PACIFIC GAS & ELECTRIC COMPANY

DIABLO CANYON NUCLEAR POWER PLANT

INDEPENDENT DESIGN VERIFICATION PROGRAM

INTERIM TECHNICAL REPORT NO. 14

REVISION 1

VERIFICATION OF THE PRESSURE, TEMPERATURE, HUMIDITY, AND SUBMERGENCE ENVIRONMENTS USED FOR SAFETY-RELATED EQUIPMENT SPECIFICATION OUTSIDE CONTAINMENT FOR AUXILIARY FEEDWATER SYSTEM AND CONTROL ROOM VENTILATION AND PRESSURIZATION SYSTEM

PERFORMED BY

STONE & WEBSTER ENGINEERING CORPORATION

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DIABLO CANYON NUCLEAR POWER PLANT - UNIT I

INDEPENDENT DESIGN VERIFICATION PROGRAM

INTERIM TECHNICAL REPORT

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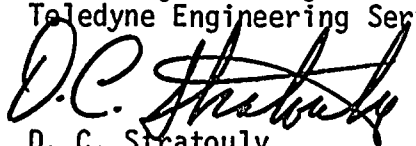
This is the revision 1 to the fourteenth of a series of Interim Technical Reports prepared by the DCNPP-IDVP for the purpose of providing a conclusion of the program.

This report provides the analytical results, recommendations and conclusions of the IDVP with respect to the initial sample.

As IDVP Program Manager, Teledyne Engineering Services has approved this ITR including the conclusions and recommendations. The methodology followed by TES in performing this review and evaluation is described by Appendix B to this report.

ITR Reviewed and Approved
IDVP Program Manager
Teledyne Engineering Services



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SECTION 1

INTRODUCTION

An Independent Design Verification Program (IDVP) review was performed which included samples of pressure, temperature, humidity, and submergence analyses performed by the Nuclear Services Corporation (NSC) for the Pacific Gas and Electric Company's (PG&E) Diablo Canyon Nuclear Power Plant Unit 1 (DCNPP-1). The review was performed in accordance with the Stone & Webster Engineering Corporation (SWEC) Scope of Work defined in Appendix D (DCNPP-IDVP-PP-002) of the IDVP Phase II Program Management Plan issued by Teledyne Engineering Services (TES) as IDVP Program Manager. The following sections of this Interim Technical Report (ITR) provide a description of the methods, results, and evaluations associated with this independent design verification.

SECTION 2

DEFINITION OF ITEMS REVIEWED

Pressure, temperature, humidity, and submergence environment calculations performed for PG&E by service-related contractors were reviewed. The review included environments calculated for the specification of safety-related equipment in the Auxiliary Feedwater (AFW) System and the Control Room Ventilation and Pressurization (CRVP) System. The review was restricted to two selected locations: one location associated with the AFW System and the other location associated with the CRVP System.

SECTION 3

DESCRIPTION OF REVIEW

3.1 REVIEW OF LICENSING DOCUMENTS

Licensing documents applicable to DCNPP-1 were reviewed to determine the relevant licensing commitments made by PG&E. The specific licensing commitments relating to the evaluation of environments associated with postulated pipe ruptures outside containment were identified.

The licensing commitments were then compared to the analyses which resulted in calculated temperature, pressure, humidity, and submergence environments for safety-related equipment specifications for the AFW System and CRVP System to verify conformance with the commitments.

3.2 REVIEW OF DESIGN CHAIN

ITR No. 29, entitled "Design Chain - Initial Sample" for the SWEC sample indicated that NSC was the only service-related contractor responsible for the development of the temperature, pressure, humidity, and submergence environments analyses outside containment for the safety-related equipment specification. NSC activities consisted of performing the calculations and writing the report which was the basis for the licensing submittal.

3.3 INDEPENDENT REVIEW OF SERVICE-RELATED CONTRACTOR ACTIVITIES

A review was performed of the NSC analyses, computer runs, and reports associated with the development of pressure, temperature, humidity, and submergence environments in areas GE and GW of the auxiliary building and in the turbine building. The following sections describe the review.

3.3.1 Items Reviewed

The following NSC reports and analyses were reviewed:

- Compartment Pressurization Analysis, 1-15-74, File No. 1.37.12, 33.5

- Long-Term Environment Analysis-Revised, 2-20-74, File No. 1.37.12, 33.421

- Environmental/Pressurization, Other High Energy Lines, 4-1-74, File No. 33.423

- Diablo Canyon Unit 1 Flooding Analysis, G Area and Auxiliary Building Revised, 6-9-76, File No. 33.440

- Thermal Hydraulic Analyses of Postulated Pipe Break Outside Containment at Diablo Canyon Unit 1, 6-26-74, Report PGE-01-27, Revision 1

- Evaluation for Effects of Postulated Pipe Breaks Outside Containment for Diablo Canyon Unit 1, 4-13-77, Report PGE-01-02, Revision 3

- Modified EOI File 8005 (Flooding) Response, 12-8-82, File No. PGE-0012.

