PROGRAM MANAGER'S PREFACE

DIABLO CANYON NUCLEAR POWER PLANT - UNIT 1
INDEPENDENT DESIGN VERIFICATION PROGRAM

INTERIM TECHNICAL REPORT
IDVP VERIFICATION OF CORRECTIVE ACTION FOR EQUIPMENT

This Interim Technical Report, ITR-67, is one of a series of ITRs prepared by the DCNPP - IDVP for the purpose of providing a conclusion to the program.

This report summarizes the IDVP-verification of the DCP corrective action to qualify equipment for both seismic and non-seismic loads. The equipment category includes tanks, filters, HVAC components, heat exchangers, pumps, valves, and electrical equipment. The IDVP verification results in this ITR will be reported in Section 4.6 and 4.9 of the IDVP Final Report.

As IDVP Program Manager, Teledyne Engineering Services has reviewed and approved this Interim Technical Report as well as the verification process and results reported therein. The methodology followed by TES in performing this review and evaluation is described in Appendix D of this report.

ITR Reviewed and Approved
IDVP Program Manager
Teledyne Engineering Services

W. E. Cooper
Project Manager

DIABLO CANYON UNIT 1
IDVP VERIFICATION OF CORRECTIVE ACTION

EQUIPMENT

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1.0 INTRODUCTION

Purpose and Scope

This interim technical report summarizes the Independent Design Verification Program (IDVP) verification of Diablo Canyon Project (DCP) corrective action for equipment performed at the Diablo Canyon Nuclear Power Plant, Unit 1 (DCNPP-1). The IDVP verification work described in this interim technical report (ITR) is defined in ITRs #8 and #35 (References 1 and 2). The equipment category includes tanks, filters, HVAC components, heat exchangers, pumps, valves, and electrical and instrumentation components. The equipment verified by the IDVP is PGandE Design Class 1 equipment.

The Corrective Action Program (CAP) is defined in the PGandE Phase I Final Report, as a "broad review" which "envelopes the various findings of the previous IDVP and ITP reviews, and provides proper corrective action to all open items found by the previous reviews." The program was intended to "provide more complete and consistent documentation of the design work, with all new work performed" (Reference 3, p. 1.5.2-2). For equipment, the CAP was to include "Review of all safety related mechanical, electrical, instrumentation and control equipment ...to assure their seismic qualification to the current seismic response spectra" (Reference 3, p. 1.5.1-4).

The IDVP verification of this work is defined in ITR #8, Verification Program for PGandE Corrective Action, supplemented by ITR #35 regarding non-Hosgri aspects. In summary, the IDVP verification of the CAP for equipment consists of verifying the scope and methodology of the DCP work plan, and the adequacy and completeness of DCP's performance of reanalysis and corrective actions according to the planned scope.

This verification covers only the structural aspects of this equipment and its compliance with structural criteria in the licensing commitments. Functional aspects and operability are included insofar as seismic design conditions and loading combinations affect the equipment.

This report is one of many interim technical reports of the IDVP. Interim technical reports include references, sample definitions and descriptions, methodology, a listing of Error and Open Item Reports, concerns, and a conclusion (Reference 4). This document will be referenced in the IDVP Phase I Final Report (Reference 5) and serves as a vehicle for NRC review.

Summary

The IDVP verification of the DCP corrective action for equipment has been completed for tanks, filters, HVAC components, and shake table tested equipment. Verification of heat exchangers, pumps and valves is not complete pending resolution of two technical issues. Verification of electrical equipment by analysis is pending resolution of EOI 1128. EOI reports issued to date have been noted.

Conclusions based on the verification completed to date are presented. IDVP verification shows that the DCP corrective action work for equipment is satisfactory in the categories where IDVP verification is complete.

2.0 IDVP METHODS

2.1 PROCEDURES

2.1.1 IDVP Review of DCP Plan and Methodology

The scope of work being performed by the DCP is described in the PGandE Phase I Final Report, which includes lists of equipment reviewed as part of the Corrective Action Program.

The IDVP reviewed the scope of the DCP work against the licensing commitments contained in the FSAR, Hosgri Report (References 7 and 8) and other licensing documents.

The IDVP verified the DCP methodology and implementation through review of the actual DCP work. Samples of DCP corrective action work were selected. These samples were reviewed and verified against both licensing criteria and the DCP plan described in the PGandE Phase I Final Report. This IDVP review was carried out in accordance with ITRs #8 and #35.

The separate steps in the IDVP review process are described in the following sections.

2.1.1 Sampling

Sample calculation packages for the various equipment categories were selected for IDVP review as specified and defined in ITR #35. To ensure broader coverage and permit a larger total number of samples, items were selected that were not included in previous IDVP Phase I work.

In many categories, the breadth of the initial sample, and in some cases additional verification work, combined with the CAP review sample allowed extensive coverage of the total number of equipment items.

The sample selected and a discussion of coverage of the equipment category is presented in the individual sections for each category.

2.1.3 Design Reviews

The IDVP performed design reviews for each of the sample DCP analysis packages selected. A design review checklist was developed after examining sample packages and determining the basic approach, type of analysis and the applicable criteria. This checklist covered all required criteria and ensured completeness of the IDVP review. Two sample checklists are presented in Appendix B. The first checklist applies to equipment qualified by analysis, and the second checklist applies to equipment qualified by test. For the review, the checklist was supplemented with assessments of the completeness, applicability, consistency, and adequacy of the DCP review and reanalysis methods and results. Where required, alternate calculations were carried out by the IDVP to verify the conclusions of the DCP reanalysis and/or IDVP assessment. The actual equipment location and configuration was field verified.

EOI reports were issued for findings and observations in accordance with IDVP reporting criteria and procedures (Reference 5). A summary of EOIs issued for equipment and their progress and status is in Appendix A.

2.2 CRITERIA

The IDVP assembled and reviewed the applicable licensing criteria. The major licensing documents used in the IDVP review were:

1. Final Safety Analysis Report for DCNPP (Reference 7)

2. Seismic Evaluation for Postulated 7.5M Earthquake (Hosgri Report - Reference 8).

Ancillary criteria used in the review were ASME Boiler and Pressure Vessel Code, Sections III and VIII, 1974 and 1980 Editions (Reference 9), and the Steel Construction Manual of the American Institute of Steel Construction, 7th and 8th Editions (Reference 10).

3.0 TANKS

3.1 DESCRIPTION

Five types of mechanical tanks were reviewed by the DCP (excluding the outdoor water storage tanks, which are considered civil structures). Three of these five types were verified for Hosgri loadings as part of the IDVP initial sample work (Reference 11). These three are also the only mechanical tanks noted as minimum Class 1 equipment required following the Hosgri event (Reference 8).

Of the two remaining types of tanks, only the CCW surge tank is required to be evaluated for both DE and DDE loadings. The fifth tank, the waste gas decay tank, is required to be evaluated for DE loadings only per USNRC Regulatory Guide 1.143 (References 3, 8, and 12).

The CCW surge tank was therefore selected as the IDVP verification sample of the DCP Corrective Action Program. The tank is a Design Class 1 tank and is located atop the auxiliary building at elevation 163 feet. One CCW surge tank is located in Unit 1.

The CCW surge tank is a horizontal cylindrical tank with semi-elliptical heads. The tank has an overall length of 30 feet, an inner diameter of 8 feet, and a shell thickness of 3/4 inch. The tank is supported on two saddles bolted to the concrete roof slab, and has additional bracing at mid-height from the concrete slab to stiffening rails along the length of both sides of the tank. Fluid level within the tank under normal operating conditions is approximately mid-height. Total weight of the empty tank is 28,000 pounds, and the flooded weight is 117,360 pounds.

3.2 DCP METHODS

The DCP analysis (Reference 13) consisted of application of revised seismic inputs to the original finite element model, and an evaluation of key areas for compliance with designated criteria for design loading conditions (DE, DDE, and Hosgri). The computer code STRUDL was used.

The finite element model geometry and properties were checked, then natural frequencies were calculated. Using these natural frequency results, seismic accelerations for the DDE and Hosgri load cases were determined. DDE accelerations were used for the DE evaluation, since this conservative approach allows one set of calculations to satisfy both load combinations.

Using these accelerations, the seismic inertial loadings on the tank and support structure were determined, conservatively assuming the tank to be full. An equivalent static method was used because the natural frequencies were in the rigid range. Stresses at key areas were calculated and compared to the allowable criteria in DCM M-45 for the load combinations considered (Reference 14). Loads developed from DDE acceleration values were compared against the DE allowables, which are more stringent than the DDE allowables. This approach, which is conservative, reduced the number of calculations required to be performed to satisfy all load combinations. Sloshing loads were not considered because the seismic inertial loads calculated on the basis of a full tank were considered to be greater.

Tank shell stresses at the nozzle junctions due to attached piping loads were evaluated using the Welding Research Council (WRC) Bulletin 107 method (Reference 15).

The DCP analysis found the tank to meet the required criteria.

