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Supplement No. 19

Safety Evaluation Report

related to the operation of
Diablo Canyon Nuclear Power Plant,
Units 1 and 2

Docket Nos. 50-275 and 50-323

Pacific Gas and Electric Company

Supplement No. 19

U.S. Nuclear Regulatory Commission

Office of Nuclear Reactor Regulation

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ABSTRACT

Supplement 19 to the Safety Evaluation Report for Pacific Gas and Electric Company's application for licenses to operate Diablo Canyon Nuclear Power Plants, Units 1 and 2 (Docket Nos. 50-275 and 50-323), has been prepared by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission. This supplement reports on the verification effort for Diablo Canyon Unit 1 that was performed between November 1981 and the present in response to Commission Order CLI-81-30 and an NRC letter to the licensee. Specifically, Supplement 19 addresses those issues and other matters identified in Supplement 18 that must be resolved prior to commencement of fuel loading operations.

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ABBREVIATIONS

ACI	American Concrete Institute
AFW	auxiliary feedwater
AFWS	auxiliary feedwater system
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASLAB	Atomic Safety and Licensing Appeal Board
ASLB	Atomic Safety Licensing Board
ASME	American Society of Mechanical Engineers
BNL	Brookhaven National Laboratory
CAP	Corrective Action Program
CCW	component cooling water
CCWS	component cooling water system
CRVPS	control room ventilation and pressurization system
DCNPP	Diablo Canyon Nuclear Power Plant
DCP	Diablo Canyon Project
DDE	double design earthquake
EOI	Error or Open Item
FSAR	Final Safety Analysis Report
GDC	General Design Criteri(on) (a)
HVAC	heating, ventilation, and air conditioning
IDVP	Independent Design Verification Program
ITP	Internal Technical Program
ITR	Interim Technical Report
LOCA	loss-of-coolant accident
NRC	U.S. Nuclear Regulatory Commission
OIR	Open Item Report
PG&E	Pacific Gas and Electric Company
QA	quality assurance
RFR	R. F. Reedy, Inc.
RLCA	Robert L. Cloud and Associates

SER	Safety Evaluation Report
SRSS	square root of the sum of the squares
SSE	safe shutdown earthquake
SSI	soil-structure interaction
SWEC	Stone & Webster Engineering Corporation
TES	Teledyne Engineering Services
ZPA	zero period acceleration

1 INTRODUCTION

The staff of the U.S. Nuclear Regulatory Commission (NRC) issued on October 16, 1974, its Safety Evaluation Report (SER) in matters of the application of the Pacific Gas and Electric Company (PG&E) to operate Diablo Canyon Nuclear Power Plant, Units 1 and 2. The SER has since been supplemented by Supplement Nos. 1 through 16 and No. 18 (Supplement 17 has not yet been issued. It is not related to the design verification effort). SER supplement No. 18 (SSER 18) presented the staff's safety evaluation on matters related to a verification effort for Diablo Canyon Unit 1 that was the result of Commission Order CLI-81-30 and an NRC letter to PG&E of November 19, 1981. This is SER Supplement No. 19 (SSER 19) and presents the staff's safety evaluation of those unresolved matters identified in SSER 18 which must be satisfactorily resolved prior to commencement of fuel loading operations at Diablo Canyon Unit 1. The verification effort relates only to Unit 1 of the Diablo Canyon Nuclear Power Plant; therefore, this supplement applies only to Unit 1 unless otherwise stated.

This supplement is based on information available to the staff as of October 13, 1983. Verification efforts required for fuel load have been completed. Confirmatory documentation will be provided by the licensee on certain items. The staff has not completed its safety evaluation of all the information that became available after the SSER 18 information cutoff date of June 30, 1983 and which relates to unresolved matters which need not be resolved prior to the commencement of fuel load operations. The staff will prepare its safety evaluation on these matters after completing its evaluation.

The verification effort covers a wide range of subjects that cannot be presented effectively in the normal format of an SER and its supplements. Therefore, the safety evaluation of the verification effort in SSER 18 was reported in Appendix C to that supplement.

Appendix A to an SER supplement is normally used for an update of the chronology for all Diablo Canyon Nuclear Power Plant related matters. The latest chronology was included in SER Supplement 16 dated August 1983. As in SSER 18, Appendix A has been omitted from this supplement. However, the continuation of the chronology for the Diablo Canyon Unit 1 verification effort has been included in Appendix C.

Appendix B to an SER supplement is normally for the bibliography to that supplement. In this supplement the bibliography has been included in Appendix C. Appendix D to this SER supplement includes the list of contributors and consultants.

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APPENDIX C

STAFF EVALUATION OF VERIFICATION EFFORT FOR DIABLO CANYON NUCLEAR POWER PLANT - UNIT 1

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*Not addressed in SSER 19.

1 BACKGROUND AND INTRODUCTION

On August 5, 1983, the NRC staff issued SER Supplement No. 18 (SSER 18) which presented the staff evaluation of a design verification effort for Diablo Canyon Unit 1. The basis for this effort and a description of the process of this effort are described in detail in SSER 18. In summary, the Commission Memorandum and Order CLI-81-30 (November 19, 1981) suspended the authorization to load fuel and perform low power testing granted by the Diablo Canyon Unit 1 Operating License No. DPR-76 because serious weaknesses had been identified in the implementation of the quality assurance programs of PG&E and its seismic, service related contractors. The Commission Order required that an independent design verification program (IDVP) of seismic, service related contract activities (pre-1978) be completed to the satisfaction of the NRC prior to lifting the suspension. In addition, the NRC staff issued a letter (November 19, 1981) which required an IDVP with respect to non-seismic, service related contract activities, PG&E internal design activities, and post-1978 seismic, service related contract activities, which must be satisfactorily completed prior to an NRC decision regarding a full power license. The activities associated with the Commission Order and the NRC letter have become known as Phase I and Phase II of the design verification, respectively.

The Diablo Canyon Unit 1 design verification effort consists of two separate efforts. One is the IDVP as discussed above. It is conducted by organizations and individuals not associated with PG&E under the program management of Teledyne Engineering Services (TES). The other effort is the PG&E internal technical program (ITP) which is performed by PG&E's Diablo Canyon Project (DCP) which is a combined PG&E/Bechtel organization.

As stated in SSER 18, by the fall of 1982 it became evident that the earlier distinction between the pre-1978 and post-1978 effectiveness of design controls was no longer valid and thus the timing for completion of Phase I and Phase II activities was no longer necessary. PG&E proposed and the Commission approved a three-step process for reinstatement of the suspended low power license and issuance of the full power license as follows:

Step 1: fuel load authorization
Step 2: criticality and low power authorization
Step 3: full power license

The specific activities that must be completed for each of the three steps were delineated in the PG&E submittal of December 3, 1982. In SSER 18 the staff presented its safety evaluation of the design verification effort, both IDVP and ITP, without specifically focusing on the requirements for the three-step concept.

The staff safety evaluation of the design verification effort in SSER 18 was based on information that had been submitted by the IDVP and PG&E as of June 30, 1983. At that time the effort had not been completed. Further analyses and verification effort by the IDVP and the DCP (including modifications by the DCP) were still in progress. The purpose of this supplement, SSER 19, is to

update the staff safety evaluation of those matters that were identified as unresolved in SSER 18 and which must be satisfactorily resolved prior to fuel load authorization, i.e., Step 1. It is based on information that had been provided to the staff as of October 13, 1983. The submittals also include information with respect to Step 2 and Step 3, and SSER 19 addresses some of these matters. However, the staff has not completed its evaluation and resolution in this regard and intends to issue further SER supplements with respect to Step 2 and Step 3, as necessary. A chronlogy of events and information exchanges is provided in Section 7 of this report.

Throughout SSER 18 the staff identified a number of items that require further action by the IDVP, PG&E, or the staff. They consist of (1) open items, (2) incomplete PG&E and IDVP effort and staff review, and (3) need for future documentation or verification. With respect to open items, the staff identified 30 specific open items in its memorandum of September 6, 1983 to the Commission (SECY-83-366). These items are listed in Table C.8.1 of this supplement. One additional item (Item 31) has since been added to the list. As shown in the table, 14 items require resolution for Step 1, 14 for Step 2, and 3 for Step 3. These open items are issues that were identified by the staff during its evaluation of the design verification effort that had been completed at that time by the IDVP or PG&E. They require further information, confirmation of data, additional justification or bases for an analysis, or additional analyses or modifications, as appropriate.