The following computer program outputs were reviewed:

- CONTEMPT output, Title: Diablo Canyon Unit 1 - Area GW-Main Steam Break-St. Valve Failure, 5-2-74

- CONTEMPT output, Title: Diablo Canyon Unit 1 - Turbine - Main Steam Break - St. Valve Failure, 5-24-76

- CONTEMPT output, Title: Diablo Canyon Unit 1 - GE at 115' Elevation - Leakage from M.S. in GW Area, 4-29-74

- PRTHRUST output, Title: Diablo Canyon Long-Term Blowdown Analysis Steam Check Valve Failure.

Selected piping schematics, structural steel, piping and mechanical, equipment location, and concrete drawings, requested by and sent to SWEC by PG&E, were also reviewed in conjunction with the independent calculation of environments.

3.3.2 Description of Review

The items listed in the preceding Section 3.3.1 were reviewed for the following attributes:

- Correctness of selection and incorporation of design input into the analyses
- Reasonableness of assumptions used in calculations
- Correctness of design interface information used in analyses
- Adequacy of design or calculational method used
- Reasonableness of the output, compared to the inputs
- Identification of applicable regulatory requirements to be used as a basis of design, as committed to in the approved DCNPP-1 licensing documents

3.4 SENSITIVITY OF RESULTS TO DIFFERENT CALCULATIONAL METHODS

3.4.1 Computer Programs Compared

- CONTEMPT - A computer program for predicting the containment pressure and temperature response to a loss-of-coolant accident (LOCA), used by NSC for calculating pressure, temperature, and

humidity environments outside containment. The computer program was developed by Phillips Petroleum Company, Idaho Falls, Idaho. The CONTEMPT computer program models only one control volume and two leakage paths to the atmosphere.

- THREED - A SWEC proprietary computer program which was used to calculate the transient response pressure, temperature, and humidity in various subcompartments following a postulated rupture in a moderate or high energy pipeline. This computer program was derived from RELAP4 with the heat sinks developed from CONTEMPT-LT/026. THREED has the capability to model multiple nodes and vent paths. SWEC computer programs are documented in accordance with the requirements of the Stone & Webster Standard Nuclear Quality Assurance Program.

3.4.2 Sensitivity Calculation Method

A sensitivity study was performed to determine the difference in magnitude of pressure and temperature transient calculations which could be attributed solely to the use of different computer programs. The SWEC analysis, which used the computer program THREED, utilized, to the maximum extent possible, identical input data used by NSC in the computer program CONTEMPT. Input data for junction loss coefficients and inertia terms had to be developed from CONTEMPT nozzle approximations and design information, respectively. The comparison between the two computer programs was made using the NSC analysis (shown in Section 3.3.1) that considered a main steam line rupture

in area GW at elevation 115 feet-0 inch, assuming failure of the steam check valve to close.

3.5 INDEPENDENT CALCULATIONS

Independent calculations of the mass and energy release data as well as the pressure, temperature, and humidity transients were performed with THREED.

The pressure, temperature, and humidity environments were calculated at two locations: one associated with the AFW System and the other with the CRVP System. The purpose of the independent calculations was to verify the environments calculated by NSC and also to allow verification of assumptions and methods used by NSC in computation of the environments.

3.5.1 Mass and Energy Release Data

Independent calculations of the mass and energy release data resulting from main steam line ruptures in area GW at elevation 115 feet-0 inch and the turbine building at elevation 140 feet-0 inch were performed. The location of the pipe rupture in each area was taken from Appendix 3.6 of the Diablo Canyon Unit 1 Final Safety Analysis Report (FSAR). Main steam line ruptures were selected based on the following:

- A main steam line rupture in area GW at elevation 115 feet-0 inch was selected because it is a high energy line and will produce the most severe environments to which safety-related equipment in the

AFW System located in area GE at elevation 115 feet-0 inch is exposed.

- A main steam line rupture in the turbine building at elevation 140 feet-0 inch was selected because it is a high energy line and will produce the most severe environments to which safety-related equipment in the CRVP System in the turbine building at elevation 140 feet-0 inch is exposed.

Two break sizes were considered for calculation of the mass and energy release data, a main steam line double-ended rupture (DER) and a 0.908 foot^2 split rupture. The DER was selected because this break size results in the highest compartment pressure and temperature transients in the short term. An additional break, namely a split rupture, was selected because liquid entrainment will not occur and this break will result in a higher calculated equilibrium temperature environment. The split rupture was selected based on the SWEC evaluation of the statement in NUREG-0588, "The objective of this review is to provide reasonable assurance that the equipment can perform its intended function in the most limiting environment in which it is expected to function."