3.3 IDVP DESIGN REVIEW

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra (References 16, 17, and 18), and design criteria from DCM M-45.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

3.4 RESULTS OF REVIEW

The IDVP review of the CCW surge tank found the seismic spectra used in the analysis to be current for the date of the analysis (Reference 19). Analytical results were judged to be acceptable. Assumptions and techniques used in the mathematical modeling of the tank were also acceptable.

The STRUDL computer model adequately represented the structure of the tank and information was properly transferred from drawings to the analysis.

With the exception of the error reported in EOI 1136 concerning bolt allowables (discussed in the next section), the analysis demonstrated correct use and satisfaction of criteria. The proper load combinations were considered. In general, the DCP analysis reflected a conservative approach.

3.5 EOI REPORTS ISSUED

EOI 1136 was initially issued regarding two items:

1. The bolt shear stress allowable was incorrectly calculated. The DCP allowable was calculated as

$$f_{vb} = \frac{0.62}{2} Su$$

whereas the ASME Boiler and Pressure Vessel Code (Reference 9) Section III Appendix XVII - 2461.2 specifies

$$f_{vb} = \frac{0.62}{3} Su.$$

Thus, the DCP allowable was incorrect.

2. Tank internal pressure was excluded from the evaluation of the tank shell stress at the nozzles.

The stresses in the bolt do not exceed the correctly calculated allowable. Further, DCP clarification of the normal operating condition of the CCW surge tank indicated that the actual internal pressure was 3 psi due only to hydrostatic pressure because the tank is vented to the atmosphere. Thus, the internal pressure effect is negligible and the DCP analysis approach was correct. Therefore, because the error in calculating the bolt shear stress allowable was not significant with respect to licensing criteria, EOI 1136 was classified as an. Error Class C.

3.6 SUMMARY OF CONCLUSIONS FOR TANKS

The IDVP review of the DCP corrective action for tanks found that this work was acceptable and satisfied licensing criteria. Seismic inputs used were current for the date of the analysis. Analysis methods were judged to be acceptable.

With the exception of the incorrectly calculated bolt shear stress allowable noted in EOI 1136, analysis criteria were properly satisfied. This error (Class C) is not considered to be significant to the overall equipment category of tanks for two reasons. First, calculated bolt stresses satisfied correctly calculated allowable criteria so no criteria were actually exceeded. Second, this mistake appears to be a random single occurrence.

Thus, because no generic concerns were identified, DCP work in the area of tanks is judged to be adequate, and licensing criteria to be satisfied. Effects of future revisions to the seismic floor spectra and piping nozzle loads on equipment remain to be evaluated.

4.0 FILTERS

4.1 DESCRIPTION

Three mechanical (non-HVAC) filters were within the IDVP scope. These three were the safety injection pump lube oil filter, diesel oil transfer filter, and the diesel oil strainer. All three were included in the DCP Corrective Action Program. No filters were included in the IDVP initial sample or additional verification work because none were noted as minimum required Design Class 1 equipment following the Hosgri event (Reference 8). The safety injection (SI) pump lube oil filter was randomly selected as the IDVP verification sample for the DCP Corrective Action Program.

One lube oil filter is mounted on each of the two safety injection pumps located in the Unit 1 portion of the auxiliary building at elevation 85 feet. These filters are screw-on type canister filters. Their mounting hardware is supported by steel angles welded to the pump base. The SI pump lube oil filters are Design Class 1 equipment.

4.2 DCP METHODS

The DCP analysis used a simplified analysis approach to evaluate the SI pump lube oil filters and support (Reference 20). A one degree of freedom mathematical model which reflected the filter mass and the support stiffness in the most flexible direction was used to calculate the natural frequency.

The filter and support structure was found to have natural frequencies in the rigid range (greater than 33 hertz). Thus, zero period accelerations were applicable. However, the DCP analysis chose conservative acceleration values of 1.0g horizontal and 0.65g vertical for use in their analysis. Loads developed from these acceleration values were compared against the DE allowables which are more stringent than the DDE and Hosgri allowables. This approach, which is conservative, reduced the number of actual calculations performed to satisfy all load combinations.

Stresses were calculated by hand for the key areas of the supporting structure and compared to allowable criteria. DCM M-45 is the applicable allowable criteria document for mechanical filters.

The DCP analysis found the filter to meet the required criteria.

4.3 IDVP DESIGN REVIEW

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra, and design criteria from DCM M-45.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

4.4 RESULTS OF REVIEW

The IDVP review of the SI pump lube oil filter analysis found all areas to be acceptable. The spectra referenced in the analysis were current for the date of the analysis (Reference 21). Conservative seismic accelerations were used. Modeling of the structure and analytical methods used were acceptable. Allowable criteria were properly used. Information from available drawings was properly transferred to the analysis. The proper load combinations were considered. The DCP analysis represented a conservative approach.

4.5 EOI REPORTS ISSUED

No EOIs were issued for filters.

4.6 SUMMARY OF CONCLUSIONS FOR FILTERS

The IDVP review of the DCP corrective action for mechanical filters found that this work was acceptable and satisfied licensing criteria. Correct seismic inputs were used consistent with the date of the analysis. Analysis criteria were properly applied, and analysis methods were acceptable.

In addition, the mechanical filters in the IDVP scope are small equipment items upon which seismic loadings are generally not significant.

Effects of future revisions to the seismic inputs on equipment remain to be evaluated.

5.0 HVAC EQUIPMENT

5.1 SUPPLY FAN S-1

5.1.1 Description

Ten types of fans were reviewed by the DCP. Individual fans within each type classification are identical. Fans were selected for IDVP verification because most are physically large units for which seismic loads may be significant.

One of the ten types of fans was verified by independent calculations in the initial sample work. A second type of fan was verified for bolt size and modeling concerns as part of the additional verification (Reference 22).

Supply fan S-1 was selected for the IDVP review of DCP corrective action as a random sample from among the larger units of the 8 types of fans not previously examined by the IDVP.

It is located in the auxiliary building at elevation 85 feet. An identical unit, S-2, is installed adjacent to S-1. These two units comprise this fan type for Unit 1.

S-1 is a centrifugal fan rated at 29,850 cfm. The overall height and width of the fan are approximately 6 feet, and the total weight is 1475 pounds. A sheet metal housing enclosing the fan wheel is supported by steel channel framework on each side. The fan shaft and bearings are supported from this steel framework. S-1 is part of the Design Class 1 Safeguards Ventilation System in the auxiliary and fuel handling buildings.

5.1.2 DCP Methods

The DCP Corrective Action Program considered safety-related HVAC equipment in the following manner. Documentation packages for the seismic qualification of all safety-related HVAC equipment were assembled. This equipment was identified and the method of seismic qualification documented. The qualification was reviewed for effect of any seismic spectra changes. Also, previous qualification methods were reviewed for validity. A reanalysis or test was performed if the spectra affected the qualification of the component or if the previous qualification was not acceptable. Redesign and modifications were implemented, if required, to maintain qualification.

The DCP corrective action work for S-1 (Reference 23) consisted of a review followed by a new analysis, to demonstrate seismic qualification, using current seismic spectra and revised modeling boundary conditions.

The analysis, based on a simplified representation of the structure in its most flexible direction, calculated its lowest natural frequency. Using this natural frequency, applicable seismic accelerations were determined. The Hosgri earthquake acceleration was determined to envelop both the DE and DDE design condition accelerations. This acceleration was used to calculate the loads and stresses at key locations. These loads and stresses were compared to allowables.

The DCP analysis found the fan in its most critical orientation to meet required criteria.

5.1.3 IDVP Design Review

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra, and design criteria from DCM CH-52 (Reference 24).

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

5.1.4 Results of Review

The IDVP review of Fan S-1 found all areas to be acceptable (Reference 25). Spectra referenced in the analysis were current for the date of the analysis, and modeling and analytical methods were acceptable for the configuration of the structure. Allowable criteria were correctly referenced and their usage was judged to be acceptable. Stresses were found to be below allowables defined by the manufacturer and DCM CH-52.

Operability of the fan was adequately demonstrated in the original qualification by checking operating clearances between the fan and housing during seismic excitation. The motor was not included as part of the DCP review/reanalysis. The seismic capability of the motor mounts was demonstrated by the vendor's original calculation.

5.1.5 EOI Reports Issued

EOI 1127 was issued for Fan S-1 to note the following concerns. The DCP frequency calculation used a simplified representation of the fan support structure that may not have included all other significant flexibilities. In addition, the formula used in the reanalysis to calculate the natural frequency was thought to have been misapplied.

The concerns noted in EOI 1127 were resolved within the IDVP during further review. The DCP's simplified representation of the fan structure used for the natural frequency calculation was determined to be acceptable. Review and comparison between S-1 and the similar Fan S-31 (verified in the initial sample work with independent calculations - Reference 22) showed that the other flexibilities do not contribute significantly to the overall flexibility of the structure for the orientation considered.

