October 13, 1982

SECY-82-414

POLICY ISSUE
(Notation Vote)

FOR: The Commissioners

FROM: William J. Dircks, Executive Director for Operations

SUBJECT: DIABLO CANYON DESIGN VERIFICATION PROGRAM - PHASE II RECOMMENDATIONS

PURPOSE: In accordance with the Commission's request (COMJA-82-6) of July 27, 1982, this paper provides the staff recommendations regarding Phase II of the Diablo Canyon Independent Design Verification Program (IDVP) and its relationship to the ongoing Phase I program.

BACKGROUND: By memorandum dated September 24, 1982, we provided you with a Status Report of ongoing activities associated with the verification of the seismic design of Diablo Canyon Unit 1. The memorandum noted that findings from Phase I of the IDVP and other recent developments may influence the staff's conclusions with regard to the Phase II Program Plan which was submitted to the NRC for approval on June 18, 1982. We have continued to pursue those matters and have developed our recommendations with regard to the Program Plan. The staff findings and recommendations are discussed below.

DISCUSSION: We have summarized in Figure 1 the elements of the Order and letter of November 19, 1981. The original requirements needed to support a fuel-load/low-power (FL/LP) decision have become known as Phase I whereas items originally requiring completion before a decision regarding power levels greater than 5% were defined as Phase II. It is important to note that although they were defined as such at the time, both the Phase I Order and the Phase II letter acknowledged that an expansion of either or both efforts may be necessary. In this context, the staff examined the overall findings to date and a number of recent developments to determine if any modifications to the originally defined scope of Phase I and Phase II need be made.

Contact:
D. Eisenhut, NRR/DL
X27672

Overall Findings to Date

As of September 24, 1982, the IDVP had identified 199 technical concerns requiring resolution. A number of these have subsequently been resolved and 13 have been classified as "A/B" errors. These are errors in which design criteria or operating limits of safety-related equipment could have been exceeded and physical modifications, changes in operating procedures, more realistic calculations, or retesting are required to bring the plant into conformance with the original design. These technical concerns can be summarized as follows:

Fully resolved:	147		
Errors:		3	(3 A/B errors)
No design criteria or operating limits exceeded:		144	
Review continuing:	52		
by PG&E:		28	(9 A/B errors)
by IDVP:		24	(1 A/B errors)
Total	199		(13 A/B errors)

Furthermore, PG&E has identified 33 concerns within their Internal Technical Program (ITP). Six have been resolved and 27 concerns have been classified as A/B errors. These errors are not directly additive because there exists some overlap between the IDVP and ITP errors.

As of September 15, 1982, PG&E had completed 344 modifications as follows:

Modifications

Pipe supports	257
Other supports	43
Annulus structure	38
Other	6
Total	344

It should be noted that not all A/B errors will necessiate modifications and that a single error may result in a number of modifications. In addition some of these modifications, made to date, were a result of the errors from either, or both, the IDVP and ITP and some were modifications undertaken by PG&E even though they believe the error could have been shown acceptable by detailed calculations.

During a meeting on September 1, 1982 the staff discussed the modifications made to that date with PG&E. With respect to those modifications, PG&E stated that:

1. Most modifications flow from their Internal Technical Program and not the IDVP.

2. All modifications are to restore margins or to meet design criteria.

3. Nothing has been found which would have prevented a system, structure or component from performing its intended safety function in the event of the postulated Hosgri earthquake.

Staff Evaluation of Recent Developments

During recent months, a number of significant developments and findings have occurred which influenced our recommendations regarding the scope of the Phase II Program Plan as proposed. For your reference, we have graphically summarized in Figure 2 the functioning of Phase I of the IDVP, the functioning of Phase II of the IDVP, and various activities undertaken by PG&E and their relationship to the IDVP. The developments examined by the staff were briefly discussed in our September 24, 1982 memorandum to you and are further discussed in enclosures to this memorandum. The developments include:

1. IDVP Phase I Results:

   a. The identification of a larger than originally expected number of errors or open items (EOIs) from both the IDVP and the PG&E ITP as discussed above. A list of these errors and open items were provided to you as attachments to the September 24, 1982 memorandum.

   b. The issuance of eight Interim Technical Reports (ITR), as of October 5, 1982, including ITR 1, which suggested that the sample for the reverification program must be expanded, and ITR 2, which identified deficiencies in QA controls for certain design activities. The staff evaluations of ITRs 1 through 5 are provided in Enclosure 1. The staff found the IDVP procedures and verification methods acceptable and concurs with the IDVP approach and recommendations.

c. The results from an independent analysis performed by the staff's contractor, Brookhaven National Laboratory, raised a number of seismic concerns regarding PG&E original seismic analysis of the containment annulus structure. BNL developed a three dimensional vertical model and identified concerns regarding the distributed masses, modeling of joints, as-built dimension variations, spectra-smoothing techniques, modeling of piping bends and calculated piping support forces used in PG&E's original analysis. These concerns were forwarded to TES for consideration of their generic implications by the IDVP. PG&E has indicated that a majority of these concerns had been separately identified by the IDVP and/or PG&E. The staff will audit the IDVP resolution of these concerns. Enclosure 2 provides additional discussion.

d. Region V inspection of the ongoing activities identified a number of open inspection issues. These issues include verification that the seismic analysis model adequately characterizes the seismic responses of the Auxiliary Building, Intake Structure and various equipment and components. Some of these issues had been previously identified by the IDVP. These issues are being closed out by both Region V and NRR personnel via their consideration in the in the ITP and IDVP. A summary of these issues is provided in Enclosure 3.

e. The original Phase I IDVP proposed, and the NRC accepted, to include a reevaluation of the Hosgri analyses only. The remaining seismic analyses will be examined by the IDVP in the Phase II program. The staff discussion of this action is provided in Enclosure 4.

2. IDVP Phase II Results:

a. Preliminary results from the R. F. Reedy Phase II QA audit indicated that there exist deficiencies in the QA controls of the PG&E design program and of certain of their contractors.

b. The results from the PG&E initiated QA audits of their in-house design activities and their safety-related service contractors are summarized in Enclosure 5. The PG&E findings are consistent with the preliminary results from the R. F. Reedy Phase II QA audit (discussed in a. above). Region V attended the R. F. Reedy, Inc. audit exit meeting and subsequently audited the PG&E self-review. A memorandum discussing

the Region's comments on both of these activities is provided as Enclosure 6. The staff has also forwarded these comments to TES for their consideration in the IDVP, in particular with respect to the scope of the audit as compared to the scope delineated in the NRR letter of November 19, 1981.

3. PG&E Actions:

   a. The establishment by the PG&E/Bechtel Project Team of a corrective action program that includes a seismic reevaluation encompassing all safety-related structures, systems, and components. The scope of the effort is discussed in more detail in Enclosure 7. The IDVP will audit and consider the results of the corrective action program.

   b. The completion of modifications, as necessary, to restore the "as-built" plant to the "as-designed" condition. A listing of modifications made to date, and a listing of anticipated additional modifications, are included in Enclosure 8.

   c. The undertaking of a review, to determine the adequacy of the seismic evaluation originally done by Blume, called the Blume Internal Report (BIR). Specifically, the BIR includes an internal technical review, conducted by Blume, of civil/structural work performed with particular attention to the work for the Hosgri evaluation in the 1977-1978 time frame. The results of this review have been documented by Blume in a report and submitted to the staff in early October 1982.

   d. The recognition by PG&E that there is probably no step-wise distinction between pre-1978 and post-1978 activities as was assumed in the issuance of the Commission Order and the NRR Letter of November 19, 1981.

   e. The decision by PG&E to undertake a reevaluation of construction QA proposed as part the IDVP. While PG&E has stated that they have no reason to question the quality of construction, they also stated that such a program is needed to remove any doubts. The IDVP has recently submitted a program plan for review of these activities. Region V has reviewed this proposed program and found it to be satisfactory and consistent with previous Region V recommendations.

f. The decision by PG&E to undertake a walkdown of as-built safety-related structures, systems, and components to increase confidence that as-built conditions are identified and evaluated.

g. The PG&E proposal for staged licensing is discussed in Enclosure 9. This proposal is to complete, prior to fuel loading, the review, analysis, and modifications for those systems required for fuel load. The remainder of the systems will be examined subsequently. The staff has reviewed the PG&E proposal and concurs in their identification of systems with some additions to the "supportive" list of equipment.

4. IDVP/ITP Interface:

The IDVP has presented plans to include the results of the expanded PG&E activities as inputs to the IDVP program. This proposal is included in the Figure 2 flow chart.

Proposed Phase II Program

With regard to the contractors for Phase II of the IDVP, PG&E has proposed to retain Teledyne Engineering Services (TES) as the IDVP program manager. The principal subcontractors to TES are Robert L. Cloud Associates (RLCA), R. F. Reedy, Inc. (RFR), and Stone & Webster Engineering Company (SWEC). The staff has examined the financial independence of the Phase II contractors from both PG&E and Bechtel in addition to the independence of individual employees assigned to the IDVP. The criteria used by the staff in its evaluation are the same as those used in the Phase I evaluation. The staff also has reviewed the technical qualifications of the IDVP contractors. Enclosure 10 summarizes the staff review and our findings, determining that the contractors are technically qualified and are independent.

The adequacy of the Phase II Program Plan was reviewed by the staff against the requirements of our November 19, 1981 letter. Enclosure 11 describes the proposed program and presents the staff findings on that program.

CONCLUSIONS: Based on our review of the proposed Diablo Canyon Phase II IDVP, the status and results of other ongoing activities, as discussed above, and consideration of comments of the intervening parties to this proceeding, we have reached the following conclusions:

1. With respect to the amount of reevaluation activities required prior to any decision regarding fuel-load/low-power, we have concluded that, in addition to the requirements of the November 19, 1981 Order, review and evaluation efforts for Phase II activities should be sufficiently complete to provide confidence that no major deficiencies exist. We therefore require that an interim report on Phase II, summarizing the IDVP conclusions and results to date, be submitted prior to the FL/LP decision. We recognize that certain plant modifications will likely not be needed prior to fuel loading, and accordingly we conclude that selected modifications could be deferred until after fuel load. Similarly, we recognize that completion of the Phase II program and other activities proposed by the IDVP and PG&E to provide additional assurance that the plant is built in accordance with the application, need not be completed prior to a fuel-load/low-power decision. Figure 3 summarizes the staff's proposal.

2. With respect to the competence of the contractors proposed by PG&E project to carry out the Independent Design Verification Program, we conclude that the necessary experience and technical skills are being provided.

3. With respect to the independence of the contractors proposed we conclude that the independence of the IDVP individuals are acceptable in view of those independence criteria provided in the Commission's February 1, 1982 responses to Congressmen Dingell and Ottinger.

4. In recognition of the expanded PG&E Program, we believe it is appropriate that the ongoing IDVP alter its approach to include a sampling of all of PG&E's efforts to gain overall confidence in that reverification effort.

