restraint to distribute the lateral seismic loads to both horizontal crane support girders (described in the Hosgri report given in 3.3.5.3.2 above). PGandE and URS/Blume subsequently jointly revised the crane construction drawings. However, spot checks need to be made to insure that modifications to construction drawings were properly implemented. The modifications have been completed in the field

3.3.5.4 Fuel Handling Building Crane

3.3.5.4.1 Design Information from PGandE to URS/Blume

Very little documentation was found in PGandE's file on design information transmitted to URS/Blume. Based upon the recollection of the lead engineer for the seismic analysis of fuel handling crane (Appendix 1.5), the latest revisions of crane manufacturer's drawings, original calculations, and material properties of crane were transmitted to URS/Blume. As is the case for some of the other structures, the information was passed on in an informal basis. However, there is no record of URS/Blume's correspondence file on crane which shows that URS/Blume received such information. Some spot checks need to be made to check the accuracy of design information transmitted.

3.3.5.4.2 Design Information from URS/Blume to PGandE

The final report entitled "Diablo Canyon Nuclear Power Plant - Fuel Handling Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)" was issued on 9/6/79 (Reference 4). Several minor structural modifications to the existing crane structural system were reported in order to prevent eccentric loading of the crane runway and excessive loading on the trolley axis.

3.3.5.4.3 Qualification of Fuel-Handling Building Crane

The qualification of fuel-handling building crane to satisfy Hosgri criteria was jointly performed by PGandE and URS/Blume. URS/Blume prepared design modifications per Hosgri report for this crane. PGandE and URS/Blume jointly revised the

subject crane construction drawings. Some spot checks will be made to insure that these modifications were properly done. The required modification have been completed in the field.

### 3.3.6 Outdoor Water Storage Tanks

#### 3.3.6.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file was searched for the design information transmitted from PGandE to URS/Blume (Appendix 4). No relevant transmittals were found.

After talking to the lead engineer of PGandE who was responsible for the seismic analysis of outdoor water storage tanks, it was learned that the seismic analyses of these tanks started in March 1977. PGandE and URS/Blume engineers worked closely as a team and the information between PGandE and URS/Blume was exchanged on a person to person basis in meetings, telephone calls, etc. (Appendix 1.6.)

An examination of telecon records kept in URS/Blume's file (Appendix 1.6) confirms the statement described above by the lead engineer of PGandE. Some design information transmitted between URS/Blume and Harding-Lawson on soil data and stability of tanks was also found in URS/Blume's telecon records. The design information was found to be transmitted informally. Some checks are required in the overall reverification program to insure its accuracy.

#### 3.3.6.2 Design Information from URS/Blume to PGandE

The final seismic analyses were completed in March 1979 and the design information transmitted on March 26, 1979 (Reference 5). Because the tank modifications were being carried out in the field at the same time as the analyses were being performed, nu-

merous revisions were made to PGandE drawings to incorporate URS/Blume's findings. The above report, therefore, reflects the actual configuration and field condition of the tanks (Appendix 1.6). Although a team effort existed between PGandE and URS/Blume in transmitting the design information, some checks need to be made to determine the accuracy of the information transferred.

3.3.6.3 Qualification of Tanks

The tanks were qualified jointly by URS/Blume and PGandE, using Hosgri criteria as they worked together. URS/Blume's Hosgri report (March 1979) documents the modifications (Reference 5). The outdoor water storage tanks and components were subsequently concluded to meet the Hosgri seismic requirement (PGandE's design verification report for outdoor water storage tanks, dated 9/21/79 (Appendix 7).

Pages 40 - 46 ... only by VJG



### 3.3.7 General Equipment and Systems

A significant portion of the scope of this report is to review the interfaces between PGandE and various equipment suppliers and qualifiers. For most equipment, the practical way to check this interface is to examine the end result, the actual seismic qualification and note whether the current applicable Hosgri response spectra curves were used.

The mechanical equipment seismic qualifications are reviewed in the section addressing the individual buildings and will be not included here. This section will deal primarily with the review of seismic qualification of the following equipment and systems.

1. Piping Systems
2. Valves
3. HVAC Components
4. HVAC Ducting
5. Electrical Equipment & Instrumentation
6. Electrical Systems - Raceways and Conduits

### 3.3.7.1 Piping Systems

This section of the report will address the transmittal of seismic design information from PGandE to consultants engaged in analysis of piping systems and supports.

As was noted in a summary by the PGandE Piping Group, the piping analysis was assigned to consultants URS/Blume and Earthquake Engineering Systems (EES). Similarly for support evaluation, URS/Blume, EES, and EDS Nuclear, Inc. were used as the primary consultants.

For support evaluation the seismic design input consists of either a spacing table with seismic factors or the actual support force output from a piping analysis computer model. PGandE uses a design guide for the seismic factors which they transmit to the consultants. This will be a significant interface to examine. For instances where piping computer analysis output is used for design, then the valve qualification is totally dependent on the design input to the piping analysis.

The transmittals for piping analyses appear to be in complete form for documents sent to EES. The only problem is that the transmittal cover sheet does not list the contents of the entire attachment. The transmittal might only read problem number and "appropriate spectra attached". To trace the flow of information it will be necessary to find the contents of the transmittals. This task may be accomplished by further examination of PGandE files or perhaps by examining EES files.

For the scope of piping assigned to URS/Blume, very little correspondence was located during the time frame

of Unit 1 piping analyses. However, URS/Blume has not yet been contacted to provide any transmittals they may have sent or received. This will be implemented for the long term reverification effort.

### 3.3.7.2 VALVES

A preliminary review was performed on seismic design information transferred across interfaces between PGandE and valve qualifiers. This review addresses the safety related valves that required seismic requalification to meet the Hosgri requirements.

The valves reviewed consist of the minimum required active valves for hot shutdown and/or cold shutdown and the valves required in case of a single failure. The containment purge valves are addressed in Section 3.3.1.3.

The valves reviewed are listed in Tables 7-3A,B and 7-7, 7-7A of the Hosgri Seismic Re-evaluation Report (Reference 6). Copies of these tables are contained in Appendix 3.2.

#### 3.3.7.2.1 Definition of Interfaces

A number of PGandE and contractor interfaces existed. Review of available documentation to date shows that the primary interfaces for valve requalification were:

PGandE → EES → PGandE for piping analysis
PGandE → EDS → PGandE for valve qualification
PGandE → Westinghouse → PGandE for valve qualification

where EES ---- Earthquake Engineering Systems, Inc.
EDS ---- EDS Nuclear Inc.
Westinghouse -- Westinghouse Electric Corp.

EES, using data proveded by PGandE, produced computer models of piping systems. Computer analyses were then performed to determine the dynamic characteristics of the piping system under earthquake loading. Results were then returned to PGandE.

Earthquake loading was determined from acceleration response spectra provided by PGandE to EES.

PGandE transferred the relavant results of the completed piping analyses, valve accelerations, and pipe loading to EDS and Westinghouse. EDS and Westinghouse then proved that the valve meets certain criteria under the given loading conditions. This was done by either analysis or testing. Results were then returned to PGandE.

3.3.7.2.2 Transmittals Between EES and PGandE

No documentation has been found concerning transmittals of information from PGandE to EES at this point in time. A search for this documentation is being continued.

Some records of EES transmittals to PGandE have been found to date. A complete set of EES transmittals to PGandE has not been compiled yet.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.3 Transmittals Between EDS and PGandE

A limited amount of documentation of information transfer from PGandE to EDS has been found to date. Complete documentation of requalification information for the valves being reviewed here has not been compiled at this point in time.

Some records of results sent by EDS to PGandE have been located. A complete set of EDS transmittals to PGandE for the valves being reviewed has not been compiled as of this date.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.4 Transmittals Between Westinghouse and PGandE

Some information on PGandE transmittals to Westinghouse has been located in PGandE files. However, insufficient records have been found to fully document information flow from PGandE to Westinghouse.

The only evidence of information returned from Westinghouse to PGandE found to date is a Westinghouse document containing valve seismic qualification forms submitted to the NRC. A copy of this document was sent to PGandE.

Documentation of transmittals between Westinghouse and PGandE located to date are contained in Appendix 3.2.2.

3.3.7.2.5 Reverification Effort

For valves on flexible piping systems, the acceleration response of the pipe must be known in order to obtain the valve accelerations, and to derive the pipe loadings on the valves. This is a result obtained from the piping analyses. Therefore, the validity of a valve qualification depends on information transferred two steps earlier: from PGandE to the piping analyst and from the return of the analysis results from the piping analyst to PGandE.

With the documentation available to date, no evidence was found to indicate whether the valve accelerations have ever been verified as being correct before being transmitted to the valve qualifiers.

To perform a thorough review of the information transferred across interfaces, the following procedure will be followed:

1. Locate and examine documentation of correct Hosgri spectra transmitted to piping analysts.

2. Locate and review transmittals of piping analysis results to PGandE, particularly valve accelerations. The accuracy of the piping model is also to be checked.

3. Locate and review transmittals of valve accelerations from PGandE to valve qualifiers.

4. Cross check data returned to PGandE from piping analysts with data transmitted out of PGandE to the valve qualifiers.

### 3.3.7.3 HVAC Components

An independent engineering review of the seismic qualification was performed for the Safety Related HVAC equipment (References 7 and 8) by EDS Nuclear, Inc.

This EDS review concluded that the majority of the HVAC equipment is seismically qualified to the Hosgri requirement, and that with minor modifications, the remainder will also be. The modifications were made.

As part of this interface review, the seismic accelerations that were used as input was checked for correctness. Out of 5 inputs checked, one of them was incorrect.

The field work is given in Appendix 3.3.1. Since the qualification accelerations are larger than the Hosgri accelerations, these particular errors were not of consequence.

### 3.3.7.4 Heating, Ventilating and Air Conditioning Duct

3.3.7.4.1 The majority of HVAC ducts required for cold shutdown has been qualified by PGandE, with the remainder of the engineering being done by EDS Nuclear. PGandE architects, HVAC engineers, and civil engineers all collaborated on the duct design. Information flow between these groups is documented in Appendix 3.3.2.1.

3.3.7.4.2 The HVAC information in Appendix 3.3.2 was supplied by the responsible PGandE engineer. Containment duct computations could be easily be found. This will be reviewed at a later date.

3.3.7.4.3 A random sampling of the duct qualification calculations was checked for seismic input (Appendix 3.3.2). Six of the twenty-seven HVAC details listed in Appendix 3.2.2.2 were chosen at random. In contrast to the random sampling shown above, <u>all</u> seismic inputs to the Fireproof Ducts were checked against current Hosgri Spectra (Appendix 3.3.2).

3.3.7.4.4 Five HVAC Details have Hosgri accelerations correctly used and one (Detail 4, Drawing 504566) has Hosgri accelerations greater than the value in the calculations. All spectra for the Fireprorfed Ducts were found to be correctly used (Appendix 3.3.2.3).

3.3.7.4.5 One HVAC Detail (Detail 4, Drawing 504566) will be ~~analyzed~~ reviewed at a later date.

Pages 49 – 54 cursory review only by VJGH, 10 – OWS & others must review

3.3.7 5 Electrical Equipment and Instrumentation

A preliminary review was performed on seismic design information transferred between PGandE and electrical equipment and instrumentation vendors and qualifiers. This review focuses strictly on design information used in requalifying safety related electrical equipment and instrumentation to meet the Hosgri seismic requirements.

The Hosgri Seismic Re-evaluation Report (Reference 6) was used to derive the list of safety related electrical equipment and instrumentation. A copy of Table 10-1 from the Hosgri Report is included in Appendix 3.4.1. Table 10-1 is a complete list of the safety related electrical equipment and instrumentation.

Although the cable trays are included in Table 10-1, they are reviewed separately and are addressed in Section 3.3.7.6.

3.3.7.5.1 Definition of Interfaces

The responsibility for electrical equipment and instrumentation seismic qualification was divided between PGandE and Westinghouse. Westinghouse was responsible for qualifying Westinghouse supplied NSSS equipment. The remaining electrical equipment and instrumentation was qualified by PGandE.

The interface between PGandE and Westinghouse allowed PGandE to send Hosgri spectra information to Westinghouse, and for Westinghouse to send the results back to PGandE.

Of the PGandE qualified equipment, it was qualified either by analysis or by testing at Wyle Laboratories.

The Wyle Labs and PGandE interface allowed PGandE and Wyle Labs to exchange information regarding Hosgri spectra, test spectra and test procedures. Also, Wyle transmitted test results back to PGandE across this interface.

3.3.7.5.2 Transmittals from PGandE to Westinghouse

No documentation has been found in the current work regarding the transmittal of information from PGandE to Westinghouse.

3.3.7.5.3 Transmittals from Westinghouse to PGandE

The only evidence of transmittals from Westinghouse to PGandE encountered to date is the existence in the PGandE files of the Westinghouse report "Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri". (Reference 9).

3.3.7.5.4 Transmittals from PGandE to Wyle Labs

No documentation has been found to date regarding the transmittal of spectra or test procedure information from PGandE to Wyle Labs.

3.3.7.5.5 Transmittals from Wyle Labs to PGandE

The only transmittals from Wyle Labs to PGandE found thus far are Wyle Labs test reports and test procedures. Two of these that were examined are Wyle Labs Test Procedure No. 3642 and Test Report No. 58255 (Reference 10).

3.3.7.5.6 Transmittals Regarding Requalification by Analysis

No documentation has been found to date regarding requalification of electrical equipment or instrumentation by analysis, by either PGandE or other Parties.

3.3.7.5.7 Westinghouse Requalification

Review of the Westinghouse report, "Summary Report on Seismic Evaluation for Postulated 7.5 M. Hosgri", (Reference 9) showed that Westinghouse electrical equipment and instrumentation was requalified for Hosgri requirements by applying certain criteria to previously performed tests and analyses.

The test spectra used in the previous tests are included in Appendix 3.4. These are identical to Figures 10-2 to 10-12 in the Hosgri report. The Westinghouse report states that the 5-9-77 spectra were used and that the Blume and Newmark spectra were enveloped.

The report also states that the vertical spectra used were taken as 2/3 of the horizontal spectra. However, in a conversation with the cognizant engineer from Westinghouse, he states that specific vertical Hosgri spectra were used in the requalification of each item of equipment. The engineer also stated that the vertical spectra for control room equipment were selected with consideration for the node point closest to the equipment location.

Requalification was performed by Westinghouse by

comparing the applicable Hosgri spectra to test spectra used in the initial pre-Hosgri qualification. The positive results of this comparison were communicated to PGandE by Westinghouse in Westinghouse Project Letter PGE-4231, Revision 1, dated September 5, 1980 sent to D. V. Kelly (Reference 12).

3.3.7.5.8 Wyle Requalification Tests

Though no documented transmittals from PGandE to Wyle have been found to date, there is evidence that Wyle test procedures were reviewed and approved by PGandE personnel:

1. A PGandE memo, dated 11-9-77, from O. Steinhardt contains comments on test spectra contained in Wyle Test Report No. 26286.

2. Wyle Test Procedure No. 3642, dated 11-30-77, is signed and approved by PGandE personnel.

Documentation on these two items is contained in Appendix 3.4.

PGandE internal memorandum indicate that General Electric was involved in Wyle Labs requalification tests of the 4.16kV Vital Switchgear (Appendix 3.4). Further investigation will be required to determine General Electric's role on requalification. If necessary, information transmittals across that interface will be examined.

3.3.7.5.9 Requalification by Analysis

For equipment requalified by analysis, as indicated by note 5 in Table 10-1 of the Hosgri report, no information has been found to date as to who had performed these analyses. Investigation in this area will be continued.

3.3.7.5.10 Preliminary Review of Electrical Equipment

A preliminary review of requalification of electrical equipment and instrumentation was conducted by checking a 50% sample of Zero Period Accelerations (ZPA's) from the Hosgri Evaluation listed in Table 10-1 of the Hosgri report.

The Hosgri ZPA's listed were cross checked against the ZPA's of the applicable up-to-date Hosgri spectra. The Hosgri ZPA's in Table 10-1 were found to be correct.

In each case, the ZPA levels used to qualify each item of equipment, as listed in Table 10-1, were greater than the Hosgri required ZPA's.

3.3.7.5.11 Reverification Approach

Should further investigation fail to uncover records that satisfactorily document the transfer of seismic requalification information between PGandE and qualifiers, the following procedure will be undertaken:

1. Actual test spectra used in requalification tests will be examined. They will be checked

to see if they envelop the applicable Hosgri spectra.

2. Requalification analyses will be examined to check if the applicable seismic information was applied. In addition, the analysis criteria used for qualification, if applicable, will be examined.

This must be reviewed by OWS 

3.3.7.6 Electrical Raceways

poor word, omit

3.3.7.6.1 The supports for the Electrical Raceways are found ~~indiscriminately~~ throughout the main buildings. With ~~in excess of~~ over six hundred unique types of support details.

The PGandE Civil Engineer responsible for electrical Raceways provided the qualification documentation. Each support detail is qualified to the Hosgri by simplified computation. Each Detail is assumed to span a maximum of eight feet.

3.3.7.6.2 With such a large volume of material, a random sampling approach was employed. The Hosgri seismic accelerations were checked for ten support details (Appendix 3.4.2.3). In addition the program employed in September 1981 by PGandE to requalify the raceways in the Annulus section of Containment was checked. The Annulus region was closely examined for the following three reasons:

No transmittals of Annulus drawings from PGandE to URS/Blume were located and URS/Blume does not, at present, have the drawings. Preliminary spectra differing from the 5/9/77 spectra was issued for Containment. Different spectra (7/21/77) superseding the 5/9/77 Hosgri Report was issued (Appendix 2.1.2).

Seven of the ten calculations checked (S86, S93, S166, S251, S370, S415, S432) did not use correct seismic accelerations for 4% damping.

The bolted cable trays can take advantage of 7% damping for the Safe Shutdown Earthquake (Regu-

latory Guide 161, Appendix 3.4.2.3). The Hosgri spectra for most locations lists only 2%, 3%, and 4% damping. Possibly the incorrect accelerations resulted from interpolations of the 4% Hosgri spectra. Detail S415 used Hosgri spectra issued before May 9, 1977.

PGandE's Electrical Raceway Seismic Requalification Program for Unit 1 (Appendices 3.4.2.2, Item 1) was also checked (Appendix 3.4.2.3, Item 2) using the same Raceway Details as above. Four of the ten calculations examined were incorrectly noted on the check list (Appendix 3.4.2.2, Item 1).

3.3.7.6.3 In summary, two of the ten Raceway Details (S414, S432) were stressed above the allowable factor of safety (Appendix 3.4.2.3, Item 3). ~~Two additional Raceway Details (S93, S147) show no requalification after the Hosgri spectra were issued on May 9, 1977.~~

Red—VSG



SUMMARY AND CONCLUSIONS

This report has been prepared in response to the NRC request for a preliminary report on the PGandE Hosgri Reverification Program. As requested, it covers a review of the applicability of seismic design and qualification information for the Hosgri earthquake that may be considered to be associated with design interface between PGandE and URS Blume. As illustrated in Figure 3.1, the design applicability was reviewed for the entire seismic chain beginning with basic plant design information developed at PGandE, through the URS/Blume interface, then back to PGandE and on to the equipment qualifiers.

In this preliminary report, the goal was to review applicability of all major design issues and identify all detailed equipment qualifications for later review, although a certain level of sample checking was performed. To accomplish the basic objective, the review was performed on a building by building basis. The findings by building are reported below.

