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RLCA

# Interim Technical Report

DIABLO CANYON UNIT 1
IDVP VERIFICATION OF DCP ACTIVITIES
-Rupture Restraints-
ITR #65, Revision 0

Docket No. 50-275
License No. DPR-76

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PROGRAM MANAGER'S PREFACE

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

**INTERIM TECHNICAL REPORT**

IDVP VERIFICATION OF RUPTURE RESTRAINTS

This Interim Technical Report, ITR-65, is one of a series of ITRs prepared by the DCNPP-IDVP for the purpose of providing a conclusion to the program.

This report summarizes the IDVP verification of the DCP activities for Rupture Restraints to date.

The IDVP has completed its review of DCP general methodology for rupture restraints and found it to be acceptable. The IDVP verification of a sample of DCP analyses for design Class 1 rupture restraints is currently in progress and will be reported in Revision 1 to ITR-65.

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

ITR Reviewed and Approved
IDVP Program Manager
Teledyne Engineering Services

R. Wray

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IDVP VERIFICATION OF DCP ACTIVITIES

RUPTURE RESTRAINTS

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## 1.0 INTRODUCTION

### Purpose

This report is one of several interim technical reports (ITRs) of the Independent Design Verification Program (IDVP) for the Diablo Canyon Nuclear Power Plant, Unit 1 (DCNPP-1). It presents the results of the IDVP verification of Design Class 1 rupture restraints outside of containment which were included in the Diablo Canyon Project (DCP) review. The DCP review of rupture restraints is an extension of the engineering sampling program (Internal Technical Program) undertaken in mid-1982. This program is DCP Phase II work (oriented to specific issues) not undertaken as part of the corrective action program. This verification of DCP activities was performed consistent with the IDVP program outlined in ITR #35 (Reference 1).

This report is one of many interim technical reports issued by the IDVP. This document is referenced in the IDVP Final Report (Reference 2) and serves as a vehicle for NRC review.

### Scope

The IDVP verification of the DCP review of rupture restraints outside of containment consists of verifying the methodology and implementation of the specified DCP work plan.

The IDVP verification of pipe whip and jet impingement effects on safety-related components and systems outside containment has been performed as documented in ITRs #21 and #23 (References 3 and 4), and thus is not included in the scope of this ITR.

It is noted that Revision 0 of this ITR primarily addresses the methodology of the DCP review program. Also included is the IDVP review methodology, sampling criteria, and descriptions of the IDVP review samples. Results pertaining to the implementation of the DCP review program will follow in Revision 1 of this ITR.

Summary

The IDVP verified the DCP general methodology for the rupture restraint review and found it to be complete and thorough and in accordance with licensing criteria. This DCP program included sampling as-built conditions against the design drawings, review of postulated high energy line break locations, substructure analysis, interference and gap checks using current piping analysis results, and further analysis and modifications where required.

As a later part of the DCP rupture restraint review, the DCP has committed to adjustment or confirmation of all cold settings and to measurement and verification of all hot gaps during plant startup. This DCP activity is not being verified by the IDVP.

The IDVP verification of DCP analyses is in progress. Results will be presented in Revision 1 of this ITR.

## 2.0 DCP REVIEW PROGRAM

One of the key purposes of the DCP review program is to show that all licensing criteria are met considering any changes in the design data such as revised pressures and temperatures and piping movements and stresses. In addition to the Final Safety Analysis Report (FSAR Reference 6), an important licensing document is the letter from A. Giambusso to PGandE dated December 18, 1972 (Reference 7) which addresses requirements for postulated pipe rupture outside of containment. The DCP has also adopted ANSI/ANS Standard 58.2 "Design Basis for Protection of Light Water Nuclear Power Plants Against Effects of Postulated Pipe Rupture" (Reference 19).

Rupture restraints are defined as structural assemblies which are designed to restrain and control the effect of pipe whip in high energy piping* systems following the postulated rupture of the pipe and its corresponding pressure boundary. For the majority of cases outside of containment, rupture restraint assemblies consist of U-shaped rods (U-bolts) or rod beam configurations (referred to as rupture restraints) which absorb the majority of the impact force and energy of the postulated broken pipe through plastic deformation. The U-bolts or rod beams are attached to essentially rigid frames (referred to as substructures). In some cases, however, the substructure serves as the energy absorbing device as well. For example, the pipe strikes the frame structure and the energy is absorbed in the frame rather than in a U-bolt or rod beam. A typical configuration for a rupture restraint is shown in Figure 1.

Rupture restraints are provided for high energy pipe greater than one inch in diameter. The postulated pipe break locations are set at terminal ends and at intermediate piping locations of high stress.

The original design work for determination of high energy line break locations, pipe whip analyses and rupture restraints outside containment was performed by Nuclear Service Corporation (NSC, currently known as Quadrex), PGandE's service-related contractor. The results of this work were reported in the FSAR.

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*The FSAR defines high energy pipe as that with temperature exceeding 200 degrees Fahrenheit and pressure exceeding 275 Psig.