RECOMMENDATIONS: That the Commission:

1. Approve the Phase II Program Plan and contractors as modified by the staff conclusions in Enclosure 11.

2. Approve the redirection of the Phase I/Phase II division to require that the Phase II review/evaluation efforts be sufficiently completed, as identified in Figure 3, prior to a fuel-load/low-power decision.

William J. Dircks
Executive Director for Operations

Enclosures:
As stated

Commissioners' comments should be provided directly to the Office of the Secretary by c.o.b. Thursday, October 28, 1982.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Thursday, October 21, 1982, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional time for analytical review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

This paper is tentatively scheduled for consideration at an Open Meeting during the Week of October 18, 1982. Please refer to the appropriate Weekly Commission Schedule, when published, for a specific date and time.

DISTRIBUTION:
Commissioners
OGC
OPE
OCA
OIA
OPA
REGIONAL OFFICES
EDO
ELD
ACRS
ASLBP
ASLAP
SECY

FIGURE 1

NRC NOVEMBER 19, 1981 REQUIREMENTS

PHASE I

COMMISSION ORDER (CLI-81-30)

- Suspended fuel loading and low power testing license.
- Required:

1. Results of an IDVP for all SSR contracts prior to 6/78. See Note (i) below.

PHASE II

STAFF LETTER

- Activities required prior to a decision regarding power levels above 5%

2. IDVP for NSSR contracts prior to 6/78.

3. IDVP for PGE internal QA, and

4. IDVP for all service related contracts post 1/78. See Note (i) below.

NOTES:

(i) Items 1, 2, 3, and 4 each require:

a. A technical report of the basic cause of the errors, their significance, and their impact on facility design.
b. PGE's conclusion on effectiveness of IDVP, and
c. A schedule for modifications; including a basis for any deferred beyond a fuel load decision.

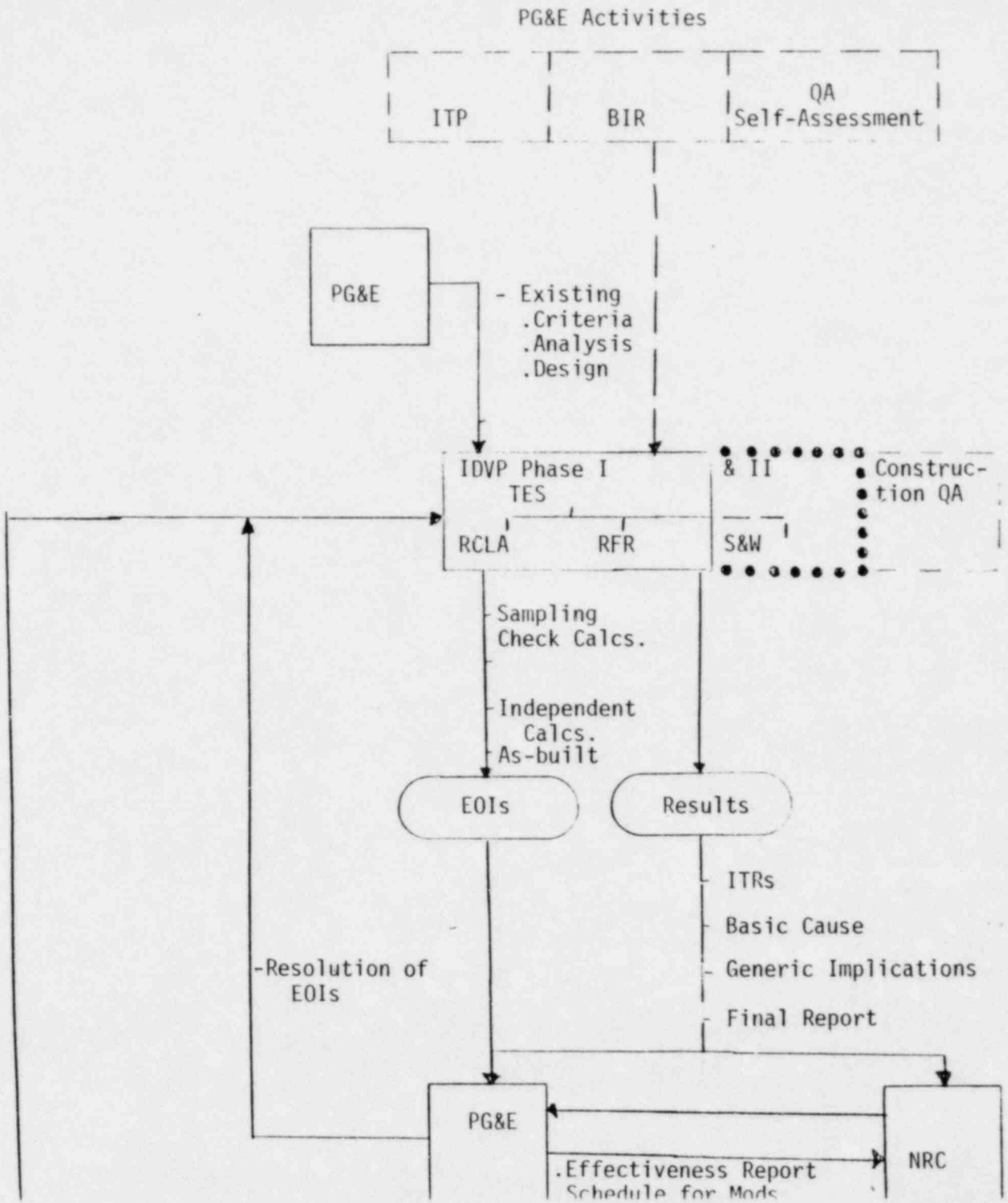
Both Phase I and Phase II activities must be performed by a qualified, independent organization.

Both Phase I and Phase II required that a Program Plan be submitted for our review and approval, and

Both Phase I and Phase II were necessary, but not necessarily sufficient, activities for the appropriate approvals.

NOMENCLATURE:
IDVP = Independent Design Verification Program
SSR = Seismic Service-Related
NSSR = Non-Seismic Service-Related

Figure 2: IDVP/PG&E Activities



PHASE I (in solid lines)

1. IDVP of all SSR prior to 6/78
   a. Basic Cause Report
   b. PG&E Concl. re: Effectiveness
   c. Schedule for Mods.

PHASE II (in "dotted" lines)

1. IDVP for NSSR prior to 6/78
2. IDVP for PG&E internal QA
3. IDVP for all SR post 1/78

   For each of 2, 3, 4

   a. Basic Cause Report
   b. Effectiveness Decision
   c. Schedule for Mods.

Other additional activities undertaken or proposed by PG&E. (dashed lines)

Figure 3: Summary of Staff Proposal

ACTIVITIES	STAFF PROPOSAL: Prior to FL/LP	Prior to FP Decision	During Operation
A. Phase I November 19, 1981 Order (Prior to FL and LP)			
1. IDVP of all SSR prior to 06/78 (interpreted to be Hosgri)	✓		
B. Phase II November 19, 1981 Letter (Prior to exceeding 5%)			
1. IDVP for NSSR prior to 06/78	Interim Report (see note)	✓	
2. IDVP for PG&E internal QA	Interim Report (see note)	✓	
3. IDVP for all SR post 01/78	Interim Report (see note)	✓	
C. Other			
1. ITP QA Program	Interim Report (see note)	✓	
2. Construction QA		Interim Report (see note)	✓
3. As-built walk-down		Interim Report (see note)	✓
4. Modifications completed, as necessary	✓	✓	✓
5. PG&E/W interface evaluation	✓		
6. Determination of correct Hosgri spectra	✓		
7. IDVP for all SSR (non-Hosgri) (prior to 06/78)	Interim Report (see note)	✓	

NOMENCLATURE:

✓ activity complete

SSR: Seismic service-related contracts
NSSR: Non-seismic service-related contracts
SR: Service-related contracts

Note: For each of these activities, an Interim Report is required to demonstrate that activities are sufficiently complete to ensure that no major unidentified deficiencies are likely to exist. The Interim Report is also required to set forth a justification for deferring a portion of that activity.

List of Enclosures

1. Staff Evaluation of Interim Technical Reports
2. BNL Independent Analysis
3. Diablo Canyon IDVP Open Inspection Issues
4. Scope of Reevaluation of DE and DDE Earthquake
5. PG&E Look Back Review of Service Contractors' Quality Assurance Programs
6. R. F. Reedy and PG&E Review of Diablo Canyon Design Quality Assurance
7. PG&E Corrective Action Program
8. Modifications Resulting from IDVP and ITP
9. PG&E Proposal for Staged Licensing
10. Staff Evaluation of Phase II Contractors
11. Staff Evaluation of IDVP Plan - Phase II

ENCLOSURE 1

Enclosure 1

STAFF EVALUATIONS OF INTERIM TECHNICAL REPORTS

ITR 1 (ADDITIONAL VERIFICATION AND ADDITIONAL SAMPLING)

Introduction

ITR 1 was developed as a status report on the original generic sample. In some areas (e.g., buildings and large-bore piping), the results from the original sample were not felt to be sufficient to close the item. Problem areas were identified and additional sampling was judged necessary to fully define the scope and severity of the problem. Analyses of other samples were completed with results that were judged sufficient to close the item under review (e.g., tanks and ITRs on that specific subject) are shown as being in preparation. Still other areas (e.g., HVAC and conduit support) were under review at the time the report was released.

Subsequent to the publication of ITR 1, PG&E announced that their Internal Technical Program (ITP) was to be expanded with the development of a joint PG&E/Bechtel program and that many of the items held open in ITR 1 were to be included. The staff has received some information concerning the scope and content of the PG&E/Bechtel program. The current staff understanding of those recommendations of ITR 1 that are included in the PG&E/Bechtel program is reflected in the following summary and status for each of the nine items discussed in the report.

Summary of Report

Buildings

The review of the buildings was based on a sample of the auxiliary/fuel handling building for independent analysis. Six issues were raised either as error or open items (EOIs) or generic concerns. ITR 6 on the auxiliary/fuel handling building has just recently been issued, and a total of 16 EOIs has been identified.

As a result of the concerns raised about the seismic analysis of the buildings relating to the structural configuration, the IDVP recommended that all of the safety-related buildings be reviewed to assess the impact of design changes on the analysis. In addition, selected changes would be field verified.

PG&E has committed to incorporate this component in their corrective action plan (ITP) sections 2.1.1 through 2.1.5. Verification of this item will be performed by the IDVP.

Piping

The review of large-bore piping discussed in ITR 1 was based on a sample of ten piping analyses chosen for independent analysis. Approximately 40 issues were raised either as EOI or generic concerns.

As a result of the large number of concerns identified, the IDVP recommended that the IDVP undertake a larger sample for purposes of further defining the scope and extent of problems that might require corrective action. The larger sample would have consisted of five additional piping analyses that would represent lines connected to large pipe analyzed by others, other systems, and field-run computer-analyzed pipe. In addition, with regard to the as-built configuration, the IDVP also recommended that PG&E "review and revise as necessary all piping design review isometrics" and further that PG&E "review and revise pipe and pipe support analyses as required."

