UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING APPEAL BOARD

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| In the Matter of:<br><br>PACIFIC GAS AND ELECTRIC COMPANY<br><br>(Diablo Canyon Nuclear Power Plant, Units 1 and 2) | Docket Nos. 50-275 O.L<br>50-323 O.L. |

TESTIMONY ON BEHALF OF THE INDEPENDENT DESIGN VERIFICATION PROGRAM

OF

Dr. William E. Cooper
Dr. Robert L. Cloud
Mr. John E. Krechting
Mr. Roger F. Reedy

REGARDING

CONTENTIONS 1, 2 and 5-8

In the Matter of:

PACIFIC GAS AND ELECTRIC COMPANY

(Diablo Canyon Nuclear Power Plant, Units 1 and 2)

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TESTIMONY REGARDING CONTENTIONS 1,2 and 5-8

INTRODUCTORY TESTIMONY

Q.1: Please state your name, current position, business address and qualifications.

A.1: (WEC) I am Dr. William E. Cooper, Consulting Engineer for Teledyne Engineering Services (TES), located at 130 Second Avenue, Waltham, Massachusetts, 02254. My educational background and professional experience are summarized in Attachment 1 to this testimony.

(RLC) I am Dr. Robert L. Cloud, Principal in the firm of Robert L. Cloud Associates (RLCA), located at 125 University Avenue, Berkeley, California, 94710. My educational background and professional experience are summarized in Attachment 2 to this testimony.

(JEK) I am John E. Krechting, Project Engineer, with Stone & Webster Engineering Company (SWEC), 245 Summer Street, Boston, Massachusetts 02107. My educational background and professional experience are summarized in Attachment 3 to this testimony.

(RFR) I am Roger F. Reedy, Principal in the firm of R.F. Reedy, Inc. (RFR), 105 Albright Way, Los Gatos, California, 95030.

My educational background and professional experience are summarized in Attachment 4 to this testimony.

Q.2: Please describe your participation in the Independent Design Verification Program (IDVP).

A.2: (WEC) As Project Manager for TES Project 5511, I managed the efforts of TES as Program Manager for the IDVP as described in A.2 of the Testimony Regarding Contentions 1 and 2.

(RLC) As the principal of RLCA, I managed the firm's efforts in connection with the IDVP as described in A.2 of the Testimony Regarding Contentions 1 and 2.

(JEK) As Project Engineer, I managed the technical effort of SWEC in connection with the IDVP as described in A.2 of the Testimony Regarding Contentions 1 and 2.

(RFR) As the principal of RFR, I managed the firm's efforts in connection with the IDVP as described in A.2 of the Testimony Regarding Contentions 1 and 2.

Q.3: What is the purpose of your testimony?

A.3: (ALL) This testimony describes the role of the IDVP in the verification of design work of the DCNPP-1, and how the IDVP performed its work. In addition, this testimony addresses Contentions 1,2 and 5-8 as they relate to the IDVP's work.

## CONTENTIONS 1 AND 2

"1. The scope of the IDVP review of both the seismic and non-seismic aspects of the designs of safety-related systems, structures and components (SS&C's) was too narrow in the following respects:

(a) The IDVP did not verify samples from each design activity (seismic and non-seismic).

(b) In the design activities the IDVP did review, it did not verify samples from each of the design groups in the design chain performing the design activity.

(c) The IDVP did not have statistically valid samples from which to draw conclusions.

(d) The IDVP failed to verify independently the analyses but merely checked data of inputs to models used by PG&E.

(e) The IDVP failed to verify the design of Unit 2.

"2. The scope of the ITP review of both the seismic and non-seismic aspects of the designs of the safety-related systems, structures and components (SS&C's) was too narrow in the following respects:

(a) The ITP did not verify samples from each design activity (seismic and non-seismic).

(b) In the design activities the ITP did review, it did not verify samples from each of the design groups in the design chain performing the design activity.

(c) The ITP did not have statistically valid samples from which to draw conclusions.

(d) The ITP has failed systematically to verify the adequacy of the design of Unit 2."

Q.1: Why was the Independent Design Verification Program (IDVP) for the Diablo Canyon Nuclear Power Plant, Unit 1 (DCNPP-1) established?

A.1: (WEC) On November 19, 1981, the Commission issued Order CLI-81-30 (Commission Order) suspending portions of Operating License No. DPR-76. At the same time, the NRC Staff issued a letter (Staff Letter) which required additional steps prior to power ascension. The Commission Order and Staff Letter required an independent verification of design efforts performed internally by Pacific Gas and Electric Company (PGandE) or on behalf of PGandE by service-related contractors on safety-related structures, systems, and components (SSCs). The IDVP was

established in response to the Commission Order and the Staff Letter.

Q.2: Which organizations participated in the IDVP?

A.2: (All) The participants in the IDVP were as follows:

- o Teledyne Engineering Services (TES) served as Program Manager. In that capacity, TES assured that the IDVP was conducted in accordance with approved program plans, including review and approval of all IDVP reports and conclusions.
- o R.F. Reedy, Inc. (RFR) performed the Design QA Audits and Reviews and the design office verification of the Diablo Canyon Project (DCP) Corrective Action Program (CAP).
- o Robert L. Cloud Associates, Inc. (RLCA) verified the seismic, structural, and mechanical aspects of the design process.
- o Stone & Webster Engineering Corporation (SWEC) verified the safety system and safety analysis aspects of the design process.

In addition to these major participants, TES retained a number of organizations and individuals to assist the IDVP in specialty areas. Of most importance in this regard was the participation of Professors Myle J. Holley, Jr., and John M. Biggs, who were sufficiently involved in the review of the civil-structural area that they were able to co-approve, with TES, the resulting Interim Technical Reports (ITRs).

Q.3: To whom did the IDVP Program Manager report?

A.3: (WEC) As IDVP Program Manager, TES reported independently to NRC (Denton) and PGandE (Maneatis).

Q.4: Please summarize the requirements of the Commission Order and the process which lead to Commission approval of the IDVP Phase I Program Plan.

A.4: (WEC, RLC) The Commission Order required performance "of an independent design verification of all safety-related activities performed prior to June 1, 1978, under all seismic-related service contracts utilized in the design process for safety-related structures, systems, and components." In summary, the IDVP was to include the following program elements: QA procedures and controls relative to the related criteria of Appendix B to 10 CFR 50; identification of interfaces between PGandE internal design groups and each contractor; implementation of the QA procedures and controls; and selection and performance of sample calculations, with criteria for expanding the sample when problems in verification are encountered.

The program developed in response to the Commission Order was identified as Phase I and was initially submitted by PGandE's letter of December 4, 1981. During the period December 1981 through March 1982 there were a series of meetings involving the various parties to review the proposed program and revisions thereto. These culminated in NRC SECY-82-89 which summarized the Staff evaluation of the scope and technical adequacy of the Phase I program and concluded that the proposed program satisfied the Commission Order requirements and, if properly implemented, would allow determination of whether there was reasonable assurance that the overall seismic design was in conformance with the

license application. After TES was named as Program Manager, it submitted the Phase I Program Management Plan, which integrated previous submittals and included requirements for TES review and acceptance of IDVP work done prior to March 25, 1982. An NRC letter to PGandE dated April 27, 1982 approved the activities covered by the Plan as being responsive to the Commission Order, to SECY-82-89 as revised and voted upon by the Commission on March 4, 1982, and to previous Staff concerns.

Q.5: Please summarize the requirements of the Staff Letter and the process which lead to Commission approval of the IDVP Phase II Program Plan.

A.5: (WEC, JEK) The Staff Letter is similar to the Commission Order, except that it addresses three aspects: all non-seismic service-related contracts prior to June 1978; PGandE internal design activities, without stated restriction as to date; and all service-related contracts post-January 1, 1978.

Based upon the total IDVP efforts to date, on June 18, 1982, TES developed and transmitted the IDVP Phase II Program Plan to NRC and PGandE. There followed a series of meetings similar to those held during the earlier period with respect to Phase I, which resulted in the Staff position documented by SECY-82-414. On December 9, 1982, the Commission approved "the Phase II Program Plan of June 18, 1982, including the proposed IDVP Contractors, as modified by the Staff in Enclosure 11 to SECY-82-414." This approval was contained in an NRC letter to PGandE dated December 25, 1982.

Q.6: Is the distinction between Phase I and Phase II meaningful at this time?

A.6: (ALL) No, in that there is a more useful distinction available, that between "seismic" and "non-seismic" considerations. In using the term "seismic", however, it must be understood that the review included effects resulting from non-seismic loadings which, in accordance with license application criteria, must be combined with the effects of seismic loadings.

Q.7: Please identify the IDVP program elements and which organization was responsible for each element.

