AREVA

CALCULATION SUMMARY SHEET (CSS)

Document No. 32 - 9219780 - 002 Safety Related: ☒ Yes ☐ No

Title Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Structural Analysis – Non Proprietary

PURPOSE AND SUMMARY OF RESULTS:

PURPOSE:

The purpose of this calculation is to qualify the Diablo Canyon Unit 2 safety/relief nozzle weld overlay design to the requirements specified in Reference [5].

The purpose of Revision 001 is to revise proprietary markings.

The purpose of Revision 002 is to revise proprietary markings.

SUMMARY OF RESULTS:

The calculation demonstrate that the design of the Pressurizer safety/relief nozzle weld overlay for the Diablo Canyon Unit 2 meets the stress and fatigue requirements of the Design Code (Reference [3]).

Based on the loads and cycles specified in References [6] and [8], the conservative fatigue analysis indicates that Pressurizer safety/relief nozzle weld overlay design has the maximum usage factor of **[ ]** for specified number of cycles per Reference [6] compared to the ASME Code allowed maximum value of 1.0.

This document is the Non-Proprietary version of 32-9049114-005.

Proprietary information is contained within bold square brackets "[ ]".

Westinghouse proprietary information is contained within blue boxes.

*The 108 pages include pages 1, 1A, 2 through 4, 4A, 5 through 106.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV
ANSYS 11.0 (Rev. 000)	
ANSYS 14.0 (Rev. 002)	

THE DOCUMENT CONTAINS ASSUMPTIONS THAT SHALL BE VERIFIED PRIOR TO USE

☐ YES
☒ NO

Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Structural Analysis – Non Proprietary

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☐ Alternate Calculation

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	All	Non-proprietary document for 32-9049114-003
001	CSS, page 1	Updated the purpose and summary.
	Page 7	Deleted revision specific purposes
	Throughout	Proprietary markings of material names removed.
	Appendix C	Proprietary markings on schematic plots of indications removed.
		Non-proprietary document for 32-9049114-004
	Throughout	Added Westinghouse proprietary indicators.
005	Throughout	Updated proprietary markings
		Non-proprietary document for 32-9049114-005

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1 PURPOSE

It is well recognized that the Alloy 600/82/182 dissimilar metal welds (DMW) are susceptible to the primary water stress corrosion cracking (PWSCC), especially those in high temperature components such as pressurizer nozzles. Pacific Gas and Electric (PG&E) plans to mitigate the pressurizer nozzle Alloy 82/182 dissimilar metal welds (DMW) with structural weld overlays (SWOL) for the Diablo Canyon Unit 2 during the spring 2008 refueling outage for Unit 2.

Since the three safety nozzles have the same dimensions with the relief nozzle (Reference [1]), only one design is created based on the minimum weld overlay design (Reference [11]); the results also bounded maximum weld overlay design (Reference [11]). Detailed sizing calculation of the weld overlay has been documented in Reference [2] for the safety and relief nozzles.

The pressurizer safety/relief nozzles are located on the upper head of the pressurizer. The weld overlay is designed to cover both the Alloy 82/182 DMW and the austenitic stainless weld between the safe end and nozzle or piping. Application of weld overlays alters the local stress distribution. A detailed finite element analysis (FEA) is therefore conducted to investigate stress conditions under various operational transients. The results are summarized in this report to certify that criteria per ASME Code Section III for Class 1 components, Reference [3], are satisfied for the pressurizer safety/relief nozzle with weld overlays.

The analysis is focused on the overlaid region for requirements on both stress distribution and fatigue failure criterion. The main scope of the analysis includes the piping, stainless steel weld between the safe end and piping, safe end, DMW between the safe end and nozzle, safety/relief nozzle and SWOL. In addition, post-processing of thermal and structural results is performed to provide data for fracture analysis of the safety/relief nozzle (see Appendix A).

