DRYWELL TEMPERATURE TRANSIENT
FOLLOWING STATION BLACKOUT

Commonwealth Edison Company
LaSalle County - Unit 1
Project File No. 35.2

System: SBO

NSLD
Calc. No. 3C7-0390-002
Date June 14, 1990
Safety Related YES
Project No(s). 8726-17
Page No. i

CALCULATION

REVISION SUMMARY SHEET

REVISION NO.	PREPARED BY/DATE	REVIEWED BY/DATE	APPROVED BY/DATE	REVISED PAGE NOS.
0	John W. Ahrens 4-16-90	Tamer Ilman 6-11-90	J. W. Ahrens June 14, 1990	N/A
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System: SBO
WIN 1218

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I. INPUT DATA

Information used in this calculation was obtained from approved Sargent & Lundy calculations or LaSalle specific General Electric documentation and is assumed to be verified data except as follows:

None.

II. COMPUTER PROGRAM

The calculations reported herein were performed using S&L Computer Program COMPARE/MODT-PC (03.7.322-1.0), which is described in Ref. 1.

III. <u>INTRODUCTION</u>

In order to demonstrate compliance with title 10 of the Code of Federal Regulations Part 50.63 requirements relative to station blackout (SBO), specific plant parameters have been examined for a 6 hour SBO scenario, (4 hours of SBO followed by 2 hours of recovery). The SBO event is defined as the loss of all AC power, including that from station diesel drives. The recovery period is defined as having the equipment available that can lower the reactor pressure vessel (RPV) temperature and/or the suppression pool temperature. The objective of this analysis is to calculate the air temperature in the Drywell (DW) atmosphere 6 hours after the beginning of the scenario. This revision was made to extend the analysis to 6 hours, to add the ability of venting from the drywell and to remove some of the conservativeness of the original calculation.

IV. ANALYTICAL MODEL

The analytical model consists of 6 nodes, as shown in Table 1, 12 Heat Structures (HSs), as presented in Table 2 and one junction. The connection of nodes and HSs is shown diagrammatically in Figure 1. Figure 1 also identifies the left-hand-face (LHF) and the right-hand-face (RHF) of each HS.

The leakage of primary system water into the drywell (DW) is represented as a blowdown mass flow rate of ste_a and an associated enthalpy flowrate into the DW. This rate is held constant for the first four h___ and then is reduced to account for the decreased reactor pressure vessel (RPV) pressure. This approach conservatively maximizes the DW temperature without being overly conservative.

Fourteen heat transfer functions (HTFs) are specified in the model, as presented in Part A of Table 3.

A blower curve (BC) is specified to transfer mass and energy from Node 1 (DW) to Node 6 (air space above the suppression pool). The mass transferred is based on a difference in pressure between the two nodes. The blower curve models the venting from the drywell to the wetwell through the suppression pool. As the drywell pressure increases, a point is reached where the water in the downcomers is blown out. If the pressure in the drywell continues to increase, air and steam will be vented to the suppression pool. The steam condenses and the air bubbles to the space above the pool, raising the pressure there.

Node 1, representing the DW atmosphere, is assigned as an active node, i.e., a node for which the COMPARE Code calculates conditions after the initial time of the transient.

Node 2, representing the region outside the sidewall of the DW, is specified as an active node with a very large volume (VLV), such that no change in conditions occurs in it throughout the transient. In particular, its temperature remains constant at the initial value of 122°F.

Node 3, whose temperature is taken as that of the fluid and metal of the hottest equipment of the primary system (including the Reactor Pressure Vessel (RPV), the Main Steam Lines (MSLs), the recirculation lines and pumps, etc.), is specified as a time-dependent volume (TDV), such that the specified temperature versus time is the saturation temperature corresponding to the specified transient RPV pressure. Based on Case 1 (RCIC operation during the SBO event) and Case 2 (HPCS operation during the SBO event) of Reference 13, a limiting case is determined for the RPV pressure decay during SBO. This pressure decay is given in Table 5.

Node 4, whose temperature is taken as that of the fluid and metal of the feed water lines (FWLs), is assigned as an active node filled with pure air, but of a pressure and volume such that its heat capacitance (i.e. (mass) times (specific heat capacity) in BTU/°F) is the same as that of the combination of metal and (initially) subcooled water in the segments of the FWLs that are within the DW.

Node 5, whose temperature is taken as that of fluid from the primary system as it vents through Safety Relief Valve (SRV) discharge lines, is assigned as a TDV. The pressure versus time and temperature versus time functions for node 5 are specified such that at each instant throughout the transient:

1) the pressure of node 5 is 40 percent of the current primary system pressure (of node 3); and

2) the temperature of node 5 corresponds to saturation conditions at the node 5 pressure.

Since, for all SRV vents (discharge lines), the stagnation pressure of fluid, even just downstream of the valve, will be less than 40 percent of the RPV pressure (with the valve fully open), the temperature of node 5, determined as described above, is expected to be conservatively high, on the average.

Node 6, representing the air space above the suppression pool is conservatively set at a fixed pressure of 36 psia, which represents the maximum pressure in the wetwell airspace following SBO. This pressure was determined based on no leakage going to the suppression pool. The pressure comes from Reference 14.

Heat transfer from venting primary system fluid to the inside surface of an SRV vent line is based on assigning a Heat Transfer Coefficient (HTC) which is proportional to the 0.8 power of the vent flow rate. Thus, heat transfer to the inside surface of a vent line occurs only during periods when flow is venting, and is zero during periods between ventings. However, HTF number 4 (for combined Natural Convection (NC) plus Surface-to-Vapor Radiation (S-R)) is assigned to the vent line outer surface and accounts for heat flow into the DW atmosphere as long as the SRV vent line metal, heated during a venting period, remains hotter than the DW atmosphere. The HTC at the inner surface of a venting SRV line, with the RPV at normal operating pressure, has been estimated to be about 400 Btu/(hr-sq.ft-F), if only forced convection from vapor is controlling and condensation is not. As an allowance for condensation, a HTC of 2.5 times the forced convection value, i.e. 1000. Btu/(hr-sq.ft) is used during the maximum vent flow rate period.

The corresponding SRV vent line inside HTC(s) (proportional to the 0.8 power of the corresponding vent mass flow rate level(s)) are presented in Part B of Table 3. This table, together with Part A of Table 2, indicates the periods when particular lines or particular groups of lines are venting.

The choice of the particular SRV vent lines flowing is based on whether the SRV is opened automatically or by operator action. Where operator action occurs, the SRV is selected to be that with the longest length exposed to the DW atmosphere, and when a second SRV is opened by the operator, it is chosen as the one with the second longest length exposed to the DW atmosphere. The longest line exposed to the DW atmosphere is MS04BB-12, and the next to longest is MS04BL-12. For automatic operation, the SRVs open in the order of increasing setpoint pressure. The "first group" (lowest setpoints) to open automatically consists of the valves on lines MS04BU-12 & MS04BS-12. The scenario for the SRV openings and closings is based on a limiting case combining Case 1 and Case 2 of Reference 13. These considerations are reflected in the areas selected for HSs 7, 8 and 9 as found in Part B of Table 2.

The stainless foil type of insulation, as used on all normally hot objects (equipment, including the RPV and recirculation pumps, and piping, including MSLs, FWLs, etc. in the DW, is considered to have properties as noted in Part C of Table 2, based on Ref. 5. The thicknesses assigned to the insulation are taken as the distance from the outer foil of the insulation to the outside surface of the insulated object, typically, and include the typical one inch of spacing between the inner foil of the insulation and the outer surface of the insulated object. Based on information provided in Ref. 7, the thicknesses of HS 3 (FWL insulation) and HS 2 (insulation on MSLs, RPV, and other "hottest" equipment) are assigned as noted in Part B of Table 2.