The safety evaluation presented in SSER 18 was incomplete in a number of areas because at that time the IDVP had not completed its verification effort and the necessary ITRs had not been issued. Table C.8.2 is a list of these areas in SSER 18. Finally, there were identified in SSER 18 certain requirements for further documentation or verification. This includes commitments by the licensee to update the Final Safety Analysis Report (FSAR) and the need for verification by the staff of certain PG&E actions. These items are listed in Table C.8.3. Resolution of these items is not required prior to fuel load authorization.

Since the issuance of SSER 18, PG&E, the IDVP, and the staff have pursued the completion of the design verification effort and the resolution of issues identified in that supplement, in particular with respect to matters that require resolution prior to fuel load authorization. This included an NRC meeting with PG&E and the IDVP on September 1, 1983 and a plant tour by the staff on September 6, 1983. All meetings since June 30, 1983 are listed in Table C.8.5 The IDVP has since submitted all ITRs and their revisions. They are listed in Table C.8.4. All substantive information is provided in the ITRs. The IDVP has updated its Final Report to incorporate that information. The licensee has addressed the issues in SSER 18 in a number of submittals to the staff. Certain items that require resolution prior to fuel load were discussed in an NRC meeting on September 28, 1983, with the licensee. Much of the information has been provided to the staff after September 1983.

This supplement presents the staff review and evaluation of IDVP and PG&E information on those matters in SSER 18 that need to be resolved prior to fuel load authorization. The staff evaluation is presented in the same section format of SSER 18 where the issues were identified.

3 SEISMIC DESIGN VERIFICATION EFFORT

3.2 Structures

3.2.1 Containment Annulus Structure

Spectrum Averaging (Table C.8.1, Item 1 - Step 1)

In Section 3.2.1.6 of SSER 18 the staff evaluated the containment annulus response, and specifically the free-hand averaging technique of spectra. In Section 3.2.1.6 it is stated:

> "Based on the insights gained through the BNL analysis of the structure as well as the review of the mathematical models, calculations, and drawings in addition to the staff field observations, the staff finds that the IDVP for the containment annulus structure was effective in ensuring that the dynamic response of the structure and attached and supported equipment will be adequately defined. It is noted, however, that while the use of free-hand averaging of peaks and valleys in the spectra previously has been accepted by the staff, the smoothed curve should be a reasonable average but not a lower bound. Also, its use should be limited to frequencies away from structural frequencies (peaks of the curve). The staff review is not yet complete. However, the staff will review the future ITRs before reaching a conclusion."

PG&E responded to the staff concern above in letters, including a letter of October 6, 1983, and in a meeting on September 28, 1983, as discussed in Section 1 of this Supplement regarding the implementation of the smoothing criteria of the floor response spectra in accordance with the FSAR commitment. PG&E furnished 3 sets of floor response spectra for the annulus steel frame number 1 at nodal point 111. One set shows the raw response spectra for 2, 3 and 7 percent equipment damping; the second set shows the smoothed response spectra for the same damping; and the third set shows the broadened response spectra for the same damping. A comparison of curves in these three sets shows the FSAR requirements regarding spectrum smoothing have been met. PG&E further indicated that free-hand averaging of response spectra was only applied to the frequency range below 5 Hz and that there were no equipment or piping systems with frequencies in that range. For frequencies greater than 5 Hz, the response spectra were enveloped and broadened. In addition, the IDVP has stated in ITR-51 Rev. 1 that the spectra smoothing and enveloping techniques used by the DCP satisfy the appropiate licensing criteria. On the basis of its review and evaluation of the information provided, the staff considers this concern resolved. PG&E has committed to provide additional spectra and other appropriate information to confirm the spectra provided to date.

Cutoff Frequency for Floor Response Spectra (Table C.8.1, Item 2 - Step 1)

In Sections 3.2.1.6 and 3.2.1.7 of SSER 18 the staff evaluation of the DCP verification expressed a concern about the use of 20 Hz as the frequency where structural members were considered rigid in the Hosgri event. The SSER stated:

> "It is noted, however, that a frequency of 20 Hz should not be considered as a frequency in the rigid range without verification. The Newmark Hosgri spectra approach ZPA at 33 Hz. It is the staff's position that the use of the 20-Hz cutoff frequency for generation of floor response spectra should be verified and/or justified."

The Diablo Canyon Project responded to the staff concern above in letters, including a letter of October 12, 1983, and in the meeting with the staff on September 28, 1983. Based on the staff review and evaluation of the information provided the staff considers this concern resolved. PG&E has committed to provide additional analyses to confirm the results provided to date.

3.2.3 Containment Exterior Shell

Applicability of AISC Code vs ASME Code (Table C.8.1, Item 3 - Step 1)

In Section 3.2.3.4 of SSER 18 the staff questioned the use of the AISC Code instead of Section III of the ASME Code. SSER 18 stated:

> "It is noted, however, that instead of the AISC Code used by the DCP, the design code for containment penetrations accepted in the original licensing documents was Section III of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code as indicated in Table 3.2-4 of the FSAR."

PG&E responded and addressed this concern by letters and in a meeting as discussed in Section 1. PG&E stated that the containment penetrations were initially qualified to the AISC Code. The evaluation of the penetrations based on the ASME Code were in preparation at the time of the SSER 18 information cutoff date of June 30, 1983. The PG&E response states the penetrations have now been shown to meet the requirements of both the AISC and ASME Codes. Therefore, since the licensing commitments have been satisfied, the staff considers this item resolved.

Yielding of Steel Plates at Openings in Containment (Table C.8.1, Item 4 - Step 1)

In Section 3.2.3.4 of SSER 18 the staff evaluation of the DCP reverification expressed a concern about the stress levels in the reinforcing plate around the equipment hatch. SSER 18 stated:

> "In addition, the IDVP should evaluate the justification for the local yielding of the steel plates around the opening."

The equipment hatch opening is surrounded by a hexagonal plate that is used to terminate the reinforcing steel in the containment shell where it is discontinuous due to the equipment hatch opening. The plate is near the outside of

the wall and is not connected to the steel liner sleeve of the hatch nor to the closure plate anchorage steel.

PG&E responded to this concern by letters and in a meeting as discussed in Section 1. This response indicated that the yielding was local in nature and permitted by the provisions of the ASME Code. In the meeting PG&E stated that the yield stress exceedance existed in only one element of the plate finite element model. This stress level was in the range of 10 percent exceedance of the actual material yield strength. ITR-54 Rev. 1 indicates the computed stress was 3 percent over the ASME allowable. The staff considers the plate acceptable based on the code provisions which allow for exceeding yield, the limited extent of the area where yield stress is exceeded and only one load combination equation is involved. This concern is resolved.

3.2.4 Auxiliary Building

Soil Spring Influence on Seismic Response (Table C.8.1, Item 7 - Step 1)

In Section 3.2.4.4 of SSER 18 the staff evaluation of the DCP reverification expressed a concern over the difference between the IDVP calculated values for the soil springs for the auxiliary building at elevation 100 feet and the values calculated by the DCP. SSER 18 stated:

> "The discrepancy between the IDVP and the DCP sensitivity study of the soil spring influence on the seismic response should be reconciled. Also the values of the soil properties should be resolved."

PG&E responded by letters and addressed the concern in a meeting with the staff as discussed in Section 1. The response indicated that sensitivity studies were done by the DCP and the effects on the structure of variations in the soil springs are not significant. The DCP used soil properties based on soil information that was not available at that time to the IDVP for the soil spring calculation. This information was made available to the IDVP for its use.

The IDVP addressed the staff concern in a letter dated September 27, 1983. The IDVP has reviewed the DCP study and accepted the results. ITR-55 Rev. 1 provides more detailed information on the range of values the DCP considered and the effects on the response of the structure to these variations. It has been shown that the effects of large variations in the soil springs resulted in very small changes in the response of the structure. The staff finds acceptable the values used by the DCP as verified by the IDVP and considers the soil spring discrepancy resolved.

3.2.8 Turbine Building

Load Combination Criteria (Table C.8.1, Item 10 - Step 1)

In Section 3.2.8.4 of SSER 18 the staff evaluation of the DCP verification expressed a concern over the load combination equation used to determine the force and capacity shown in Table 2.1.4-13 of the PG&E Phase I Final Report. The staff concern was that the other loads required by the load combination equations were not considered in the evaluation of the members. SSER 18 stated:

"Although the design criteria stipulate that the strength requirement for the structural members is based on combined dead, live, and earthquake forces, the summary tables showing the member forces do not indicate clearly such combination. If the member forces are due to earthquake alone, then a discrepancy exists."

PG&E responded to the staff concern in letters and addressed the concern in a meeting as discussed in Section 1. The response stated that the design forces given in Table 2.1.4-13 of the Phase I Final Report included the loading combinations given in the design criteria, and the members were evaluated for a combination of dead, live, and earthquake forces. The staff considers the concerns resolved.

