UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

CHAIRMAN

August 31, 1984

50-275 OL
50-323 OL

The Honorable Jerry M. Patterson
United States House of Representatives
Washington, D. C. 20515

'84 SEP -5 P4:38

Dear Congressman Patterson:

This is in response to your letter of July 30, 1984, regarding concerns raised by Mr. Isa Yin during his briefing on July 25, 1984, on the Diablo Canyon Nuclear Power Plant.

At the March 26, 1984, Commission meeting, certain issues were raised by Mr. Yin which he felt should be resolved prior to operation at low power. The Commission requested that the Advisory Committee on Reactor Safeguards (ACRS) and the staff look into these issues and report back to the Commission before any low power licensing decision. To provide special expertise and priority to this effort, the staff appointed a Peer Review Group (PRG) to study these issues. On the basis of the ACRS recommendation and the results of the review performed by the PRG, we reinstated the low power license for Diablo Canyon, effective on April 19, 1984, with seven license conditions to be satisfied before operation would be authorized above 5% power.

At the August 2, 1984, Commission meeting, the staff informed us that the PRG had been augmented in April to review the licensee's actions to satisfy the license conditions. This expanded group consisted of over a dozen well qualified engineers, including six consultants, a reactor construction inspector from the NRC Region I office and several senior NRC staff from the headquarters offices. Task groups were formed from the PRG members to evaluate the licensee's responses on each of the license conditions and to evaluate aspects of the Independent Design Verification Program that Mr. Yin found to be lacking. An additional task group was formed to audit the licensee's effectiveness in removing final engineering work of a safety-related nature from the Onsite Project Engineering Group (OPEG).

The activities of the PRG from early April to mid-July included participation in over 25 meetings, audits and site inspections with licensee representatives, the ACRS, and allegers of design and construction deficiencies. The PRG informed us that over two staff years had been expended on this effort, which also included the review of over 10 voluminous information submittals from the licensee, the review of detailed calculational and engineering packages,

and the conduct of detailed hardware inspections and pipe walkdowns. Mr. Yin was invited to all meetings and audits, was provided with all of the documents received from the licensee, and draft reports and internal memorandum were shared with him. However, Mr. Yin's schedule did not allow his full participation in the meetings and audits.

Consistent with Mr. Yin's inspection report, the PRG also found areas of insufficient documentation and some calculational errors, failure to follow documented procedures, and practices that are not generally used and that required follow up. However, in probing these issues, the group found that the licensee's design and engineering could be technically supported and that hardware in the plant met applicable requirements. As a result of the effort on the seven license conditions as well as the activities of the two additional task groups examining the IDVP and OPEG matters, the staff concluded that no significant modifications were required to plant hardware. It was the judgement of the PRG that the licensee satisfactorily met all of the conditions imposed in the low power license and that the issues raised by Mr. Yin should not preclude operation of Diablo Canyon Unit 1 at full power. A copy of the "Report of Diablo Canyon NRC Peer Review Group on Piping and Supports" is attached.

At the Commission's request, the Advisory Committee on Reactor Safeguards (ACRS) reviewed the report prepared by the PRG during its meeting of July 13, 1984, and heard further from Mr. Yin. Both the PRG and Mr. Yin had earlier briefed the ACRS Subcommittee on Diablo Canyon on July 11, 1984. The ACRS agreed with the conclusions reached by the PRG that the issues were resolved and should not prevent the full power operation of the Diablo Canyon Nuclear Power Plant, Unit 1.

After a very lengthy review of these and other pertinent subjects on August 2, 1984, the Commission voted in favor of granting Diablo Canyon a full power license. In doing so, the Commission believed that the "high level of confidence" commitment made in our February 17, 1983, letter to Congressman Udall was fulfilled, and that further investigation by Mr. Yin prior to full power operation would not be necessary.

Commissioner Asselstine adds: I do not agree with the Commission's response. The record of this proceeding, allegations filed by former workers at the site and subsequent NRC inspections, including those performed by NRC inspector Isa Yin, all document a widespread quality assurance breakdown in the seismic design work for small bore piping in the plant. This quality assurance breakdown raises serious questions regarding both the adequacy of quality assurance for other design

activities for the plant and the adequacy of the Independent Design Verification Program (INVP). Those questions are of special importance for the IDVP, which was established to verify that the seismic design problems that led to the Commission's suspension of the Diablo Canyon low power license had been identified and corrected.

These questions existed at the time that the Commission authorized the reinstatement of the low power license for Diablo Canyon Unit 1. When I voted to permit low power operation, it was with the understanding that Mr. Yin and other elements of the NRC staff were in agreement on the measures needed to resolve those questions prior to a Commission decision authorizing full power operation. I am particularly disappointed in the staff's subsequent handling of Mr. Yin's concerns. Given the special significance of seismic design for this plant and the extent of the quality assurance breakdown in the seismic design program for portions of the plant, it was incumbent on the NRC staff to make every effort to verify that all significant design errors had in fact been identified and corrected. Based upon the continuing concerns expressed by Mr. Yin regarding the adequacy of the staff's verification efforts and the extent of the seismic design quality assurance breakdown in the case, I am not yet satisfied that the Commission has the information needed to conclude, with a high degree of confidence, that all significant seismic design errors for this plant have been identified and corrected. The Agency's handling of these questions is particularly unfortunate since the adequacy of the seismic design of the plant is a matter of public concern and since it appears that an adequate design verification program to resolve Mr. Yin's concerns could be completed in a matter of a few weeks. In light of the District of Columbia Circuit's recent decision to stay the issuance of a full-power license for several months, I hope that my colleagues will reconsider their decision not to allow Mr. Yin to undertake a program to resolve his concerns.

(End of Commissioner Asselstine's additional comments.)

Sincerely,

Nunzio J. Palladino

Enclosure:
"Report of Diablo Canyon NRC
Peer Review Group on Piping
and Supports"

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

CHAIRMAN

August 31, 1984

The Honorable Leon E. Panetta
United States House of Representatives
Washington, D. C. 20515

'84 SEP -5 P4:38

Dear Congressman Panetta:

This is in response to your letter of July 30, 1984, regarding concerns raised by Mr. Isa Yin during his briefing on July 25, 1984, on the Diablo Canyon Nuclear Power Plant.

At the March 26, 1984, Commission meeting, certain issues were raised by Mr. Yin which he felt should be resolved prior to operation at low power. The Commission requested that the Advisory Committee on Reactor Safeguards (ACRS) and the staff look into these issues and report back to the Commission before any low power licensing decision. To provide special expertise and priority to this effort, the staff appointed a Peer Review Group (PRG) to study these issues. On the basis of the ACRS recommendation and the results of the review performed by the PRG, we reinstated the low power license for Diablo Canyon, effective on April 19, 1984, with seven license conditions to be satisfied before operation would be authorized above 5% power.

At the August 2, 1984, Commission meeting, the staff informed us that the PRG had been augmented in April to review the licensee's actions to satisfy the license conditions. This expanded group consisted of over a dozen well qualified engineers, including six consultants, a reactor construction inspector from the NRC Region I office and several senior NRC staff from the headquarters offices. Task groups were formed from the PRG members to evaluate the licensee's responses on each of the license conditions and to evaluate aspects of the Independent Design Verification Program that Mr. Yin found to be lacking. An additional task group was formed to audit the licensee's effectiveness in removing final engineering work of a safety-related nature from the Onsite Project Engineering Group (OPEG).

The activities of the PRG from early April to mid-July included participation in over 25 meetings, audits and site inspections with licensee representatives, the ACRS, and allegers of design and construction deficiencies. The PRG informed us that over two staff years had been expended on this effort, which also included the review of over 10 voluminous information submittals from the licensee, the review of detailed calculational and engineering packages,

and the conduct of detailed hardware inspections and pipe walkdowns. Mr. Yin was invited to all meetings and audits, was provided with all of the documents received from the licensee, and draft reports and internal memorandum were shared with him. However, Mr. Yin's schedule did not allow his full participation in the meetings and audits.

Consistent with Mr. Yin's inspection report, the PRG also found areas of insufficient documentation and some calculational errors, failure to follow documented procedures, and practices that are not generally used and that required follow up. However, in probing these issues, the group found that the licensee's design and engineering could be technically supported and that hardware in the plant met applicable requirements. As a result of the effort on the seven license conditions as well as the activities of the two additional task groups examining the IDVP and OPEG matters, the staff concluded that no significant modifications were required to plant hardware. It was the judgement of the PRG that the licensee satisfactorily met all of the conditions imposed in the low power license and that the issues raised by Mr. Yin should not preclude operation of Diablo Canyon Unit 1 at full power. A copy of the "Report of Diablo Canyon NRC Peer Review Group on Piping and Supports" is attached.

At the Commission's request, the Advisory Committee on Reactor Safeguards (ACRS) reviewed the report prepared by the PRG during its meeting of July 13, 1984, and heard further from Mr. Yin. Both the PRG and Mr. Yin had earlier briefed the ACRS Subcommittee on Diablo Canyon on July 11, 1984. The ACRS agreed with the conclusions reached by the PRG that the issues were resolved and should not prevent the full power operation of the Diablo Canyon Nuclear Power Plant, Unit 1.

After a very lengthy review of these and other pertinent subjects on August 2, 1984, the Commission voted in favor of granting Diablo Canyon a full power license. In doing so, the Commission believed that the "high level of confidence" commitment made in our February 17, 1983, letter to Congressman Udall was fulfilled, and that further investigation by Mr. Yin prior to full power operation would not be necessary.

Commissioner Asselstine adds: I do not agree with the Commission's response. The record of this proceeding, allegations filed by former workers at the site and subsequent NRC inspections, including those performed by NRC inspector Isa Yin, all document a widespread quality assurance breakdown in the seismic design work for small bore piping in the plant. This quality assurance breakdown raises serious questions regarding both the adequacy of quality assurance for other design

activities for the plant and the adequacy of the Independent Design Verification Program (INVP). Those questions are of special importance for the IDVP, which was established to verify that the seismic design problems that led to the Commission's suspension of the Diablo Canyon low power license had been identified and corrected.

These questions existed at the time that the Commission authorized the reinstatement of the low power license for Diablo Canyon Unit 1. When I voted to permit low power operation, it was with the understanding that Mr. Yin and other elements of the NRC staff were in agreement on the measures needed to resolve those questions prior to a Commission decision authorizing full power operation. I am particularly disappointed in the staff's subsequent handling of Mr. Yin's concerns. Given the special significance of seismic design for this plant and the extent of the quality assurance breakdown in the seismic design program for portions of the plant, it was incumbent on the NRC staff to make every effort to verify that all significant design errors had in fact been identified and corrected. Based upon the continuing concerns expressed by Mr. Yin regarding the adequacy of the staff's verification efforts and the extent of the seismic design quality assurance breakdown in the case, I am not yet satisfied that the Commission has the information needed to conclude, with a high degree of confidence, that all significant seismic design errors for this plant have been identified and corrected. The Agency's handling of these questions is particularly unfortunate since the adequacy of the seismic design of the plant is a matter of public concern and since it appears that an adequate design verification program to resolve Mr. Yin's concerns could be completed in a matter of a few weeks. In light of the District of Columbia Circuit's recent decision to stay the issuance of a full-power license for several months, I hope that my colleagues will reconsider their decision not to allow Mr. Yin to undertake a program to resolve his concerns.

(End of Commissioner Asselstine's additional comments.)