It should be noted that the original safety/relief nozzle configuration without the weld overlay is not analyzed in this calculation. The application of the SWOL will increase the secondary stress due to thermal gradients and added discontinuities at the SWOL to pipe, and SWOL to nozzle junctures. The cumulative fatigue usage factors calculated in this document assume the safety/relief nozzle SWOL has been in place since the plant conception. Therefore, the usage factors calculated will be higher than the actual usage factors based on summing safety/relief nozzle's usage prior to SWOL and usage with the SWOL.

The purpose of this calculation is to qualify the weld overlay design to the requirement specified in Reference [8]. The design is qualified to meet the criteria and fatigue requirements of the Reference [3].

2 ANALYTICAL METHODOLOGY

The general methodology of the stress analysis consists of:

1) Only the minimum SWOL will be modeled and evaluated. Based on past experience, the stresses due to transients had minor differences between the maximum SWOL and minimum SWOL, and the minimum SWOL stresses due to external loads control over the maximum SWOL. Therefore, it is reasonable to evaluate the minimum SWOL only.
2) Building 2-D models of the safety/relief nozzle minimum weld overlay and adjacent part of the pressurizer upper head. The model incorporates the geometry (of the adjacent upper head, nozzle, safe end, welds, weld overlay, pipe) of the pressurizer safety/relief nozzle (Reference [1] & [11]), appropriate materials and boundary conditions. The 2-D model is converted into a 2-D finite element model with axisymmetric elements that treat the 2-D model as if it were rotated 360° around the center axis. There are two finite element models consisting of thermal and structural elements, respectively so as to enable the thermal and structural analysis using ANSYS 11.0 (Reference [4])
3) Applying the design conditions of the pressure and temperature to the structural finite element model and obtaining the deformation and stresses in the model. The deformation field is used to verify the correct behavior of the model and correct modeling of the boundary and load conditions.
4) Applying the thermal loads pertaining to the service level transients (in the form of transient temperatures and corresponding heat transfer coefficients versus time). Each of the major service level transients requires a separate run on the thermal finite element model.
5) Reviewing the results of the thermal analysis by examining the magnitude of temperature difference between key locations of the model. The time points of the maximum temperature gradient are those at which the maximum thermal stresses develop.
6) Applying the corresponding mechanical (pressure) and thermal (nodal temperature) loads at each time point identified in step 4 to the structural finite element model. Since the weld overlay configuration contains layers of different materials having different coefficient of expansion, it is possible that one material is in compression and another is in tension due to thermal expansion. The standard method in defining a path is to go from a free surface to a free surface. However, using this method and applying the mathematical equations that ANSYS uses to find the membrane and membrane + bending stresses, may average the stresses at the boundary of the two materials. Since there is no guidance on how to evaluate sections with multiple materials, in addition to the free surface to free surface path, two partial paths (one in each material) are generated at the same location. These paths will be used to check the 3Sm criteria and to obtain the maximum Ke factor. It is recognized that no continuous and progressive displacement can occur in one of the materials without the other material restraining that displacement. Therefore this approach is very conservative.
7) Hand calculating the effects due to nozzle external loads and adding the resulting stresses to the stress results due to pressure and temperature effect.
8) Comparing the results to the ASME Code criteria for acceptability.
9) Documenting stresses and temperatures for the fracture mechanics analysis of the safety/relief nozzle weld overlay design.

3 KEY ASSUMPTIONS

There are no major assumptions for this calculation. Minor assumptions are noted where applicable.

4 DESIGN INPUT

4.1 Geometry

[ ]

Two weld overlay configurations are provided for the safety/relief nozzles (Reference [11]) in terms of the overlay size – the minimum and maximum weld overlay. The minimum weld overlay has a thickness of [ ] measured from the nozzle end outside surface, at the Alloy 82/182 DM weld and is tapered on to the pipe covering the weld at the safe end-pipe connection.