3.3 Piping and Piping Supports

3.3.1 Large-Bore Piping and Supports

Large-Bore Piping Support Analysis Verification (Table C.8.1, Item 16 - Step 1)

The staff stated in Section 3.3.1.4 of SSER 18 that Table 2.2.1-3 did not report the maximum stress or load ratios for the large bore piping supports and that this was considered a deficiency. PG&E addressed this deficiency in letters and in a meeting as discussed in Section 1. The response stated that due to the considerable number of supports per piping system and the large number of Design Class I piping systems it would be practical to provide the requested information for all supports. The Diablo Canyon Project (DCP), however, provided the support stress ratio summary for two small piping systems, which showed that all stress ratios for these supports and their components were less than 1.0, the highest being .99 in an anchor bolt. In addition, the DCP also provided a computerized status of the DCP review to the IDVP for their review and verification. The IDVP reported the completed verification of the DCP corrective actions on large bore pipe supports in ITR-60, Rev. 1, "Large and Small Bore Pipe Supports." The IDVP stated that the methodology used by the DCP adequately addressed the scope of large bore supports in the plant. The IDVP verified on a sample basis that all licensing criteria were met and concluded that the large bore piping supports were designed in conformity with applicable licensing requirements. The staff has reviewed the response by the DCP and the IDVP verification effort reported in ITR-60, Rev. 1, and finds these acceptable. This issue is therefore considered resolved.

Buckling Criteria for Linear Supports (Table C.8.1, Item 17 - Step 1)

The staff recommended in Section 3.3.1.4 of SSER 18 that the IDVP should evaluate and justify the buckling criterion specified for linear supports, specifically the use of the Euler buckling equation for calculating the critical buckling load for all slenderness ratios. The IDVP stated that it is outside its scope to evaluate these criteria. However, the IDVP also questioned the use of the Euler equation without regard to the slenderness ratio on the IDVP Final Report, 10th submittal. The DCP responded to the staff concern in letters, including a letter of October 6, 1983, and in the meeting on September 28, 1983. The DCP has stated, and the IDVP has verified, that the buckling criterion in the Diablo Canyon Design Control Manual (DCM) M-9 was supplemented with an additional buckling criterion. This criterion was reviewed by the staff and found

unacceptable. The staff has proposed an alternate supplementary buckling criterion. The DCP has also submitted the results of a study of 24 typical cases of standard components with small slenderness ratios. The results of this study indicate that the compressive loads in these members are considerably lower than the buckling values determined according to the staff criterion. Based on the staff review and evaluation of the information provided the staff considers this concern resolved. The licensee has committed to provide additional analyses and information to confirm the results provided to date.

Analysis of Piping Systems with Revised Supports and Curent Loadings (Table C.8.1, Item 18 - Step 1)

The staff stated in Section 3.3.1.4 of SSER 18 that selected piping systems analyzed previously by the IDVP and reported in ITR-12 Rev. 0, "Piping," and ITR-17 Rev. 0, "Piping - Additional Samples," be reanalyzed independently with revised support configuration and current loadings to verify that piping and supports satisfy corresponding design criteria. This reanalysis should include a case where the thermal loads govern the acceptance of the analysis. The DCP responded to the staff concern in letters, including a letter dated October 6, 1983, and in the meeting on September 28, 1983. The DCP has stated that the IDVP has reviewed and verified the DCP Corrective Action Program for large bore piping. The IDVP review was reported in ITR-59, Rev. 1, "Large Bore Piping," which provided assurance, through comprehensive reviews of DCP procedures and sample analyses, that all previous concerns as identified in ITR-12 and ITR-17 were incorporated into the DCP Corrective Action Program, and that the large bore piping analyses met the licensing criteria. The IDVP review sample included the piping systems previously reviewed in ITR-12 and ITR-17. The staff reviewed ITR-59, Rev. 1, and found it acceptable. However, since the IDVP included the same problems which had previously been analyzed, the staff selected different piping problems, which have not been reviewed by the IDVP. Two piping problems were selected, which the staff considers adequate to provide final confirmation of the piping design process. Based on the results provided to date and the fact that no significant plant modifications are likely to be required, the staff finds the DCP commitment acceptable and considers this issue resolved for fuel loading.

3.3.2 Small-Bore Piping and Supports

Scope of Small-Bore Piping (Table C.8.1, Item 19 - Step 1)

The staff indicated in Section 3.3.2.4 of SSER 18 that additional clarification was needed to determine the actual extent of the DCP review of small bore piping. In letters and in the meeting on September 28, 1983 as discussed in Section 1 the DCP has provided this clarification and stated that all small bore piping was reviewed and requalified for conformance with the original design criteria, on a sample basis. However, all small bore piping was also reviewed and reanalyzed as necessary for certain design considerations as described in the DCP Phase I Final Report. This review program resulted in review and reanalysis of approximately 63 percent of the piping and 75 percent of the supports. The staff finds the DCP response accepable and considers this issue resolved.

3.4 Equipment and Support

3.4.3 Electrical Equipment and Instrumentation and Supports

Qualification of Cable Trays (Table C.8.1, Item 23 - Step 1)

In Section 3.4.3.4 of SSER 18 the staff evaluation of the DCP verification expressed a concern over the qualification of the cable tray system. The staff's concern was that the trays and supports were analyzed separately and not as a system and the trays themselves did not appear to be qualified. SSER 18 stated:

> "The report, as filed, does not address the qualifications of the cable trays themselves or how the flexibility of the cable trays interact with the supports. This subject should be addressed."

PG&E responded to the staff concern by letter and addressed the concern in a meeting as discussed in Section 1. The response stated the cable trays themselves were qualified for the DDE and Hosgri events generically. Where the trays could not be qualified generally, then the as-built condition was analyzed. A field walkdown was carried out to determine the as-built conditions.

The supports were evaluated using two separate analyses. The first analysis was based on the support itself and using the tributary weights of the cable trays. The approved criteria damping value of 7 percent was used to determine the acceleration values used in the analysis. The second analysis used a coupled system and response was determined using 15 percent damping. The 15 percent damping was based on a series of tests conducted by Bechtel several years ago. The staff does not accept the 15 percent damping and the results of this test for the Diablo Canyon Plant. The test results have been accepted for other plants but with very stringent restrictions. The original licensing basis for the cable trays was the first analysis. PG&E considers the second analysis to be confirmatory and not a basis for the license. In ITR-63 Rev. 1, "HVAC Ducts, Electrical Raceways, Instrument Tubing and Associated Supports," the IDVP has evaluated the cable tray and support system qualification and found it to be acceptable. The staff considers the concern resolved based on the DCP qualification of the trays and supports to the original licensing criteria.

Qualification of Superstrut Welds (Table C.8.1, Item 24 - Step 1)

In Section 3.4.3.4 of the SSER 18, the staff evaluation of the DCP verification expressed a concern over the incorporation of the allowable shear values for spot welds in the tray support members determined from testing of field samples: SSER 18 stated:

> "In addition, the DCP in a separate effort established through testing of field samples the allowable limits for welds used in superstrut construction. These limits should be used in the qualification of the cable trays supported by superstrut material."

PG&E responded by letters and addressed this concern in a meeting as discussed in Section 1. The response stated that the DCP determined the 35 support

types out of 420 support types that had the lowest margin of safety (less than 1.1) in flexure. The DCP selected an additional 13 types that were judged to be susceptible to direct shear in the spot welds. Based on these analyses using the allowable weld values determined from the tests the lowest margin of safety of shear in the spot welds was 1.27.

Based on the information provided, the staff finds the results of the analysis acceptable and considers the concern resolved.

4 NONSEISMIC DESIGN VERIFICATION EFFORT

4.2 Initial Sample

4.2.3 Instrumentation and Control Design

Classification of Valves FCV-37 and FCV-38 (Table C.8.1, Item 27 - Step 1)

In Section 4.2.3.1 of SSER 18, the staff evaluated the IDVP review of the Auxiliary Feedwater (AFW) system as addressed in the IDVP Final Report and in Interim Technical Report 27, Rev. 1. As noted in SSER 18, the staff requires that the valve operators and control circuits for the isolation valves (FCV-37 & FCV-38), which provide the steam supply to the turbine-driven AFW pump, to be classified by PG&E as safety-related. This is consistent with the Diablo Canyon FSAR commitment to General Design Criterion GDC 57 for these valves. The classification of these valves were the subject of the IDVP EOI File 8018. By letter dated August 10, 1983, the licensee noted that the subject valves were procured and installed as Class 1E components and the valve operators have been reclassified as Instrument Class 1A (safety-related). This change in the instrument classification for the valve operators involves revising appropriate documentation and qualification files to reflect this change and confirming that the related reviews are not affected. Further, by letter dated October 6, 1983, the licensee noted that the control circuits for the valves are now classified as safety-related. Based on this action, the staff considers this matter closed.