Further IDVP review of the DCP analysis method showed that the concern over use of the formula to calculate the natural frequency was not a valid concern.

On the basis of the resolutions of these concerns, EOI 1127 was classified as a closed item.

5.2 COMPRESSOR CP-35

5.2.1 Description

Compressor CP-35 and an identical and adjacent unit, CP-36, are the only compressors in Unit 1. Both CP-35 and CP-36 are covered in the same DCP analysis package. The sample randomly selected for IDVP review was CP-35.

CP-35 is a six cylinder reciprocating air conditioning compressor driven by an integral electric motor. It has a weight of approximately 790 pounds and is rigidly bolted to the floor slab at elevation 154 feet 6 inches in the auxiliary building. Overall length of the compressor is approximately three feet. CP-35 is part of the Design Class 1 control room ventilation and pressurization system.

5.2.2 DCP Methods

The DCP performed separate review and reanalyses for the overall compressor structure and the motor contained within the compressor housing (References 26 and 27).

A simplified representation of the compressor was used to calculate the natural frequency. The lowest natural frequency, which was calculated to be in the rigid range (greater than 33 hertz), permitted application of the zero period seismic accelerations. The Hosgri seismic accelerations were determined to envelop both the DE and DDE accelerations. Loads and stresses developed from Hosgri accelerations values were compared against the more stringent DE allowables. Loads and stresses were calculated at the key areas. Operability of the motor was examined by comparing the deflection of the rotating elements due to seismic excitation with the available internal clearance.

The DCP analyses found the compressor to meet the required criteria.

5.2.3 IDVP Design Review

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra, and design criteria from DCM CH-52 (Reference 24).

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

5.2.4 Results of Review

The IDVP review of compressor CP-35 and its motor found all areas to be acceptable with the exception of the vertical seismic acceleration value used in the analysis (References 28 and 29). This exception is noted in EOI 1125. The spectra referenced in the analysis were current for the date of the analysis, and the acceleration values used for the horizontal direction were correct.

Modeling and analytical methods were acceptable for the configuration of the component. Allowable criteria were correctly referenced and their usage was judged to be acceptable. Operability of the component was adequately demonstrated.

5.2.5 EOI Reports Issued

EOI 1125 was issued because Revision 1 of the DCP corrective action analysis of CP-35 used an incorrect vertical acceleration value. The analysis used a value of 0.61g which applies to the rigid floor slab at elevation 154 feet 6 inches. However, CP-35 is located on flexible floor slab number 7 per the Hosgri seismic criteria document DCM C-17. Thus, a higher vertical acceleration value of 1.0g should have been used.

The DCP demonstrated that the PGandE Phase I Final Report Table 2.3.3-1 dated 5/16/83, which, based on the original Revision 0 analysis, contained the correct vertical acceleration value. In addition, Revision 2 of the DCP corrective action analysis was issued, which showed that use of the correct vertical seismic acceleration produces stresses that are still below allowable criteria.

Although an incorrect and unconservative vertical seismic acceleration was used in Revision 1, an earlier analysis revision used the correct value and the correct acceleration produced stresses that were below criteria, therefore, EOI 1125 was resolved as a Class C Error.

5.3 SUMMARY OF CONCLUSIONS FOR HVAC EQUIPMENT

The IDVP review of the DCP corrective action for HVAC equipment found that this work was acceptable and satisfied the licensing criteria. Analysis methods and modeling of the structures were determined to be acceptable.

Seismic inputs used were current for the date of the analysis. The incorrect vertical acceleration used in the analysis of compressor CP-35 was deemed to be an isolated instance and not a generic concern because the spectra criteria used were current for the date of the analysis.

Application and satisfaction of all other established DCP criteria was found to be adequate.

Thus, because no generic concerns were identified, DCP work in the area of HVAC equipment is judged to be adequate. Effects of future revisions to the seismic floor spectra and other applicable seismic inputs on equipment remain to be evaluated.

6.0 SHAKE TABLE TESTED EQUIPMENT

6.1 PORTABLE FIRE PUMP

6.1.1 Description

The portable fire pump was selected as one of the samples for IDVP review in the area of equipment qualified by shake table testing. It constitutes the only item of equipment thus qualified within the DCP. mechanical discipline's scope of responsibility.

In the previous IDVP verification of the initial sample of shake table tested equipment, only equipment from the electrical discipline and the instrument discipline were selected (References 30 and 31). Thus, the IDVP selection of the portable fire pump broadens the scope of the review to an additional discipline as well as representing a complete verification of the shake table tested equipment within that discipline.

In addition, the equipment in the initial sample was tested by Wyle Laboratories, Inc. The portable fire pump was tested by ANCO Inc. (a seismic service-related contractor). The inclusion of the portable fire pump in the IDVP review sample, then, also represents verification of another of PGandE's seismic service-related contractors.

The portable fire pump is a trailer mounted pump and diesel engine combination. The trailer is 88 inches long and 47 inches wide, and the complete assembly weighs approximately 1750 pounds. Two identical units are located just south of the Unit 1 condensate polishing area, west of the turbine building. The portable fire pumps are Design Class I equipment.

Each trailer is supported at the rear of the trailer on an I-beam section, thus keeping the main wheels elevated above the ground. The trailer is secured by turnbuckles and chains from eyebolts on the trailer to expansion eyebolts anchored in the concrete floor slab.

6.1.2 DCP Methods

The DCP Corrective Action Program work consisted of a review of the earlier test by ANCO Inc. to verify test validity for current spectra (Reference 32). In addition, the difference between mountings of the current installed configuration and the earlier installation and test mounting configuration was reviewed and assessed.

In the original test, the trailer was mounted in a rigid frame structure to which actuators were connected. These actuators imparted vectored horizontal and vertical motion to the frame structure. The trailer was rigidly pinned to mounting points on the test frame.

No specific criteria are given in the licensing commitments for seismic testing of mechanical equipment; therefore, IEEE Standard 344-1975 was used for the test (Reference 33). To satisfy this criteria, the trailer was subjected to five operating basis earthquakes and one design level safe shutdown earthquake. This set of six individual test runs was applied to the trailer in each of four orientations; the trailer was rotated 90 degrees in the horizontal plane from the last position for each set of six tests. After the seismic shake tests were completed, the pump and motor were started and water was pumped to demonstrate operability.

The DCP reviewed the test report for the ANCO tests to confirm that test levels also satisfied the current spectra requirements. The safe shutdown earthquake test levels were compared to the applicable DDE and Hosgri spectra, current for the date of the review, contained in the spectra criteria DCM C-30, C-25, and C-17.

In addition, the DCP reviewed the difference between the current anchorage configuration and the previous installation and test anchorage configuration for structural adequacy.

The DCP review found the portable fire pump to meet the current criteria.

6.1.3 IDVP Design Review

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra. Items relating to IEEE Standard 344-1975 were also included.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP review. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

6.1.4 Results of Review

The IDVP review of the portable fire pump found all areas to be acceptable (Reference 34). The spectra referenced in the DCP review of the original test were current for the date of the analysis. Use of IEEE Standard 344-1975 as criteria was determined to be acceptable for testing of this equipment.

Test criteria were met. Test machine acceleration inputs were to the machine limits, which proved to be a conservative overtest of the equipment compared to the required response spectra.

The difference in mounting configurations was determined to have been adequately evaluated. Operability of the portable fire pump following the seismic testing was demonstrated.

6.1.5 EOI Reports Issued

No EOI reports were issued for the portable fire pump.

6.2 RADIATION MONITOR RE-14A

6.2.1 Description

Radiation monitor RE-14A was randomly selected as the second of the two samples for IDVP review of the DCP Corrective Action Program in the area of shake table test qualified equipment. RE-14A was one of twenty-eight different types of instrumentation equipment shake table tested under the responsibility of the DCP instrumentation group. Prior instrumentation examined by the IDVP in the initial sample included only instrumentation which had been tested through the coordination of the DCP electrical engineering group.

RE-14A is one of a number of instruments upgraded to Class 1E after November 30, 1981. RE-14A is a plant vent gas radiation monitor and is part of the Unit 1 plant vent radiation monitoring system. This system is designed to set off an alarm in the control room when airborne radiation is present in the plant exhaust vent.

The radioactive gas detector system is housed in a steel cabinet which also contains associated relays, valves, piping, wires, flow switch, air pump, and muffler. The cabinet is bolted to the concrete floor at elevation 115 feet in the auxiliary building, adjacent to the plant vent.

Associated electronics racks which control the operation of the monitor and display the measured radiation levels are located in the control room.

6.2.2 DCP Methods

Since RE-14A was upgraded to Class 1E, the DCP work was a new qualification, not a review of a prior qualification or a reanalysis. A prototype unit was sent to PGandE's Department of Engineering Research (DER). There, the cabinet was modified for added structural strength and to enhance functional capability. A functional test plan was developed. This prototype unit was then tested on a shake table at Wyle Laboratories, Inc. to PGandE supplied seismic spectra. During the seismic test at Wyle Labortories, DER retained responsibility for the functional portions of the test, including functional monitoring and verifying satisfaction of the functional test requirements.