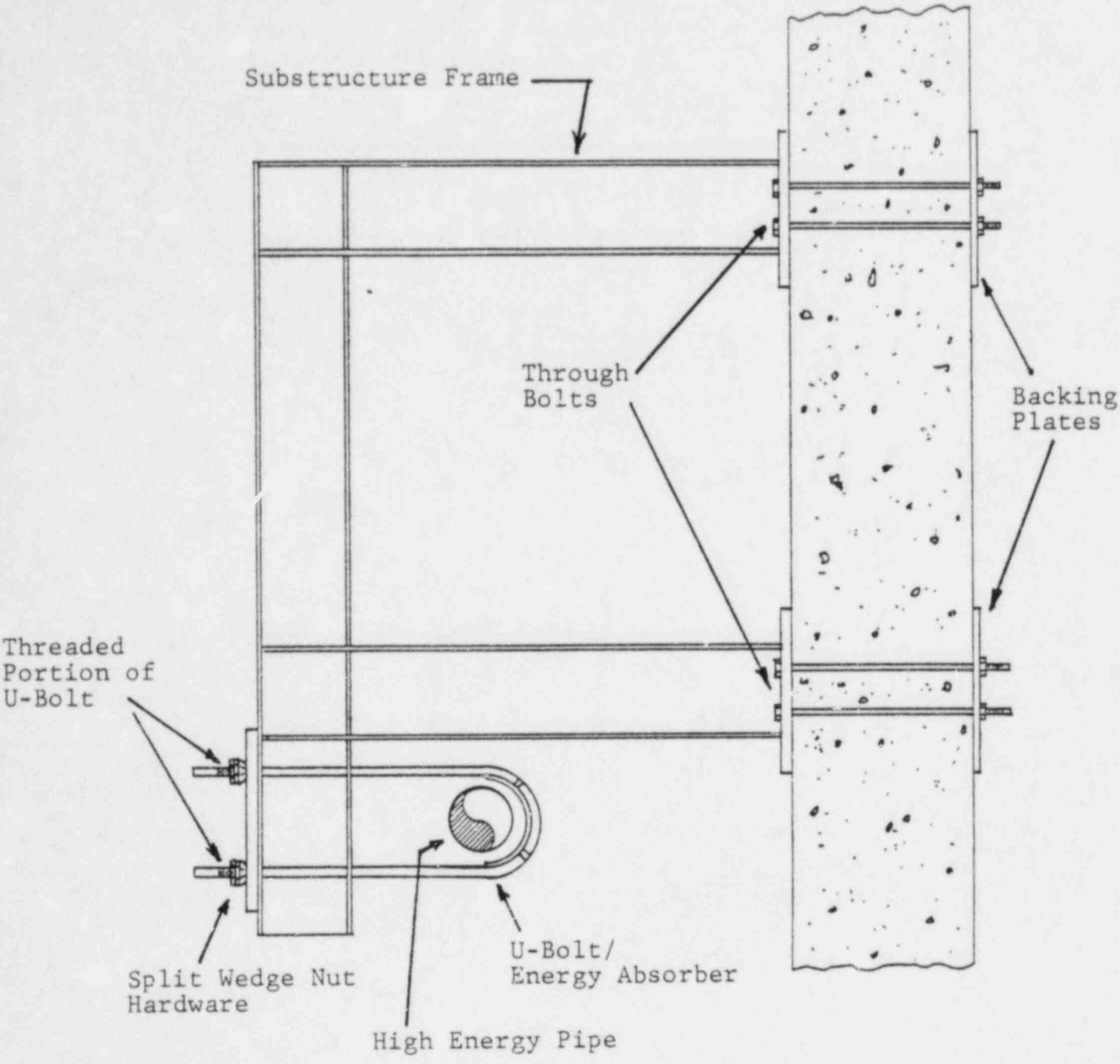


Figure 1
Rupture Restraint 1193-1
Typical Configuration

The DCP review of rupture restraints outside of the containment building was initially described in the DCP letter of January 31, 1983, ( Reference 8). A representative sample of 30% of the pipe rupture restraints outside containment was originally selected by the DCP to check the adequacy of the original NSC work for the current configurations and conditions. The DCP program has evolved to include the review of all the rupture restraints (energy absorbers) outside of contain- ment and an expanded sample of the associated restraint substructures. The substructure sampling and other steps in the DCP program are described below.

DCP Sampling Methodology (Substructures)

The DCP sampling methodology was based on the selection of a representative sample according to restraint substructure configurations and piping systems. The sample was selected by grouping the restraints by substructure configuration and then selecting the substructure(s) that appeared to be the critical case(s) within the groups. A minimum of 25% of the restraints in each group were selected by the DCP for evaluation. The selection within the groups was based on member size, applied rupture loads, design margins as presented in the NSC Structural Evaluation Report (Reference 10) and engineering judgement.

Pipe restraint substructures outside of containment were divided into the following areas:

- o Auxiliary building
- o Turbine building
- o High energy line well
- o Pipeway structure.

These selected substructures were then analyzed by the DCP for the NSC determined loads. If a substructure was found to require modification, the remaining substructures in that specific group were evaluated to verify their adequacy.

The number of substructures evaluated by the DCP in this sampling approach was 46 of 124 substructures in the auxiliary and turbine buildings, 12 of 24 nodes in the high energy line well (2 space frames), and 19 of 43 nodes in the pipeway (north frame plus beam 500).

## Overall DCP Program

The overall DCP rupture restraint review program, as presented to the IDVP, is shown diagrammatically in Figure 2.

The following activities were included in the DCP review:

- o Comparison of as-built configurations with design drawings on a sampling basis (substructures)
- o Check of current pressures and temperatures against NSC values used for determination of loads
- o Confirmation of the adequacy of design of the following:
  - restraint substructure (frames)
  - attachments (base plates and anchor bolts)
  - U-bolts, rod beams, and associated gaps
  - full penetration welds
  - connections and attachments
  - building elements (e.g. walls and slabs)

The DCP review of rupture restraints outside containment proceeded in the following manner.

High energy lines outside containment were identified. The latest piping stress analyses for these lines under the required system operating modes were reviewed, and postulated break locations confirmed and/or updated based on the stress results. The active rupture restraints for these postulated break locations were identified.

Pressures and temperatures of these high energy lines for the required operating modes were reviewed to confirm that they were within the previous design envelope and hence did not exceed the design enthalpy.

Next, pipe movements were calculated for each active rupture restraint based on the latest piping analyses. The movements were reviewed to confirm that they did not result in potential interference with the restraint and that the maximum gaps were satisfied. The structural adequacy of the restraint substructure for the maximum design loads was confirmed through analysis.