The mass and energy release data for these two specific breaks were calculated using two different methods: 1) The mass and energy release data for the DER were developed assuming a constant blowdown until steam generator dry-out occurred. The flow rate and enthalpy of this constant flow were established based on the initial plant operating conditions. 2) Westinghouse mass and energy release data provided by the DCP for a 0.908 foot^2

main steam line split rupture inside containment were conservatively modified for use outside containment. This modification consisted of utilizing the Westinghouse data for release rates from 0 to 94.5 seconds, as provided. The release rate was held constant from 94.5 seconds until 600 seconds when operator action was assumed to have isolated flow.

3.5.2 Area GE Environments

An independent calculation of the pressure and temperature transients in area GE at elevation 115 feet-0 inch of the auxiliary building was performed. This location was selected based on the following:

- Components of the AFW System are located in this area.
- Calculation of environments in area GE at elevation 115 feet-0 inch required the modeling of a blowout panel and the modeling of flow through louvers, flow through screens, and flow from adjacent compartments.
- Comparison can be made between the environments calculated by NSC and SWEC which resulted from a high energy line rupture.

A model was developed to calculate the environments in area GE due to a main steam line rupture in area GW at elevation 115 feet-0 inch. The piping and mechanical, equipment location, and concrete drawings were utilized to develop the model. The SWEC computer program THREED was used to calculate the pressure and temperature transients.

3.5.3 Turbine Building Environments

An independent calculation of the pressure and temperature transients in the turbine building at elevation 140 feet-0 inch was performed. This location was selected based on the following:

- A rupture of the main steam line in this area would result in environments to which safety-related equipment in the control room ventilation and pressurization system would be exposed.

- A comparison could be made between the pressure and temperature transients calculated by SWEC and NSC.

The independent model of the turbine building at elevation 140 feet-0 inch was developed using the piping and mechanical, equipment location, and concrete drawings. The temperature and pressure transients resulting from a main steam line rupture were calculated using the SWEC computer program THREED.

3.6 INDEPENDENT INSPECTION OF SITE GEOMETRY (SITE VISIT)

Verification that NSC and SWEC developed geometric models that adequately reflected the "as-built" conditions of the plant was accomplished by a site inspection of the areas of interest.

3.6.1 Areas Inspected

The areas inspected were the turbine building and areas GE and GW of the auxiliary building at all elevations.

3.6.2 Method of Inspection

The inspection consisted of a walkdown of the following systems:

- Auxiliary Feedwater System
- Control Room Ventilation and Pressurization System
- Main Steam System.

3.6.3 Observations

The walkdown verified the relative locations of the systems listed above and the locations of vent areas in compartment walls and floors in the areas through which these systems passed.

The calculation by SWEC of the vent area to the atmosphere from the turbine building was confirmed by observation of this vent area during the site inspection.

Differences were observed between the "as-built" geometries of areas GE and GW of the auxiliary building and the calculational inputs which were utilized by NSC. However, the differences would not significantly affect the pressure, temperature, humidity, and submergence environment results calculated in these areas.

SECTION 4

SUMMARY OF REVIEW RESULTS

4.1 RESULTS OF INDEPENDENT REVIEW OF SERVICE-RELATED CONTRACTOR ANALYSES

The results of the SWEC reviews of the analyses, computer program outputs, and reports described in Section 3.3.1, utilizing the methods described in Section 3.3.2, are summarized in the following sections.

4.1.1 Mass and Energy Release Data

The review of the mass and energy release data resulting from a main steam line rupture consisted of the following:

- A review of the mass and energy release data which was utilized as input into the CONTEMPT computer program for the calculation of pressure and temperature environments

- A review of the model developed by NSC to calculate the main steam line mass and energy release data.

The mass and energy release data, utilized to calculate the pressure and temperature transients in area GW and the turbine building, considered the effects of liquid entrainment in the break effluent. Liquid entrainment will lower the enthalpy values and the corresponding energy rates from the break. The effects of the lower effluent energy rates and the increased amounts of liquid in the atmosphere will lower the calculated temperature.

If entrainment effects in the break effluent are included, additional break sizes must be investigated to assure that the worst temperature environment has been calculated.

A review was also performed of the analysis which resulted in the long-term mass and energy release data due to a main steam line DER. Results of the review revealed that the methods utilized for modeling the steam generators will have the effect of overpredicting the level swell and the amount of liquid entrainment in the break effluent.

4.1.2 Area GE Environments

The review of the analysis and computer program outputs that developed the pressure and temperature transients in area GE at elevation 115 feet-0 inch due to a main steam line break in area GW at elevation 115 feet-0 inch resulted in the following:

- The enthalpy values were underpredicted for the energy flow from area GW at elevation 115 feet-0 inch into area GE at elevation 115 feet-0 inch following a main steam line break. The inflow and accumulation of air, that was calculated by CONTEMPT in area GW, lowers the value of the enthalpy that was developed and utilized as input into the area GE at elevation 115 feet-0 inch. Refer to Section 4.2 for additional discussion of the air inflow.