Sincerely,

Nunzio J. Palladino

Enclosure:
"Report of Diablo Canyon NRC
Peer Review Group on Piping
and Supports"

Congress of the United States

House of Representatives

Washington, D.C. 20515

July 30, 1984

'84 SEP -5 P4:38

Honorable Nunzio Palladino
Chairman
Nuclear Regulatory Commission
1717 "H" Street, N.W.
Washington, D.C. 20555

Dear Mr. Chairman:

Thank you for your assistance in making Isa Yin of the NRC Region III staff available for a briefing on the Diablo Canyon nuclear facility on July 25. We sincerely appreciate your help in complying with Congressional requests of this kind, and hope this spirit of cooperation will continue.

We initially requested the briefing with Mr. Yin out of concern about his resignation from and lack of confidence in the investigation conducted by the NRC Peer Review Group (PRG) into the design control and quality assurance issues raised by Mr. Yin before the Commission on March 26. As you know, the PRG was organized to review and evaluate the Diablo licensee's compliance with seven License Conditions attached to the low power test Operation License issued by the Commission on April 13.

At the July 25 briefing Mr. Yin outlined his concerns about the inadequate scope and improper documentation of the PRG's efforts, and conveyed his belief that additional measures were necessary to ensure compliance with the seven License Conditions. Specifically, Mr. Yin discussed: 1) the necessity of properly documenting and performing additional analysis of small bore piping support computer calculations, 2) the need to more closely analyze the spacing and shimming of closely-spaced rigid support structures, 3) the importance of examining design assumptions relative to the placement of snubbers close to rigid restraints, and 4) the need to perform additional theoretical and on-site analysis of potential main stem pipe contact with structural and electrical interference objects.

Mr. Yin also detailed his continuing concerns about the improper use of "quick fix" design changes at Diablo and possible inadequacies in the Independent Design Verification Program. He believes these problems point to a substantial quality assurance breakdown in the areas of small and large bore piping design control. Mr. Yin also discussed his findings of inadequate personnel training and the improper control of critical documents relative to the On-Site Project Engineering Group.

We are particularly concerned that while it was Mr. Yin who raised the issues which led to the License Conditions, he was not considered essential to the PRG's effort to ensure the licensee's compliance with them. Mr. Yin said that many of the PRG's meetings and on-site investigations were conducted whilehe had other commitments, and that he was denied access to critical documents when he requested them later. Mr. Yin also indicated that the PRG examined the various issues related to the License Conditions simultaneously, and as a result, he was unable to participate in many staff sessions.

Most important, Mr. Yin believes that the scope of the PRG's review was inadequate, and that many of the original design-related problems at Diablo may persist. As he states in testimony prepared for the Commission's August 2 Full Power Operations License hearing, "Subsequent review of the Peer Review Team reports contained in the draft SSER revealed that they contain mostly undocumented reviews and casual observations. There were cases where the inspection sample selected was extremely small, where problems originally identified continued to exist, where review criteria were compromised without technical justification, and where Team failed to address the specific program deficiency issues."

Last year, Mr. Yin was able to step into the Diablo licensing process and identify substantive design and quality assurance problems which had gone unnoticed by the NRC staff and on-site inspectors. In short, while he was largely responsible for the imposition of the seven License Conditions, he is far from satisfied that they have been complied with. In fact, Mr. Yin responded to us in the negative when asked directly if he believed Diablo should be given a full power license at this time. In this connection, we are very concerned by the issues he raised with us, and feel he is uniquely qualified to evaluate the licensee's compliance with the seven License Conditions.

Therefore, we respectfully request that you provide Mr. Yin with the additional time and organizational freedom necessary to undertake a thorough analysis of the critical design and quality assurance issues at Diablo which he feels have not been adequately addressed. We feel that such an investigation should be conducted prior to the Commission's consideration of a full power Operation License for the Diablo facility.

Mr. Yin indicated to us that such a review could be accomplished in only three to five weeks, after which time he could report his findings directly to the Commissioners. While this additional analysis may mean a short delay in the licensing process, such action is clearly warranted given Mr. Yin's experience and continuing concerns. Mr. Yin is viewed in the local community and by Members of Congress as a man of great personal integrity and substantial technical expertise, and such a review would go far toward assuring the public that every step has been taken to provide for the safety of the Diablo facility.

In your February 17, 1983 letter to Representative Morris K. Udall, Chairman of the House Committee on Interior and Insular Affairs, you stated that "We will require a high level of confidence that no significant design or construction deficiencies affecting safety at any authorized level of operation exist at the facility before reaching a decision to authorize that level of operation."

Given that Mr. Yin has serious doubts about the resolution of issues which he himself first brought to the Commission's attention, we do not believe that a "high level of confidence" in the full power operability of the plant can exist at this time. Accordingly, we urge you to consider authorizing a full and independent investigation of these issues by Mr. Yin in the interest of ensuring compliance with the Commission's high licensing standards.

Thank you very much for your consideration of our views.

Sincerely,

Jerry M. Patterson

JERRY M. PATTERSON
Member of Congress

LEON E. PANETTA
Member of Congress

APPENDIX A

REPORT OF DIABLO CANYON NRC PEER REVIEW GROUP ON PIPING AND SUPPORTS

Introduction and Conclusion

On March 29, 1984 the EDO directed that a comprehensive review be initiated with respect to the large and small bore piping issues raised by Mr. Isa Yin, Region III inspector assigned to review allegations at the Diablo Canyon plant. The Diablo Canyon Piping Peer Review Group (Group) was formed in response to this direction. The Group originally consisted of nine senior staff engineers from NRR, IE and the Regions expert in piping and support design and quality assurance, and one expert piping consultant.

The Group first held discussions with Mr. Yin, following their review of his inspection report, and reviewed relevant licensee responses to sections of that report. The Group then traveled to California where a public transcribed meeting was held with the licensee. At this meeting the licensee presented its responses to the concerns enumerated in the subject inspection report. Following the public meeting, members of the Group traveled to the reactor site in order that Mr. Yin might show them physical examples that represented his areas of concern.

Based on the Group review of information acquired by these activities the Group published a report of its findings on April 12, 1984. In that report, the Group recommended seven specific actions to be required of the licensee prior to a full power licensing decision. Those seven recommendations were the bases for the seven licensing conditions ultimately approved by the Commission when low power operation was authorized and issued as "Order Modifying License" on 4/18/84.

Following authorization of low power operation, the review of each of the seven licensing conditions was assigned to task groups working under the Group. Additional consultants were added to the Group to provide the resources necessary to allow concurrent review for each of the licensing conditions. Each of the consultants selected has extensive experience in the design of piping and piping supports for nuclear facilities. Two consultants were selected from each of the following: Energy Technology Engineering Center, Idaho National Engineering Laboratories, and Battelle Columbus Laboratories. Although some of the members served on one or more task groups, each license condition was assigned to an individual task group leader who, with the members of his task group, was responsible for full review and evaluation of the licensing actions required to fulfill the assigned licensing condition.

The chronology of the peer review meetings and related activities is given in Table 1. The specific task group activities, in addition to general meetings and review of additional information from the licensee are as follows:

TASK GROUPS FOR LICENSE CONDITION 1 - REVIEW OF SMALL BORE COMPUTER CALCULATIONS AND LICENSE CONDITION 7 - SMALL BORE AND LARGE BORE TECHNICAL ISSUES

Conducted audits of the licensee's review methods and results on two occasions (May 14 through May 18, 1984 and May 29 through June 1, 1984). Further audits of small bore calculations were conducted the week of June 18, 1984.

TASK GROUPS FOR BOTH LICENSE CONDITION 2 - RIGID/RIGID SUPPORTS AND LICENSE CONDITION 3 - INACTIVE SNUBBERS

This task group conducted an audit of the licensee's activities on May 21 through May 25, 1984 including a one-day inspection at the site. During the week of June 18, 1984 completed discussions with PG&E.

TASK GROUPS FOR BOTH LICENSE CONDITION 4 - THERMAL GAPS AND LICENSE CONDITION 5 - PIPING SYSTEM HOT WALKDOWNS

This task group performed an audit on the licensee's response on May 21 through May 25, 1984 at the reactor site. The task group also participated in field inspection and measurements of parts of the main steam system and the RHR system in both the hot and cold condition.

TASK GROUP FOR LICENSE CONDITION 6 - QUICK FIX PROGRAM

This task group performed an audit of the licensee's actions during May 21 through May 25, 1984 including a one-day site inspection.

The findings of the task groups on license conditions are contained in Sections 1.0 through 7.0 of this report.

A task group was also assigned to the issues raised by Mr. Yin on the Independent Design Verification Program (IDVP). Although the IDVP had been reviewed extensively by the staff, as reported in SSER 18, 19 and 20, issues were raised concerning the effectiveness of the IDVP in dealing with piping and piping support design deficiencies. The task group discussed these issues with Mr. Yin, reviewed relevant material he had prepared, and met with Teledyne and Cloud to perform a detailed 3-day audit of the IDVP activities and work packages. Finally, the task group discussed these issues with the licensee and IDVP participants in a transcribed public meeting on July 2, 1984. The findings of the task group are contained in Section 8.0 of this report.

The final issue to be considered by the Group was one of a programmatic concern over the measures in place to control the work activities performed by onsite engineering groups. The measures in question, all part of the Commission's requirements in quality assurance for safety-related structures, systems and components, included indoctrination and training, procedures and procedural control, audits, and design

review. A discussion of the resolution of this concern is provided in Section 9.0 of this report.

It is the conclusion of the Diablo Canyon Peer Review Group that the seven license conditions imposed on the low power license have been satisfactorily addressed by the licensee, that the past staff conclusions on the IDVP remain valid, and that the programmatic issues raised concerning onsite engineering have been resolved. It is therefore the Group's conclusion that these issues should not prevent operation of Diablo Canyon Unit 1 at full power. -

Chronology of Peer Review Group Meetings and Related Activities

Date	Place	Activity	Group Attendees*
3/30/84	Bethesda	Staff mtg with I. Yin to discuss draft inspection report	RV, JT, IY, JK, RB, DA, RH, ES
4/2/84	San Francisco	Transcribed mtg to discuss inspection findings	RV, JT, JK, RB, RH, DA, BF, IY, KM, ES, BS, HS
4/3/84	Diablo Canyon	Site tour to observe examples of piping and supports in inspection report	RV, JK, RB, ES, BS, KM, RH, DA, HS
4/3/84	San Luis Obispo	Interview with C. Stokes to discuss allegations	RV, JK, RB, ES, BS, KM, RH, DA, HS
4/3/84		Draft inspection report issued in Board Notification No. 84-071	
4/5/84	Bethesda	Peer Review Group meeting to discuss review group findings	JK, RB, BS, ES, KM, IY
4/6/84	Wash., D.C.	Transcribed meeting with ACRS	RV, JK, JT, RH, RB, DA, ES, KM, IY
4/9/84		ACRS letter on Diablo Canyon low power license issued	
4/10/84	Bethesda	Transcribed mtg with C. Stokes to further discuss technical issues	JK, RH, RB, BS, KM, IY, MH, ES, HS
4/11&12/84	Bethesda	Staff meetings to plan and program work to resolve issues	RV, JK, RB, ES, BS, KM, MH
4/18/84		Order to modify facility operating license	
4/30/84 to 5/2/84	San Francisco	Audit on procedures, calculations and license conditions (L.C.)	BS, RH, IY
5/9/84	Bethesda	Transcribed meeting with PG&E to discuss April 27, 1984 submittal	RV, JK, RB, TB, MH, KM, PC, ES
5/14-18/84	San Francisco	Audit on L.C. Items 1 and 7	MH, KM

* Key to abbreviations on last page of enclosure.