# PIPE RUPTURE RESTRAINTS OUTSIDE OF CONTAINMENT

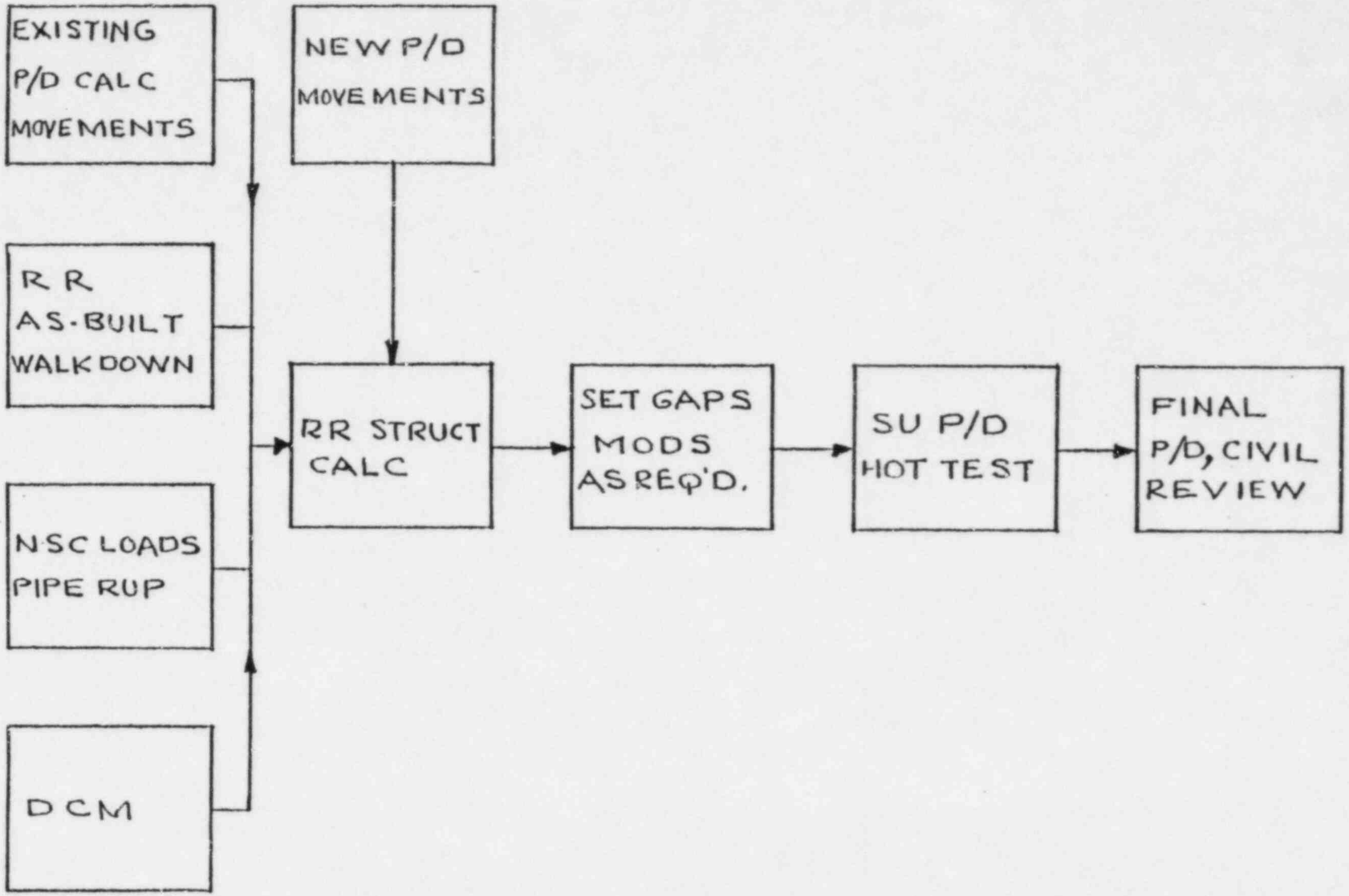


Figure 2
DCP Review Program
For Rupture Restraints

SU = Startup
P/D = Pipe Displacements

JUNE 22, 1983

If the gap sizes were larger than the maximum design size, or the pressures and temperature exceeded the design envelope, new loads and elastic/plastic deformations were calculated. These new deformations (of the U-bolt or energy absorber) were compared to the previous allowable design values and any required modifications were designed.

In addition, the DCP performed a test program for fasteners, couplings and hardware for the energy absorbers. The results are being incorporated into the overall DCP review of the rupture restraint energy absorbers.

As a later part of the DCP program (i.e, during the startup process), cold gaps will be set and hot gaps confirmed by field measurements. This DCP activity is not being verified by the IDVP.

## 3.0 IDVP VERIFICATION METHODS

### 3.1 VERIFICATION OF DCP METHODOLOGY

The IDVP has reviewed the methodology of the DCP work against the licensing commitments contained in the FSAR.

The DCP criteria for rupture restraints, as contained in DCP Design Criteria Memoranda (DCMs References 11 to 13) and applied in the DCP review have been reviewed for adequacy with respect to licensing requirements.

The IDVP will verify the adequacy of the DCP sample approach and the applicability of generic conclusions drawn by the DCP from this sampling.

### 3.2 VERIFICATION OF DCP ANALYSES

The IDVP reviews were conducted using checklists (see Appendix A). One checklist was used for the rupture restraints (energy absorbers); another checklist was used for the restraint substructures. The separate checklists reflect the level of detail and thoroughness of the IDVP review as well as the different criteria and significant items associated with the two types of DCP calculations.

These checklists include items for completeness of documentation, transfer of information from drawings, design gap sizes, loads and load combinations, structural modeling, analysis assumptions, satisfaction of criteria and completeness of qualification. Analysis inputs will be verified as being correctly transferred from the specified design sources. The checklists will be supplemented with alternate calculations where necessary, in order to verify the DCP analysis results or to confirm IDVP review conclusions.

In addition, the generic test program performed by the DCP for rupture restraint fasteners, couplings, and hardware will be reviewed. The results of this review will be reported in Revision 1 of this ITR.

Postulated break locations will be verified on a sample basis through review of selected high energy line piping analyses, using DCP break postulation criteria. The results of this review will also be reported in Revision 1 of this ITR.

## 3.3 IDVP SAMPLING CRITERIA AND SELECTION

Samples of DCP analyses were selected for IDVP review as specified and defined in ITR #35. The IDVP verification sample was selected to enable examination of the various aspects of the DCP review work. This sample was diverse so that conclusions could be made regarding the validity of the DCP review sample, criteria and their application, completeness of review and analysis, and implementation of DCP methodology.

In selecting specific DCP analyses, the IDVP considered various types and configurations of rupture restraints and substructures, at various plant locations. Based on review of the earlier NSC results, those restraints with large gaps and/or requiring large thermal clearances were selected, as well as those restraints with large postulated pipe rupture loads and/or low design margins.

### IDVP Sample Selection

Specific DCP analyses were selected from a DCP calculation index log (Reference 22). The IDVP selected a sample of 7 analyses out of a total of 112 rupture restraint analyses. Of these, 5 were for U-bolts and 2 were for rod beam assemblies.

The IDVP also selected a sample of 7 out of a total of 42 substructure analyses. Of these, 5 were for independent substructures, one was for a portion of a pipeway frame (north frame), and one substructure that serves as the restraint (i.e., pipe impacts the frame, not a U-bolt).

To verify the postulated high energy line break locations, the IDVP selected 2 piping analyses containing high energy lines. These were selected from a group of IDVP samples previously chosen as part of the IDVP verification of large bore piping (Reference 5).

## 4.0 IDVP VERIFICATION OF DCP METHODOLOGY

The IDVP has evaluated the DCP methodology for the review of rupture restraints outside of containment. Based on documentation transmitted and DCP presentations to the IDVP, the purpose of the DCP review program is to achieve the following:

- o Identification of high energy piping outside of containment, based on current pressures and temperatures
- o Location and identification of existing rupture restraints
- o Establishment of design criteria in a controlled manner and in conformance with licensing criteria
- o To address worst case configurations
- o Together with the established NSC pipe rupture and design parameters, to provide generic qualification of the restraints outside of containment

The IDVP, through evaluation of the DCP review methodology in the above areas, has determined that the DCP review program contains all the essential elements to achieve the above items and is satisfactory.

Further conclusions on the specifics of the DCP review methodology will be presented following completion of the IDVP verification of actual DCP reviews and analyses.

## 5.0 IDVP REVIEW OF RUPTURE RESTRAINTS (ENERGY ABSORBERS)

The DCP analysis of U-bolts and rod beams consisted of calculating and specifying the design cold and hot gaps at the restraint. DCP calculations for U-bolts and rod beams were divided into two separate sets of calculations. The first set of calculations, labeled U-xxx (where xxx is the calculation number), were used to determine the effective length of the U-bolt or rod beam. The second set of calculations, labeled U-xxx-1, specify the new cold position of the U-bolt taking into account effective gaps, and all hot and cold pipe displacements.

### 5.1 DCP CALCULATION U-10

#### Description

Calculation U-10 (Reference 23) applies to the energy absorbing 2 inch diameter U-bolt rupture restraint 1047-2RT. This restraint is for the 16 inch diameter auxiliary feedwater line (line 577), and is located at elevation 120 feet in the auxiliary building.

#### Results

The IDVP review is being finalized and results will be reported in Revision 1 of this ITR.

### 5.2 DCP CALCULATION U-30

#### Description

Calculation U-30 (Reference 24) applies to the set of two 1-3/8 inch diameter U-bolts used as the energy absorbing rupture restraint 1047-4RT in the lateral direction only. The substructure frame acts as the rupture restraint in the vertical direction (see Section 6.2). This restraint is for the 16 inch diameter feedwater line (line 557), and is located at elevation 119 feet in the auxiliary building.