A.7: (ALL) The program elements are described in Section 3.5 of the IDVP Final Report. A convenient breakdown of the program elements, including subsequent portions of this testimony where each is addressed, is as follows:

| Element | Q/A No. | IDVP Program Element |
|---|---|---|
| 1 | 9-14 | Design Chain |
| 2 | 15 | QA Audits and Reviews |
| 3 | 16, 20 | Initial and additional sample verification |
| 4 | 17-19 | Verification of CAP |
| 5 | 21-24 | Identification and resolution of concerns |

RFR, RLCA and SWEC performed element (1). RFR performed element (2) and the QA audit and the "design office verification" which was part of element (4).

RLCA and SWEC performed elements (3), (5), and (6) in their area of responsibility and RLCA performed the design process verification identified as part of element (4). The RLCA area of responsibility included all seismic, structural and mechanical

aspects as defined by the IDVP Program Plan and ITR-1, and the verification of the CAP as defined in ITRs-8 and -35.

The SWEC area of responsibility included the system design aspects of safety-related systems and the performance of safety-related analyses for the sample systems and analyses defined by the IDVP Program Plan, and verification of the corrective action taken by the DCP with respect to the generic concerns identified by the IDVP (ITR-34).

All of the major IDVP participants were involved in the identification of "basic cause", in the evaluations contained in Section 6 of the IDVP Final Report, and in developing the IDVP conclusions contained in Section 2 of that report.

Q.8: Please describe the types of reports issued by the IDVP.

A.8: (WEC) A description of Program Reporting is included in Section 3.6 of the IDVP Final Report, and can be summarized as follows:

- The IDVP issued Semimonthly Reports to all parties.
- The Error or Open Item (EOI) File System was used for tracking of IDVP concerns. When either the verification of the initial sample or the QA Audits and Reviews determined that an item did not meet verification criteria or unresolved issues existed, an Open Item Report (OIR) was issued. An OIR indicated a concern that had not been verified, fully understood, or assessed as to its significance.
- Interim Technical Reports (ITRs) were used by the IDVP to document programmatic aspects or to report detailed

technical results. An ITR was prepared when a program participant completed an aspect of its assigned effort. Most ITRs were technical and provided the results of a completed verification or were in support of an Error, Open Item, or Program Resolution Report. Other ITRs (e.g., ITRs-1, -8, -34, and -35) were programmatic and used to define the IDVP decision as to the need for additional verification, additional samples, or verification of DCP activities.

- The IDVP Final Report summarizes the IDVP efforts and includes the IDVP conclusions and evaluation in response to the Commission Order and the Staff Letter.

Q.9: What is a "design chain", and were design chains identified by the IDVP?

A.9: (ALL) As discussed in the IDVP Final Report, Section 4.1, the IDVP developed design chains that identified the organizations involved in the separate but linked process of providing the design for a specific safety-related SSC selected for evaluation. Each design chain was developed from a listing of service-related PGandE contractors. The specific contractors who had an influence on the final (as of November 30, 1981) safety-related design were identified. Additionally, interfaces were identified between service-related contractors and PGandE.

Q.10: What assurance does the IDVP have that all service-related contractors contributing to the final (as of November 30, 1981) design were identified?

A.10: (ALL) The SSCs subject to Hosgri qualification and the participating organizations were identified by RLCA prior to

the development of the Phase I Program Plan, so were considered in developing the initial samples. Similarly, the systems for which PGandE was responsible were known at the time the Phase II Program Plan was developed and three SWEC sample systems were chosen accordingly.

RFR performed a review of the contractors list early in Phase II, which provided additional assurance as to the role of the various organizations. The RFR effort confirmed the earlier RLCA work with respect to Hosgri organizations. With respect to the three SWEC sample systems considered in Phase II, the SWEC design process verification confirmed the RFR developed contractor list. The remaining organizations to be identified were those involved with PGandE subsequent to January 1, 1978 which were not involved with Hosgri qualification or the SWEC sample. The RFR identification of these organizations was confirmed by the subsequent QA Audit and Review of PGandE interfaces with contractors and by the review of the PGandE "lookback" QA review. These combined activities provided assurance that the IDVP considered the proper service-related organizations in performance of the QA Audits and Reviews and the design process verification.

Q.11: Which service-related contractors were included in the design chains identified by the IDVP?

A.11: (ALL) The nine firms were ANCO Engineers, URS/J. Blume, Cygna Energy Services (formerly Earthquake Engineering Services), EDS Nuclear, Inc., Garretson-Elmendorf-Zinov, Harding-Lawson Associates, Quadrex (formerly Nuclear Services Corp.), Radiation Research Associates, and Wyle Laboratories.

Q.12: Please explain why other service-related contractors were eliminated from the list of those considered by the IDVP?

A.12: (ALL) As stated in Section 4.1.4 of the IDVP Final Report, PGandE had identified 61 safety-related service contractors which were active at any time for seismic and non-seismic activities. All of these and their scope of work are identified in ITR-9. Of the 52 contractors not included in the IDVP design chains, 43 were eliminated because they did not contribute significantly to the final design, that is, they were involved only in licensing or in design studies, they provided only minor design input, they performed only non-destructive examination (NDE) services, or they provided only design inputs which were not used in final design.

The remaining nine firms were eliminated for the following reasons. Two firms, RLCA and TES, were eliminated because they were participating in the IDVP. Westinghouse was eliminated because it is the NSSS supplier. Three firms, James Engineering Company, Kaiser Engineers and Mark G. Jones, were eliminated because all of their work had been performed in the PGandE office under the PGandE QA program. Two firms, Nutech, Inc. and Western Canada Hydraulic Laboratories, were eliminated because their work was subject to separate audit by the NRC. Finally, General Electric Co. was eliminated because it provided only consulting services in the testing of switchgear. It is included in this specific listing only because its name had been raised in previous dicussions. However, since its participation was limited to consulting services, it could have been eliminated on the same

basis as other firms which did not contribute significantly to the final design.

Q.13: Please explain why the elimination of these contractors from the IDVP's verification did not detract from the IDVP's ability to reach its conclusions as to the design of DCNPP-1.

A.13: (ALL) Obviously the elimination of the contractors which did not contribute significantly to the final design had no impact on the IDVP's efforts.

Elimination of the contractors named in A.12 did not detract from the IDVP's ability to reach its conclusions for differing reasons dependent upon the specific firms involved. The exclusion of the IDVP participants (TES and RLCA) was a recognized fact since the beginning of the program, and the Program Plans were approved by the Commission with that exclusion. The exclusion of Westinghouse is discussed in the testimony regarding Contention 6. The work of the three firms working under the PGandE program was subject to verification as part of the PGandE effort, and thus was included or excluded solely on the basis of whether it was part of an IDVP sample. Two firms, Nutech and Western Canada Hydraulic Laboratories, were excluded because the specific work performed with regard to DCNPP-1 had previously been reviewed by the NRC, and it was unnecessary to duplicate such effort.

Q.14: What was the effect of this design chain effort on the verification performed by the IDVP?

A.14: (ALL) The nine service-related contractors included in the design chains were all subjected to the IDVP QA Audits and

Reviews, in accordance with the requirements of the Commission Order and the Staff Letter. Knowledge of the participating organizations was also useful in verification of the design process. Of the nine identified organizations, the work of all but two was included in the initial samples for one or both of the design process verification phases. The two organizations, whose work was not included in the initial samples, were Harding-Lawson Associates and Garretson-Elmendorf-Zinov (GEZ). Because of negative results from the subsequent evaluation of the QA Audit and Review, additional verification was performed of the soils work originally conducted by Harding-Lawson Associates. Because GEZ was known not to be included in the initial sample for Phase II, particular attention was given to its efforts by RFR, and EOI 7001 was opened to assure that additional investigation was conducted of an aspect of potential concern. Additional verification resolved the potential concern satisfactorily, and the EOI file was closed.

Q.15: What was the purpose of performing the QA Audits and Reviews?

A.15: (WEC, RFR) The QA Audits and Reviews were performed to evaluate both the formal QA program imposed for the work and the implementation of that program. Although QA Audits and Reviews provided certain information in direct response to the Commission Order and Staff Letter, another IDVP purpose was to obtain background information which might have impacted the extent of design process verification. Based on Phase I experience, an additional step was added for Phase II. If the reviewed organization did not have a formal QA program, or if its formal

QA program was not properly implemented, its actual design control practices were evaluated and reported as a part of the QA Audit and Review Report. Additional sampling was considered if negative results were obtained from the QA Audit and Review of an organization whose work was not included in the initial sample. Similarly, additional verification was considered when the organization's work was included in the initial sample, but that sample did not include the negative aspect.

Q.16: How were the initial samples chosen for verification of the design process?