Single Relay Used to Terminate Steam Generator Blowdown (Table C.8.1, Item 28 - Step 3)

In Section 4.2.3.1 of SSER 18, the staff evaluated the IDVP review of the use of a single, nonsafety-related relay used to terminate steam generator blowdown on starting of an AFW pump. The IDVP had identified this aspect of the design as a potential concern with regard to the capability of the AFW system to satisfy the minimum design flow requirements for events which may not result in a safety injection signal. This concern was identified in EOI File 8047 and was addressed in ITR 27. The staff concurred with the conclusions of the IDVP that the AFW system satisfied the minimum design flow requirement without reliance on termination of steam generator blowdown. However, the use of a single nonsafety grade relay was not consistent with the design described on FSAR Figure 7.1-2, Sheet 15. The staff noted that this was a matter it would pursue with the licensee.

By letters dated September 9, and October 6, 1983, the licensee committed to install a redundant relay consistent with the logic as shown on Sheet 15 of FSAR Figure 7.2-1 and to classify the circuits used to terminate steam generator blowdown on start of an AFW pump as safety-related. These actions are to be completed prior to full power operation. In addition, in the review of this matter the staff had identified other areas of the FSAR in which inconsistencies existed. By letter dated October 6, 1983, the licensee provided a commitment to correct the identified inconsistencies in the FSAR in the next

FSAR update. The staff finds that the licensee's commitments to modify and reclassify as safety-related the steam generator blowdown circuits, as noted above, resolve the conflict between the existing design and the logic shown on FSAR Figure 7.2-1, Sheet 15. Further, the licensee's commitment to complete these modifications prior to full power operation is acceptable since they do not involve protection which is essential to plant safety nor would they have any safety significance during low power testing. Finally, the licensee's commitment to correct the discrepancies in the FSAR which were identified during this review, is acceptable since in no instance were any problems found that were contrary to any licensing criteria or requirements. Therefore, based on these actions, the staff considers this matter closed.

4.3 Additional Verfication

4.3.5 Jet Impingement Effects on Postulated Pipe Ruptures Inside Containment

Jet Impingement Loads on Piping Inside Containment (Table C.8.1, Item 29 - Step 2)

The staff stated in Section 4.3.5.3 of SSER 18 that the DCP had not as yet demonstrated nor had the IDVP verified, that possible jet impingement loads were considered in the design and qualification of all safety-related piping and equipment inside containment. The IDVP reported the results of its verification in ITR-48, Rev. 0, "Additional Verification of Jet Impingement Effects of Postulated Pipe Rupture Inside Containment." The report provides a description of the work done, summary and evaluation of the results, and conclusions of the IDVP with respect to the concern of the jet impingement effects inside containment. The DCP responded to the staff concern by letters, including a letter of October 12, 1983, and in the meeting on September 28, 1983. Based on the review and evaluation of the information provided the staff concludes that the licensing commitment in the FSAR regarding the consideration of jet impingement loads have been met and therefore this concern is resolved with respect to fuel load considerations. The staff will continue its evaluation to assure that the licensee has given appropriate considerations to the more stringent current requirements. The staff will complete this effort prior to full power authorization. The staff does not consider it likely that significant modifications are likely to be required.

4.3.6 Rupture Restraints

Rupture Restraints Inside and Outside Containment (Table C.8.1, Item 30 - Step 1)

The staff reported in Section 4.3.6.2 of SSER 18 that the DCP had not as yet satisfactorily reviewed, nor the IDVP verified, that the rupture restraints outside and inside containment were properly designed and installed to provide protection against postulated ruptures in high pressure piping. The DCP responded to this concern by letters, including a letter of October 11, 1983, and in the meeting on September 28, 1983. The DCP response stated that rupture restraints, both inside and outside containment, were evaluated and their acceptability verified by utilizing a common review program. This applies to all restraints except those which use crushable energy absorbing materials, and which are located inside containment only. Except for these crushable bumpers, restraint configurations and design principles used outside containment include all those inside containment.

The IDVP verification of rupture restraints was reported in ITR-65, Rev. 1, "Rupture Restraints." However, this report addresses restraints outside containment only. The IDVP review did not include any restraints inside containment because of a potential conflict of interest by the IDVP, in that a member of the IDVP had previously reviewed some of these restraints in his capacity as a consultant to PG&E. The IDVP review consisted of examining the DCP qualification of rupture restraint designs outside containment for pipe rupture loading. It also included field inspection on a sample basis to ensure conformance of design drawings to as-built conditions, and a verification that the DCP methodology and criteria satisfy the licensing requirements. Based on the verification of the DCP corrective action program, the IDVP concluded that there is reasonable assurance that rupture restraints outside containment were designed in conformity with PG&E licensing criteria and are, therefore, acceptable. This IDVP conclusion is based on the assumption that the final phase of DCP rupture restraint review will be completed correctly. This final phase consists of determining and setting the final cold and hot gaps between the rupture restraints and the pipes during startup.

Although the IDVP did not verify the design and installation of rupture restraints inside containment, the staff considers these designs acceptable, except for crushable bumpers, since these restraints were evaluated under a common review program by the DCP and the same methodology and design criteria were applied to the restraints inside and outside containment.

The staff has received additional information regarding the DCP design of the crushable bumpers. The DCP stated that these restraints were designed based on criteria documented in DCP Design Criteria Memorandum DCM-64, "Design of Rupture Restraints Inside Containment." These criteria are based on results of tests which were performed in 1977. These tests results and calculation were stated to be available in the DCP files. The final design of these bumpers have been verified against new piping loads, but some modifications may be necessary to accommodate piping hot movements during startup. The design of these crushable bumpers will be audited by the staff prior to criticality/low power (Step 2). Based on the staff review and evaluation of the information provided the staff considers this concern resolved.

5 SUMMARY AND CONCLUSIONS

The purpose of SSER 19 is to present the staff safety evaluation of those concerns in SSER 18 that must be satisfactorily resolved prior to the commencement of fuel load operations at Diablo Canyon Unit 1 (i.e., Step 1 of the three-step process). In Section 1 of this supplement, the staff concerns in SSER 18 have been categorized in three groups:

(1) Open Items (Table C.8.1)
(2) Incomplete Efforts (Table C.8.2)
(3) Followup Items (Table C.8.3)

The IDVP and the Diablo Canyon Project of PG&E have provided extensive additional information after the June 30, 1983 information cutoff date regarding their continuing efforts and have responded to the staff's concerns, in particular with respect to fuel load items. The IDVP has submitted all Interim Technical Reports (ITRs) and their revisions. The IDVP also submitted the last installment to its Final Report, including an Executive Summary. PG&E has responded in a number of letters to most of the staff concerns in SSER 18, in particular those that relate to fuel load requirements. In addition, PG&E has provided information that updates the Phase I and Phase II Final Reports. Much of the information from PG&E and the IDVP was submitted to the staff during the two weeks prior to the issuance of this supplement. The staff has concentrated its efforts on those matters that relate to fuel load. The staff is continuing its review and evaluation of all other matters and will provide the results in a future supplement.

As stated in Section 1, the staff requires that 14 of the Open Items in Table C.8.1 be satisfactorily resolved prior to fuel load (Step 1). During the course of the review the staff determined that Item 29 - Jet Impingement Loads, also be resolved at Step 1. In its review the staff relied on information provided by PG&E, and on selected information provided in the IDVP Interim Technical Reports. The staff has not completed its evaluation of all matters covered in these ITRs and will present its conclusions in a future supplement with respect to all incomplete efforts listed in Table C.8.2. As stated in Section 1, the followup activities listed in Table C.8.3 need not be accomplished prior to fuel load.

Based on the review and evaluation of the information provided the staff considers that the concerns expressed in all 15 Open Items that are required to be resolved prior to the commencement of fuel load operations have satisfactorily been resolved. PG&E has committed to provide additional analyses and information to confirm the results provided to date for three Open Items (1, 2 and 17); the requirement for complete resolution has been changed for two Open Items (18 and 29) and one Open Item (30) requires a staff audit. A complete listing of all fuel load Open Items is presented below.