#### Results

The IDVP review is being finalized and results will be reported in Revision 1 of this ITR.

## 5.3 DCP CALCULATION U-131

### Description

Calculation U-131 (Reference 25) applies to the single 7/8 inch diameter U-bolt used as the energy absorbing rupture restraint 594-8. This restraint is for the 4 inch diameter steam line (line 594), and is located in the auxiliary building.

### Results

The IDVP review is being finalized and results will be reported in Revision 1 of this ITR.

## 5.4 DCP CALCULATION U-192

### Description

Calculation U-192 (Reference 26) applies to the 2-1/2 inch diameter U-bolt, rupture restraint SD-4. This restraint SD-4 consists of 2 U-bolts, connected end-to-end, which form a loop around both the 24 inch diameter main steam dump line (line 589) and the 28 inch diameter main steam line (line 585). These U-bolts are located in the auxiliary building.

### Results

The IDVP review is being finalized and results will be reported in Revision 1 of this ITR.

## 5.5 DCP CALCULATION U-295

Calculation U-295 (Reference 27) applies to the rod beam assembly with 1-3/4 inch diameter rods used as the energy absorbers on rupture restraint MS34-4. This restraint is for the 28 inch main steam line (line 585), and is located in the turbine building.

### Results

The IDVP review is being finalized and results will be reported in Revision 1 of this ITR.

## 5.6 DCP CALCULATION U-313

### Description

Calculation U-313 (Reference 28) applies to the rod beam assembly that comprises the energy absorber for the 28 inch diameter main steam lead line (line 586) at the G-Line upper frame (NSC Node 3100) in the turbine building. This assembly consists of a pair of 2-1/2 inch diameter threaded rods bolted to the rod beam.

### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 5.7 DCP CALCULATION U-355

### Description

Calculation U-355 (Reference 29) applies to the set of two 2-1/4 inch diameter U-bolts used as the energy absorbers on the 28 inch diameter main steam lead (line 583). This assembly is located in the pipeway structure (NSC Node 1172).

### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 5.8 DCP TESTING PROGRAM

DCP initiated a test program to ensure structural adequacy of the U-bolt rod connectors. The test involved tensile loading a straight threaded U-bar with different types of threaded connectors. The criteria for qualification of the connectors was that the bar failed in some acceptable mode not associated with the connector.

### Results

The IDVP review is in progress and the results will be reported in Revision 1 of this ITR.

## 6.0 IDVP REVIEW OF RESTRAINT SUBSTRUCTURES

The DCP analysis of substructures consisted of three main parts. First, appropriate design amplification factors were applied to design rupture loads. Next, a frame analysis was performed on the substructure frame using these design rupture loads. For simple frames, hand calculations were performed to obtain member forces and support reactions. For more complicated frames, a computer analysis was performed to obtain frame member forces and stresses along with support reactions. Finally, the results of the frame analysis were used to verify the structural integrity of the frame and its attachments. Stresses in all key structural parts including beams, columns, plates, and anchor systems were computed and compared to allowables in order to determine the adequacy of the substructure.

### 6.1 DCP CALCULATION S-20

#### Description

Calculation S-20 (Reference 30) reviews two nearly identical frame restraints, 1047-3RT and 1047-12RT. These restraints are located at elevation 115 feet of the auxiliary building. Loading on the restraints was derived from postulated pipe breaks of lines 556 and 557 respectively. Each frame restraint consists of a welded box frame, surrounding the pipe and acting as the energy absorber, and a substructure supporting the box 4-1/2 feet above the auxiliary building slab. Both frame and substructure were constructed of W12X133 wide flange beams connected by full penetration welds and attached to steel plates anchored by studs to the concrete floor slab.

#### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 6.2 DCP CALCULATION S-30

### Description

Calculation S-30 (Reference 31) reviews the frame for rupture restraint 1047-4RT located at elevation 115 feet in the auxiliary building. This restraint resists postulated pipe breaks in line 557. The frame supports two U-bolts for loading in the horizontal direction and acts as a frame rupture restraint for both upward and downward vertical loadings.

The geometry of the restraint consists of a box shaped frame of W12X133 beams and a W36X300 column surrounding the pipe. The column, anchored to both the floor and ceiling, supports the frame 4 feet 5 inches above the auxiliary building floor slab at elevation 115 feet. In addition, one side of the frame is attached to the floor by a short W12X133 member which, in turn, is attached to the floor slab with through-bolts.

### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 6.3 DCP CALCULATION S-130

### Description

Calculation S-130 (Reference 32) applies to the substructure for rupture restraints 594-7,-8,-9,-11 and -12 located at elevation 131 feet in the auxiliary building. This substructure accepts postulated break loads from line 594.

This substructure is a welded steel frame constructed from wide flange beams and attached to the wall with rock bolts. The frame was designed to accept postulated break loads at two locations from several break orientations.

### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

### 6.4 DCP CALCULATION S-150

Description

Calculation S-150 (Reference 33) applies to the substructure for rupture restraints 3874-4, 3874-6, 3876-6, 3880-5 and 3880-6. The substructure is located at elevation 115 feet in the auxiliary building.

The substructure is a welded steel frame constructed of W8x28 beams. A diagonal brace is installed to be active in the direction of restraint. The base of the frame is anchored to the concrete floor slab, while the top of the frame is anchored to a concrete column.

Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

### 6.5 DCP CALCULATION S-240

Description

Calculation S-240 (Reference 34) applies to the substructure for rupture restraint 1193-1, located at elevation 114 in the turbine building. This substructure accepts postulated pipe break loads from line 1193.

The substructure is a welded cantilever frame constructed from W14x48 and W14x111 beams and anchored to a concrete wall with through bolts and backing plates.

Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 6.6 DCP CALCULATION S-260

### Description

Calculation S-260 (Reference 35) applies to the substructure for rupture restraints MS-13,-23,-33,-43,-12, -22,-32, and -42. This substructure is located at elevation 140 feet in the turbine building, and accepts postulated pipe rupture loads from lines 583, 384, 585 and 586.

The substructure is constructed primarily of welded W14x103 and W14x342 beams, and is bolted to the floor of the turbine pedestal with rock bolts and bolted to the 140 foot elevation deck with through-bolts.

### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 6.7 DCP CALCULATION S-331

### Description

Calculation S-331 (Reference 36) applies to the substructure for rupture restraint 1025-10RT. This substructure is located at elevation 109 feet in the pipeway structure and is part of the larger substructure for rupture restraints 1025-8RT and 1046-7RT. Rupture restraint 1025-10RT accepts loads from postulated pipe rupture of line 227.

The substructure is a welded frame constructed from W14x202 and W14x158 beams and is anchored to the pipeway structure and the containment exterior wall. The W14x158 beams, in a vertical orientation, have cutout sections for pipe movement clearances.

### Results

The IDVP review is being finalized and the results will be reported in Revision 1 of this ITR.

## 7.0 IDVP VERIFICATION OF POSTULATED HIGH ENERGY LINE BREAK LOCATIONS

The IDVP has selected two piping analyses which contain high energy lines to verify the DCP program to identify and address postulated break locations.

### 7.1 DCP PIPING ANALYSIS 7-100

Description

DCP analysis 7-100 (Reference 37) consists of piping in the reactor coolant system for the resistance temperature detection system. This piping system is located within the containment interior, and includes 3/4, 1, 2, and 3 inch piping.