- The methods utilized to calculate the mass discharge data into area GE at elevation 115 feet-0 inch and the model developed to analyze the environments in area GE at elevation 115 feet-0 inch will underpredict the pressure and temperature transients, since the effects of adjacent compartments were neglected. The mass discharge data into area GE considered only flow from area GW at elevation 115 feet-0 inch and assumed all vents out of the GE area were exhausted to the outside atmosphere.

4.1.3 Turbine Building Environments

The ventilation fans for the CRVP System are located in the turbine building at elevation 140 feet-0 inch. This location, therefore, was selected for review of the pressure and temperature environments resulting from a main steam line rupture, to which the CRVP System is exposed.

Reviews were performed of the CONTEMPT computer program output that calculated the environments and the NSC report that summarized the results of the analysis.

The review of the input data utilized in CONTEMPT revealed that enthalpy values that were too low were used in the long term. Enthalpy values of 1130 Btu/lbm at 60 seconds increasing linearly to 1150 Btu/lbm at 2000 sec were used as input instead of the constant enthalpy value of 1200 Btu/lbm which was the value used in the auxiliary building.

4.1.4 Initial Temperature Conditions

The values of the initial temperatures used in areas GE, GW, the turbine building, and the atmosphere were 70°F. The 70°F initial temperature which is contained in Section 4.2 of Reference 3 to Appendix 3.6 of the FSAR is lower than the maximum temperatures specified in Chapter 9 of the DCNPP-1 FSAR for these areas.

The effect on the equilibrium temperature of initial temperatures is not significant in the area of the break. However, in areas away from the break, lower initial temperatures have an impact which results in calculation of lower equilibrium temperatures.

4.1.5 Submergence Analysis

A review of the submergence analysis in the areas GE and GW, due to a design basis break in the feedwater line, was conducted. The feedwater line break was selected because it is representative of other high energy lines and a rupture in this line could affect components in the AFW System. A review of the submergence analyses in other areas was not performed because the methods and assumptions utilized would be similar to those used in areas GE and GW, and components of the CRVP System are not affected by flooding due to pipe breaks.

The initial results of the submergence analysis review identified that the flood heights calculated in areas GE and GW may be too low because the maximum available water inventory was not considered. The inventory

available for release from the steam generator considered only the liquid mass above the feedwater sparger ring (inlet pipe); therefore, only approximately 25,000 lbm from the steam generator were considered for calculation of the maximum flood height. Also, the auxiliary feedwater flow out the ruptured pipe that occurs until isolation (approximately 10 minutes) was not considered.

A subsequent analysis was performed by NSC to detail the several conservative assumptions and methodology used in the original submergence analysis. This analysis was reviewed by SWEC with the conclusion that the initial NSC submergence analysis results in water release volumes and flooding heights that are conservative, even though the maximum available steam generator water inventory and AFW system flow rates were not considered.

4.2 RESULTS OF COMPUTER PROGRAM SENSITIVITY STUDY

The comparison between the temperature transients calculated in area GW, using the computer programs CONTEMPT and THREED, shows good agreement for the first 50 seconds. Both computer programs calculated an initial increase in temperatures to approximately 300°F followed by a decrease to approximately 215°F. After 50 seconds, the temperature transients vary significantly. The long-term temperature calculated by THREED increases and reaches an equilibrium value of 313°F, while the equilibrium temperature calculated by CONTEMPT decreases to 200°F. The difference between the long-term temperatures can be explained by the different vent models that were utilized to calculate flow to the atmosphere. The computer program

CONTEMPT utilizes a nozzle approximation without inertia effects, while the computer program THREED solves the momentum equation and considers fluid inertia effects.

As the compartment pressure approaches ambient, CONTEMPT calculates pressure oscillations that vary between atmospheric and subatmospheric. As a result, the direction of the vent flow also oscillates as the compartment pressure oscillates. In CONTEMPT, the direction of the vent flow is only a function of the presure gradient and changes directions instantaneously and unrealistically as the direction of the pressure gradient changes. The compartment flow direction oscillations that CONTEMPT calculates allow the unrealistic accumulation of air to occur inside the compartment. The inflow of 70°F air and the accumulation of the air reduces the compartment temperature calculated by CONTEMPT to a value which is too low.