Step 1 Open Items (Table C.8.1)		Status
1.	Spectrum averaging for containment annulus	resolved; confirmation required
2.	20 Hz cutoff frequency for floor response spectra	resolved; confirmation required
3.	Code for containment penetrations	resolved
4.	Yielding of steel plates at opening in containment	resolved
7.	Soil spring influence on seismic response	resolved
10.	Load combinations for turbine building	resolved
16.	Large-bore piping support analysis	resolved
17.	Buckling criteria for linear supports	resolved; confirmation required
18.	Analysis of piping systems as modififed	resolved; completion at Step 3
19.	Scope of DCP small-bore piping review	resolved
23.	Qualification of cable trays	resolved
24.	Allowable limits for welds in superstrut	resolved
27.	Control circuits safety classification	resolved
*29.	Jet impingement loads	resolved; completion at Step 3
30.	Rupture restraint design and installation	resolved; audit required

*Item not listed in Table C.8.1.

The staff believes that all matters required for fuel loading have been acceptably resolved.

7 CHRONOLOGY PERTAINING TO DIABLO CANYON UNIT 1 VERIFICATION EFFORTS

SSER 18 provided a choronology for the Diablo Canyon Unit verification efforts from September 22, 1981 through June 30, 1983. The following is the continuation of the chronology:

July 1, 1983	Letter from licensee transmitting "Final Report on Evaluation of Spot-Welded Materials Used in Support Systems for Electrical Conduit & Cable Trays at Diablo Canyon Power Plant."
July 1, 1983	Board Notification 83-91 transmitting Teledyne June 24th letter and Stone & Webster June 24th letter.
July 1, 1983	Letter from licensee advising that fuel building modifications are complete.
July 1, 1983	Letter from licensee regarding, anonymous allegations discussed in letter from D. Fleischaker dated March 28, 1983.
July 5, 1983	Memo to Commission, Status of Diablo Canyon Unit 1 Design Verification Program.
July 5, 1983	Letter to Teledyne requesting assessment of circumstances reported in June 23rd letter from J. Reynolds.
July 6, 1983	Meeting with licensee to discusse seismic analysis of buried tanks.
July 7, 1983	Board Notification 83-92 transmitting Teledyne June 28th and June 30th letters.
July 8, 1983	Letter from Stone & Webster advising of no open item reports for July semimonthly report.
July 8, 1983	Letter from Teledyne regarding J. Reynolds June 23rd letter and NRC July 5th letter.
July 8, 1983	Letter from licensee transmitting 41st semimonthly status report.
July 8, 1983	Letter from R. L. Cloud transmitting Open Item reports.
July 8, 1983	Letter from Teledyne transmitting semimonthly report.
July 14, 1983	Board Notification 83-98 transmitting trip report for May 12th meeting and transcript of July 6th meeting.

July 14, 1983	Letter from licensee advising that Joint Intervenors' statements regarding IDVP independence are incorrect.
July 15, 1983	Letter from Commission Office of the Secretary providing schedule for remainder of Commission review.
July 15, 1983	Letter from Teledyne transmitting Errata Package No. 3 and schedule for IDVP Final Report.
July 22, 1983	Letter from Teledyne transmitting semimonthly status report.
July 22, 1983	Letter fom licensee transmitting 42nd semimonthly status report.
July 22, 1983	Letter from Teledyne forwarding list of effective pages and "Table of Contents" for Final Report.
July 22, 1983	Letter from Teledyne transmitting ITR 50, Rev 0.
July 26, 1983	Board Notification 83-103 transmitting R. L. Cloud July 8th letter, Teledyne July 8th letter, and Stone & Webster July 8th letter.
July 26, 1983	Letter from Teledyne regarding review of IDVP resolution to EOI File 8018 and 8047 (flow control valves and non-safety relay device).
July 26, 1983	Letter from licensee providing additional information on containment spray timing.
July 27, 1983	Letter from Stone & Webster transmitting ITR 20, Rev 2; ITR 22, Rev 2; and ITR 27, Rev 2.
July 27, 1983	Letter from licensee transmitting information on classification of instrumentation and control for containment isolation valves.
July 28, 1983	Letter from Stone & Webster transmitting ITR 14, Rev 2, and ITR 28, Rev 2.
July 28, 1983	Board Notification 83-77A - Allegation Concerning Release of an NRC Draft Report.
July 29, 1983	Letter from Stone & Webster transmitting ITR 48, Rev 0.
July 29, 1983	Letter from Teledyne transmitting Errata Package No. 4 of IDVP Final Report.
August 1, 1983	Letter from licensee regarding pending submittal on buried diesel fuel oil tanks.
August 2, 1983	Letter from R. L. Cloud transmitting ITR 57, Rev. 0.

August 5, 1983	Board Notification 83-113 transmitting Teledyne July 25 letter.
August 5, 1983	Issuance of Supplement 18 to SER.
August 5, 1983	Letter from R. L. Cloud transmitting ITR 31, Rev. 1.
August 9, 1983	Letter from R. L. Cloud transmitting ITR 58, Rev 0.
August 10, 1983	Letter from licensee transmitting "Operational Readiness," concerning actions taken or to be taken to be ready for fuel loading and low power testing.
August 10, 1983	Letter from licensee in response to concerns discussed in SER Supplement 18 concerning classification of instrumentation for auxiliary feedwater turbine shutoff valves.
August 10, 1983	Letter from Joel Reynolds regarding independence of IDVP.
August 10, 1983	Letter from R. L. Cloud transmitting Open Item Reports 1138, 1139, 1140, 1141 and 1142.
August 12, 1983	Letter from Teledyne transmitting 2nd Friday semimonthly report.
August 12, 1983	Letter from licensee transmitting 43rd semimonthly status report.
August 12, 1983	Letter from Stone & Webster, reporting for August semi-monthly report no Open Item reports.
August 15, 1983	Letter from R. L. Cloud transmitting ITR 66, Rev 0.
August 16, 1983	Board Notification 83-120 transmitting Teledyne letters of July 22nd (3 letters), Stone & Webster letters of July 27th (2 letters) and July 28th, Teledyne letter of July 29th and Stone & Webster letter of July 29th.
August 18, 1983	Letter from R. L. Cloud transmitting report ITR 60, Rev 0.
August 19, 1983	Letter from licensee transmitting Harding & Lawson Associates report, "Geotechnical Studies, Diesel Fuel Oil Storage Tanks."
August 19, 1983	Letter from R. L. Cloud transmitting report ITR 59, Rev 0.
August 19, 1983	Letter from Teledyne transmitting 8th Text Submittal of IDVP Final Report.

August 19, 1983	Letter from licensee transmitting proposed changes to post-fuel loading initial test program.
August 22, 1983	Letter from Teledyne transmitting Errata Package No. 5 for IDVP.
August 23, 1983	Letter from R. L. Cloud transmitting report ITR 63, Rev. 0.
August 23, 1983	Board Notification 83-124 - NRC Region V Inspection Report 50-275/83-26 relating to apparent less than minimum piping wall thickness.
August 23, 1983	Letter from licensee requesting exemption from requirements of 10 CFR 50.71(e)(3)(i) until after completion of design verification program.
August 25, 1983	Letter to licensee transmitting SER Supplement No. 16.
August 26, 1983	Board Notification 83-130 - transmitting R. L. Cloud letters of August 10th, August 19th, August 18th, August 15th, Stone & Webster letter of August 12th, Teledyne letters of August 12th, August 19th, and August 22th.
August 26, 1983	Letter from licensee transmitting 44th semimonthly status report.
August 26, 1983	Letter from Teledyne transmitting semimonthly status report for August.
August 29, 1983	Board Notification 83-127 transmitting R. L. Cloud letters of August 5th, August 2th, August 9th, and August 10th and J. P. Knight memo of August 8th regarding Brookhaven report on buried diesel fuel oil tank seismic analysis.
August 30, 1983	Letter from Teledyne discussing soil springs for auxiliary building model.
August 30, 1983	Letter from licensee transmitting response to unresolved items in SER Supplement 18.
August 31, 1983	Letter from licensee regarding status of compliance with certain license conditions.
September 1, 1983	Letter from J. Reynolds commenting on IDVP Final Report and SER Supplement No. 18.
September 2, 1983	Letter to licensee requesting review of draft working paper regarding QA case studies.
September 2, 1983	Letter from Teledyne transmitting ITR 51, Rev. 0.