A.16: (WEC, RLC, JEK) The selection of the initial samples to be used for verification of the design process are indicated in the Engineering Program Plan for each phase. All initial sample activities were performed on work completed on or before November 30, 1981. For both the seismic and non-seismic verifications, the initial samples were chosen on the basis of engineering judgement, considering the experience of the participants in the design of Pressurized Water Reactors (PWRs) and the implications of seismic and other operating conditions on such systems.

Q.17: Was the IDVP's work on the initial samples and additional verifications/samples in the seismic review superseded by subsequent events?

A.17: (WEC, RLC) Yes. In response to the seismic design concerns identified by June, 1982, PGandE instituted the CAP, which was consistent with and responsive to both the IDVP and the Commission Order. As described in the PGandE Phase I Final Report, Section 1.5.2, the CAP included the performance of a

broad-based review of safety-related SSCs enveloping and correcting the previous ITP and IDVP results. The expanded ITP effort provided more complete and consistent documentation of the design work, with all new work performed to the latest approved QA requirements and procedures. Finally, the expanded program was intended to make it unnecessary to review older analyses or calculations which were being redone. The CAP results became the seismic analyses of record.

In response to this action, the IDVP issued ITR-8, "Verification of the Corrective Action Program". This plan included an examination of the corrective action scope, criteria, and methodology for consistency with the criteria of the license application. It also required that the CAP be audited for proper implementation of the NRC-approved QA requirements, with emphasis on technical interface control and project indoctrination. The purpose of these audits was to gain assurance that the very extensive CAP was being conducted in a planned and controlled manner.

Q.18: What was the scope of the IDVP verification of the CAP seismic review and how was it accomplished?

A.18 (WEC, RLC) The scope of the IDVP verification of the CAP seismic review required a verification of all the CAP activities for each safety-related SSC within PGandE's original scope for design.

The IDVP verification program for CAP activities was defined by ITR-8. Prior to preparation of that ITR, the DCP had provided its detailed plans in open meetings during the summer of 1982 and had described its methodology in sufficient detail for the IDVP

to judge that the CAP was a reasonable substitute for the program of additional verification described by Revision 0 to ITR-1. Specifically, it permitted the IDVP to combine several EOI Files that had either indicated errors in the previous PGandE work, or that had raised issues about that work which had not been resolved, into a limited number of generic EOIs which were used to track the IDVP verification of the CAP work. Hence, those generic EOIs identified all of the IDVP concerns previously identified and all of the DCP efforts related to the safety-related SSCs to which these concerns applied.

The general approach of the IDVP toward verification of CAP activities was intended to develop a sound understanding of all of the engineering used in the design activities subject to the IDVP. The IDVP wanted to understand the rationale, methods and computer codes used by considering: all the options available; the level and degree of sophistication of models employed; and the completeness of the work. In short, the IDVP sought to develop a complete undertanding of the design process and confidence that the process was being properly applied.

With respect to SSCs, ITR-8 defined the following to be subject to verification:

- o Buildings (containment, auxiliary, fuel handling, turbine, intake)
- o Piping (large and small bore, with the supports)
- o Mechanical and electrical equipment (at least one of each type)
- o HVAC equipment and ducts, electrical raceways, and instrument tubing, all with supports.

The detailed application of this definition is described by the appropriate sections of the IDVP Final Report and in the ITRs numbered -51 and higher.

Three different approaches were followed by the CAP in the performance of its review: a complete reanalysis, a complete review followed by reanalysis of deficient segments and a sampling approach. The IDVP verification methodology varied with the approach followed by the CAP, which is also defined in ITR-8.

Given the SSCs subject to verification and the CAP identification of the approach it intended to use for each, it was possible for the IDVP to establish categories of like items, where the term "like" relates to the engineering process required for qualification. For example, the qualification of piping and supports involves similar features and uniform methodologies, whereas each of the buildings involves unique features and a differing methodology.

For each category, the IDVP reviewed the methodology to be applied, requested and received a complete index of the CAP work with respect to the subject SSCs, reviewed that index to assure that the CAP work was totally responsive to its scope, and then selected Design Review Packages (DRPs) for detailed review. The selection of appropriate DRPs was crucial to achieving the objectives of the verification efforts. It was necessary to select DRPs that addressed concerns developed by the IDVP either during earlier verifications or during review of the CAP methodology. It was also important for the IDVP to select a total set of DRPs sufficient to provide for an evaluation of the entire CAP process and to develop confidence in the implementa-

tion of that process. In addition, the DRPs were chosen to review the CAP work both while in-progress and after completion of a significant portion of the work. In total, approximately 200 DRPs were reviewed in detail by the IDVP. Both the available and the selected packages are identified in an appendix in each of the CAP-related ITRs.

Upon receipt, each DRP was subjected to detailed review by the IDVP, applying, singularly or in combination, two of the recognized methods for design verification--design review or independent analysis. As questions arose, they were transmitted in writing to the CAP and all responses which the IDVP relied upon were also in writing.

After completion of the review of various DRPs, the IDVP applied its improved knowledge of the CAP design process to develop a comprehensive understanding of that process and of the results obtained through the process. Where, in the opinion of the IDVP, additional reviews were required or where planned reviews could be deleted, the IDVP verification process was revised. Finally, the IDVP reached its present state of understanding and acceptance of the CAP work.

Q.19: Please describe in more detail how the verification of the CAP was performed by considering a specific area of seismic verification.

A.19: (RLC) The specific area chosen as an example is the verification of stresses in the containment shell.

Verification of the containment building was reported in ITR-54. That verification included both the interior and exterior concrete structures as well as the polar crane. The

containment shell and the base slab constitute the exterior structure, which is a Design Class 1 structure. The seismic conditions considered are Hosgri (both Newmark and Blume), Design Earthquake (DE) and the Double Design Earthquake (DDE), each in appropriate combination with thermal effects, pipe reactions, missile impact and internal pressures.

The scope of the DCP work is defined in the PGandE Phase I Final Report, and included a complete review of the dynamic analysis and member qualifications, with physical modifications to be implemented if required. The first step in the IDVP verification was to compare the DCP scope to the applicable criteria of the license application to assure that all requirements were being addressed.

The second step in the IDVP verification was to review the methodology described in the PGandE Phase I Final Report with respect to assumptions, modeling techniques and structure-unique requirements. For example, the basic safety function of the containment shell is to retain pressure during a Faulted Condition with recognition of all the defined load combinations.

Therefore, the methodology review included an evaluation of the three-dimensional models used for analysis of the containment shell with respect to assumptions, computation of mass and stiffness properties, boundary conditions and the finite element modeling of the physical structure. The DCP analysis of the overall dynamic response of the containment building was not reviewed in detail, because such review was performed with respect to other structures.

Having developed an understanding of the general approach to be applied by the DCP in its review of the containment shell, and considering the IDVP knowledge of the similarities and differences between the containment shell and the other structures, the IDVP was in a position to select the DRPs for detailed review. The first step in this process was the receipt from the DCP of a calculation index identifying all calculations pertinent to the containment building, which is an appendix to ITR-54. The IDVP examined this index to assure that all calculations required to perform the work were included, and found that it was complete. The IDVP reviewed this list for the purpose of identifying those DRPs which were to be subjected to detailed review. This selection was made with the objective of reviewing those DRPs which dealt with any previously identified IDVP concerns and those which, when considered together with the DRPs requested on other subjects, would provide a comprehensive understanding of the DCP process.

With respect to verification of the containment shell, the IDVP requested DRPs applicable to:

- Evaluation of the general containment shell using seismic loads from the URS/Blume axisymmetric models (Hosgri) and the associated pressure and thermal loads.
- Modeling and evaluation of the equipment hatch region.
- Modeling and evaluation of the base slab/shell junction.

The first of these calculations permitted review of the general characteristics of the containment shell. The second and third

permitted review of those portions of the containment shell which are usually limiting in the structural capability.

Each DRP was then reviewed by RLCA in accordance with a checklist which was designed to ensure that all significant topics are addressed. The main checklist items and guidelines are as follows:

- o Proper transfer of data from construction (pour lift and shop drawings) to design drawings. Verification of field conditions versus drawings was done on a sample basis.
- o Limitations of formulas, mathematical models, etc. and impact on results. Degree of conservatism or non-conservatism present, if any.
- o Formulation of mathematical models with respect to licensing commitments and required data. Use of proper seismic ground motion.
- o Inclusion of proper degree of freedom, mass, stiffness, and boundary conditions.
- o Accuracy of results obtained and assessment of any method limitations.
- o Applicability of the time history and response spectrum analysis methods.
- o Verification that proper formulas are used.
- o Verification of the mathematical accuracy of selected calculations.
- o Verification that all required loads, displacements and accelerations are obtained for member evaluation.
- o Review of all required load combinations and resulting

stresses against allowables in accordance with the specified criteria.