4.3 RESULTS OF INDEPENDENT CALCULATION OF PRESSURE, TEMPERATURE, AND HUMIDITY

The results of the independent calculations of the pressure and temperature transients utilizing the methods described in Section 3.5 are as follows:

4.3.1 Area GE Environments

The pressure, temperature, and humidity transients in area GE at elevation 115 feet-0 inch due to a main steam line rupture in area GW at elevation 115 feet-0 inch were calculated. The following three cases were analyzed:

- Case 1: A DER using the SWEC calculated mass and energy release data with the initial temperature values equal to the values used in the NSC analysis (Section 4.2 of Reference 3 to Appendix 3.6 of the DCNPP-1 FSAR).

- Case 2: A DER using the SWEC calculated mass and energy release data with the initial temperature values equal to the values specified in Chapter 9 of the DCNPP-1 FSAR.

- Case 3: A 0.908 foot^2 split rupture using SWEC modified Westinghouse mass and energy release data with the initial temperature values equal to the values specified in Chapter 9 of DCNPP-1 FSAR.

The equilibrium temperature and peak pressure calculated for each case by SWEC along with the temperature and pressure calculated by NSC are presented in Table 4-1. This table indicates that the NSC results are lower.

The relative humidity specified for equipment qualification by NSC was 100 percent which would bound the resulting relative humidity of all high energy line breaks.

4.3.2 Turbine Building Environments

The pressure, temperature, and humidity transients due to a main steam line rupture were calculated in the turbine building at elevation 140 feet-0 inch. The following three cases were analyzed:

- Case 1: A DER using the SWEC calculated mass and energy release data with the initial temperature values equal to the values used in the NSC analysis (Section 4.2 of Reference 3 to Appendix 3.6 of the DCNPP-1 FSAR).

- Case 2: A DER using the SWEC calculated mass and energy release data with the initial temperature values equal to the values specified in Chapter 9 of the DCNPP-1 FSAR.

- Case 3: A 0.908 foot^2 split rupture using SWEC modified Westinghouse mass and energy release data with the initial temperature values equal to the values specified in Chapter 9 of the DCNPP-1 FSAR.

The equilibrium temperature and the peak pressure calculated for each case by SWEC along with the temperature and pressure calculated by NSC are presented in Table 4-2. This table indicates that the NSC temperature results are lower.

The relative humidity specified for equipment qualification by NSC was 100 percent which would bound the resulting relative humidity of all high energy line breaks (HELBs).

TABLE 4-1

RESULTS OF INDEPENDENT CALCULATION OF ENVIRONMENTS
FOR AREA GE ELEVATION 115 FEET-0 INCH

	Peak Pressure (psia)	Equilibrium Temperature (°F)
SWEC Case 1 - Initial conditions sensitivity case	20.7	295
SWEC Case 2 - Initial conditions sensitivity case	20.6	297
SWEC Case 3 - Equilibrium temperature case	15.3	321
NSC Documented Results	16.8	212

TABLE 4-2

RESULTS OF INDEPENDENT CALCULATION OF ENVIRONMENTS FOR TURBINE BUILDING ELEVATION 140 FEET-0 INCH

	Peak Pressure (psia)	Equilibrium Temperature (°F)
SWEC Case 1 - Initial conditions sensitivity case	15.3	181
SWEC Case 2 - Initial conditions sensitivity case	15.2	204
SWEC Case 3 - Equilibrium temperature case	14.8	278
NSC Documented Results	14.8	165

SECTION 5

EOI REPORTS ISSUED

Nine EOI files were issued as a result of the verification of the pressure, temperature, humidity, and submergence environments used for safety-related equipment specification outside containment for the AFW System and the CRVP System. The status of these files is summarized in Appendix A. The resolution of these files is discussed in this section.

EOI File 8001 was issued because of the inappropriate application by NSC of the computer program CONTEMPT for calculation of environmental conditions outside the containment for equipment specification. PG&E has committed to perform a reanalysis of the pressure and temperature transients for HELBs outside containment using a multi-node computer program which is appropriate for this type of analysis. This file is presently an Error Class A or Error Class B.

EOI File 8002 was issued because the method used by NSC (effect of liquid entrainment included without additional breaks considered) in calculating mass and energy release data for determination of environments outside the containment results in temperatures which are lower than those which would be calculated if split ruptures without liquid entrainment were considered. This method was not considered adequate based on the IDVP interpretation of the NUREG-0588 statement concerning "most limiting environment."

However, the following clarification of the DCNPP-1 licensing commitment was provided by PG&E.

"At the time of the original analysis, all NRC required break sizes were considered. Subsequently, in NUREG 0588 the NRC recommended, but did not require, consideration of additional break sizes. PG&E's response to this recommendation is found on page IV-16 of a letter dated 9-2-81 from Crane (PG&E) to Miraglia (NRC). The response, in essence, states that break sizes were chosen in conformance with the acceptance criteria at the time of the analysis."

Based on the above response, this file has been closed.

EOI File 8003 was issued because the value of the enthalpy used by NSC for calculating the temperature environment in the turbine building was too low.