The inside surface areas for HS 3 (representing the cylindrical insulation employed on the FWLs) and HS 2 (representing the cylindrical insulation employed on all other hot piping, the RPV, the recirculation pumps etc.) were chosen such that, together with the inside and outside HTCs employed, the appropriate heat loads (as implied from Refs. 4 & 6) would be obtained at the start of the transient. In particular, for the "normal operation 100% reactor power" condition, the total sensible hot piping and equipment loads implied in the table on page 1 of Ref. 4 apply at the start of the calculated transient (within 1 percent). Furthermore, the fraction of total hot piping and equipment heat load (HS 3 plus HS 2) that is contributed by HS 3 (from the FWLs) is 0.93 of the scaled up load from the FWLs implied by the relative heat rejection rates given in columns 4, 5 & 6 of Table 1 of Ref. 4. This modeling of the FWLs load fraction is considered a conservative (but not overly conservative) choice.

For this analysis, it is required that the modeling maximize the transient temperature in the DW. The modeling features adjusted to this end are:

1 The heat transfer to the heat receiving surfaces in the DW (heat sinks) is assigned in accordance with NUREG-0588 (involving only NC or Uchida Condensing (UC), whichever gives the larger heat transfer rate).

2 The heat transfer from heat sources (normally hot piping and equipment (HSs 2 & 3) and heated SRV vent lines (after the start of a transient)) is assigned as the combined heat transfer rate due to NC plus SVR.

3 The rate at which leakage flow enters the DW during the 4 hour SBO event is 61 gpm (7.79 lbm/s), based on a Technical Specification limit of 25 gpm total leakage (Reference 11) plus 18 gpm per recirculation pump (as allowed by Reference 12). After 4 hours, credit is taken for the drop in RPV pressure and a leakage flow of 27.4 gpm (3.50 lbm/s) is modeled, based on an RPV pressure of 200 psia discharging to initial atmospheric conditions (See Appendix A). Since the RPV pressure at 4 hours is less than 200 psia (Table 5) and the drywell pressure is greater than 15.45 psia at 4 hours, this approach is conservative (Flow is proportional to the square root of the pressure difference). Representation of the leakage flow calculated to flash is modeled by using a "time-dependent mass energy blowdown" (see Table 4).

4 While the heat load due to the fan-cooler motors & blowers is absent, so, of course, is the sensible and latent heat removal to the fan-cooler's chilled water stream that would normally occur.

5 The initial relative humidity in the DW is taken as unity. This choice was found to yield maximum DW temperature during the hotter (later) part of the transient.

6 A blower curve is modeled to determine the mass flowrate from Node 1 to Node 6 based on the difference in the pressure for each node. The pressure in Node 6 is fixed at 36 psia (the maximum) throughout the transient.

V. ASSUMPTIONS AND INFORMATION

Information and the major assumptions governing the calculation reported herein are summarized below.

1. The temperature of node 3 (fluid and metal walls of the RPV, the MSLs, the recirculation lines and pumps, but not the FWLs) for the first four hours is assumed to be at the saturation temperature for the pressure versus time relationship given in Table 5. After 4 hours 15 minutes, the RPV (and Node 3) is assumed to be cooled down at a rate of 100°F/hr due to the restoration of RPV cooling.

2. The temperature of node 4 (fluid and metal walls of the FWLs) is calculated on the basis that the heat capacitance of the FWLs remains constant at its initial value throughout the transient.

3. The HTF governing heat flow to the inside of an SRV vent line is assigned a fixed value of 1000 Btu/(hr-sq.ft-F) while the SRV is open.

4. Heat flow to the DW atmosphere from the insulation on hot piping and equipment, and from heated SRV vent lines is assigned as NC (Natural Convection) plus SVR (Surface-to-Vapor Radiation).

5. Areas assigned to normally hot piping and equipment are chosen so that the heat loads predicted for "normal 100% Reactor Power operation" in Ref. 4 apply at the start of the transient.

6. HTFs governing heat transfer from the DW atmosphere to heat sinks (the DW sidewall and floor, the Pedestal, the Sacrificial Shield, and beams and gratings within the DW) are assigned as the larger of NC or UC (Uchida Condensing).

7. The initial latent heat load is based on flashing 37.76 percent of the 61 gpm leakage. After 4 hours, 17.85 percent of the 27.4 gpm is assumed to flash. The enthalpy of the flashed steam is taken as 1205.6 Btu/lbm. Thermodynamic justification for selecting these values is presented in Appendix A.

8. The fan-cooler-chiller system is assumed to be off from the start of the transient, i.e. there is no motor-blower heat loading to the DW atmosphere and no sensible or latent heat removal from the DW atmosphere to the fan-cooler chilled water system.

9. The initial relative humidity in the DW is assumed, conservatively, to be unity.

10. The pressure difference between Node 1 and Node 6 required for flow to leave the DW is assumed to be greater than 6 psi. The pressure difference was calculated in Appendix A and requires a 6 psi differential between the drywell and wetwell airspace for the water in the downcomer to be initially pushed out. The flowrate is based on the pressure difference. The total flow loss coefficient (entrance and exit) is taken to be 5.2 (Reference 22).

VI. RESULTS

The drywell temperature transient calculated for the SBO event is presented in Figure 2. An initial temperature peak of 162°F occurs about one minute after the SBO begins. Thereafter, the temperature rises continuously, reaching a peak of 251°F at 4 hours. A decreased drywell temperature of 245°F is computed 6 hours after the start of the SBO scenario, or after 2 hours of recovery from the SBO event. This is to be expected since leakage into the drywell decreases (and thus the heat input decreases) at 4 hours.

VII. DISCUSSION OF RESULTS

Figure 2 shows a maximum temperature of 251°F for the 6 hour SBO scenario, which is well below the DW design limit of 340°F, listed in Table 6. The temperature after 6 hours must be kept below a bounding temperature of 250°F (Table 6). The computed temperature at 6 hours is 245°F. The temperature is expected to decrease as equipment continues to remove heat in the drywell and the reactor power continues to decay.

Two effects are believed to contribute to the formation of the initial peak temperature at about 1 minute after the start of the SBO:

1) Transition from NC to UC as the mode of heat transfer from the DW atmosphere to concrete walls, and

2) Rapid falloff of the heat load from the SRV lines which vent just after the start of the SBO, but not afterwards.

An additional computer run was made for the case where no venting occurs to the wetwell. The results from this run were used as input to Reference 14. The output is included in Appendix B.

VIII. REFERENCES

1. User's Manual for COMPARE/MODT-PC (S&L Program No. 03.7.322-1.0), "A Computer Program for the Transient Calculation of a System of Volumes Connected by Flowing Vents."

2. Attachment DAC 270 of letter from H. R. Peffer (GE) to G. R. Crane (CECo) of 2/11/83: "LaSalle County Station, Units 1 & 2, LaSalle Station Blackout Analysis." (DAC 270 is a report from GE entitled: "LaSalle Station Blackout Analysis," dated February 1983 and approved by E. C. Eckert & A. S. Rao.)

3. "Heat Sink Thermophysical Properties," Table 3 of Branch Technical Position CSB 6-1 of Standard Review Plan 6.2.1, p. 6.2.1.5-8 (dated 11/24/75) of NUREG-75/087.

4. Memo from W. B. Paschal & E. P. Richohermoso , R. H. Pollock of 11/12/82: "High Drywell Temperature, AIR No. 1-8-460," and Attachments - Table 1 & Figure 1.

5. Report prepared for Johns-Manville Corp. by Colorado School of Mines Research Institute, Project A21007: "Determination of Thermal Transference of Metallic Pipe Insulation," dated 1/26/73, by J. B. Allison.

6. Memo from E. P. Ricohermoso to R. J. Hammersley and B. Obernel of 10/18/82: "HVAC Input to Perform Blackout Test." (This ref. notes the total power to motors of both fan-coolers gives a heat load of 569120 Btu/hr to the DW atmosphere.)