Analysis 7-100 includes lines 1154, 1155, 1156, 1157, 3496 and 4247.

Results

The IDVP review of the postulated break locations is being finalized and results will be reported in Revision 1 of this ITR.

### 7.2 DCP PIPING ANALYSIS 9-113

Description

DCP analysis 9-113 (Reference 38) consists of piping in the chemical and volume control system and the seal water system. This piping is located within containment and runs primarily between the regenerative heat exchanger and the containment interior shell.

The analysis includes 1, 2, 3, and 4 inch diameter lines, whose line numbers are 25, 26, 62, 234, 401 through 406, 748, 883, 3134, 3790 and 4002.

Results

The IDVP review of the postulated break locations is being finalized and results will be reported in Revision 1 of this ITR.

## 8.0 EOI REPORTS ISSUED

One EOI, 1141, has been issued to date for rupture restraints. Appendix B shows the date, progress and status of the EOI Reports.

EOI 1141 was issued because DCP procedure P-11 (Reference 14) Revision 4, which includes a list of all the high energy lines outside containment with postulated breaks, did not include high energy lines 26, and 1040 through 1043 for postulated break review.

The IDVP was subsequently informed by the DCP that the review and listing of postulated high energy line break locations was controlled by DCP project instruction I-47 (Reference 15), not by procedure P-11. Project instruction I-47 had not been finalized, thus EOI 1141 was resolved as a closed item by combining it with EOI 1098 for inclusion in the IDVP completion sample verification (see ITR #59 Reference 5 for description of EOI 1098).

## 9.0 SUMMARY OF RESULTS

The IDVP has verified the DCP review methodology for rupture restraints. Essential elements of this program include the following:

- o Review of as-built configurations against design drawings on a sampling basis (substructures)
- o Check of current pressures and temperatures against NSC values used for determination of loads
- o Substructure analysis
- o Check of clearances and maximum gaps
- o Further DCP analyses if required
- o Review of postulated pipe break locations
- o Testing program for fasteners, couplings and hardware for energy absorbers.

IDVP verification of the DCP analyses is nearing completion. These results will be included in Revision 1 of this ITR.

## 10.0 CONCLUSIONS

The IDVP verified the DCP review methodology for rupture restraints. The purpose of the DCP review, together with the established NSC design parameters, is to provide for generic qualification of the rupture restraints outside of containment. Final IDVP conclusions on the implementation of the DCP review program and verification of DCP analyses is nearing completion and will be reported in Revision 1 of this ITR.

## 11.0 REFERENCES


| Reference No. | Title | RLCA File No. |
|---|---|---|
| 1 | Independent Design Verification Program (IDVP), Interim Technical Report (ITR) #35, IDVP Verification Plan for Diablo Canyon Project Activities, Revision 0. | P105-4-839-035 |
| 2 | IDVP, Diablo Canyon Nuclear Power Plant--Unit 1, Final Report, Independent Design Verification Program. | |
| 3 | IDVP, ITR #21, Verification of the Effects of High Energy Line Cracks and Moderate Energy Line Breaks for Auxiliary Feedwater System and Control Room Ventilation and Pressurization System, Revision 1. | P105-4-839-021 |
| 4 | IDVP, ITR #23, Verification of High Energy Line Break and Internally Generated Missile Review Outside Containment for Auxiliary Feedwater System and Control Room Ventilation and Pressurization System, Revision 1. | P105-4-839-023 |
| 5 | IDVP, ITR #59, IDVP Verification of Corrective Action, Large Bore Piping, Revision 0. | P105-4-839-059 |
| 6 | Diablo Canyon Site Units 1 and 2, Final Safety Analysis Report, USAEC Docket Nos. 50-275 and 50-323. | P105-4-200-005 |

| Reference No. | Title | RLCA File No. |
|---|---|---|
| 7 | Letter from A. Giambusso (AEC) to F. T. Searls (PGandE). Basis of Requirements for Pipe Rupture Design Outside of Containment, December 18, 1972. | P105-4-432-101 |
| 8 | DCP Letter to Teledyne Engineering Services (TES), Moore to Cooper, DCVP-TES-748, Additional Work in Selected Phase II Areas, 1/31/83. | P105-4-611-427 |
| 9 | Nuclear Servicves Corporation, NSC Report No. PGE-01-27, Thermal Hydraulic analyses of Postulated pipe break outside CTMT at Diablo Canyon Unit 1, Rev. 1 April 4, 1977. | P105-4-422-029 |
| 10 | Nuclear Services Corporation, NSC Report No. PGE-01-28, Structural evaluation of postulated pipe break outside CTMT at Diablo Canyon Unit 1, Rev. 1, April 11, 1977. | P105-4-422-163 |
| 11 | DCP, DCM C-54, Structural Evaluation of the Pipe Whip Restraints Outside the Containment, Rev. 0. | P105-4-200-163 |
| 12 | DCP, DCM C-63, Diablo Canyon Units 1 & 2 - Concrete Embedded Plates, Revison 0, January 5, 1983. | P105-4-200-168 |

| Reference No. | Title | RLCA File No. |
|---|---|---|
| 13 | DCP, DCM M-9, Guidelines for Design of Class 1 Pipe Supports: Units 1 & 2 Diablo Canyon Power Plant, Revision 8. August 10, 1983. | P105-4-200-021 |
| 14 | Pacific Gas and Electric Company (PGandE) P-11, Procedure for Piping Stress Analysis May 23, 1983. | P105-4-200-095 |
| 15 | DCP Instruction No. I-47, Instruction for Postulating Pipe Break Locations and Providing Displacements at Rupture Restraint Locations. | P105-4-200-170 |
| 16 | DCP, DCM C-17, Hosgri Response Spectra for Structures, Systems, and Components - Units 1 & 2 Diablo Canyon Revision 7, May 26, 1983. | P105-4-200-014 |
| 17 | DCP, DCM C-25, Design Earthquake Response Spectra for Structures, Systems, and Components - Units 1 & 2 Diablo Canyon Plant Revison 2, March 29, 1983. | |
| 18 | DCP, DCM C-30, Double Design Earthquake Respnse Spectra for Structures, Systems, and Components - Units 1 & 2 Diablo Canyon Plant Revision 4, May 26, 1983. | P105-4-200-056 |

| Reference No. | Title | RLCA File No. |
|---|---|---|
| 19 | American National Standards Institute, American Nuclear Society, Standard ANSI/ ANS-58.2-1980, Design Basis for Protection of Light Water Nuclear Power Plants Against Effects of Postulated Pipe Rupture, December 31, 1980. | P105-4-432-101 |
| 20 | American Concrete Institute Building code requirements for reinforced concrete, ACI Standard 318-71, 1971. | |
| 21 | American Institute of Steel Construction, Manual of Steel Construction, Seventh Edition, 1970. | |
| 22 | DCP Calculation Index Log, System Pipe Rupture Restraint Revison 2, August 8, 1983 | P105-4-432-767 |