The seismic test was performed to comply with IEEE Standard 344-1975. Thus, the seismic test sequence consisted of five operating basis earthquakes (OBEs) followed by one safe shutdown earthquake (SSE). This series of tests was performed biaxially (one vertical and one horizontal direction simultaneously) with the cabinet in each of two orientations. In the second orientation, the cabinet was rotated 90 degrees in the horizontal plane from its first orientation.

Based on the successful completion of the testing of the modified prototype cabinet, with satisfaction of all structural and functional criteria, similar modifications were recommended for all similar radiation monitoring cabinet assemblies being upgraded to Class 1E, including the sample RE-14A. Also, the seismic test spectra were compared to current seismic floor spectra requirements. Qualification is documented in References 35, 36, and 37.

6.2.3 IDVP Design Review

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra. Items relating to IEEE Standard 344-1975 were also included.

In addition, the checklist items included applicability of approach and methods, boundary conditions, reasonableness of results, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP review. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

6.2.4 Results of Review

The IDVP review of radiation monitor RE-14A and its electronics drawers found all areas to be acceptable (Reference 38).

The spectra used in the DCP review of the test were current for the date of the analysis. The actual accelerations were conservatively developed.

Test criteria and IEEE Standard 344-1975 were determined to have been met. Functional requirements were adequately addressed. Application of test results and suggested modifications as a result of testing was determined to have been adequately implemented. Licensing criteria have been met.

6.2.5 EOI Reports Issued

No EOI Reports have been issued for radiation monitor RE-14A.

6.3 SUMMARY OF CONCLUSIONS FOR SHAKE TABLE TESTED EQUIPMENT

The IDVP review of the DCP corrective action for shake table tested equipment found that this work was acceptable and satisfied the licensing criteria. Test and review methods for the equipment were determined to be acceptable.

The IDVP review included both DCP review of equipment that was previously tested and equipment tested during the corrective action period. Current spectra were used in the DCP review process.

Established criteria were applied and met, including IEEE Standard 344-1975. The DCP review addressed the question of functional capability, and modifications dictated by test results were implemented.

Thus, because no generic concerns were identified, DCP work in the area of shake table tested equipment is judged to be adequate. Effects of future revisions to seismic inputs on equipment remain to be evaluated.

7.0 HEAT EXCHANGERS

7.1 DESCRIPTION

The IDVP selected the component cooling water (CCW) pump lube oil cooler as the sample for review of the DCP Corrective Action Program for heat exchangers. The equipment category includes only fluid type heat exchangers and does not include air conditioning coolers and coils, which are considered in the HVAC equipment category.

The CCW pump lube oil cooler is one of two heat exchangers reviewed by the DCP. The second, the CCW heat exchanger, was verified by the IDVP for Hosgri earthquake loads as part of the initial sample work reported in ITR #43 (Reference 39). Thus, both heat exchangers reviewed by the DCP have been examined by the IDVP.

One CCW pump lube oil cooler is located on each of the three Unit 1 CCW pumps. These pumps are located at elevation 73 feet of the auxiliary building. The cooler is attached to the base of the pump just above the floor with steel angle support members. The cooler has a horizontal cylindrical copper shell with an overall length of approximately 19 inches, shell outer diameter of 5-1/2 inches and a shell thickness of 0.65 inch. The cooler's fittings are of bronze and cast iron.

7.2 DCP METHODS

The DCP Corrective Action Program work for the CCW pump lube oil cooler consisted of an analysis of the cooler and support structure for revised piping nozzle loads and incorporation of current seismic spectra criteria (Reference 40). The DCP reanalysis used a simplified model of the cooler, representing the cooler itself as rigid and the support angles with their actual properties.

The natural frequency of the cooler on its supports was determined to be in the rigid range (greater than 33 hertz). Zero period seismic accelerations and piping nozzle loads were applied to the structure.

The key areas of the supporting structure were examined. Calculated stresses were compared to allowables determined using DCM M-45 criteria guidelines.

The DCP analysis shows all stresses below allowables.

7.3 IDVP DESIGN REVIEW

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra, and design criteria from DCM M-45.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

7.4 RESULTS OF REVIEW

The IDVP review of the CCW lube oil cooler found the seismic spectra used in the analysis to be current for the date of the analysis. Analytical methods were judged to be acceptable. Assumptions and techniques used in the mathematical modeling of the tank were also acceptable.

The STRUDL computer model adequately represented the structure of the cooler.

One issue is yet to be resolved for the CCW lube oil cooler. Completion of the IDVP review is pending IDVP/DCP agreement on the allowable stress criteria to be used for cast iron. No guidance is given for this area in the licensing commitments. Resolution of this item and completion of the review will be reported in Revision 1 to this ITR.

7.5 EOI REPORTS ISSUED

EOI 1130 was issued because the DCP reanalysis of the CCW pump lube oil cooler showed that allowable criteria were exceeded and physical modifications were required. This reanalysis was the analysis of record when the DCP had indicated that all seismic work in this area was complete and no physical modifications were necessary (PGandE Phase I Final Report, Revision 3, dated April 22, 1983, Reference 3).

Action required for qualification of the cooler was not mentioned in the PGandE Phase I Final Report. However, the IDVP subsequently determined that the cooler qualification was internally tracked within the DCP, and that implementation of the required actions was planned. As a result, EOI 1136 was resolved as a Deviation.

7.6 SUMMARY OF CONCLUSIONS FOR HEAT EXCHANGERS

The IDVP review of the DCP corrective action for heat exchangers is not complete pending resolution of a technical issue involving the allowable stress criteria to be applied to cast iron material. In addition, effects of future revisions to seismic inputs on equipment remain to be evaluated.

For the other areas, the IDVP review found that this work was acceptable and satisfied the licensing criteria. Seismic inputs were current for the date of the analysis, and analysis methods were judged to be acceptable.

Application and satisfaction of all established DCP criteria were found to be adequate.

Final conclusions and resolution of the one remaining technical issue will be reported in Revision 1 to this report.

8.0 PUMPS

8.1 DESCRIPTION

The fire pump was selected as the sample for IDVP review. This pump is one of eight types of pumps reviewed by the DCP. Of these eight types, seven were qualified by analysis, and one, the portable fire pump, was qualified by shake table testing. This section includes only those pumps qualified by analysis.

Five of the remaining seven pumps were included in the IDVP initial sample and additional verification work; this work is reported in ITR #32 (Reference 41, Revision 1). Thus, with the IDVP's selection of the fire pump for review of corrective action, six of the seven safety-related pumps qualified by analysis and in the IDVP scope have been included in the IDVP's verification program.

The fire pump is a centrifigal pump driven by an electric motor. Two identical units are installed adjacent to each other at elevation 115 feet in the Unit 1 portion of the auxiliary building. The cast iron pump and its integral base are bolted to a steel member base plate structure, which is shared with the motor. This base plate structure is bolted to the floor slab and filled with grout. The fire pump is Design Class 1 equipment.

8.2 DCP METHODS

The DCP analysis consisted of application of revised seismic inputs to a finite element model representing the fire pump and motor. Separate finite element analyses, using the computer code STRUDL, were performed for the fire pump electric motor and the combined pump, motor and support structure (References 42 and 43).

Natural frequencies were calculated from these finite element models. The natural frequencies were determined to be in the rigid range and the zero period seismic accelerations were applied to the finite element models. Loads at key areas due to the seismic accelerations and attached piping loads at the pump nozzles were calculated. Stresses at these key areas were then calculated and compared to allowables.

8.3 IDVP DESIGN REVIEW

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra, and design criteria from DCM M-45.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

8.4 RESULTS OF REVIEW

The IDVP review of the fire pump and motor found the seismic spectra used in the analysis to be current for the date of the analysis. Analytical methods used in the DCP analysis were judged to be acceptable. Assumptions and techniques used in the mathematical modeling of the pump and motor structure were also acceptable. Information from available drawings was properly transferred to the analysis. Operability was adequately demonstrated.

The IDVP found that the as-built configuration of the fire pump discharge nozzle flanged joint did not conform to the applicable PGandE piping specification, which pertains to the attached piping.

One unresolved technical issue remains, relating to the allowable stress criteria to be applied to cast iron material. Completion of the IDVP review is pending IDVP/DCP agreement on this criteria because no guidance is given for this area on the licensing commitments. Resolution of this review will be reported in Revision 1 to this ITR.

8.5 EOI REPORTS ISSUED

EOI 1140 was issued because the IDVP found the fire pump discharge nozzle flange bolting to exceed allowable criteria when an ASME Section III, Class 3 analysis method was applied. However, application of a more appropriate code, ANSI B31.1 - Power Piping, and a revised alternate calculation showed the bolt stress to be below allowable criteria. Therefore this item was closed.