7. Personal Communications from E. P. Ricohermoso (HVACD):
   a. Insulation on RPV and MSLs is 3.5 inches thick,

b. Insulation on FWLs is 3.0 inches thick..

8. Memo from M. Vega (PMD) to B. Obersnel & R. Curry of 3/1/83: "Control Rod Drive Thermal Loading," with attachment: "General Electric Co. Document No. 22A2715AA, Rev. 1." This ref. notes that following scram, the heat load from the 185 uninsulated scram discharge lines (each about 70 ft long 3/4-inch NPS, S.S. TP-304, with 0.154 inch wall thickness) is 1.128E6 Btu/hr, and the lines and their liquid content are 280°F.

9. NSLD Calc. No. 3C7-0678-002, Rev. 1, Approved 5/11/79 in particular page 9 of the computer printout: "Line Characteristic Summary," and personnel communication from J. W. Ahrens.

10. NSLD Calc. No. 3C7-1082-001, Rev. 0, "Station Blackout: Drywell Temperature Transient," approved 4-22-83.

11. Commonwealth Edison Company, LaSalle County Station Unit 2 Technical Specifications, Appendix "A" to License No. 18, Section 3/4.4.3 "Reactor Coolant System Leakage."

12. "Station Blackout (SBO) Implementation: Request for Supplemental Submittal to NRC," Letter from Byron Lee, Jr. (NUMARC), January 4, 1990.

13. NSLD Calc. No. 3C7-0390-001, Rev. 1, "Suppression Pool Temperature Transient Following Station Blackout", Approved May 11, 1992.

14. ATD Calc. No. ATD-0117, Rev. 0, "Evaluation of NPSH Requirements for HPCS, RHR and RCIC Pumps and Backpressure Limitations of RCIC Turbine Following Station Blackout", Approved May 11, 1992.

15. Crane Technical Paper No. 410, 1986.

16. User's Manual for RELAP4/MOD5 (S&L Program No. 09.8.026-5.70), "A Computer Program for Transient Thermal-Hydraulic Analysis of Nuclear Reactors and Related Systems".

17. LaSalle County Station Updated Final Safety Analysis Report, Table 3.11-4, Rev. 0, 1984.

18. Keenan, J. H., Keys, F. G., Hill, P.G., Moore, J. G., "Steam Tables (English Units)", John Wiley & Sons, Inc., N.Y. 1969.

19. S&L Structural Drawing S-325, Revision P, Reactor Containment Liner Plate Cross Section, LaSalle County Station, Unit 1.

20. LaSalle County Station, Units 1 & 2, S&L Structural Drawing List, 4-03-92.

21. S&L Structural Drawing S-826, Revision V, Reactor Containment Liner Plate Sections and Details, Sheet 1, Unit 2.

22. NSLD Calc. No. 3C7-0277-004, Rev. 0, "Calculation of the Loss Coefficient for the Vent System", Approved 3/10/77.

23. NEDO-10320, The General Electric Pressure Suppression Containment Analytical Model, Page 20, May 1971.

24. LaSalle County Station Updated Final Safety Analysis Report, Tables 6.2-1 and 6.2-3, Rev. 0 April 1984.

TABLE 1 - NODE DESCRIPTIONS, VOLUMES AND INITIAL CONDITIONS

Node Number	Net Volume (cu. ft)	Initial Conditions: Temp. (°F)	Initial Conditions: Press (psia)	Initial Conditions: Relative Humidity (fraction)	Description
1	173857.	135.	15.45	1.0	Drywell Atmosphere
2	(VLV)	122.	14.7	0.	Region outside DW sidewall
3	(TDV)	550.	14.7	0.	RPV, MSLs & Recirc. lines and pumps (metal walls and contained fluid)
4	6.62E6	425.	14.7	0.	FWLs (metal walls and contained fluid)
5	(TDV)	450.	14.7	0.	Fluid in SRV vent lines
6	(TDV)	---	36.0	---	Wetwell Airspace

Notes:

1. "TDV" refers to a "Time Dependent Volume" for which conditions after time zero are user specified functions of time.

2. Node 2 is a "Very Large Volume" (VLV), such that conditions remain fixed at their initial values throughout the transient.

3. The temperatures of nodes 3 and 4 are assumed to apply equally to the metal walls and the contained fluids throughout the transient.

4. The volume of air assigned to node 4 has the same heat capacity, (Btu/F), as the metal walls plus the contained liquid water of the FWLs.

5. Since the pressure of Node 6 is fixed, the other initial conditions have no bearing on the analysis.

TABLE 2 - HEAT STRUCTURES

PART A - Descriptions of Heat Structures (HSs)

HS Number	HS Description RC = Reinforced Concrete, SSFI = Stainless Steel Foil Insulation
1	RC sidewall of DW
2	SSFI on RPV, MSLs, & Recirc. lines and pumps
3	SSFI on FWLs
4	RC floor of DW
5	RC Sacrificial Shield
6	RC Pedestal (below RPV and Sac. Shield
7	Steel wall of SRV vent line: MS04BB-12
8	Steel wall of SRV vent line: MS04BL-12
9	Steel wall of SRV vent line(s): other SRV lines
10	Steel beams and supports inside DW
11	Steel gratings inside DW
12	Scram Discharge Piping (metal walls and contained fluid)

TABLE 2 - HEAT STRUCTURES (Cont'd)
PART B - HS Parameters

HS No.	LHF Node No.	LHF HTF No.	RHF Node No.	RHF HTF No.	LHF Area, (sq.ft)	Thickness, (inch)	Number of Elements
1	1	1	2	1	15976.	72.	24
2	3	8	1	4	31204.	3.5	3
3	4	8	1	4	1744.8	3.0	3
4	1	2	0*	7	3667.	36.	6
5	1	1	1	1	4297.	24.	6
6	1	1	0	7	1751.	58.	10
7	5	9	1	4	360.4	.688	1
8	5	10	1	4	305.2	.688	1
9	5	11	1	4	2142.**	.688	1
10	1	12	0	0	28702.	.5	1
11	1	13	0	0	12539.	.1875	1
12	1	14	0	0	3580.	.2625	1

*Reference to node or HTF number "0" automatically imposes an adiabatic boundary condition at the corresponding HS face.

**See Appendix A

TABLE 2 - HEAT STRUCTURES (Cont'd)

PART C - HS Notes

HSs 2, 3 & 6 are treated as cylindric geometry, all others as slab geometry. For HS no. 2: IR = 13.0 inches; OR = 16.5 inches. For HS no. 3: IR = 12.0 inches; OR = 15.0 inches. For HS no. 6: IR = 121 inches; OR = 179 inches.

LHF = Left Hand Face; RHF = Right Hand Face; HTF = Heat Transfer Function.
IR = Inner Radius; OR = Outer Radius

The properties used for reinforced concrete are:

Thermal conductivity = 0.92 Btu/(hr-ft-F),
Density = 145. lbm/(cu.ft), &
Specific heat = 0.156 Btu/(lbm-F).

The properties used for steel (HSs 8, 9, 10, 11 & 12)

Thermal conductivity = 27. Btu/(hr-ft-F),
Density = 490. lbm/(cu.ft), &
Specific heat = 0.12 Btu/(lbm-F).

The properties used for Stainless Steel Foil Insulation (SSFI) are:

Thermal conductivity in Btu/(hr-ft-F): = 0.1786 for FWLs (HS no. 3) = 0.1166 for RPV, MSLs, etc. (HS no. 2)
Density = 27.7 lbm/(cu.ft), &
Specific heat = 0.12 Btu/(lbm-F).

"Number of Elements" refers to the number of elements into which the thickness of the HS is divided for the finite difference representation.

TABLE 3 - HEAT TRANSFER FUNCTIONS

Notes:
HT = Heat Transfer; HTF = Heat Transfer Function; NC = Natural Convection;
UC = Uchida Condensing; SVR = Surface to Vapor Radiation;
HTC = Heat Transfer Coefficient, (BTU)/(hr-sq.ft-F);
t = time in seconds; NHTO = HTF option index used in COMPARE code;
IWT = Wall Type index for NC: = 1 for NC to a sidewall, = 2 for NC to a floor, = 3 for NC to a ceiling; NA = Not Applicable.