- Sample verification of data transfer for both hand calculations and computer runs.
- Verification that all calculation files reviewed are properly signed, dated, referenced and approved.

Review of each of the DRPs against the applicable portions of this check list was intended to assure that the IDVP considered the important aspects of each DRP. ITR-54 includes a summary of the DCP and IDVP results for each DRP.

The effort expended by the IDVP for the review, briefly described above, was extensive. RLCA first reviewed each DRP to identify issues where more information was required from the CAP. Following receipt of the additional information, a final review was made. RLCA documented both reviews, and the DCP and RLCA packages were reviewed by TES in conjunction with Professors Holley and/or Biggs. Formal Requests for Information (RFI) were used by both RLCA and TES to obtain additional information from the DCP whenever questions arose in the course of the review, and public meetings were held to permit the DCP to explain its approach, to answer questions and to identify additional information which was available through the RFI process. In the course of this total verification effort RLCA issued almost 1200 RFIs and approximately 40 open meetings were held.

It was this extensive effort which enabled the IDVP to reach the affirmative conclusions concerning the design of the containment shell that are stated in ITR-54 and Section 4.4.4 of the IDVP Final Report.

Q.20: Please explain the scope of the IDVP's non-seismic review and why the IDVP believes that this scope was sufficient.

A.20: (WEC, JEK) The selection of the non-seismic sample of safety-related systems and analyses to be verified by the IDVP was based on engineering judgement. The objective was to select samples of various types of engineering design work to ensure that generic errors did not exist in the unreviewed design.

The first step in the sample selection procedure was to identify the safety-related systems designed by PGandE and any service-related contractors who performed work that significantly affected the system's final design as of November 30, 1981. The IDVP also identified the various PGandE internal design groups that were responsible for the PGandE designed safety-related systems.

Based on this information, the IDVP selected samples of systems such that all of the PGandE design groups responsible for non-seismic system design were sampled. In addition, the service-related contractor who performed the most significant design work in the non-seismic system design area was reviewed. The only other seismic-related contractor which performed system-related design work was reviewed in detail as to its QA and design control practices by the IDVP. See discussion of GEZ in A.14. The IDVP selected safety-related analysis work such that all other identified service-related contractors which performed significant non-seismic analyses were sampled.

The selected systems were the auxiliary feedwater (AFW) system, the control room ventilation and pressurization (CRVP)

system and the safety-related portion of the 4160 V electric distribution system.

The AFW system was selected because its design represents an interrelationship of several design criteria and interfaces. Specifically, it involves interface with NSSS vendor criteria, with containment design criteria, interface of PGandE internal design organizations, and the methodology of determining a water system's mechanical, electrical, and control component design criteria. In addition, AFW systems often appear in the dominant accident sequences in various probabilistic risk assessment programs.

The CRVP system was selected because it too represents an interrelationship of several design criteria and interfaces. Specifically, it involves interface with a service-related contractor, interface of PGandE internal design organizations, and interface with the control room habitability criteria. It also represents a contrast of design methods since it is an air system rather than a water system.

The safety-related portion of the 4160 V electrical distribution system was selected because it is the basic power supply for safety-related electrical equipment. It also represents an interrelationship of several design criteria and involves the interfaces among several PGandE internal design organizations.

The three sample systems were designed by different engineering groups within PGandE, thus providing for evaluation of a broad spectrum of the PGandE engineering organization.

In addition, the IDVP selected two areas of safety-related analyses for review: the integrated dose analyses; and the tem-

perature, pressure and humidity analyses as they affect environmental qualification of equipment. These analyses were selected since this work was done almost exclusively by three service-related contractors and utilized by PGandE. The service-related contractors were different and their work involved a flow of design information through PGandE engineering groups.

For the three selected sample systems, a complete vertical verification of the system design was performed. The applicable licensing criteria were identified, and a system design chain was developed. The system's design was then reviewed to determine if the licensing criteria were satisfied. The review included the aspects of mechanical, electrical and instrumentation and control design.

In addition, the IDVP performed the following verifications of the sample systems. The IDVP verified the fire protection provided for the sample systems, including the separation, fire barriers, suppression and detection systems provided in areas containing sample system components. The IDVP verified that the AFW and CRVP systems were adequately protected from the effects of a high energy line break (HELB), high energy line crack (HELC), and moderate energy line break (MELB). This was an extensive effort which required identification of all high energy and moderate energy lines in relationship to the AFW and CRVP system components to ensure that these components were adequately protected. The IDVP verified that the AFW and CRVP system components were adequately protected from the effects of internally generated missiles. This again required identification of

potential missile sources and AFW and CRVP system targets to ensure that adequate protection was provided.

Although the verification described by the preceding paragraph and the safety-related analyses verification (radiation and pressure, temperature and humidity) previously described were specific to the three sample systems, the design work and methodology reviewed are generic to all safety-related systems in DCNPP-1, and in this sense are horizontal reviews. Thus, these reviews permitted the IDVP to examine a very broad aspect of safety-related design that is applicable to all safety-related systems.

In addition, when the IDVP identified concerns that were potentially generic, another review was performed by the DCP for that specific concern for all PGandE designed safety related systems and was verified by the IDVP. These reviews and verifications were performed in all areas of analyses of pressure, temperature and humidity due to HELB; selection of system design pressure and temperature; selection of differential pressure across power operated valves; redundancy of power supplies for shared systems; separation and single failure criteria for mutually redundant circuits; and jet impingement effects of HELB inside containment.

In summary, the IDVP not only performed very detailed and comprehensive reviews of three sample systems which included all the PGandE internal design groups responsible for non-seismic safety-related system design, but the IDVP verification also included work by the service-related contractor who provided the most significant input into the safety-related system design. In

addition, the IDVP performed many verifications of analysis and design functions that are generic to the design or design methodology of all safety-related systems. Moreover, the latter reviews included work from the various PGandE design groups as well as from all service-related contractors performing significant non-seismic design analysis.

Based on these extensive and detailed reviews, the IDVP has achieved a very broad-based and comprehensive understanding of the non-seismic design of the DCNPP-1. It is this broad-based and comprehensive understanding that provides the IDVP confidence in its conclusions as to the adequacy of the non-seismic design of DCNPP-1, as discussed in Sections 2 and 6 of the IDVP Final Report.

Q.21: How did the IDVP resolve any specific concern that it identified?

A.21: (ALL) Additional verifications were performed to resolve specific concerns if deficiencies were found by the evaluation of the QA Audits and Reviews with respect to the safety-related SSCs of the initial sample systems or if the verification criteria were found to be violated.

Additional sampling was performed either when significant deficiencies in the QA Program or its implementation were identified for an organization that was not a part of the initial sample system design chain, or when the reasons for the discrepancies found during design process verification were not clear and additional information was required.

Based on the results of each additional verification or additional sample, the responsible IDVP participant submitted a

recommendation to the Program Manager. When the item was determined not to have met licensing criteria, this recommendation may have included recommendations for additional verification of a generic concern. When the IDVP determined that the item met licensing criteria, the item was closed and the results reported.

Q.22: How were generic concerns identified and resolved?

A.22: (ALL) The identification of generic concerns was an important part of the IDVP. A generic concern was a concern which could impact design acceptability beyond the immediate SSCs for which the concern was initially identified. The IDVP conclusion that a generic concern existed was identified in an ITR (e.g., ITRs-1, -34). When generic concerns were identified, the steps that were taken included, as appropriate, the evaluation of the effect of the generic concern on other safety-related structures and components within the initial sample system, and/or an evaluation of the effect of the generic concern on safety-related structures and components in other systems.

Q.23: What did the IDVP do when it determined that corrective action was required?

A.23: (WEC, RLC, JEK) An item that was determined not to have met licensing criteria was reported to DCP for corrective action, and the IDVP performed verifications of DCP corrective actions. As stated in the Program Management Plan, "After PGandE takes corrective action on an error, or performs physical modifications to alleviate an error or deviation originating in the independent program, the PGandE engineering results are subject to design verification by the independent program to assure that proper resolution has been achieved." When IDVP verification of

a corrective action indicated that the corrected item met licensing criteria, the item was considered closed. If verification indicated that the corrective action did not meet licensing criteria, the item was again reported to DCP for continuation of corrective action.

Q.24: The answer to Q.19 describes how the IDVP resolved its concerns in a specific area of seismic verification. Please describe similarly how the IDVP identified and resolved concerns in a specific area of non-seismic verification.

A.24: (JEK) A similar example in the non-seismic area is the IDVP verification process related to the pressure and temperature analysis to determine the environmental conditions for equipment qualification for DCNPP-1, which has been reported in ITRs -14, -34, and -47.