Containment

The Hosgri evaluation was performed using the original models for the DDE evaluation based upon 1970 drawings. These drawings were reviewed against current revisions. No changes were sufficient to require re-modeling. There were few formal transmittals from PGandE to URS/Blume in the early time period, because engineers from the two organizations were working together as though in one organization.

The annulus area lacked formal transmittals and was found to have been modeled using the Unit 2 configuration, as was known.

With the exception of the annulus, the containment building models were based upon applicable drawings.

URS/Blume performed the seismic analysis of the containment building and supplied several well documented reports to PGandE.

PGandE received the well documented seismic results from URS/Blume. Building response spectra were supplied to equipment suppliers to permit equipment qualification. The applicability of the design information for the following major equipment was verified:

Reactor Coolant System (RV, SG, PCP, Piping)
Hydrogen Recombiner
Containment Purge Valves
Regenerative Heat Exchangers
Containment Fan Coolers

Other equipment is discussed subsequently.

## Intake Structure

The seismic analysis of the Intake Structure was based upon information contained in a transmittal from PGandE in 1976. This transmittal was examined. URS/Blume issued a report on the seismic analysis of the Intake Structure in April 1977. After modifications, it was finalized in 1979. The drawings used to prepare the model were outdated, but building revisions were minor and did not affect the analysis.

The qualification of auxiliary salt water pumps was based upon the ground level motion, which considers the building to be rigid. Due to the low elevation of

pumps within the building itself, this is considered a sound assumption. Nevertheless, it will be checked in the reverification effort.

Turbine Building

There was no design interface between PGandE and URS/Blume in the initial aspect of the design and qualification because URS/Blume had design responsibility for the building. ~~Although URS/Blume designed the building, the drawings were prepared by PGandE Design Drafting~~.

The building had to be modified to qualify it for the Hosgri earthquake. All relevant drawings have been obtained, and a complete design verification effort completed by PGandE was documented. The in-depth verification was left to the final program since this building is less important than certain others.

The diesel generator, including the fuel system and starting air re~~view~~ceivers, was reviewed. The correct seismic input information was used for this safety related equipment.

Auxiliary/Fuel Handling Building

The Hosgri requalification of the Auxiliary Building was performed with the same models used in the earlier DDE analysis. This model was developed jointly by PGandE and URS/Blume using specialized computer programs for computing building properties. Reports of reviews of building properties and configurations were noted prior to initiation of the Hosgri analysis. The applicable drawings were used and referenced in the building analysis. Records of discussions on model properties, however, suggests that limited checks on

Note: Original design was designed and drafted by URS/Blume
Hosgri modifications were designed by URS/Blume and drafted by PG&E on new drawings which showed the modifications on and referred to the original drawing(s).

mass and stiffness should be made in the verification study.

In addition, a separate refined finite element analysis was used for the control room. Spectra from this refined analysis which were higher than the preliminary spectra were used for qualification (mainly by Westinghouse) of control room equipment.

## Cranes

For most of the cranes, the design information was provided to URS/Blume on an informal basis. For each of the major cranes in the plant, URS/Blume issued a complete design report. In addition, a design review was completed by URS/Blume for the Containment Polar Crane. These are positive findings, however, in some cases the qualification report does not have a complete record of drawings upon which models were based.

Also during the Hosgri requalification, some of the cranes were modified with the addition of holddowns, lateral restraints, etc. Additional checks to ensure analysis reflected the as modified drawings would be beneficial.

## Outdoor Water Storage Tanks

The information transmittal from PGandE to URS/Blume for qualification of the outdoor tanks was done on an informal basis since the two organizations were working together as a team. Substantial modifications were made to these tanks in the course of the Hosgri requalifications. Indirect interfaces existed in the analysis of these tanks via Harding-Lawson, soil consultants,

since one of the modifications was to dig out under the tank foundation and strengthen this structure. Communications were informal in many cases. Based upon the information that has been reviewed, there is no reason for concern. However, this area will be reviewed in much more detail in the final program because there was an indirect interface and because of informa~~tion~~l communications.

## CONCLUSION

In the course of this preliminary work a great deal of material has been examined. A certain amount of assurance has been established that there are no additional explicit errors, and several areas have been found that suggest more detailed review in the reverification effort.

As discussed at the outset, this review was conducted on the engineering material itself. The present findings and conclusions are independent of the normal convolutions of the design process, and whether work was done formally or informally, with the exception of course that informal transmittals, etc. require additional verification of the end product.

The analysis of the major buildings in the plant were based upon drawings that represent the correct building configuration, even though in many cases drawings were revised after the analysis was complete. The major items of safety related equipment in the Containment Building were qualified with correct response spectra. The Containment Building and Intake Structure were scrutinized in more depth than the other buildings. The ~~Inlet~~ Intake Structure and the safety related auxiliary pumps were qualified using applicable drawings and

spectra.

As with any review of any design project, some errors and some mistakes real or apparent will be found. In the present limited effort certain such findings arose. In one case, an item of HVAC equipment was qualified with the wrong spectra. The reviewer compared it to the correct spectra and found it was satisfactory in view of a large safety factor.

The documentation on the unistrut design details were misleading to the reviewer and one or two conduit supports appeared to be qualified with the wrong spectra. ~~There~~ They will be reviewed thoroughly in the final report, but it is expected that resolutions will result, since deeper inquiry did produce resolutions in other cases.

In conclusion, the limited review performed to date showed explicitly that the reactor coolant system and other major equipment were qualified using correct design information and no information has come to light thus far that calls the safety of the plant into question. Some areas have been found where further review is indicated, primarily because of a lack of ready documentation of the applicability of the design information.

# REFERENCE LIST


1. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis (URS/Blume, July 1970)

2. Diablo Canyon Nuclear Power Plant, Earthquake Analysis, Turbine Building, Unit 1 (URS/Blume, July 1970)

3. Diablo Canyon Nuclear Power Plant - Turbine Building crane evaluation for the 7.5 M Hosgri Earthquake (revised) November 1979.

4. Diablo Canyon Nuclear Power Plant - Fuel Handling Building crane Evaluation for the 7.5 M Hosgri Earthquake (revised) September 6, 1979.

5. Diablo Canyon Nuclear Power Plant - Units 1 and 2 - Outdoor Water Storage Tanks - Dynamic Seismic Analyses for the 7.5 M Hosgri criteria (revised), March 1979.

6. Seismic Evaluation for Postulated 7.5 Hosgri Earthquake - Units 1 and 2 - Diablo Canyon Site - PGandE.

7. "Engineering Review of Hosgri Seismic Qualification of Design Class 1 HVAC Equipment", EDS Nuclear Inc. February 22, 1979.

8. "Diablo Canyon Nuclear Plant, Seismic Qualification of HVAC Equipment", EDS Nuclear Inc., August 24, 1979.

9. Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri.

10. Wyle Labs Test Procedures No. 3642, and Test Report No. 58255.

11. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure, Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake, (URS/Blume, May 1979).

12. Westinghouse Project Letter PGE-4231, Revision 1, September 5, 1980 to D. V. Kelly.

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October 21, 1981

Mr. Jim Rocca
Chief Mechanical Engineer
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Dear Jim,

Enclosed please find "A Preliminary Report on the Design Interface Review of the Seismic Reverification Program."

Yours truly,

R L Cloud

R. L. Cloud

JJM
2 DAB
3 RVB
4 JVR

DO NOT DUPLICATE #4

RLC:ljs

Enclosure

Jim Rocca comments.
SM 11/03/81

# DRAFT COPY

A ~~PRELIMINARY~~ PARTIAL? REPORT ON THE DESIGN
INTERFACE REVIEW OF THE SEISMIC
REVERIFICATION PROGRAM
ADDRESSING THE URS/BLUME CONTRACTS
FOR THE ~~THIS~~ TIME FRAME

October 1981

Project 105-4

Report of work performed for Pacific Gas &
Electric Go. by R. L. Cloud Associates, Inc.

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TABLE OF CONTENTS

APPENDICES

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PARTIAL?
# A ~~PRELIMINARY~~ REPORT ON THE DESIGN INTERFACE REVIEW OF THE SEISMIC REVERIFICATION PROGRAM

## 1.0 Introduction

As a result of the discovery of a misapplication of seismic floor spectra to the annulus area of the Diablo Canyon Power Plant Unit 1, a Seismic Reverification Program* was established to determine if further errors exist in seismic qualification of the plant for the Hosgri 7.5 M earthquake. This program was presented verbally to the U. S. Nuclear Regulatory Commission in a meeting at Bethesda, Maryland on October 9, 1981. The NRC felt the program was valuable, but requested a preliminary report on part of Task 3 of the Reverification Program on a priority basis. This was expanded to include activities exclusively performed by PG&E and/or Blume as regards development, transmittal and use of data. Task 3 of the original program is titled "Design Interface Review" and consists of a review of seismic design and qualification information that was transmitted back and forth between PGandE and subcontractors during the evaluation of the plant for the Hosgri earthquake. The part of Task 3 requested in an early preliminary report was a review of the particular design interface as expanded above that existed between PGandE and URS/Blume during the Hosgri re-evaluation.

This report has been prepared in response to the NRC request for a preliminary report on the URS/Blume - PGandE Seismic Design Interface. It has been completed on a priority basis and must be considered a Partial ~~preliminary~~ report, as requested and ~~as~~ titled. Any omissions of significant information or other incompleteness will be addressed in the overall reverification program.

---

* "Seismic Re-Verification Program, Robert L. Cloud Associates, Inc., Berkeley, California, October 12, 1981.

## 2.0 Objective and Scope

The objective of this preliminary part of the verification program was to examine Seismic Design and Qualification information of ~~three~~ five categories:

(1) development of data by PG&E for transmittal

(2) that transmitted from PGandE to URS/Blume

(3) program followed by URS/Blume

(4) that transmitted from URS/Blume to PGandE

(5) that received from URS/Blume by PGandE and subsequently distributed, by PGandE, to those qualifying equipment and how it was used.

The requirement was to perform an engineering review of this information in a selective manner, as described below. It was reviewed to establish that correct building and equipment configurations were transmitted for analysis; that analysis was performed using applicable drawings with the correct revision, applicable equipment weights, etc.

7 Verification that URS/Blume was following a QA Program and that it was adhered to

Design spectra, building loads and other output of URS/Blume as transmitted by URS/Blume and received by PGandE were scheduled for examination with the objective of checking to see that URS/Blume-generated information was properly applied. The methodology employed in this task is described in Section 3.2 herein.

The scope of the present effort is limited to the review of the Design Interface as was planned of PGandE with URS/Blume. Other design interfaces will be reviewed in the overall re-verification study. The buildings and equipment reviewed in the present effort are those required for safe cold shutdown, and were requalified in the Hosgri reanalysis.

# 3.0 Program Methodology

## 3.1 Definition of Seismic Qualification Interfaces

The seismic qualification interfaces of interest for the present effort are illustrated in Figure 3.1. As can be seen, there are three primary interfaces that are denoted by Roman Numerals. The word interface refers to the process or activity in which certain engineering work is done in one organization, then transmitted to another. In the receiving organization, the engineering work is used, and perhaps transformed or reduced, and transmitted on to other organizations.

Referring to Figure 3.1, The three primary interfaces are:

I. Development and assembly of structural configurations, equipment locations and masses, together with the description of the Hosgri earthquake. This basic plant engineering description and seismic loading are forwarded to URS/Blume for dynamic analysis.

II. URS/Blume receives the plant configuration description. From this information, URS/Blume develops analytical models of the civil structures, and performs the dynamic analysis of the structures to determine their response to the Hosgri earthquake. This response, in the form of amplified floor response spectra and building loads or building qualification reports, is then transmitted to PGandE.

III. PGandE receives the civil/structural seismic response information and organizes and/or reduces

it into suitable forms for in-house use or transmittal to third parties for use in qualifying equipment, and in some cases, buildings. Equipment as used here refers to everything in the plant other than civil structures.

Figure 3.1, illustrating the interfaces, has additional flow paths that indicate feedback loops across the interfaces and dashed lines that indicate possible indirect interfaces. These additional communications paths are listed to complete all possible interface interaction activity.

## 3.2 Review Methodology

It was convenient to develop an organized approach to the review to minimize confusion, lost motion, and to ensure that a complete review was accomplished. The following paragraphs describe the methodology that was devised for use in the current preliminary effort.

The ~~basic orientation~~ basis for ~~of~~ the review was to ensure that the ~~applicable~~ correct design and qualification information was used for building and equipment qualification by studying the engineering work itself. Although ~~casual~~ observations were made on QA/QC type questions such as independent checking, following of procedures, etc., the ~~basic~~ primary intent of the ~~present~~ effort was to determine if the ~~applicable~~ correct engineering data was used in the seismic qualification calculations, regardless of the formality with which it was handled.

A second tenet of this effort was to perform a review that was both broad and complete, but also had the requisite depth. In order to accomplish this objective, two goals were set. The first goal was to examine all the interface design information involving URS-Blume to verify consistency and ~~general~~ overall accuracy. The second goal was to review all the interface information involving URS/Blume for two selected buildings in complete and comprehensive detail. The two buildings selected were the Intake Structure and the Containment Building.

### 3.2.1 Listing

Having defined the design interfaces, the next step was to list the categories of information expected to flow across each of the 3 interfaces. These categories are listed in Figure 3.2.

### 3.2.2 Structures

To break the required information into more manageable packages, the design information was examined separately for each building. The buildings are listed in Figure 3.2.2-1 with cognizant responsibilities for major tasks. As indicated, there was a separate responsible PGandE building engineer for each structure.

The interface design information was studied separately for each building and is reported separately ~~herein~~.

### 3.2.3 Equipment

The overall cognizant responsibilities for the Hosgri requalification of equipment was divided between PGandE and Westinghouse, as listed in Figure 3.2.3-1. PGandE performed this qualification in-house with PGandE engineers in some cases, and utilized subcontractors for others. Subcontractor interfaces on equipment qualification are described ~~in the body of~~ within this report.

The ~~general~~ strategy regarding equipment qualification was straight forward. The flow of design spectra was traced from the URS/Blume report on the relevant building to the qualification document for the individual items or classes of safety related equipment. For this ~~preliminary~~ report, much of the specific seismic input for certain types of equipment required more time to track than was available. When

?

what does [illegible] mean?
how much?

this occurred it is noted and the input will be reviewed in the overall report.

A sizeable portion of Hosgri required equipment was qualified by Westinghouse. The flow of seismic design information sent to Westinghouse by PGandE was partially documented (See Appendix 3.1.1).

The Intake Structure Hosgri spectra were sent to Westinghouse April 15, 1977. These spectra are identicle to the current Hosgri spectra, ~~through~~ contained in Ammendment 83. The Auxiliary Structure Hosgri spectra and control room slab update, April 11, 1977 and March 25, 1980 respectively are also identical to the current Hosgri spectra, ~~through~~ contained in Ammendment 83.

The spectra transmitted to Westinghouse for the Containment Structure on March 16 and 23, 1977 were superceded by the spectra issued June 5, 1977. Spectra could not be located in PGandE files. On August 9, 1977, PGandE transmitted vertical spectra for the Containment Structure to Westinghouse. These spectra were thought to be valid until October 1981.

Then why? now not valid? Spectra [illegible]

No record was found of any Turbine Building spectra ever being sent to Westinghouse.

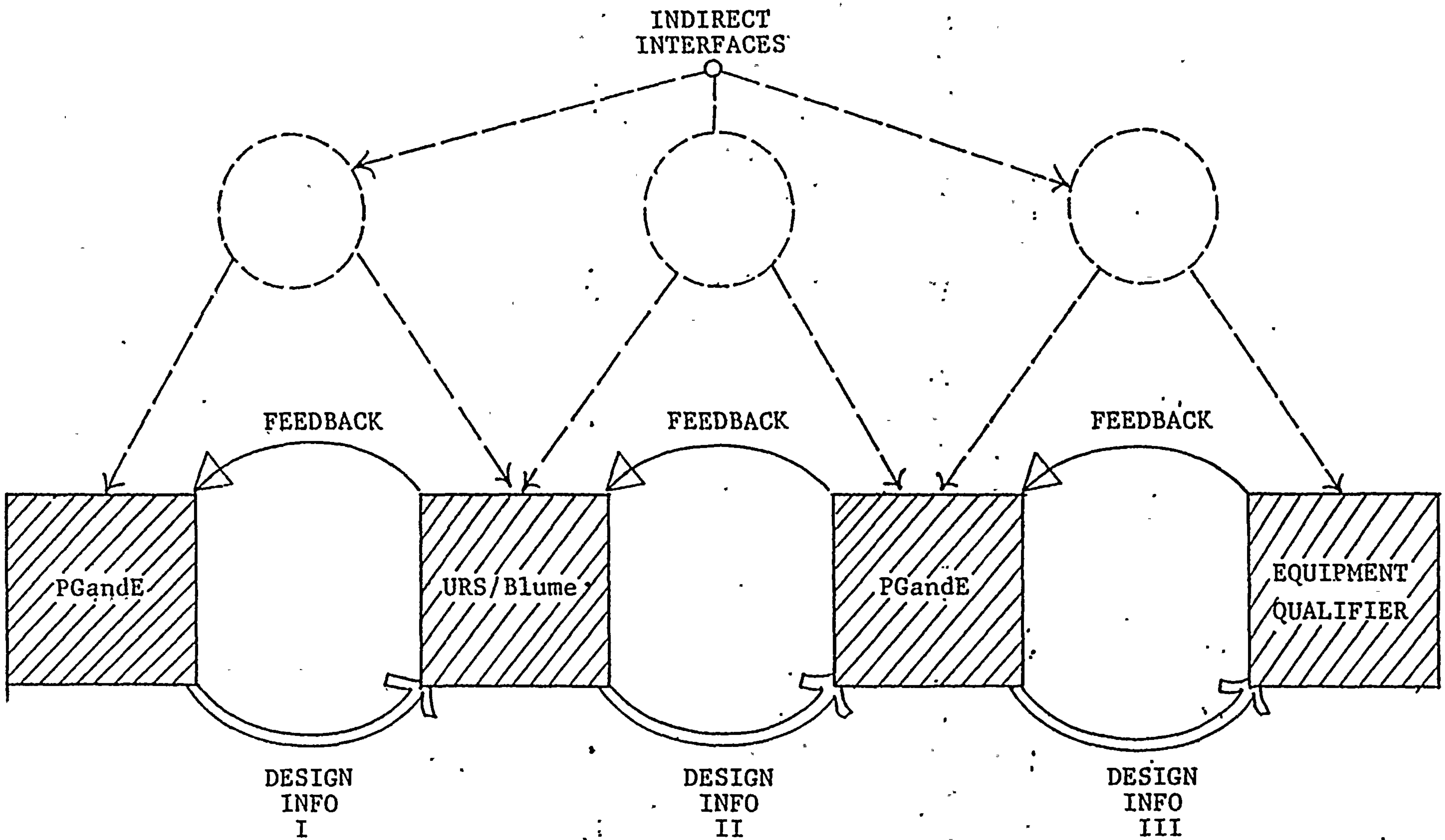


FIGURE 3.1: SEISMIC QUALIFICATION INTERFACES

| Interface I | Interface II | Interface III |
|---|---|---|
| Building Drawings | Floor Response Spectra for all locations throughout plant | Envelope Floor Spectra |
| Equipment Weights and C. G. | | Static g Loads |
| | Building Loads | Equipment Specifications |
| Documentation of Verbal Discussion | Dynamic Analysis Reports for all Buildings | Test Specifications |
| Definition of Ground Motion | | Purchase Orders |
| | | in-house use ? |

FIGURE 3.2 INFORMATION CATEGORIES OF INTERFACE

| | INTAKE BUILDING | CONTAINMENT BUILDING | AUXILIARY BUILDING | TURBINE BUILDING | CRANES | FIELD ERECTED TANKS |
|---|---|---|---|---|---|---|
| MODELING & DYNAMIC ANALYSIS | URS/Blume | URS/Blume | PGandE, URS/Blume | URS/Blume | W* - 3<br>URS/B - 4 | URS/Blume |
| DEVELOP SPECTRA | | URS/Blume | URS/Blume | URS/Blume | | |
| SEISMIC QUALIFICATIONS | URS/Blume | PGandE | PGandE | URS/Blume | W - 3<br>URS/B - 4 | URS/Blume |

* Westinghouse

Diablo Canyon Nuclear Power Plant Unit 1

SEISMIC ANALYSIS AND QUALIFICATION OF BUILDINGS - COGNIZANT RESPONSIBILITIES

Figure 3.2.2-1

| EQUIPMENT | RESPONSIBILITY |
|---|---|
| Reactor Coolant System and Equipment | W* |
| Piping Systems 6" and over connected to Reactor Coolant System | W |
| Secondary Systems | PGandE & Subcontractors |
| Safety Related Conduit & Raceways | PGandE |
| Safety Related Mechanical Equipment | PGandE |
| HVAC | PGandE |
| Instrumentation and Control Equipment | PGandE |

* Westinghouse

FIGURE 3.2.3-I RESPONSIBILITY OF EQUIPMENT QUALIFICATION

JVB

### 3.3 Reveiw of Structures and Equipment

The review of interface information for structures and equipment was performed using the methodology described in Section 3.2. To break the required information into more managable packages, the design information was examined for the following categories:

1. Containment Structure } in depth
2. Intake Structure
3. Turbine Building
4. Auxiliary and Fuel Handling Building } overview
5. Cranes
6. Outdoor Water Storage Tanks
7. General Equipment and Systems

Sections 3.3.1 through Sections 3.3.7 discuss in detail the interface information for the above mentioned categories.