| Reference No. | Title | | | RLCA File No. |
|---|---|---|---|---|

DCP Calculations

| | DCP Calculation Number | | Substructure/ Frame Restraint Type | |
|---|---|---|---|---|
| 23 | U-10 | Rev. 0 | 1047-2RT (-Z) | P105-4-432-874 |
| | U-10-1 | Rev. 0 | 1047-2RT (-Z) | P105-4-432-828 |
| 24 | U-30 | Rev. 0 | 1047-4RT (+X) | P105-4-432-884 |
| | U-30-1 | Rev. 0 | 1047-4RT (+X) | P105-4-432-811 |
| 25 | U-131 | Rev. 0 | 594-8 (+Z) | P105-4-432-885 |
| | U-131-1 | Rev. 0 | 594-8 (+X) | P105-4-432-815 |
| 26 | U-192 | Rev. 0 | SD4 (+Z) | P105-4-432-886 |
| | U-192-1 | Rev. 0 | SD4 (+Z) | P105-4-432-816 |
| 27 | U-295 | Rev. 0 | MS 34-4 (-Z) | P105-4-432-927 |
| | U-295-1 | Rev. 0 | MS 34-4 (-Z) | P105-4-432-926 |
| 28 | U-313 | Rev. 0 | NSC Node 3100 (+Z) | P105-4-432-888 |
| | U-313-1 | Rev. 0 | NSC Node 3100 (+Z) | P105-4-432-823 |
| 29 | U-355 | Rev. 0 | NSC Node 1172 (+X) | P105-4-432-889 |
| | U-355-1 | Rev. 0 | NSC Node 1172 (+X) | P105-4-432-819 |
| 30 | S-20 | Rev. 0 | Frame Rupture Restraints 1047-3RT, 1047-12RT | P105-4-432-827 |
| 31 | S-30 | Rev. 0 | Frame Restraint (+Y) and Substructures (FX) For Rupture Restraint 1047-4RT, | P105-4-432-826 |
| 32 | S-130 | Rev. 0 | Substructure for Rupture Restraints 594-7, 8, 9, 11, 12 | P105-4-432-818 |
| 33 | S-150 | Rev. Open | Substructure For Rupture Restraints 3874, 3876, 3878, 3880 | P105-4-432-560 |

| Reference No. | | | Title | File No. |
|---|---|---|---|---|
| | | | DCP Calculations | |
| | DCP Calculation Number | | Substructure/ Frame Restraint Type | |
| 34 | S-240 | Rev. 0 | Substructure For Rupture Restraint 1193-1 | P105-4-432-567 |
| 35 | S-260 | Checked 5/5/83 | Substructure For Rupture Restraints MS-13, 23, 33, 43 and MS-12, 22, 32, 42 | P105-4-432-568 |
| 36 | S-331 | Checked 5/5/83 | Bent 48 Pipeway Structure Supporting Restraint 1025-10RT | P105-4-432-488 |
| 37 | 9-113 | Rev. 1 | DCP, Design Class 1 Piping Stress Analysis, June 9, 1980 | P105-4-432-892 |
| 38 | 7-100 | Rev. 2 | DCP, Design Class 1 Piping Stress Analysis, May 26, 1983 | P105-4-432-855 |

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Appendix A

Sample Checklists

(8 pages)

# Checklist for Rupture Restraints
(A1-A5)

Checklist for Rupture Restraints

DCNPP-1 Calculation No. __________ Rev. ______

Rupture Retraint No. __________

By:____________ Date:__________ Page ____of____

Project: P105-4

| | Satisfactory Yes | Satisfactory No | Comment |
|---|---|---|---|
| 1. Analysis Cover Sheet | ____ | ____ | __________ |
| 2. Analysis Revision Sheet | ____ | ____ | __________ |
| 3. Analysis Summary Sheet | ____ | ____ | __________ |
| 4. Analysis Checklist | ____ | ____ | __________ |
| 5. Isometric Drawings: | | | |
| a. Walkdown Isometric | ____ | ____ | __________ |
| b. Design Review Isometric | ____ | ____ | __________ |
| c. NSC Isometric | ____ | ____ | __________ |
| d. Pipe Stress Analysis Isometric | ____ | ____ | __________ |
| e. DCP Rupture Restraint Isometric | ____ | ____ | __________ |
| 6. Pipe Stress Summary: | | | |
| a. HELB postulated per FSAR Section 3.6.4 | ____ | ____ | __________ |
| b. Restraint location agrees with Item 5 drawings (new break locations only) | ____ | ____ | __________ |

Checklist for Rupture Restraints

DCNPP-1 Calculation No. __________ Rev. ______

Rupture Retraint No. __________

By:____________ Date:___________ Page ____ of ____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| 7. Pipe Displacements at Rupture Restraints correctly taken from DCP Pipe Stress Analysis Reference ___. | | | |
| a. TH | ____ | ____ | __________ |
| b. THO | ____ | ____ | __________ |
| c. THA | ____ | ____ | __________ |
| d. FV | ____ | ____ | __________ |
| e. RVOT | ____ | ____ | __________ |
| f. DE | ____ | ____ | __________ |
| g. DDE | ____ | ____ | __________ |
| h. HOS | ____ | ____ | __________ |
| i Other ________________ | ____ | ____ | __________ |
| j. Pipe displacement transformed to the local coordinate system in the plane of the restraint. | ____ | ____ | __________ |
| 8. Pipe Rupture Restraint Type: | | | |
| a. U-Bolt | ____ | ____ | __________ |
| b. Rod Beam | ____ | ____ | __________ |
| c. Frame Restraint | ____ | ____ | __________ |
| d. Other ________________ | ____ | ____ | __________ |
| 9. Pipe Rupture Restraint Drawings | | | |
| a. Restraint Orientation | ____ | ____ | __________ |
| b. Orientation agrees with piping isometic | ____ | ____ | __________ |
| c. Design gaps specified | ____ | ____ | __________ |
| d. All components specified in parts list | ____ | ____ | __________ |
| e. Number and hardware sizes specified | ____ | ____ | __________ |

Checklist for Rupture Restraints

DCNPP-1 Calculation No. __________ Rev. ________

Rupture Restraint No. ___________

By:________________ Date: _____________ Page ____ of ____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| f. Restraint attachments specified (e.g. connectors, bolts, welds, end attachments, etc.) | ____ | ____ | __________ |
| g. Necessary dimensions specified | ____ | ____ | __________ |
| h. General configuration field verified | ____ | ____ | __________ |
| i. DCP modifications to end attachments of U-bolt/rod assemblies specified | ____ | ____ | __________ |
| j. DCP modifications to connectors of U-bolt/rod assemblies specified | ____ | ____ | __________ |
| 10. Restraint Gaps: | | | |
| a. Effective Gap specified in Reference _____. | ____ | ____ | __________ |
| b. As-built gaps specified in field drawings | ____ | ____ | __________ |
| c. The calculated pipe thermal movements in the local restraint coordinated system: | | | |
| 1) S, Transverse movement | ____ | ____ | __________ |
| 2) S, Longitudinal movement | ____ | ____ | __________ |
| d. The Item 7.0 pipe movements are correctly transformed into the local restraint coordinate system | ____ | ____ | __________ |