PART A - Description & type of HTFs

HTF No.	NHTO	Description
1	2,IWT=1	Max. of UC or NC to a room sidewall
2	2,IWT=2	Max. of UC or NC to a room floor
3	2,IWT=3	Max. of UC or NC to a room ceiling
4	10,IWT=1	Combined NC and SVR for room sidewall or large object (RPV, pipe, pump)
5	10,IWT=2	Combined NC and SVR for room floor
6	10,IWT=3	Combined NC and SVR for room ceiling
7	3	HTC = 0. set throughout transient
8	3	HTC = 10. set throughout transient
9	4	HTC vs. t as per table 3 part B
10	4	HTC vs. t as per table 3 part B
11	4	HTC vs. t as per table 3 part B
12	2,IWT=1	Max. of UC or NC to beams (height = 6 inches)
13	2,IWT=1	Max. of UC or NC to grating bars (ht. = 1.2 in.)
14	4	HTC=0.(t<.001); HTC=2.173(t>1.0)

TABLE 3 - HEAT TRANSFER Fʟ. IONS (Cont'd)

Part B - Subtables of HTC vs. t for HTFs of type NHTO = 4 (HTF Nos. 9, 10 & 11)

Pt. No.	HTF 9		HTF 10		HTF 11	
	T	HTC	T	HTC	T	HTC
1	0.	0.	0.	0.	0.	0.
2	.001	1000	3	0.	5.9	0.
3	140.4	1000	3.1	1000	6	1000
4	140.5	0.	86.9	1000	26.9	1000
5	329.5	0.	87	0.	27	0.
6	329.6	1000	1.E6	0.	1.E6	0.
7	1.E6	1000				

TABLE 4 - BLOWDOWN OF MASS AND ENERGY INTO DRYWELL

Blowdown table representing leakage from primary system vs. time

Time (sec)	Blowdown Mass (lbm/s)	Blowdown Enthalpy (BTU/s)
0	2.942	3547
14399	2.942	3547
14400	0.625	754
1.E6	0.625	754

Notes:
Linear interpolation applies between adjacent points of each table.

TABLE 5 - TRANSIENT RPV CONDITIONS

TIME(Sec)	PRESSURE (psia)	TEMPERATURE (°F)
0	1040	549
140.5	912	534
1290	1015	546
1312	993	545
1694	844	524
2212	746	510
[illegible]	450	456
5969	264	406
6442	227	393
7207	176	371
15300*	170	368
18900	41	268
22500	--	168
24228	--	120
1.E6	--	120

*After 15,300 seconds, the RPV temperature is based on a cooling rate of 100°F/hr down to a temperature of 120°F,

TABLE 6 - HARSH ENVIRONMENT ZONE H2 - BOUNDING UFSAR ENVIRONMENTAL TEMPERATURE INSIDE THE DRYWELL (Reference 17)

Temperature °F	340	320	250	200
Duration	0-3 hr	3-6 hr	6 hr to 1 day	1 day to 100 days

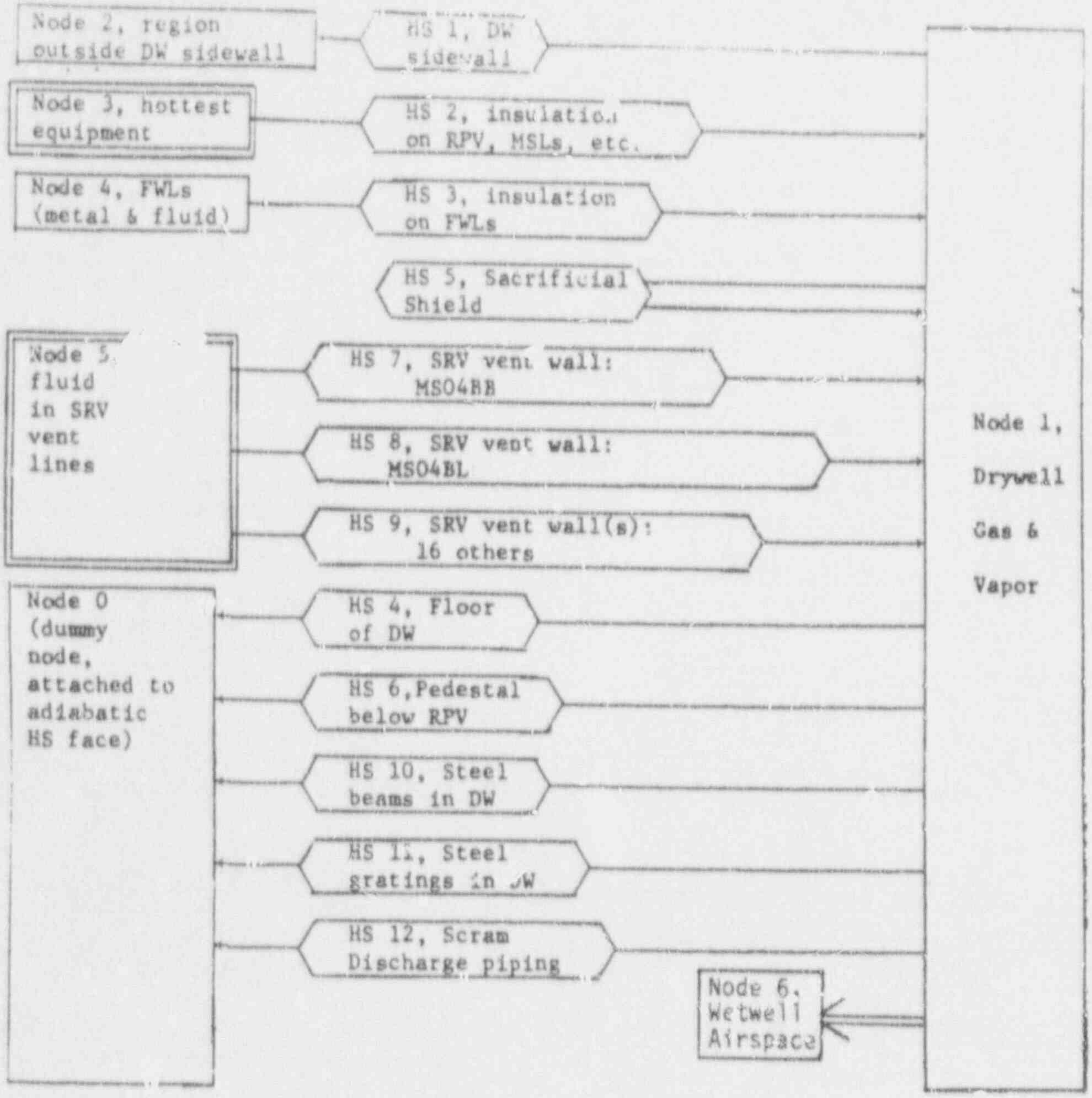


FIGURE 1 - SCHEMATIC OF NODES AND HEAT STRUCTURES

DW=Drywell; TDV=Time-Dependent Volume; LHF=Left Hand Face; RHF=Right Hand Face; RPV=Reactor Pressure Vessel; MSL=Main Steam Line; FWL=Feed Water Line; SRV=Safety Relief Valve; HS=Heat Structure