#### 3.3.1 Containment Structure

The Containment Structure was originally investigated for the Double Design Earthquake (DDE) by URS/Blume. Results of this investigation are given in the URS/Blume report dated July 1970, "Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis", (Reference 1). To comply with the 7.5 M Hosgri specification, the Containment Structure was re-evaluated. This re-evaluation is presented in the URS/BLume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Containment Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake", May 1979 (Reference 11).

The following sections describe the transfer of information between PGandE and URS/Blume for the Containment Structure

and five major pieces of equipment. ~~Generic~~ Auxiliary equipment, such as cranes, piping, heating, ventilating and air conditioning, etc. are covered in Sections 3.3.5 through Sections 3.3.7.

3.3.1.1 Design Information from PGandE to URS/Blume

The close and informal relationship between PGandE and URS/Blume engineers resulted in sparse documentation of design information, drawings, equipment weights, pipe loads, etc. from PGandE to URS/Blume. Appendix 1.1 contains all the transmittal documentation for the period 1969 through 1981 for the Containment Structure. The documentation in Appendix 1.1 was obtained from Central Files in the Mechanical Engineering Department (Appendix 5) and Civil Engineering department (Appendix 4) and various personal files of engineers at PGandE. In addition part of the information was obtained from URS/Blume's project file. The document supporting this informal interface process contains the personal recollections of the PGandE engineer responsible for the Containment (Appendix 1.1, item #16).

For the Hosgri re-evaluation (Reference 11) the dynamic model used was the same as for the double design earthquake (DDE) analysis (Reference 1), with additional annulus information provided by PGandE and field visits (Appendix 1.1, item #16).

To verify that the documents used by URS/Blume to develop the original dynamic model (used subsequently for the Hosgri ev-evaluation) were correct, a list of drawings was checked. This list, given in Appendix 1.1, item #14, was obtained from the July 1970 report on the Containment Structure (Reference 1).

It appears the NRC expansion wants more of a look at what DHS did in developing the data they sent? I don't see that in this section

The criteria established to check the referenced drawings are tabulated as follows:

1. These are Containment Structure - Unit 1 drawings.

2. Since the reference drawings had no revision numbers, it was assumed that the drawings were current in July 1970.. ?

3. When the drawings had no revisions dated later than July 1970, they were marked "O.K." If revisions were made, these were so noted.

A review of the above mentioned drawings was performed, and it was found that revisions made after 1970 were minor (Appendix 1.1, item #14), and do ~~would~~ not affect the model in the horizontal direction.

In the case of the annulus, the only drawing documentation available are the four sketches sent to URS/Blume from PGandE (Appendix 1.1, item #5), and the calculation sketch at URS/Blume (Appendix 1.1, item #17). These sketches are for Unit 2 annulus and not for Unit 1. Unit 2 drawings, as provided by PGand E, were used by URS/Blume to formulate the seismic model because they were clearer and more easily read.

Thus, for the Hosgri ev-evaluation report (Reference 11) the containment dynamic model used was a Unit 1 interior and exterior and a Unit 2 annulus. According to URS/Blume this posed no problem as they were under the impression the Unit 1 and Unit 2 were identical. This is identified in.

Appendix 1.1, item #18. Use of Unit 2 annulus and Unit 1 interior should have no affect on the shape of the annulus spectra, because of the axisymetric interior, as discussed in Appendix 1.1, item #18. The only change in the annulus regions covered by the 5 referenced frames will be affected due to Unit 1 being mirror image opposite hand configuration from the Unit 2 model.

How about Blume's indepent work!

3.3.1.2 Design Information from URS/Blume to PGandE

Unlike the informal transmittal documentation from PGandE to URS/Blume, the documentation from URS/Blume to PGandE was more formal. This is verified by reviewing the transmittal documents listed in Appendix 2.1.1. This Appendix contains transmittal documents sent to PGandE from February 1977 to the present. These documents were obtained from URS/Blume during the week of October 13, 1981. The contents of the transmittal documents marked with an asterisk are in Appendix 2.1.2.

3.3.1.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

For the purpose of this interface review, the seismic input information for the following equipment was evaluated:

1. Reactor Coolant System
2. Hydrogen Recombiner
3. Containment Purge Valves
4. Regenerative Heat Exchanger
5. Containment Cooling Fans

What did PG&E do with info from Blume?
In (1) [illegible] equipment [illegible] but not [illegible] [illegible]

It was found that most of the design information for the above equipment was transmitted to Westinghouse (Appendix 3.1). The accuracy of this information is discussed in the next section.

### 3.3.1.4 Qualification of Containment Structure and Equipment

#### 3.3.1.4.1 Containment Structure

A comprehensive design review of the Containment Structure was originally completed on 2/28/77. This review had one outstanding item - pipe rupture restraints. This item was cleared, and an amendment issued on 1/16/78. The original review and the amendment were performed by PGandE and are given in Appendix 7.

Another design review of the Containment Structure was completed by PGandE on 1/22/79. This design review addressed the structural adequacy of the Containment Structure for the postulated 7.5 M Hosgri seismic event (Appendix 2.1).

Because of the recent development due to the discovery of an error in the annulus spectra, no conclusion can be drawn on the structural adequacy of the annulus. As this structure supports many equipment and piping systems, further in-depth review is necessary in the overall reverification program.

Is the structure's adequacy really in question because of the error? or just systems and supports.

3.3.1.4.2 Equipment

A detailed review of equipment is given in Appendix 3.1. A summary is given below:

1. Reactor Coolant System
   Westinghouse (W) seismically qualified the Reactor Coolant vessel for the Hosgri requirement as discussed in the W report, "Summary Report, Seismic Evaluation of Westinghouse Equipment for Postulated 7.5 M Hosgri Earthquake, Diablo Canyon Units 1 and 2, August 1979 (Appendix 3.1.2). The seismic spectra used for qualification envelope the current Hosgri spectra for the interior concrete, and thus the seismic qualification is valid.

This is also covered in technical report. See attached write-up

2. Hydrogen Recombiner
   Westinghouse (W) originally qualified the Hydrogen Recombiner in the annulus region by test. These were transmitted to PGandE as discussed in Appendix 3.1.2. Due to the conservative nature of the test spectra utilized in the original qualification, it was confirmed that the Hydrogen Combiners qualify to the new enveloped annulus spectra.

3. Continment Purge Valves
   The Containment Purge Valves were reviewed by T. N. Crawford as stated in the memo-to-file dated 6/11/79 (Appendix 3.1.2). The zero period accelerations used in analysis

are more conservative than the current Hosgri spectra. ~~Considering that the computations were correct~~, the containment purge valves are qualified to the 7.5 M Hosgri earthquake.

This type of statement doesn't give me a warm feeling

4. Regenerative Heat Exchangers
Westinghouse (W) performed the seismic qualification of the Regenerative Heat Exchangers using the Hosgri spectra as discussed in Appendix 3.1.2.

more work! will this be in completed interim report?

This qualification will require close scrutiny to properly evaluate the conclusion of the review.

5. Containment Cooling Fans
A detailed discussion of the qualification and review process for the containment cooling fans is given in Appendix 3.1.2. The end result of this check shows that superceded spectra were utilized for qualification. In this particular case, the conclusions are still valid because the spectra that were used envelope the current spectra.

This is also covered in Bechtel report see attached write-up

Besides the equipment reviewed above, other equipment in the Containment Structure has not been reviewed for the current effort, but will be done in the Reverification Program.

is this another [illegible] in [illegible] containment?

### 3.3.2 INTAKE STRUCTURE

#### 3.3.2.1 Design Information from PGandE to URS/Blume

PGandE's Civil Engineering file was searched for the design information transmitted from PGandE to URS/Blume on the Intake Structure during and prior to the Hosgri studies (Appendix 4). No such information was found. The following information was taken from the file of the lead PGandE engineer responsible for the Intake Structure.

Again development of info transmitted to Blume.

The seismic analysis of the Intake Structure for the Hosgri criteria was initiated on April 26, 1976. (Appendix 1.2). The relevant information such as civil/mechanical drawings and equipment weights were found to be transmitted from PGandE to URS/Blume from April 26 to June 22, 1976 (See Appendix 1.2).

What does Blume do independently?

#### 3.3.2.2 Design Information from URS/Blume to PGandE

A two-phase work scope of the seismic analysis of the Intake Structure for the Hosgri criteria was found in a memorandum dated 5/6/76 from URS/Blume to PGandE (Appendix 2.2.1). Some weekly progress reports from URS/Blume were found in the PGandE civil engineering file (Appendix 4).

A preliminary report on the seismic analysis of the Intake Structure was issued by URS/Blume to PGandE on April 6, 1977. Modifications of this report were made on 5/9/77 and 2/14/78, and the final report was issued on 5/16/79. An additional report entitled "Diablo Canyon Intake Structure -

Factor of Safety Against Overturning, Foundation Bearing Pressures", was issued on 11/13/78 (Appendix 2.2.2).

The design drawings used by URS/Blume to develop the mathematical model for the seismic analysis were reported in "DCNPP - Intake Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Criteria", May 9, 1977 (See Appendix 2.2.2). These drawings were compared with the Intake Structure drawings in the PGandE file (Appendix 1.2). A list of Intake Structure drawings currently in URS/Blume files is also given in Appendix 1.2. It was found by comparing the drawings used in developing the mathematical model of the Intake Structure with those in the PGandE file, that the PGandE file has later revision drawings. The revisions are based on spot checks. These minor changes ~~will~~ do not affect the mathematical model used in the seismic analysis.

what does this mean?

again, what did PG&E do with data from Blume? how used

3.3.2.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

No information was found to be given to equipment suppliers.

3.3.2.4 Qualification of Intake Structure and Equipment

3.3.2.4.1 Intake Structure

According to the lead PGandE engineer responsible for the Intake Structure, the building was qualified by using seismic response output produced in the URS/Blume 5/9/77 report (Appendix 1.2). The URS/Blume 5/16/79 report

gave smaller building response. Therefore, the building does not need to be requalified. However, the design review of the Intake Structure (Appendix 7) was dated September 1976, and has not reflected the Hosgri seismic requirement. Further investigation will be performed to determine the process of building qualification in the overall reverification program.

3.3.2.4.2 Auxiliary Salt Water Pumps

The safety-related Class 1 equipment inside the Intake Structure are the auxiliary salt water pumps. They were qualified by PGandE using the site design spectra (Hosgri criteria, see Appendix 2.2) based on the ~~for the~~ reason that the building is ~~essential~~ly rigid. Although the 5/9/77 and 5/16/79 reports by URS/Blume differ in seismic structural responses, there is no need to requalify the auxiliary salt water pumps if the building is truly rigid since the site seismic design spectra were used to qualify these pumps. Rigidity of the building ~~appears to be~~ is a good assumption based upon a ~~cursory~~ examination of the drawings. ~~but~~ This as~~sumption~~ will be verified in an engineering sense in the reverification study.

this should be stated differently i.e. "as the building is rigid."

Is this one of the issues Karl was talking about!

3.3.2.4.3 Buried Pipelines

The buried pipelines connecting the Intake Structure to the Turbine Building were qualified by PGandE with input from URS/

Blume. PGandE's qualification work was independently checked by Harding-Lawson Associates, using input from URS/Blume (See Appendix 7). The input used in the above two studies will be verified in the overall reverification program.

### 3.3.3 Turbine Building

The Turbine Building was originally designated a seismic Design Class II structure and designed on the basis of a minimum horizontal seismic coefficient of 0.2 g. The structure was later analyzed for the double design earthquake (DDE) and was found to require minor structural mofification. This is presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Earthquake Analysis Turbine Building, Unit 1", dated July, 1970 (Reference 2).

Because the building contains some design Class I equipment and because it is in close proximity to the Class I Auxiliary Building, it was necessary to show that under the postulated 7.5 M Hosgri motions the building would not have a failure which would impair either the Class I equipment contained in the Turbine Building or the Class I Auxiliary Building. For this reason, the Turbine Building was investigated for the Hosgri inputs. This resulted in major strucutral modifications, which are given in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Turbine Building Evaluation and Structural Modification for the 7.5 M. Hosgri EArthquake", March, 1980 (Refernece 3).

The following sections address the interface issue between PGandE, URS/Blume, and Equipment Suppliers and Qualifiers for the Turbine Building.

#### 3.3.3.1 Design Information from PGandE to URS/Blume

The original design and analysis, including the generation of drawings of the Turbine Building, were done by URS/Blume. Following the Hosgri requirement to re-evaluate the Turbine Building in 1977, URS/Blume performed the analysis and reevaluation. Design changes and drawings were

generated by PGandE from URS/Blume input. These were then checked and verified by URS/Blume. (This is documented in Section 4, Appendix 1.3.)

In the case of the Turbine Building, a large number of transmittals were documented. Appendix 1.3 contains transmittal documentation for the period 1974 to 1979. Relevant design information transmitted is given in Appendix 1.3.

3.3.3.2 Design Information from URS/Blume to PGandE

Appendix 2.3.1 contains transmittal documents from URS/Blume to PGandE. They reference various spectra, design, analysis and test reports and other correspondence of technical nature.

The detail, transmittals themselves have not been reviewed, ~~and~~ this will be a part of the overall reverification work.

3.3.3.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

In the Turbine Building, the major safety related mechanical equipment system, per Hosgri requirement, is the Diesel Generator System. Since PGandE was its own qualifier, no interface between equipment vendor or suppliers was required.

The Diesel Generator System consists of six major components:

1. Diesel Generators
2. Starting Air Receivers
3. Fuel Oil Filter
4. Fuel Oil Priming Tank
5. Fuel Oil Strainer
6. Fuel Oil Transfer Pump

The Mechanical Engineering Central File Index (Appendix 5) was reviewed to check for correct and current seismic inputs in the qualifying documents for the above mentioned components. The specific details of each component is discussed at length in Appendix 3.1.5.

Results of this review show that the Diesel Generator System was conservatively qualified to correct Hosgri seismic input.

3.3.3.4 Qualification of Building and Components

The Turbine Building design qualification responsibilities were divided between URS/Blume and PGandE.

The qualification of major seismic resistant components of the building for the Hosgri evaluation was performed by URS/Blume and specific drawings which reflect the modifications are included in the report entitled "DCNPP, Unit 1 - Turbine Building Evaluation and Structural Modifications for the 7.5 M Hosgri Earthquake", March 1980 (Appendix 2.3.2). PGandE implemented modifications to qualify the building frames, interior block and concrete walls and anchorage that were not qualified by URS/Blume. Tables 3.3.1 and 3.3.2 contain the list of

PGandE drawings for these modifications, obtained from conferring with the responsible lead engineer.

The PGandE design review is presented in the report "Hosgri Design Verification - Turbine Building", February, 1980 (Appendix 7).

Since the design review did not verify the interface procedures between URS/Blume, PGandE and the field (Figure 4-10-2, URS/Blume Report on Design Review, Appendix 7), these will be investigated in the overall reverification program.

Should anything be said about these drawings like checked and etc

## TABLE 3.3.1

Drawings prepared by PGandE containing modification information for Structural Frames, Beams and Columns per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463684 | 465135 |
| 465127 | 465136 |
| 465128 | 465137 |
| 465129 | 465138 |
| 465130 | 465139 |
| 465131 | 465140 |
| 465132 | 465141 |
| 465133 | 465142 |
| 465134 | 465143 |

## TABLE 3.3.2

Drawings containing modification information for Equipment Anchorage per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463671 | 463677 |
| 463672 | 463678 |
| 463673 | 463679 |
| 463674 | 463680 |
| 463675 | 463681 |
| 463676 | 463682 |
| | 463683 |

### 3.3.4 Auxiliary/Fuel Handling Buildings

#### 3.3.4.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file (Appendix 4) was searched for the design information transmitted from PGandE to URS/Blume on the Auxiliary/Fuel Handling Buildings during and prior to the Hosgri studies. Specifically, Civil/Structure files No. 9.3, Auxiliary Building, and No. 9.31, Seismic Analysis, were searched thoroughly (Appendix 4). One transmittal issued by PGandE to URS/Blume dated April 16, 1971 was found. In this memo, the steam anchorage drawings of the Auxiliary Building were discussed (Appendix 1.4).

After discussions with the lead engineer of PGandE who was responsible for the seismic analyses of Auxiliary/Fuel Handling Buildings, it was learned that during the DDE analysis, PGandE developed, with the assistance of URS/Blume, computer programs "Dybox-2" and "Shewal-4" to compute the mass and stiffness properties of the mathematical model for the Auxiliary/Fuel Handling Building (Appendix 1.4). The computations by computer were done at PGandE and the output was given to URS/Blume as input to compute the seismic response of the buildings (Appendices 1.4 and 2.4.2 - May 9, 1977, pp. 8 and 9).

The lead engineer of PGandE also stated that for the Hosgri criteria, the original data (for DDE analysis) used as an input for Dybox-2 was checked against the as-built conditions. The results of this check confirmed that there were no changes in the concrete dimensions. Consequently, the DDE model was used

in the Hosgri study (Appendix 1.4). The same statements were found in the URS/Blume Report of May 9, 1977 (Appendix 2.4.2).