## Checklist for Rupture Restraints

DCNPP-1 Calculation No. ____________ Rev. ________

Rupture Restraint No. ___________

By:______________ Date:_________ Page_____ of _____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| e. DCP calculated and specified gaps: | | | |
| 1) EG, Effective gap | ____ | ____ | __________ |
| 2) $C_L$, Longitudinal hot gap | ____ | ____ | __________ |
| 3) $C_T$, Transverse hot gap | ____ | ____ | __________ |
| 4) $C_R$, Min. radial hot gap | ____ | ____ | __________ |
| 5) $G_L$, Longitudinal cold gap | ____ | ____ | __________ |
| 6) $G_T$, Transverse cold gap | ____ | ____ | __________ |
| 7) $G_R$, Minimum radial cold gap | ____ | ____ | __________ |
| f) The Item 5 gaps are properly transmitted to the field | ____ | ____ | __________ |
| g) Special instructions for field adjustments | ____ | ____ | __________ |
| h) Field problems properly resolved | ____ | ____ | __________ |
| 11. Calculated Effective Length: | | | |
| a. Elastic range | ____ | ____ | __________ |
| b. Strain hardening range | ____ | ____ | __________ |
| 12. Restraint Characteristics: | | | |
| a. EG, Effective gap | ____ | ____ | __________ |
| b. Le, Elastic deflection | ____ | ____ | __________ |
| c. L, Plastic deflection limit | ____ | ____ | __________ |
| d. P, Restraint load at yield | ____ | ____ | __________ |
| e. P, Restraint load at plastic limit | ____ | ____ | __________ |
| f. Ke, Elastic modulus | ____ | ____ | __________ |
| g. Kp, Plastic modulus | ____ | ____ | __________ |

Checklist for Rupture Restraints

DCNPP-1 Calculation No.____________ Rev.____________

Rupture Restraint No.______________

By:____________ Date:____________ Page ____ of ____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| 13. Pipe rupture blowdown loads and direction correctly selected from Reference ____. | ____ | ____ | __________ |
| 14. Rupture restraint evaluation | | | |
| a. By energy balance method | ____ | ____ | __________ |
| b. By dynamic rupture computer analysis | ____ | ____ | __________ |
| 15. List of References | ____ | ____ | __________ |
| 16. List of Attachements | ____ | ____ | __________ |
| 17. DCP Calculation, Ref. __ is reasonable | ____ | ____ | __________ |

Abbreviations

TH Thermal, 100% Power

THO Thermal, other plant normal and upset conditions, excluding 100% power

THA Thermal, accident

FV Fast Valve Closure

RVOT Relief Valve Opening Thrust

DE Design Earthquake

DDE Double Design Earthquake

HOS Hosgri Earthquake

N/A Not applicable

HELB High energy line break

Checklist for Substructures
(A6-A8)

## Checklist of Rupture Restraint Substructure

DCNPP-1 Calculation No. __________ Rev. ______

Substructure For Restraint No. __________

By: __________ Date:_________ Page ____ of ____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| 1. Analysis Cover Sheet | | | |
| 2. Analysis Revision Sheet | | | |
| 3. Analysis Summary Sheet | | | |
| 4. Substructure Drawing: | | | |
| a. Substructure orientation | | | |
| b. Restraint orientation agrees with piping isometric | | | |
| c. All components specified in parts list | | | |
| d. Structrual member sizes specified | | | |
| e. Hardware sizes specified | | | |
| f. Member attachments specified (e.g. bolts, welds) | | | |
| g. Necessary dimensions specified | | | |
| h. Field verification | | | |
| 5. Evaluation of Frame as a Rupture Restraint: | | | |
| a. Frame stiffness requirements | | | |
| b. Gap requirements met | | | |
| 6. Design Loads: | | | |
| a. Rupture restraint reactions | | | |
| b. Additional loading (pipe support, seismic, etc.) | | | |
| c. Design amplification factors | | | |
| d. Material increase factor | | | |
| e. Dynamic impact factor for: | | | |
| substructure | | | |
| attachments | | | |
| f. Load combinations | | | |

Checklist of Rupture Restraint Substructure

DCNPP-1 Calculation No. __________ Rev. ______

Substructure For Restraint No. __________

By: __________ Date:_________ Page ____ of ____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| 7. Hand Frame Analysis: | | | |
| a. Assumptions | ____ | ____ | __________ |
| b. Appropriate load cases evaluated | ____ | ____ | __________ |
| c. Appropriate boundary conditions | ____ | ____ | __________ |
| d. Appropriate analysis equations | ____ | ____ | __________ |
| e. Member properties | ____ | ____ | __________ |
| f. Results properly interpreted | ____ | ____ | __________ |
| g. Allowable stress per DCM C-54 | ____ | ____ | __________ |
| 8. Computer Frame Analysis: | | | |
| a. Computer program run/date | ____ | ____ | __________ |
| b. Assumptions | ____ | ____ | __________ |
| c. Geometry | ____ | ____ | __________ |
| d. Member properties | ____ | ____ | __________ |
| e. Appropriate load cases evaluated | ____ | ____ | __________ |
| f. Boundary conditions | ____ | ____ | __________ |
| g. Results properly interpreted | ____ | ____ | __________ |
| h. Allowable stress per DCM C-54 | ____ | ____ | __________ |
| 9. Internal Connections | | | |
| a. Assumptions | ____ | ____ | __________ |
| b. Appropriate boundary conditions | ____ | ____ | __________ |
| c. Appropriate analysis equations | | | |
| Bolts | ____ | ____ | __________ |
| Welds | ____ | ____ | __________ |

Checklist of Rupture Restraint Substructure

DCNPP-1 Calculation No. __________ Rev. ______

Substructure For Restraint No. __________

By: __________ Date: __________ Page ____ of ____

Project: P 105-4

| | Satisfactory | | |
|---|---|---|---|
| | Yes | No | Comment |
| 10. Attachments: | | | |
| a. Assumptions | ____ | ____ | __________ |
| b. Appropriate factored reactions evaluated | ____ | ____ | __________ |
| 1) Base Plates | | | |
| Welds | ____ | ____ | __________ |
| Critical section | ____ | ____ | __________ |
| Plate bending | ____ | ____ | __________ |
| 2) Anchor system: | | | |
| Anchor bolts (A490) | ____ | ____ | __________ |
| Williams rock bolt | ____ | ____ | __________ |
| Nelson studs | ____ | ____ | __________ |
| Expansion anchor (red head) | ____ | ____ | __________ |
| Embedment length | ____ | ____ | __________ |
| 11. Other Loads Evaluated | | | |
| a. Pipe Support | ____ | ____ | __________ |
| b. Seismic | ____ | ____ | __________ |
| c. Other __________ | ____ | ____ | __________ |
| 12. List of References | ____ | ____ | __________ |
| 13. List of Attachments | ____ | ____ | __________ |
| 14. Computer Output Included | ____ | ____ | __________ |
| 15. DCP Calculation, Ref. __ is Reasonable | ____ | ____ | __________ |

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Appendix B

EOI Status - Rupture Restraints

(1 page)

EOI Status - Rupture Restraints

| EOI File No. | Subject | Rev. | Date | By | Type | Action Required | Physical Mod. |
|---|---|---|---|---|---|---|---|
| 1141 | Identification of High Energy Lines - Combined with EOI 1098 | 0<br>1<br>2<br>3 | 8/2/83<br>8/27/83<br>8/31/83<br>8/31/83 | RLCA<br>RLCA<br>TES<br>TES | OIR/OIP<br>PPRR/CI<br>PRR/CI<br>CR | PGandE<br>TES<br>TES<br>NONE | <br><br>NONE<br> |



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

OIR - Open Item Report
PPRR - Potential Program Resolution Report
PRR - Program Resolution Report
PER - Potential Error Report
OIP - Open Item with future action by PGandE

ER - Error Report
CR - Completion Report
CI - Closed Item
DEV - Deviation

A - Class A Error
B - Class B Error
C - Class C Error
D - Class D Error

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

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Appendix C

Key Term Definitions

(9 pages)

## Appendix C

## Key Terms And Definitions

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

Active Rupture Restraint

- A rupture restraint at a postulated break location.