The response by PG&E stated that appropriately chosen values of enthalpy will be used in the reanalysis in response to EOI File 8001. The concern described in this EOI file will be addressed in the review of the re-analysis. This file has been closed.

EOI File 8004 was issued because the maximum initial temperatures identified in Section 4.2 of Reference 3 to Appendix 3.6 of the FSAR and used by NSC for calculating temperature environments in the areas GE, GW, and turbine building were lower than the ones specified in Chapter 9 of the DCNPP-1 FSAR. However, the DCNPP-1 licensing commitment was clarified by PG&E to indicate the initial conditions assumed in the analysis are the ones specified in Section 4.2 of Reference 3 to Appendix 3.6 of the DCNPP-1 FSAR. This file has been closed.

EOI File 8005 was issued because flooding heights for safety-related equipment may have been too low due to neglected water volumes in the NSC calculation. Based on the response provided by PG&E, this file has been closed.

EOI File 8006 was issued because documentation necessary to verify analysis methods and inputs, such as the vent area in the turbine building, could not be provided. The response by PG&E stated that a complete reanalysis of the turbine building is now being performed in response to EOI File 8001. The concern of this EOI file will be addressed in the review of the reanalysis. This file has been closed.

EOI File 8033 was issued because it was determined that NSC used an inappropriate method to model the steam generator for calculation of the mass and energy release data. The responses by PG&E stated that the entire analyses are being redone in response to EOI 8001 and that Westinghouse blowdown data will be used in the reanalyses. The concern described in this EOI file will be addressed in the review of the reanalysis. This file has been closed.

EOI File 8034 was issued because the methods used by NSC to calculate the pressure and temperature transients in the area GE did not consider the effects of adjacent compartments. This resulted in the calculation of low values for equilibrium temperature and peak pressure. The concerns of this EOI will be addressed by the PG&E reanalysis committed to as a result of EOI File 8001. This file has been closed.

EOI File 8040 was issued because the water inventory, calculated by NSC as available for flooding, neglected some sources of water volume available. Based on the response provided by PG&E, it was concluded that the assumptions used in the original analysis will result in flooding heights that are conservative. This file has been closed.

SECTION 6

EVALUATION OF RESULTS

6.1 MASS AND ENERGY RELEASE DATA

The mass and energy release data, calculated by NSC and utilized for developing the environments in the turbine building and areas GE and GW of the auxiliary building, included liquid entrainment. The resulting temperature transients calculated were not the worst environments which can be postulated.

6.2 COMPUTER PROGRAM, CONTEMPT

The use of the computer program CONTEMPT for calculation of the pressure and temperature transients in areas outside containment is not appropriate and will yield results which are too low. This is due to the vent model utilized and the inability to model adjacent compartments and their venting effect on the equilibrium temperature. Additional investigation by SWEC concluded that a later version of CONTEMPT (i.e., CONTEMPT-LT/026) will also exhibit the behavior described in Section 4.2 when used in a manner similar to the NSC analyses.

6.3 AREA GE ENVIRONMENTS

The temperature and pressure transient results calculated by NSC were too low due to the following:

- The use of liquid entrainment by NSC in the mass and energy release data.

- The use of the computer program CONTEMPT by NSC to calculate the environments in area GE.

- The effects of adjacent compartments on the environments calculated in area GE were neglected by NSC.

The review of the pressure and temperature environments in area GE at elevation 115 feet-0 inch calculated by NSC indicated that both these results were too low. The use of these environments for equipment qualification for the AFW System resulted in the specification of temperature and pressure environments that were not the worst case which can be postulated to occur.

The higher peak pressure (20.7 psia) calculated by SWEC in area GE due to a main steam line DER in area GW may also affect the environments in the fuel handling building. The door between the two areas, which was assumed closed, will experience a pressure which exceeds its design value of approximately 2 psid and will allow venting into the fuel building.

Additional doors which were assumed closed are located in area GE at elevations 115 feet-0 inch, 100 feet-0 inch, and 85 feet-0 inch. The higher calculated pressure in these areas, due to a main steam line DER in area GW, may exceed the design value for these doors and allow venting into areas which were assumed isolated from the main steam line rupture environments.

6.4 TURBINE BUILDING ENVIRONMENTS

Reviews of the analyses performed by NSC, as well as the independent calculation of the temperature environments in the turbine building, at elevation 140 foot-0 inch, performed by SWEC, indicated that the temperature transient calculated by NSC was too low. The temperature results calculated by NSC were too low due to the following:

- The use of liquid entrainment by NSC in the mass of the energy release data

- The use of the computer program CONTEMPT by NSC to calculate the environments

- The incorrect values of enthalpy were utilized by NSC as input into the computer program CONTEMPT.