However, an examination of some telecon records (from 3/9/77 to 3/24/77, Appendix 1.4) kept in URS/Blume's file reveals that there were discussions on discrepancy of weights computed by PGandE in the E-W and N-S directions for the DDE model, and a difference of 35% in the weight at Elevation 140', computed by PGandE for the DDE model and URS/Blume's computation in March 1977.

An average weight of ~~weights~~ those in the E-W and N-S directions and the weight of DDE model at Elevation 140' were finally used in the Hosgri analysis, with no explanations as to how the weight difference was resolved. A detailed examination of the above will be performed in the overall reverification program.

Was this [illegible] calc

what does Blume do independently

3.3.4.2 Design Information from URS/Blume to PGandE

The flow of information from URS/Blume to PGandE on the Auxiliary Building is documented in Appendix 2.4.

Preliminary Hosgri spectra were issued by URS/Blume prior to the issuance of the May 9, 1977 (May 11, 1977 transmittal) Hosgri Final Report (Appendix 2.4.2).

During the qualification of the Auxiliary Building it was decided to make a separate more detailed finite element model of the control room due to its importance. This model is the basis for the control room qualification (Appendix 2.4.2). Since the final control room spectra are higher than the preliminary

spectra, a detailed review of equipment qualification will be performed in the final program to be sure the preliminary spectra were not used.

Spectra transmittals after May 11, 1977 provide additional, but not different, information.

3.3.4.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

Seismic qualification of major mechanical equipment is addressed in Section 3.3.4.4.2. Seismic qualification of other equipment and systems is addressed in Section 3.3.7.

3.3.4.4 Qualification of Buildings and Equipment

3.3.4.4.1 Buildings

The statement by the responsible engineer at PGandE in Appendix 1.4 confirmed that the structural evaluation of the Auxiliary Building was done based on the output from URS/Blume's 7.5 M Hosgri seismic analysis. No effort has been spent, because of time constraints, to spot-check the building qualification details. In the full length verification study, seismic input loads used for building verification report dated 1974, of the Auxiliary Building is in PGandE's Civil Engineering file (Appendix 7). The design verification report has an attached note indicating revision for Hosgri. This will be investigated further in the Reverification Program.

3.3.4.4.2 Equipment

The major equipment of the Auxiliary Building was qualified either by Westinghouse and PGandE or reviewed by Westinghouse. Table 3.3.5.4 summarizes the qualification of mechanical equipment in the Auxiliary Building. The detailed information on this equipment qualification is given in Appendix 3.1.4.

JVR



### 3.3.5 Cranes

#### 3.3.5.1 Containment Structure Cranes

There are two cranes in the Containment Structure that required seismic evaluation per 7.5 M Hosgri specification. These are the Polar crane and the Dome Crane. A brief discussion of the two cranes is given in the following sections.

##### 3.3.5.1.1 Containment Polar Crane

The Containment Polar Crane is a gantry crane with trolleys and consists primarily of welded structural steel members and full moment resisting bolted connection. Results of a 3-D non-linear seismic analysis are presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Containment Polar Cranes Evaluation for the 7.5 M Hosgri Earthquake", dated Jly 1979 (Appendix 2.5.2). X

The drawings and other design information utilized for the modeling of the cranes are not referenced in the report. Nor are there any transmittals documenting the transfer of these from PGandE to URS/Blume.

At present the only documentation that substantiates the above mentioned report are the calculations (Appendix 2.5.2). These documents basically reflect that the design review was completed by URS/Blume and that the results concluded are valid. The drawings included in the Appendix of the July 1979 report were checked against the X

model in the report (Appendix 2.5.2). This preliminary review shows that the information was transformed correctly from the drawings to the model.

3.3.5.1.2 Dome Crane

The dome service crane is a maintenance crane located on top of the polar crane. PGandE was in the process of designing modification to comply with the 7.5 M Hosgri Evaluation. As of May 5, 1981, PGandE halted this process and is presently considering retaining a consultant to evaluate the consequences of assumed failure. This is documented in the letter dated May 5, 1981 given in Appendix 1.5. The documentation of seismic qualification of this crane for the Hosgri requirement was not found in the current effort. It will be verified in the overall reverification program.

3.3.5.2 Intake Structure Crane

3.3.5.2.1 Design Information from PGandE to URS/Blume

Some design information for the seismic analysis of Intake Structure Crane was transmitted from PGandE to URS/Blume on 1/18/79, More design information for crane, trolley assembly and frames were respectively transmitted on 12/21/78 and 1/24/79. In February 1979, field measurement of Intake Structure crane was performed (Appendix 1.5).

3.3.5.2.2 Design Information from URS/Blume to PGandE

URS/Blume requested field measurement and transmitted SK-1-12-9 on 1/23/79. The crane hoist engineering drawings were found to be transmitted on 3/5/79. The final seismic analyses report entitled "DCNPP - Intake Structure Crane Evaluation for the 7.5 M Hosgri Earthquake", November 1979, was transmitted on 11/28/79 and documents the seismic design qualification information for this crane (Appendix 2.5).

3.3.5.2.3 Qualification of Intake Structure Crane

A quick review of the final report listed in Section 3.3.5.2.2 found many suggested design modifications. They are: the installation of a seismic hold-down and lateral restraint mechanism, and minor structural modifications to transmit horizontal forces from crane legs to truck and then to the rail. These modifications to design drawings were made by URS/Blume and were also reported in the above report. The modifications to construction drawings were jointly made by PGandE and URS/Blume. However, spot checks need to be made to insure that modifications to construction drawings were properly done.

3.3.5.3 Turbine Building Crane

3.3.5.3.1 Design Information from PGandE to URS/Blume

In the case of the Turbine Building Crane, a formal transmittal of drawings and equipment weights was done on 7/22/75. The transmittal documentation giving the drawing number is listed in Section 1 of Appendix 1.5. Besides this design information, no other transmittals were found.

3.3.5.3.2 Design Information from URS/Blume to PGandE

The final report entitled "Diablo Canyon Nuclear Power Plant - Turbine Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)", November 1979, presents the design information required to modify the crane for the Hosgri criteria (Reference 3).

3.3.5.3.3 Qualification of Turbine Building Crane

The qualification of Turbine Building crane was jointly performed by PGandE and URS/Blume. Based upon design information presented in 3.3.5.3.2 above, URS/Blume modified the crane design to provdie tiedown of the crane trolley to the bridge girder and lateral seismic restraint to distribute the lateral seismic loads to both horizontal crane support girders (described in the Hosgri report given in 3.3.5.3.2 above). PGandE and URS/Blume subsequently jointly revised the crane construction drawings. However, spot checks need to be made to insure that modifications to construction drawings were properly implemented.

3.3.5.4 Fuel Handling Building Crane

3.3.5.4.1 Design Information from PGandE to URS/Blume

Very little documentation was found in PGandE's file on design information transmitted to URS/Blume. Based upon the recollection of the lead engineer for the seismic analysis of fuel handling crane (Appendix 1.5), the latest revisions of crane manufacturer's drawings, original calculations, and material properties of crane were transmitted to URS/Blume. As is the case for some of the other structures, the information was passed on in an informal basis. However, there is no record of URS/Blume's correspondence file on crane which shows that URS/Blume received such information. Some spot checks need to be made to check the accuracy of design information transmitted.

Is this part of reverification program?

3.3.5.4.2 Design Information from URS/Blume to PGandE

The final report entitled "Diablo Canyon Nuclear Power Plant - Fuel Handling Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)" was issued on 9/6/79 (Reference 4). Several minor structural modifications to the existing crane structural system were reported in order to prevent eccentric loading of the crane runway and excessive loading on the trolley axis.

3.3.5.4.3 Qualification of Fuel-Handling Building Crane

The qualification of fuel-handling building crane to satisfy Hosgri criteria was jointly performed by PGandE and URS/Blume. URS/Blume prepared design modifications per Hosgri report for this crane. PGandE and URS/Blume jointly revised the

subject crane construction drawings. Some spot checks will be made to insure that these modifications were properly done.

I assume in reverification program

## 3.3.6 Outdoor Water Storage Tanks

### 3.3.6.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file was searched for the design information transmitted from PGandE to URS/Blume (Appendix 4). No relevant transmittals were found.

After talking to the lead engineer of PGandE who was responsible for the seismic analysis of outdoor water storage tanks, it was learned that the seismic analyses of these tanks started in March 1977. PGandE and URS/Blume engineers worked closely as a team and the information between PGandE and URS/Blume was exchanged on a person to person basis in meetings, telephone calls, etc. (Appendix 1.6.)

An examination of telecon records kept in URS/Blume's file (Appendix 1.6) confirms the statement described above by the lead engineer of PGandE. Some design information transmitted between URS/Blume and Harding-Lawson on soil data and stability of tanks was also found in URS/Blume's telecon records. The design information was found to be transmitted informally. Some checks are required in the overall reverification program to insure its accuracy.

### 3.3.6.2 Design Information from URS/Blume to PGandE

The final seismic analyses were completed in March 1979 and the design information transmitted on March 26, 1979 (Reference 5). Because the tank modifications were being carried out in the field at the same time as the analyses were being performed, nu-

merous revisions were made to PGandE drawings to incorporate URS/Blume's findings. The above report, therefore, reflects the actual configuration and field condition of the tanks (Appendix 1.6). Although a team effort existed between PGandE and URS/Blume in transmitting the design information, some checks need to be made to determine the accuracy of the information transferred.

and will be examined in the reverification program

3.3.6.3 Qualification of Tanks

The tanks were qualified jointly by URS/Blume and PGandE, using Hosgri criteria as they worked together. URS/Blume's Hosgri report (March 1979) documents the modifications (Reference 5). The outdoor water storage tanks and components were subsequently concluded to meet the Hosgri seismic requirement (PGandE's design verification report for outdoor water storage tanks, dated 9/21/79 (Appendix 7).

### 3.3.7 General Equipment and Systems

A significant portion of the scope of this report is to review the interfaces between PGandE and various equipment suppliers and qualifiers. For most equipment, the practical way to check this interface is to examine the end result, the actual seismic qualification and note whether the current applicable Hosgri response spectra curves were used.

The mechanical equipment seismic qualifications are reviewed in the section addressing the individual buildings and will be not included here. This section will deal primarily with the review of seismic qualification of the following equipment and systems.

1. Piping Systems
2. Valves
3. HVAC Components
4. HVAC Ducting
5. Electrical Equipment & Instrumentation
6. Electrical Systems - Raceways and Conduits

### 3.3.7.1 Piping Systems

This section of the report will address the transmittal of seismic design information from PGandE to consultants engaged in analysis of piping systems and supports.

As was noted in a summary by the PGandE Piping Group, the piping analysis was assigned to consultants URS/Blume and Earthquake Engineering Systems (EES). Similarly for support evaluation, URS/Blume, EES, and EDS Nuclear, Inc. were used as the primary consultants.

For support evaluation the seismic design input consists of either a spacing table with seismic factors or the actual support force output from a piping analysis computer model. PGandE uses a design guide for the seismic factors which they transmit to the consultants. This will be a significant interface to examine. ~~For instances~~ where piping computer analysis output is used for design, then the valve qualification is totally dependent on the design input to the piping analysis.

The transmittals for piping analyses appear to be in complete form for documents sent to EES. The only problem is that the transmittal cover sheet does not list the contents of the entire attachment. The transmittal might only read problem number and "appropriate spectra attached". To trace the flow of information it will be necessary to find the contents of the transmittals. This task ~~may~~ will be accomplished by further examination of PGandE files or perhaps by examining EES files.

For the scope of piping assigned to URS/Blume, very little correspondence was located during the time frame

of Unit 1 piping analyses. However, URS/Blume has not yet been contacted to provide any transmittals they may have sent or received. This will be ~~implemented for~~ accomplished during the long term reverification effort.

### 3.3.7.2 VALVES

A preliminary review was performed on seismic design information transferred across interfaces between PGandE and valve qualifiers. This review addresses the safety related valves that required seismic requalification to meet the Hosgri requirements.

The valves reviewed consist of the minimum required active valves for hot shutdown and/or cold shutdown and the valves required in case of a single failure. The containment purge valves are addressed in Section 3.3.1.3.

The valves reviewed are listed in Tables 7-3A,B and 7-7, 7-7A of the Hosgri Seismic Re-evaluation Report (Reference 6). Copies of these tables are contained in Appendix 3.2.

#### 3.3.7.2.1 Definition of Interfaces

A number of PGandE and contractor interfaces existed. Review of available documentation to date shows that the primary interfaces for valve requalification were:

PGandE → EES → PGandE for piping analysis
PGandE → EDS → PGandE for valve qualification
PGandE → Westinghouse → PGandE for valve qualification

where EES ---- Earthquake Engineering Systems, Inc.
EDS ---- EDS Nuclear Inc.
Westinghouse -- Westinghouse Electric Corp.

EES, using data provided by PGandE, produced computer models of piping systems. Computer analyses were then performed to determine the dynamic characteristics of the piping system under earthquake loading. Results were then returned to PGandE.

Earthquake loading was determined from acceleration response spectra provided by PGandE to EES.

PGandE transferred the relevant results of the completed piping analyses, valve accelerations, and pipe loading to EDS and Westinghouse. EDS and Westinghouse then proved that the valve meets certain criteria under the given loading conditions. This was done by either analysis or testing. Results were then returned to PGandE.

3.3.7.2.2 Transmittals Between EES and PGandE

No documentation has been found concerning transmittals of information from PGandE to EES at this point in time. A search for this documentation is being continued.

Some records of EES transmittals to PGandE have been found to date. A complete set of EES transmittals to PGandE has not been compiled yet.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.3 Transmittals Between EDS and PGandE

A limited amount of documentation of information transfer from PGandE to EDS has been found to date. Complete documentation of requalification information for the valves being reviewed here has not been compiled at this point in time.

Some records of results sent by EDS to PGandE have been located. A complete set of EDS transmittals to PGandE for the valves being reviewed has not been compiled as of this date.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.4 Transmittals Between Westinghouse and PGandE

Some information on PGandE transmittals to Westinghouse has been located in PGandE files. However, insufficient records have been found to fully document information flow from PGandE to Westinghouse.

The only evidence of information returned from Westinghouse to PGandE found to date is a Westinghouse document containing valve seismic qualification forms submitted to the NRC. A copy of this document was sent to PGandE.

Documentation of transmittals between Westinghouse and PGandE located to date are contained in Appendix 3.2.2.

3.3.7.2.5 Reverification Effort

For valves on flexible piping systems, the acceleration response of the pipe must be known in order to obtain the valve accelerations, and to derive the pipe loadings on the valves. This is a result obtained from the piping analyses. Therefore, the validity of a valve qualification depends on information transferred two steps earlier: from PGandE to the piping analyst and from the return of the analysis results from the piping analyst to PGandE.

With the documentation available to date, no evidence was found to indicate whether the valve accelerations have ever been verified as being correct before being transmitted to the valve qualifiers.

To perform a thorough review of the information transferred across interfaces, the following procedure will be followed:

1. Locate and examine documentation of correct Hosgri spectra transmitted to piping analysts.

2. Locate and review transmittals of piping analysis results to PGandE, particularly valve accelerations. The accuracy of the piping model is also to be checked.

3. Locate and review transmittals of valve accelerations from PGandE to valve qualifiers.

4. Cross check data returned to PGandE from piping analysts with data transmitted out of PGandE to the valve qualifiers.

3.3.7.3 HVAC Components

An independent engineering review of the seismic qualification was performed for the Safety Related HVAC equipment (References 7 and 8) by EDS Nuclear, Inc.

This EDS review concluded that the majority of the HVAC equipment is seismically qualified to the Hosgri requirement, and that with minor modifications, the remainder will also be.

As part of this interface review, the seismic accelerations that were used as input was checked for correctness. Out of 5 inputs checked, one of them was incorrect.

The field work is given in Appendix 3.3.1. Since the qualification accelerations are larger than the Hosgri accelerations, these particular errors were not of consequence.

3.3.7.4 Heating, Ventilating and Air Conditioning Duct

3.3.7.4.1 The majority of HVAC ducts required for cold shutdown has been qualified by PGandE, with the remainder of the engineering being done by EDS Nuclear. PGandE architects, HVAC engineers, and civil engineers all collaborated on the duct design. Information flow between these groups is documented in Appendix 3.3.2.1.

3.3.7.4.2 The HVAC information in Appendix 3.3.2 was supplied by the responsible PGandE engineer. Containment duct computations could be easily be found. This will be reviewed at a later date.

3.3.7.4.3 A random sampling of the duct qualification calculations was checked for seismic input (Appendix 3.3.2). Six of the twenty-seven HVAC details listed in Appendix 3.2.2.2 were chosen at random. In contrast to the random sampling shown above, <u>all</u> seismic inputs to the Fireproof Ducts were checked against current Hosgri Spectra (Appendix 3.3.2).

3.3.7.4.4 Five HVAC Details have Hosgri accelerations correctly used and one (Detail 4, Drawing 504566) has Hosgri accelerations greater than the value in the calculations. All spectra for the Fireprorfed Ducts were found to be correctly used (Appendix 3.3.2.3).

what is its significance

3.3.7.4.5 One HVAC Detail (Detail 4, Drawing 504566) will be analyzed at a later date.

3.3.7 5 Electrical Equipment and Instrumentation

A preliminary review was performed on seismic design information transferred between PGandE and electrical equipment and instrumentation vendors and qualifiers. This review focuses strictly on design information used in requalifying safety related electrical equipment and instrumentation to meet the Hosgri seismic requirements.

The Hosgri Seismic Re-evaluation Report (Reference 6) was used to derive the list of safety related electrical equipment and instrumentation. A copy of Table 10-1 from the Hosgri Report is included in Appendix 3.4.1. Table 10-1 is a complete list of the safety related electrical equipment and instrumentation.

Although the cable trays are included in Table 10-1, they are reviewed separately and are addressed in Section 3.3.7.6.

3.3.7.5.1 Definition of Interfaces

The responsibility for electrical equipment and instrumentation seismic qualification was divided between PGandE and Westinghouse. Westinghouse was responsible for qualifying Westinghouse supplied NSSS equipment. The remaining electrical equipment and instrumentation was qualified by PGandE.

The interface between PGandE and Westinghouse allowed PGandE to send Hosgri spectra information to Westinghouse, and for Westinghouse to send the results back to PGandE.

Of the PGandE qualified equipment, it was qualified either by analysis or by testing at Wyle Laboratories.

The Wyle Labs and PGandE interface allowed PGandE and Wyle Labs to exchange information regarding Hosgri spectra, test spectra and test procedures. Also, Wyle transmitted test results back to PGandE across this interface.

3.3.7.5.2 Transmittals from PGandE to Westinghouse

No documentation has been found in the current work regarding the transmittal of information from PGandE to Westinghouse.

3.3.7.5.3 Transmittals from Westinghouse to PGandE

The only evidence of transmittals from Westinghouse to PGandE encountered to date is the existence in the PGandE files of the Westinghouse report "Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri". (Reference 9).

3.3.7.5.4 Transmittals from PGandE to Wyle Labs

No documentation has been found to date regarding the transmittal of spectra or test procedure information from PGandE to Wyle Labs.

3.3.7.5.5 Transmittals from Wyle Labs to PGandE

The only transmittals from Wyle Labs to PGandE found thus far are Wyle Labs test reports and test procedures. Two of these that were examined are Wyle Labs Test Procedure No. 3642 and Test Report No. 58255 (Reference 10).