In addition, the as-built flanged joint configuration on this nozzle did not conform to the applicable PGandE piping specification pertaining to the attached piping. The discrepancy was resolved as an Error Class C. This situation is unique to the fire pump flange interface.

Based on this last item, EOI 1140 was resolved as an Error Class C. If the DCP indicates that no modifications will be applied, then EOI 1140 will be completed. This will be reported in Revision 1 of this ITR.

8.6 SUMMARY OF CONCLUSIONS FOR PUMPS

The IDVP review of the DCP corrective action for pumps found this work acceptable and satisfied licensing criteria with the exception of the following item. First, the IDVP has not completed its review pending resolution of allowable stress criteria for cast iron. In addition, the completion of EOI 1140 will be reported in Revision 1 of this ITR.

For all other areas, application and satisfaction of established DCP criteria was found to be adequate. Licensing criteria were satisfied.

9.0 ELECTRICAL EQUIPMENT BY ANALYSIS

9.1 DESCRIPTION

The station battery racks were selected as the sample for IDVP verification. The station battery racks are one of five major items of electrical and instrumentation equipment qualified by analysis that are within the IDVP scope. "Major equipment" in this case excludes small panels, transmitters, switches, circuit breakers and other small items of this type.

Of the five major equipment items, two were included in the IDVP initial sample work: the main annunciator cabinet and the hot shutdown remote control panel. Two others were included in the additional verification sample: the local instrument panels and the instrument AC panel (reported in ITR #33 - Reference 44). Thus, with the inclusion of the station battery racks, all major electrical equipment and instrumentation items qualified by analysis have been included in the IDVP verification effort.

The station battery racks are a steel member frame structure of bolted and welded construction. Each rack holds one row of 15 individual battery cells weighing 341 pounds each. The battery cells sit on parallel rows of channels, and the battery set is encircled by a rail assembly at a level below the tops of the cells.

Twelve separate racks are located on elevation 115 feet of the auxiliary building. The batteries are Design Class 1 equipment.

9.2 DCP METHODS

The DCP analysis of the battery racks used hand calculations with a simplified mathematical representation of the racks (Reference 45). The structure was simplified to one degree of freedom models in each of two horizontal directions. A beam type representation was used for the vertical direction.

Based on the natural frequency results obtained using the above models, the applicable Hosgri seismic accelerations were applied to simplified representations of the rack and battery structure. Loads and stresses were calculated for key areas. These stresses were compared to allowable values defined by the AISC Code and PGandE's expansion anchor bolt criteria.

9.3 IDVP DESIGN REVIEW

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis. The checklist incorporated requirements for seismic inputs from DCMs C-17, C-25, and C-30 for Hosgri, DE, and DDE spectra.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes, and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

9.4 RESULTS OF REVIEW

The IDVP review of the station battery racks found the seismic spectra used in the analysis to be current for the date of the analysis (Reference 46).

However, the IDVP did not agree with certain methods and assumptions used in the DCP analysis. Certain load distributions between structural members were unconservatively assumed or not sufficiently justified in the DCP analysis. The hold-down clips were not examined in sufficient detail, and the hold-down anchor bolt at this location was analyzed as 3/4 inch in diameter while the actual size is 1/2 inch in diameter. The 3/4 inch anchor bolt was installed at a different anchor location.

In addition, a structural bolt was analyzed as 1/2 inch in diameter, whereas the actual size is 3/8 inches in diameter; in addition, the axial force in the diagonal member connected to this bolt was not resolved from its components. These two items are reported in EOI 1128.

As a result of these discrepancies, the IDVP performed an alternate calculation to assess their effect on the rack's structural integrity. This review has not been completed. Results will be reported in Revision 1 of this ITR.

9.5 EOI REPORTS ISSUED

EOI report 1128 was issued for the station battery racks. The DCP analysis used 1/2 inch bolts at the connections of the diagonal frame stiffeners. However, the actul bolt size is 3/8 inch. In addition, the resolved shear force at these bolted joints was not considered.

Resolution of this EOI will be reported when the IDVP review of the station battery racks is completed.

9.6 SUMMARY OF CONCLUSIONS FOR ELECTRICAL EQUIPMENT BY ANALYSIS

Conclusions for the station battery racks will be reported in Revision 1 to this report after the design review is finalized and all issues resolved. While certain discrepancies were noted, no generic implications resulted because the station battery racks were the only remaining major electrical and instrumentation item qualified by analysis that was not included in the previous IDVP verification samples.

The effects of future revisions to the seismic inputs on equipment remain to be evaluated.

10.0 VALVES

10.1 DESCRIPTION

LCV-110 was randomly selected as the sample for IDVP review of the DCP Corrective Action Program. LCV-110 represents one valve type which includes three other identical valves: LCV-111, LCV-113, and LCV-115. The DCP analysis applies to all four of these valves.

The actual valve qualification takes place in the piping analysis wherein the valve is treated as an in-line component. The modeling of the valve in the piping analysis uses natural frequency information contained in DCM M-58 (Reference 47) for the natural frequency of the extended structure.

The accelerations of the valve eccentric mass (center of gravity of an actuator or other extended structure) resulting from the piping seismic analysis are compared to the maximum allowable values listed in DCM M-58. Qualification of the valve body with respect to piping nozzle loads takes place through application of Piping Procedure P-11 (Reference 48). Additional support is added to the piping system or valve as required to meet the allowable valve accelerations stipulated in DCM M-58. These steps are part of the individual piping analyses and are documented therein.

The scope of work reported in this ITR is the verification of the DCP analysis which generates the DCM M-58 values. The IDVP initial sample work for valves is reported in ITR #37 (Reference 49).

The DCP analyzed six types of valves as part of its Corrective Action Program. The number of actual installed valves of each type varies from one valve to many. The DCP analyses lump all valves of each type into one analysis, which applies to all valves of this type.

All four valves, LCV-110, 111, 113, and 115, are 2 inch drag valves with electro-hydraulic actuators. They are installed on auxiliary feedwater lines that serve the Unit 1 steam generators.

Valve LCV-110 is mounted in-line on Line 575. The actuator is mounted in a vertical orientation approximately 38 inches above the pipe center line. The actuator is supported from the valve body by a yoke structure approximately 22 inches long. The yoke is a cast aluminum structure essentially consisting of two parallel ribbed plates with a bolted cover plate, resulting in a channel type section. Total valve assembly weight is 190 pounds, of which 60 pounds is the actuator weight.

10.2 DCP METHODS

The DCP analyzed LCV-110 because the original actuator and yoke assembly had been replaced with a new type and configuration, thus invalidating the previous vendor design analysis.

Valve natural frequencies were calculated by hand using simplified lumped mass single degree of freedom representations of the valve and yoke structure (Reference 50). Next, key areas of the valve extended structure were identified, and loads and stresses at these areas were calculated as a function of acceleration applied to the eccentric mass at its center of gravity location. Loads and stresses were calculated by hand, using simplified representations of the valve structure. These loads and stresses were compared to the allowable criteria, and the maximum allowable valve acceleration was determined.

This valve analysis examines only the limiting acceleration which affects the eccentric mass (actuator/yoke structure) for the general case. The actual valve installation is examined in the piping analysis. Therefore, seismic inputs and any added valve supports are not within the scope of this valve analysis or the IDVP equipment review of valves, but are included in the piping review as part of the individual piping analyses.

10.3 IDVP DESIGN REVIEW

The IDVP design review is structured around a checklist developed by the IDVP for this review. This checklist reflects significant technical items, analytical steps, specification and use of applicable design criteria, and results of the DCP analysis.

In addition, the checklist items included applicability of approach and methods, boundary conditions, acceptability of modeling, reasonableness of results, use of computer codes and satisfaction of design conditions.

This checklist was supplemented with assessments of the completeness, applicability, consistency and adequacy of the DCP analysis. These assessments were in the form of comments and notes accompanying the individual checklist items.

The combination of the checklist and assessments permitted a thorough review that verified the DCP analysis for acceptability and satisfaction of criteria. All aspects were considered, from the interpretation of drawings and actual component configurations, to modeling, arithmetic, solution approach, and comparison of results to proper criteria.

10.4 RESULTS OF REVIEW

The IDVP review of valve LCV-110 has yet to be completed pending resolution of a technical issue involving allowable criteria to be used for valves. Results of the review will be reported when this issue is resolved and the design review is finalized.

10.5 EOI REPORTS ISSUED

No EOI reports have been issued to date for valves.

10.6 SUMMARY OF CONCLUSIONS FOR VALVES

Conclusions for valves will be reported in Revision 1 to this report after the design review is finalized and all issues resolved.

11.0 EVALUATION OF EQUIPMENT

The IDVP has completed its equipment verification in the areas of tanks, filters, HVAC equipment, shake table tested equipment, and electrical equipment qualified by analysis. The review of heat exchangers, pumps, and valves is yet to be completed pending resolution of the following isolated technical issues:

1. Allowable stress criteria to be applied to cast iron material

2. Allowable stress criteria applicable to valves.

3. EOI 1128.

With the exception of the above areas, the IDVP found the DCP corrective program work in the equipment area, with the exception of certain minor errors, to be satisfactory.