The results of the detailed review of the environments calculated by NSC have identified that the temperature environment specified for equipment qualification of the CRVP System was not the worst temperature transient which can be postulated to occur.

6.5 SUBMERGENCE ANALYSIS

The review of both the initial submergence calculations and summary contained in the DCNPP-1 FSAR, as well as the flooding analysis verification

calculation, provided by PG&E in response to EOI Files 8005 and 8040 indicated that the assumptions used in the original analysis will result in overprediction of the water release volumes and flooding heights.

SECTION 7

CONCLUSIONS

The review of the pressure, temperature, humidity, and submergence analyses has been completed. The corresponding EOI files described in Section 5 were issued. A discussion of errors and an evaluation of their significance are summarized in Sections 4 and 6, respectively.

The analyses which addressed the consequences of the postulated ruptures in high energy lines outside containment at DCNPP-1 were performed by NSC in 1974 in accordance with existing NRC guidelines. However, additional guidelines and clarification were issued later by the NRC as IE Bulletins (e.g., 79-01B) and as NUREG-0588. PG&E was required by the NRC (letter from J. F. Stolz to J. C. Morrissey, dated March 3, 1980) to perform a review of the environmental qualification program and to respond to the NRC with an identification of the degree of compliance with NUREG-0588.

The PG&E response is contained in the Environmental Qualification Report, dated September 1981, which identifies the degree of compliance with NUREG-0588 on a point-by-point basis.

The IDVP has concluded that PG&E has met the DCNPP-1 licensing commitment as specified in the FSAR and the Equipment Qualification Report.

However, the results in Section 4 and the evaluation in Section 6 demonstrate that the pressures and temperatures used for equipment qualification specifications are too low and do not "...provide reasonable assurance that

the equipment can perform its intended function in the most limiting environment in which it is expected to function" as stated in NUREG-0588.

The fundamental error associated with the inapplicability of the CONTEMPT computer program used by NSC and other identified NSC analytical errors form the basis for this conclusion; therefore, the NSC analyses which address the pressure and temperature consequences of pipe ruptures outside containment will be recalculated by PG&E. This reanalysis is necessary to provide environmental conditions for specification of safety-related equipment. This reanalysis requires additional verification by the IDVP which is described in ITR No. 34.

All the files opened as a result of this IDVP verification, with the exception of File 8001, have been closed.

EOI File 8001 will remain open until the reanalysis effort is completed and will be classified as an Error Class A or Error Class B when it is determined if modifications will be required. The results of the IDVP verification of this reanalysis will be reported in an ITR.

The results in Section 4 and the evaluation in Section 6 demonstrate that the submergence analysis performed by NSC resulted in flooding heights which are considered adequate for the specification of safety-related equipment.

The relative humidity specified for equipment qualification by NSC in the Environmental Qualification Report was 100 percent. When this value is used, it would bound the resulting relative humidity of all postulated pipe ruptures; therefore, no additional verification by the IDVP is required for humidity and submergence parameters used in equipment qualification.

APPENDIX A

EOI FILES

APPENDIX A

DCNPP IDVP STATUS REPORT

FILE NO.	REV. 0 DATE	REV. 0 REV.	LATEST REV. DATE	LATEST REV. BY	LATEST REV. STATUS	SUBJECT
8001	820909	0	820909	SWEC	OIR	EVALUATION OF ENVIRONMENT IN COMPARTMENT GW
8001	820909	1	820909	SWEC	PER/AB	EVALUATION OF ENVIRONMENT IN COMPARTMENT GW
8001	820909	2	821004	TES	ER/AB	EVALUATION OF ENVIRONMENT IN COMPARTMENT GW
8001	820909	3	830225	TES	ER/AB	REEVALUATION OF ENVIRONMENT OUTSIDE CONTAINMENT
8002	820909	0	820909	SWEC	OIR	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	1	821001	SWEC	PER/AB	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	2	821018	TES	ER/AB	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	3	821029	TES	OIR	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	4	821116	SWEC	PER/AB	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	5	821119	TES	ER/AB	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	6	830124	TES	OIR	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	7	830131	SWEC	PPRR/CI	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	8	830210	TES	PRR/CI	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	9	830210	TES	CR	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	10	830225	TES	OIR	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	11	830225	TES	PRR/OIP	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	12	830225	TES	PRR/CI	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8002	820909	13	830225	TES	CR	NONCONSERVATIVE CALCULATION OF MASS/ENERGY RELEASE
8003	820909	0	820909	SWEC	OIR	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	1	821001	SWEC	PER/AB	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	2	821018	TES	ER/AB	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	3	821029	TES	OIR	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	4	821116	SWEC	PER/AB	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	5	821118	TES	ER/AB	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	6	830210	TES	OIR	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	7	830217	SWEC	PER/C	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	8	830222	TES	ER/C	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8003	820909	9	830222	TES	CR	EVALUATION OF ENVIRONMENT IN TURBINE BUILDING
8004	820909	0	820909	SWEC	OIR	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	1	821001	SWEC	PER/AB	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	2	821018	TES	ER/AB	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	3	821029	TES	OIR	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	4	821116	SWEC	PER/AB	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	5	821119	TES	ER/AB	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	6	830124	TES	OIR	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	7	830131	SWEC	PPRR/CI	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	8	830210	TES	PRR/CI	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	9	830210	TES	CR	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	10	830225	TES	OIR	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	11	830225	TES	PRR/OIP	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	12	830225	TES	PRR/CI	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8004	820909	13	830225	TES	CR	EVALUATION OF ASSUMED INITIAL TEMP. IN GE/GW
8005	820909	0	820909	SWEC	OIR	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	1	821001	SWEC	PPRR/OIP	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	2	821022	SWEC	PPRR/OIP	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	3	821028	TES	PRR/OIP	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	4	821029	TES	OIR	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	5	821116	SWEC	PPRR/OIP	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	6	821118	TES	PRR/OIP	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	7	830131	TES	OIR	EVALUATION OF EFFECT OF WATER INVENTORY IN GW