3.3.7.5.6 Transmittals Regarding Requalification by Analysis

No documentation has been found to date regarding requalification of electrical equipment (or instrumentation) by analysis, by either PGandE or other Parties.

3.3.7.5.7 Westinghouse Requalification

Review of the Westinghouse report, "Summary Report on Seismic Evaluation for Postulated 7.5 M. Hosgri", (Reference 9) showed that Westinghouse electrical equipment and instrumentation was requalified for Hosgri requirements by applying certain criteria to previously performed tests and analyses.

The test spectra used in the previous tests are included in Appendix 3.4. These are identical to Figures 10-2 to 10-12 in the Hosgri report. The Westinghouse report states that the 5-9-77 spectra were used and that the Blume and Newmark spectra were enveloped.

The report also states that the vertical spectra used were taken as 2/3 of the horizontal spectra. However, in a conversation with the cognizant engineer from Westinghouse, he states that specific vertical Hosgri spectra were used in the requalification of each item of equipment. The engineer also stated that the vertical spectra for control room equipment were selected with consideration for the node point closest to the equipment location.

Requalification was performed by Westinghouse by

comparing the applicable Hosgri spectra to test spectra used in the initial pre-Hosgri qualification. The positive results of this comparison were communicated to PGandE by Westinghouse in Westinghouse Project Letter PGE-4231, Revision 1, dated September 5, 1980 sent to D. V. Kelly (Reference 12).

3.3.7.5.8 Wyle Requalification Tests

Though no documented transmittals from PGandE to Wyle have been found to date, there is evidence that Wyle test procedures were reviewed and approved by PGandE personnel:

1. A PGandE memo, dated 11-9-77, from O. Steinhardt contains comments on test spectra contained in Wyle Test Report No. 26286.

2. Wyle Test Procedure No. 3642, dated 11-30-77, is signed and approved by PGandE personnel.

Documentation on these two items is contained in Appendix 3.4.

PGandE internal memorandum indicate that General Electric was involved in Wyle Labs requalification tests of the 4.16kV Vital Switchgear (Appendix 3.4). Further investigation will be required to determine General Electric's role on requalification. If necessary, information transmittals across that interface will be examined.

3.3.7.5.9 Requalification by Analysis

For equipment requalified by analysis, as indicated by note 5 in Table 10-1 of the Hosgri report, no information has been found to date as to who had performed these analyses. Investigation in this area will be continued.

3.3.7.5.10 Preliminary Review of Electrical Equipment

A preliminary review of requalification of electrical equipment and instrumentation was conducted by checking a 50% sample of Zero Period Accelerations (ZPA's) from the Hosgri Evaluation listed in Table 10-1 of the Hosgri report.

The Hosgri ZPA's listed were cross checked against the ZPA's of the applicable up-to-date Hosgri spectra. The Hosgri ZPA's in Table 10-1 were found to be correct.

In each case, the ZPA levels used to qualify each item of equipment, as listed in Table 10-1, were greater than the Hosgri required ZPA's.

3.3.7.5.11 Reverification Approach

Should further investigation fail to uncover records that satisfactorily document the transfer of seismic requalification information between PGandE and qualifiers, the following procedure will be undertaken:

1. Actual test spectra used in requalification tests will be examined. They will be checked

to see if they envelop the applicable Hosgri spectra.

2. Requalification analyses will be examined to check if the applicable seismic information was applied. In addition, the analysis criteria used for qualification, if applicable, will be examined.

3.3.7.6 Electrical Raceways

3.3.7.6.1 The supports for the Electrical Raceways are found indiscriminately throughout the main buildings. With in excess of six hundred unique types of support details.

The PGandE Civil Engineer responsible for electrical Raceways provided the qualification documentation. Each support detail is qualified to the Hosgri by simplified computation. Each Detail is assumed to span a maximum of eight feet.

3.3.7.6.2 With such a large volume of material, a random sampling approach was employed. The Hosgri seismic accelerations were checked for ten support details (Appendix 3.4.2.3). In addition the program employed in September 1981 by PGandE to requalify the raceways in the Annulus section of Containment was checked. The Annulus region was closely examined for the following three reasons:

No transmittals of Annulus drawings from PGandE to URS/Blume were located and URS/Blume does not, at present, have the drawings. Preliminary spectra differing from the 5/9/77 spectra was issued for Containment. Different spectra (7/21/77) superceding the 5/9/77 Hosgri Report was issued (Appendix 2.1.2).

Seven of the ten calculations checked (S86, S93, S166, S251, S370, S415, S432) did not use correct seismic accelerations for 4% damping.

The bolted cable trays can take advantage of 7% damping for the Safe Shutdown Earthquake (Regu-

latory Guide 161, Appendix 3.4.2.3). The Hosgri spectra for most locations lists only 2%, 3%, and 4% damping. Possibly the incorrect accelerations resulted from interpolations of the 4% Hosgri spectra. Detail S415 used Hosgri spectra issued before May 9, 1977.

PGandE's Electrical Raceway Seismic Requalification Program for Unit 1 (Appendices 3.4.2.2, Item 1) was also checked (Appendix 3.4.2.3, Item 2) using the same Raceway Details as above. Four of the ten calculations examined were incorrectly noted on the check list (Appendix 3.4.2.2, Item 1).

3.3.7.6.3 In summary, two of the ten Raceway Details (S414, S432) were stressed above the allowable factor of safety (Appendix 3.4.2.3, Item 3). Two additional Raceway Details (S93, S147) show no requalification after the Hosgri spectra were issued on May 9, 1977.

(Corrected)

[illegible]

JVR

## 4.0 SUMMARY AND CONCLUSIONS

This report has been prepared in response to the NRC request for a preliminary report on the PGandE Hosgri Reverification Program. As requested, it covers a review of the applicability of seismic design and qualification information for the Hosgri earthquake that may be considered to be associated with design interface between PGandE and URS Blume. As illustrated in Figure 3.1, the design applicability was reviewed for the entire seismic chain beginning with basic plant design information developed at PGandE, through the URS/Blume interface, then back to PGandE and on to the equipment qualifiers.

In this preliminary report, the goal was to review applicability of all major design issues and identify all detailed equipment qualifications for later review, although a certain level of sample checking was performed. To accomplish the basic objective, the review was performed on a building by building basis. The findings by building are reported below.

Containment

The Hosgri evaluation was performed using the original models for the DDE evaluation based upon 1970 drawings. These drawings were reviewed against current revisions. ? No changes were sufficient to require re-modeling. There were few formal transmittals from PGandE to URS/Blume in the early time period, because engineers from the two organizations were working together as though in one organization.

The annulus area lacked formal transmittals and was found to have been modeled using the Unit 2 configuration, as was known.

With the exception of the annulus, the containment building models were based upon applicable drawings.

URS/Blume performed the seismic analysis of the containment building and supplied several well documented reports to PGandE.

what did it do with it?

PGandE received the well documented seismic results from URS/Blume. Building response spectra were supplied to equipment suppliers to permit equipment qualification. The applicability of the design information for the following major equipment was verified:

Reactor Coolant System (RV, SG, PCP, Piping)
Hydrogen Recombiner
Containment Purge Valves
Regenerative Heat Exchangers
Containment Fan Coolers

Other equipment is discussed subsequently.

Intake Structure

The seismic analysis of the Intake Structure was based upon information contained in a transmittal from PGandE in 1976. This transmittal was examined. URS/Blume issued a report on the seismic analysis of the Intake Structure in April 1977. After modifications, it was finalized in 1979. The drawings used to prepare the model were outdated, but building revisions were minor and did not affect the analysis.

The qualification of auxiliary salt water pumps was based upon the ground level motion, which considers the building to be rigid. Dur to the low elevation of

pumps within the building itself, this is considered a sound assumption. Nevertheless, it will be checked in the reverification effort.

Turbine Building

There was no design interface between PGandE and URS/Blume in the initial aspect of the design and qualification because URS/Blume had design responsibility for the building. Although URS/Blume designed the building, the drawings were prepared by PGandE Design Drafting.

The building had to be modified to qualify it for the Hosgri earthquake. All relevant drawings have been obtained, and a complete design verification effort completed by PGandE was documented. The in-depth verification was left to the final program since this building is less important than certain others.

The diesel generator, including the fuel system and starting air reviewers, was reviewed. The correct seismic input information was used for this safety related equipment.

Auxiliary/Fuel Handling Building

The Hosgri requalification of the Auxiliary Building was performed with the same models used in the earlier DDE analysis. This model was developed jointly by PGandE and URS/Blume using specialized computer programs for computing building properties. Reports of reviews of building properties and configurations were noted prior to initiation of the Hosgri analysis. The applicable drawings were used and referenced in the building analysis. Records of discussions on model properties, however, suggests that limited checks on

mass and stiffness should be made in the verification study.

In addition, a separate refined finite element analysis was used for the control room. Spectra from this refined analysis which were higher than the preliminary spectra were used for qualification (mainly by Westinghouse) of control room equipment.

Cranes

For most of the cranes, the design information was provided to URS/Blume on an informal basis. For each of the major cranes in the plant, URS/Blume issued a complete design report. In addition, a design review was completed by URS/Blume for the Containment Polar Crane. These are positive findings, however, in some cases the qualification report does not have a complete record of drawings upon which models were based.

Also during the Hosgri requalification, some of the cranes were modified wiht the addition of holddowns, lateral restraints, etc. Additional checks to ensure analysis reflected the as modified drawings would be beneficial.

Outdoor Water Storage Tanks

The information transmittal from PGandE to URS/Blume for qualification of the outdoor tanks was done on an informal basis since the two organizations were working together as a team. Substantial modifications were made to these tanks in the course of the Hosgri requalifications. Indirect interfaces existed in the analysis of these tanks via Harding-Lawson, soil consultants,

since one of the modifications was to dig out under the tank foundation and strengthen this structure. Communications were informal in many cases. Based upon the information that has been reviewed, there is no reason for concern. However, this area will be reviewed in ~~much~~ more detail in the final program because there was an indirect interface and because of information communications. informal

## 5.0 CONCLUSION

In the course of this preliminary work a great deal of material has been examined. A certain amount of assurance has been established that there are no additional seismic output explicit errors, ~~and~~ Several areas have been found that suggest more detailed review in the reverification effort.

As discussed at the outset, this review was conducted on the engineering material itself. The present findings and conclusions are independent of the normal convolutions of the design process, and whether work was done formally or informally, with the exception of course that informal transmittals, etc. require additional verification of the end product.

The analysis of the major buildings in the plant were based upon drawings that represent the correct building configuration, even though in many cases drawings were revised after the analysis was complete. The major items of safety related equipment in the Containment Building were qualified with correct response spectra. The Containment Building and Intake Structure were scrutinized in more depth than the other buildings. The ~~Inlet~~ Intake Structure and the safety related auxiliary pumps were qualified using applicable drawings and

spectra.

~~As with any review of any design project, some errors and some mistakes real or apparent will be found.~~ In the present limited effort certain such findings arose. In one case, an item of HVAC equipment was qualified with the wrong spectra. The reviewer compared it to the correct spectra and found it was satisfactory in view of a large safety factor.

The documentation on the unistrut design details were misleading to the reviewer and one or two conduit supports appeared to be qualified with the wrong spectra. There will be reviewed thoroughly in the final report, but it is expected that resolutions will [illegible] ~~result~~, since deeper inquiry did produce resolutions in other cases.

In conclusion, the limited review performed to date showed explicitly that the reactor coolant system and other major equipment were qualified using correct design information and no information has come to light thus far that calls the safety of the plant into question. Some areas have been found where further review is indicated, primarily because of a lack of ready documentation of the applicability of the design information.

60

REFERENCES ~~LIST~~


1. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis (URS/Blume, July 1970)

2. Diablo Canyon Nuclear Power Plant, Earthquake Analysis, Turbine Building, Unit 1 (URS/Blume, July 1970)

3. Diablo Canyon Nuclear Power Plant - Turbine Building crane evaluation for the 7.5 M Hosgri Earthquake (revised) November 1979.

4. Diablo Canyon Nuclear Power Plant - Fuel Handling Building crane Evaluation for the 7.5 M Hosgri Earthquake (revised) September 6, 1979.

5. Diablo Canyon Nuclear Power Plant - Units 1 and 2 - Outdoor Water Storage Tanks - Dynamic Seismic Analyses for the 7.5 M Hosgri criteria (revised), March 1979.

6. Seismic Evaluation for Postulated 7.5 Hosgri Earthquake - Units 1 and 2 - Diablo Canyon Site - PGandE.

7. "Engineering Review of Hosgri Seismic Qualification of Design Class 1 HVAC Equipment", EDS Nuclear Inc. February 22, 1979.

8. "Diablo Canyon Nuclear Plant, Seismic Qualification of HVAC Equipment", EDS Nuclear Inc., August 24, 1979.

9. Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri.

10. Wyle Labs Test Procedures No. 3642, and Test Report No. 58255.

11. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure, Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake, (URS/Blume, May 1979).

12. Westinghouse Project Letter PGE-4231, Revision 1, September 5, 1980 to D. V. Kelly.

General Notes 10/23/81

(i) - PG+E can have analysis done by suppliers or consultants, but ultimate responsibility for qualification must rest with the Licensee — PG+E. Stating otherwise will red flag the NRC.

(a yellow net)

— J. J. McCracken

ROBERT L. CLOUD ASSOCIATES, INC.
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October 21, 1981

Mr. Jim Rocca
Chief Mechanical Engineer
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Dear Jim,

Enclosed please find "A Preliminary Report on the Design Interface Review of the Seismic Reverification Program."

Yours truly,

R. L. Cloud

R. L. Cloud

DO NOT DUPLICATE!

#5

RLC:ljs

Enclosure

DRAFT COPY

# A PRELIMINARY REPORT ON THE DESIGN INTERFACE REVIEW OF THE SEISMIC REVERIFICATION PROGRAM

October 1981

Project 105-4

Report of work performed for Pacific Gas & Electric Co. by R. L. Cloud Associates, Inc.

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TABLE OF CONTENTS

APPENDICES

Jim



# A PRELIMINARY REPORT ON THE DESIGN INTERFACE REVIEW OF THE SEISMIC REVERIFICATION PROGRAM

## 1.0 Introduction

As a result of the discovery of a misapplication of seismic floor spectra to the annulus area of the Diablo Canyon Power Plant Unit 1, a Seismic Reverification Program* was established to determine if further errors exist in seismic qualification of the plant for the Hosgri 7.5 M earthquake. This program was presented verbally to the U. S. Nuclear Regulatory Commission in a meeting at Bethesda, Maryland on October 9, 1981. The NRC felt the program was valuable, but requested a preliminary report on part of Task 3 of the Reverification Program on a priority basis.

Task 3 of the original program is titled "Design Interface Review" and consists of a review of seismic design and qualification information that was transmitted back and forth between PGandE and subcontractors during the evaluation of the plant for the Hosgri earthquake. The part of Task 3 requested in an early preliminary report was a review of the particular design interface that existed between PGandE and URS/Blume during the Hosgri re-evaluation.

This report has been prepared in response to the NRC request for a preliminary report on the URS/Blume - PGandE Seismic Design Interface. It has been completed on a priority basis and must be considered a preliminary report, as requested and as titled. Any omissions of significant information or other incompleteness will be addressed in the overall reverification program.

---

* "Seismic Verification Program, Robert L. Cloud Associates, Inc., Berkeley, California, October 12, 1981.

also mark-up

Jim



## 2.0 Objective and Scope

The objective of ~~this preliminary part of~~ the re verification program was to ~~examine Seismic Design and Qualification information of three categories~~:

1. Ensure that all ...... applied.
2. Chart the ..... design chain.
3. Review ..... interface specifically:

(1) that transmitted from PGandE to URS/Blume

(2) that transmitted from URS/Blume to PGandE

(3) that received from URS/Blume by PGandE and subsequently distributed, by PGandE, to those qualifying equipment

The requirement for this preliminary report was to perform an engineering review of this information in a selective manner, as described below. ~~It~~ The info was reviewed to establish that correct building and equipment configurations were transmitted for analysis; that analysis was performed using applicable drawings with the correct revision, applicable equipment weights, etc.

Design spectra, building loads and other output of URS/Blume as transmitted by URS/Blume and received by PGandE were scheduled for examination with the objective of checking to see that here URS/Blume-generated information was properly applied. The methodology employed in this task is described in Section 3.2 ~~herein~~.

The scope of the present effort is limited to the review of the Design Interface of PGandE with URS/Blume. Other design interfaces will be reviewed in the overall re-verification study. The buildings and equipment reviewed in the present effort are those required for safe cold shutdown, and were requalified in the Hosgri reanalysis.

## 3.0 Program Methodology

### 3.1 Definition of Seismic Qualification Interfaces

The seismic qualification interfaces of interest for the present effort are illustrated in Figure 3.1. As can be seen, there are three primary interfaces that are denoted by roman numerals. The word interface refers to the process or activity in which certain engineering work is done in one organization, then transmitted to another. In the receiving organization, the engineering work is used, and perhaps transformed or reduced, and transmitted on to other organizations.

Referring to Figure 3.1, The three primary interfaces are:

I. Development and assembly of structural configurations, equipment locations and masses, together with the description of the Hosgri earthquake. This basic plant engineering description and seismic loading are forwarded to URS/Blume for dynamic analysis.

II. URS/Blume receives the plant configuration description. From this information, URS/Blume develops analytical models of the civil structures, and performs the dynamic analysis of the structures to determine their response to the Hosgri earthquake. This response, in the form of amplified floor response spectra and building loads or building qualification reports, is then transmitted to PGandE.

III. PGandE receives the civil/structural seismic response information and organizes and/or reduces

it into suitable forms for transmittal to third parties for use in qualifying equipment, and in some cases, buildings. Equipment as used here refers to everything in the plant other than civil structures.

Figure 3.1, illustrating the interfaces, has additional flow paths that indicate feedback loops across the interfaces and dashed lines that indicate possible indirect interfaces. These additional communications paths are listed to complete all possible interface interaction activity.

## 3.2 Review Methodology

It was convenient to develop an organized approach to the review to minimize confusion, lost motion, and to ensure that a complete review was accomplished. The following paragraphs describe the methodology that was devised for use in the current preliminary effort.

The basic orientation of the review was to ensure that the applicable design and qualification information was used for building and equipment qualification by studying the engineering work itself. Although casual observations were made on QA/QC type questions such as independent checking, following of procedures, etc., the basic intent of the present effort was to determine if the applicable engineering data was used in the seismic qualification calculations, regardless of the formality with which it was handled.

A second tenet of this effort was to perform a review that was both broad and complete, but also had the requisite depth. In order to accomplish this objective, two goals were set. The first goal was to examine all the interface design information involving URS-Blume to verify consistency and general accuracy. The second goal was to review all the interface information involving URS/Blume for two selected buildings in complete and comprehensive detail. The two buildings selected were the Intake Structure and the Containment Building.

### 3.2.1 Listing

Having defined the design interfaces, the next step was to list the categories of information expected to flow across each of the 3 interfaces. These categories are listed in Figure 3.2.

### 3.2.2 Structures

To break the required information into more manageable packages, the design information was examined separately for each building. The buildings are listed in Figure 3.2.2-1 with cognizant responsibilities for major tasks. As indicated, there was a separate responsible PGandE building engineer for each structure.