Concerns which are identified in the EOI reports and their significance and resolution are summarized below.

Concerns identified in EOIs 1125 (vertical spectra value), 1136 (bolt allowable stress), and 1140 (flange as-built configuration) were considered by the IDVP to be all single instance discrepancies. In addition, none of these discrepancies impacted the equipment's satisfaction of licensing criteria. Therefore, these concerns do not impact the overall acceptability of the DCP corrective action work for the respective equipment categories.

The concerns noted in EOI 1127 were later found to be invalid, so this EOI has no impact.

EOI 1130 reported a concern over the possibility that a required corrective action may not be implemented. However, the IDVP determined that this item was simply a documentation mistake in the PGandE Phase I Final Report. Thus, this concern was not an issue and had no impact.

Due to the nature of the IDVP verification, reviews were conducted on the DCP analyses of record at the time the sample was selected. To verify DCP completion, the IDVP will verify a completion sample of the DCP work. This sample will verify the final approved calculations for inputs, configuration and criteria current as of a cutoff date of June 30, 1983. This completion sample verification will be reported in Revision 1 to this ITR.

12.0 CONCLUSIONS

The IDVP verification of tanks, filters, HVAC equipment, and shake table tested equipment, has been completed. Verification of three equipment categories, heat exchangers, pumps, and valves, is pending resolution of the two issues involving allowable stress criteria identified in Section 11.0. Verification of electrical equipment by analysis is pending resolution of EOI 1128.

Based on the IDVP verfication completed to date, the IDVP concludes that the DCP corrective action work for equipment is satisfactory. Final conclusions, and conclusions dependent upon resolution of the remaining technical issues, will be reported in Revision 1 to this ITR.

13.0 REFERENCES

Reference No.	Title	RLCA File No.
1	Independent Design Verification Program, Interim Technical Report (ITR) #8, Verification Program for PGandE Corrective Action, Revision 0, October 5, 1982.	P105-5-839-008
2	IDVP, ITR #35, Verification Plan for Diablo Canyon Project Activities, Revision 0, April 1, 1983.	P105-4-839-035
3	Pacific Gas and Electric Company (PGandE), Phase I Final Report - Independent Design Verification Program, Diablo Canyon Nuclear Power Plant, June 21, 1983.	
4	DCNPP IDVP, Phase I, Revision 1 July 6, 1982, (Revision 0, March 29, 1982).	
5	IDVP, Diablo Canyon Nuclear Power Plant Unit 1, Final Report, 1983.	
6	IDVP, Program Procedure, Preparation of Open Item Reports, Error Reports, Program Resolution Reports and IDVP Completion Reports, DCNPP-IDVP-PP-003, Revision 1, June 18, 1982.	

Reference No.	Title	RLCA File No.
7	Diablo Canyon Site Units 1 and 2, Final Safety Analysis Report, USAEC Docket Nos. 50-275 and 50-323.	P105-4-200-005
8	Seismic Evaluation for Postulated 7.5M Hosgri Earthquake, USNRC Docket Nos. 50-275 and 50-323.	P105-4-200-001
9	American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Sections III and VIII with appendices, 1980, with addenda.	
10	American Institute of Steel Construction, Manual of Steel Construction, 7th and 8th Editions.	
11	IDVP, ITR #3, Tanks, Revision 0.	P105-4-839-003
12	USNRC Regulatory Guide, 1.143, Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants, Revision 1, October 1979.	
13	DCP Analysis SQE-4.4, CCW Surge Tank, Revision 0.	P105-4-435-056
14	DCP DCM M-45, Mechanical Seismic Design Criteria.	P105-4-200-121
15	Welding Research Council, Bulletin No. 107, Local Stresses in Spherical and Cylindrical Shells due to External Loadings, Wichman, Hopper and Mershon, March 1979 Revision.	

Reference No.	Title	RLCA File No.
16	Diablo Canyon Project (DCP) Design Criteria Memorandum (DCM) C-17, Hosgri Response Spectra for Structures, Systems, and Components.	P105-4-200-100
17	DCP DCM C-25, Design Earthquake Response Spectra for Structures, Systems, and Components.	P105-4-200-014
18	DCP DCM C-30, Double Design Earthquake Response Spectra for Structures, Systems and Components.	P105-4-200-056
19	RLCA Final Design Review Package, CCW Surge Tank.	P105-4-506-089
20	DCP Analysis SQE-3.1, Safety Injection Pump Lube Oil Filter, Revision 0.	P105-4-435-061
21	RLCA Final Design Review Package, Safety Injection Pump Lube Oil Filter.	P105-4-506-035
22	IDVP, ITR #31, HVAC Components, Revision 1.	P105-4-839-031
23	DCP Analysis HV-1.1, Supply Fan S-1 and S-2.	P105-4-436-065
24	DCP DCM CH-52, Seismic Review of HVAC Equipment.	P105-4-200-084
25	RLCA Final Design Review, Supply Fan S-1.	P105-4-506-071
26	DCP Analysis HV-3.1, Compresser CP-35, CP-36	P105-4-436-064 P105-4-436-067

Reference No.	Title	RLCA File No.
27	DCP Analysis HV-7.4, Motors for Compresser CP-35, CP-36.	P105-4-436-095
28	RLCA Final Design Review, Compresser CP-35.	P105-4-506-111
29	RLCA Final Design Review, Motor for Compresser CP-35.	P105-4-506-108
30	IDVP, ITR #4, Shake Table Testing, Revision 0.	P105-4-839-004
31	IDVP, ITR #44, Shake Table Test Mountings, Revision 0.	P105-4-839-044
32	DCP Analysis, SQE-7.3, Portable Fire Pump (Diesel).	P105-4-435-062 P105-4-435-084
33	IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations, Standard 344-1975, The Institute of Electrical and Electronics Engineers, Inc.	
34	RLCA Final Design Review Package, Portable Fire Pump.	P105-4-506-070
35	PGandE, Department of Engineering Research, Structural Modification and Seismic Testing of Diablo Canyon Radiation Monitors R-11 and R-12, Report 411-82.257, January 20, 1983.	P105-4-437-081
36	Wyle Laboratories, Seismic Test of Plant Vent Radiation Monitor Components, Report No. 58994, September 28, 1982.	P105-4-447-025

Reference No.	Title	RLCA File No.
37	DCP Analysis IS-9, Plant Vent Radiation Monitor.	P105-4-437-116
38	RLCA Final Design Review Package, Radiation Monitor RE-14A.	P105-4-506-131
39	IDVP, ITR #43, Heat Exchangers.	P105-4-839-043
40	DCP Analysis SQE-4.5, CCW Pump Lube Oil Cooler.	P105-4-435-058 P105-4-435-102
41	IDVP, ITR #32, Pumps, Revision 1.	P105-4-839-032
42	DCP Analysis SQE-2, Fire Pump Motor.	P105-4-435-067
43	DCP Analysis SQE-7.1, Fire Pump.	P105-4-435-066
44	IDVP, ITR #33, Electrical Equipment and Instrumentation by Analysis, Revision 1.	P105-4-839-033
45	DCP Analysis D-E-3.4-1, Station Battery Racks.	P105-4-437-061 P105-4-437-075
46	RLCA Final Design Review Package, Station Battery Racks.	P105-4-506-134
47	DCP DCM M-58. Active Valves: Allowable Accelerations and Frequencies.	P105-4-200-152
48	PGandE, Mechanical and Nuclear Engineering, Procedure for Piping Stress Analysis, Procedure No. P-11.	P105-4-200-095
49	IDVP, ITR #37, Valves.	P105-4-839-037
50	DCP Analysis D-927-1, Level Control Valves.	P105-4-433-027

Appendix A
EOI Reports Issued and Status
(two pages)

EOI File No.	Subject	Rev.	Date	By	Type	Action Required	Physical Mod.
1125	Compressor CP-35 - Vertical spectra value incorrect	0	5/20/83	RLCA	OIR	RLCA	
		1	5/26/83	RLCA	PER/C	TES	
		2	6/2/83	TES	ER/C	PGandE	None
		3	6/9/83	TES	CR	None	
1127	Supply Fan S-1 - Frequency calculation and modeling	0	5/25/83	RLCA	OIR	RLCA	
		1	6/13/83	RLCA	PPRR/CI	TES	
		2	6/16/83	TES	PRR/CI	TES	None
		3	6/16/83	TES	CR	None	
1128	Station Battery Racks - Load calculation and bolt size	0	5/31/83	RLCA	OIR	RLCA	
		1	6/20/83	RLCA	OIR/OIP	TES	
		2	6/27/83	RLCA	PPRR/OIP	TES	
		3	6/28/83	TES	PRR/OIP	PGandE	
		4	8/9/83	TES	OIR	RLCA	
		5	8/9/83	RLCA	PER/C	TES	

STATUS: Status is indicated by the type of classification of latest report received by PGandE:

OIR - Open Item Report
PPRR - Potential Program Resolution Report
PRR - Program Resolution Report
PER - Potential Error Report
OIP - Open Item with future action by PGandE
ER - Error Report
CR - Completion Report
CI - Closed Item
DEV - Deviation
A - Class A Error
B - Class B Error
C - Class C Error
D - Class D Error

PHYSICAL MOD: Physical modification required to resolve the issue. Blank entry indicates that modification has not been determined.