The IDVP recommendations however have been incorporated in the PG&E corrective action plan (ITP) section 2.2.1 and the results are scheduled to be sumbitted in November 1982. Verification of the disposition of these recommendations by the PG&E corrective action plan will be performed by the IDVP.

Pipe Supports

The review of pipe supports was based on a sample of twenty supports chosen for field verification and independent analysis. The field verification is complete and the analysis is continuing. Three issues were raised as either EOIs or generic concerns. The most pressing concern is the apparent omission of certain pipe inertia loads on the supports.

As a result of this concern for inertia load omission the IDVP recommended that the IDVP do additional investigation. This investigation would have consisted of documenting the method used by the selected computer programs, running simple problems to verify the conclusions, and reviewing one or more of the initial pipe samples.

The IDVP recommendations however have been included as a portion of the PG&E corrective action plan (ITP) section 2.2.1 and the results are scheduled to be submitted in November 1982. Verification of the disposition of this item by the corrective action plan will be performed by the IDVP.

Small-Bore Piping

The review of small-bore piping was based on a sample of three runs chosen for field verification and a review of the support spacing criteria. Approximately 10 issues were raised, either as EOIs or generic concerns.

As a result of these findings, additional verification was recommended by the IDVP. This verification would have consisted of reviewing and revising, as necessary, the isometrics and spacing criteria. It was recommended that RLCA analyze five examples of axial pipe runs and lug design and five examples of small-bore lines to verify the adequacy of the "engineering judgement" used in treatment of conditions other than those covered by PG&E criteria.

The IDVP recommendations however have been included in the PG&E corrective action plan (ITP) section 2.2.2. Verification of the disposition of this item will be performed by the IDVP. The PG&E results are scheduled to be submitted in November 1982.

Equipment

The review of the six equipment types was based on a sample of two valves, two items of electrical equipment, three tanks, one heat exchanger, three pumps, and two HVAC components chosen for independent analysis. Eleven issues were raised as either EOIs or generic concerns. The results and recommendations of the original tank sample have been reported in ITR 3.

As a result of the concerns identified in the above review, the IDVP recommended that the IDVP undertake a larger sample be reviewed so that the scope and extent of the problem could be better defined. The larger sample would have consisted of the main control board, the remaining two Hosgri required tanks, the two remaining Hosgri safety-related pumps, and an additional sample of two HVAC components.

PG&E is addressing these IDVP concerns in their corrective action plan (ITP) section 2.3 and the results are scheduled to be submitted in October 1982. Verification of the desposition of this item will be performed by the IDVP.

Shake Table

The review of the seismic qualification of equipment by shake table testing was based on a sample of 44 items divided into seven groups. The grouping was based on seismic inputs, test procedure, location, and mounting. Five issues were raised either as EOIs or generic concerns. The results and recommendations of this original sample have been reported in ITR 4.

As a result of this sample, the IDVP recommended that the IDVP undertake verifying the field locations and mounting of all the equipment excluding the NSSS vendor equipment, and verifying the use of the correct test spectra.

PG&E is addressing the IDVP concern in their corrective action plan (ITP) section 2.3.2.3.3 and the results are scheduled to be submitted in October 1982. Verification of the disposition of this item will be performed by the IDVP.

Conduit Supports

The review of the conduit supports consisted of a sample of twenty supports for field review and a sample twenty supports for analysis. The field review has been completed; however, the twenty analysis samples have not been selected or analyzed. Three EOIs and three generic concerns were raised as part of the field review.

As a result of the field review findings, PG&E committed to perform a complete reevaluation of all of the supports and the results are scheduled to be submitted in October 1982. Pending completion of the PG&E reevaluation the IDVP will selectively verify the PG&E program including analysis.

HVAC Duct

The review of the HVAC ducts consisted of a sample of two sections for field review and independent analysis. The field review is complete, and the independent analysis is currently under way. Two EOIs have been issued and no generic concern has been identified to date.

PG&E is addressing HVAC ducts on a generic basis in their corrective action plan (ITP) section 2.5 and the results are scheduled to be submitted in October 1982. Verification of the PG&E work will be performed by the IDVP.

Hosgri Spectra

The review of the seismic inputs into the design consisted of identifying and checking the spectra. Approximately 20 issues were raised, either EOIs or generic.

As a result of this review, the IDVP recommended that PG&E assemble and issue a controlled set of design spectra that will carry a unique number for each spectra figure.

The IDVP also recommended that PG&E review all Hosgri qualifications against this set of spectra, including the nuclear steam supply system (NSSS) vendor. A set of controlled spectra has been issued by PG&E as DCM-17. The IDVP will selectively verify the applicability of the controlled spectra.

EVALUATION:

ITR 1 presents the first compilation of the error and open item (EOI) reports developed by the IDVP. The grouping of the EOI's with the corresponding IDVP task from Phase I program plan Section 5.4.2, as given in Figure 3-2 through 3-9, provides an effective summary of the IDVP. Although the IDVP review for a number of items has not been completed, ITR 1 offers substantial evidence that the initial sampling plan is an effective means of examining the seismic adequacy of the Diablo Canyon plant features considered in the sample.

It appears that the majority, if not all, of the concerns identified in ITR 1 have been forwarded into the PGE/Bechtel internal technical program (corrective action plan). Confirmation of this should be accomplished by further IDVP activities.

ITR 2 (QUALITY ASSURANCE PROGRAM)

The second interim technical report (ITR 2) for Diablo Canyon IDVP evaluates the quality assurance program and its implementation of PG&E and of six seismic service related contractors within the scope of Phase I. The report provides TES' conclusions on the IDVP with respect to the QA-related work performed by R. F. Reedy, Inc. (RFR) in accordance with Sections 3.0 and 4.0 of the Phase I Engineering Program Plan (DCNPP-IDVP-001). The report was submitted by W. E. Cooper, Teledyne Engineering Services, by letter dated June 24, 1982.

TES' conclusion in ITR 2 is, basically, that no additional verification or sampling, beyond that specified in ITR 1,* is required in response to the RFR report, in spite of the reported general lack of quality assurance controls during the safety-related design activities performed prior to June 1, 1978. ITR 2 indicates that additional design verification and additional sampling was already specified in ITR 1 both in the knowledge of the lack of QA controls, and based (primarily) on the design verification that had been previously completed (ITR 2, page 5). However, certain exceptions are identified for the Cygna (ITR 2, p. 33), HLA (ITR 2, p. 33), and URS/J. A. Blume (ITR 2, p. 34) areas of work. The conclusion (ITR 2, pages 32-35) is drawn, therefore, that no additional verification or sampling beyond that already identified is required solely on the basis of the reported lack of QA controls.

ITR 1, submitted by Robert L. Cloud Associates, Inc. (RLCA), recommends 30 additional review, checking, verification or sampling activities based on the results of Phase I of the IDVP. These recommendations are, again, based primarily on the Phase I design verification that had been completed but with the knowledge of the results of the RFR findings regarding QA deficiencies. The recommendations appear to broaden the scope of the Phase I effort to provide reasonable assurance that the plant meets the technical criteria for licensing for the areas covered by Phase I. The recommendations include some field verification effort.

The staff concludes, with respect to the Reedy findings for Phase I of the IDVP as discussed in ITR2 that, despite the general lack of certain quality assurance controls for PG&E and several of its subcontractors as identified by the RFR review, the recommendations of ITR 1 and the exceptions noted above in ITR 2 (pp. 33 and 34), when properly carried out and with proper followup, should adequately demonstrate the acceptability of the design effort addressed by Phase I of the IDVP and should resolve our concerns resulting from the lack of QA controls for certain design phase activities.

ITR 3 (TANKS)

Introduction

The third interim technical report (ITR 3) for the Diablo Canyon IDVP has been reviewed by the staff. The report was also selected as a vehicle for a staff audit of the IDVP process and the activities of RLCA in particular. The audit was conducted on September 8, 9 and 10, 1982, at the offices of R. L. Cloud Associates in Berkeley, California.

ITR 3 summarizes the independent analysis and verification of the initial sample of tanks at Diablo Canyon Nuclear Power Plant. The tank sample consists of the boric acid, starting air receiver, and the diesel generator oil priming tanks.

Based on the initial task sample, the IDVP concludes that the tasks repeated by the sample at Diablo Canyon meet the applicable licensing criteria and that

*Additional Verificiation and Additional Sampling, June 10, 1982, Rev. 0.

consequently no further sampling is required. Based on the staff review of ITR 3, in conjunction with the audit of the technical information assembled at R. L. Cloud Associates for their review, the staff concurs in this conclusion. In addition, the audit referenced above allowed the staff to trace, in detail, the review process used at RLCA and to assess that process and the level of confidence that this position of the IDVP provides. The staff concludes that the RLCA review was thorough and of high technical competence, and was well documented and carried out in full compliance with the approved program plan.

Summary of Report

The tank sample consisted of the three tank types located inside various structures, namely the boric acid tank, the diesel generator starting air receiver vertical tank, and the diesel generator oil priming tank. This sample represents the spectrum of tank configurations within the plant.

The boric acid tanks are used to store a boric acid solution that will be injected into the reactor primary coolant loop in the event rapid shutdown of the reactor is required. The tanks shells are 3/8 in. thick and the material is ASME SA-240 Type 304 stainless steel. Each tank is 10 ft in diameter and 15 ft 9 in. in height with a semi-elliptical bottom and a flat top. Each tank rests on a skirt 3/8 in. and 4 ft 6 in. tall. The plant contains four such tanks located in the auxiliary building on the el 115 ft floor. The tanks are normally filled with a boric acid solution to within 1 ft 3 in. of the top. The tank weighs 9000 lb empty and 76400 lb when full. The skirt is anchored to the concrete floot by 36 1-in.-diameter ASTM A-307 bolts distributed evenly along the skirt perimeter and are cast into the concrete floor. The boric acid is moved to and from the tank by attached piping.

The six diesel generator starting air receiver vertical tanks are used to store compressed air at 250 psi for starting the diesel engines. Two tanks are located on opposite sides of each diesel generator unit, which are positioned at the northwest corner of the turbine building. Each tank consists of a 3-ft-diameter, 1/2-in.-thick cylinder with a 1/2-in.-thick elliptical head at both the top and bottom. Overall height is 8.5 ft and total weight is 2045 lb. The material is ASTM A-515 grade 70 stainless steel. Each tank is supported by a skirt connected to a base plate anchored to the el 85 ft concrete floor by four 7/8-in.-diameter bolts cast into the concrete floor.

The three diesel generator oil priming tanks are located at the northwest corner of Unit 1 turbine building at el 85 ft. Each tank consisted of a 16-in.-diameter stainless steel cylinder 13.25 in. tall with a flat top and bottom. The tanks are mounted on top of an 83-in.-tall, 4-in.-diameter schedule 40 ASTM A-53 steel pipe. The tank is supported laterally by two horizontal perpendicular braces anchored to the adjacent walls at el 92 ft. Each tank has a level indicator mounted externally to the cylinder. Each tank assembly weighs 198 lb when full of fuel oil and the support pipe weighs 93 lb. The pipe support is anchored to the concrete floor at el 85 ft by four bolts.