able 1 Cont'd

ate	Place	Activity	Group Attendees
/21-25/84	San Francisco and Diablo Canyon	Audit on L.C. Items 2, 3, and 6	RB, BS, DKM, TB
5/21-25/84	Diablo Canyon	Audit on L.C. Items 4 and 5	ES, ER, PC, HF
5/22/84	San Francisco	Transcribed meeting with anonymous alleger	RV, JK, RB, BS, DKM, TB, IY, HS
5/23/84	Diablo Canyon	ACRS site tour with I. Yin to observe examples of his concerns	RV, JK, HS, IY
5/29-6/1	San Francisco	Audit on L.C. Items 1 and 7	MH, KM, PC, HF, JB
6/5/84	Bethesda	Staff meeting with I. Yin to discuss L.C.s	RV, JK, JT, RB, BS, ES, KM, MH, RH, DA, IY
6/12(?)/84	Wash., D.C.	Briefing of Henry Meyers and other Congressional staff	RV, IY
6/14/84	Wash.,D.C.	Transcribed meeting with ACRS on L.C.s	RV, JK, MH, KM, BS, RB, ES, IY
6/14/84	Wash., D.C.	Udall hearing	RV, JK, IY
6/18-21	Berkeley, CA	Audit of IDVP	RV, RB, KM, BS, ES, MH, IY
6/20-21	Berkeley	Audit on L.C. Items 2 and 3	BS, DKM, TB, MH, RB
6/21/84	San Francisco	Audit of IDVP related to Reedy issues	RV, ES
7/2/84	Bethesda	Transcribed meeting with PG&E to discuss L.C.s and programmatic issues associated with OPEG	RV, JK, ES, RB, MH, BS
7/11/84	Wash., D.C.	Transcribed meeting with ACRS Subcommittee on Diablo Canyon	RV, JK, RB, ES, BS, MH, KM, ER, IY

Key to Abbreviations

RV	Richard Vollmer, NRR
JT	James Taylor, IE
JK	James Knight, NRR
BF	Bobby Faulkenberry, R-V
IY	Isa Yin, R-III
RB	Robert Bosnak, NRR
RH	Robert Heishman, IE
DA	Dennis Allison, IE
MH	Mark Hartzman, NRR
BS	Bernie Saffell, Battele Columbus Laboratory
ES	Edmund Sullivan, NRR
KM	Kamal Manoly, R-I
DKM	Keith Morton, EG&G Idaho
TB	Thomas Burr, EG&G Idaho
PC	Paul Chen, Energy Technology Engineering Center
HF	Hank Fleck, Energy Technology Engineering Center
JB	John Brammer, Energy Technology Engineering Center
ER	Everet Rodabaugh, ECR Associates
HS	Hans Schierling, NRR

1.0 License Condition 2.C (11), Item 1

"PG&E shall complete the review of all small bore piping supports which were reanalyzed and requalified by computer analysis. The review shall include consideration of the additional technical topics, as appropriate, contained in License Condition No. 7 below."

1.1 Scope of Review

The NRC task group and their consultants conducted a review of PG&E activities related to License Condition 2.C (11), Item 1. The review was performed by auditing a random sample of small bore pipe support calculations which had been analyzed by computer analysis and requalified by PG&E staff in San Francisco. The review also covered consideration of the technical topics, as appropriate, contained in License Condition 2.C.(11), Item 7.

The sample consisted of 21 support packages out of a population of 191 that had been reviewed by PG&E at the time of the NRC review. In general, the supports were of the frame type and were analyzed utilizing the STRUDL computer code.

PG&E indicated that the total population of small bore supports associated with Item 1 of License Condition 2.C.(11) is 357 supports. PG&E has since completed the review of all of these supports.

The review was based on the procedures contained in PG&E Instructions I-55, I-58 and I-59 and design criteria DCM-M9.

1.2 Basis for Evaluation

The 21 pipe support design packages selected for review represent approximately 11% of the 191 packages that had been reviewed by PG&E and approximately 6% of the total population of small bore pipe supports which had been reanalyzed and requalified by computer analysis.

None of the supports reviewed were judged to require modifications for structural integrity or functional adequacy.

Based on the above, the sample size provided reasonable assurance that the remainder of small bore pipe support design calculations will meet the design criteria.

1.3 Document Review

The review was conducted in the following two phases:

1. Review of PG&E responses to the NRC concerns.

2. Review of sample calculation packages.

The PG&E responses to the NRC concerns were contained in the PG&E submittals of April 27, May 10, June 11, June 29 and July 3, 1984.

Following the PG&E/NRC meeting of May 9, 1984 and subsequent discussions during the review period, PG&E has implemented review procedures addressing the NRC concerns related to this License Condition. The procedures are contained in the following documents.

1. PG&E Instruction No. I-55, Rev. 2, "Instruction for the Review of Small Bore pipe Support Calculation, Diablo Canyon Unit #1, 4/24/84.
2. PG&E Instruction I-58, Rev.0, "Instruction for Determining the Angle BETA," 5/29/84.
3. PG&E Instruction No. I-59, Rev. 0, "Instruction for the Evaluation of Licensing Condition No. 7 concerns - Diablo Canyon Units 1 & 2. 5/29/84.
4. PG&E Design Criteria Memorandum (DCM) No. M-9, Rev. 10 "Guidelines for Design of Class 1 Pipe Supports," 5/23/84.

The review of the procedures in these documents was judged to be adequate to address the NRC concerns.

The review of the 21 sample calculation packages was conducted by the task group to verify the understanding and implementation of these procedures by the PG&E review engineers.

The task group identified discrepancies in some design calculations. some of these discrepancies were judged as insignificant since they did not violate the design criteria and were insufficient to affect the structural adequacy of the supports. Other discrepancies were identified to require a follow-up action by PG&E as outlined in the following section.

1.4 Findings

1. Deficiencies due to lack of proper documentation of design judgments were identified in some design calculations originated by OPEG site personnel and reviewed by the San Francisco engineering staff. The task group concluded that these deficiencies did not impact the design adequacy of the supports reviewed and that no further action is required.

2. Deficiencies related to some calculational errors were identified regarding assumptions of member properties and geometry input in the STRUDL computer code which is used for the analysis of pipe support structures. The contribution of these errors was judged to have insignificant effect on the support adequacy and no further action is required.

3. The PG&E review identified three cases where the ratio of L/t for angle sections in S/B supports had exceeded the limit of 270 as specified in the project criteria. These supports were modified to comply with the design criterion limit.

4. Considerations of seismic loads on support structures resulting from the self weight excitation of the supports were accounted for in some supports, and ignored in others. The task group determined that such considerations should be included in the evaluation of S/B and L/B pipe supports where it is significant. The evaluation however, need not be completed before ascension to full power.

Subsequently, PG&E provided the task group with a program for the review of small and large bore pipe supports for effects of seismically induced self-weight excitation. The program includes the review of all small bore calculations that use STRUDL analysis. A re-analysis will be performed for those supports, where the effects of self-weight excitations has not been considered. PG&E committed to complete this program by October 1, 1984. With regard to large bore supports, a sample review of the 200 supports which had been re-evaluated for considerations related to Item 7 of License Condition 2.C.(11), it was determined that less than 10% of the supports did not consider the effects of self-weight excitation,

and that the contribution of self-weight excitation has little impact on the overall qualification of large bore supports. The task group accepted PG&E position that further analysis was not warranted for large bore supports. PG&E also committed to the revision of pipe support design criteria memorandum DCM M-9 to require consideration of seismic accelerations on pipe support structures in all new pipe support calculations.

1.5 Conclusion

Based on the audit of small bore computer analyzed pipe support calculations, the task group concluded that the supports were adequately designed for anticipated loads as required for ascension to full power. Technical concerns associated with License condition 2.C.(11), Item 7 were properly addressed in the review effort performed by PG&E.

2.0 LICENSE CONDITION 2.C.(11) ITEMS 2 AND 3

Items 2 and 3 of License Condition 2.C.(11) require that:

Item 2. The licensee shall identify all cases in which rigid supports are placed in close proximity to other rigid supports or anchors. For these cases, the licensee shall conduct a program that assures loads shared between these adjacent supports and anchors result in acceptable piping and support stresses. Upon completion of this effort, the licensee shall submit a report to the NRC staff documenting the results of the program.

Item 3. The licensee shall identify all cases in which snubbers are placed in close proximity to rigid supports and anchors. For these cases, utilizing snubber lock-up motion criteria acceptable to the staff, the licensee shall demonstrate that acceptable piping and piping support stresses are met. Upon completion of this effort, the licensee shall submit a report to the NRC staff documenting the results.

Since both of these license conditions are similar in nature, this section will discuss the evaluation made of the licensee's methods, practices, and submittals relative to both Items 2 and 3.

2.1 Background and Origin of Concern

The design history of the Diablo Canyon Nuclear Power Plant is the key to understanding why rigid supports and snubbers would be placed in close proximity to other rigid supports, snubbers, anchors, or equipment nozzles. The Diablo Canyon Plant was initially designed for a 0.2 g peak ground acceleration seismic event which was called the Design Earthquake (DE) and a 0.4 g peak ground acceleration seismic event which was called the Double Design Earthquake (DDE). However, in 1977, after a significant amount of construction had been completed, the Hosgri Fault was discovered offshore, near the Diablo Canyon site. The proximity of the Hosgri Fault resulted in the site's peak ground acceleration for a postulated seismic event increasing to the 0.75 g level. This is nearly double the previously

defined DDE. In addition, in late 1981, the licensee discovered errors in the seismic design spectra calculated for portions of the containment for Unit 1. These conditions mandated a reanalysis effort, leading to additional supports to reduce pipe stresses, valve accelerations, support loads, and equipment nozzle loads. As a result, instances arose where supports and anchors were located in close proximity to other existing supports.

Typical industry practice is to design a 1/16 of an inch gap (on each side between the pipe and restraint) in the line of action of the rigid restraint in order to accommodate axial and radial thermal expansion of the pipe. It is also typical industry practice to ignore this small gap when performing linear elastic piping analyses. However, for closely spaced supports, the concern is that these supports could have significantly different sized gaps (or lost motion) and the supports would not share the imposed loads as assumed in the piping stress analysis. This condition could possibly lead to the overload and failure of the supports, which could then result in overstressed piping not being able to carry out its intended function.

2.2 Formulation of License Condition

In response to allegations concerning inadequate design considerations with respect to large and small bore pipe supports, the NRC staff reviewed various analyses, project criteria, and performed an on-site inspection at the Diablo Canyon Plant, Unit 1. The staff concluded, based on this audit (Reference 2.1), that certain practices may not be in compliance with NRC requirements.

Subsequent review of this problem was accomplished by an NRC Peer Review Group (PRG) formed to address this and other Diablo Canyon piping related issues. The PRG agreed that this issue should not preclude criticality and operation at low power and did not, by itself, demonstrate a generic breakdown of design effectiveness. However, sufficient concern existed within the PRG to establish Items 2 and 3 of License Condition 2.C.(11).

2.3 Initial Licensee Review of Closely Spaced Supports

The licensee established and implemented a program to identify all snubbers and rigid restraints located in close proximity to anchors and to identify, for large bore piping only, all snubbers and rigid restraints located close to rigid restraints. The objective of this effort was (a) to provide assurance that snubbers would function when located close to another support or rigid restraints would share the load with the support located close to it and (b) to assure that acceptable piping and support stresses were maintained. This program consisted of the following elements:

a. Criteria - definition of the term "close proximity" and establishment of criteria to assure the supports were effective.

b. Identification, Inspection, and Analysis - identification of "close proximity" supports and inspection to determine effectiveness.

c. Shimming, as required, for rigid restraints to show compliance with support effectiveness acceptance criteria.