EOI File No.	Subject	Rev.	Date	By	Type	Action Required	Physical Mod.
1130	CCW Pump Lube Oil Cooler - Documentation of qual-ification inconsistent	0	6/3/83	RLCA	OIR	RLCA	
		1	6/18/83	RLCA	PPRR/DEV	TES	
		2	6/27/83	TES	PRR/DEV	TES	
		3	6/30/83	TES	CR	None	
1136	CCW Surge Tank - Incorrect bolt allowable	0	6/16/83	RLCA	OIR	RLCA	
		1	6/30/83	RLCA	PER/C	TES	
		2	7/7/83	TES	ER/C	PGandE	None
		3	7/7/83	TES	CR	None	
1140	Fire Pump - Discharge nozzle flange bolting overstress	0	7/29/83	RLCA	OIR/OIP	PGandE	
		1	8/12/83	RLCA	OIR	RLCA	
		2	8/12/83	RLCA	PER/C	TES	
		3	8/12/83	TES	ER/C	PGandE	

STATUS: Status is indicated by the type of classification of latest report received by PGandE:

OIR - Open Item Report
PPRR - Potential Program Resolution Report
PRR - Program Resolution Report
PER - Potential Error Report
OIP - Open Item with future action by PGandE
ER - Error Report
CR - Completion Report
CI - Closed Item
DEV - Deviation
A - Class A Error
B - Class B Error
C - Class C Error
D - Class D Error

PHYSICAL MOD: Physical modification required to resolve the issue. Blank entry indicates that modification has not been determined.

Appendix B
Sample IDVP Checklists
(9 pages)

APPENDIX B(1)

Mechanical/Nuclear Engineering Equipment Design Review Checklist

Equipment_____ Page____of_____
File No._____Calc. No._____ By_____Date_____

	Satisfactory Yes	No	Comment
1.0 GENERAL COMMENTS			
1.1 Pages are sequentially numbered and titled.	____	____	_____
1.2 Description of equipment includes:			
1.2.1 Title, drawings, revision number/letter.	____	____	_____
1.2.2 Type of structure & material seismic category, dead weight location, etc.	____	____	_____
1.2.3 Field verification data.	____	____	_____
1.3 Design requirements and/or criteria references the applicable specifications, standards, codes and revisions.	____	____	_____
1.4 Method of analysis and assumptions are clearly stated.	____	____	_____
1.5 Summary or conclusion statement verifies that equipment satisfies structural and/or functional criteria.	____	____	_____
1.6 Computer program names and version are documented.	____	____	_____
1.6.1 Computer programs are verified or included on approved listing.	____	____	_____
1.7 References are documented.	____	____	_____

	Satisfactory Yes	No	Comment
2.0 DESIGN REQUIREMENTS			
2.1 Design temperature complies with design or operating conditions.	____	____	_____
2.2 Material properties are specified at the design temperature.	____	____	_____
2.3 Structural damping values comply with DCM M-45.	____	____	_____
2.4 Static Loads are documented and comply with project specification (see Section 1.3).	____	____	_____
2.4.1 Pressure (internal, external), thermal, mechanical, dead weight, pipe reaction and nozzle loadings are documented.	____	____	_____
2.4.2 Load magnitude and direction are documented.	____	____	_____
2.4.3 Loads are prescribed with units of loading (i.e., lb., kip, psi, etc.).	____	____	_____
2.5 Seismic (dynamic) response spectra curves are documented and comply with project specification (see Section 1.3).	____	____	_____
2.5.1 Spectra and damping are applicable to equipment at appropriate floor elevation(s) (see DCM C-17, C-25 and C-30).	____	____	_____
2.5.2 Hosgri, DE and DDE are documented.	____	____	_____
2.6 Static and Seismic load combinations conform to DCM M-45	____	____	_____
2.7 Acceptance Criteria			
2.7.1 Allowable stress limits are prescribed for static, seismic, or load combinations.	____	____	_____

	Satisfactory Yes	No	Comment
2.7.2 Applicable design criteria of ASME, ACI, and AISC are considered.	____	____	_____
2.7.3 Considered design criteria for			
2.7.3.1 Deflection	____	____	_____
2.7.3.2 Natural frequency	____	____	_____
2.7.3.3 Temperature	____	____	_____
2.7.3.4 Strain limit	____	____	_____
2.7.3.5 Operability	____	____	_____
3.0 METHOD OF ANALYSIS			
3.1 Analytical method provides response (stresses, deflection, etc.) equal to or greater than in-service conditions.	____	____	_____
3.2 Assumptions provide conservative stresses and deflections.	____	____	_____
3.3 Applied static and seismic loads equal or envelop design loads in Sections 2.4 and 2.5.	____	____	_____
3.4 Specified boundary conditions provide solution equal to or more severe than in-service conditions.	____	____	_____
3.5 Computer programs and/or analytical methods and assumptions are applicable to the equipment and loading.	____	____	_____
3.6 Detailed hand calculations comply as follows:			
3.6.1 Equations reference standards or textbooks.	____	____	_____
3.6.2 Equations are applicable to method of analysis and assumptions.	____	____	_____
3.6.3 Considers the three-dimensional response, if applicable.	____	____	_____
3.6.4 Evaluates local stresses at discontinuities and connections.	____	____	_____

	Satisfactory Yes	No	Comment
3.7 Computer program output shall be verified for the following:			
3.7.1 Verification of model description.			
3.7.1.1 Coordinate axis is a right hand system.	____	____	_____
3.7.1.2 Nodal point X, Y, Z coordinates are correct.	____	____	_____
3.7.1.3 Finite element (i.e., plates, beams, etc.) description and orientation are correct.	____	____	_____
3.7.1.4 Graphical plots (if available) correlate with the actual structure.	____	____	_____
3.7.1.5 Material properties are correct.	____	____	_____
3.7.1.6 Nodal point restraints are equal to conditions in Section 3.4.	____	____	_____
3.7.1.7 Nodal point and distributed loads are equal to Section 3.3.	____	____	_____
3.7.2 Verification of computer static or dead load solution.			
3.7.2.1 Nodal point translations ($\Delta x, \Delta y, \Delta z$) and rotations ($\theta x, \theta y, \theta z$) are approximately of the same order.	____	____	_____
3.7.2.2 Node points with zero (00.000) deflection and rotation are consistent with Sections 3.4 and 3.7.1.6.	____	____	_____
3.7.2.3 Total dead weight and center of gravity, if available, are correct.	____	____	_____

	Satisfactory Yes	No	Comment
3.7.2.4 Total lateral reaction forces and applied loads are in equilibrium.	____	____	_____
3.7.2.5 Load path at unique joints are acceptable based upon good engineering judgement.	____	____	_____
3.7.2.6 Simple hand calculations assure adequacy of model and solution.	____	____	_____
3.7.3 Verification of computer or hand calculation natural frequency solution.			
3.7.3.1 Lowest reasonant frequency and mode shape compare with hand solution for simple system.	____	____	_____
3.7.3.2 Other resonant frequencies and mode shapes are acceptable.	____	____	_____
3.7.3.3 Lowest resonant frequency is greater than 33 hertz.	____	____	_____
3.7.4 Verification of computer response spectra solution.			
3.7.4.1 Echo listing of response spectra is identical to curves reviewed in Section 2.5.	____	____	_____
3.7.4.2 Input response spectra includes frequencies between lowest resonance and zero period acceleration.	____	____	_____
3.7.4.3 Total "generalized mass" is approximately 90 % of total dead weight.	____	____	_____

	Satisfactory Yes	No	Comment
3.7.5 Verification of computer load combination solution.			
3.7.5.1 Echo listing includes load combinations in Section 2.6.	____	____	_____
3.7.5.2 Hand calculations show proper summation of load cases.	____	____	_____
3.7.5.3 Hand calculations show correct stress computation.	____	____	_____
4.0 DETAILED STRESS ANALYSIS			
4.1 Hand calculation and/or computer stresses are summarized in their proper stress and material categories.	____	____	_____
4.2 Stresses are computed for local details, such as welds, bolting, or local discontinuities.	____	____	_____
4.3 Max. stresses satisfy acceptance criteria in Section 2.7 or applicable design criteria.	____	____	_____
4.4 Deflections satisfy acceptance criteria, if applicable.	____	____	_____

APPENDIX B(2)