The verification was performed in accordance with the IDVP scope of work defined in the Phase II Engineering Program Plan, SWEC Project Procedure 5-2-2, "System Design Verification Program", and the NRC-approved Topical Report, SWQAP 1-74A, "Stone & Webster Standard Nuclear Quality Assurance Program".

The sample verified was defined in the Engineering Program Plan to include the temperature and pressure analyses for two representative locations outside containment, one associated with the AFW and the other associated with the CRVP. The scope of work was further defined to include a calculation by IDVP using identical input to the codes used by PGandE or service-related contractors from one specific calculation. The independent results calculated by IDVP using its codes were to be compared with the PGandE design analysis.

Document requests were sent to PGandE to obtain plant specific licensing documents such as Safety Analysis and Evaluation Reports and plant design drawings. Applicable generic licensing documents were also reviewed. The "Design Chain-Initial Sample" (ITR-29) indicated that Nuclear Service Corp. (NSC) was the only service-related contractor responsible for the subject analysis.

After preliminary review of the DCNPP-1 design documents, two specific locations in the auxiliary and turbine buildings were chosen for the initial sample work. The following activities were then undertaken by the IDVP to verify the analysis of those areas:

- Two independent blowdown calculations were performed for main steam line double-ended rupture in the selected areas.
- Independent calculations were performed of pressure and temperature transients in two areas.
- A sensitivity study was performed to compare CONTEMPT, the computer program used by NSC, to THREED, the SWEC program used in the independent analysis.

The computer sensitivity study revealed that CONTEMPT calculated lower temperatures and could not model adjacent compartments properly. As a result EOI 8001 was issued to report the inappropriate application of CONTEMPT.

However, IDVP continued the verification procedure to determine if further concerns existed. The IDVP's independent pressure and temperature calculations were performed using models and input data developed from the basic plant design documents

and IDVP's blowdown calculations without reference to the existing NSC calculations. These independent calculations resulted in higher pressure and temperatures. The NSC analyses were then reviewed and it was determined that the calculation of computer program input data was not appropriate. Several further EOIs were issued as a result of this review, as reported in ITR-14.

In order to perform the above work, the IDVP performed six calculations based on input from approximately 64 drawings, reviewed five NSC calculations and two reports, and performed a field verification of as-built geometries used for input calculations.

In parallel with this analytical design effort, the IDVP performed a QA audit and review of NSC as described in the Engineering Program Plan. Two EOIs were issued concerning the QA aspects of information used as inputs to the NSC calculations.

The IDVP received information concerning all the EOIs issued for this area of verification from DCP during several meetings and resolution/completion packages for each EOI. The IDVP reviewed this information and determined that the analytical errors and the QA concerns addressed in seven EOIs were not resolved. Therefore, the DCP committed to reanalyze all the pressure and temperature transients to resolve the EOIs. These were combined in EOI 8001, which was classified as a Class A/B Error.

Since the CONTEMPT computer program was used for areas outside containment other than those included in the initial sample, the problem was considered to be generic and, as such, required additional verification. The additional verification was per-

formed on the DCP reanalysis on a sample basis as identified in ITR-34. The approach taken for this additional sample was similar to the initial sample with the exception that more areas were reviewed. Document requests were issued to obtain the calculations and results of the DCP reanalysis. Approximately 12 calculations were reviewed and the results reported in ITR-47.

The DCP utilized the Bechtel Computer program FLUD to perform the reanalysis. The IDVP performed a sensivity study to compare FLUD and THREED with satisfactory results. The DCP results for the selected areas were compared with the IDVP independent calculations and were satisfactory. Further, the DCP calculations were reviewed to determine if the specific concerns identified in the EOI files and related to the initial sample had been addressed by PGandE. The results of this review were also satisfactory.

Based on these satisfactory reviews of the reanalysis, no further additional verification was required. The IDVP Final Report describes the initial sample verification in Section 4.7.6, the additional verification in Section 4.8.4, the IDVP findings in Section 5.2 and the causes of EOI 8001 in Section 6.3.4.

Q.25: There have been approximately 300 EOIs. Does this mean that there were 300 errors in the DCNPP-1 design?

A.25: (ALL) No. The opening of an EOI File meant that a condition had been identified which required additional evaluation to determine its significance, so a file number had been assigned to track this additional effort. If the additional effort subsequently established that an applicable license appli-

cation criterion had been violated, the item would be classified and reported as an IDVP Finding. Many of the EOIs were, of course, resolved without being established as errors. Further, since the significance of an EOI cannot be determined simply by looking at its eventual classification, it is very easy to overestimate or to underestimate the significance of EOIs by a simple "counting" of the files.

There is also no general relationship between the eventual classification of a file and the potential for that file to indicate a generic concern. The IDVP carefully considered the generic implication of every EOI, as well as the generic implications of possibly related concerns reflected in several EOIs, as described in the IDVP Final Report, Sections 5.5 and 5.6.

Q.26: In the judgement of the IDVP, was the scope of the IDVP sufficient to provide reasonable assurance that those aspects of DCNPP-1 design which did not meet the criteria of the license application have been identified?

A.26: (ALL) Yes. The initial sample and additional sample effort resulted in detailed verification of aspects of the work, a so-called vertical slice. When the IDVP identified concerns with respect to specific aspects of these samples, the IDVP work was expanded in accordance with the program plans to review those concerns as they may have affected other safety-related SSCs, a so-called horizontal slice. Thus, the IDVP program utilized a systematic approach for determining the extent of its review necessary to identify technical concerns. With respect to seismic design, the fact that the DCP undertook an essentially total review of the DCNPP seismic design, subject to verification

by the IDVP, provides further assurance that technical concerns were identified. Similar, but less extensive, DCP responses were made with respect to non-seismic generic concerns. For the reasons described in the IDVP Final Report and the previous testimony, in the judgement of the IDVP the scope of the IDVP was sufficient to provide the assurance sought by the Commission Order and Staff Letter, and such scope was, of course, approved by the Commission.

Q.27: Does this mean that the IDVP identified each and every deficiency in compliance with the criteria of the license application?

A.27: (ALL) No. The IDVP was not intended to do this, nor could any reasonable independent verification program. The IDVP was sufficient, and the procedures utilized to identify concerns effective, to provide reasonable assurance that those aspects of the design work on DCNPP-1 performed by PGandE or service-related contractors which did not meet the license application criteria have now been identified. This conclusion should not be interpreted, however, to mean that the IDVP identified each and every error or questionable aspect of the design product of PGandE and its contractors or of the design process they utilized. It does mean that, in the judgment of the IDVP, there is very little likelihood that any significant undetected errors exist in such design work.

Q.28: Did the IDVP retain a statistician in the conduct of its program?

A.28: (WEC) No. Neither the Commission Order nor the Staff Letter required the use of a statistician in the IDVP efforts.

Appendix C of the Program Management Plans indicated that the IDVP would arrange for an evaluation of the completed program by an expert in the application of statistics to an engineered system. However, the IDVP later determined that such an evaluation was not required, particularly since in its review of the Phase II Program Plan the NRC Staff stated that "Rigorous statistical techniques are largely inappropriate for a design verification program" (see Enclosure 11 to SECY-82-414), and on December 9, 1982, the Commission approved "the Phase II Program Plan of June 18, 1982, including the proposed IDVP contractors as modified by the Staff in Enclosure 11 to SECY-82-414." Nevertheless, because issues relating to the use of statistics continued to be raised by some of the interested parties, the IDVP believed that a review of its efforts by a statistician should be conducted. As described in Section 3.5 of the IDVP Final Report, the IDVP recommended that any proper statistical evaluation should address the efforts of both the IDVP and the DCP and concurred in the selection of a statistician retained by PGandE.

Q.29: In the judgement of the IDVP, was the scope of its program sufficient without the participation of a statistician?

A.29: (ALL) Yes. The IDVP never intended to use statistical sampling in its verification program. The IDVP believes that the scope of its review was sufficient without the participation of a statistician because its program complied with the Program Plans for Phases I and II approved by the Commission and the Staff and because it enabled the IDVP to obtain reasonable assurance that the design of DCNPP-1 complies with license application criteria, as stated in Sections 2 and 6 of the IDVP

Final Report. The IDVP did not perform analyses to determine whether its sampling was "statistically valid" to any particular statistical confidence level.

The IDVP technical program concept employed an audit and review of design QA in parallel with an engineering program for verification of the design process in a manner which did not depend upon the effectiveness of the QA program applied in the original DCNPP-1 process. The IDVP verification samples were carefully chosen in both the seismic and non-seismic areas, and the verification was expanded whenever necessary to resolve concerns that were identified in our original review. All potential concerns were recorded, tracked, and resolved in a systematic manner using the EOI system, and reported in detail in ITRs. In addition, the IDVP was organized to require levels of engineering peer review by different organizations within the program to ensure the validity of all IDVP technical conclusions. The reasons for the IDVP's belief that these samples were properly chosen and suitable for the IDVP's purposes are set forth in the IDVP final Report and the ITRs, and are amply illustrated in A.19 and A.24.