For snubbers, compliance with piping and support allowable stresses was assured by evaluating the need for snubbers or demonstrating functionality. Items 2 and 3 License Condition 2.C.(11) were addressed by the licensee in Reference 2.2

The licensee's response to Item 2 was the implementation of a program to shim those rigid supports with excessive gaps. The program defined close proximity as rigid supports within a distance of five times the nominal diameter (5D). A total of 103 rigid supports located in close proximity to other rigid supports, anchors, or equipment nozzles on safety related piping systems were identified (see Attachment 2-3 of Reference 2.2). For these supports, the relative (or differential) gap between the subject support and the adjacent rigid support was measured in both a hot and a cold condition. If the maximum relative gap was already less than or equal to 1/16 of an inch, no modification was deemed necessary. If the maximum relative gap was greater than 1/16 of an inch, shim plates were added to either the subject

or the adjacent support until the relative gap was equal to or less than 1/16 of an inch. Piping two inches and smaller was excluded from the program.

Similarly, the licensee's response to Item 3 was the implementation of a program to assure that necessary snubbers would function. A total of 27 snubbers located in close proximity to rigid supports, anchors, or equipment nozzles on safety related piping systems were identified. For Item 3, close proximity was defined as 5D for piping less than 8 inches in nominal diameter and 3D for piping equal to or larger than 8 inches. Piping system reanalyses were performed by the licensee assuming that the close proximity snubbers did not exist. If the reanalyzed displacement at the snubber location was greater than 1/16 of an inch, the snubber installation was considered acceptable, i.e., lock up would occur. If the displacement was less than or equal to 1/16 of an inch, the new calculations were reevaluated for pipe stress, pipe support, and valve acceleration acceptance. If unacceptable, the actual manufacturer's test reports on lost motion were reviewed for the unique snubber. The snubber's lost motion (by test) was compared to the reanalyzed displacement to demonstrate lock up.

2.4 Initial Task Group Review

The task group's evaluation included: (1) reviewing licensee submittals (2) meeting with licensee representatives and, (3) performing an audit inspection at both the engineering offices and at the plant site. Subsequent paragraphs identify the major issues discussed during the task group's review.

The licensee submitted the proximity criteria study which developed the 5D and 3D span lengths. This study was reviewed by the task group. The task group did not agree with the screening criteria submitted by the licensee. First, the task group noted that the 3D screening criterion for close proximity snubbers on eight inch or larger pipe was not acceptable. The task group agreed that 5D was an acceptable screening criterion for all large bore piping supports (rigid restraints and snubbers) in close proximity and the licensee agreed. Second, the task group did not agree with the licensee's

screening criteria for large bore pipe supports in close proximity to anchors (equipment nozzles, penetrations, and pipe support anchors) and required that the licensee initiate a 10D screening criterion for both rigid restraints and snubber supports on large bore piping in close proximity to anchors.

The task group did not accept the licensee's proposal to exempt Design Class 1 piping 2 inches and less from review for proximity criteria. After consideration that small bore piping generally utilizes redundant supports and is inherently flexible as evidenced by its performance in actual seismic events, the task group required that the licensee use the following proximity criteria for the evaluation of small bore piping support effectiveness:

a. Small bore piping qualified by span rule--supports within 10D of an anchor (equipment nozzles, penetrations, and pipe support anchors).

b. Computer analyzed small bore piping--supports within 10D of an anchor (equipment nozzles, decoupled branch connections, penetrations, and pipe support anchors).

For each of the above criteria, the need for appropriate action, shimming or snubber removal with system reevaluation without the snubber, will be performed for each identified case.

For piping having any "Z" configurations, the licensee indicated that it had conservatively considered the distance between adjacent supports as the distance in one direction only, and ignored the length of pipe perpendicular to the two legs of the "Z" plus the flexibility of the two inclusive elbows or bends.

With respect to nozzle loads, the licensee stated that nozzle reactions given to the vendor considered the effect of supports and restraints near the nozzle. Since the licensee's shimming program for rigid restraints will insure small relative gaps typical of industry practice, it was decided to

check a case where a snubber was in close proximity to an equipment nozzle. In fact, only five snubber installations (14-67SL, 4-39SL, 18-1SL, 4-98SL, and 14-79SL) were initially identified as a snubber in close proximity to an equipment nozzle. The task group reviewed Analysis No. 4-134, Revision 4 dated January 7, 1984 and the associated 5D study calculation (analysis without the snubber). Since the project criteria (acceptable pipe stresses, support loads, and valve accelerations) were satisfied for DE, DDE, and the Hosgri without the subject snubber (14-67SL), lock-up was not required. Since nozzle loads are submitted to the vendor for approval, the piping stresses at the nozzle were checked in order to evaluate the potential impact of a nonfunctioning snubber. Comparing values between the analyses with and without the snubber, the stress increase was extremely small (less than 2%).

Concerning the measurement of gaps on rigid restraints, the licensee indicated the following:

(a) All the gaps were measured while the plant was in cold shutdown. Most of the systems measured were cold systems such as component cooling water or auxiliary feedwater. Those systems that do experience temperature increases were remeasured at hot standby.

(b) The above described procedure adequately envelopes the range of operating conditions and postulated accident conditions.

(c) There was little or no change in the gaps when comparing the measurements taken at hot and cold conditions. Gap changes up to the temperature in a postulated accident would be insignificant.

The licensee provided additional details on the nine rigid restraints with limited accessibility. First, three of the nine restraints had been accessed and had already been measured for relative gaps. Therefore, only six restraints remained. These six restraints are all associated with the diesel generator engine exhaust lines. The licensee indicated that the

localized deformations that might occur as a result of the possible gap misalignment and resulting load transfer between restraints would not compromise the integrity of the piping for the intended service.

With respect to the definition of snubber functionality, the licensee indicated that whenever the movement of the piping system was greater than 1/16 of an inch, the snubber installation was considered acceptable. In cases where the predicted system movement was less than or equal to 1/16 of an inch, the lost motion test result for that specific necessary snubber was compared against the predicted system movement. In the evaluation of gaps, the licensee verified that the total support installation had been considered for both rigid restraints and snubbers when determining the load actuated displacement (gap or lost motion).

The plant site inspection provided the task group an opportunity to inspect the affected components on a first hand basis. With respect to Item 2, the task group viewed a rigid restraint that had been shimmed. This restraint (number unavailable) was near valves 9001B and 9003B of the RHR containment spray discharge tie. The restraint installation verified the implementation of the licensee's shimming program. With respect to Item 3, three supports were viewed by the task group. Support 14-67SL was a snubber that was in close proximity to an equipment nozzle and a rigid restraint. Supports 4-32SL and 4-2SL were snubbers in close proximity to rigid restraints 98-14R and 98-16R respectively.

To verify the information provided in the licensee's submittal (Reference 2.2), the task group reviewed three piping system analyses (No. 4-134, Revision 4 dated January 7, 1984; No. 4-135, Revision 2 dated October 15, 1983; and No. 4A-107 Revision 3, dated October 13, 1983 and the associated 50 study calculations (analyses without the snubbers). These analyses dealt with snubbers 14-67SL, 14-83SL, and 11-33SL respectively (see Attachment 3-1, Reference 2.2). Five manufacturer's test records, which determined each unique snubber's lost motion, were also reviewed. These were for snubbers 4-67SL, 18-1SL, 4-98SL, 14-79SL, and 16-29SL.

2.5 Task Group Review of Final Submittal

The final licensee submittal (Reference 2.3) for Items 2 and 3 was reviewed by the task group. Based on the revised screening criteria, the licensee identified a total of 423 rigid restraints and 95 snubbers as being close proximity supports. Rigid restraints requiring shimming to meet the licensee's program requirements will be completed by July 13, 1984. All 95 snubbers were indicated to be either necessary and functioning or unnecessary since reanalysis efforts demonstrated that pipe stresses, support stresses, and valve accelerations were acceptable without the close proximity snubber. The licensee has committed to reevaluate all snubber installations as part of its snubber optimization program. The final submittal was acceptable to the task group as an adequate response to Items 2 and 3.

2.6 Task Group Findings

The task group found the licensee's programs for resolving Items 2 and 3, including the final screening criteria for determining close proximity supports, to be acceptable. The licensee's responses to all of the generated questions for both Items 2 and 3 were acceptable. The Diablo Canyon Plant site inspection enabled the task group to view actual close proximity support installations and verify that the rigid restraint shimming program was indeed being implemented. All inspected rigid restraint and snubber support installations appeared acceptable to the task group. The task group determined that the three piping system analyses and the snubber manufacturer's test records provides sufficient demonstration that the licensee adequately carried out its program of assuring snubber functionality. Finally, the task group believes the licensee's proposed snubber optimization program, to be initiated in the near future, to be appropriate and beneficial.

2.7 Conclusions

The task group concluded that the licensee's programs, developed and implemented in response to License Condition 2.C.(11) Items 2 and 3, are acceptable. The licensee's program provides assurance that close proximity rigid restraints will share imposed loads and that snubbers located close to another support will function. The programs and the corrective actions taken by the licensee are adequate for full power operation.

2.8 REFERENCES

2.1 I. T. Yin, Diablo Canyon 1 Draft Investigation/Inspection Report, Rev. 3, March 29, 1984 (Preliminary).

2.2 J. O. Schuyler Letter to D. G. Eisenhut, Docket No. 50-275, OL-DPR-76, Diablo Canyon Unit 1, License Condition 2.C.11 - Final Report, PG&E Letter DCL-84-203, June 1, 1984.

2.3 J. O. Schuyler Letter to D. G. Eisenhut, Docket No. 50-275, OL-DPR-76, Diablo Canyon Unit 1, License Condition 2.C.(11)-Final Report, PG&E Letter DCL-84- 253, July 3, 1984.

3.0 LICENSE CONDITION 2.C.(11) ITEM 3

Item 3 of License Condition 2.C.(11) requires that:

The licensee shall identify all cases in which snubbers are placed in close proximity to rigid supports and anchors. For these cases, utilizing snubber lock-up motion criteria acceptable to the staff, the licensee shall demonstrate that acceptable piping and piping support stresses are met. Upon completion of this effort, the licensee shall submit a report to the NRC staff documenting the results.

Since Item 3 of this license condition is similar in nature to Item 2, the investigation of Item 3 was made in conjunction with Item 2. Refer to Section 2.0 for the discussion and evaluation of the licensee's methods, practices and submittals relative to Item 3.

4. License Condition 2.C(11), Item 4

"PG&E shall identify all pipe supports for which thermal gaps have been specifically included in the piping thermal analyses. For these cases the licensee shall develop a program for periodic inservice inspection to assure that these gaps are maintained throughout the operating life of the plant. PG&E shall submit to the NRC staff a report containing the gap monitoring program.

4.1 Introduction

Enclosure 4 of PG&E letter dated April 27, 1984(1) indicated that a total of 4 gaps had been modeled in 2 large bore piping analyses and 43 gaps have been modeled in 15 small bore piping analyses. These gaps are in no cases larger than the field construction tolerances. The actual field measured gaps have been modeled in piping thermal analyses to provide lower support or anchor design loadings or lower pipe stresses than would be obtained if credit were not taken for the gaps in the analyses.

The analyses include situations where the gaps would not be expected to be fully closed on piping thermal expansion as well as situations where the gaps are expected to fully close during the heatup of the piping.