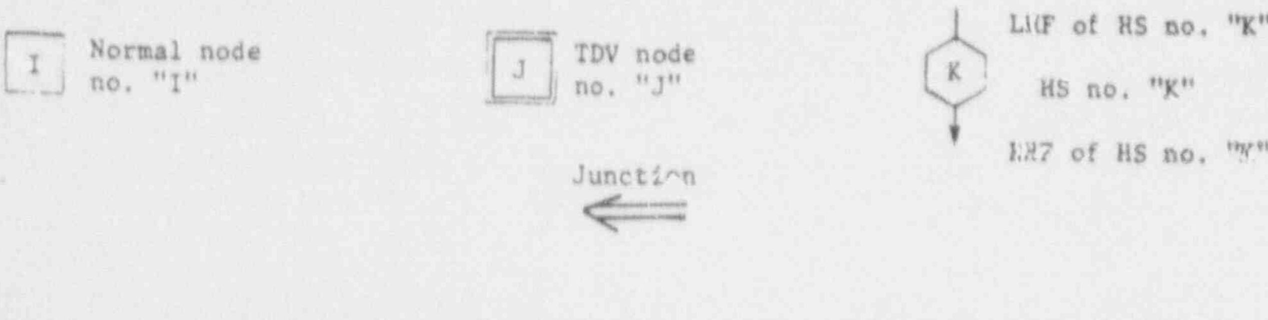
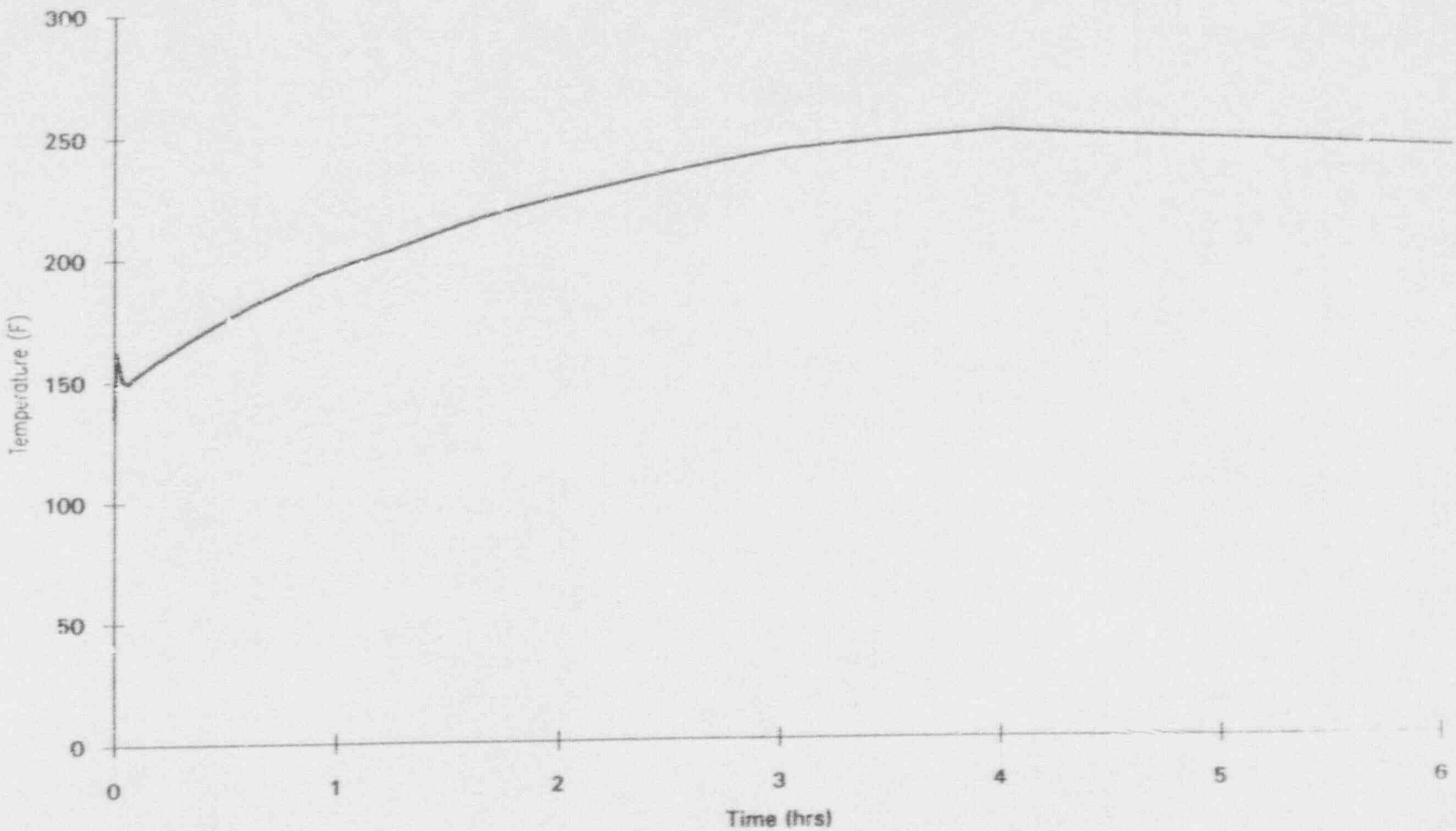


Fig. 2 Drywell Temperature After Station Blackout



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Project No. 8726-17

REVIEW METHOD SHEET

This calculation has been reviewed by me according to the method(s) checked below.

1. Computer Aided Calculations

a	Review to determine that the computer program(s) has been validated and documented, is suitable to the problem being analyzed, and that the calculation contains all necessary information for reconstruction at a later date.
b	Review to determine that the input data as specified for program execution is consistent with the design input, correctly defines the problem for the computer algorithm and is sufficiently accurate to produce results within any numerical limitations of the program.
c	Review to verify that the results obtained from the program are correct and within stated assumptions and limitations of the program and are consistent with the input.
d	Review validation documentation for temporary [illegible] to listed, or developmental, or unique single application programs, to assure that methods used adequately validate the program for the intended application.
e ✓	Review of code input only, since the computer program has sufficient history of use at Sargent & Lundy in similar calculations.
f ✓	Review arithmetic necessary to prepare code input data.
g	Other:

2. Hand Prepared Design Calculations

a	Detailed review of the original calculations.
b	Review by an alternate, simplified, or approximate method of calculation.
c	Review of a representative sample of repetitive calculations.
d	Review of the calculation against a similar calculation previously performed.

3. Revisions

a	Editorial changes only
b	Elimination of unapproved input data without altering calculated results.
c ✓	Other: DETAILED REVIEW OF REVISED CALC.

4. Other

Reviewer: Thomas J. Ka[signature] Date 05-11-92

- APPENDIX A -

HAND CALCULATIONS

SARGENT & LUNDY ENGINEERS	Calcs. For		Calc. No. 3C7-0395-002
			Rev. 1 Date
	X Safety-Related	Non-Safety-Related	Page A2 of

Client		Prepared by	Date
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TO FIND FLASHING OF STEAM:

TOTAL LEAKAGE ≈1 GPM

ASSUMING FLUID CONDITION IS SATURATED LIQUID AT 1040 PSIA REFERENCE 24

$h_f = 548.48$ BTU/lbm INTERPOLATING REFERENCE 18

ASSUME CONSTANT ENTHALPY THROTTLING

AT DRYWELL PRESSURE OF 15.45 PSIA (REFERENCE 24)

$h_f = 182.68$ BTU/lbm INTERPOLATING
$h_g = 1151.44$ BTU/lbm INTERPOLATING } REFERENCE 18
$h_{fg} = 1151.44 - 182.68 = 968.76$ BTU/lbm

$h|_{1040\ PSIA} = h|_{15.45\ PSIA} = h_f + x\,h_{fg}$ $\quad x \equiv$ QUALITY

$548.48\ \text{BTU/lbm} = 182.68\ \text{BTU/lbm} + x\,968.76\ \text{BTU/lbm}$

$x = 0.3776$ ⇒ 37.76 % FLASHES FOR 4 HOURS

THIS IS CONSERVATIVE SINCE THE RPV PRESSURE DECREASES WITH TIME AND THE DRYWELL PRESSURE INCREASES WITH TIME (QUALITY OF STEAM GOES DOWN)

AFTER 4 HOURS, RPV PRESSURE IS 200 PSIA

$h_f = 355.6$ BTU/lbm (REF 18), THROTTLING TO 15.45 PSIA

$355.6\ \text{BTU/lbm} = 182.68\ \text{BTU/lbm} + x\,968.76\ \text{BTU/lbm}$

$x = .1785$ ⇒ 17.85% FLASHES AFTER 4 HOURS.