September 2, 1983	Letter to NRC Office of the Secretary from State of California Attorney General regarding verification program.
September 2, 1983	Board Notification 83-135 - Diablo Canyon Quality Assurance Case Study.
September 6, 1983	Letter from licensee regarding unresolved item in SER Supplement 18.
September 6, 1983	Board Notification 83-134 advising of issuance of Supplement No. 16 to SER.
September 6, 1983	Board Notification 83-136 transmitting R. L. Cloud August 23rd letter and Teledyne August 26th letter.
September 6, 1983	Plant tour to view modifications made as a result of the verification program.
September 8, 1983	Letter from R. L. Cloud transmitting ITR 55, Rev. 0.
September 8, 1983	Letter from R. L. Cloud transmitting ITR 57, Rev. 1.
September 9, 1983	Letter to licensee transmitting Federal Register reprint for Sholly notices reported in August monthly report.
September 9, 1983	Letter from R. L. Cloud transmitting Open Item reports 1143 and 1144, Rev. 0.
September 9, 1983	Letter from licensee transmitting 45th semimonthly status report.
September 9, 1983	Letter from licensee providing requested information concerning seismic design of diesel generator intake/ exhaust piping, silencers and filters.
September 9, 1983	Letter from Teledyne transmitting second Friday semi-monthly report.
September 9, 1983	Letter from Teledyne transmitting 9th text submittal of IDVP Final Report.
September 9, 1983	Letter from licensee regarding unresolved items identified in SER Supplement 18.
September 10, 1983	Letter from licensee regarding post-fuel loading modifications.
September 12, 1983	Letter from NRC Office of Secretary regarding changes in meeting scheduled for September 13, 1983.
September 13, 1983	Letter from R. L. Cloud transmitting report ITR 67, Rev. 1.

September 14, 1983	Letter from R. L. Cloud transmitting ITR 54, Rev., 0.
September 14, 1983	Letter from Battelle transmitting "Independent Calculation for the Diablo Canyon Project of the Temperature and Pressure Distribution Resulting from a Split Break Located in Area GE/GW of the Auxiliary Building."
September 15, 1983	Letter from D. S. Fleischaker to Commission requesting that meeting be held in California to hear views of parties on reinstatement of low power test license.
September 15, 1983	Letter from D. S. Fleischaker regarding role of Joint Intervenor's role as intermediary between NRC staff and author of eight allegations.
September 15, 1983	Board Notification 83-143 transmitting October 1 meeting transcript, Cloud letters of October 2nd, October 8th (two letters), and October 9th, and Teledyne letter of October 9th.
September 19, 1983	Letter to J. R. Reynolds in response to August 10th letter regarding independence of IDVP.
September 19, 1983	Letter from R. L. Cloud transmitting ITR 65, Rev. 0.
September 20, 1983	Letter from R. L. Cloud transmitting ITR 56, Rev. 0.
September 21, 1983	Board Notification 83-145 transmitting Teledyne letter of October 9th and R. L. Cloud letters of October 13th and October 14th.
September 21, 1983	Letter from licensee transmitting comments on draft working paper on QA.
September 22, 1983	Letter from R. L. Cloud transmitting ITR 68, Rev. 0.
September 23, 1983	Letter from Teledyne transmitting September semimonthly status report.
September 23, 1983	Letter from Teledyne transmitting errata page for ITR 51, Rev. 1.
September 23, 1983	Letter from licensee transmitting 46th semimonthly status report.
September 26, 1983	Board Notification 83-148 - Diablo Canyon QA Case Study.
September 26, 1983	Letter from R. L. Cloud transmitting ITR 59, Rev. 1.
September 27, 1983	Letter from licensee requesting license restoration at earliest possible time.

September 27, 1983	Letter from Teledyne providing first IDVP response to SER Supplement 18 open times.
September 28, 1983	Letter from State of California Attorney General transmitting information received by R. B. Hubbard from anonymous source regarding electrical construction work.
September 30, 1983	Letter from NRC Office of the Secretary advising of October 28th meeting to receive comments from utility, Joint Intervenors and Governor of California regarding IDVP completion and NRC analysis and recommendation to reinstate license.
September 30, 1983	Board Notification transmitting Teledyne letters of September 21st, 23rd, and 25th and R. L. Cloud letters of September 14th, 19th, 20th, and 22nd, 1983.
October 1, 1983	Letter from R. L. Cloud transmitting report ITR 58, Rev. 1.
October 1, 1983	Letter for R. L. Cloud transmitting report ITR 55.
October 2, 1983	Letter from R. L. Cloud transmitting report ITR 61 Rev. 1.
October 2, 1983	Letter from R. L. Cloud transmitting report ITR 63, Rev. 1.
October 4, 1983	Letter from R. L. Cloud transmitting report ITR 54, Rev. 1.
October 4, 1983	Letter from R. L. Cloud transmitting report ITR 60, Rev. 1.
October 4, 1983	Letter from R. L. Cloud forwarding diagram of forces & stresses at OWST foundation.
October 5, 1983	Letter from R. L. Cloud transmitting report ITR 68, Rev. 1.
October 6, 1983	Letter from licensee regarding unresolved Item 28 in SER Supplement 18.
October 6, 1983	Letter from licensee regarding Diablo Canyon Unit 2 design review.
October 6, 1983	Letter from licensee regarding unresolved items in SER Supplement 18.
October 7, 1983	Letter from licensee regarding unresolved item on flow control valves in SER Supplement 18.

October 7, 1983	Letter from licensee regarding superstrut raceway supports.
October 7, 1983	Letter from licensee regarding Generic Letter 83-28 (reactor trip breakers).
October 10, 1983	Letter from Teledyne transmitting IDVP Final Report 10th Submittal.
October 10, 1983	Letter from Teledyne transmitting IDVP Executive Summary.
October 11, 1983	Letter from R. L. Cloud transmitting report ITR-65, Rev. 1.
October 11, 1983	Letter from licensee regarding unresolved Item 30 in SER Supplement 18.
October 11, 1983	Letter from licensee transmitting update information on PG&E Phase I and Phase II Final Reports.
October 11, 1983	Letter from licensee regarding additional information on turbine building tornado loads.
October 12, 1983	Letter from licensee regarding operational readiness with respect to containment integrity.
October 12, 1983	Letter from licensee regarding Item 29 in SER Supplement 18.
October 12, 1983	Letter from licensee regarding Item 2 in SER Supplement 18.

8 TABLES

Table C.8.1 Open Items in Diablo Canyon SER Supplement 18

The following open items had been identified in SSER 18. Page reference and resolution requirement are listed in parentheses.

1. Free-hand averaging of spectra for containment annulus structure should be in accordance with staff approved technique. (C.3-9; Step 1)

2. Cutoff frequency of 20 Hz for generation of floor response spectra in containment annulus structure should be justified. (C.3-9; Step 1)

3. Use of AISC Code for design of containment penetrations should be justified. (C.3-17; Step 1)

4. Local yielding of steel plates around opening in containment should be justified. (C.3-17; Step 1)

5. Assumptions in model for auxiliary building floor slab qualification regarding rigidity/flexibility should be clarified and justified, including documentation of parametric studies. (C.3-22; Step 2)

6. Use of different versions of ACI code in FSAR and in design verification effort of auxiliary building should be justified. (C.3-22; Step 2)

7. Discrepancy between IDVP and DCP sensitivity of soil spring influence on seismic response of auxiliary building should be reconciled, including resolution of soil properties and documentation of parametric studies. (C.3-22; Step 1)

8. Use of translational and torsional response of auxiliary building as input to base of fuel handling building should be documented, including parametric studies. (C.3-26; Step 2)

9. Selection of set of degrees of freedom in dynamic model for fuel handling building should be justified. (C.3-26; Step 2)

10. Load combinations in analysis of turbine building should be clarified. (C.3-36; Step 1)

11. Modeling of roof trusses in turbine building should be clarified and justified. (C.3-36; Step 3)

12. Effect of one continuous exterior wall in analysis of turbine building should be evaluated. (C.3-37; Step 2)

13. Differences in turbine building modeling of steel frame and roof truss for two vertical models should be clarified. (C.3-37; Step 3)

14. The use of alternative procedures for model combinations by SRSS method should be explained and clarified. (C.3-37; Step 2)

15. Use of increased allowable stresses in accordance with AISC Code 8th Edition should be justified with respect to criteria delineated in FSAR. (C.3-37; Step 2)

16. Results of analysis of large bore piping supports should be verified. (C.3-48; Step 1).

17. Buckling criteria for linear supports, specifically the Euler buckling equation for calculating critical buckling loads for all slenderness ratios, should be evaluated and justified. (C.3-48; Step 1)

18. Calculations for selected piping systems analyzed previously in ITR 12 and ITR 17 should be repeated with revised support configurations and current loadings to verify that piping and supports satisfy corresponding desing criteria. Results of piping system reevaluation with high thermal load should be verified. (C.3-48; Step 1)

19. The scope of the DCP small bore piping review should be clarified. (C.3-57; Step 1)

20. All equipment listed in Table 2.3.1-1 of DCP Phase I Final Report should be seismically qualified for nozzle loads and component configurations should be verified. (C.3-59 and C.3-70; Step 2)