Section 4 of the enclosure to the June 7, 1984 PG&E letter(2) notes that at the time of that submittal in the thermal analyses of 11 piping systems, PG&E has taken credit for 37 field measured clearances or gaps for 28 supports.

This submittal also indicates that the two large bore piping systems discussed in the April 27, 1984 submittal have been reanalyzed with the gaps removed from the models. All pipe stresses, pipe support loads, and nozzle loads have been shown to remain within allowables. Additional small bore piping systems have been reanalyzed with the gaps removed and similar results were obtained. This is the reason for the difference between the 43 gaps in the April 27, 1984 submittal and the 37 gaps in the more recent submittal of June 7, 1984.

This subject area has also been discussed in SSER 22[3] under allegation 88. In that SSER the staff concluded that the modeling of thermal gaps in piping with service below 200°F was acceptable without a gap monitoring program since those thermal movements are small and not expected to be of concern. The staff also concluded that the practice of modeling gaps in piping thermal analyses for piping with service conditions above 200°F is acceptable only if these gap configurations can be shown to be present and repeatable throughout the life of the plant.

4.2 PG&E Program

Enclosure 4 of PG&E letter dated April 27, 1984 proposed an inservice inspection (ISI) program for monitoring thermal gaps. The proposed program would require monitoring of gaps for piping with service above 200°F (i.e., piping subjected to temperatures above 200°F, or piping attached to lines subjected to temperatures above

200°F). The ISI program would require these gaps to be measured during each refueling outage and any exception to previously established minimum gap requirements to be reported to Engineering for resolution.

4.3 NRC Review

A task group of NRC staff and consultants made a site visit which took place May 21 through May 25, 1984. During this site visit discussions were held to review typical cases for which gaps were modeled, the actual analyses and related documentation, and the PG&E proposed inservice inspection program. The task group concluded that the proposed program was not adequate for the piping with service above 200°F during normal and upset conditions since the proposed program would not provide information on the support gaps when the piping is in the hot configuration. Furthermore, because of ALARA considerations it would be undesirable to obtain the hot condition information required to make such a monitoring program acceptable.

To resolve this concern, PG&E proposed to undertake a program to qualify the piping system supports for loads obtained with the gaps ignored in the thermal analyses. This program will be undertaken only for piping with service above 200°F during normal and upset conditions. The program will be completed by the end of the first

refueling outage and may result in some support modifications. This commitment was provided in the PG&E letter dated June 7, 1984.

Thermal gaps in piping with service above 200°F only during emergency and faulted conditions have been analyzed and meet criteria. These lines will experience a very low number of thermal cycles, if any, and thus the need for assurance that the gaps are present throughout the life of the plant is not necessary. Therefore, the task group agrees that this piping need not be included in the program to reanalyze without the thermal gaps.

The piping systems with thermal gaps and service above 200°F during normal and upset conditions have been analyzed using as-built gaps and have been shown to meet criteria. These systems have also been heated up and cooled down through hot functional testing without any adverse affects. During one fuel cycle the number of additional thermal cycles for these systems would be small and the as-built gaps would not be expected to change appreciably. Therefore, the task group finds acceptable the proposed program to remove gaps from the thermal analyses of these piping systems and requalify the piping equipment nozzles and supports by the end of the first refueling outage.

4.4 Conclusions

PG&E has identified all pipe supports for which thermal gaps have been specifically included in the piping thermal analyses. Section 4 of the report identified as reference (1) includes a commitment to undertake a program to qualify the piping system supports for loads obtained with the gaps ignored in the thermal analyses. PG&E also committed to complete this program by the end of the first refueling outage. Based on the review as discussed in Section 3 above, the task group concluded that the terms of license condition 2.C.(11), item 4 have been satisfactorily met.

4.5 References

(1) PG&E Letter dated April 27, 1984 from J. O. Schuyler (PG&E) to Darrell G. Eisenhut (NRC), on subject of Docket No. 50-275, OL-DPR-76, Diablo Canyon Unit 1, License Condition 2.C.(11).

(2) PG&E License Condition 2.C.(11) Final Report, Section 4, Thermal Gap Modeling, received with letter from J. O. Schuyler (PG&E) to D. G. Eisenhut (NRC) dated June 7, 1984.

(3) NUREG-0675, Supplement No. 22, Safety Evaluation Report related to the operation of Diablo Canyon Nuclear Power Plant, Units 1 and 2, March, 1984.

5. License Condition 2.C.(11), Item 5

"PG&E shall provide to the NRC the procedures and schedules for the hot walkdowns of the main steam system piping. PG&E shall document the main steam hot walkdown results in a report to the NRC Staff."

5.1 Introduction

Hot walkdowns consist of visual examination of piping systems at elevated temperatures to assure that the piping systems are restrained only as designed. In addition, displacement measurements at both cold and hot piping temperatures are made at selected points. These cold-to-hot measured displacements are then compared with calculated cold-to-hot displacements. The objective is to assure that calculations of piping pressure-boundary stresses, support loads and nozzle loads are reasonably accurate. Comparisons of calculated and measured displacements are often helpful in finding unintended piping system restraints.

Enclosure 5 of PG&E letter dated April 27, 1984(1) provided Procedures P-36, "Walkdown of Piping During Initial Plant Heatup"(2) and P-38, "Walkdown of Piping During Power Ascension"(3). Review of the procedures raised several questions concerning the details of implementing these procedures as applied specifically to main steam lines and, more generally, to all lines covered by Procedures P-36 and P-38. These questions were discussed at a meeting with PG&E at Bethesda on May 9, 1984(4) at which time arrangements were made or a site visit which took place May 21-25, 1984.

Several generic aspects of piping system walkdowns are discussed in paragraphs 5.2, 5.3 and 5.4. A task group of NRC staff and consultants observed walkdowns of portions of the residual heat removal system (RHR)*; this is discussed in paragraph 5.5. They also observed walkdowns of portions of main steam piping; this is discussed in paragraph 5.6. Conclusions on Licensing Condition 2.C.(11), Item 5, based on these generic and specific reviews, are given in paragraph 5.8.

5.2. Assurance of Correct Dimensional Correlations

During piping system walkdowns, it is essential that the calculated displacements be translated into corresponding directions at the measurement points; e.g., movement north or south for a cold-to-hot piping system temperature change. The task group determined that PG&E has taken appropriate steps to assure that calculated displacements are appropriately identified as to direction for correlation with measured displacements.

---

*The Review Group on Diablo Canyon Issues[5] suggested staff inspection of the mainsteam and main feedwater hot walkdown. However, obtaining feedwater operational temperatures is not possible under the low power license. PG&E agreed to conduct another walkdown of RHR for the NRC review team. Main feedwater hot walkdown is included as part of Item 5, P-38[3] during power ascension.

5.3 Temperature or Power Level Plateaus

During heatup and power ascension, it is prudent to check piping systems at several ascending steps to assure that damage will not occur if, for example, some unintended restraint is acting on the piping system.

Startup procedures, including hot walkdowns of piping, are contained in PG&E Test Procedure No. 40, "Startup Program Master Document"[6]. This procedure covers both heatup and power ascension tests. During heatup tests, plateaus have been established at reactor coolant system (RCS) temperatures of 250°F, 340°F, 450°F and 547°F. At each RCS temperature plateau, Procedure No. 40 includes the check-off item: "PTGC has successfully completed the piping walkdown." PTGC stands for Plant Team, General Construction. This must be initialed and dated by the Shift Startup Engineer before the step to the next higher temperature plateau can be started.

In applications reviewed by the task group, the Shift Startup Engineer obtained approval from the Onsite Project Engineer Group (OPEG) acting for PTGC. The piping systems that are included in the heatup walkdowns are identified in Appendix B of P-36[2].

This aspect is discussed in 5.4.1 of reference 7.

It should be recognized that the temperature plateaus are in terms of RCS temperatures. However, main steam piping hot conditions outside containment can be reasonably well-controlled only when RCS temperatures are about 500°F. The walkdown of main steam outside containment is not included in Appendix B of P-36[2] because reactor heat, before ascension above 5% power, was intended to be removed by atmospheric dump valves. These dump valves are located upstream of most of the main steam piping outside containment. Walkdown of main steam piping outside containment before ascension above 5% power is included in P-38[3] as a special case: "In addition, a walkdown of the main steam piping outside containment will be performed before ascension above 5% power with NRC participation." The results of this walkdown are discussed in paragraph 5.6 herein.

Procedure 40, for Power Ascension, provides steps of power levels at 30%, 50%, 75% and 100%. At each power plateau, Procedure 40 includes the check off item: "Confirm through PTGC Mechanical Department that walkdown of piping systems has been satisfactorily completed to allow power escalation to X% RTP." X is the power plateau and RTP is reactor thermal power.

The task group determined that PG&E has exercised appropriate controls to avoid damage to piping systems and supports during heatup and will exercise similar controls during power ascension.

5.4 Records of Previous Walkdowns

PG&E has established a record of heatup walkdowns in the form of "Heatup Walkdown Packages." There are 47 such packages, identified in Appendix B of P-36[2]. In addition, there is a package for mainsteam piping outside containment.

Each of these packages describes the results of measurements and visual examination for the piping included in the package. A total of 320 measurement points were used on Packages 1-44. Measurements at these points have been taken o various heatup temperature plateaus and, in some cases, have been retaken during subsequent heatups. The total number of measurements is in the order of 1500. A plot made of the last set of 320 readings at RCS temperature of 547°F showed how the differences between calculated and measured displacements compare with the acceptance criteria described by Appendix D of P-36[2]. All except 8 of the 320 measurements met the criteria. The "8-outside-criteria" are discussed later herein.

The measurements for Packages 45-47 (Diesel exhaust piping) were not completed as of the site visit. They entail another 10 measurement points. Measurements on main steam are discussed in paragraph 5.6 herein.

Visual examinations during walkdowns were guided by comparisons of measured with calculated displacements and led to the identification and correction of approximately 135 unintended

restraints; 80 in Packages 1-47; 56 in mainsteam outside containment. The large displacements of main steam lines (up to 7") led to the relatively large number of unintended restraints in mainsteam systems.

The "8-Outside-Criteria" measurement points previously referred to were on the following five lines:

1. Steam Generator 1, Blowdown Inside Containment
   Line No. 1040-2 1/2
2. Steam Generator 2, Blowdown Inside Containment
   Line No. 1041-2 1/2.
3. Reactor Coolant Pump 2, Seal Water Injection Bypass Line
   No. 1499- 3/4
4. Residual Heat Removal & Safety Injection to Loops 1 & 2
   Hot Legs Line No. 2576-8
5. Component Coolant Water, Thermal Barrier Return From Reactor
   Coolant Pumps 3 and 4 Line No. 2342-3.

Four of the eight discrepant data points are associated with the Steam Generator 1 and 2 Blowdown Lines. The discrepancies were due to interference between pipe clamps on adjacent pipes which move towards each other during heatup. Prior to this audit, PG&E performed analyses of these two lines which considered the effects of thermal restraint induced by this minor but unintended interference. The analyses indicated that stresses in the pipe

lines and their supports would still satisfy the appropriate pipe and support code stress allowables and thus were acceptable. Since the effect of this interference was minor and code stress allowables were met, no modifications were considered necessary.

The Reactor Coolant Pump 2 Seal Water Injection Bypass Line had one of the eight discrepant data points. This line was originally analyzed at 100°F, with a 70°F ambient temperature, and thermal anchor displacements from the Reactor Coolant Pump at 547°F. The discrepant data point is at a considerable distance from the pump and effects of pump displacements at the data point location would be expected to be minimal. The thermal movement measured at this point will therefore depend on the range of temperature experienced by the pipe only. The actual line and building ambient temperature was observed by PG&E to be 80 to 90°F in the location of this data point. PG&E performed an analysis with this actual ambient temperature and showed the thermal movement at this data point to now be within the acceptance criteria.