Form GO 3.08.1 Rev. 2

SARGENT & LUNDY ENGINEERS	Calcs. For			Calc. No. [illegible]
				Rev. 1 Date
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Client		Prepared by	Date
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MASS FLASHED AT 1040 PSIA

PICK WEIGHT OF WATER = 7.6608 lbm/GAL AT 300°F (REFERENCE 15)
THIS IS AN AVERAGE WEIGHT

7.6608 lbm/GAL X 61 GPM ÷ 60 SEC/MIN = 7.79 lbm/s

.3776 (7.79 lbm/s) = 2.942 lbm/s FLASHED FOR 4 HOURS

TO GET MASS FLASHED AFTER 4 HOURS

$$\frac{GA}{G_oA_o} = \frac{m}{m_o} \Rightarrow m = m_o \frac{GA}{G_oA_o} \Rightarrow m = m_o \frac{G}{G_o}$$

G ≡ MASS FLUX FOUND IN TABLE VI OF REFERENCE 16
A ≡ CROSS SECTIONAL AREA OF FLOW
m ≡ MASS OF FLOW

FOR 1040 PSIA FROM REFERENCE 16

	G
1000 PSIA SATURATED LIQUID	7883.7
1200 PSIA SATURATED LIQUID	8566.61

INTERPOLATING AT 1040 PSIA

$$G = 7883.7 + \left(\frac{40}{200}\right)(8566.61 - 7883.7)$$

$$G = 8020.28$$

G 200 PSIA = 3608.16 REF 16

$\therefore$ $\dot{m} = 7.79 \text{ lbm/s} \left(\frac{3608.16}{8020.28}\right) = 3.50 \text{ lbm/s} \div 7.6608 \text{ lbm/GAL} \times 60$
$= 27.4 \text{GPM}$

3.50 lbm/s x .1785 = 0.625 lbm/s FLASHES AT 200 PSIA
INTO 15.45 PSIA CONTAINMENT

TO BE CONSERVATIVE THE MAXIMUM SATURATED ENTHALPY OF VAPOR IS USED FOR THE RANGE OF PRESSURES / TEMPERATURES CONSIDERED: h_g = 1205.6 BTU/lbm

ENERGY RATES:

FIRST 4 HOURS: 2.942 lbm/s x 1205.6 BTU/lbm = 3546.88 BTU/s
AFTER 4 HOURS: 0.625 lbm/s x 1205.6 BTU/lbm = 753.5 BTU/s

DOWNCOMER INFORMATION

DOWCOMER LENGTH : 49'-3½" + ⅜" : 49'-3⅞" REFERENCE 21
NUMBER OF DOWNCOMERS : 98 } REFERENCE 24
DIAMETER OF DOWNCOMERS : 23½" = 1.96' }
CROSS SECTIONAL AREA = $\pi (1.96)^2/4$ = 3 FT²
BASED ON REFERENCE 22:
f = 0.012
LOSS COEFFICIENT K = 5.20

TO ACCOUNT FOR INERTIA OF WATER OUTSIDE THE DOWNCOMER, REFERENCE 23 SAYS
USE FICTITIOUS LENGTH = DIAMETER OF PIPE = 1.96'

BASED ON A NORMAL WATER LEVEL, THE PIPE IS SUBMERGED 12' (REF 19 & 24)

TOTAL LENGTH TO CLEAR : 12 + 1.96 = 13.96'

SARGENT & LUNDY ENGINEERS	Calcs. For		Calc. No. 3C7-0390-002	
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USE SPECIFIC VOLUME AT POOL TEMPERATURE = 105°F (REF 13)
v = 0.016148 Ft³/lbm

$\Delta P = \Delta h / (144 \times v) = 13.96\ ft / (144 \times 0.016148) = 6.0\ PSI$

∴ IT TAKES A 6 PSI DIFFERENTIAL TO CLEAR THE DOWNCOMER

USING $\Delta h = (K_{TOTAL}) \frac{V^2}{2g}$ AND $27.6923\ \frac{"H_2O}{PSI} \Rightarrow \frac{1 PSI \times 144 \times 12}{62.4}$

WHEN ΔP (DRYWELL - WETWELL) = 0   Q = 0 ft³/s
WHEN ΔP = 6 PSI = 166 " H_2O Q = 0 ft³/s

WHEN ΔP = 7 PSI = 194 " H_2O USE $v_{SAT\ VAPOR}$ 15 PSIG = 7.1736 REF 1 (P DESIGN OF DRYWELL)
7-6 PSI = 1 PSI RELATIVE TO 6 PSI = $144 \frac{IN^2}{FT^2} \times 7.1736 \frac{ft^3}{lbm} \times 1 \frac{lbF}{IN^2} \times \frac{g_c}{g}$
= 1033 FT

$1033\ FT = (5.2) \frac{V^2}{64.4}$
V = 113.1 FT/S
Q = 113.1 FT/S × 3 FT² × 98 × 60 S/MIN = 1995216.4 CFM

* USE 90% OF FLOW TO BE CONSERVATIVE

.90 (1995216.4) = 1795695 CFM

WHEN ΔP = 10 PSI = 277 " H_2O
RELATIVE ΔP = 4 PSI = 144 × 7.1736 × 4 = 4132 FT

$4132\ FT = (5.2) \frac{V^2}{64.4}$

V = 226.2 FT/S
Q = 226.2 × 3 × 98 × 60 × .9 = 3591390 CFM

Form GQ-3.08.1 Rev. 2

M3599.001 6-90

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WHEN ΔP = 15 PSI = 415 "H_2O
ΔP RELATIVE = 9 x 1033 = 9297 FT

$$9297 \text{ FT} = (5.2)\frac{V^2}{64.4}$$
V = 339.32 FT/S
Q = 339.32 x 3 x 98 x 60 x .9 = 5387084 CFM

WHEN ΔP = 20 PSI = 554 "H_2O
ΔP_{REL} = 14 PSI = 14 x 1033 = 14462 FT

$$14462 \text{ FT} = (5.2)\frac{V^2}{64.4}$$
V = 423.2 FT/S
Q = 423.2 x 3 x 98 x 60 x .9 = 6718875 CFM

WHEN ΔP = 30 PSI = 831 "H_2O
ΔP_{REL} = 24 PSI = 24 x 1033 = 24792 FT

$$24792 \text{ FT} = (5.2)\frac{V^2}{64.4}$$
V = 554.11 FT/S
Q = 554.11 x 3 x 98 x 60 x .9 = 8797072 CFM

WHEN ΔP = 40 PSI = 1108 "H_2O
ΔP_{REL} = 34 PSI = 34 x 1033 = 35122 FT

$$35122 \text{ FT} = (5.2)\frac{V^2}{64.4}$$
V = 659.52 FT/S
Q = 659.52 x 3 x 98 x 60 x .9 = 10470610 CFM

WHEN ΔP = 50 PSI = 1385 "H_2O
ΔP_{REL} = 44 PSI = 44 x 1033 = 45452 FT

$$45452 \text{ FT} = (5.2)\frac{V^2}{64.4}$$
V = 750.3 FT/S
Q = 750.3 x 3 x 98 x 60 x .9 = 11911291 CFM

SARGENT & LUNDY ENGINEERS	Calcs. For		Calc. No. 3C7-6390-002	
			Rev. 1	Date
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Client		Prepared by	Date
Project		Reviewed by	Date
Proj. No. 8726-17	Equip. No.	Approved by	Date