Allowable Criteria

- Maximum stress or load provided by the licensing criteria.

As-Built

- Present configuration of DCNPP-1 as shown by IDVP field verification; same as in-service.

Calculation Files

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

Closed Item

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

Completion Report

- Used to indicate that the IDVP effort related to the Open Item identified by the File Number is complete. It references either a Program Resolution Report which recategorized the item as a Closed Item or a PGandE document which states that no physical modification is to be applied in the case of a Deviation or a Class D Error.

Corrective Action

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

DCNPP-1

- Diablo Canyon Nuclear Power Plant, Unit 1.

DCP

- Diablo Canyon Project: PGandE and Bechtel Power Corporation.

DDE

- Double design earthquake.

DE

- Design earthquake.

Dead Load

- A constant load exerted by the weight of a mass at rest; also known as static load.

Deadweight

- Sustained load caused by acceleration due to gravity.

Design Analysis

- Work performed by or for PGandE.

Design Codes

- Accepted industry standards for design (e.g., AISC, AISI, ANSI, ASME, AWWA, IEEE).

Deviation

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

Dynamic Load

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

Elastic

- Capable of sustaining deformation without permanent loss of size or shape.

Elements

- Mathematical computer representation of stiffness connections between node points (e.g., a beam).

Enthalpy

- Total energy content of a system.

Envelop

- The property of a function or set of numbers values whereby all values exceed the values of another function or set against which it is compared.

EOI

- Error and Open Item Report.

Error Report

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

  Each Error shall be classified as one of the following:

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

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

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

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

Field Verification

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

Finite Element Method

- Idealisation of a structure with representation of members and masses by nodes, beams, plates, etc.

FSAR

- PGandE's Final Safety Analysis Report.

IDVP

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

Interface

- Point of information transfer and communication between PGandE and their seismic service-related contractors.

Internal Technical Program

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

Interim Technical Report

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

Isometrics

- Refers to PGandE's Piping Walkdown Isometrics; PGandE's three-dimensional drawings of piping contained in Diablo Canyon Nuclear Power Plant, Unit 1.

Licensing Criteria

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

Load

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

Moment

- A rotational load about a point produced by applying a force at the end of a lever from that point.

Normal Conditions

- Those operating conditions in the course of system startup, operation, hot standby, refueling, and shutdown other than upset, emergency or faulted plant condition.

NRC

- Nuclear Regulatory Commission (formerly the AEC).

NRC Order Suspending License CLI-81-30

- The order dated November 19, 1981 that suspended the license to load fuel and operate DCNPP-1 at power levels up to 5% of full power. It also specified the programs that must be completed prior to lifting the suspension.

Open Item

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

Pacific Gas and Electric Company Internal Groups

- RLCA term to identify these PGandE groups/ departments: Civil Engineering, HVAC (Heating, Ventilation and Air Conditioning), Electrical Engineering, Site Electrical, Mechanical and Nuclear Engineering, Piping, Site Piping, Instrumentation and Control, Design Drafting Services, Department of Engineering Research (see Seismic Design Chain).

PGandE

- Pacific Gas and Electric Company.

PGandE Design Class 1

- PGandE engineering classification for structures, systems and components which corresponds to NRC Regulatory Guide 1.29 Seismic Category I classification.

PGandE Technical Program

- Verification program undertaken by PGandE to evaluate DCNPP for compliance with licensing criteria.

Phase II Program

- Work performed by RLCA, TES, Stone & Webster, and RFR; includes non-seismic-related contracts prior to June 1, 1978, PGandE internal design activities and all service-related contracts after January, 1978.

Plastic

- To undergo a permanent change in shape or size when subjected to a load or stress.

Potential Program Resolution Report and Potential Error Report

- Forms used for communication within the IDVP.

Program Resolution Report

- Used to indicate that the specific item is no longer active in the IDVP. It indicates whether the resolution is a Closed Item, a Deviation, or that responsibility for an Open Item has been transferred to the PGandE Technical Program. Further IDVP action is required upon completion of the associated PGandE Technical Program task if the IDVP transfers an Open Item to PGandE or if physical modifications are applied with respect to a Deviation.

Qualification

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

Response

- The motion resulting from an excitation of a device or system under specified conditions.

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Rod Beam

- A rupture restraint (energy absorber) which consists of 2 rods connected to a beam, with the beam being the point of contact of the broken pipe. Energy is absorbed through the plastic deformation of the rods after the pipe strikes the beam.

Rupture Restraint

- The energy absorbing device which is designed to bring to rest a broken high energy pipe. In this ITR, normally related to a U-bolt or rod beam.

Seismic

- Refers to earthquake data.

Seismic Load

- Load produced by an earthquake.

Service-Related Contractors

- Term to identify those PGandE contractors who performed service-related work prior to June, 1978.

Shear

- Parallel to the plane of reference.

Substructure -

- The structural framework to which a rupture restraint is attached.

Torsion

- The in-plane rotation of a point or body about an axis perpendicular to that plane.

Translation

- The linear movement of a point in space without any rotation.

U-Bolt

- A rupture restraint (energy absorber) which consists of a U-shaped rod which is placed around the high energy pipe. Energy is absorbed through the plastic deformation of the U-bolt after the pipe strikes the U-bolt.

Young's Modulus

- The material property characterizing the ratio of uniaxial stress with strain.

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Appendix D

Program Manager's Assessment

(1 page)

## APPENDIX D

## PROGRAM MANAGERS ASSESSMENT

As IDVP Program Manager, TELEDYNE ENGINEERING SERVICES (TES) has established a Review and Evaluation Team, headed by a qualified team leader, as described in Section 7.4 (C) of the Phase I Program Management Plan (Rev. 1). The assigned team for Rutpure Restraints, included in this Interim Technical Report, are in the process of reviewing the RLCA design review packages of selected DCP calculation files as well as the underlying DCP documents. The team leaders are discussing these items with RLCA personnel, as needed. In addition, the TES team leaders have reviewed the Open Item Files pertaining to their areas of responsibility and, in particular, those fields for which RLCA has issued Potential Program Resolution Reports or Potential Error Reports, and on the basis of this evaluation, has recommended appropriate resolution to the IDVP Program Manager.

Based on this review and evaluation process to date, the Team Leaders, along with the TES Program Management Team, have studied and have concurred with the conclusions outlined in Section 10.0 of this report .