The Residual Heat Removal and Safety Injection Line is a Balance of Plant Line that has been analyzed by Westinghouse. The two discrepant data points in this line were transmitted to Westinghouse for resolution. Westinghouse concluded that friction in the sliding type pipe supports was the reason that these points did not respond as originally predicted. Westinghouse made an additional thermal computer analysis with the actual measured

displacements as additional boundary conditions, superimposed with the thermal growth of the piping system. This analysis showed an increase in pipe and support stresses, but did not result in any pipe or support stresses exceeding their code allowable stresses and thus were acceptable.

The Component Coolant Water Return Line had one of the eight discrepant data points. PG&E determined that the friction of the sliding type supports in this location was the reason for this discrepant data point. PG&E made a new computer model which reflected the additional frictional forces and found close agreement with the measured displacements at all reference points, but they also found that the pipe stresses exceeded the code allowables. Subsequently, PG&E modified those appropriate sliding type (friction) supports to sway struts to eliminate the friction forces and to reduce the pipe stresses to be within code allowables.

In conclusion, PG&E has used reasonable engineering approaches to resolve the "8-outside-criteria" measurement points through: (1) additional analysis to determine the possible causes and effects of these discrepancies on the piping and support systems and (2) support redesign to ensure that the pipe and support stresses will not exceed their code allowables.

The task group audit provided assurance that PG&E has been diligent in assuring that piping systems covered by P-36[(2)] behave in

reasonable agreement with calculated behavior and that an acceptable effort has been made to remove unintended restraints.

During power ascension, P-38[3] will provide additional checks on the behavior of the piping systems covered therein.

5.5 Residual Heat Removal (RHR) Walkdown

Prior to the site visit by the task group from May 21, 1984 through May 25, 1984, several walkdowns had been conducted on RHR piping. Heatup Walkdown Package No. 40 is directly relevant to the staff site audit. This package was prepared while conducting the RHR piping walkdowns during initial heatup under Procedure P-36. Package 40 identifies 24 measurement points and gives the results of those measurements and comparisons with calculated displacements.

Package 40 includes 25 Heatup Walkdown Problem Reports, identifying 12 interference problems that were corrected, 2 out-of-criteria measurements (later resolved by additional measurements) and 11 other miscellaneous problems such as instrument tubing of inadequate flexibility and a twisted support.

The task group examined the basis used for selecting the 24 measurement points; these measurement points consisted of locations where measurements could be conveniently made for example using snubber or spring can travel, and where the hot-to-cold

displacement was calculated to be relatively large. In the RHR walkdowns, measurements were taken at points with calculated displacements ranging from 0.2 to 1.0", the largest calculated displacement at any point on the piping. The number of measurement points chosen was regarded by the NRC audit team to be of a minimal size for their intended purposes. However, after a careful review of the piping configuration and the predicted motions it was concluded that the number of measurement points was sufficient to validate piping behavior and detect unintended restraints that would impede piping system thermal growth. The review also determined that the methods for determining the actual deflections was acceptable.

The task group observed walkdowns of the RHR system outside containment from Penetration 27, through RHR pumps 1-1 and 1-2, and continuing as far as RHR heat exchangers 1-1 and 1-2. Cold measurements were taken on 5/21/84 and hot measurements were recorded on 5/24/84. There were 12 measurement points in this walkdown, including one not included in earlier walkdowns discussed in paragraph 4.

Visual observations were made by the task group to determine any potential or actual interferences. The task group concluded that there were no interferences. It is also noted that sufficient clearances exist between the piping and any adjacent structures or

equipment in both the hot and cold conditions to accommodate seismic displacements. The PG&E staff members did not note any unintended interferences although observed leakages at a flanged joint and at the RHR 1-2 pump casing were noted. The measurements taken during the walkdowns agreed with calculated displacements somewhat more closely for several points than did those from the previous walkdown made in November 1983. All measured displacements were within the PG&E acceptance criteria, Appendix D of P-36[2].

The RHR walkdown is also discussed in reference (7).

The review concluded that PG&E has been diligent in assuring that the RHR piping systems are behaving in agreement with calculated behavior and that an acceptable effort has been made to remove unintended restraints.

5.6 Main Steam (MS) Walkdown

Heatup walkdowns had been conducted on mainsteam piping prior to the Item-5 review team site visit of May 21, 1984 through May 25, 1984. The results of these walkdowns for the mainsteam piping inside containment are contained in Heatup Walkdown Packages 5 through 8. Packages 5-8 identify 2 measurement points for each steam generator outlet line and gives the results of measured

deflections and comparisons of measured vs. calculated deflections. Additional heatup walkdown packages were prepared for the piping outside containment. These packages focus on interference problems and measurements were not taken for the mainsteam piping outside containment. These packages were all prepared while conducting the piping walkdowns during initial heatup under Procedure P-36.

Each of the Heatup Walkdown Packages 5-8 included one Heatup Walkdown Problem Report (HWPR) except Package no. 7 which contained two. These HWPR's were related to deflections which were measured at temperatures less than the maximum heatup temperature and which were outside criteria. The problems were later resolved at higher temperatures when the measured deflections were within criteria. These problems were attributed to support frictional effects. The packages for mainsteam outside containment included 56 HWPR's. These problems related to interference problems that were corrected and miscellaneous other problems, such as inadequate flexibility of instrument tubing and buckling of a support.

The task group reviewed the power ascension walkdown procedures that were applicable to heatup walkdowns of the mainsteam piping being conducted during the NRC site visit. The task group examined the basis for the selection of the 7 measuring points proposed for each of the mainsteam lines. Five of the seven points were located outside containment and two inside containment. The review

indicated that although the number of measuring points selected was minimal, they were located such that discrepancies between measured and calculated deflections at any one of their locations would suffice to indicate the presence of unintended thermal restraints. It was concluded, therefore, that the number of points selected was acceptable. The review also found the methods for determining the actual deflections to be acceptable. Calculated deflections were in the range of 0.2 in. - 6.8 in.

The task group participated in walkdowns of all four mainsteam lines from the four steam generator outlets to the anchors at the seismic to non-seismic classification change. All 4 lines were observed visually; however, thermal measurements were taken on the two mainsteam lines from steam generators 1 and 3. The lines from steam generators 1 and 3 are configured similarly to the lines from steam generators 2 and 4 and their deflections during heatup are similar. The data generated during the walkdown were documented in special Power Ascension Walkdown packages 5 and 17 for the mainsteam lines from steam generator 1 inside and outside containment, respectively, and packages 7 and 19 for the mainsteam lines from steam generator 3 inside and outside containment, respectively.

Visual observations were made by the task group to determine any potential or actual interferences. The task group concluded that

there were no interferences except as noted below. It is also noted that sufficient clearances exist between the piping and any adjacent structures or equipment in both the hot and cold conditions to accommodate seismic displacements.

Five Power Ascension Walkdown Problem Reports (PAWR) were included in Power Ascension Package No. 17 and four in Package No. 19. The problems included: (1) one outside of criteria measured deflection on each line, (2) loss of data due to removal of a measuring scale during painting of the support, (3) interference with temporary scaffolding erected for the walkdown, and (4) miscellaneous other problems, such as valve leakage and wrong support identification. Additionally, an unintended contact was observed between an abandoned stanchion on mainstream line 3 (from steam generator 3) and a structural column. This interference only existed on full heatup.

The data in Power Ascension Package Nos. 5 and 7 indicated that the mainsteam piping inside containment was responding during thermal cycling within the acceptance criteria.

As indicated above there was one data point on each line outside containment that was outside the acceptance criteria. Accordingly additional thermal stress analyses were performed by Westinghouse with the actual measured displacements as additional boundary conditions, superimposed with the thermal growth of the piping

system. The analyses showed that stresses in piping, pipe supports and flued heads were within their respective code allowables.

The mainsteam walkdown is also discussed in reference (7).

The task group concluded that PG&E has been diligent in assuring that the mainsteam piping systems are behaving in reasonable agreement with calculated behavior and that an acceptable effort has been made to remove unintended restraints.

5.7. Report on Mainsteam Walkdown Results

A part of License Condition 2.c(11), Item 5 states: "PG&E shall document the main steam hot walkdown results in a report to the NRC Staff." Section 5 of the report identified as reference (7) covers more than the mainsteam hot walkdown results. The task group has reviewed Section 5 of the PG&E report, including those portions on mainsteam hot walkdown results and concludes that it is acceptable as the report to the NRC staff on the mainsteam hot walkdown results.

5.8. Conclusions

In conjunction with the review of the Mainsteam Walkdown the task group reviewed the general aspects of the engineering techniques used by PG&E to perform hot piping walkdowns of the systems covered by Procedure P-36. The evaluation of these aspects is covered in

paragraphs 2, 3 and 4 of this section. In addition, the task group observed a walkdown of a portion of the RHR system outside containment. The evaluation of this walkdown is covered by paragraph 5 of this section. Paragraphs 6 and 7 cover the main steam walkdown and the report on the main steam walkdown results which was the specific subject matter of the license condition. The review concluded that PG&E used acceptable engineering techniques in conducting piping hot walkdowns and that the RHR and main steam walkdowns observed by the task group resulted in piping system thermal movements in agreement with calculated movements. Based on the above the task group concluded that the terms of the license condition 2.C.(11), item 5 have been satisfactorily met.

5.9 References

(1) PG&E Letter Dated April 27, 1984 from J. O. Schuyler (PG&E) to Darrell G. Eisenhut (NRC). on Subject of Docket No. 50-275, OL-DPR-76, Diablo Canyon Unit 1, License Condition 2.c.(11).

(2) PG&E, Mechanical and Nuclear Engineering, Diablo Canyon Unit 1, Walkdown of Piping During Initial Heatup, Procedure P-36, Revision 2, 4/26/84.

(3) PG&E, Mechanical and Nuclear Engineering, Diablo Canyon Unit 1, Walkdown of Piping During Power Ascension, Procedure P-38, Revision 1, 4/26/84.

(4) Transcript of Meeting with Staff and Utility on Diablo Canyon, Bethesda, Maryland, May 9, 1984.

(5) Richard H. Vollmer to Harold R. Denton, April 12, 1984, on Subject of Report of the Review Group on Diablo Canyon Piping Issues.

(6) PG&E Station Construction Department, Diablo Canyon Project, Unit 1, Test Procedure No. 40, "Startup Program Master Document," Rev. 5, 4/30/84.

(7) PG&E License Condition 2.C.(11) Final Report, Section 5, Hot Piping Walkdown, received with letter from J. O. Schuyler (PG&E) to D. G. Eisenhut (NRC) dated June 7, 1984.

6.0 LICENSE CONDITION 2.C.(11)/ITEM 6

PG&E shall conduct a review of the "Pipe Support Design Tolerance Clarification" (PSDTC) Program and the "Diablo Problem" (DP) System activities. The review shall include specific identification of the following:

(a) Support changes which deviated from the defined PSDTC Program scope

(b) Any significant deviations between as-built and design configurations stemming from the PSDTC or DP activities

(c) Any unresolved matters identified by the DP system.

The purpose of this review is to ensure that all design changes and modifications have been resolved and documented in an appropriate manner. Upon completion, PG&E shall submit a report to the NRC staff documenting the results of this review.