4.2 Finite Element Model

One finite element models is built based on the minimum weld overlay design. Model is developed with ANSYS 11.0 (Reference [4]) and documented in the following computer file:

DC2_geo.out

The 2-D model is meshed with the 8-node PLANE183 elements in the structural analysis and all elements are replaced by the equivalent thermal elements PLANE77 in the thermal analysis. The meshed model is shown in Figure 1 and Figure 2.

Finite element model is built with the liner attached to the inside surface of the nozzle. Where in the field the liner is inserted inside of the nozzle and welded at the ends. To study the effect of this discrepancy at the same analysis, the influence is negligible without any effect on final results.

The largest contribution to the stresses is due to a thermal effect. The interface between the inserted liner and the nozzle is considered to have a higher thermal conduction resistance than the fused cladding (modeled configuration). This resistance could be significantly increased during a cool down transient when a separation of the liner and the nozzle could occur, decreasing thermal stresses. A sensitivity study was performed on similar nozzle to simulate the effect on stresses due to heat transfer reduction during the liner separation. The sensitivity study concluded that the fused or inserted liners produced similar stresses (± 2 % difference which is negligible for this type of nozzle).

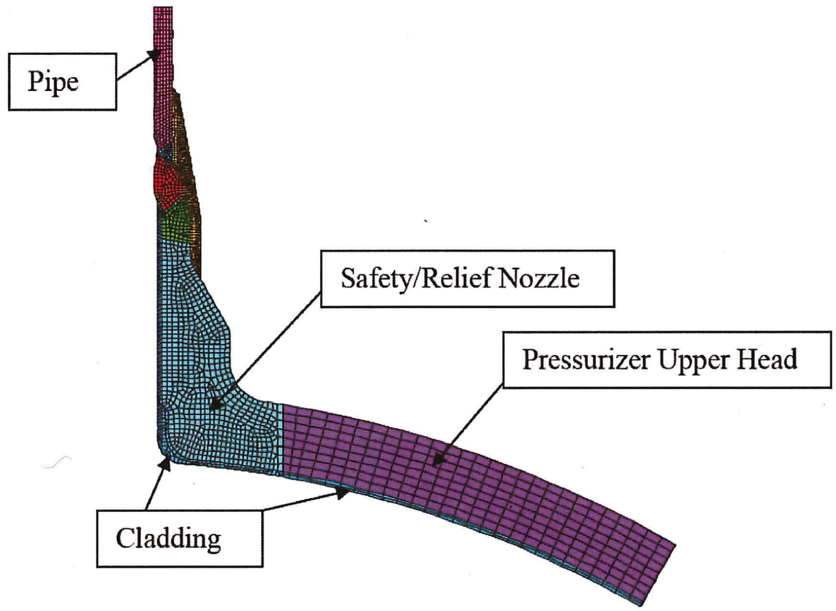


Figure 1 Finite Element Model

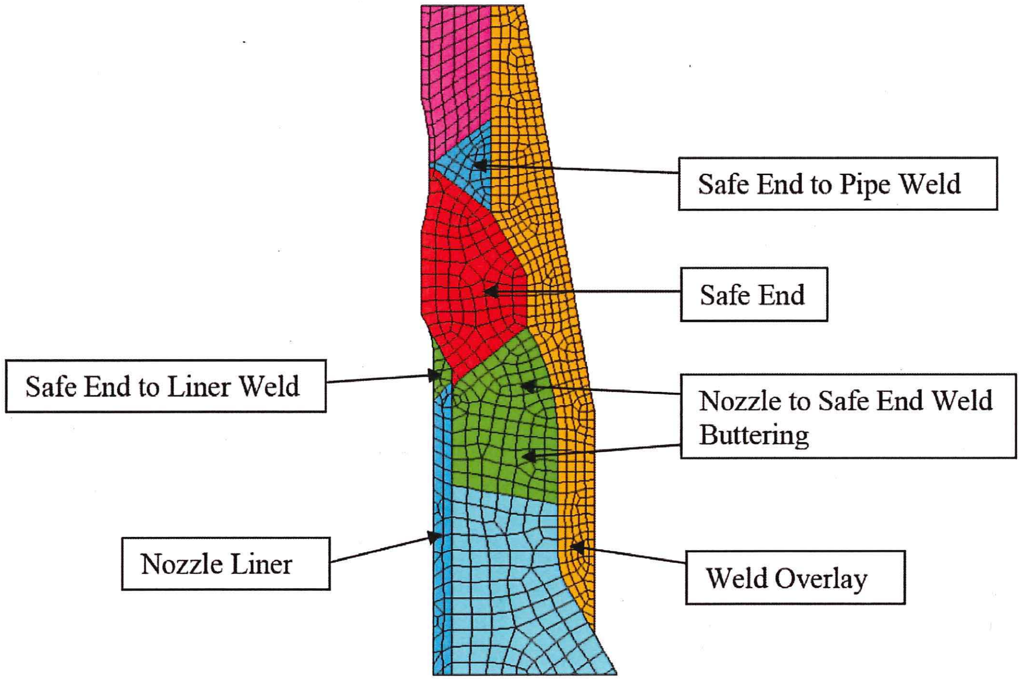


Figure 2 Finite Element Model Details of Buttering, Nozzle to Safe End Weld, Safe End, Safe End to Pipe Weld and Weld Overlay)

4.3 Materials