21. Stresses in extreme fibers at interface between valve nozzle and pipe should be evaluated and results be documented. (C.3-66; Step 2)

22. Stresses in pump flanges should be verified to be within allowable limits. (C.3-69; Step 2)

23. Qualification of cable trays and interaction of trays with supports should be addressed. (C.3-80; Step 1)

24. Allowable limits for welds based on field samples should be used in qualification of trays supported by superstrut. (C.3-80; Step 1)

25. Total lateral forces, total resistance to sliding and factor of safety against sliding of intake structure should be fully evaluated. (C.3-86; Step 2)

26. Additional analyses of buried diesel fuel oil tanks should be performed (analyses with refined mesh and without deconvolution, partially filled tank, examination of properties). (C.3-99; Step 2)

27. Control circuits for isolation valves in steam supply line for turbine driven auxiliary feedwater pump should be classified as safety-related. (C.4-11; Step 1)

28. Auxiliary relay for automatic closure of redundant steam generator blowdown isolation valves should meet Westinghouse requirements. (C.4-12; Step 3)

29. Consideration of jet impingment loads in design and qualification of all safety-related piping and equipment should be clearly demonstrated. (C.4-29; Step 2)

30 It should be clearly indicated that rupture restraints inside and outside containment have been properly designed and installed. (C.4-31; Step 1)

31. The combination of codirectional responses to three components of earthquake for the turbine building should be explained. (C.3-37; Step 2)

Table C.8.2 Diablo Canyon SER Supplement 18
Incomplete Effort

1.	Containment Annulus Structure	C.3-9
2.	Containment Interior Structure	C.3-13
3.	Containment Exterior Shell	C.3-17
4.	Auxiliary Building	C.3-22
5.	Fuel Handling Building	C.3-26
6.	Intake Structure	C-3-28
7.	Turbine Building	C-3-37
8.	Large Bore Piping	C-3.48
9.	Large Bore Piping Supports	C-3-48
10.	Small Bore Piping	C.3-58
11.	Small Bore Piping Supports	C.3-58
12.	Mechanical Equipment and Supports	C-3-70
13.	HVAC Equipment	C.3-73
14.	Raceways, Tubing & Supports	C.3-76/77, C.3-80
15.	Soils Intake Structure	C.3-83
16.	Soils Intake Structure Boring Capacity	C.3-85
17.	Shake Table Testing	C.3-89
18.	Main Control Board	C.3-91

Table C.8.3 Diablo Canyon SER Supplement 18
Followup Items

1. PG&E will perform a startup test of AFWS runout control system to confirm dynamic stability. (C.4-3)

2. PG&E will delete from design drawing steam trap in steam supply line for turbine driven pump of AFWS. (C.4-5)

3. PG&E will revise FSAR to reflect acceptability of as-built conditions regarding separation and color coding of electrical circuits for AFWS. (C.4-8)

4. PG&E will correct table in environmental qualification report with respect to flow transmitters and flow control valves in AFWS. (C.4-12)

5. PG&E will conduct analyses to determine qualified life of motor capacitor for steam generator control valves. (C.4-12)

6. PG&E will amend FSAR to indicate that pipe breaks are not postulated in steam supply line to turbine driven pump of AFWS. (C.4-16)

7. PG&E will amend FSAR to include all changes for equipment qualification (CRVPS and AFWS) that resulted from reanalysis of pipe break environments outside containment. (C.4-16)

8. PG&E will revise FSAR licensing commitment regarding need for protective shields for AFWS components (valves) against effects of moderate energy line breaks. (C.4-17)

9. Staff will confirm that any modifications required in safety-related systems with respect to pressure/temperature rating and power-operated valve operability are implemented. (C.4-26)

10. PG&E will verify assumptions regarding closing/opening of doors and operation of ventilation systems in their continuing pressure-temperature environmental reanalysis. (C.4-27)

11. PG&E will make modifications and provide revised documentation as necessary based on results of pressure-temperature environmental reanalysis (C.4-27).

12. Staff will evaluate PG&E results of reanalysis with respect to assuring environmental qualification of equipment. (C.4-27)

13. PG&E will revise FSAR to incorporate use of ANS 58.2 jet impingement temperature calculational method where applicable. (C.4-14 & 16)

14. PG&E will revise equipment qualification documentation to include qualified AFWS cable/wire other than that previously identified. (C.4-16)

15. PG&E will revise FSAR to incorporate results of moderate energy line break analyses on the CRVPS. (C.4-17)

Table C.8.4 Interim Technical Reports (ITRs) and Other Reports Issued by IDVP

Number	Title, IDVP organization, revision, and date
ITR-1:	Additional Verification and Additional Sampling (Phase I) (RLCA). Revision 0, June 10, 1982 Revision 1, October 22, 1982
ITR-2:	Comments on R. F. Reedy, Inc., Quality Assurance Audit Report on Safety Related Activities Performed by Pacific Gas and Electric Prior to June 1978 (TES). Revision 0, June 23, 1982
ITR-3:	Tanks (RLCA). Revision 0, July 16, 1982
ITR-4:	Shake Table Testing (RLCA). Revision 0, July 23, 1982
ITR-5:	Design Chain (RLCA). Revision 0, August 19, 1982
ITR-6:	Auxiliary Building (RLCA). Revision 0, September 10, 1982
ITR-7:	Electrical Raceway Supports (RLCA). Revision 0, September 17, 1982
ITR-8:	Independent Design Verification Program for Verification of Pacific Gas and Electric Company Corrective Action (Phase I) (RLCA). Revision 0, October 7, 1982
ITR-9:	Development of the Service-Related Contractor List for Non-Seismic Design Work Performed for Diablo Canyon Nuclear Power Plant - Unit 1 Prior to June 1, 1978 (RFR). Revision 0, October 18, 1982
ITR-10:	Verification of Design Analysis Hosgri Spectra (RLCA). Revision 0, October 18, 1982
ITR-11:	Pacific Gas and Electric - Westinghouse Interface Review (TES). Revision 0, June 23, 1982
ITR-12:	Piping (RLCA). Revision 0, November 5, 1982
ITR-13:	Soils-Intake Structure (RLCA). Revision 0, November 5, 1982
ITR-14:	Verification of the Pressure, Temperature, Humidity, and Submergence Environments Used for Safety-Related Equipment Specifications Outside Containment for Auxiliary Feedwater System and Control Room Ventilation and Pressurization System (SWEC). Revision 0, December 6, 1982 Revision 1, May 9, 1983 * Revision 2, July 25, 1983
ITR-15:	HVAC Duct and Supports Report (RLCA). Revision 0, December 10, 1982

Table C.8.4 (Continued)

Number	Title, IDVP organization, revision, and date
ITR-16:	Soils - Outdoor Water Storage Tanks (RLCA). Revision 0, December 8, 1982
ITR-17:	Piping - Additional Samples (RLCA). Revision 0, December 14, 1982
ITR-18:	Verification of the Fire Protection Provided for Auxiliary Feedwater System, Control Room Ventilation and Pressurization System Safety-Related Portion of the 4160 V Electric System (SWEC). Revision 0, December 13, 1982 Revision 1, May 24, 1983
ITR-19:	Verification of the Post-LOCA Portion of the Radiation Environments Used for Safety-Related Equipment Specification Outside Containment for Auxiliary Feedwater System and Control Room Ventilation and Pressurization System (SWEC). Revision 0, December 16, 1982
ITR-20:	Verification of the Mechanical/Nuclear Design of the Control Room Ventilation and Pressurization System (SWEC). Revision 0, December 16, 1982 Revision 1, April 26, 1983
*	Revision 2, July 25, 1983
ITR-21:	Verification of the Effects of High Energy Line Cracks and Moderate Energy Line Breaks for Auxiliary Feedwater System and Control Room Ventilation and Pressurization System (SWEC). Revision 0, December 15, 1982 Revision 1, May 3, 1983
ITR-22:	Verification of the Mechanical/Nuclear Portion of the Auxiliary Feedwater System (SWEC). Revision 0, December 17, 1982 Revision 1, April 26, 1983
*	Revision 2, July 25, 1983
ITR-23:	Verification of High Energy Line Break and Internally Generated Missile Review Outside Containment for Auxiliary Feedwater System and Control Room Ventilation and Pressurization System (SWEC). Revision 0, December 20, 1982 Revision 1, May 27, 1983
ITR-24:	Verification of the 4160 V Safety-Related Electrical Distribution System (SWEC). Revision 0, December 21, 1982 Revision 1, May 4, 1983
ITR-25:	Verification of the Auxiliary Feedwater System Electrical Design (SWEC). Revision 0, December 21, 1982 Revision 1, April 29, 1983
ITR-26:	Verification of the Control Room Ventilation and Pressurization System Electrical Design (SWEC). Revision 0, December 21, 1982 Revision 1, May 2, 1983