Q.30: In the conduct of its program, has the IDVP "merely checked data of inputs to models used by PGandE"?

A.30: (WEC, RLC, JEK) No. In its verification of seismic design, the IDVP performed a complete independent analysis of the initial sample and additional sample/verification in accordance with the Phase I Program Plan. In its verification of the CAP as defined by ITR-8, and in its verification of the DCP activities as defined in ITR-35, the IDVP used independent calculations on a

selected basis as part of the design verification process. In every aspect of the IDVP's seismic work, the verification process consisted of much more than merely checking data of inputs to models used by PGandE.

In its verification of the non-seismic design, the IDVP performed independent calculations or analyses, and/or independent review of PGandE calculations and analyses in accordance with the Phase II Program Plan. The majority of the Phase II non-seismic verification consisted of the performance by the IDVP of independent calculations or analyses. The independent calculations and analyses performed by the IDVP used independent models developed by IDVP and/or different computer programs. In its additional verification of DCP-performed activities as defined by ITR-34, the IDVP used independent calculations, analyses, and/or field verification for essentially all of the verification effort. In every aspect of the IDVP's non-seismic work, the verification process consisted of much more than merely checking data of inputs to models used by PGandE.

The full extent of the IDVP's verification efforts is spelled out in the IDVP Final Report and the ITRs, and is amply illustrated in A.19 and A.24.

Q.31: Did the IDVP verify the design of the Diablo Canyon Nuclear Power Plant, Unit 2?

A.31: (WEC) No. The IDVP's review was performed in accordance with the Commission Order and the Staff Letter, which contemplated only an independent verification of Unit 1. In addition, the IDVP completed its work in accordance with the

Program Plans, approved by the Commission, which included only Unit 1.

Q.32: Was the scope of the ITP's analyses and modifications of the seismic and non-seismic aspects of the design of safety-related SSCs at DCNPP-1 sufficient for the purposes of the IDVP?

A.32: (ALL) Yes. The scope of the ITP's analyses and modifications was sufficient to respond to all of the IDVP's concerns, to permit the IDVP to complete its verification in accordance with the Program Plans, and to enable the IDVP to reach the conclusions and evaluations stated in Section 2 and 6 of the IDVP Final Report. The design work performed by the ITP for verification by the IDVP is set forth in ITRs-8, -34, and -35 and is discussed further in Section 3.5 of the IDVP Final Report. The results of the IDVP's verification of design activities performed by the ITP is set out in ITRs-45 to -49 (SWEC), ITR-51 (TES) and ITRs-54 to -61, -63, -65, -67 and -68 (RLCA).

Q.33: In summary, in the judgment of the IDVP, was the scope of its efforts sufficient that it could properly reach the conclusions and evaluations stated in Sections 2 and 6 of the IDVP Final Report?

A.33: (ALL) Yes.

**CONTENTION 5**

"The verification program has not verified that Diablo Canyon Units 1 and 2 'as built' conform to the design drawings and analyses."

Q.1: As part of its verification of non-seismic design, did the IDVP perform field verifications of implementation of the design of the DCNPP-1?

A.1: (WEC, JEK) Yes.

Q.2: Please explain how such field verifications were performed.

A.2: (JEK) As described in the Phase II Program Plan, the IDVP performed independent field verifications to ensure that the safety-related SSCs in its sample are configured in the same manner as described in the PGandE design documents used in the IDVP analysis or calculations. The IDVP also independently field verified all modifications performed by the DCP to resolve EOIs. However, the field verifications did not necessarily include all of the aspects normally associated with a complete "as-built" review, such as material selection and application, fabrication, examination and inspection (including the pre-service inspection requirements), system installation requirements, system cleaning, pre-operational testing or wiring checkout, unless these were specifically required to support the IDVP's conclusions.

The specific IDVP field verifications of as-built conditions are described in detail in various ITRs. For example, ITR-18 describes the field verification of the as-built location of AFW and CRVP system electrical cables/wires to ensure that FSAR separation requirements were satisfied. This ITR also describes the field verification of the fire zone separation/barriers,

detection system, suppression system, and special hazards control for areas containing AFW and CRVP system components to ensure that they were installed in accordance with licensing commitments. Additional descriptions of the IDVP non-seismic field verifications are contained in ITRs -14, -19 through -28, -48, and -49.

Q.3: As part of its verification of seismic design, did the IDVP perform field verifications of the implementation of the design of the DCNPP-1?

A.3: (WEC,RLC) Yes.

Q.4: Please explain how such verifications were performed.

A.4: (RLC) Field verifications were performed as part of the seismic design verifications of the initial samples, the additional verifications, and the verification of the CAP.

A field verification was performed for the purpose of determining if an SSC was configured in the manner for which it was qualified. The word "configured" was used in the IDVP program plans to emphasize that the field verification was a part of the design verification process and that there was no intention to include the aspects of material selection and application, fabrication, examination, or inspection. The purpose was to gain reasonable assurance that the as-built dimensions were properly established and used in the design process or in the verification program. As with all IDVP activities, the IDVP applied the criteria on configurations which were intended to be used during the licensing process. For example, in evaluating the as-built configuration of piping systems, the acceptance criteria were those used with I&E Bulletin 79-14.

The specific field verifications performed are described in detail in the various seismic-related ITRs. Of particular significance in this regard, because the CAP effort superseded the earlier activities as described in A.17 of the Testimony on Contentions 1 and 2, are the ITRs numbered above -50, with the exception of ITR-68. In each case the field verification was performed by a joint RLCA-TES team working with specific checklists. Field verifications were performed as required with respect to the specific DRPs being verified, were sometimes performed before selection of the DRPs either to assist in the IDVP's understanding of the methodology or to help to select the DRPs, and were performed as a part of the "completion sample" to assure that intended modifications had been implemented.

Q.5: Did the IDVP include within its scope any other verification relating to the conformance of the DCNPP-1 "as-built" to design drawings?

A.5: (WEC, RFR) Yes. As part of the audit of the implementation of the CAP, RFR audited the procedures for engineering review of design changes recommended in the field and the related procedures for incorporating field changes into the final design drawings. The audit of implementation of the CAP process for controlling the as-built update of engineering documents included both the method for controlling design changes and the update of documents to as-built conditions. The interfaces involved both DCP internal activities (among engineering design groups and between engineering and construction) and DCP external activities (between PGandE and outside contractors). ITR-41 concluded that

this portion of the QA program was being implemented in a full and effective manner.

Q.6: Based upon the work performed by the IDVP, what conclusions has the IDVP reached with respect to whether the "as-built" condition of the DCNPP-1 conforms to final design documents?

A.6: (ALL) The IDVP has not performed an as-built walkdown of DCNPP-1. However, the IDVP has determined that the as-built condition of those aspects of the DCNPP-1 that it field-verified properly implement the essential design elements reviewed by the IDVP.

**CONTENTION 6**

"The verification program failed to verify that the design of safety related equipment supplied to PGandE by Westinghouse met licensing criteria."

Q.1: Did the IDVP verify that the design of safety-related equipment provided to PGandE by Westinghouse met licensing criteria?

A.1: (ALL) No. However, the IDVP did verify the Westinghouse/PGandE interfaces. This verification was initially performed in response to EOIs 976, 978 and 1004 which were opened because of concerns identified by RLCA in its November 1981 Preliminary Report. The specific issues included questions concerning transmittals of information and the Westinghouse use of a tau-corrected spectrum in computing a vertical design response spectrum, rather than the uncorrected spectrum as required by the Hosgri Report. The need for verification of this interface was also recommended by the NRC Staff in SECY-82-414, and this recommendation was approved by the Commission. Since the non-seismic Phase II efforts described below were also in progress at the time the Staff recommendation was made, the IDVP did not consider this Commission-approved Staff recommendation to be an expansion of its planned program. Rather, it was considered as further assurance that the IDVP plans were consistent with the NRC requirements.

ITR-11 reports the Phase I verification of this interface with respect to seismic considerations. This ITR was prepared by TES based upon an in-house audit of Westinghouse and subsequent review of the information obtained from Westinghouse. The verification included the interface for transmittal of the Hosgri

spectra and the review, on a sampling basis, of the Westinghouse use of the Hosgri spectra in its qualification and evaluation process. ITR-11 concluded that the Hosgri spectra were being properly transmitted by PGandE and properly received, controlled, and applied by Westinghouse. This verification provides reasonable assurance that this aspect of the design of Westinghouse-supplied equipment was properly performed.