Reference [5] provides the material designations and properties of the various components. Per the same reference, the material properties for the structural analysis shall be in accordance with ASME Code 1965 Edition including Addenda through Summer 1966 (Reference [12]) for existing material and ASME Code 2001 Edition including Addenda through 2003 (Reference [3]) for weld filler material. Since not all materials and material properties for existing components are provided by Reference [12], later Addenda or Editions of the ASME Code (Reference [13], Reference [14], and Reference [15]) were used to determine the remaining material properties.

Pressurizer Upper Head	- SA-533, Grade A, Class 2
Safety/Relief Nozzle	- SA-508, Class 2
Safe End	- SA-182, F316L
Nozzle to Safe End Weld	- Alloy 82 and 182 equivalent to Alloy 600 (SB-166)
Buttering Weld	- Alloy 82 and 182 equivalent to Alloy 600 (SB-166)
Pipe	- SA-376, TP 316
Safe End to Pipe Weld	- SA-213, TP304 (1)
Cladding	- SA-213, TP 304 (1)
Nozzle Liner	- SA-213, TP 304
Safe End to Liner Weld	- Alloy 82 equivalent to alloy 600 (SB-166)
Weld Overlay (2)	- Alloy 52M equivalent to Alloy 690 (SB-166)

Note (1): Per Ref. [5] par. 4.1.5 and 4.1.7 specifies that the cladding material properties should be equivalent to ER309 weld filler material and the existing pipe to safe end weld is E308 austenitic stainless steel. These materials are used for welding components with similar chemical composition such as Type 304 (18Cr-8Ni) material. Therefore material SA-213, TP304 is considered representative of these materials.

Note (2): Per Ref. [5] par. 4.2.2 specifies material (Alloy 82 and ER309L) for the "Barrier Layer." This very thin layer (0.065in., Reference [11]) is not modeled in detail in this analysis and is covered by the weld overlay filler material. The effect on the results is negligible.

The analysis herein uses the thermal properties – mean coefficient of thermal expansion (α), specific heat (C), thermal conductivity (k) and the mechanical properties – modulus of elasticity (E), Poisson's ratio (μ), density (ρ). These pertinent properties (thermal & structural) for the materials are listed in the following tables.