The interface design information was studied separately for each building and is reported separately herein.

### 3.2.3 Equipment

The overall cognizant responsibilities for the Hosgri requalification of equipment was divided — no between PGandE and ~~Westinghouse,~~ as listed in Figure 3.2.3-1. PGandE performed this qualification in-house with PGandE engineers in some cases, and utilized subcontractors for others. Subcontractor interfaces on equipment qualification are described in the body of this report.

The general strategy regarding equipment qualification was straight forward. The flow of design spectra was traced from the URS/Blume report on the relevant building to the qualification document for the individual items or classes of safety related equipment. For this preliminary report, much of the specific seismic input for certain types of equipment required more time to track than was available. When

this occurred it is noted and the input will be reviewed in the overall report.

A sizeable portion of Hosgri required equipment was qualified by Westinghouse. The flow of seismic design information sent to Westinghouse by PGandE was partially documented (See Appendix 3.1.1).

— oops!

The Intake Structure Hosgri spectra were sent to Westinghouse April 15, 1977. These spectra are identicle to the current Hosgri spectra, through Ammendment 83. The Auxiliary Structure Hosgri spectra and control room slab update, April 11, 1977 and March 25, 1980 respectively are also identical to the current Hosgri spectra, through Ammendment 83.

The spectra transmitted to Westinghouse for the Containment Structure on March 16 and 23, 1977 were superceded by the spectra issued June 5, 1977. Spectra could not be located in PGandE files. On August 9, 1977, PGandE transmitted vertical spectra for the Containment Structure to Westinghouse. These spectra were thought to be valid until October 1981.

No record was found of any Turbine Building spectra ever being sent to Westinghouse.

PG+E reviewed the analysis performed by westinghouse, and documented the review in the appropriate engineering release.

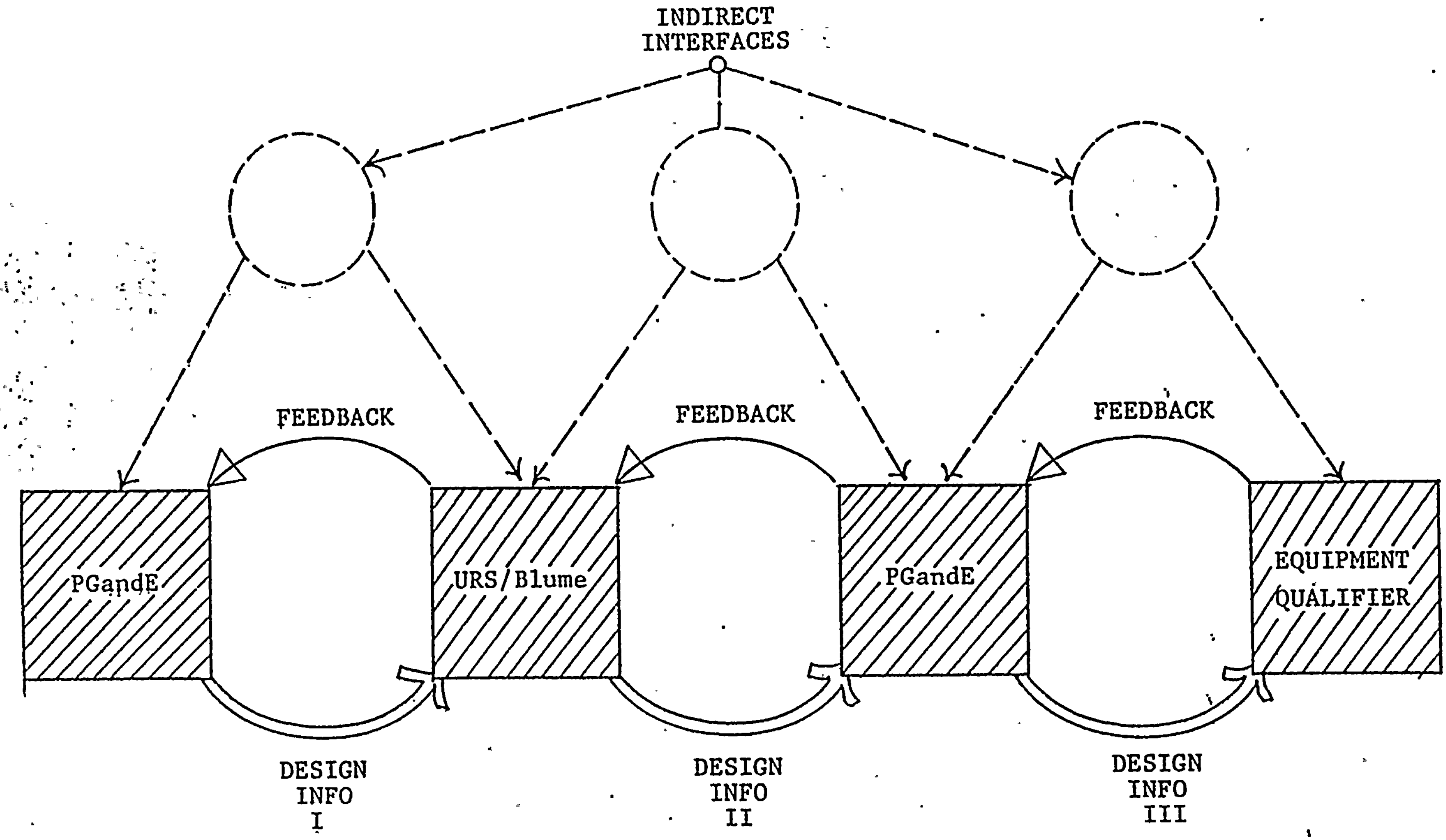


FIGURE 3.1: SEISMIC QUALIFICATION INTERFACES

| Interface I | Interface II | Interface III |
|---|---|---|
| Building Drawings<br><br>Equipment Weights and C. G.<br><br>Documentation of Verbal Discussion<br><br>Definition of Ground Motion | Floor Response Spectra for all locations throughout plant<br><br>Building Loads<br><br>Dynamic Analysis Reports for all Buildings | Envelope Floor Spectra<br><br>Static g Loads<br><br>Equipment Specifications<br><br>Test Specifications<br><br>Purchase Orders |

FIGURE 3.2 INFORMATION CATEGORIES OF INTERFACE

| | INTAKE BUILDING | CONTAINMENT BUILDING | AUXILIARY BUILDING | TURBINE BUILDING | CRANES | FIELD ERECTED TANKS |
|---|---|---|---|---|---|---|
| MODELING & DYNAMIC ANALYSIS | URS/Blume | URS/Blume | PGandE, URS/Blume | URS/Blume | <u>W</u>* - 3<br>URS/B - 4 | URS/Blume |
| DEVELOP SPECTRA | | URS/Blume | URS/Blume | URS/Blume | | |
| SEISMIC QUALIFICATIONS | URS/Blume | PGandE | PGandE | URS/Blume | <u>W</u> - 3<br>URS/B - 4 | URS/Blume |

* Westinghouse

Diablo Canyon Nuclear Power Plant Unit 1

SEISMIC ANALYSIS ~~AND QUALIFICATION~~ OF BUILDINGS - COGNIZANT RESPONSIBILITIES

Figure 3.2.2-1

PLTE Responsible for Qualification

| EQUIPMENT | RESPONSIBILITY |
|---|---|
| Reactor Coolant System and Equipment | ~~W*~~ PG+E |
| Piping Systems 6" and over connected to Reactor Coolant System | ~~W~~ PG+E |
| Secondary Systems | PGandE & ~~Subcontractors~~ |
| Safety Related Conduit & Raceways | PGandE |
| Safety Related Mechanical Equipment | PGandE |
| HVAC | PGandE |
| Instrumentation and Control Equipment | PGandE |

* Westinghouse

FIGURE 3.2.3-1 RESPONSIBILITY OF EQUIPMENT QUALIFICATION

Jim



### 3.3 Reveiw of Structures and Equipment

The review of interface information for structures and equipment was performed using the methodology described in Section 3.2. To break the required information into more managable packages, the design information was examined for the following categories:

1. Containment Structure
2. Intake Structure
3. Turbine Building
4. Auxiliary and Fuel Handling Building
5. Cranes
6. Outdoor Water Storage Tanks
7. General Equipment and Systems

Sections 3.3.1 through Sections 3.3.7 discuss in detail the interface information for the above mentioned categories.

#### 3.3.1 Containment Structure

The Containment Structure was originally investigated for the Double Design Earthquake (DDE) by URS/Blume. Results of this investigation are given in the URS/Blume report dated July 1970, "Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis", (Reference 1). To comply with the 7.5 M Hosgri specification, the Containment Structure was re-evaluated. This re-evaluation is presented in the URS/BLume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Containment Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake", May 1979 (Reference 11).

The following sections describe the transfer of information between PGandE and URS/Blume for the Containment Structure

and five major pieces of equipment. Generic equipment, such as cranes, piping, heating, ventilating and air conditioning, etc. are covered in Sections 3.3.5 through Sections 3.3.7.

3.3.1.1 Design Information from PGandE to URS/Blume

The close and informal relationship between PGandE and URS/Blume engineers resulted in sparse documentation of design information, drawings, equipment weights, pipe loads, etc. from PGandE to URS/Blume. Appendix 1.1 contains all the transmittal documentation for the period 1969 through 1981 for the Containment Structure. The documentation in Appendix 1.1 was obtained from Central Files in the Mechanical Engineering Department (Appendix 5) and Civil Engineering department (Appendix 4) and various personal files of engineers at PGandE. In addition part of the information was obtained from URS/Blume's project file. The document supporting this informal interface process contains the personal recollections of the PGandE engineer responsible for the Containment (Appendix 1.1, item #16).

For the Hosgri re-evaluation (Reference 11) the dynamic model used was the same as for the double design earthquake (DDE) analysis (Reference 1), with additional annulus information provided by PGandE and field visits (Appendix 1.1, item #16).

To verify that the documents used by URS/Blume to develop the original dynamic model (used subsequently for the Hosgri ev-evaluation) were correct, a list of drawings was checked. This list, given in Appendix 1.1, item #14, was obtained from the July 1970 report on the Containment Structure (Reference 1).

The criteria established to check the referenced drawings are tabulated as follows:

1. These are Containment Structure - Unit 1 drawings.

2. Since the reference drawings had no revision numbers, it was assumed that the drawings were current in July 1970. ?

3. When the drawings had no revisions dated later than July 1970, they were marked "O.K." If revisions were made, these were so noted.

A review of the above mentioned drawings was performed, and it was found that revisions made after 1970 were minor (Appendix 1.1, item #14), and would not affect the model in the horizontal direction.

In the case of the annulus, the only drawing documentation available are the four sketches sent to URS/Blume from PGandE (Appendix 1.1, item #5), and the calculation sketch at URS/Blume (Appendix 1.1, item #17). These sketches are for Unit 2 annulus and not for Unit 1. Unit 2 drawings, as provided by PGand E, were used by URS/Blume to formulate the seismic model because they were clearer and more easily read.

Thus, for the Hosgri ev-evaluation report (Reference 11) the containment dynamic model used was a Unit 1 interior and exterior and a Unit 2 annulus. According to URS/Blume this posed no problem as they were under the impression the Unit 1 and Unit 2 were identical. This is identified in

Appendix 1.1, item #18. Use of Unit 2 annulus and Unit 1 interior should have no affect on the shape vertically of the annulus spectra, because of the axisymetric interior, as discussed in Appendix 1.1, item #18. The only change in the annulus regions covered by the 5 referenced frames will be affected due to Unit 1 being mirror image opposite hand configuration from the Unit 2 model.

3.3.1.2 Design Information from URS/Blume to PGandE

Unlike the informal transmittal documentation from PGandE to URS/Blume, the documentation from URS/Blume to PGandE was more formal. This is verified by reviewing the transmittal documents listed in Appendix 2.1.1. This Appendix contains transmittal documents sent to PGandE from February 1977 to the present. These documents were obtained from URS/Blume during the week of October 13, 1981. The contents of the transmittal documents marked with an asterisk are in Appendix 2.1.2.

3.3.1.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

For the purpose of this interface review, the seismic input information for the following equipment was evaluated:

1. Reactor Coolant System
2. Hydrogen Recombiner
3. Containment Purge Valves
4. Regenerative Heat Exchanger
5. Containment Cooling Fans

It was found that most of the design information for the above equipment was transmitted to Westinghouse (Appendix 3.1). The accuracy of this information is discussed in the next section.

3.3.1.4 Qualification of Containment Structure and Equipment

3.3.1.4.1 Containment Structure

A comprehensive design review of the Containment Structure was originally completed on 2/28/77. This review had one outstanding item - pipe rupture restraints. This item was cleared, and an amendment issued on 1/16/78. The original review and the amendment were performed by PGandE and are given in Appendix 7.

Another design review of the Containment Structure was completed by PGandE on 1/22/79. This design review addressed the structural adequacy of the Containment Structure for the postulated 7.5 M Hosgri seismic event (Appendix 2.1).

Because of the recent development due to the discovery of an error in the annulus spectra, no conclusion can be drawn on the structural adequacy of the annulus. As this structure supports many equipment and piping systems, further in-depth review is necessary in the overall reverification program.

3.3.1.4.2 Equipment

A detailed review of equipment is given in Appendix 3.1. A summary is given below:

1. Reactor Coolant System
   Westinghouse (W) seismically analyzed ~~qualified~~ the Reactor Coolant vessel for the Hosgri requirement as discussed in the W report, "Summary Report, Seismic Evaluation of Westinghouse Equipment for Postulated 7.5 M Hosgri Earthquake, Diable Canyon Units 1 and 2, August 1979 (Appendix 3.1.2). The seismic spectra used for ~~qualifica-tion~~ analysis envelope the current Hosgri spectra for the interior concrete, and thus the seismic ~~qualification~~ analysis is valid.

2. Hydrogen Recombiner
   Westinghouse (W) originally analyzed ~~qualified~~ the Hydrogen Recombiner in the annulus region by test. These were transmitted to PGandE as discussed in Appendix 3.1.2. Due to the conservative nature of the test spectra utilized in the original qualification, it was confirmed that the Hydrogen Combiners qualify to the new enveloped annulus spectra.

3. Continment Purge Valves
   The Containment Purge Valves were qualified ~~reviewed~~ by T. N. Crawford as stated in the memo-to-file dated 6/11/79 (Appendix 3.1.2). The zero period accelerations used in analysis

are more conservative than the current Hosgri spectra. Considering that the computations were correct, the containment purge valves are qualified to the 7.5 M Hosgri earthquake.

4. Regenerative Heat Exchangers
Westinghouse (W) performed the seismic ~~qualification~~ analysis of the Regenerative Heat Exchangers using the Hosgri spectra as discussed in Appendix 3.1.2.

This ~~qualification~~ analysis will require close scrutiny to properly evaluate the conclusion of the review.

5. Containment Cooling Fans
A detailed discussion of the ~~qualification~~ analysis and review process for the containment cooling fans is given in Appendix 3.1.2. The end result of this check shows that superceded spectra were utilized for qualification. In this particular case, the conclusions are still valid because the spectra that were used envelope the current spectra. Done by Pacific 2

Besides the equipment reviewed above, other equipment in the Containment Structure has not been reviewed for the current effort, but will be done in the Reverification Program.

### 3.3.2 INTAKE STRUCTURE

#### 3.3.2.1 Design Information from PGandE to URS/Blume

PGandE's Civil Engineering file was searched for the design information transmitted from PGandE to URS/Blume on the Intake Structure during and prior to the Hosgri studies (Appendix 4). No such information was found. The following information was taken from the file of the lead PGandE engineer responsible for the Intake Structure.

The seismic analysis of the Intake Structure for the Hosgri criteria was initiated on April 26, 1976. (Appendix 1.2). The relevant information such as civil/mechanical drawings and equipment weights were found to be transmitted from PGandE to URS/Blume from April 26 to June 22, 1976 (See Appendix 1.2).

#### 3.3.2.2 Design Information from URS/Blume to PGandE

A two-phase work scope of the seismic analysis of the Intake Structure for the Hosgri criteria was found in a memorandum dated 5/6/76 from URS/Blume to PGandE (Appendix 2.2.1). Some weekly progress reports from URS/Blume were found in the PGandE civil engineering file (Appendix 4).

A preliminary report on the seismic analysis of the Intake Structure was issued by URS/Blume to PGandE on April 6, 1977. Modifications of this report were made on 5/9/77 and 2/14/78, and the final report was issued on 5/16/79. An additional report entitled "Diablo Canyon Intake Structure -

Factor of Safety Against Overturning, Foundation Bearing Pressures", was issued on 11/13/78 (Appendix 2.2.2).

The design drawings used by URS/Blume to develop the mathematical model for the seismic analysis were reported in "DCNPP - Intake Structure Dynamic Seismic Analysis for the 7.5 M Hosgri Criteria", May 9, 1977 (See Appendix 2.2.2). These drawings were compared with the Intake Structure drawings in the PGandE file (Appendix 1.2). A list of Intake Structure drawings currently in URS/Blume files is also given in Appendix 1.2. It was found by comparing the drawings used in developing the mathematical model of the Intake Structure with those in the PGandE file, that the PGandE file has later revision drawings. The revisions are based on spot checks. These minor changes will not affect the mathematical model used in the seismic analysis.

3.3.2.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

No information was found to be given to equipment suppliers.

3.3.2.4 Qualification of Intake Structure and Equipment

3.3.2.4.1 Intake Structure

According to the lead PGandE engineer responsible for the Intake Structure, the building was qualified by using seismic response output produced in the URS/Blume 5/9/77 report (Appendix 1.2). The URS/Blume 5/16/79 report

gave smaller building response. Therefore, the building does not need to be requalified. However, the design review of the Intake Structure (Appendix 7) was dated September 1976, and has not reflected the Hosgri seismic requirement. Further investigation will be performed to determine the process of building qualification in the overall reverification program.

3.3.2.4.2 Auxiliary Salt Water Pumps

The safety-related Class 1 equipment inside the Intake Structure are the auxiliary salt water pumps. They were qualified by PGandE using the site design spectra (Hosgri criteria, see Appendix 2.2) for the reason that the building is ~~essentially~~ rigid. Although the 5/9/77 and 5/16/79 reports by URS/Blume differ in seismic structural responses, there is no need to requalify the auxiliary because salt water pumps ~~if~~ the building is truly rigid since the site seismic design spectra were used to qualify these pumps. Rigidity of the building appears to be reasonable ~~a good assumption~~ based upon a cursory examination of the drawings, but this assumption will be verified in an engineering sense in the reverification study.

3.3.2.4.3 Buried Pipelines

The buried pipelines connecting the Intake Structure to the Turbine Building were qualified by PGandE with input from URS/

Blume. PGandE's qualification work was independently checked by Harding-Lawson Associates, using input from URS/Blume (See Appendix 7). The input used in the above two studies will be verified in the overall reverification program.

### 3.3.3 Turbine Building

The Turbine Building was originally designated a seismic Design Class II structure and designed on the basis of a minimum horizontal seismic coefficient of 0.2 g. The structure was later analyzed for the double design earthquake (DDE) and was found to require minor structural mofification. This is presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Earthquake Analysis Turbine Building, Unit 1", dated July, 1970 (Reference 2).