In the Phase II Program, the IDVP verified that Westinghouse obtained from PGandE and used the correct design parameters for the AFW in its analysis of accidents identified in Chapter 15 of the FSAR. (See ITR-22 and IDVP Final Report, Section 4.1.3.) The IDVP also performed independent calculations to verify that condensate storage tank capacity and required AFW flow rates specified by Westinghouse were met by PGandE's design. In addition, RFR's Phase II QA audit and review also included an examination of the interface between PGandE and Westinghouse. (See ITR-42 and IDVP Final Report, Section 4.1.3.) Based upon the work described above, the IDVP verified that the PGandE/Westinghouse interface for the NSSS system included appropriate controls for the transfer of design information and that the NSSS vendor used the applicable information.

Q.2: Why was the design of Westinghouse equipment excluded from the scope of the IDVP?

A.2: (WEC) The Commission Order and the Staff Letter required an independent verification of the design work of PGandE and service-related contractors. This was interpreted as not including design work of vendors of systems and equipment, such as Westinghouse. Accordingly, the Program Plans submitted to, and

approved by, the Commission specifically excluded design work performed by Westinghouse.

**CONTENTION 7**

"The verification program failed to identify the root causes for the failures in the PGandE design quality assurance program and failed to determine if such failures raise generic concerns."

Q.1: Did the IDVP ascertain the "root" or "basic" causes of the design errors it identified during the Program?

A.1: (ALL) Yes. The Commission Order and the Staff Letter directed that the IDVP assess and report the basic causes of all design errors identified during the program. This was done close to the conclusion of the IDVP program and was based upon a backward look at all of the deficiencies identified by the IDVP. The IDVP's determinations of basic cause are reported in the IDVP Final Report, Section 6.3.

Q.2: In the judgment of the IDVP, what were the basic causes of the design errors it identified?

A.2: (ALL) The two basic causes of design errors identified by the IDVP, in addition to random causes, were control of design interfaces and documentation and interpretation of design. However, the basic causes can only be properly addressed in light of several underlying factors that, in combination, contributed significantly to most of the design problems. These factors are identified in the IDVP Final Report as follows:

(1) Safety-related systems were seismically designed twice to meet two sets of criteria, with a substantial time interval between the two design efforts.

(2) The plant had substantial design work performed as a result of I&E bulletins and TMI requirements.

(3) The design work was performed over a period of 15 years.

(4) Seismic design methodology and criteria changed significantly during the 15 years from a rudimentary to a reasonably mature, systematic, and sophisticated process.

(5) Nuclear plant design naturally requires the transfer of large amounts of information from one design group to another; such design interfaces existed in especially large numbers both within PGandE and between PGandE and its service-related contractors.

(6) Design control practices acceptable during the period of the initial design process were not consistent with the eventual duration and complexity of the reiterative design process required at DCNPP.

Q.3: Is the IDVP satisfied that the consequences of these basic causes were identified and corrected?

A.3: (ALL) Yes. Although the basic causes were not explicitly identified until late in the program, they involved aspects of the design process which had been carefully reviewed throughout the program.

Because of the known concerns about control of design interfaces, the IDVP had paid particular attention to review of the flow of information among PGandE and its contractors and within PGandE. This concern was addressed by both QA and design process verification efforts and, in the case of the CAP, by the "design office verification" procedure developed specifically by the IDVP to assure that the QA procedures and their implementation were adequate to the specific design aspects.

With respect to the documentation and interpretation of design, the IDVP was sensitive to the possibility that any identified deficiencies in these areas could have generic impacts. Thus, throughout the verification efforts, criteria and methodology were carefully defined and documented so as to assure that generic concerns associated with problems in documentation and interpretation of design were identified and resolved.

Q.4: Did the IDVP identify generic concerns associated with design errors identified during its program?

A.4: (ALL) Yes. The IDVP reviewed every EOI resulting from the verification effort for generic concerns and resolved all such generic concerns as part of the verification effort. As discussed in A.22 of the Testimony on Contentions 1-2, the identification of generic concerns was an important part of the IDVP.

Q.5: Did the identification of basic causes later in the program result in any new generic concerns?

A.5: (ALL) No. The verification effort for the initial samples and additional sample/verification were performed under the assumption that design QA was deficient, and the basic causes identified turned out to be design QA related. Since the IDVP assumed inadequate design QA in developing the IDVP programs, the identification of root causes which were actually associated with QA deficiencies was no surprise to the IDVP and did not result in a requirement for additional expansion.

Q.6: In his answers to interrogatories (e.g., Answer No. 66 to Applicant's Second Set of Interrogatories), Governor Deukmejian appears to criticize the IDVP for allegedly failing to

identify the underlying cause for any EOI. Did the IDVP ignore causation in resolving EOIs?

A.6: (ALL) No. In resolving every EOI, the IDVP not only disposed of the specific concern raised by the EOI, but determined whether there existed a generic concern, as described in A.22 of the Testimony on Contentions 1 and 2. Obviously, in some cases it was necessary to examine the cause of the EOI as part of the specific concern which had to be remedied; while in other instances the cause of the EOI led to its being designated as a generic concern. Although the IDVP documentation did not necessarily include a specific label for "cause", in the case of each EOI the IDVP determined whether the factors relating to the cause of the EOI required that any additional action be taken.

To the extent that Governor Deukmejian is suggesting that the IDVP, in addition to dealing with causation as described above, should also have separately identified the "basic cause" of each and every EOI, the IDVP believes that such an exercise was wholly unnecessary. In the IDVP's view, assessment of basic cause (as such term was used by the IDVP) is more meaningful when it can encompass a review of all the deficiencies identified in an entire program, rather than by focusing on isolated items. This is what the IDVP did as reported in Section 6.3 of the Final Report.

Q.7: Has the IDVP neglected "to identify the root causes for the failures in the PGandE design quality assurance program," as alleged in Contention 7?

A.7: (ALL) As explained in A.1 above, the IDVP identified two basic causes for the design errors identified by it. Each of

these causes related to some extent to a QA function: control of design interfaces and inadequate documentation of design. If this ambiguous contention is alleging that the IDVP should have ascertained the basic causes associated with QA deficiencies, the IDVP has in part done so in its discussion of basic causes and the underlying factors which contributed to them. (See A.2 above and discussion of "Fundamental Factors" in IDVP Final Report, Section 6.3.1.)

However, if the contention alleges that the IDVP should automatically have ascertained the basic cause (as such term was used by the IDVP) of each identified deficiency in the PGandE design QA program, this was neither done nor necessary, as discussed in A.6. Moreover, as discussed in A.5, the IDVP program for verification of design was structured to verify conformance of the design of DCNPP-1 to license criteria without reliance on the effectiveness of a design QA program. Thus, no purpose would have been served by inquiry by the IDVP into the basic causes of design QA deficiencies.

Q.8: Does this mean that the IDVP may have failed to identify generic concerns with the design of the DCNPP-1 that could have resulted from failures in the PGandE design QA program?

A.8: (ALL) No. IDVP's confidence that this has not occurred is based upon the IDVP's exhaustive review which, as stated above, included a detailed search for the type of generic concerns which could result from design QA deficiencies (e.g., concerns relating to interface control, checking of calculations, etc.).

**CONTENTION 8**

"The ITP failed to develop and implement in a timely manner a design quality assurance program in accordance with 10 CFR Part 50, Appendix B to assure the quality of the recent design modifications to the Diablo Canyon facility and the IDVP failed to ensure that the corrective and preventative action programs implemented by the ITP are sufficient to assure that the Diablo Canyon facilities will meet licensing criteria."

Q.1: Did the IDVP perform an audit of the implementation of the DCP design QA program for the ITP?

A.1: (WEC, RFR) RFR audited that portion of the ITP work which was performed as part of the CAP. Other work performed by the ITP was outside of the RFR audit scope, as specified in ITR-8.

Q.2: Why was this audit performed?

A.2: (WEC, RLC, RFR) Both the Phase I and Phase II IDVP Program Plans required the IDVP to verify any PGandE corrective action resulting from the design verification performed by the IDVP. The CAP was considered such a corrective action, and the IDVP issued ITR-8 to describe the IDVP's verification of CAP activities. ITR-8 committed the IDVP to perform an audit of the DCP QA program implementation commencing August 20, 1982.

Q.3: When was the audit performed?

A.3: (RFR) An initial audit of the CAP was performed during the period of November 11, 1982 through December 7, 1982. A follow-up audit was performed on March 17, 1983.

Q.4: Why was the initial audit not performed until November 11, 1982?

A.4: (WEC, RFR) The DCP QA program, initially submitted for NRC review and approval on June 18, 1982, was found acceptable by the NRC on August 2, 1982, and was approved contingent upon DCP

submittal of revisions which addressed NRC comments. The DCP response to the NRC comments was submitted on August 13, 1982.