Young's Modulus	E	[10^6 psi]
Poisson's Ratio	μ	[-]
Density	ρ	[lb/in3]
Coefficient of Thermal Expansion	α	[10^{-6} in/in-°F]
Thermal Conductivity	k	[Btu/hr-in-°F]
Specific Heat	C	[Btu/lb-°F]
Design Stress Intensity	S_m	[ksi]
Yield Strength	S_y	[ksi]
Tensile Strength	S_u	[ksi]

(C is a calculated value: C = k/(ρ * thermal diffusivity) where thermal diffusivity is taken from the same source as "k")

Note: Values for Coefficient of Thermal Expansion in Table 1 through Table 6 were taken from Reference [13] (ASME Code, 1965 Edition including Addenda through Winter 1967) instead of the main source of the material properties – Reference [12] (ASME Code, 1965 Edition including Addenda through Summer 1966). The small negligible differences have no effect on the results in the documented analysis.

Table 1 Pressurizer Upper Head Material Properties

SA-533, Grade A, Class 2 (C,Mn,Mo)									
Temp	E	μ	ρ	α	k	C	Sm	Sy	Su
Reference	[12]	typical	[16]	[13]	[15]	calculated	[14]	[14]	[14]

Table 2 Safety/Relief Nozzle Material Properties

SA-508, Class 2 (C,1/2Mo,Cr,Ni)									
Temp	**E**	**μ**	**ρ**	**α**	**k**	**C**	**Sm**	**Sy**	**Su**
Reference	[12]	typical	[16]	[13]	[15]	calculated	[13]	[13]	[13]

Table 3 Safe End Material Properties

SA-182, F316L (17Cr-12Ni-2Mo)									
Temp	**E**	**μ**	**ρ**	**α**	**k**	**C**	**Sm**	**Sy**	**Su**
Reference	[12]	typical	[16]	[13]	[15]	calculated	[12]	[12]	[12]

Table 4 Safe End to Liner Weld, Nozzle to Safe End Weld and Buttering Material Properties

Alloy 600, SB-166 (Ni-Cr-Fe)									
Temp	**E**	**μ**	**ρ**	**α**	**k**	**C**	**Sm**	**Sy**	**Su**
Reference	[12]	typical	[16]	[13]	[15]	calculated	[13]	[13]	[13]

Table 5 Safe End to Pipe Weld, Cladding and Liner Material Properties

SA-213, TP304 (18Cr-8Ni)									
Temp	E	μ	ρ	α	k	C	Sm	Sy	Su
Reference	[12]	typical	[16]	[13]	[15]	calculated	[12]	[12]	[12]

Table 6 Pipe Material Properties

SA-376, TP316 (16Cr-13Ni-3Mo)									
Temp	E [(1)]	μ	ρ	α	k	C	Sm	Sy	Su
Reference	[12]	typical	[16]	[13]	[15]	calculated	[12]	[12]	[12]

Note [(1)]: Small differences in E used in ANSYS input file have negligible impact on the results.

Table 7 Weld Overlay Material Properties

Alloy 690, SB-166 (58Ni-29Cr-9Fe)									
Temp	E	μ	ρ	α	k	C	Sm	Sy	Su
Reference	[3]	typical	[16]	[3]	[3]	calculated	[3]	[3]	[3]

4.4 Boundary Conditions

The model simulates, in 2-D space, a section of the safety/relief nozzle, safe end, related welds, pipe, and part of the adjacent pressurizer upper head.

Thermal Analysis: During operation, the inside surfaces of the Upper Head (INSHEAD), the inside surface of the Nozzle, Nozzle to Safe End Weld, Safe End, Safe End to Pipe Weld and Pipe (INSNOZ) are in contact with the pressurizer steam temperature. An appropriate heat transfer coefficient (HTC) and bulk temperature (BT) versus time is applied on these surfaces (Figure 3). The pressurizer steam temperature varies with time depending upon the service load condition that is being applied and is discussed further in section 4.5.3.

The outside surfaces of the Upper Head, Nozzle, Pipe and Weld Overlay (OUTHEAD) are exposed to the ambient temperature in conjunction with a small HTC. The safety/relief nozzle is assumed to be insulated. A very small HTC of[ ]BTU/hr-in^2-F is used in this calculation.