WHEN $\Delta P = 100$ PSI 2769 "H_2O

$\Delta P_{REL} = 94$ PSI $= 94 \times 1033 = 97102$ FT

$97102 \text{ FT} = (5.2)\frac{V^2}{64.4}$

$V = 1096.62$ FT/S

$Q = 1096.62 \times 3 \times 98 \times 60 \times .9 = 17409907$ CFM

WHEN $\Delta P = 6.1$ PSI $= 169$" H_2O

$\Delta P_{REL} = .1$ PSI $= .1 \times 1033 = 103.3$ FT

$103.3 \text{ FT} = (5.2)\frac{V^2}{64.4}$

$V = 35.77$ FT/S

$Q = 35.77 \times 3 \times 98 \times 60 \times .9 = 567849$ CFM

HEAT STRUCTURE 9

REFERENCE 10 DEFINES THE AREA OF HS 9 AS THE AREA OF THE SRV'S MINUS THE TWO LONGEST. THUS 16 SRV'S ARE CONSIDERED IT THE VALUE OF 4283 FT² (18-2=16) SINCE REFERENCE 13 SHOWS THAT ONLY A MAXIMUM OF 10 SRV'S ARE OPEN (8 DUE TO HS 9) THE AREA OF HS 9 IS CORRECTED

$4283\left(\frac{8}{16}\right) = 2142 \text{ FT}^2$

Form GQ 3.08.1 Rev. 2

- APPENDIX B -

COMPUTER INPUT DATA AND OUTPUT

```
INITIAL RUN
CASE-1D:DW T & P,SBO,FIXED ARE 61 GPM LEAK AND RPV T & P; INITIAL DW RH=1.
6 1 0 12 1 0 0 0 0 1 3 1 0 0 0 12 0 10 0 /B
1 0. .00002 30 0 /B1
1000000 1 7 0. 22000. 500. 1. /C1
.001 .00021 2 2 1 1 /C2-1
3. 1.0 1 1 1 1 /C2-2
3600. 3.0 300 7196 1 1 /C2-3
6000. 1.0 200 2400 1 1
14400 0.1 400 4200 1 1 /C2-4
15900 .1 500 1500 1 1 /C2-5
1.E6 0.5 500 4000 1 1 /C2-6
173857. 15.45 135. 1. 8*0. 0 0. /D-1
1.E35 14.7 122. 0. 8*0. 0 0. /D-2
1. 14.7 550. 0. 8*0. 1 0. /D-3
6.62E6 14.7 425. 0. 8*0. 0 0. /D-4
1. 14.7 450. 0. 8*0. 2 0. /D-5 SRVL'S FLUID (TDV NO. 2)
163000. 36.0  260.96 1. 8*0. 3 0.  /D-6 VENTING NODE BY KIN
0. 0. 0 0 /DD
6 1 6 0 1 0 0  /E-1 JUNCTION INPUT J KIN
1.0 0.5 1.0 0.5 1.0 -1 0. 0 11*0.   /F-1 JUNCTION INPUT J KIN
NO  /FF-1 NO CHOKE FOR JUNCTION J KIN
15
0. 1040. 549. 8*0.
141. 912. 534. 8*0.
1290. 1015. 546. 8*0.
1312. 993.  545. 8*0.
1694. 844. 524. 8*0.
2212. 746. 510. 8*0.
4169. 450. 456. 8*0.
5969. 264. 406. 8*0.
6442. 227. 393. 8*0.
7207. 176. 371. 8*0.
15300. 170. 368. 8*0.
18900. 40.5 268. 8*0.
22500. 15.45 168. 8*0.
24228. 15.45 120. 8*0.
1.E6   15.45 120. 8*0. /J-1
15
0 416. 448. 8*0.
141. 365. 436. 8*0.
1290. 406. 446. 8*0.
1312. 397. 443. 8*0.
1694. 338. 428. 8*0.
2212. 298. 416. 8*0.
4169. 180. 373. 8*0.
5969. 106. 332. 8*0.
6442. 91. 321. 8*0.
7207. 70. 303. 8*0.
15300. 68. 301. 8*0.
18900. 15.45  01. 8*0.
22500. 15.45 120. 8*0.
24228. 15.45 120. 8*0.
1.0E6 15.45 120. 8*0.  /J-2
2 0. 36.0 260.96 1.0 7*0 1.0E6 36.0 260.96 1.0 7*0    /J-3
1 11 0.    /K-1 BCC INFO FOR JUNCTION J KIN
   0         0
 -166.       0
 -169.   567849.
 -194.  1795695.
 -277.  3591390.
 -415.  5387084.
 -554.  6718875.
 -831.  8797072.
-1108. 10470610.
-1385. 11911291.
```

```
-2769. 17409907.      /L
1 4 3*0 /Q
    0. 2.942 3546.88
14399. 2.942 3546.88
14400.   .625  753.50
1.E6     .625  753.50
SINK 1 - DW SIDEWALL
1 1 1 1 2 1 15976. 0. 1.E6 8*0 /X-1
24 0 72. 133. 124. -2 0 0 1 0 2 /Z-1
.92 145. .156 /Z3-1
SINK 2 - INSULATION ON  RPV,PUMPS,PIPES @ 550 F
2 1 3 8 1 4 31204. 13. 1.E6 8*0
3 0 16.5 549. 268.8 -2 0 0 1 0 2
.1166 27.7 .12 /Z3-2
SINK 3 - INSULATION ON FW PIPING
2 1 4 8 1 4 1744.8 12. 1.E6 8*0
3 0 15. 425. 268.8 -2 0 0 1 0 2
.1786 27.7 .12 /Z3-3 (SEG 1)
SINK 4 - DW FLOOR (BOTTOM SURFACE ADIABATIC)
1 1 1 2 0 7 3667. 0. 1.E6 8*0
6 0 36. 2*135. 2 0 0 1 0 2
.92 145. .156 /Z3-4
SINK 5 - SAC.SHIELD
1 1 1 1 1 1 4297. 0. 1.E6 8*0
6 0 24. 2*135. 2 0 0 1 0 2
.92 145. .156 /Z3-5
SINK 6 - PEDESTAL (INNER FACE ADIABATIC)
2 1 1 1 0 7 1751. 179. 1.E6 8*0 /X-6
10 0 121. 2*135. 2 0 0 1 0 2 /Z-6
.92 145. .156 /Z3-6
SINK 7 - WALL OF MS04BB-12 (LONGEST SRV VENT IN DW)
1 1 5 9 1 4 360.4 0. 1.E6 8*0.
1 0 .688 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 8 - WALL OF MS04BL-12
1 1 5 10 1 4 305.2 0. 1.E6 8*0. /
1 0 .688 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 9 - 16 OTHER SRV WALLS
1 1 5 11 1 4 2142. 0. 1.F6 8*0. /
1 0 .688 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 10 - BEAMS INSIDE DW
1 1 1 12 0 0 28702. 0. 1.E6 8*0. /
1 0 .5 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 11 - GRATINGS INSIDE DW
1 1 1 13 0 0 12539. 0. 1.E6 8*0. /
1 0 .1875 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 12 - SCRAM DISCHARGE PIPING
1 1 1 14 0 0 3580. 0. 1.E6 8*0. /
1 0 .2625 2*280. 2 0 0 1 0 2 /
27. 490. .12 /
2 -1. 1. 1. .92 1. 1 70. 2*0 /ZZ1-1
2 -1. 1. 1. .92 1. 2 70. 2*0 /ZZ1-2
2 -1. 1. 1. .92 1. 3 70. 2*0 /ZZ1-3
10 1 70. 60. .9 5*0 /ZZ1-4
10 2 70. 60. .9 5*0 /ZZ1-5
10 3 70. 60. .9 5*0 /ZZ1-6
3 9*0. /ZZ1-7
3 10. 8*0. /ZZ1-8
4 1 7 7*0. /ZZ1-9
4 2 6 7*0. /ZZ1-10
4 3 6 7*0. /ZZ1-11
2 -1. 1. 1. .92 1. 1 .5 2*0. /ZZ1-12
```

```
0 -1. 1. 1. .92 1. 1 .1 2*0. /ZZ1-13
4 4 4 7*0. /ZZ1-14
0 0 .001 1000 140.4 1000 140.5 0 329.5 0 329.6 1000 1.E6 1000  /ZZ2-1
0 0 3 0 3.1 1000 86.9 1000 87 0 1.E6 0  /ZZ2-2
0 0 5.9 0 6 1000 26.9 1000 27 0 1.E6 0 /ZZ2-3
0. 0. .001 0. 1. 2.173 1.E6 2.173 /ZZ2-4
```

```
INITIAL RUN
CASE-1D:DW T & P,SBO,FIXED ARE 61 GPM LEAK AND RPV T & P:NO VENTING
6 1 0 12 1 0 0 0 0 1 3 1 0 0 0 12 0 10 0 /B
1 0. .00002 30 0 /B1
100000 1 7 0. 15300. 500. 1. /C1
.001 .00021 2 2 1 1 /C2-1
3. 1.0 1 1 1 1 /C2-2
3600. 3.0 300 7196 1 1 /C2-3
6000. 1.0 200 2400 1 1
14400 2.0 400 4200 1 1 /C2-4
15900 2.0 200 1500 1 1 /C2-5
1.E6 0.5 500 4000 1 1 /C2-6
173857. 15.45 135. 1. 8*0. 0 0. /D-1
1.E35 14.7 122. 0. 8*0. 0 0. /D-2
1. 14.7 550. 0. 8*0. 1 0. /D-3
6.62E6 14.7 425. 0. 8*0. 0 0. /D-4
1. 14.7 450. 0. 8*0. 2 0. /D-5 SRVL'S FLUID (TDV NO. 2)
163000. 36.0  260.96 1. 8*0. 3 0.  /D-6 VENTING NODE BY KIN
0. 0. 0 0 /DD
6 1 6 0 1 0 0  /E-1 JUNCTION INPUT J KIN
1.0 0.5 1.0 0.5 1.0 -1 0. 0 11*0.   /F-1 JUNCTION INPUT J KIN
NO  /FF-1 NO CHOKE FOR JUNCTION J KIN
15
0. 1040. 549. 8*0.
141. 912. 534. 8*0.
1290. 1015. 546. 8*0.
1312. 993.  545. 8*0.
1694. 844. 5[illegible]4. 8*0.
2212. 746. 510. 8*0.
4169. 450. 456. 8*0.
5969. 264. 406. 8*0.
6442. 227. 393. 8*0.
7207. 176. 371. 8*0.
15300 170. 368. 8*0.
18900  40.5 268. 8*0.
22500. 15.45 168. 8*0.
24228. 15.45 120. 8*0.
1.0E6  15.45 120. 8*0  /J-1
15
0 416. 448. 8*0.
141. 365. 436. 8*0.
1290. 406. 446. 8*0.
1312. 397. 443. 8*0.
1694. 338. 428. 8*0.
2212. 298. 416. 8*0.
4169. 180. 373. 8*0.
5969. 106. 332. 8*0.
6442. 91. 321. 8*0.
7207. 70. 303. 8*0.
15300. 68. 301. 8*0.
18900. 15.45 201. 8*0.
22500. 15.45 120. 8*0.
24228. 15.45 120. 8*0.
1.0E6 15.45 120. 8*0.   /J-2
2 0. 36.0 260.96 1.0 7*0 1.0E6 36.0 260.96 1.0 7*0    /J-3
1 11 20000.     /K-1 BCC INFO FOR JUNCTION J KIN
    0.         0
  -166.        0
  -169.    567849.
  -194.   1795695.
  -277.   3591390.
  -415.   5387084.
  -554.   6718875.
  -831.   8797072.
 -1108.  10470610.
 -1385.  11911291.
```