6.1 INTRODUCTION

The Pipe Support Design Tolerance Clarification (PSDTC) Program and Diablo Problem (DP) System are described and evaluated based on submittals provided by the licensee and the understanding of the task group consultants on these activities. Numerous meetings with licensee personnel, discussions with allegers, and audit of the PSDTC and DP Programs by the task group provided the bases for this understanding and for evaluation of these activities. While the PSDTC Program interfaces with the DP System, this SSER addresses each separately for the sake of clarity. The licensee defined scope and their implementation of each program is

evaluated to assess compliance with program intent and the effectiveness of each process in insuring that the installed pipe support designs have been properly analyzed and documented.

6.2 PIPE SUPPORT DESIGN TOLERANCE CLARIFICATION PROGRAM (PSDTC)

6.2.1 Background

The licensee established a special team of pipe support engineers in January 1983. Their assignment, then and now, consists of direct engineering liaison with General Construction resident engineers and Pullman Power Products craft personnel for the purpose of providing expeditious resolution of minor construction difficulties in the installation of large and small bore pipe supports. This group of engineers had the authority to resolve construction problems in the field based on their best engineering judgement and knowledge of applicable Diablo Canyon design criteria. The licensee described the PSDTC program in Reference 6-1 with supplemental information provided by References 6-2, 6-3, and 6-4.

QPEG Guide 4, Rev. 1, dated January 7, 1983, and titled "Guide for Issue of Pipe Support Quick Fix Design Changes" initially provided the control and defined the responsibilities and authority for administration of the "Quick Fix" program. This guide was superseded by Project Engineer's Instruction (PEI) 12 on March 11, 1983, which defines the Pipe Support Design Tolerance Clarification (PSDTC) Program. The practices defined by these two documents are based upon identical philosophy and intent.

As provided in PEI-12, field construction problems are defined as pipe support installation problems which can not be resolved using the construction tolerances explicitly stated in Pullman Power Products document ESD-223, "Installation and Inspection of Pipe Supports". Construction tolerances contained in ESD-223 were those that could be applied

to any pipe support in the plant without additional engineering justification. Changes beyond those tolerances are permitted but must be evaluated against the criteria contained in Diablo Canyon Design Criteria Memorandum (DCM) M-9, "Guidelines on Design of Class I Pipe Supports and Restraints."

For Unit 1, field construction problems were referred to PSDTC team engineers who, based on their engineering judgment and knowledge of DCM M-9, would, on a case-by-case basis, determine whether use of expanded tolerance limits could be authorized to resolve the construction problem while maintaining an acceptable support design.

Where field resolutions could be made, in the judgment of the PSDTC team engineer, they were documented on individual PSDTC forms (See Figure 6-1). Field construction problems, which could not be resolved without a design change in the judgment of the PSDTC engineer, were returned to General Construction for formal referral to other project procedures. When a PSDTC form was completed, a copy was attached to the pipe support design package and was treated exactly like the original design package in order to assure that standard quality control procedures were applied to all work accomplished by General Construction. Upon completion of construction of the support, the complete as-built package, including any PSDTC forms associated with that support, was forwarded by Construction to Engineering for final acceptance in accordance with project engineering procedures. The as-built acceptance process involved review of the revised support design and performance of necessary calculations for qualification of the design. Where qualification could not be shown, a new design was prepared and issued for Construction. The PSDTC process just described is illustrated by Figure 6-2 as provided by the licensee in Reference 6-2.

FIGURE 6-1.
PIPE SUPPORT DESIGN TOLERANCE CLARIFICATION FORM

SEQUENCE NUMBER (UNIT + NUMBER)

SUBJECT (USE SUPPORT NUMBER) CLASS (I OR II)

LOCATION (AREA AND ELEVATION)

DESCRIPTION:

1. Describe problem clearly.
2. Use sketches in this space or in attachments.
3. Clearly show proposed changes.
4. Attachments may include marked up copy of support drawings.

REFERENCE DRAWING (USE DCN NUMBER PLUS ANY OTHER APPLICABLE)

ATTACHMENTS YES NO PAGES (INC. THIS SHEET)

AREA ENGINEER:

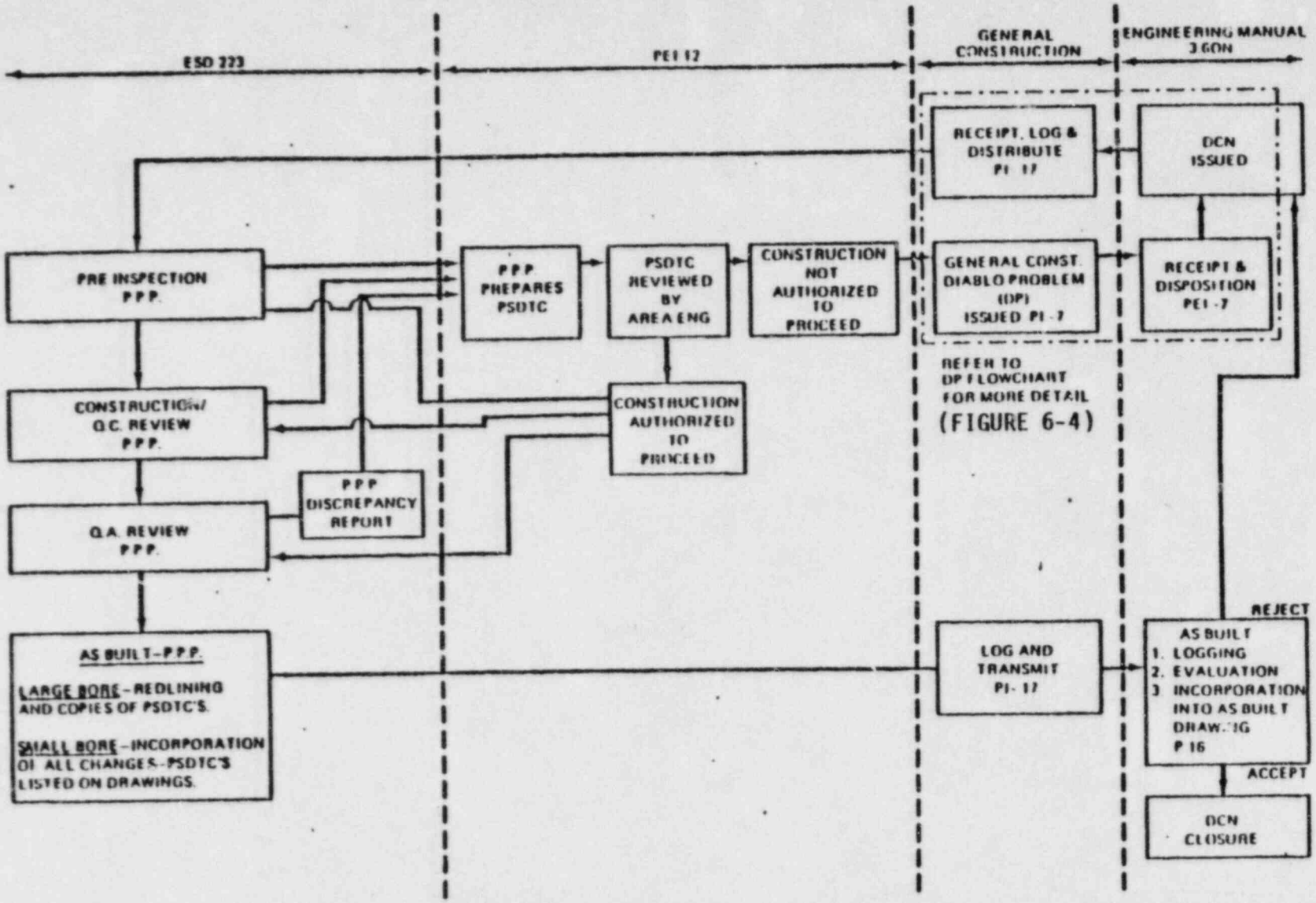
CONSTRUCTION MAY PROCEED (PIPE SUPPORT AREA ENGINEER SIGNATURE)

DATE

CONSTRUCTION D.P. REQ'D (PIPE SUPPORT AREA ENGINEER SIGNATURE)

CONTRACTOR RECEIPT (CONTRACTOR'S QC OR OTHER REP.) DATE (RECEIPT DATE)

FIGURE 6-2.
FLOW CHART FOR PSDTC



P.P.P. - Pullman Power Products
This chart is from Reference 6-2.

The procedures used or related to this program in addition to PEI-12 and ESD 223 are:

- P-10, "OPEG Small Bore Piping and Hanger Review Procedure"
- I-37, "Instructions for Incorporation of Field Correction Transmittals"
- I-40, "Instructions for Disposition of As-Builts Associated with Design Change Notices"
- PI-17, "Document Control operating Instructions"
- P-16, "Procedure for the Preparation, Review, Approval, Update, and Issue of Pipe Support Detail Drawings".

P-16 supercedes I-37 and I-40 as of April 7, 1984.

In summary, the licensee defined and implemented a program to allow minor pipe support changes to be made by qualified field engineers. The PSDTC process was initially controlled by a guide and later by formal procedures which provided a mechanism for insuring field changes were evaluated by appropriate Engineering personnel. Some 15,000 field changes or corrections have been made as part of the PSDTC Program.

6.2.2 Formulation of License Condition

In response to allegations concerning quality assurance and quality control as related to Diablo Canyon Project design control and construction practices, the NRC staff commenced its review of licensee programs with a series of inspection trips, Ref. 6-5. In tne case of the PSDTC program, governing procedures and implementation of this program were reviewed with the licensee and its contractor personnel. This effort included review of the following:

- DCP OPEG document titled "Guide for Issue of Pipe Support Quick Fix Design Changes", Rev. 1, dated January 7, 1983

- DCP Instruction No. 12, "Pipe Support Design Tolerance Clarifications", Rev. 1, dated August 5, 1983
- TC 1-11202 for pipe support 74-33R and analysis file
- TC 1-11306 for pipe support 322-7R and analysis file
- TC 1-11369 for pipe support 18-7R and analysis file
- TC 1-14057 for pipe support 57-15.

The staff concluded, based on this audit, that "there appeared to be a breakdown in the licensee's QA program for site design change control."

Subsequent review of this program was accomplished by an NRC Peer Review Group formed to address this and other Diablo Canyon piping related issues. This group agreed that this issue should not preclude criticality and operation at low power and did not, by itself, demonstrate a generic breakdown of quality assurance or design and construction effectiveness. However, sufficient concern existed within the review group to establish Item 6 of License Condition 2.C.(11) as it pertains to the PSDTC Program.

6.2.3 Licensee Review of PSDTC Program

The licensee has performed a two-stage review involving more than 2000 of the 15,000 PSDTC's written since the inception of this program. During the initial review phase, 1100 small and large bore pipe support PSDTC's were reviewed to identify those containing significant design changes. This review resulted in the identification of PSDTC's for seven small bore and twenty large bore supports which had significant design changes and which would receive a further, more detailed review.

the total information available on a given topic. The task group believes that it is difficult to clearly understand the basis for some of the IDVP decisions reached on the acceptability of pipe and pipe supports designs and analysis based solely on what is available in the ITR's. However, with the benefit of the information in the back-up IDVP review packages, the task group believes that comments made in the ITR's which may appear to be significant on the surface, can be placed into proper perspective.

8.2 PRINCIPAL INSPECTION CONCERNS

A. Acceptability of Span Rule Analyzed Small Bore Piping

A series of inspections performed in response to allegations included review of the Independent Design Verification Program (IDVP) performed by R. L. Cloud Associates (RLCA). A concern resulting from these inspections is the licensee's basis for qualifying, without further evaluation, the approximately 15,000 ft. of piping analyzed by span rule and its associated pipe supports. The inspector noted that the licensee's justification for qualifying this piping is based on the review of a 5,000 ft. sample of pipe analyzed using the ME-101 computer code.