Structural Analysis: Pressurizer steam pressure is applied to all surfaces of these components: INSHEAD, INSNOZ (Figure 3 and Figure 4). The upper end of the reducer (ENDCAP) has a pressure, p*, applied to represent the hydrostatic end load from the piping closure. The exteriors of the pressurizer head are not loaded by pressure.

Pressure p* is calculated as follows:

$$p^* = -\frac{p \cdot d^2}{D^2 - d^2}$$

Where:
p = actual pressure applied
d = ID of the pipe
D = OD of the pipe

The boundary conditions for the structural analysis are set to have zero displacement in the circumferential direction (CF) (from the nozzle axis) (Figure 4).

Figure 3 Surfaces for Thermal Boundary Conditions (Temperature)

Figure 4 Surfaces for Structural Boundary Conditions (Pressure)

4.5 Loads

Loads applied to the model include temperatures and heat transfer coefficients for the thermal analysis, and internal pressures for the structural analysis. External forces and moments are evaluated by hand calculation and added to the results from the finite element analysis.

4.5.1 External Loads

The applicable external loads applied at the safe end are defined in Reference [6] and [7]. The Thermal Expansion (TH), OBE and Valve Operating (VO) loads are listed in Table 8 and Table 9 and are further evaluated in Section 5.4.2.1 for primary + secondary SI Ranges.

Table 8 Applicable External Loads

[ ]

Note (1): Loads are enveloped from loads on page 8, 9, 10 and 11 of Reference [6]. All other loads are taken from Table 2B of Reference [6].

Table 9 Summary of External Loads

[ ]

Note (1): Shear is calculated as the SRSS of Fy and Fz.

Note (2): Bending is calculated as the SRSS of My and Mz.

4.5.2 Design Conditions

Diablo Canyon Units 1 & 2 pressurizer is designed to satisfy the applicable ASME Code criteria at the design pressure of 2485 psig and temperature of 680°F are assuming. These design conditions are simulated on the model by applying a uniform and reference temperature of 680°F throughout the model (the temperature is used to determine the material properties and not for thermal expansion) and uniform pressure of 2485 psig on all inside surfaces of the model. Equivalent end cap pressure is also applied on the pipe cross-section.

4.5.3 Operational Transient Loads

The safety/relief nozzles are located on top of the pressurizer such that the inside surfaces are subjected to the pressurizer steam region thermal and pressure conditions. The applicable Level A (Normal) and Level B (Upset) transients defined in References [6] and [8] are listed in Table 10 together with the corresponding number of cycles. Some transients such as Steady State Fluctuations and Boron Concentration Equalization are insignificant in fatigue evaluation and are neglected. NB 3226 (e) of ASME Code (Ref. [3]) does not require evaluation for the first ten cycles of Testing Condition and therefore, Primary Hydro Test at 3107 psig (Ref. [6]) is not included in fatigue analysis. The Safety Valve Opening and the Relief Valve Opening transients have the same trend, but Safety Valve Opening transient has higher pressure a temperature. Since both transients cannot occur at the same time, conservatively is used Safety Valve Opening transient to cover also Relief Valve Opening transient. Plant Loading and Unloading transient Reference [8] for safety/relief nozzles have the constant parameters (temperature and pressure); therefore Plant Loading and Unloading transient is a steady state condition for safety/relief nozzles and does not affect present analysis.

Table 10 Transients for Safety/Relief Nozzles

Abbreviation	Transient Name	Design Cycles
HUCD	Heatup at 100°F/hr [Normal] Cooldown at 100°F/hr [Normal]	250
LDLI	10% Step Load Decrease [Normal] 10% Step Load Increase [Normal]	2,500
LLD	Large Step Load Decrease [Normal]	250
LOL	Loss of Load [Upset]	100
LOP	Loss of Power [Upset]	50
LOF	Loss of Flow [Upset]	100
RT	Reactor Trip [Upset]	500
TRT	Turbine Roll Test [Test]	10
IASA	Inadvertent Auxiliary Spray Actuation [Normal]	12

SVO/RVO [1]	Safety Valve Opening Transient / Relief Valve Opening Transient	50
LT [2]	Leak Test at 2485 psig [Test]	60
OBE	OBE	400

Note [1] see discussion above Table 10
Note [2] Leak Test at 2485 psig is included in HUCD transient.