DCNPP IDVP STATUS REPORT

	REV. 0		LATEST REV.			
FILE NO.	DATE	REV.	DATE	BY	STATUS	SUBJECT
8005	820909	8	830210	SWEC	PPRR/CI	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	9	830210	TES	PRR/CI	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8005	820909	10	830210	TES	CR	EVALUATION OF EFFECT OF WATER INVENTORY IN GW
8006	820909	0	820909	SWEC	OIR	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	1	821001	SWEC	PPRR/OIP	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	2	821018	TES	PRR/OIP	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	3	821029	TES	OIR	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	4	821116	SWEC	PPRR/OIP	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	5	821118	TES	PRR/OIP	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	6	830111	TES	OIR	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	7	830118	SWEC	PPRR/CI	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	8	830124	TES	PRR/CI	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8006	820909	9	830124	TES	CR	LACK OF REFERENCE MATERIAL TO EVALUATE ENVIRONMENT
8033	821014	0	821014	SWEC	OIR	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8033	821014	1	821028	SWEC	PER/B	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8033	821014	2	821104	TES	ER/B	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8033	821014	3	830210	TES	OIR	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8033	821014	4	830217	SWEC	PER/C	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8033	821014	5	830225	TES	ER/C	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8033	821014	6	830225	TES	CR	AFW & CRVP EQUIPMENT OUTSIDE CONTAINMENT
8034	821014	0	821014	SWEC	OIR	AFW SYSTEM EQUIPMENT
8034	821014	1	821028	SWEC	PER/AB	AFW SYSTEM EQUIPMENT
8034	821014	2	821104	TES	ER/B	AFW SYSTEM EQUIPMENT
8034	821014	3	830131	TES	OIR	AFW SYSTEM EQUIPMENT
8034	821014	4	830210	SWEC	PPRR/CI	AFW SYSTEM EQUIPMENT
8034	821014	5	830216	TES	OIR	AFW SYSTEM EQUIPMENT
8034	821014	6	830218	SWEC	PER/C	AFW SYSTEM EQUIPMENT
8034	821014	7	830225	TES	ER/C	AFW SYSTEM EQUIPMENT
8034	821014	8	830225	TES	CR	AFW SYSTEM EQUIPMENT
8040	821022	0	821022	SWEC	OIR	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	1	821028	SWEC	PER/B	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	2	821030	TES	ER/B	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	3	830131	TES	OIR	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	4	830210	SWEC	PPRR/CI	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	5	830217	TES	OIR	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	6	830218	SWEC	PER/C	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	7	830222	TES	ER/C	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.
8040	821022	8	830222	TES	CR	S-R EQUIP./FLOOD LEVELS OUTSIDE CONTAINMENT.

APPENDIX B

PROGRAM MANAGER'S ASSESSMENT

Independent review by TES of the tasks performed by SWEC to verify the environmental parameters outside containment was done in accordance with IDVP Phase II Program Management Plan, dated June 18, 1982, and the Engineering Procedure EP-1-014.

The review included several visits to the site and to the SWEC offices for detailed discussion and review, with SWEC personnel, of the work performed by SWEC including the methodology used in the evaluation of the environmental parameters outside containment, and criteria used with specific reference to the SWEC analysis, calculations, comparisons, etc.

The EOI files issued by SWEC were reviewed thoroughly and specific recommendations were made to the IDVP Manager delineating appropriate resolution.

As a result of the verification of the initial sampling selected by SWEC and the assessment of the impact of SWEC findings, TES, as Program Manager, is of the opinion that the temperature and pressure environments outside containment for safety-related equipment require additional verification.