The procedures and methodology used by RLCA to evaluate the tank sample are summarized in the following steps:

(1) Acquire drawings and specifications and trace quality assurance for each document.

(2) Establish design criteria (FSAR, Hosgri criteria, codes, Regulatory Guides).

(3) Establish envelope response spectra for each tank considering all tank locations, using the Hosgri Report response spectra and damping.

(4) Perform field inspections to confirm tank locations, mounting, appurtenance, and other design features.

(5) Estimate fundamental natural frequency using a simple single-lumped mass single-spring model. (The sloshing effect of the contained fluid was accounted for by using procedures from TID 7024 chapter 6.)

(6) Using the fundamental frequency estimates, determine the corresponding acceleration from the envelope response spectra established above.

(7) Compare the seismic loading to that used in the original design and adopt the more conservative loading.

(8) Use the equivalent static load method to evaluate the structural adequacy of the tanks by

   (a) Applying horizontal and vertical seismic loads at the center of gravity of the tanks.

   (b) Evaluating the stresses at critical locations (based on the analyst judgments) using standard engineering hand calculation formula and/or a finite element computer program.

(9) Compare the computed stresses with allowable based on FSAR commitments as modified by the Hosgri Report.

(10) Compare the computed stresses with those presented in the design reports.

Each step above was performed by one individual and checked by another. A complete documentation file was maintained.

Evaluation

In the course of this evaluation, the staff and their consultant firms reviewed ITR 3 on its own merits and then developed audit questions based on the review. In some instances the RLCA calculations were more detailed and comprehensive than the PG&E design calculations; i.e., RLCA computed stresses at more locations or considered more design features than did PG&E in their original design calculations. Specific examples includes:

(1) The evaluation of the diesel generator starting air receiver tank support skirt for buckling, in which RLCA considered the combined vertical and horizontal loads while PG&E considered only the vertical loads.

(2) The evaluation of stresses in the weld between the diesel generator starting air receiver tank support skirt and the lower head, in which RLCA developed a detailed axisymmetric finite element model of the skirt-tank head region whereas PG&E relied on the composite overall tank model to produce the stress fields.

It should be noted, however, that the tanks were originally designed to meet Section VIII of the ASME Boiler and Pressure Vessel Code which could, by usual practice at the time of original design, be interpreted to not require as comprehensive an analysis as the one performed by RLCA. RLCA followed good current engineering practice while performing this review.

The staff finds, after the ITR review and the audit in the offices of RLCA, that the evaluation procedures and methodology are acceptable. The evaluation, although based on simplified seismic models, hand calculations, and limited computer analysis, is in general more comprehensive than the original design calculations. In addition, the calculations are supported by field verifications of the tank configuration and good quality control of the evaluation basis. The staff concludes that the procedures used by RLCA to verify the tanks are technically sound and the conclusions reached by RLCA are supported by the facts developed.

ITR 4 (SHAKE TABLE TESTING)

Introduction

The fourth interim technical report (ITR 4) for the Diablo Canyon IDVP has been reviewed by the staff. This report was also selected as a vehicle for a staff audit of the IDVP process and the activities of R. L. Cloud Associates in particular. The audit was conducted on September 8, 9 and 10, 1982 at the offices of RLCA in Berkeley, California.

The purpose of ITR 4 was to determine if the seismic testing procedure used for Diablo Canyon conformed with the licensing criteria. The equipment considered in ITR 4 was the Class 1E electrical equipment and instruments listed in Table 10-1 of the Hosgri Report that were qualified by PG&E or a seismic service-related contractor. The content of the report is not entirely consistent with the title. ITR 4 addresses only verification that spectra identified for use in the test programs were appropriate. The title may infer to some a complete verification of shake test methods, including equipment test mounting and its correspondence to field conditions, test anomalies, and test procedures. The staff understands that these matters will be the subject of a subsequent ITR.

Summary of Report

Seven groups of items tests at Wyle Laboratories were chosen as the sample. The individual groups contained items from a common plant location. Forty-four individual items were evaluated.

The seven groups are listed below.

Group I -- Switchgear area of the turbine building el 119 ft

Group II -- Diesel generator area of the turbine building el 85 ft

Group III -- Cable spreading and control room area of the auxiliary building el 128 and 140 ft

Group IV -- Battery area of auxiliary building el 115 ft

Group V -- Switchgear area of the auxiliary building el 100 ft

Group VI -- Adjacent to switchgear areas of turbine building el 119 ft

Group VII -- Control room of auxiliary building el 140 ft

The verification of spectra used for shake table testing purposes was undertaken following the compilation of the spectra set. The procedures and methodology used by RLCA to evaluate the shake table testing sample are summarized in the following steps.

(1) Acquire a list of all PG&E equipment and their contractor-supplied equipment qualified by shake table testing.

(2) Determine the locations of all equipment.

(3) Field verify all equipment locations.

(4) Establish worst-case spectra for each equipment group by:

(a) Following the PG&E procedures in which all equipment was segregated into seven groups.

(b) Selecting a spectra that exhibits the greatest amplification considering all equipment locations.

(c) Using a Hosgri Report damping value or the one selected by PG&E if the PG&E value is more conservative. In some cases, PG&E used a lower damping value that would produce a higher load which is, therefore, more conservative.

(5) Compare worst-case spectra with PG&E test spectra:

(a) Test spectra were considered acceptable if a line drawn through minimum spectral acceleration values enveloped the worst-case spectra by a margin of 10% in acceleration at all frequencies, except those frequencies less than 2 Hz. Motion at frequencies less than 2 Hz was judged to be unimportant in the qualification of equipment for Diablo Canyon because either the required spectra has a very low acceleration value at less than 2 Hz or because the equipment did not have a significant modal frequency at less than 2 Hz.

(b) For those frequencies where the 10% rule was violated, the test spectra was accepted if a line drawn through the local mean of the tests spectra exceeded the worst-case spectra by 10% (peak accelerations with significant frequency span were grossly underestimated by the minimum curve).

(6) Compare worst-case spectra with PG&E target spectra.

Evaluation

Based on staff review of ITR 4 and subsequent audit of the evaluation procedures and methods used by RLCA, the staff concurs with the IDVP concluding that the response spectra used for shake table testing of Class 1E electrical equipment were correctly used. The evaluation is based on RLCA compilation of Hosgri spectra and supported by field audit of the equipment location and configuration. RLCA had instituted a good quality control program to track the comprehensive documentation used as the evaluation basis. The staff concludes that the procedures used by RLCA to verify the shake table testing of the Class 1E electrical equipment are technically sound, and the conclusions reached by RLCA are supported by the facts developed.

ITR 5 (DESIGN CHAINS)

Introduction

The fifth interim technical report (ITR 5) for the Diablo Canyon IDVP has been reviewed by the staff.

ITR 5 presents the Phase I design chains for Diablo Canyon. It also summarizes the methods used by RLCA to develop the design chains. The design chains defined by RLCA illustrate structure of PG&E's evaluation of buildings, equipment, and components for the postulated 7.5M Hosgri earthquake.

The purpose of the design chains is to show internal and external PG&E interfaces, describe information passing between interfaces, and list the responsibilities of seismic service-related contractors and PG&E internal design groups prior to June 1978.

The design chains were developed by RLCA between October 1981 and March 1982. Six seismic service-related contractors employed by PG&E prior to June 1978 were identified. These contractors became the basis for the quality assurance audit performed by R. F. Reedy, Inc. (RFR), which was also specified in the Phase I plan and was the subject of ITR 2.

Summary of Report

RLCA developed the design chain using the following method. First, the Hosgri Report was reviewed to define the sample space. Second, a PG&E seismic service-related contractor list was developed. Third, a selection process was used that screened out those contractors who had no significant effect on the final Hosgri plant design. Also eliminated were contractors who performed work

to establish Hosgri criteria or were involved in construction or field modifications.

In early October 1981, RLCA met with PG&E management and engineering personnel to develop an initial list of PG&E contractors who performed analysis, design, or testing for the plant from the project inception to June 1978.

As a result of these meetings, a list was established that consisted of PG&E contract numbers, start and end dates, and a brief description of work scope. This list served as a basis for additional meetings to discuss contractor work scope in detail. For each of the contractors, RLCA attempted to meet with the staff member responsible for the PG&E interface. In many cases, the exact scope of the contractor's work could not be established. Five slightly different preliminary lists were also developed by PG&E between October 1981 and March 1982. RLCA compared these lists with the initial list. When differences were encountered, RLCA resolved them through further meetings and discussions.

In April 1982, PG&E formally issued a list of contracts entitled "Diablo Canyon Consultant Contracts - Revision 2." This list included the contract number, work scope, contract dollar amount, PG&E department interface, and an indication as to whether the work was safety related. RLCA verified that PG&E's formal list was consistent with the previously gathered information and adopted the formal contractor list for the design chain.

The design chains presented in ITR 5 are organized according to the items evaluated by PG&E for the postulated Hosgri earthquake. Each chain represents the sequence for the evaluation of major groups of items. Design chains for the sixteen groups listed below are provided:

Buildings	Electrical equipment
Piping	Instrumentation
Pipe supports	Outdoor water storage tanks
Heat exchanger	Buried piping
Tanks	Buried tanks
Pumps	HVAC duct supports
HVAC equipment	Cranes
Valves	Electrical raceway supports

In general, the chain begins with the supplier of the drawings and response spectra generated by URS/Blume and ends with qualification. Internal and external PG&E interfaces are shown in relation to the information they transmit, review, analyze, or test.

ITR 5 presents the IDVP conclusion that only the following six contractors had a significant effect on the seismic design and qualifications of the Diablo Canyon plant:

Applied Nucleonics Incorporated (ANCO)
Cygna Energy Services (EES)
EDS Nuclear, Inc. (EDS)
Harding Lawson Associates (HLA)
URS/John A. Blume and Associates, Engineers (Blume)

Wyle Laboratories (Wyle)

Evaluation

The staff concurs that the format and general content of ITR 5 satisfies the NRC requirement for definition of the design chain network required in Phase I of the IDVP. In the course of the staff review, inquiries were made with RLCA to ascertain the criteria for excluding seismic service-related contractors that were judged to have no significant effect on final plant design. RLCA identified two broad categories for excluded contractors. The first included highly specialized consultants who only participated at random times and for small dollar-value contracts. The second category included consultants or contractors whose work had been superseded by PG&E efforts or others. The staff concludes that these were appropriate criteria for exclusion. The staff therefore also concurs that the group of six contractors is the appropriate group to be considered in the independent quality assurance and design qualification review.