The following tables list the time points used in the thermal analysis.

Table 11 Heatup and Cooldown (HUCD)

[ ] [ ]

Table 12 Step Load Increase and Decrease (LILD)

[ ] [ ]

Table 13 Large Step Load Decrease (LLD)

Table 14 Loss of Load (LOL)

Table 15 Loss of Power (LOP)

[ ] [ ]

[ ]

Table 16 Loss of Flow (LOF)

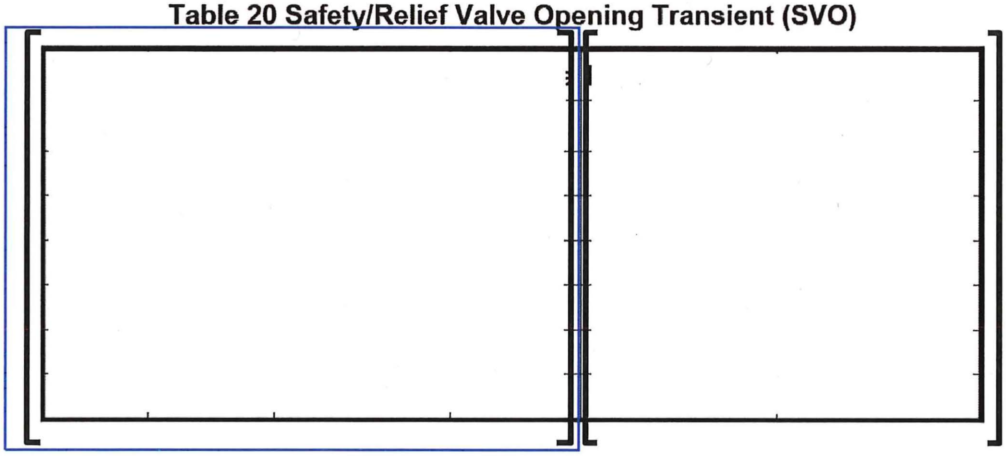
Table 17 Reactor Trip (RT)

[ ] [ ]

Table 18 Turbine Roll Test (TRT)

Table 19 Inadvertent Auxiliary Spray Actuation (IASA)

Table 20 Safety/Relief Valve Opening Transient (SVO)



5 CALCULATION

5.1 Design Condition

Stress analysis of the model under the design pressure provides a basis for verification of the expected behavior of the model, the boundary and load conditions and verifies attenuation of stress effects at regions distant from the nozzle.

The ANSYS output for the design condition is documented in the following file:

DC2_des_pres.out

Figure 5 shows a deformed shape of the model under design pressure along with the un-deformed shape. The stress intensity contours developed in the model under design pressure case are shown in Figure 6.

[ ]

Figure 5 Deformed Shape vs. Un-Deformed Shape

[ ]

Figure 6 Stress Intensity Contours for Design Condition

5.2 Thermal Analysis

The ANSYS input files containing the transient definition, as tabulated in Table 11 to Table 20 are:

HUCD_tr.mac	LOF_tr.mac
LDLI_tr.mac	RT_tr.mac
LLD_tr.mac	TRT_tr.mac
LOL_tr.mac	IASA_tr.mac
LOP_tr.mac	SVO_tr.mac

The ANSYS output files are listed as follows:

Thermal analysis:

DC2_HUCD_th.out	DC2_LOF_th.out
DC2_LDLI_th.out	DC2_RT_th.out
DC2_LLD_th.out	DC2_TRT_th.out
DC2_LOL_th.out	DC2_IASA_th.out
DC2_LOP_th.out	DC2_SVO_th.out