B. Evaluation of Span Rule Analyzed Small Bore Piping

The task group has discussed this issue with the licensee and R. L. Cloud Associates. The task group believes that there was sufficient justification for RLCA in the IDVP to accept the span rule piping as meeting licensing criteria. The task group did request additional information from the licensee to confirm its understanding of span rule analyzed piping characteristics. This was provided in PGEDCL letter 84-254 of July 3, 1984. The task group's evaluation of the licensee's basis for accepting, without further evaluation, the span rule qualified piping and the IDVP's rationale for concurring with the licensee's conclusion is addressed in subsequent paragraphs.

A significant portion of the small bore piping in the Diablo Canyon plant was initially qualified using span rules (File 44). Small bore at this time included all piping with a nominal diameter equal to or less than six inches. During the evolution of the seismic design criteria and with the initiation of the Corrective Action Program, the definition of small bore piping was revised to include piping whose nominal diameter is less than or equal to 2 inches. All piping greater than 2 inches nominal diameter has been computer analyzed as has much of the currently defined small bore piping.

The small bore piping now qualified solely by span rule in the Diablo Canyon plant consists of piping with the following characteristics:

- o Nominal pipe diameter is 2 inches and less;
- o All relatively cold piping (design temperature is less than 160°F for stainless steel or 200°F for carbon steel);
- o No large concentrated masses such as motor operated valves;
- o Small seismic anchor movements;
- o Small thermal anchor movements;
- o Existence of over spans causing overstress considered very unlikely.

The licensee reviewed the File 44 span criteria and verified its acceptability for the Hosgri event. The IDVP also reviewed this span criteria. All small bore piping which does not have the above noted characteristics has been computer analyzed as have the associated supports. The IDVP reviewed the licensee's Corrective Action Program, including the basis for not specifically

requalifying portions of small bore piping and pipe supports and agreed that this was acceptable. Based on the characteristics of the piping qualified by span rule and the review of the span rule criteria, the task group concluded that the acceptability of this piping has been demonstrated.

C. Distribution of IDVP Audits Among Various Groups Performing Analyses

Large bore piping and support analyses under the Corrective Action Program for Diablo Canyon Unit 1 were performed by the Diablo Canyon Project (DCP), Cygna, Impell (formerly EDS) and Westinghouse.

The IDVP task group was interested in determining the reasons and basis for the distribution of the analyses reviewed by the IDVP since the number of analyses reviewed were not proportionately distributed among the various design organizations according to the number of analyses performed by these organizations.

D. Evaluation of Appropriateness of Sample Distribution Among Various Groups Analyzing Large Bore Piping and Supports

For the review of DCP corrective action analyses of large bore piping and supports, the IDVP chose analyses that would reflect various combinations of the following considerations:

1. Configuration of piping
   - o Connected to flexible equipment
   - o With branch lines and/or overlaps
   - o With heavy in-line components (i.e., remote-operated valves)

2. Building location and application of spectra
   - o Piping attached to the containment annulus and/or turbine building
   - o Piping spans between buildings
   - o Piping attached to pipeway and/or auxiliary building flexible slabs

3. Characteristics of piping
   - o High energy lines (design temperature $\geq$ 200 degrees Fahrenheit and design pressure $\geq$ 275 psig)

4. Groups performing analysis
   - o DCP
   - o CYGNA (EES)
   - o Impell (EDS Nuclear)

5. Design analysis results
   - o High stress ratio
   - o High number of support modifications required

All five of the considerations were given attention and the review sample selection was such that the distribution among the various contractors was not proportionate. There are various detailed reasons that the distribution was not proportionate by contractor.

At the time the sample selection was being made the results of the IDVP QA review were being made available. The results showed that historically the Cygna and Impell organizations had a strong QA program. Therefore, under 4 above, the IDVP did not believe it was necessary to choose large sample sizes for these contractors.

Work by contractors under the Corrective Action Program was under the same procedural controls as work within the Diablo Canyon Project (DCP). Therefore, the IDVP did not regard that there was any significant differences between the interfaces within the DCP and interfaces between DCP and contractors.

Under the Corrective Action Program, about half of the piping analysis work performed by Impell was fire protection system piping and supports. The IDVP felt that since these are low temperature and low pressure lines and since there were other safety significant considerations in selecting review samples, it was not necessary to review more than one of these lines.

One of the considerations in the sample selection was the importance of reviewing piping attached to flexible equipment (natural frequency <20 Hz). The Cygna scope of Corrective Action Program work included one piece of flexible equipment. This was included in the IDVP review. The Impell scope did not include any flexible equipment. All of the flexible equipment in the DCP scope was included in the IDVP review. Because of the high importance attached to this consideration, higher sampling of DCP scope occurred.

The Westinghouse scope of work was not included in the IDVP. This matter was the subject of a prior staff evaluation at the time the IDVP program plan was reviewed. Therefore, the task group did not discuss this subject during its visit to the RLCA offices.

Based on the points discussed above regarding the basis for the distribution of analyses reviewed by the IDVP, the task group concluded that an appropriate sample distribution was selected by the IDVP.

E. Large number of ITR-identified "deficiencies" and the consequent need to expand the IDVP Scope

During the verification review of L/B and S/B piping and supports, the IDVP (RLCA) identified a variety of deficiencies and concerns. The results of this review were summarized in a series of Interim Technical Reports (ITR's) as follows:

ITR 59 - L/B Piping

ITR 60 - L/B and S/B Piping Supports

ITR 30 & 61 - S/B Piping

In the course of investigating certain allegations regarding the design qualification of S/B piping and supports at DCNPP, a concern regarding the IDVP review of the DCP effort in the piping area was identified with respect to the number of comments in the ITR's perceived to be deficiencies by the inspector.

The L/B piping and support analyses were questioned as to acceptability without expanding the review sample size due to the large number of identified deficiencies. The IDVP identified deficiencies of varying kinds in all except one of the L/B piping analyses. These were all reviewed by the task group. A similar concern for S/B supports by the inspector was raised. The requirement that the DCP review all computer analyses S/B pipe supports as stated in License Condition 2.C. (11), Item 1 of the DCNPP 1 Operating License later made this concern moot.

F. Evaluation of "deficiency" significance based on task group review of IDVP back up packages

The IDVP task group reviewed the documentation of the design review performed by RLCA of some of the DCP design packages of piping and

supports; some of the packages reviewed are the following:

A. L/B piping, ITR 59:

1. DCP #4A-100, Rev. 0: Phase I and Phase II review
2. DCP #8-117, Rev. 2
3. DCP #12-101, Rev. 0

B. S/B Piping, ITR 61:

1. DCP #19-307H, Rev. 3

C. L/B & S/B Supports, ITR 60:

1. DCP #S-1281, Rev. 3: Support 10/70 SL
2. DCP #S-582, Rev. 7: Support 56N/92R
3. DCP #S-497, Rev. 10: Support 57N/34R

Each RLCA design review package was reviewed thoroughly by one or more members of the special IDVP task group together with RLCA personnel. For each package the appropriate RLCA checklist and documentation was reviewed in detail to determine the actual nature of each listed deficiency or discrepancy and in particular to determine the significance of those deficiencies listed in the ITR's. In all cases the task group and RLCA members reviewed the nature of a given deficiency and its ultimate resolution. Based on this review the task group concluded that the effort performed by RLCA was much more extensive than that which was described in the

ITR's. Furthermore, the significance of the deficiencies listed in the ITR's was not addressed in sufficient detail in the ITR's, so that it is possible that the ITR description of these deficiencies could be misunderstood. During the time of the previous (original) review of the ITR's, the staff acceptance was based on understanding of the total IDVP effort from direct communication between the staff and RLCA, rather than just a strict reading of the ITR contents. Nevertheless, the task group believes that a valid criticism is insufficient description and documentation in the ITR's even though this criticism has no bearing on IDVP acceptability. It is recognized that the ITR's were meant to summarize the RLCA review effort, but in retrospect for those not directly connected with the IDVP, the ITR's should have contained more detail than was presented. However, based on its review of the backup IDVP packages, the task group has concluded that the identified deficiencies were not significant and did not disturb the final IDVP conclusions that the Diablo Canyon licensing criteria were met.

8.3. FINDINGS OF THE IDVP TASK GROUP

Based on its review at RLCA, the IDVP task group has the following findings regarding the IDVP effort on design of L/B and S/B piping and supports:

1. That the IDVP did examine the licensee's basis for not specifically requalifying the small bore piping not addressed by the

licensee's Corrective Action Program and concluded that licensing criteria for this piping was satisfied. That the IDVP effort, together with the additional confirmatory characteristics verification performed by the task group, provides an acceptable basis for the adequacy of this pipe.

2. That the IDVP selected a sample size distribution among the various groups performing large bore piping and support analyses based on a number of well founded judgmental factors and that there was no need to base sample distribution purely on amount of work performed by each group.

3. That the number and type of samples chosen by RLCA was adequate for the purposes of the IDVP, namely, verification of DCP design methodology, conformance with licensing criteria, and detection of significant, generic type deficiencies in the DCP verification effort. In addition, the task group agreed with RLCA that it is highly improbable that any additional significant issues of a generic nature would have been discovered if the sample size had been expanded.

4. That based solely on a review of the IDVP work reported in the ITR's, the inspector's concerns of perceived unexplained ITR "deficiencies" were justified. The ITR's can be criticized as

and the sample of 200 large bore supports, that there was no impact on satisfying the licensing criteria.

8.4 CONCLUSION

Because of the above findings reached by the task group reevaluating the IDVP, the staff concludes that its earlier evaluation, i.e., that the IDVP goal of design verification of large and small bore piping and associated supports had been achieved, remains valid.

9.0 PROGRAMMATIC CONCERNS

9.1 Programmatic Issues

As a result of inspections conducted onsite to verify the effectiveness of design control measures utilized by the Onsite Project Engineering Group (OPEG), a number of deficiencies were noted. These deficiencies can be summarized as follows:

a. inadequate personnel indoctrination and training to assure effective implementation of all QA and technical program requirements;

b. inadequate site procedures and use of unauthorized documents to perform work functions;

c. inadequate procedural control of preliminary design data and design interfaces between onsite groups and offsite groups;

d. lack of timeliness of project responses to site personnel safety concerns and QA audit findings;

e. inadequate QA program audits that well ensure that all aspects design control requirements are implemented in accordance with program provisions and ensure that the audit results are thoroughly evaluated prior to accepting any corrective actions;

f. inadequate tolerance clarification program implementation to assure that adequate design reviews are made prior to major hardware modifications.

On June 14, 1984, the licensee recinded the authority of OPEG to perform final safety-related engineering work. All remaining activities are to be performed by the project engineering organization in San Francisco. Support activities, such as field walkdowns, construction feasibility checks, and interfacting will still be performed by OPEG.

This decision by the licensee to redefine the authority and activities of OPEG was discussed with the licensee during the audit on June 21 and at the public meeting on July 2. This action does not rectify any design deficiencies that may have resulted prior to June 14, 1984; however, the task group's detailed audit of these design activities, as well as the findings of IDVP, results in confidence that licensing criteria have been met. In addition, the task group questioned the licensee on his actions to assure that this transfer of responsibility will be effectively controlled.

The task group plans on an audit of the effectiveness of this licensee action in the near future. Therefore, it is our conclusion that the actions taken by the licensee, coupled with the task group findings on the adequacy of technical work performed by OPEG resolves this issue.