ITR-8 was issued on October 5, 1982. On October 27, 1982, a pre-audit scoping meeting was held between the IDVP and DCP for the purpose of reviewing the status of DCP work which was performed as part of the CAP and which was, therefore, within the audit scope. As a result of this meeting, RFR scheduled the initial audit on November 11, 1982 in order to provide an early evaluation of the effectiveness of the CAP's implementation of the DCP design QA program.

Q.5: Please explain how RFR prepared for the initial audit.

A.5: (RFR) Preparations for the audit occurred in several steps. Initially, RFR obtained and reviewed the DCP QA manual and implementing procedures. An audit team was selected, consisting of experienced design control auditors, all of whom were qualified to ANSI 45.2.23. After the October 27 meeting with representatives of the DCP, audit checklists were prepared using the DCP QA manual and implementing procedures as the basis to cover every significant commitment of the DCP QA program.

Two checklists were developed: one was designed to audit CAP internal design activities and the other to audit internal and external interface controls. During the preparation of these checklists, RFR also reviewed the QA procedures for conformance to the commitments of the DCP QA manual. Finally, members of the audit teams were instructed as to the checklists and assigned audit areas by the team leaders.

Q.6: Please explain how RFR conducted the initial audit.

A.6: (RFR) A pre-audit conference was held with representatives of the DCP on November 11, 1982 to discuss the audit scope. For the actual audit, the audit team was then split into four sub-teams consisting of civil/structural, electrical and instrumentation and controls (I&C), mechanical/piping, and administrative controls. The audit team for each engineering discipline then selected representative design activities within that team's area. Using the design activities associated with each discipline, each audit team determined whether the CAP had complied with the checklist items by reviewing design documents, memos, letters, audit reports, EOIs and other DCP documentation. At the conclusion of each day of auditing, an administrative meeting to discuss audit status and schedule was held between the audit team members and representatives of the DCP.

Q.7: Please describe the results of the initial audit.

A.7: (RFR) The initial audit showed that a number of design and QA activities were incomplete at the time of the audit or not yet fully documented. As a result, insufficient completed documentation was available to determine accurately the adequacy of the DCP QA program implementation. Twenty-four (24) conditions or areas that were found to be incomplete were identified in the first audit for subsequent follow-up by the IDVP.

Q.8: Did the IDVP consider that the DCP did not implement its design QA program in a timely fashion because of the aspects of the design QA program that were not fully implemented at the time of the IDVP's first audit?

A.8: (WEC, RFR) No. The QA program was determined to be implemented in a timely manner.

Q.9: When did the IDVP conduct its follow-up audit?

A.9: (RFR) The follow-up audit was conducted on March 17, 1983.

Q.10: Why did RFR wait until that time?

A.10: (RFR) RFR waited to conduct a follow-up audit to allow for design activities performed by the CAP to progress to a point where a sufficient volume of documentation had been completed that could then be reviewed to assess adequately the overall implementation of the QA program. During the period between the two audits, RFR was in communication with the other IDVP organizations and, through this communication, was able to select the earliest date for a follow-up audit which was consistent with the required status of completion of CAP design activities.

Q.11: Did RFR prepare for and conduct the follow-up audit in the same manner as the initial audit?

A.11: (RFR) Yes, except for a few differences. Initially, the follow-up included a specific review of the 24 conditions noted during the first audit. For each of these conditions the documentation looked at earlier was again requested and reexamined to determine the adequacy of correction or completion, and documents not available initially were requested and examined to determine compliance with QA program commitments. Finally, responsible DCP personnel were questioned to determine whether they understood the requirements of the QA program.

Q.12: Please describe the results of the follow-up audit.

A.12: (RFR) RFR's conclusion, based upon the information obtained during the follow-up audit, was that the open or unre-

solved items from the previous audit were satisfactorily resolved, and no new items of non-compliance were identified.

Q.13: Based upon the results of the audits of the CAP, did the IDVP identify any generic concerns as to the overall DCP QA program?

A.13: (WEC, RFR) No.

Q.14: Did the IDVP conduct any further audit of the implementation of the DCP QA program?

A.14: (WEC, RFR) No. The audits of the CAP showed that the DCP QA program, under which all ITP work was being done, was being effectively implemented, and it was therefore determined that no further audits were necessary. This is standard practice for the conduct of QA audits.

Q.15: In addition to auditing the performance of the CAP QA program, did the IDVP also verify the DCP's control of information across design interfaces?

A.15: (RFR) Yes. Design interface controls were verified during the CAP audit conducted on December 6 and 7, 1982, and as part of each of the Design Office Verification (DOV) audits.

Q.16: Please describe the DOV audits performed by the IDVP.

A.16: (WEC, RLC, RFR) ITR-8 required that interface control and project indoctrination be verified by the IDVP for each subject where design process verification was required. RFR performed these aspects of the DOV between December 20, 1982 and March 11, 1983. Audit teams verified technical interface controls and project indoctrination in order to assure that the Hosgri and non-Hosgri seismic design inputs were correctly translated into applicable design documents and across design inter-

faces using the most recent inputs. The audit was performed by tracking seismic inputs from the ground acceleration values to each seismic Category I structure and to the building floor spectra applicable to the piping design documents sampled. The DOV also verified that computer programs used in the seismic design analyses had been verified by the DCP. As described in ITR-41, the DOV was performed in the areas of mechanical equipment, the auxiliary building, the intake structure, large bore piping and supports, instrument tubing and supports, the fuel handling building, the turbine building, the HVAC system, electrical equipment and instrumentation, small bore piping and supports, electrical raceway supports and the containment structure. The DOV was conducted by selected professionals experienced in design control and qualified to ANSI N45.2.23 . The audit team used a checklist based upon ITR-8 and the DCP QA program procedures applicable to the control of the design interfaces, training and the verification of computer programs.

Q.17: What were the results of the DOV?

A.17: (WEC, RFR) The DOV showed that control of internal and external interfaces was adequate to assure the use of correct seismic inputs and the correct translation of seismic inputs into corresponding design documents. The auditors also determined that design personnel using seismic information were aware of the applicable QA program controls and that computer programs that were used by the DCP were appropriately verified.

Q.18: What are the overall conclusions reached by the IDVP on the basis of its audit of the DCP QA program and the DOV?

A.18: (WEC, RFR) As a result of the CAP audits and the DOV, the IDVP concluded that the DCP QA program was effectively implemented. The IDVP's conclusions are reported in ITR-41 and in the IDVP Final Report, Section 4.2.

Q.19: Did the IDVP also verify the engineering work of the ITP as applied to corrective actions apart from its verification of the DCP QA program?

A.19: (WEC, RLC, JEK) Yes. The IDVP conducted a detailed engineering peer review on a sampling basis, similar to that performed in the verification of the initial samples, and in accordance with the Program Plans. The peer review, conducted by RLCA, TES, and SWEC, was conducted in accordance with the method prescribed in the Program Plans. The areas where this verification was to be performed, along with the approach to be used, were specified in ITRs -8, -34, and -35. The results of the IDVP review of DCP corrective actions is presented in the series of corrective action ITRs (ITRs -45 to -49, -51, -54 to -61, -63, -65, -67, and -68) issued to document the results of the IDVP peer review.

Q.20: What were the results of the IDVP's peer review of the ITP?

A.20: (WEC, RLC, JEK) The IDVP determined that the ITP has been effective in resolving earlier EOIs and in reviewing the seismic design of the DCNPP-1. The IDVP's verification of the activities of the ITP resulted in 26 new EOIs, each of which was subsequently resolved and closed.

Q.21: In the judgment of the IDVP, does the issuance of these EOIs indicate that the design work performed by the ITP was not being performed in a competent manner?

A.21: (WEC, RLC, JEK) No. The EOIs do not necessarily represent a confirmed violation of license criteria, but rather are a vehicle established by the IDVP to indicate an area which requires further investigation before the IDVP can reach a decision on whether it will impact on the satisfaction of licensing criteria. Of the 26 EOIs identified in this portion of the program only 1 was later designated as a Finding. Thus, of the tremendous volume of design work reviewed, the IDVP found only a very limited area where the ITP did not initially demonstrate commpliance with the licensing criteria.

Q.22: In the judgment of the IDVP, does the issuance of these EOIs indicate that the ITP was not implementing its design QA program properly?

A.22: (ALL) No. The fact that an EOI file was opened as to a technical issue does not necessarily mean that there is either a design error or a breakdown in the DCP QA program - only that a technical question exists. No EOIs were issued by RFR identifying any inadequacy in the DCP QA program implementation.

Q.23: In the judgment of the IDVP, has the ITP developed and implemented in a timely manner the design QA program approved by the NRC?

A.23: (ALL) Yes. The IDVP's conclusion is based upon the audits and verifications it has performed, as described in this testimony. The EOIs issued by the IDVP do not detract from the conclusion reached by the IDVP.