Temperature gradients:

DC2_HUCD_dt.out	DC2_LOF_dt.out
DC2_LDLI_dt.out	DC2_RT_dt.out
DC2_LLD_dt.out	DC2_TRT_dt.out
DC2_LOL_dt.out	DC2_IASA_dt.out
DC2_LOP_dt.out	DC2_SVO_dt.out

The results of the thermal analyses are evaluated to identify the maximum and minimum temperature gradients between critical locations in the model and the corresponding time points. These temperature gradients generate maximum and minimum thermal stresses, which in turn contribute to maximum range of stress intensities in the model.

The node numbers corresponding to the two locations for evaluation of temperature gradient are listed in Table 21. The locations are shown in Figure 7.

Table 21 Temperature Gradients of Interest

Gradient Designation	Node Numbers		Description
A1_A2	1487	1600	Nozzle to head conjunction
B1_B2	1235	1483	OD change on nozzle
C1_C2	1324	1452	Safe end weld to weld overlay
D1_D2	1574	1408	Safe end to weld overlay
E1_E2	1790	285	Thickness change from pipe to weld overlay
F1_F2	2145	2171	ID to OD head

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Figure 7 Locations for Evaluation of Temperature Gradients

The temperatures of selected nodes versus transient time as well as the temperature gradients are shown in Figure 8 to Figure 27. These figures are provided to show the trend and for visual aid only. Specific data is taken from computer output files. Computer file "DC2_inp_dt.mac" contains definition of the node numbers for temperature and gradients calculation.

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Figure 8 Temperatures of Selected Locations (HUCD)

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Figure 9 Thermal Gradients of Selected Locations (HUCD)

Figure 10 Temperatures of Selected Locations (LDLI)

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Figure 11 Thermal Gradients of Selected Locations (LDLI)

Figure 12 Temperatures of Selected Locations (LLD)

Figure 13 Thermal Gradients of Selected Locations (LLD)

Figure 14 Temperatures of Selected Locations (LOL)

Figure 15 Thermal Gradients of Selected Locations (LOL)

Figure 16 Temperatures of Selected Locations (LOP)

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Figure 17 Thermal Gradients of Selected Locations (LOP)

Figure 18 Temperatures of Selected Locations (LOF)

Figure 19 Thermal Gradients of Selected Locations (LOF)

Figure 20 Temperatures of Selected Locations (RT)

Figure 21 Thermal Gradients of Selected Locations (RT)

Figure 22 Temperatures of Selected Locations (TRT)

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Figure 23 Thermal Gradients of Selected Locations (TRT)

Figure 24 Temperatures of Selected Locations (IASA)

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Figure 25 Thermal Gradients of Selected Locations (IASA)

Figure 26 Temperatures of Selected Locations (SVO)

Figure 27 Thermal Gradients of Selected Locations (SVO)

5.3 Stress Analysis

Stress analyses are performed at the time points listed in Table 22 through Table 31. These time points include those at which the maximum temperature gradients (maximum thermal stresses) and the maximum and minimum pressures occur, as well as those of analytical interest. The nodal temperature at the particular time points is read into the structural model directly from the result file of the thermal analysis. The corresponding pressure is obtained by interpolation from Table 11 through Table 20. The computer output files for structural analyses are:

DC2_HUCD_st.out	DC2_LOF_st.out
DC2_LDLI_st.out	DC2_RT_st.out
DC2_LLD_st.out	DC2_TRT_st.out
DC2_LOL_st.out	DC2_IASA_st.out
DC2_LOP_st.out	DC2_SVO_st.out

Table 22 Time Points of Interest for the HUCD Transients

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Table 23 Time Points of Interest for the LDLI Transients

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Table 24 Time Points of Interest for the LLD Transients

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Table 25 Time Points of Interest for the LOL Transients

Table 26 Time Points of Interest for the LOP Transients