The following additional ITR's have been issued and are currently under staff review:

ITR 6 - Auxiliary Building
ITR 7 - Electrical Raceway Supports
ITR 8 - Verification Program for PG&E Corrective Action

ENCLOSURE 2

BNL INDEPENDENT ANALYSIS

During the early stages of evaluating the so called "diagram error" the staff felt that the complexity of the situation warranted an independent analysis for the containment annulus region in question. With this objective in mind, the staff requested the assistance of Brookhaven National Laboratory (BNL) to perform a best available analysis without reference to the time when the original analysis was done nor the techniques used at that time. The BNL staff developed a three dimensional vertical seismic analysis model for the containment annulus structure based entirely on the information obtained from PG&E.

BNL has since completed the analysis and published their report as NUREG/CR-2834, entitled "Independent Seismic Evaluation of the Diablo Canyon Unit 1 Containment Annulus Structure and Selected Piping Systems." Our initial review of the report lead the staff to conclude, as a minimum that the following items required further exploration and assessments as to their generic implications.

1. The distributed masses of the steel members comprising the annulus structures apparently were not included in the mathematical model used in the original seismic analysis.

2. The mathematical model used in the original analysis apparently considered the joints between the beams and columns to be rigid whereas the BNL interpretation of the drawings indicate these joints are more appropriately considered flexible (shear carrying only).

3. Statements in the URS/Blume report "Diablo Canyon Nuclear Plant Unit 1 Containment Structure, Dynamic Seismic Analysis for 7.5 M Hosgri Earthquake," May 1979 (page 11), concerning the structural connections may not be consistent with the mathematical model used in the original analysis.

4. The response spectrum smoothing techniques employed in the original analyses appear inconsistent with the FSAR commitments.

5. Design dimensions were apparently used instead of the as-built dimensions in the two piping problems sampled (PG&E piping models, 6-11 and 4A-26).

6. The 5D bends in the piping analysis were apparently modelled as long radius bends. This has the effect of softening the model and reducing the natural frequencies.

7. The piping support forces computed by the BNL model are much larger than those computed by the PG&E model.

The BNL report was transmitted to the IDVP by letter from H. Denton to W. Cooper dated July 1, 1982 recommending that the report be treated as an

input to the IDVP decision making process regarding seismic adequacy of Diablo Canyon Unit 1. In addition, it was requested that IDVP inform us of their views regarding the validity of the BNL results and an assessment of their generic implication.

The staff has requested continued participation by BNL in the staff review of the IDVP. In addition to BNL support through various technical assistance programs that provide continuing input to the staff review in the structural, mechanical and equipment qualification review areas, NRC has specifically used Dr. Paul Bressler of BNL has been retained as the reviewer for the Mechanical Engineering Branch. In addition, NRC intends to use other BNL staff and their consultants as appropriate to assist in auditing future IDVP efforts with respect to the PG&E corrective action plan (see Enclosure 7).

In conjunction with the staff review, BNL will undertake the following additional independent analyses.

1. independent horizontal seismic analysis for the annulus structure.

2. seismic and stress analyses of one buried diesel oil tank, and

3. independent analyses for two additional piping problems (one of Westinghouse scope and one of PG&E scope).

These areas were chosen to provide the staff with confirmatory information in areas that either are not being included in the PG&E/Bechtel corrective action plan or to complete previous BNL analyses efforts. These efforts are anticipated to be completed in January.

ENCLOSURE 3

Enclosure 3

DIABLO CANYON IDVP OPEN INSPECTION ITEMS

1. Auxiliary Building - Verify that the seismic analysis model adequately characterizes the seismic responses of the structure and the in-situ structure masses and stiffnesses. This matter will be resolved by the IDVP and the NRC staff.

2. Criteria for Measurement Tolerances and Piping Supports - This matter will be resolved by the ITP and reviewed by the IDVP and the NRC staff.

3. Examine Changes to IDVP - This matter will be resolved by the NRC staff.

4. Piping As-Built Discrepancies - Verify the piping models reflect as-built configurations. This matter will be resolved IDVP and the NRC staff.

5. Intake Structure - Verify that all safety related components were designed considering appropriate response spectra corresponding to their attachment points. This matter will be resolved by the IDVP and the NRC staff.

6. Containment Polar Crane - Verify the structural integrity and response of the polar taking into account the 3-D seismic excitation of the crane and the flexibility of the seismic stop support structures. This matter will be resolved by the ITP and reviewed by the IDVP and the NRC staff.

7. Dome Service Crane - Verify the structural integrity of this crane considering appropriate response of the supporting polar crane. This matter will be resolved by the NRC staff.

8. Piping and Support - Verify that piping analysis procedures include the load combination or stress allowable criteria and that appropriate snubber flexibilities are included in the RCLA analyses. This matter will be resolved by the NRC staff.

9. Main Annunciator Cabinet - Verify the adequacy of RCLA equipment calculations, the PG&E cabinet response calculations and the in-situ adequacy ofthe cabinet construction. This matter will be resolved by the IDVP and the NRC staff.

10. Flexibility of Certain Containment Structures - Verify the adequacy of the structures and the attached piping, equipment and components considering the flexibility of the steam generator and pressurizer enclosures, containment pipeway and exhaust vent. This will be resolved by the IDVP and the NRC staff.

11. Annulus Spectra Revisions - Verify that piping attached to annulus have been analyzed for appropriate response spectra. This matter will be resolved by the IDVP and the NRC staff.

12. Blume Internal Review - Followup - This matter will be resolved by the ITP, IDVP and the NRC staff.

13. Response Spectra Document Control Manual (DCM) Adequacy - This matter will be resolved by the IDVP and the NRC staff.

ENCLOSURE 4

SCOPE OF REEVALUATION OF DESIGN AND DOUBLE DESIGN EARTHQUAKE

The original earthquake design basis for Diablo Canyon Units 1 and 2 was based on a set of 4 earthquakes which varied in magnitude and distance from the plant site. These four earthquakes produced various acceleration values and frequency content at the plant site. The response spectra of these four earthquakes were compared and enveloped to produce the design response spectra. The hypothetical earthquake (based on the set of 4) that produced the design response spectra anchored at 0.2g for 2% damping was defined to be the Design Earthquake (DE). Structures and equipment vital to safe shutdown and required to maintain the integrity of the reactor coolant boundary without loss of function were designed to a design response spectrum anchored at 0.4g which had for all periods twice the DE spectral values, however for 5% damping. The earthquake that produced this design response spectrum was defined as the Double Design Earthquake (DDE). In 1971 a published report by two geologists (Hoskins and Griffiths) showed a fault passing within 3 miles of the plant site. This fault was considered "capable" and it was postulated to produce a ground motion that was characterized by a Regulatory Guide 1.60 spectrum anchored at 0.75g. This earthquake was defined as the Hosgri earthquake (HOSGRI).

There are a number of differences between the analyses performed for the DE, DDE and HOSGRI earthquake. These differences occur in the areas of ground design spectra and associated acceleration time histories, damping values, models, analytical techniques, acceptance criteria, etc. For example, no vertical seismic analyses were performed in the DE and DDE analyses, whereas in the HOSGRI evaluation a vertical analysis was performed for each structure. Primarily because of the low damping values used in the original DE and DDE analyses the design of some structural members, piping, and equipment at Diablo Canyon was controlled by either the DE or DDE, even though the HOSGRI input design spectra were higher than either the DE or DDE spectra.

The scope of the IDVP initially was limited to review the Hosgri analyses. As a result of the recently instituted corrective action program (see Enclosure 7) the IDVP will include a review of the non-Hosgri analyses as part of the Phase II program. The staff finds this to be acceptable.

ENCLOSURE 5

LOOK BACK REVIEW OF SERVICE CONTRACTORS' QUALITY ASSURANCE PROGRAMS

INTRODUCTION

The PG&E Quality Assurance Department has reviewed the quality assurance programs and practices used by PG&E's service contractors during the Phase I and Phase II time periods. The time frames encompassed by Phase I and Phase II are those defined by the NRC Order of November 19, 1981.

The purpose of these reviews was to ascertain if there were shortcomings in the quality assurance activities relating to these contractors which could impact adequacy of the Diablo Canyon Plant design. Areas of investigation covered contractor quality assurance programs and implementation of same. Special attention was directed toward interface controls between the contractor and PG&E. A summary of the findings are as follows:

PHASE I SERVICE CONTRACTORS

The contractors reviewed during the Phase I time period were:

1. ANCO Engineers
2. CYGNA (EES)
3. EDS Nuclear
4. Harding-Lawson Associates
5. URS/Blume
6. WYLE Laboratories

SUMMARY

The review team found that some contractors had implemented a satisfactory quality assurance program and that others had deficiencies in implementation of their programs. In two cases, no formal quality assurance programs were applied to the work.

The following areas of concern were found among those contractors who had deficiencies in implementation of their quality assurance program:

1. External Design Interface Control
2. Document Control
3. Identification and Maintenance of Quality Assurance Records
4. Test Control
5. Design Verification
6. Instructions, Procedures, and Drawings
7. Training

Note: The enclosure is an excerpt of Attachment 5 to PG&E letter dated September 15, 1982.

PG&E was found to be deficient in the contracts issued to several of the contractors in the following areas of concern:

1. Disposition of Quality Assurance Records
2. Interface Control
3. Control of Purchased Services
4. Control of Transmitted Information

These areas of concern are the items referred to as deficiencies in the following summaries.

RESULTS

Our review indicated that the following two (2) contractors had satisfactory quality assurance programs in place at the time they performed work for PG&E as we identified very few, if any, deficiencies in their documentation:

1. EDS Nuclear

2. CYGNA (EES)

The following two (2) contractors were found to have deficiencies in the implementation of their quality assurance program:

1. ANCO Engineers

   ANCO Engineers had not satisfactory implemented several requirements in their quality assurance program. Seven deficiencies were identified; however, one was attributed to PG&E.

2. WYLE Laboratories

   WYLE had not satisfactorily implemented several requirements in their quality assurance program. Six deficiencies were identified; however, two were attributed to PG&E.

The following two (2) contractors were found to have no formal quality assurance programs applied to their past work that occurred within the time period of our Phase I review:

1. Harding-Lawson Associates

2. URS/Blume

PHASE II SERVICE CONTRACTORS

The contractors listed below were reviewed for work performed during the Phase II time period:

1. ANCO Engineers
2. CYGNA (EES)
3. EDS Nuclear
4. Garretson-Elmendorf-Zinov
5. General Electric
6. Grinnell Fire Protection Systems
7. Harding-Lawson Associates
8. NUS Corporation
9. NUTECH
10. Quadrex Corporation (NSC)
11. Radiation Research Associates
12. Robert L. Cloud Associates
13. STAFCO
14. Teledyne Engineering Services
15. Western Canada Hydraulic Laboratories
16. Westinghouse
17. WYLE Laboratories

SUMMARY

The review process again noted a range of program implementation during the Phase II portion of the Look Back Review effort. There was a noted improvement in the quality assurance contractual requirements since 1978 as compared to the Phase I and there was also improvement in actual overall implementation.