Because the building contains some design Class I equipment and because it is in close proximity to the Class I Auxiliary Building, it was necessary to show that under the postulated 7.5 M Hosgri motions the building would not have a failure which would impair either the Class I equipment contained in the Turbine Building or the Class I Auxiliary Building. For this reason, the Turbine Building was investigated for the Hosgri inputs. This resulted in major strucutral modifications, which are given in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Unit 1, Turbine Building Evaluation and Structural Modification for the 7.5 M. Hosgri EArthquake", March, 1980 (Refernece 3).

The following sections address the interface issue between PGandE, URS/Blume, and Equipment Suppliers and ~~Qualifiers~~ Consultants for the Turbine Building.

#### 3.3.3.1 Design Information from PGandE to URS/Blume

The original design and analysis, including the generation of drawings of the Turbine Building, were done by URS/Blume. Following the Hosgri requirement to re-evaluate the Turbine Building in 1977, URS/Blume performed the analysis and re-evaluation. Design changes and drawings were

generated by PGandE from URS/Blume input. These were then checked and verified by URS/Blume. (This is documented in Section 4, Appendix 1.3.)

In the case of the Turbine Building, a large number of transmittals were documented. Appendix 1.3 contains transmittal documentation for the period 1974 to 1979. Relevant design information transmitted is given in Appendix 1.3.

3.3.3.2 Design Information from URS/Blume to PGandE

Appendix 2.3.1 contains transmittal documents from URS/Blume to PGandE. They reference various spectra, design, analysis and test reports and other correspondence of technical nature.

The detail transmittals themselves have not been reviewed and will be a part of the overall reverification work.

3.3.3.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

In the Turbine Building, the major safety related mechanical equipment system, per Hosgri requirement, is the Diesel Generator System. Since PGandE was its own qualifier, no interface between equipment vendor or suppliers was required.

The Diesel Generator System consists of six major components:

1. Diesel Generators
2. Starting Air Receivers
3. Fuel Oil Filter
4. Fuel Oil Priming Tank
5. Fuel Oil Strainer
6. Fuel Oil Transfer Pump

The Mechanical Engineering Central File Index (Appendix 5) was reviewed to check for correct and current seismic inputs in the qualifying documents for the above mentioned components. The specific details of each component is discussed at length in Appendix 3.1.5.

Results of this review show that the Diesel Generator System was conservatively qualified to correct Hosgri seismic input.

3.3.3.4 Qualification of Building and Components

The Turbine Building design qualification responsibilities were divided between URS/Blume and PGandE.

The qualification of major seismic resistant components of the building for the Hosgri evaluation was performed by URS/Blume and specific drawings which reflect the modifications are included in the report entitled "DCNPP, Unit 1 - Turbine Building Evaluation and Structural Modifications for the 7.5 M Hosgri Earthquake", March 1980 (Appendix 2.3.2). PGandE implemented modifications to quali-Q fy the building frames, interior block and concrete walls and anchorage that were not qualified by URS/ Blume. Tables 3.3.1 and 3.3.2 contain the list of

PGandE drawings for these modifications, obtained from conferring with the responsible lead engineer.

The PGandE design review is presented in the report "Hosgri Design Verification - Turbine Building", February, 1980 (Appendix 7).

Since the design review did not verify the interface procedures between URS/Blume, PGandE and the field (Figure 4-10-2, URS/Blume Report on Design Review, Appendix 7), these will be investigated in the overall reverification program.

## TABLE 3.3.1

Drawings prepared by PGandE containing modification information for Structural Frames, Beams and Columns per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463684 | 465135 |
| 465127 | 465136 |
| 465128 | 465137 |
| 465129 | 465138 |
| 465130 | 465139 |
| 465131 | 465140 |
| 465132 | 465141 |
| 465133 | 465142 |
| 465134 | 465143 |

## TABLE 3.3.2

Drawings containing modification information for Equipment Anchorage per Hosgri evaluation for the Turbine Building.

| | |
|---|---|
| 463671 | 463677 |
| 463672 | 463678 |
| 463673 | 463679 |
| 463674 | 463680 |
| 463675 | 463681 |
| 463676 | 463682 |
| | 463683 |

### 3.3.4 Auxiliary/Fuel Handling Buildings

#### 3.3.4.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file (Appendix 4) was searched for the design information transmitted from PGandE to URS/Blume on the Auxiliary/Fuel Handling Buildings during and prior to the Hosgri studies. Specifically, Civil/Structure files No. 9.3, Auxiliary Building, and No. 9.31, Seismic Analysis, were searched thoroughly (Appendix 4). One transmittal issued by PGandE to URS/Blume dated April 16, 1971 was found. In this memo, the steam anchorage drawings of the Auxiliary Building were discussed (Appendix 1.4).

After discussions with the lead engineer of PGandE who was responsible for the seismic analyses of Auxiliary/Fuel Handling Buildings, it was learned that during the DDE analysis, PGandE developed, with the assistance of URS/Blume, computer programs "Dybox-2" and "Shewal-4" to compute the mass and stiffness properties of the mathematical model for the Auxiliary/Fuel Handling Building (Appendix 1.4). The computations by computer were done at PGandE and the output was given to URS/Blume as input to compute the seismic response of the buildings (Appendices 1.4 and 2.4.2 - May 9, 1977, pp. 8 and 9).

The lead engineer of PGandE also stated that for the Hosgri criteria, the original data (for DDE analysis) used as an input for Dybox-2 was checked against the as-built conditions. The results of this check confirmed that there were no changes in the concrete dimensions. Consequently, the DDE model was used

in the Hosgri study (Appendix 1.4). The same statements were found in the URS/Blume Report of May 9, 1977 (Appendix 2.4.2).

However, an examination of some telecon records (from 3/9/77 to 3/24/77, Appendix 1.4) kept in URS/Blume's file reveals that there were discussions on discrepancy of weights computed by PGandE in the E-W and N-S directions for the DDE model, and a difference of 35% in the weight at Elevation 140', computed by PGandE for the DDE model and URS/Blume's computation in March 1977.

An average weight of weights in the E-W and N-S directions and the weight of DDE model at Elevation 140' were finally used in the Hosgri analysis, with no explanations as to how the weight difference was resolved. A detailed examination of the above will be performed in the overall reverification program.

3.3.4.2 Design Information from URS/Blume to PGandE

The flow of information from URS/Blume to PGandE on the Auxiliary Building is documented in Appendix 2.4.

Preliminary Hosgri spectra were issued by URS/Blume prior to the issuance of the May 9, 1977 (May 11, 1977 transmittal) Hosgri Final Report (Appendix 2.4.2).

During the qualification of the Auxiliary Building it was decided to make a separate more detailed finite element model of the control room due to its importance. This model is the basis for the control room qualification (Appendix 2.4.2). Since the final control room spectra are higher than the preliminary

spectra, a detailed review of equipment qualification will be performed in the final program to be sure the preliminary spectra were not used.

Spectra transmittals after May 11, 1977 provide additional, but not different, information.

3.3.4.3 Design Information from PGandE to Equipment Suppliers and Qualifiers

Seismic qualification of major mechanical equipment is addressed in Section 3.3.4.4.2. Seismic qualification of other equipment and systems is addressed in Section 3.3.7.

3.3.4.4 Qualification of Buildings and Equipment

3.3.4.4.1 Buildings

The statement by the responsible engineer at PGandE in Appendix 1.4 confirmed that the structural evaluation of the Auxiliary Building was done based on the output from URS/Blume's 7.5 M Hosgri seismic analysis. No effort has been spent, because of time constraints, to spot-check the building qualification details. In the full length verification study, seismic input loads used for building verification report dated 1974, of the Auxiliary Building is in PGandE's Civil Engineering file (Appendix 7). The design verification report has an attached note indicating revision for Hosgri. This will be investigated further in the Reverification Program.

3.3.4.4.2 Equipment

The major equipment of the Auxiliary Building was qualified ~~either~~ by ~~Westinghouse and~~ PGandE or reviewed by Westinghouse. Table 3.3.5.4 summarizes the qualification of mechanical equipment in the Auxiliary Building. The detailed information on this equipment qualification is given in Appendix 3.1.4.

## 3.3.5 Cranes

### 3.3.5.1 Containment Structure Cranes

There are two cranes in the Containment Structure that required seismic evaluation per 7.5 M Hosgri specification. These are the Polar crane and the Dome Crane. A brief discussion of the two cranes is given in the following sections.

Service

#### 3.3.5.1.1 Containment Polar Crane

The Containment Polar Crane is a gantry crane with trolleys and consists primarily of welded structural steel members and full moment resisting bolted connection. Results of a 3-D non-linear seismic analysis are presented in the URS/Blume report, "Diablo Canyon Nuclear Power Plant, Containment Polar Cranes Evaluation for the 7.5 M Hosgri Earthquake", dated Jly 1979 (Appendix 2.5.2).

The drawings and other design information utilized for the modeling of the cranes are not referenced in the report. Nor are there any transmittals documenting the transfer of these from PGandE to URS/Blume.

At present the only documentation that substantiates the above mentioned report are the calculations (Appendix 2.5.2). These documents basically reflect that the design review was completed by URS/Blume and that the results concluced are valid. The drawings included in the Appendix of the July 1979 report were checked against the

model in the report (Appendix 2.5.2). This preliminary review shows that the information was transformed correctly from the drawings to the model.

3.3.5.1.2 Dome Crane

The dome service crane is a maintenance crane located on top of the polar crane. PGandE was in the process of designing modification to comply with the 7.5 M Hosgri Evaluation. As of May 5, 1981, PGandE halted this process and is presently considering retaining a consultant to evaluate the consequences of assumed failure. This is documented in the letter dated May 5, 1981 given in Appendix 1.5. The documentation of seismic qualification of this crane for the Hosgri requirement was not found in the current effort. It will be verified in the overall re-verification program.

3.3.5.2 Intake Structure Crane

3.3.5.2.1 Design Information from PGandE to URS/Blume

Some design information for the seismic analysis of Intake Structure Crane was transmitted from PGandE to URS/Blume on 1/18/79, More design information for crane, trolley assembly and frames were respectively transmitted on 12/21/78 and 1/24/79. In February 1979, field measurement of Intake Structure crane was performed (Appendix 1.5).

3.3.5.2.2 Design Information from URS/Blume to PGandE

URS/Blume requested field measurement and transmitted SK-1-12-9 on 1/23/79. The crane hoist engineering drawings were found to be transmitted on 3/5/79. The final seismic analyses report entitled "DCNPP - Intake Structure Crane Evaluation for the 7.5 M Hosgri Earthquake", November 1979, was transmitted on 11/28/79 and documents the seismic design qualification information for this crane (Appendix 2.5).

3.3.5.2.3 Qualification of Intake Structure Crane

A quick review of the final report listed in Section 3.3.5.2.2 found many suggested design modifications. They are: the installation of a seismic hold-down and lateral restraint mechanism, and minor structural modifications to transmit horizontal forces from crane legs to truck and then to the rail. These modifications to design drawings were made by URS/Blume and were also reported in the above report. The modifications to construction drawings were jointly made by PGandE and URS/Blume. However, spot checks need to be made to insure that modifications to construction drawings were properly done.

3.3.5.3 Turbine Building Crane

3.3.5.3.1 Design Information from PGandE to URS/Blume
In the case of the Turbine Building Crane, a formal transmittal of drawings and equipment weights was done on 7/22/75. The transmittal documentation giving the drawing number is listed in Section 1 of Appendix 1.5. Besides this design information, no other transmittals were found.

3.3.5.3.2 Design Information from URS/Blume to PGandE
The final report entitled "Diablo Canyon Nuclear Power Plant - Turbine Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)", November 1979, presents the design information required to modify the crane for the Hosgri criteria (Reference 3).

3.3.5.3.3 Qualification of Turbine Building Crane
The qualification of Turbine Building crane was jointly performed by PGandE and URS/Blume. Based upon design information presented in 3.3.5.3.2 above, URS/Blume modified the crane design to provdie tiedown of the crane trolley to the bridge girder and lateral seismic restraint to distribute the lateral seismic loads to both horizontal crane support girders (described in the Hosgri report given in 3.3.5.3.2 above). PGandE and URS/Blume subsequently jointly revised the crane construction drawings. However, spot checks need to be made to insure that modifications to construction drawings were properly implemented.

3.3.5.4 Fuel Handling Building Crane

3.3.5.4.1 Design Information from PGandE to URS/Blume
Very little documentation was found in PGandE's file on design information transmitted to URS/Blume. Based upon the recollection of the lead engineer for the seismic analysis of fuel handling crane (Appendix 1.5), the latest revisions of crane manufacturer's drawings, original calculations, and material properties of crane were transmitted to URS/Blume. As is the case for some of the other structures, the information was passed on in an informal basis. However, there is no record of URS/Blume's correspondence file on crane which shows that URS/Blume received such information. Some spot checks need to be made to check the accuracy of design information transmitted.

3.3.5.4.2 Design Information from URS/Blume to PGandE
The final report entitled "Diablo Canyon Nuclear Power Plant - Fuel Handling Building Crane Evaluation for the 7.5 M Hosgri Earthquake (Revised)" was issued on 9/6/79 (Reference 4). Several minor structural modifications to the existing crane structural system were reported in order to prevent eccentric loading of the crane runway and excessive loading on the trolley axis.

3.3.5.4.3 Qualification of Fuel-Handling Building Crane
The qualification of fuel-handling building crane to satisfy Hosgri criteria was jointly performed by PGandE and URS/Blume. URS/Blume prepared design modifications per Hosgri report for this crane. PGandE and URS/Blume jointly revised the

subject crane construction drawings. Some spot checks will be made to insure that these modifications were properly done.

### 3.3.6 Outdoor Water Storage Tanks

#### 3.3.6.1 Design Information from PGandE to URS/Blume

PGandE's Civil/Structure file was searched for the design information transmitted from PGandE to URS/Blume (Appendix 4). No relevant transmittals were found.

After talking to the lead engineer of PGandE who was responsible for the seismic analysis of outdoor water storage tanks, it was learned that the seismic analyses of these tanks started in March 1977. PGandE and URS/Blume engineers worked closely as a team and the information between PGandE and URS/Blume was exchanged on a person to person basis in meetings, telephone calls, etc. (Appendix 1.6.)

An examination of telecon records kept in URS/Blume's file (Appendix 1.6) confirms the statement described above by the lead engineer of PGandE. Some design information transmitted between URS/Blume and Harding-Lawson on soil data and stability of tanks was also found in URS/Blume's telecon records. The design information was found to be transmitted informally. Some checks are required in the overall reverification program to insure its accuracy.

#### 3.3.6.2 Design Information from URS/Blume to PGandE

The final seismic analyses were completed in March 1979 and the design information transmitted on March 26, 1979 (Reference 5). Because the tank modifications were being carried out in the field at the same time as the analyses were being performed, nu-

merous revisions were made to PGandE drawings to incorporate URS/Blume's findings. The above report, therefore, reflects the actual configuration and field condition of the tanks (Appendix 1.6). Although a team effort existed between PGandE and URS/Blume in transmitting the design information, some checks need to be made to determine the accuracy of the information transferred.

3.3.6.3 Qualification of Tanks

qualified by

The tanks were ~~qualified jointly~~ analyzed by URS/Blume and PGandE, using Hosgri criteria as they worked together. URS/Blume's Hosgri report (March 1979) documents the modifications (Reference 5). The outdoor water storage tanks and components were subsequently concluded to meet the Hosgri seismic requirement (PGandE's design verification report for outdoor water storage tanks, dated 9/21/79 (Appendix 7).

### 3.3.7 General Equipment and Systems

A significant portion of the scope of this report is to review the interfaces between PGandE and various equipment suppliers and qualifiers. For most equipment, the practical way to check this interface is to examine the end result, the actual seismic qualification and note whether the current applicable Hosgri response spectra curves were used.

The mechanical equipment seismic qualifications are reviewed in the section addressing the individual buildings and will be not included here. This section will deal primarily with the review of seismic qualification of the following equipment and systems.

1. Piping Systems
2. Valves
3. HVAC Components
4. HVAC Ducting
5. Electrical Equipment & Instrumentation
6. Electrical Systems - Raceways and Conduits

### 3.3.7.1 Piping Systems

This section of the report will address the transmittal of seismic design information from PGandE to consultants engaged in analysis of piping systems and supports.

As was noted in a summary by the PGandE Piping Group, the piping analysis was assigned to consultants URS/Blume and Earthquake Engineering Systems (EES). Similarly for support evaluation, URS/Blume, EES, and EDS Nuclear, Inc. were used as the primary consultants.

table giving seismic factors a function hanger spacing

For support evaluation the seismic design input consists of either a spacing table with seismic factors or the actual support force output from a piping analysis computer model. PGandE uses a design guide publication for the seismic factors which they transmit to the consultants. This will be a significant interface to examine. For instances where piping computer analysis output is used for design, then the valve qualification is totally dependent on the design input to the piping analysis.

The transmittals for piping analyses appear to be in complete form for documents sent to EES. The only problem is that the transmittal cover sheet does not list the contents of the entire attachment. The transmittal might only read problem number and "appropriate spectra attached". To trace the flow of information it will be necessary to find the contents of the transmittals. This task may be accomplished by further examination of PGandE files or perhaps by examining EES files.

For the scope of piping assigned to URS/Blume, very little correspondence was located during the time frame

of Unit 1 piping analyses. However, URS/Blume has not yet been contacted to provide any transmittals they may have sent or received. This will be implemented for the long term reverification effort.

### 3.3.7.2 VALVES

A preliminary review was performed on seismic design information transferred across interfaces between PGandE and valve ~~qualifiers~~. This review addresses the safety related valves that required seismic requalification to meet the Hosgri requirements.

Testing organizations

The valves reviewed consist of the minimum required active valves for hot shutdown and/or cold shutdown and the valves required in case of a single failure. The containment purge valves are addressed in Section 3.3.1.3.

The valves reviewed are listed in Tables 7-3A,B and 7-7, 7-7A of the Hosgri Seismic Re-evaluation Report (Reference 6). Copies of these tables are contained in Appendix 3.2.

#### 3.3.7.2.1 Definition of Interfaces

A number of PGandE and contractor interfaces existed. Review of available documentation to date shows that the primary interfaces for valve requalification were:

PGandE → EES → PGandE for piping analysis
PGandE → EDS → PGandE for valve qualification
PGandE → Westinghouse → PGandE for valve qualification

where EES ---- Earthquake Engineering Systems, Inc.
EDS ---- EDS Nuclear Inc.
Westinghouse -- Westinghouse Electric Corp.

EES, using data proveded by PGandE, produced computer models of piping systems. Computer analyses were then performed to determine the dynamic characteristics of the piping system under earthquake loading. Results were then returned to PGandE.

Earthquake loading was determined from acceleration response spectra provided by PGandE to EES.

PGandE transferred the relavant results of the completed piping analyses, valve accelerations, and pipe loading to EDS and Westinghouse. EDS and Westinghouse then proved that the valve meets certain criteria under the given loading conditions. This was done by either analysis or testing. Results were then returned to PGandE.

3.3.7.2.2 Transmittals Between EES and PGandE

No documentation has been found concerning transmittals of information from PGandE to EES at this point in time. A search for this documentation is being continued.

Some records of EES transmittals to PGandE have been found to date. A complete set of EES transmittals to PGandE has not been compiled yet.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.3 Transmittals Between EDS and PGandE

A limited amount of documentation of information transfer from PGandE to EDS has been found to date. Complete documentation of requalification information for the valves being reviewed here has not been compiled at this point in time.