Table C.8.4 (Continued)

Number	Title, IDVP organization, revision, and date
ITR-27:	Verification of the Instrument and Control Design of the Auxiliary Feedwater System (SWEC). Revision 0, December 23, 1982 Revision 1, May 13, 1983
*	Revision 2, July 25, 1983
ITR-28:	Verification of the Instrument and Control Design of the Control Room Ventilation and Pressurization System (SWEC). Revision 0, December 23, 1982 Revision 1, May 13, 1983
*	Revision 2, July 25, 1983
ITR-29:	Design Chain - Initial Sample (SWEC). Revision 0, January 17, 1983
ITR-30:	Small Bore Piping Report (RLCA). Revision 0, January 12, 1983
ITR-31:	HVAC Components (RLCA). Revision 0, January 14, 1983
*	Revision 1, August 4, 1983
ITR-32:	Pumps (RLCA). Revision 0, February 17, 1983 Revision 1, April 1, 1983
ITR-33:	Electrical Equipment Analysis (RLCA). Revision 0, February 18, 1983 Revision 1, April 28, 1983
ITR-34:	Verification of DCP Effort by Stone & Webster Engineering Corporation (SWEC). Revision 0, February 4, 1983 Revision 1, March 24, 1983
ITR-35:	Independent Design Verification Program Verification Plan for Diablo Canyon Project Activities (RLCA). Revision 0, April 1, 1983
ITR-36:	Final Report on Construction Quality Assurance Evaluation of G. F. Atkinson (SWEC). Revision 0, February 25, 1983 Revision 1, June 20, 1983
ITR-37:	Valves (RLCA). Revision 0, February 23, 1983
ITR-38:	Final Report on Construction Quality Assurance Evaluation of Wismer & Becker (SWEC). Revision 0, March 1, 1983 Revision 1, March 16, 1983 Revision 2, June 20, 1983
ITR-39:	Soils - Intake Structure Bearing Capacity and Lateral Earth Pressure (RLCA). Revision 0, February 25, 1983

Table C.8.4 (Continued)

Number	Title, IDVP organization, revision, and date
ITR-40:	Soils Report - Intake Sliding Resistance (RLCA). Revision 0, March 9, 1983
ITR-41:	Corrective Action Program and Design Office Verification (RFR). Revision 0, April 19, 1983
ITR-42:	R. F. Reedy, Inc., Independent Design Verification Program Phase II Review and Audit of Pacific Gas and Electric Company and Design Consultants for Diablo Canyon Unit 1 (RFR). Revision 0, April 15, 1983
ITR-43:	Heat Exchangers (RLCA). Revision 0, April 14, 1983
ITR-44:	Shake Table Test Mounting Class 1E Electrical Equipment (RLCA). Revision 0, April 15, 1983
ITR-45:	Additional Verification of Redundancy of Equipment and Power Supplies in Shared Safety-Related Systems (SWEC). Revision 0, May 17, 1983
ITR-46:	Additional Verification of Selection of System Design Pressure and Temperature and Differential Pressure Across Power-Operated Valves (SWEC). Revision 0, June 27, 1983
ITR-47:	Additional Verification of Environmental Consequences of Postulated Pipe Ruptures Outside of Containment (SWEC). Revision 0, June 27, 1983
*ITR-48:	Additional Verification of Jet Impingement Effects on Postulated Pipe Ruptures Inside Containment Revision 0, July 27, 1983
*ITR-49:	Additional Verification of Circuit Separation and Single Failure Review of Safety-Related Electrical Equipment (SWEC). Revision 0, June 23, 1983
*ITR-50:	Containment Annulus Structure Vertical Seismic Evaluation (TES). Revision 0, July 22, 1983
*ITR-51:	Containment Annulus Structure Seismic Evaluation (TES). Revision 0, September 2, 1983 Revision 1, September 21, 1983
*ITR-52:	Combined with ITR 68
*ITR-53:	Combined with ITR 68
*ITR-54:	Containment Building - Corrective Action (RLCA) Revision 0, September 11, 1983 Revision 1, October 3, 1983
*ITR-55:	Auxiliary Building - Corrective Action (RLCA). Revision 0, Septembr 8, 1983 Revision 1, October 1, 1983

Table C.8.4 (Continued)

Number	Title, IDVP organization, revision, and date
*ITR-56:	Turbine Building - Corrective Action (RLCA). Revision 0, September 9, 1983 Revision 1, September 24, 1983
*ITR-57:	Fuel Handling Building - Review of DCP Activities (RLCA). Revision 0, August 1, 1983 Revision 1, September 8, 1983
*ITR-58:	Intake Structure - Verification of DCP Activities (RLCA). Revision 0, August 8, 1983 Revision 1, October 1, 1983
*ITR-59:	Large Bore Piping - IDVP Verification of Correction Action (RLCA). Revision 0, August 18, 1983 Revision 1, September 24, 1983
*ITR-60:	Large and Small Bore Pipe Supports - IDVP Review of Corrective Action (RLCA). Revision 0, August 17, 1983 Revision 1, October 3, 1983
*ITR-61:	Small Bore Piping - IDVP Review of Corrective Action (RLCA). Revision 0, September 10, 1983 Revision 1, October 2, 1983
*ITR-62:	Combined with ITR-60
*ITR-63:	HVAC Ducts, Electrical Raceways, Instrument Tubing and Associated Supports - IDVP Verification of Corrective Action (RLCA). Revision 0, August 22, 1983 Revision 1, October 2, 1983
*ITR-64:	Combined with ITR-63
*ITR-65:	Rupture Restraints - IDVP Verification of DCP Activities (RLCA). Revision 0, September 16, 1983 Revision 1, October 11, 1983
*ITR-66:	Combined with ITR 63
*ITR-67:	Equipment - IDVP Verification of Corrective Action (RLCA). Revision 0, August 12, 1982 Revision 1, September 9, 1983
*ITR-68:	Verification of HLA Soils Work Revision 0, September 20, 1983 Revision 1, October 4, 1983

NOTE: The following reports were issued by RFR before the establishment of the ITR concept:

1: Review of ANCO Engineers, March 1, 1982.
2: Review of Cygna Energy Services, March 1, 1982.
3: Review of EDS Nuclear Inc., January 20, 1982.

Table C.8.4 (Continued)

Number	Title, IDVP organization, revision, and date
4:	Review of Harding Lawson Associates, January 26, 1982.
5:	Review of Pacific Gas and Electric Company, March 5, 1982.
6:	Review of URS/Blume and Associates, Engineers, March 5, 1982.
7:	Review of Wyle Laboratories, March 1, 1982.

*Indicates reports dated after SSER 18 information cut off date of June 30, 1983.

Table C.8.5 Meetings on Diablo Canyon Unit 1 Verification Effort

The following is a listing of NRC meetings that have been held since June 30, 1983. It is a continuation of Table C.1.2 in SSER 18.

Date		Participants/attendants/location
(30)	July 6, 1983	NRC, BNL, PG&E (DCP) Bethesda, Md.
(31)	September 1, 1983	NRC, PG&E (DCP), IDVP, Gov. of California, Joint Intervenors Bethesda, Md.
(32)	September 6, 1983	NRC Plant Tour-Diablo Canyon Site
(33)	September 7, 1983	NRC, PG&E (DCP), Gov. of California San Luis Obispo, Calif.
(34)	September 13, 1983	NRC Commission Meeting Washington D.C.
(35)	September 27, 1983	NRC Commission Meeting Washington, D.C.
(36)	September 28, 1983	NRC, PG&E (DCP) Bethesda, Md.

APPENDIX D

LIST OF CONTRIBUTORS

NRC Staff

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M. Hartzman	Mechanical Engineering
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H. Polk	Structural Engineering
H. Schierling	Licensing

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16. ABSTRACT *(200 words or less)*

Supplement No. 19 to the Safety Evaluation Report for Pacific Gas and Electric Company's application for licenses to operate the Diablo Canyon Nuclear Power Plant (Docket Nos. 50-275 and 50-323), located in San Luis Obispo County, California, has been prepared by the Office of Nuclear Reactor Regulation of the U.S. Nuclear Regulatory Commission. This supplement presents the staff's safety evaluation of those unresolved matters identified in Supplement No. 18 which must be satisfactorily resolved prior to commencement of fuel loading operations at Diablo Canyon Unit 1.

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