The following areas of concern were found among those contractors who had deficiencies in implementation of their quality assurance program:

1. External Design Interface Control
2. Document Control
3. Identification and Maintenance of Quality Assurance Records
4. Test Control
5. Design Verification

PG&E was found to be deficient in the contracts issued to several of the contractors in the following three (3) areas:

1. Disposition of Quality Assurance Records
2. Interface Control
3. Control of Purchased Services

These areas of concern are the items referred to as deficiencies in the following summaries.

RESULTS

Our review indicated that the following seven (7) contractors had satisfactory quality assurance programs in place at the time they performed work for PG&E as we identified very few, if any, deficiencies in their documentation:

1. CYGNA (EES)
2. EDS Nuclear
3. NUS Corporation
4. NUTECH
5. Quadrex Corporation (NSC)
6. Teledyne Engineering Services
7. Westinghouse

The following four (4) contractors were found to have deficiencies in the implementation of their quality assurance program:

1. ANCO

   ANCO had not satisfactorily implemented several requirements in their quality assurance program. Seven deficiencies were identified; however, one was attributed to PG&E.

2. Radiation Research Associates

   Radiation Research had not satisfactorily implemented several requirements in their quality assurance program. Six deficiencies were identified; however, one was attributed to PG&E.

3. STAFCO

   STAFCO had not satisfactorily implemented several requirements in their quality assurance program. Six deficiencies were identified; however, one was attributed to PG&E.

4. WYLE Laboratories

   WYLE had not satisfactorily implemented several requirements in their quality assurance program. Five deficiencies were identified; however, one was attributed to PG&E.

The following six (6) contractors were found to have no formal quality assurance programs applied to their past work that came under the parameters of our Phase II review:

1. Garretson-Elmendorf-Zinov
2. General Electric
3. Grinnel Fire Protection Systems
4. Harding-Lawson Associates
5. Robert L. Cloud Associates
6. Western Canada Hydraulic Laboratories

ENCLOSURE 6

ENCLOSURE 6

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION V
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CALIFORNIA 94596

SEP 15 1982

MEMORANDUM FOR: H. R. Denton, Director, Office of Nuclear Reactor Regulation

FROM: R. H. Engelken, Regional Administrator

SUBJECT: R. F. REEDY AND PG&E REVIEW OF DIABLO CANYON DESIGN QUALITY ASSURANCE

On September 10, 1982, R. F. Reedy, Inc.,(a Diablo Canyon Independent Design Verification, IDVP, contractor) conducted his audit exit meeting with representatives of the licensee. A member of our staff (T. W. Bishop) attended this meeting. Following the Reedy meeting Mr. Bishop met with licensee representatives to review their audits of PG&E in-house design activities and safety-related consultants. A summary of these audits and related comments are provided below.

R. F. Reedy IDVP Phase II Design QA Audit

R. F. Reedy, Inc., conducted design quality assurance audits of PG&E and some of their safety-related design contractor's who were not examined during the Phase I activities. Reedy audited five of the safety-related design organizations, these were: PG&E; EDS Nuclear; Radiation Research Associates (RRA); Quadrex/NSC; and Garretson-Elmendorf-Zinov (GEZ). The design activities audited were those related to the hardware samples discussed in the IDVP Phase II Program Plan. Reedy approached the audits in one of two ways. If the organization had developed and implemented a satisfactory design quality assurance program, then a "routine" design QA audit was performed (this approach was used for EDS and RRA). If a satisfactory design QA program was not evident, then Reedy conducted an audit of design quality assurance "practices", evaluating the organizations' practices against criteria identified in IDVP procedure No. DCNPP-IDVP-PP-002, Section 5.7. Due to a lack of adequately documented design QA programs Reedy chose to audit PG&E, Quadrex, and GEZ using this approach. Audits of design practices were subdivided into six categories: design inputs; design processes; design analyses; design outputs; change control; and interface control.

Note: This memorandum was forwarded to Teledyne Engineering Services by letter from D. G. Eisenhut, dated October 6, 1982.

During the exit meeting Reedy provided the following "generic" comments based on his audits:

PG&E:

Design Inputs	- lack of evidence of documentation for design input data
Design Processes	- processes were generally adequate
Design Analyses	- lack of evidence of independent checking of calculation sheets and computer analyses
Design Outputs	- outputs were generally adequate
Change Control	- lack of evidence of control of changes to calculations; drawing change control was found to be adequate
Interface Control	- no generic problems were identified with internal interface control; there was lack of evidence of external interface control

EDS Nuclear:

EDS appeared to have established and adequately implemented a design QA program.

Radiation Research Associates (RRA):

RRA appeared to have established and adequately implemented a design QA program.

Quadrex/NSC:

Quadrex/NSC had not established a design QA program for their PG&E work. In general, however, Quadrex was found to have adequate design control practices

Garretson-Elmendorf-Zinov (GEZ):

GEZ had not established a design QA program for their PG&E work. GEZ design practices exhibited three "generic" problems.

- lack of evidence of control of design inputs
- lack of evidence of independent checking of calculations
- lack of identification of changes in design calculations

Reedy stated that he had not yet categorized his findings (e.g. as errors or open items), nor fully assessed the implications of the findings. He anticipated these actions would be completed following discussion with other IDVP members (Teledyne and Stone & Webster). Reedy expects to issue his report at the end of October, 1982.

PG&E Look Back Reviews

In response to the original (September 1981) concerns regarding design interface control the licensee initiated audits of their in-house design activities and their safety-related consultant contracts (involving 18 contractors). The proposal to conduct these audits was discussed by the licensee in a transcribed meeting with the NRC staff on November 3, 1981. The licensee refers to these audits as "Look Back Reviews" since most of the activities examined involved closed contracts. The stated purpose of the reviews was to "verify all design activities comply with quality procedures and NRC regulations..." The licensee's QA organization was responsible for completion of the reviews and the Engineering Quality Control organization was responsible for resolution of the review of findings. The audits were initiated November 30, 1981 and were completed April 2, 1982. In June 1982 the licensee decided that an additional contractor (Garretson-Elmendorf-Zinov) should be audited since work performed by the contractor (HVAC) involved a safety function (the contract had been designated non-safety). This final audit was completed July 23, 1982.

All items which were found to be of "questionable status" were documented on "Look Back Deficiency Notices" (LBDN). 159 LBDN's were issued as a result of the reviews. 82 of the LBDN's pertained to licensee consultants, while 77 related to in-house design activities. In addition, a few Nonconformance, Deficiency, and Open Item Reports were issued to document the review findings. Many of the review items are similar to the R. F. Reedy findings. The Look Back Review items include:

In-House design - loads added to battery systems without effects analysis; design calculations/verifications not completed; uncontrolled changes to design; unapproved specification changes; inconsistencies with the FSAR; design change notice reviews not controlled by procedure; FSAR not maintained as a controlled document; instrument set points not controlled.

Contractor design - quality assurance program not specified as a requirement; quality assurance program not applied; drawing inconsistent with FSAR data; recommended "design assumption" tests not performed; calculations not controlled

The above examples <u>are not</u> representative of all the Look Back Review findings but do illustrate the similarity between the "generic" Reedy findings and the licensee's audit findings. This becomes significant since some of the licensee findings were identified in areas which were not specifically reviewed by Reedy (e.g. component cooling water system, 125V DC system).

Region V Comments

In consideration of the above, we offer the following comments and questions.

1. Did R. F. Reedy, Inc., comply with the requirements of the NRR letter of November 19, 1981 regarding scope and approach?

   The November 19, 1981 letter required quality assurance reviews of all service related contractors. R. F. Reedy, Inc., narrowed the scope of the reviews to contractors with significant safety-related design responsibilities, auditing only a portion of the safety-related service contractors. Service-related contractors such as Stafco, Inc. (responsible for quality "Q-list" and FSAR updating) and Western Canada Labs, Inc. (tank vortexing study) were not examined by R. F. Reedy. It appears that the omission of certain service-related contractors is inconsistent with the NRR letter.

   During the conduct of the audits, once the lack of an effective QA program or implementation was identified, R. F. Reedy chose to initiate a review of "design practices". Further assessments of programmatic (procedural) controls were discontinued. The NRR letter requires a review to determine whether quality assurance procedures and controls were fully and effectively implemented. Without thoroughly examining the extent and implementation of the programmatic controls, an assessment of generic findings is inhibited (especially in the area of design control consistency). An evaluation of the need to complete the programmatic reviews may be appropriate.

2. How should the PG&E Look Back Review findings be used?

   The IDVP Phase II Plan states that the primary IDVP purpose of the R. F. Reedy, Inc., audits is to obtain information which impacts the extent of design process verification. The plan further states that negative audit results reveal the potential for a low level of design control consistency and indicate the possible need for additional verification. We concur with IDVPs proposed use of the Reedy findings. Consistent with this, the PG&E Look Back Review findings provide further data which may be useful in assessing the need for additional verification. This is particularly valid since the sample of the Look Back Reviews was different from that of R. F. Reedy, Inc., in some cases. Accordingly, it is recommended that the detailed results of the Look Back Revew be provided to the IDVP for their use in future decisions on additional verifications.

3. Should the scope of the IDVP Phase II Program Plan be reexamined in light of the R. F. Reedy and PG&E findings?

   The IDVP Phase II Plan currently provides for expansion of the verification program if warranted by design quality assurance audit findings. Although the R. F. Reedy findings are preliminary and may not accurately represent the final evaluation, their combination with the licensee audit findings suggests the possibility of broad programmatic deficiencies in the licensee's design program and certain of their contractors. Based on this condition, it may be appropriate to reexamine the scope of the initial verification sample defined in the Phase II Program Plan.

It is suggested that the above comments be provided to the IDVP for their timely use in completing the verification program. We would be pleased to discuss the above comments with you further (contact T. W. Bishop FTS 463-3751).

R. H. Engelken
Regional Administrator

cc: R. DeYoung
D. Eisenhut
R. Vollmer
E. Case
L. Chandler
J. Knight
T. Novak
F. Miraglia
H. Schierling
J. Kerrigan

ENCLOSURE 7

Enclosure 7

PG&E CORRECTIVE ACTION PROGRAM

PG&E is conducting a separate[1], internal technical program (ITP) in accordance with its responsibility as the licensee for the Diablo Canyon Power Plant to ensure that it is designed and constructed in accordance with the licensing criteria. The ITP plan as described by PG&E in a March 25, 1982 meeting was approved (NRR letter to PG&E, dated April 27, 1982) and its activities are reported in the PG&E semimonthly reports. In a meeting on August 6, 1982, PG&E advised the staff that, as a result of findings by the IDVP and the ITP, a corrective action program (CAP) had been initiated as part of the ITP. Within the program, a complete review of certain major areas of the plant seismic design is being performed including (1) all major safety-related structures (containment building, auxiliary/fuel handling building, turbine building and intake structure); (2) verification of all large-bore safety-related piping, including complete walkdown of piping systems; (3) review of small-bore piping systems and complete reanalyses where found necessary.