Some records of results sent by EDS to PGandE have been located. A complete set of EDS transmittals to PGandE for the valves being reviewed has not been compiled as of this date.

Copies of transmittals located thus far are located in Appendix 3.2.2.

3.3.7.2.4 Transmittals Between Westinghouse and PGandE

Some information on PGandE transmittals to Westinghouse has been located in PGandE files. However, insufficient records have been found to fully document information flow from PGandE to Westinghouse.

See Jim McAuliffe for help on this!

The only evidence of information returned from Westinghouse to PGandE found to date is a Westinghouse document containing valve seismic qualification forms submitted to the NRC. A copy of this document was sent to PGandE.

Documentation of transmittals between Westinghouse and PGandE located to date are contained in Appendix 3.2.2.

### 3.3.7.2.5 Reverification Effort

For valves on flexible piping systems, the acceleration response of the pipe must be known in order to obtain the valve accelerations, and to derive the pipe loadings on the valves. This is a result obtained from the piping analyses. Therefore, the validity of a valve qualification depends on information transferred two steps earlier: from PGandE to the piping analyst and from the return of the analysis results from the piping analyst to PGandE.

With the documentation available to date, no evidence was found to indicate whether the valve accelerations have ever been verified as being correct before being transmitted to the valve qualifiers.

To perform a thorough review of the information transferred across interfaces, the following procedure will be followed on a sampling basis:

1. Locate and examine documentation of correct Hosgri spectra transmitted to piping analysts.

2. Locate and review transmittals of piping analysis results to PGandE, particularly valve accelerations. The accuracy of the piping model is also to be checked.

3. Locate and review transmittals of valve accelerations from PGandE to valve ~~qualifiers~~. testing organizations.

4. Cross check data returned to PGandE from piping analysts with data transmitted out of PGandE to the valve ~~qualifiers~~. testing organizations.

3.3.7.3 HVAC Components

An independent engineering review of the seismic qualification was performed for the Safety Related HVAC equipment (References 7 and 8) by EDS Nuclear, Inc.

This EDS review concluded that the majority of the HVAC equipment is seismically qualified to the Hosgri requirement, and that with minor modifications, the remainder will also be.

As part of this interface review, the seismic accelerations that were used as input was checked for correctness. Out of 5 inputs checked, one of them was incorrect.

The field work is given in Appendix 3.3.1. Since the qualification accelerations are larger than the Hosgri accelerations, these particular errors were not of consequence.

3.3.7.4 Heating, Ventilating and Air Conditioning Duct

3.3.7.4.1 The majority of HVAC ducts required for cold shutdown has been qualified by PGandE, with the remainder of the engineering being done by EDS Nuclear. PGandE architects, HVAC engineers, and civil engineers all collaborated on the duct design. Information flow between these groups is documented in Appendix 3.3.2.1.

3.3.7.4.2 The HVAC information in Appendix 3.3.2 was supplied by the responsible PGandE engineer. Containment duct computations could be easily be found. This will be reviewed at a later date.

3.3.7.4.3 A random sampling of the duct qualification calculations was checked for seismic input (Appendix 3.3.2). Six of the twenty-seven HVAC details listed in Appendix 3.2.2.2 were chosen at random. In contrast to the random sampling shown above, all seismic inputs to the Fireproof Ducts were checked against current Hosgri Spectra (Appendix 3.3.2).

3.3.7.4.4 Five HVAC Details have Hosgri accelerations correctly used and one (Detail 4, Drawing 504566) has Hosgri accelerations greater than the value in the calculations. All spectra for the Fireprorfed Ducts were found to be correctly used (Appendix 3.3.2.3).

3.3.7.4.5 One HVAC Detail (Detail 4, Drawing 504566) will be analyzed at a later date.

### 3.3.7.5 Electrical Equipment and Instrumentation

A preliminary review was performed on seismic design information transferred between PGandE and electrical equipment and instrumentation vendors and ~~qualifiers~~. Testers.
This review focuses strictly on design information used in requalifying safety related electrical equipment and instrumentation to meet the Hosgri seismic requirements.

The Hosgri Seismic Re-evaluation Report (Reference 6) was used to derive the list of safety related electrical equipment and instrumentation. A copy of Table 10-1 from the Hosgri Report is included in Appendix 3.4.1. Table 10-1 is a complete list of the safety related electrical equipment and instrumentation.

Although the cable trays are included in Table 10-1, they are reviewed separately and are addressed in Section 3.3.7.6.

#### 3.3.7.5.1 Definition of Interfaces

Westinghouse analyzes, BL+E qualifies

The responsibility for electrical equipment and instrumentation seismic qualification was divided between PGandE and Westinghouse. Westinghouse was responsible for qualifying Westinghouse supplied NSSS equipment. The remaining electrical equipment and instrumentation was qualified by PGandE.

The interface between PGandE and Westinghouse allowed PGandE to send Hosgri spectra information to Westinghouse, and for Westinghouse to send the results back to PGandE.

Of the PGandE qualified equipment, it was qualified by PG&E either ~~by~~ analysis or by testing at Wyle Laboratories.

after

The Wyle Labs and PGandE interface allowed PGandE and Wyle Labs to exchange information regarding Hosgri spectra, test spectra and test procedures. Also, Wyle transmitted test results back to PGandE across this interface.

3.3.7.5.2 Transmittals from PGandE to Westinghouse

No documentation has been found in the current work regarding the transmittal of information from PGandE to Westinghouse.

3.3.7.5.3 Transmittals from Westinghouse to PGandE

The only evidence of transmittals from Westinghouse to PGandE encountered to date is the existence in the PGandE files of the Westinghouse report "Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri". (Reference 9).

3.3.7.5.4 Transmittals from PGandE to Wyle Labs

No documentation has been found to date regarding the transmittal of spectra or test procedure information from PGandE to Wyle Labs.

3.3.7.5.5 Transmittals from Wyle Labs to PGandE

The only transmittals from Wyle Labs to PGandE found thus far are Wyle Labs test reports and test procedures. Two of these that were examined are Wyle Labs Test Procedure No. 3642 and Test Report No. 58255 (Reference 10).

### 3.3.7.5.6 Transmittals Regarding Requalification by Analysis

No documentation has been found to date regarding requalification of electrical equipment or instrumentation by analysis, by either PGandE or other Parties.

### 3.3.7.5.7 Westinghouse Requalification

Review of the Westinghouse report, "Summary Report on Seismic Evaluation for Postulated 7.5 M. Hosgri", (Reference 9) showed that Westinghouse electrical equipment and instrumentation was requalified for Hosgri requirements by applying certain criteria to previously performed tests and analyses.

The test spectra used in the previous tests are included in Appendix 3.4. These are identical to Figures 10-2 to 10-12 in the Hosgri report. The Westinghouse report states that the 5-9-77 spectra were used and that the Blume and Newmark spectra were enveloped.

The report also states that the vertical spectra used were taken as 2/3 of the horizontal spectra. However, in a conversation with the cognizant engineer from Westinghouse, he states that specific vertical Hosgri spectra were used in the requalification of each item of equipment. The engineer also stated that the vertical spectra for control room equipment were selected with consideration for the node point closest to the equipment location.

Requalification was performed by Westinghouse by

comparing the applicable Hosgri spectra to test spectra used in the initial pre-Hosgri qualification. The positive results of this comparison were communicated to PGandE by Westinghouse in Westinghouse Project Letter PGE-4231, Revision 1, dated September 5, 1980 sent to D. V. Kelly (Reference 12).

3.3.7.5.8. Wyle Requalification Tests

Though no documented transmittals from PGandE to Wyle have been found to date, there is evidence that Wyle test procedures were reviewed and approved by PGandE personnel:

1. A PGandE memo, dated 11-9-77, from O. Steinhardt contains comments on test spectra contained in Wyle Test Report No. 26286.

2. Wyle Test Procedure No. 3642, dated 11-30-77, is signed and approved by PGandE personnel.

Documentation on these two items is contained in Appendix 3.4.

PGandE internal memorandum indicate that General Electric was involved in Wyle Labs requalification tests of the 4.16kV Vital Switchgear (Appendix 3.4). Further investigation will be required to determine General Electric's role on requalification. If necessary, information transmittals across that interface will be examined.

3.3.7.5.9 Requalification by Analysis

For equipment requalified by analysis, as indicated by note 5 in Table 10-1 of the Hosgri report, no information has been found to date as to who had performed these analyses. Investigation in this area will be continued.

3.3.7.5.10 Preliminary Review of Electrical Equipment

A preliminary review of requalification of electrical equipment and instrumentation was conducted by checking a 50% sample of Zero Period Accelerations (ZPA's) from the Hosgri Evaluation listed in Table 10-1 of the Hosgri report.

The Hosgri ZPA's listed were cross checked against the ZPA's of the applicable up-to-date Hosgri spectra. The Hosgri ZPA's in Table 10-1 were found to be correct.

In each case, the ZPA levels used to qualify each item of equipment, as listed in Table 10-1, were greater than the Hosgri required ZPA's.

3.3.7.5.11 Reverification Approach

Should further investigation fail to uncover records that satisfactorily document the transfer of seismic requalification information between PGandE and qualifiers the following procedure will be undertaken: Consultants

1. Actual test spectra used in requalification tests will be examined. They will be checked

to see if they envelop the applicable Hosgri spectra.

2. Requalification analyses will be examined to check if the applicable seismic information was applied. In addition, the analysis criteria used for qualification, if applicable, will be examined.

3.3.7.6 Electrical Raceways

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3.3.7.6.1 The supports for the Electrical Raceways are found indiscriminately throughout the main buildings. With in excess of six hundred unique types of support details.

The PGandE Civil Engineer responsible for electrical Raceways provided the qualification documentation.. Each support detail is qualified to the Hosgri by simplified computation. Each Detail is assumed to span a maximum of eight feet.

3.3.7.6.2 With such a large volume of material, a random sampling approach was employed. The Hosgri seismic accelerations were checked for ten support details (Appendix 3.4.2.3). In addition the program employed in September 1981 by PGandE to requalify the raceways in the Annulus section of Containment was checked. The Annulus region was closely examined for the following three reasons:

No transmittals of Annulus drawings from PGandE to URS/Blume were located and URS/Blume does not, at present, have the drawings. Preliminary spectra differing from the 5/9/77 spectra was issued for Containment. Different spectra (7/21/77) superceding the 5/9/77 Hosgri Report was issued. (Appendix 2.1.2).

Seven of the ten calculations checked (S86, S93, S166, S251, S370, S415, S432) did not use correct seismic accelerations for 4% damping.

The bolted cable trays can take advantage of 7% damping for the Safe Shutdown Earthquake (Regu-

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latory Guide 161, Appendix 3.4.2.3). The Hosgri spectra for most locations lists only 2%, 3%, and 4% damping. Possibly the incorrect accelerations resulted from interpolations of the 4% Hosgri spectra. Detail S415 used Hosgri spectra issued before May 9, 1977.

PGandE's Electrical Raceway Seismic Requalification Program for Unit 1 (Appendices 3.4.2.2, Item 1) was also checked (Appendix 3.4.2.3, Item 2) using the same Raceway Details as above. Four of the ten calculations examined were incorrectly noted on the check list (Appendix 3.4.2.2, Item 1).

3.3.7.6.3 In summary, two of the ten Raceway Details (S414, S432) were stressed above the allowable factor of safety (Appendix 3.4.2.3, Item 3). Two additional Raceway Details (S93, S147) show no requalification after the Hosgri spectra were issued on May 9, 1977.

D.Scritz

Jim

SUMMARY AND ~~CONCLUSIONS~~

This report has been prepared in response to the ~~NRC~~ PG+E request for a preliminary report on the PGandE Hosgri Reverification Program. As requested, it covers a review of the applicability of seismic design and qualification information for the Hosgri earthquake that may be considered to be associated with design interface between PGandE and URS Blume. As illustrated in Figure 3.1, the design applicability was reviewed for the entire seismic chain beginning with basic plant design information developed at PGandE, through the URS/Blume interface, then back to PGandE and on to the equipment ~~qualifiers~~ testing consultants.

In this preliminary report, the goal was to review applicability of all major design issues and identify all detailed equipment qualifications for later review, although a certain level of ~~sample checking~~ random sampling was performed. To accomplish the basic objective, the review was performed on a building by building basis. The findings by building are reported below.

Not always the case. HVAC

Containment

The Hosgri evaluation was performed using the original models for the DDE evaluation based upon 1970 drawings. These drawings were reviewed against current revisions. No changes were sufficient to require re-modeling. There were few formal transmittals from PGandE to URS/ Blume in the early time period, because engineers from the two organizations were working together as though in one organization.

Buildings

?

The annulus area lacked formal transmittals and was found to have been modeled using the Unit 2 configuration, as was known.

With the exception of the annulus, the containment building models were based upon applicable drawings.

URS/Blume performed the seismic analysis of the containment building and supplied several well documented reports to PGandE.

PGandE received the well documented seismic results from URS/Blume. Building response spectra were supplied to equipment suppliers to permit equipment qualification. The applicability of the design information for the following major equipment was verified:

Reactor Coolant System (RV, SG, PCP, Piping)
Hydrogen Recombiner
Containment Purge Valves
Regenerative Heat Exchangers
Containment Fan Coolers

Other equipment is discussed subsequently.

Intake Structure

The seismic analysis of the Intake Structure was based upon information contained in a transmittal from PGandE in 1976. This transmittal was examined. URS/Blume issued a report on the seismic analysis of the Intake Structure in April 1977. After modifications, it was finalized in 1979. The drawings used to prepare the model were outdated, but building revisions were minor and did not affect the analysis.

The qualification of auxiliary salt water pumps was based upon the ground level motion, which considers the building to be rigid. Dur to the low elevation of

pumps within the building itself, this is considered a sound assumption. Nevertheless, it will be checked in the reverification effort.

Turbine Building

There was no design interface between PGandE and URS/Blume in the initial aspect of the design and qualification because URS/Blume had design responsibility for the building. Although URS/Blume designed the building, the drawings were prepared by PGandE Design Drafting.

The building had to be modified to qualify it for the Hosgri earthquake. All relevant drawings have been obtained, and a complete design verification effort completed by PGandE was documented. The in-depth verification was left to the final program since this building is less important than certain others.

The diesel generator, including the fuel system and starting air reviewers, was reviewed. The correct seismic input information was used for this safety related equipment.

Auxiliary/Fuel Handling Building

The Hosgri requalification of the Auxiliary Building was performed with the same models used in the earlier DDE analysis. This model was developed jointly by PGandE and URS/Blume using specialized computer programs for computing building properties. Reports of reviews of building properties and configurations were noted prior to initiation of the Hosgri analysis. The applicable drawings were used and referenced in the building analysis. Records of discussions on model properties, however, suggests that limited checks on

mass and stiffness should be made in the verification study.

In addition, a separate refined finite element analysis was used for the control room. Spectra from this refined analysis which were higher than the preliminary spectra were used for qualification (mainly by Westinghouse) of control room equipment.

Cranes

For most of the cranes, the design information was provided to URS/Blume on an informal basis. For each of the major cranes in the plant, URS/Blume issued a complete design report. In addition, a design review was completed by URS/Blume for the Containment Polar Crane. These are positive findings, however, in some cases the qualification report does not have a complete record of drawings upon which models were based.

Also during the Hosgri requalification, some of the cranes were modified with the addition of holddowns, lateral restraints, etc. Additional checks to ensure analysis reflected the as modified drawings would be beneficial.

Outdoor Water Storage Tanks

The information transmittal from PGandE to URS/Blume for qualification of the outdoor tanks was done on an informal basis since the two organizations were working together as a team. Substantial modifications were made to these tanks in the course of the Hosgri requalifications. Indirect interfaces existed in the analysis of these tanks via Harding-Lawson, soil consultants,

since one of the modifications was to dig out under the tank foundation and strengthen this structure. Communications were informal in many cases. ~~Based upon the information that has been reviewed, there is no reason for concern.~~ However, this area will be reviewed in much more detail in the final program because there was an indirect interface and because of ~~information~~ informal communications.

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5.0 CONCLUSION don't underline

In the course of this preliminary work a great deal of material has been examined. A certain amount of assurance has been established that there are no additional explicit errors, and several areas have been found that suggest more detailed review in the reverification effort.

As discussed at the outset, this review was conducted on the engineering material itself. The present findings and conclusions are independent of the normal convolutions of the design process, and whether work was done formally or informally, with the exception of course that informal transmittals, etc. require additional verification of the end product.

The analysis of the major buildings in the plant were based upon drawings that represent the correct building configuration, even though in many cases drawings were revised after the analysis was complete. The major items of safety related equipment in the Containment Building were qualified with correct response spectra. The Containment Building and Intake Structure were scrutinized in more depth than the other buildings. The ~~Inlet~~ Intake Structure and the safety related auxiliary pumps were qualified using applicable drawings and

spectra.

As with any review of any design project, some errors and some mistakes real or apparent will be found. In the present limited effort certain such findings arose. In one case, an item of HVAC equipment was qualified with the wrong spectra. The reviewer compared it to the correct spectra and found it was satisfactory in view of a large safety factor.

The documentation on the unistrut design details were misleading to the reviewer and one or two conduit supports appeared to be qualified with the wrong spectra. These will be reviewed thoroughly in the final report, but it is expected that resolutions will result, since deeper inquiry did produce resolutions in other cases.

In conclusion, the limited review performed to date showed explicitly that the reactor coolant system and other major equipment were qualified using correct design information and no information has come to light thus far that calls the safety of the plant into question. Some areas have been found where further review is indicated, primarily because of a lack of ready documentation of the applicability of the design information.

# 6.0 REFERENCE ~~LIST~~


1. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure - Finite Element Method Dynamic Seismic Analysis (URS/Blume, July 1970)

2. Diablo Canyon Nuclear Power Plant, Earthquake Analysis, Turbine Building, Unit 1 (URS/Blume, July 1970)

3. Diablo Canyon Nuclear Power Plant - Turbine Building crane evaluation for the 7.5 M Hosgri Earthquake (revised) November 1979.

4. Diablo Canyon Nuclear Power Plant - Fuel Handling Building crane Evaluation for the 7.5 M Hosgri Earthquake. (revised) September 6, 1979.

5. Diablo Canyon Nuclear Power Plant - Units 1 and 2 - Outdoor Water Storage Tanks - Dynamic Seismic Analyses for the 7.5 M Hosgri criteria (revised), March 1979.

6. Seismic Evaluation for Postulated 7.5 Hosgri Earthquake - Units 1 and 2 - Diablo Canyon Site - PGandE.

7. "Engineering Review of Hosgri Seismic Qualification of Design Class 1 HVAC Equipment", EDS Nuclear Inc. February 22, 1979.

8. "Diablo Canyon Nuclear Plant, Seismic Qualification of HVAC Equipment", EDS Nuclear Inc., August 24, 1979.

9. Summary Report on Seismic Evaluation for Postulated 7.5 M Hosgri.

10. Wyle Labs Test Procedures No. 3642, and Test Report No. 58255.

11. Diablo Canyon Nuclear Power Plant, Unit No. 1, Containment Structure, Dynamic Seismic Analysis for the 7.5 M Hosgri Earthquake; (URS/Blume, May 1979).

12. Westinghouse Project Letter PGE-4231, Revision 1, September 5, 1980 to D. V. Kelly.