Mechanical Equipment

Design Review Checklist
Shake Table Tested Equipment

Equipment_____ Reviewed by_____Date_____

File No._____Calc. No._____ Page_____of_____

		Satisfactory Yes	No	Comment
1.0	GENERAL COMMENTS			
1.1	Design requirements and/or criteria references the applicable specifications, standards, codes and revisions?	____	____	_____
1.2	Methods and assumptions are clearly stated?	____	____	_____
1.3	Summary or conclusion statement verifies that equipment satisfies structural and/or functional criteria?	____	____	_____
1.4	References are documented?	____	____	_____
2.0	TEST REQUIREMENTS			
2.1	Seismic response spectra curves are documented and comply with project specification?	____	____	_____
2.2	Spectra and damping are applicable to equipment at appropriate floor elevation location (see DCM C-17, C-25 and C-30)?	____	____	_____
2.3	Hosgri, DE and DDE are documented?	____	____	_____
2.4	Is the RRS frequency range adequate to meet the design requirements?	____	____	_____
2.5	RRS reflects envelope of the current spectra revisions or is it more conservative?	____	____	_____

Equipment_____ Reviewed by_____Date_____

File No._____ Calc. No._____ Page_____of_____

		Satisfactory Yes	No	Comment
2.6	Are design operating conditions simulated for the test?	____	____	_____
3.0	CODES AND STANDARDS			
3.1	Are the applicable codes, standards and/or guidelines referenced?	____	____	_____
3.2	Are these codes, standards and/or guidelines correctly specified for the test?	____	____	_____
4.0	TEST PERFORMANCE			
4.1	Does the performance of the test adhere to the applicable codes, standards and/or guidelines specified?	____	____	_____
4.2	Do the test mountings accurately represent the as-built configuration with respect to:			
	a. location of attachments	____	____	_____
	b. dynamic characteristics	____	____	_____
	c. non-linearities, if any	____	____	_____
4.3	Is the test mounting adequate to predict the structural adequacy of the in-service mounting?	____	____	_____
4.4	Do the test orientations satisfy the specifications?	____	____	_____
4.5	Do the number of types of test runs meet the requirements of the specifications?	____	____	_____
4.6	Does the TRS envelop the specified RRS throughout?	____	____	_____
4.7	If the TRS does not envelop the RRS throughout, are the qualification results adequately justified?	____	____	_____

Equipment_____ Reviewed by_____Date_____

File No.____ Calc. No._____ Page_____of_____

		Satisfactory Yes	No	Comment
5.0	EQUIPMENT MODIFICATIONS			
5.1	Did the equipment meet performance requirements without modification?	____	____	_____
5.2	Were the modifications adequately documented?	____	____	_____
5.3	Were the modifications performed upon the equipment in the plant?	____	____	_____

Appendix C
Key Term Definitions
(6 pages)

APPENDIX C

KEY TERM DEFINITIONS

(The definitions in this glossary establish the meanings of words in the context of their use in this document. These meanings in no way replace the specific legal and licensing definitions.)

Allowable Criteria

- Maximum stress or load provided by the licensing criteria.

Calculation Files

- DCP term for set of individual, numbered design calculations.

Class 1E

- The safety classification of the electrical equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment.

Closed Item

- A form of program resolution of an Open Item which indicates that the report aspect is neither an Error nor a Deviation. No further IDVP action is required.

Corrective Action

- Response of the Diablo Canyon Project to concerns related to the Hosgri qualification which were identified either by the IDVP or by the DCP Internal Program.

DCP

- Diablo Canyon Project: PGandE and Bechtel Power Corporation.

DDE

- Double design earthquake.

DE

- Design earthquake.

Design Analysis

- Work performed by or for PGandE.

Deviation

- A form of program resolution of an Open Item indicating a departure from standard procedure which is not a mistake in analysis, design, or construction. No physical modifications are required, but if any are applied, they are subject to verification by the IDVP.

Dynamic Load

- A force exerted by a moving body on a resisting member, usually in a relatively short time interval; also known as energy load.

EOI

- Error and Open Item Report.

Equivalent Static Method

- Static analysis method whereby an acceleration figure is applied to the component configuration.

Error Report

- An Error is a form of program resolution of an Open Item indicating an incorrect result that has been verified as such. It may be due to a mathematical mistake, use of wrong analytical method, omission of data, or use of inapplicable data.

  Each Error shall be classified as one of the following:

o Class A: An Error is considered Class A if the design criteria or operating limits of safety-related equipment are exceeded and, as a result, physical modifications or changes in operating procedures are required. Any PGandE corrective action is subject to verification by the IDVP.

- o Class B: An Error is considered Class B if the design criteria or operating limits of safety-related equipment are exceeded, but are resolvable by means of more realistic calculations or retesting. Any PGandE corrective action is subject to verification by the IDVP.

- o Class C: An Error is considered Class C if incorrect engineering or installation of safety-related equipment is found, but no design criteria or operating limits are exceeded. No physical modifications are required, but if any are applied, they are subject to verification by the IDVP.

- o Class D: An Error is considered Class D if safety-related equipment is not affected. No physical modifications are required, but if any are applied, they are subject to verification by the IDVP.

Field Verification

- The process of verifying actual configuration of equipment, buildings, and components at the installation site against PGandE isometric drawings.

FSAR

- PGandE's Final Safety Analysis Report.

Generic

- Relating to or characteristic of a whole group or class; general.

Hosgri Criteria

- Licensing criteria referring specifically to the postulated 7.5M Hosgri earthquake.

Hosgri Report

- A report issued by PGandE that summarizes their evaluation of the DCNPP-1 for the postulated Hosgri 7.5M earthquake; includes seismic licensing criteria.

Hosgri 7.5M Earthquake

- Maximum intensity earthquake for which the plant is designed to remain functional.

IDVP

- Independent Design Verification Program undertaken by R. L. Cloud Associates, Teledyne Engineering Services, Stone & Webster Engineering Corporation and R. F. Reedy to evaluate Diablo Canyon Nuclear Power Plant for compliance with the licensing criteria.

IEEE

- The Institute of Electrical and Electronics Engineers, Inc.

Independent Analysis

- Seismic analysis performed by Robert L. Cloud and Associates.

In-Line

- Refers to equipment connected to and supported solely from piping, such as the residual heat removal pump that is qualified, based on pipe analysis results.

Interim Technical Report

- Interim Technical Reports are prepared when a program participant has completed an aspect of their assigned effort in order to provide the completed analysis and conclusions. These may be in support of an Error, Open Item or Program Resolution Report, or in support of a portion of the work which verifies acceptability. Since such a report is a conclusion of the program, it is subject to the review of the Program Manager. The report will be transmitted simultaneously to PGandE and to the NRC.

Internal Technical Program

- Combined Pacific Gas and Electric Company and Bechtel Power Corporation project formed for Diablo Canyon completion.

Licensing Criteria

- Contained in PGandE licensing documents; includes allowable criteria (see Hosgri Report).

Load

- Consists of forces, moments, accelerations, and displacements which are applied to piping, attached equipment, or supports.

NRC

- Nuclear Regulatory Commission (formerly the AEC).

Open Item

- A concern that has not been verified, fully understood and its significance assessed. The forms of program resolution of an Open Item are recategorized as an Error, Deviation, or a Closed Item.

PGandE

- Pacific Gas and Electric Company.

Qualification

- The final step in the process of evaluating plant buildings, systems and components, and confirming that they comply with the plant licensing criteria.

Response Spectra

- A plot, for all periods of vibration, of the maximum acceleration experienced by single degree of freedom vibration bodies during a particular earthquake; used in seismic analysis. Types of spectra comprise both vertical and horizontal. Vertical spectra consist of translational effects only. Horizontal spectra include East-West and North-South translation, and East-West and North-South torsion.

RLCA

- Robert L. Cloud and Associates, Incorporated.

Shake Table Testing

- A method for seismic qualification of components; items are tested to simulated seismic activity.

Single Degree of Freedom Model

- Simplified mathematical representation of a structure.

Spectral Input

- Acceleration value taken from response spectra for input into seismic analysis.

Appendix D
Program Manager's Assessment
(1 page)

APPENDIX D

PROGRAM MANAGER'S ASSESSMENT

As IDVP Program Manager, Teledyne Engineering Services (TES) has established Review and Evaluation Teams, headed by a qualified team leader, as described in Section 7.4(c) of the Phase I Program Management Plan (Revision 1). The assigned teams for the equipment areas included in this Interim Technical Report, have reviewed the RLCA design review packages of selected DCP calculation files as well as the underlying DCP documents. The team leaders have discussed these items with RLCA personnel as needed. In addition, the TES team leaders have reviewed the Open Item Files pertaining to their areas of responsibility and, in particular, those files for which RLCA has issued Potential Program Resolution Reports or Potential Error Reports, and on the basis of these evaluations, has recommended appropriate resolutions to the IDVP Program Manager.

It should be noted that the final resolution of EOI's 1128 and 1140 will be reported in revision 1 of this ITR.

Based on this review and evaluation process to date, the Team Leaders, along with the TES Program Management Team, have studied and have concurred with the conclusions outlined in Section 12.0 of this report.