The CAP will also include the resolution of open items in these specific areas as identified by the IDVP and ITP, including appropriate analyses and plant modifications. PG&E will issue a final report for the Phase I design verification program that will include the scope, criteria, methodology, findings, and conclusions for the corrective action program.

The IDVP will review and evaluate findings of the CAP with respect to the need for additional verification or additional sampling.

---

[1]Separate from the IDVP, which is performed by organizations independent of PG&E under the management of Teledyne Engineering Services.

ENCLOSURE 8

MODIFICATIONS RESULTING FROM IDVP AND ITP
(Per PG&E Submittal date September 15, 1982)

System/Component	Modification(s)
A. Pipe Supports (257 total)	
Structural modifications (large and small bore)	121
Base plate/anchor bolts (large bore)	18
Additions (large and small bore)	27
Spring or seismic limiter settings	3
Gap adjustment (large and small bore)	46
Rod supports (small bore)	42
B. Other Supports (43 total)	
Valves	1
Containment fan cooler	1
Instrument testing (non-safety-related)	2
Annunciator cabinet	1
Raceways (various types)	38
C. Annulus Structure (38 total)	
Wide flange corrections	27
Members	11
D. Other (6 total)	
125-V dc breakers	6
E. Anticipated Additional Modifications	
HVAC ducts and supports	

System/Component	Modification(s)
Equipment in various locations	
Piping rerouting in containment and auxiliary buildings	
Pipe supports in various buildings	
Polar crane and dome service crane	
Electrical power supply to control room HVAC	
Raceway supports	

ENCLOSURE 9

PG&E PROPOSAL FOR STAGED LICENSING

At a meeting on August 6, 1982, Pacific Gas and Electric Company (PG&E) provided the staff with a proposed schedule for the completion of Phase I of the Independent Design Verification Program (IDVP), including a proposed date for initial fuel loading of November 30, 1982. PG&E has provided a listing of all systems, components, and structures required to support initial fuel loading including the rationale for the listing. PG&E provided information in submittals dated August 24, 1982 and September 8, 1982. PG&E made the following assumptions for activities up to and including fuel loading:

1. No decay heat and no fission product inventory will be generated.

2. The steam generators will remain in dry layup throughout the period.

3. Other systems and components not included in the listing will be available and may be used if necessary or desirable.

4. All instrumentation associated with the required systems will be available.

5. Building and structures that contain or support the required systems and equipment will be available.

PG&E provided lists of equipment "required" for fuel loading and equipment which would provide operational "support." The equipment in the "required" list will be seismically requalified, whereas the equipment in the "support" list will be verified operationally but would not necessarily be requalified by their proposed fuel loading date.

The systems identified by PG&E as required for fuel loading and for which seismic requalification modifications will be complete were selected based on FSAR Chapter 15 analyses for core and system conditions which would exist during initial loading (e.g., no decay heat or fission product inventory). Only inadvertent boron dilution was determined to require protection equipment. Inadvertent control rod withdrawal cannot occur since the trip breakers will be deenergized.

The staff has reviewed the PG&E proposal and concurs with the identification of systems by PG&E. The staff reviewed the list of equipment required to protect against boron dilution events (FSAR page 15.2-20) and concludes that this equipment is included in the list. The staff notes that fire protection and control room habitability equipment is also included. The staff also reviewed the current Diablo Canyon Technical Specifications for equipment required for loading of unirradiated fuel. The staff notes that the following supportive equipment is required by the current Technical Specifications which is not listed in either PG&E's list of "required" equipment, or the list of "supportive" equipment:

1. containment ventilation isolation equipment,

2. equipment for communication between the control room and the refueling station, and

3. containment ventilation system.

The staff believes that this equipment should also be verified as operable before fuel loading. This equipment need not be seismically requalified prior to fuel loading since the occurrence of a large earthquake simultaneously with the fueling operations would be unlikely. Moreover, no fission product release could occur during initial fuel loading unless a reactivity transient resulting in fuel damage also occurred. This would also be unlikely since PG&E will have available seismically requalified equipment to protect against reactivity excursions.

With the above additions to the supportive equipment list, the staff finds that the lists of equipment identified by PG&E as "required" and "supportive" for fuel loading are acceptable. We will assure that in accordance with the Commission's Order of November 19, 1981, a adequate basis for not completing other modifications prior to fuel load has been provided.

ENCLOSURE 10

Enclosure 10

STAFF EVALUATION OF PHASE II CONTRACTORS

Technical Qualifications of Contractors

The principal subcontractors to Teledyne Engineering Services (TES) for the Phase II program are Robert L. Cloud Associates (RLCA), R. F. Reedy, Inc. (RFR), and Stone & Webster Engineering Company (SWEC).

Phase II seismic structural and mechanical review is designated largely for RLCA. This is the same role that they played in Phase I, and the staff sees no reason to question the continued participation of RLCA in this capacity. The quality assurance aspects are assigned to RFR. Since the same assignment was given to RFR during Phase I, the staff also sees no reason to change their continued participation in Phase II. In summary, the technical qualifications of RLCA and RFR were well established prior to Phase I and have been amply verified by their activities to date.

The SWEC scope includes the selection of representative samples of safety-related system designs and analysis performed by Pacific Gas and Electric Company (PG&E) and service contractors, the development of the design chain for the sample activities, a review of the selected sample systems, and performance of representative calculations for the purpose of design process verification. The verification program includes review of the safety-related system design requirements, including the electrical and control design requirements, equipment environmental qualification, and design analyses.

The staff has reviewed numerous facilities designed by SWEC and audited their design process both at the quality assurance and technical levels. SWEC had full responsibility for the concept, design, and installation of systems similar to those available for sampling at Diablo Canyon. Based on this experience, the staff concluded that SWEC is fully qualified to perform the functions assigned in the Phase II Independent Design Verification Program (IDVP) for Diablo Canyon.

In addition Teledyne has identified (Semi-Monthly Report, dated August 27, 1982) the following consultants that will provide assistance to the IDVP in specialized areas:

Hansen, Holley and Biggs (civil/structural)
General Dynamics (radiation)
Alexander Tusko Inc. (electric power)
Foster Miller Associates (instrumentation and control)
J. W. Wheaton (electric power team leader)
Abendruh Inc. (soils).

Independence of Contractors

During Phase I, the staff concluded that TES, RLCA, SWEC and RFR were independent from PG&E. Mr. Howard Friend, the Diablo Canyon Project Manager has informed the NRC staff that all of Bechtel's stock is held by the Bechtel family or officers

of the company and is not available to these or other subcontractors. In addition, he does not believe that Bechtel does any business with any of the subcontractors listed above with the exception of TES. He estimates that Bechtel's business accounts for about 2% of TES's annual revenues.

The staff has requested written verification from both TES and Bechtel regarding any business dealings between PG&E and Bechtel and the Phase II subcontractors. Based on the above, however, it appears that no financial conflicts of interest exist among the IDVP subcontractors, PG&E and Bechtel.

Verification of Independence for Technical Reviewers

TES has developed during Phase I of the IDVP a procedure to assure the financial and professional independence of individuals assigned to the IDVP. The staff reviewed the procedure and approved it by letter dated September 8, 1982. The procedure applies to TES and subcontractor employees and includes a confidential conflict of interest statement.

Region V has initiated a program to routinely verify the independence of IDVP technical reviewers. The purpose of this program is to assure that the individuals performing the IDVP will provide an objective, dispassionate technical judgment, based solely on technical merit. The following factors were considered in evaluating the question of independence:

(1) Whether the individuals involved had been previously hired by PG&E or BPC to do similar design work.

(2) Whether any individual involved had been previously employed by PG&E or BPC (and the nature of the employment).

(3) Whether the individual owns or controls significant amounts of PG&E or BPC stock.

(4) Whether members of the present household of individuals involved are employed by PG&E or BPC.

(5) Whether any relatives are employed by PG&E or BPC in a managment capacity.

The organizations involved in the IDVP (TES, SWEC, RLCA, RFR) developed "conflict of interest statements" for their applicable employees to sign. The statements were used to screen the proposed participants for any potential or apparent conflicts of interest with respect to the IDVP. Originally, the conflict of interest statements referred only to PG&E; however, BPC has recently been added to the statement. In addition to signing the original statements, the participants will be required to sign the revised statements reflecting the current Bechtel involvement in Diablo Canyon.

To verify that the individual participants meet the established independence criteria, the staff has reviewed conflict of interest statements, reviewed resumes, and confidentially interviewed participants. The following is a summary of that effort:

(1) Conflict of Interest Statement--The Region V staff reviewed conflict of interest statements of all of the key TES participants (44 statements). These 44 statements included statements of six individuals employed by consultants to TES. The organizations that these individuals represent are J. W. Wheaton Tecnlology; Hasen, Holley, Biggs, Inc.; Alexander Kusko, Inc.; and Foster-Miller Associates. The conflict of interest statements signed by these individuals indicated that none of the individuals have any significant past or present involvement with PG&E or Diablo Canyon. The conflict of interest statements did not include BPC. Recently, Bechtel has been added to the statements. The revised statements will be signed by the individuals involved.

Region V has completed independence reviews of R. F. Reedy Inc. and R. L. Cloud Associates. The reviews has established that two senior managers from R. F. Reedy Inc., were previously employed by Bechtel Power Company. During the Teledyne/ PG&E/NRC meeting of October 7, 1982, it was determined that Teledyne intends to have R. F. Reedy, Inc., examine the PG&E/Bechtel design quality assurance applied to the corrective action program. Region V has identified to senior PG&E management the possible "conflict of interests" in this matter. PG&E management has stated that they will take appropriate action to assure that there will be no "apparent" conflict of interests in the quality review of corrective actions.

In addition to the conflict of interest statements of the TES individuals, the staff has reviewed the conflict of interest statements of the SWEC participants in the IDVP. Sixty-six conflict of interest statements were reviewed and included all of the SWEC participants with the exception of two individuals whose statements were not available at the time of the review. The conflict of interest statements signed by these individuals indicated that none of the individuals have any significant past or present involvement with PG&E or Diablo Canyon. Similiar to the TES conflict of interest statements, the SWEC statements did not include Bechtel; the statements will be revised to include Bechtel and will be re-signed by the SWEC participants.

(2) Resumes--The professional resumes of key TES and SWEC participants have been reviewed by the staff to give additional information regarding the question of independence. This effort included 34 resumes of TES personnel (including consultants) and 36 resumes of SWEC personnel. The resumes indicated no employment history with either PG&E or Bechtel.

In addition, the resumes were used to evaluate the professional experience and competence of the participants. The staff concluded that the TES and SWEC individuals involved in the IDVP are competent and experienced in the matters under review.

(3) Confidential Interviews--To further evaluate the question of independence, the staff selected key participants in the IDVP and conducted condfidential interviews with them. This effort included interviews with thirteen TES personnel, nine SWEC personnel, and approximately 50% of the RLCA participants from their West Coast office. In addition to the question of independence, the line of questioning by the staff included the possiblity of pressure being applied to suppress findings. Based on these interviews, the staff concluded that there is no conflict of interest between the participants in the IDVP and PG&E and Bechtel, and the participants feel no pressure to suppress possible findings.