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```
-2769. 17409907.     /L
1 4 3*0 /Q
0.      2.942 3546.88
14399. 2.942 3546.88
14400.  .625  753.50
1.E6    .625  753.50
SINK 1 - DW SIDEWALL
1 1 1 1 2 1 15976. 0. 1.E6 8*0 /X-1
24 0 72. 133. 124. -2 0 0 1 0 2 /Z-1
.92 145. .156 /Z3-1
SINK 2 - INSULATION ON  RPV,PUMPS,PIPES @ 550 F
2 1 3 8 1 4 31204. 13. 1.E6 8*0
3 0 16.5 549. 268.8 -2 0 0 1 0 2
.1166 27.7 .12 /Z3-2
SINK 3 - INSULATION ON FW PIPING
2 1 4 8 1 4 1744.8 12. 1.E6 8*0
3 0 15. 425. 268.8 -2 0 0 1 0 2
.1786 27.7 .12 /Z3-3 (SEG 1)
SINK 4 - DW FLOOR (BOTTOM SURFACE ADIABATIC)
1 1 1 2 0 7 3667. 0. 1.E6 8*0
6 0 36. 2*135. 2 0 0 1 0 2
.92 145. .156 /Z3-4
SINK 5 - SAC.SHIELD
1 1 1 1 1 1 4297. 0. 1.E6 8*0
6 0 24. 2*135. 2 0 0 1 0 2
.92 145. .156 /Z3-5
SINK 6 - PEDESTAL (INNER FACE ADIABATIC)
2 1 1 1 0 7 1751. 179. 1.E6 8*0 /X-6
10 0 121. 2*135. 2 0 0 1 0 2 /Z-6
.92 145  .156 /Z3-6
SINK 7   WALL OF MS04BB-12 (LONGEST SRV VENT IN DW)
1 1 5 9 1 4 360.4 0. 1.E6 8*0.
1 0 .688 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 8 - WALL OF MS04BL-12
1 1 5 10 1 4 305.2 0. 1.E6 8*0. /
1 0 .688 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 9 - 16 OTHER SRV WALLS
1 1 5 11 1 4 2142. 0. 1.E6 8*0. /
1 0 .688 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 10 - BEAMS INSIDE DW
1 1 1 12 0 0 28702. 0. 1.E6 8*0. /
1 0 .5 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 11 - GRATINGS INSIDE DW
1 1 1 13 0 0 12539. 0. 1.E6 8*0. /
1 0 .1875 2*135. 2 0 0 1 0 2 /
27. 490. .12 /
SINK 12 - SCRAM DISCHARGE PIPING
1 1 1 14 0 0 3580. 0. 1.E6 8*0. /
1 0 .2625 2*280. 2 0 0 1 0 2 /
27. 490. .12 /
2 -1. 1. 1. .92 1. 1 70. 2*0 /ZZ1-1
2 -1. 1. 1. .92 1. 2 70. 2*0 /ZZ1-2
2 -1. 1. 1. .92 1. 3 70. 2*0 /ZZ1-3
10 1 70. 60. .9 5*0 /ZZ1-4
10 2 70. 60. .9 5*0 /ZZ1-5
10 3 70. 60. .9 5*0 /ZZ1-6
3 9*0. /ZZ1-7
3 10. 8*0. /ZZ1-8
4 1 7 7*0. /ZZ1-9
4 2 6 7*0. /ZZ1-10
4 3 6 7*0. /ZZ1-11
2 -1. 1. 1. .92 1. 1 .5 2*0. /ZZ1-12
```

```
2 -1. 1. 1. .92 1. 1 .1 2*0. /ZZ1-13
4 . 4 7*0. /ZZ1-14
0 0 .001 1000 140.4 1000 140.5 0 329.5 0 329.6 1000 1.E6 1000  /ZZ2-1
0 0 3 0 3.1 1000 86.9 1000 87 0 1.E6 0  /ZZ2-2
0 0 5.9 0 6 1000 26.9 1000 27 0 1.E6 0 /ZZ2-3
0. 0. .001 0. 1. 2.173 1.E6 2.173 /ZZ2-4
```