Interviews with TES West Coast employees, RFR employees, and RLCA East Coast employees are currently in progress

ENCLOSURE 11

STAFF EVALUATION OF IDVP PLAN - PHASE II

I. TES Program Plan

The Teledyne Engineering Services IDVP-Phase II plan, dated June 18, 1982, is intended to respond to the requirements of the Commission Order and the November 19, 1981 letter from H. Denton to Mr. M. M. Furbush. The program plan includes the following features:

1. Selection of representative samples of safety related systems, designs and analyses performed by PG&E and service contractors.

2. Development of the design chains for all non-seismic safety-related actitivies performed by service contractors prior to June 1978, for safety related activities for samples performed by service contractors after January 1978 and for PG&E internal design activities for selected samples.

3. QA audits and reviews of the organizations identified through the design chain utilizing essentially the same methods and criteria applied in Phase I.

4. Review of design control practices where deficiencies at either the program level or implementation level are discerned during the QA audits.

5. Review of design requirements for the sampled systems and components including electrical and control design requirements, equipment environmental qualification and design analyses.

6. Verification of the design process for each selected sampled to include as a minimum:

   - correct selection and incorporation of design input into the design,
   - reasonableness of assumptions used in the design,
   - identification of applicable codes, standards, and regulatory requirements to be used as a basis of design as committed to in the approved DCNPP-1 licensing documents,
   - correctness of design interface information used in the design,
   - adequacy of design or calculation method used,
   - reasonableness of the outputs compared to the inputs,
   - adequacy of equipment for the required application,
   - review of completed pre-operational tests when applicable to evaluate system and component operating performance,

- review of the sample system design requirements for compatibility with the Technical Specifications,

- review of redundancy to determine if the system design satisfies the single failure criteria as defined in the DCNPP-1 licensing documents,

- review of the fire protection provided for the selected sample systems for conformance with the plant's licensing commitments, and

- verification that the system as designed and analyzed is equivalent to the licensed design and that adequate separation (distance, barriers, or restraints) exists to accommodate potential piping failure results (pipe whip, fluid jet, flooding, environment) and/or internally generated missiles such that the system can accomplish its designed safety-related function during exposure to such pipe break/cracks or missiles.

The Governor of the State of California and Joint Intervenors provided comments to the staff on the Phase II plan, which were discussed at a meeting on September 9, 1982 and which are summarized in Attachment 8 to the September 24, 1982 memorandum from the Executive Director for Operations to the Commission.

II. Staff Findings and Resolution of Comments

Based on the staff's review of the Phase II program plan proposed by TES and review of the comments provided by the intervening parties it is concluded that:

1. The proposed Phase II program as modified by the September 17, 1982 letters and the additional requirements noted in this attachment should provide adequate identification and evaluation of significant design errors in the selected sample and an adequate understanding of the root cause.

2. The sample selected and the provisions for additional sampling should provide adequate assurance that the full significance of any design errors disclosed in Phase II will be developed.

3. The Phase II program plan should be expanded consistent with the agreement of the IDVP and PG&E to include construction QA activities.

4. The Phase II program plans should be expanded to explicitly include the TES and PG&E commitment to provide for IDVP review of the PG&E corrective action plan.

5. The distinction between work performed under Phase I and Phase II as a basis for restoration of the low power license is no longer appropriate.

6. Rigorous statistical techniques are largely inappropriate for a design verification program.

A description of the IDVP plan for Phase II, including the results of the staff review, are presented in Sections III through V of this enclosure.

III. Initial Sample Selection

The Auxiliary Feedwater (AFW) system, and the Control Room Ventilation and Pressurization (CRVP) system and the safety-related portion of the 4160 V Electric Distribution System are selected in the Phase II Program Plan as the initial systems for which independent verification will be performed.

The AFW system includes the condensate storage tank and/or the seismic Category I water supply, valving and cross-connects, connections with the steam generators which include the safety Class 2 (safety-related) portions of the main feedwater system and the safety-related steam supply system to the turbine driven pump. The AFW system also includes all equipment and interconnections with other systems whose failure could affect the safety functions of the AFW system. As a basis for selecting the AFW system TES noted that the design process involved interfaces with NSSS vendor criteria (Westinghouse) with containment design criteria, and with PG&E internal design organizations. TES also noted that the AFW system design represents a typical example of the methodology of determining a water system's mechanical, electrical and control component design requirement. The staff concurs with these bases for selection.

The CRVP system includes all mechanical components which constitute the safety-related portion of the sytsem as well as all equipment and cross-connects whose failure could affect the safety functions of the CRVP system. As bases for selection of the CRVP system TES noted that deign of the CRVP system also represents an interrelationship of several design criteria and interfaces. Specifically, it involves interface with several service contractors, interface of PG&E internal design organizations, and interface with the control room habitability criteria. Experience gained by the staff in the review of IDVP's recently conducted for a number of plants has shown that significant differences frequently exist between the methods and approach to design employed for air systems as compared to water systems. The staff therefore concludes that the selection of the CRVP represents a significant addition to the initial sample for Phase II.

Integrated radiation dose analyses as well as the temperature, pressure and humidity analyses which were employed to develop equipment specification will be reviewed at two representatives locations outside containment. One location will be associated with the Auxiliary Feedwater System, while the other will be associated with the Control Room Ventilation and Pressurization System. These analyses performed by several service-related contractors were different and their work involved a flow of design information through PG&E engineering groups.

The electrical design of safety-related equipment included in the AFW and CRVP systems as well as the safety related instrumentation and Controls (I&C) portions of these systems will be also reviewed under the proposed Phase II program plan. The electrical review will include the loads, feeders, raceways, and protective devices which are part of these systems. The I&C design review will include monitoring and alarming criteria and design implementation, system control device criteria and design implementation, review of design documents and installation drawings for compliance with regulatory and vendor equipment requirements, review of equipment environmental qualifications and review of process functions.

The safety related portion of the 4160 V Electrical Distribution System (4160 V system) includes class IE buses, the stand-by start-up and unit auxiliary transformer supply connections to these buses, the diesel generators connected to the buses, and the cable feeders and bus duct connecting this equipment. As a bases for selection TES notes that the safety-related portion of the 4160 V system is the basic power supply for safety-related electrical equipment. It also represents an interrelationship of several design criteria and involves the interface of several PG&E internal design organizations. The staff concurs in the selection of the 4160 V system and we conclude that this selection in conjunction with the electrical and I&C reviews discussed above provide an adequate initial sample of the design process for electrical and instrumentation and control systems.

IV. Piping and Equipment

The Phase II IDVP methodology for the verification of piping will consist of the following steps:

- field verification of sample lines in the AFW system,
- development of models from RLCA field verified drawings,
- analysis by methods that will in general parallel those used for the design analysis of the piping, and
- independent verification of postulated AFW pipe break locations.

Based on the experience gained in Phase I of the IDVP a modified criterion will be employed for evaluation of the independent analyses for piping. In both the verification and design analysis all points in the line that are stressed to 70% of allowable stress or more will be selected as reference locations. If fewer than 5 such points are found, the 5 most highly stressed points will be selected as reference locations. If, for either the design or verification analyses, the stresses at the reference locations differ by more than 25% or exceed allowable stress additional verification will be required.

Selected pipe and pipe rutpure supports will be chosen for a field verification of consistency with design configuration and for comparison of the loads calculated from the independent analyses with those calculated in original design analyses. Loads differing by 25% or loads over allowable

values will require issuance of an Open Item Report and additional verification to resolve the Open Item.

Based on our review of the Phase I results to date the staff concurs that the use of a 25% criterion is appropriate. In our acceptance of a 15% criterion for the Phase I portion of the IDVP for Diablo Canyon we noted that deviations of up to fifteen percent are considered normal and have been implicitly accounted for by the design factors approved for usage in design criteria for nuclear plants. The same is largely true of twenty-five percent deviation when taken in the context of reasonable variations in modeling and allowable tolerances in location of supports and restraints. The fifteen percent criterion used during Phase I frequently led to the designation of open items whose root cause was differences in dimensions used in the piping models that were within allowable tolerances. The staff concludes therefore that the purpose of the IDVP for Diablo Canyon is best served by use of the more significant 25% criterion.

The original design of pipe supports required each support to have a minimum natural frequency of 20 Hz considering the stiffness of the support and the mass of the supported pipe. Selected supports will be verified and the first mode frequency of the pipe supports will be verified to be equal to or greater than 20 Hz. During review of the Phase II program plan the staff requested clarification of this criterion with respect to any allowed error band. In response to the staff request, representatives of RLCA indicated that any calculated frequency below 20 Hz would be considered an open item. The staff finds this criterion acceptable.

For equipment such as cooling coils, condensate storage tank, pumps, valves/dampers, electrical panels and cabinets, fans and filters, design drawings will be field verified and stress analysis methods used for verification of the equipment qualification. Verification analyses will consider stresses in the equipment itself as well as equipment supports and support structure including the anchorage. The loading combinations and structural criteria for both the mechanical equipment and supports will be compred to those given in the License Application and differences reported. The staff finds this approach and the related criteria acceptable.

V. Additional Verification and Additional Sampling

The Phase II program plan contains explicit provision for additional verification or additional sampling to be performed when engineering evaluation determines its necessity based upon the nature (generic/specific) of an identified deficiency. Generic deficiencies, which could be propagated throughout the engineering work reviewed will require additional verification to resolve the generic concern. The plan recognizes that generic deficiencies may be a function of engineering methods, engineering personnel or contractors and that deficiencies may result not only from the engineering design verification, but also from the Quality Assurance (QA) verification. The plan also provides that QA and Design Control Practices deficiencies that are generic may trigger additional engineering verification. The staff concludes that the additional sampling provisions of the Phase II program plan adequately provides for treatment of possible generic findings and is therefore acceptable.

12/81

TRANSMITTAL TO: ☑ Document Control Desk, 016 Phillips

ADVANCED COPY TO: ☐ The Public Document Room

DATE: 10/21/82

From: SECY OPS Branch

cc: OPS File

C&R (Natalie)

Attached are copies of a Commission meeting transcript/s/ and related meeting document/s/. They are being forwarded for entry on the Daily Accession List and placement in the Public Document Room. No other distribution is requested or required. Existing DCS identification numbers are listed on the individual documents wherever known.

Meeting Title: Discussion of Phase II Reverification Program for Diablo Canyon

MEETING DATE: _____ Open X Closed ___

ITEM DESCRIPTION:	Copies Advanced To PDR:	DCS COPIES: (1 of each Checked) Original Document	May be Dup*	Duplicate Copy*
1. Transcript (w/ viewgraphs attached)	1	1		
2. SECY 82-414	2		1	
3.				
4.				
5.				

*Verify if in DCS, and change to "PDR available."

(PDR is advanced one of each document, two of each SECY paper.)