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Our ref: DCP_NRC_003171

June 12, 2011

Subject: Transmittal of Revision 19 DCD Markups Resulting from the Revision of APP-GW-GLR-096 Proprietary), "Evaluation of the Effect of the AP1000® Enhanced Shield Building Design on the Containment Response and Safety Analyses" for the Updated Peak Containment Pressure Calculation

Westinghouse is submitting Design Control Document (DCD) Revision 19 Markups associated with the revision to APP-GW-GLR-096 (Proprietary), "Evaluation of the Effect of the AP1000 Enhanced Shield Building Design on the Containment Response and Safety Analyses" which documents the updated peak containment pressure calculation in support of the AP1000 Design Certification Amendment Application (Docket No. 52-006). The DCD Revision 19 markups are provided in Enclosure 1 to this letter. The information provided in this letter is generic and is expected to apply to all Combined Operating License (COL) applicants referencing the AP1000 Design Certification and the AP1000 Design Certification Amendment Application.

Questions or requests for additional information related to the content and preparation of this report should be directed to Westinghouse. Please send copies of such questions or requests to the prospective applicants for combined licenses referencing the AP1000 Design Certification. A representative for each applicant is included on the cc: list of this letter.

Very truly yours,

R. F. Ziesing
Director, U.S. Licensing

Enclosure:

1. AP1000 Design Control Document Revision 19 Markups

D063
NRO

cc:
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ENCLOSURE 1

AP1000 Design Control Document Revision 19 Markups

(Non-Proprietary)

Table 1-1 (Cont.)
Index of AP1000 Tier 2 Information Requiring NRC Approval for Change

Item	Expiration at First Full Power	Tier 2 Reference
Maximum Fuel Rod Average Burnup	No	4.3.1.1.1
Reactor Core Description (First Cycle)	Yes	Table 4.3-1
Nuclear Design Parameters (First Cycle)	Yes	Table 4.3-2
Reactivity Requirements for Rod Cluster Control Assemblies	Yes	Table 4.3-3
ASME Code Piping Design Restrictions	Yes	5.2.1.1
Reactor Coolant Pump Design	No	5.4.1.2.1
MOV Design and Qualification	Yes	5.4.8.1.2
Other Power-Operated Valves Design and Qualification	Yes	5.4.8.1.3
Motor Operated Valves	Yes	5.4.8.5.2
Power Operated Valves	Yes	5.4.8.5.3
ASME Code Cases	Yes	Table 5.2-3 5.2.1.2
General Screen Design Criteria	No	6.3.2.2.7.1
Heat Sink Data for Containment Peak Pressure Calculation	No	Table 6.2.1.1-10
WCAP-17201-P, "AC160 High Speed Link Communication Compliance to DI&C-ISG-04 Staff Position 9, 12, 13, and 15," Rev 0, February 2010	Yes	Table 1.6-1 7.1.7
WCAP-15927 (Non-Proprietary), "Design Process for AP1000 Common Q Safety Systems," Rev 2	Yes	Table 1.6-1 7.1.2.14.1 7.1.7
WCAP-17179, "AP1000 Component Interface Module Technical Report" Rev 2	Yes	Table 1.6-1 7.1.7
WCAP-16097-P-A, "Common Qualified Platform," Rev 0	Yes	Table 1.6-1 7.1.2.14.2 7.1.7
WCAP-16096-NP-A, "Software Program Manual for Common Q Systems," Rev 01A	Yes	Table 1.6-1 7.1.2.14 7.1.2.14.1 7.1.7
Verification and Validation	Yes	7.1.2.14
Hard-wired DAS manual actuation	No	7.7.1.11
Nuclear Island Fire Areas	No	Figure 9A-1
Turbine Building Fire Areas	No	Figure 9A-2
Annex I & II Building Fire Areas	No	Figure 9A-3

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Comment [tlw30]: 38
Deleted: WCAP-14605, "Westinghouse Setpoint Methodology for Protection Systems, AP600," Rev 0
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The containment vessel is designed and constructed in accordance with the ASME Code, Section III, Subsection NE, Metal Containment, as described in subsection 3.8.2.

Structural steel non-pressure retaining parts such as ladders, walkways, and handrails are designed to the requirements for steel structures defined in subsection 3.8.4.

The design features provide adequate containment sump levels following a design basis event as described in subsection 3.4.

Containment and subcompartment atmospheres are maintained during normal operation within prescribed pressure, temperature, and humidity limits by means of the containment air recirculation system (VCS), and the central chilled water system (VWS). The recirculation system cooling coils are provided with chilled water for temperature control. The filtration supply and exhaust subsystem can be utilized periodically to purge the containment air for pressure control. Periodic inspection and maintenance verify functional capability.

6.2.1.1.3 Design Evaluation

The Westinghouse-GOTHIC (WGOTHIC) computer code (Reference 20) is a computer program for modeling multiphase flow in a containment transient analysis. It solves the conservation equations in integral form for mass, energy, and momentum for multicomponent flow. The momentum conservation equations are written separately for each phase in the flow field (drops, liquid pools, and atmosphere vapor). The following terms are included in the momentum equation: storage, convection, surface stress, body force, boundary source, phase interface source, and equipment source.

To model the passive cooling features of the AP1000, several assumptions are made in creating the plant decks. The external cooling water does not completely wet the containment shell, therefore, both wet and dry sections of the shell are modeled in the WGOTHIC analyses. The analyses use conservative coverage fractions to determine evaporative cooling.

Heat conduction from the dry to wet section is considered in the analysis. The combination of passive containment cooling system coverage area and heat conduction from the dry to wet sections is explained in Chapter 7 of Reference 20. An analysis is also performed for the limiting LOCA event without considering heat conduction from the dry to wet section. The analyses conservatively assume that the external cooling water is not initiated until 400 seconds (Reference 36) into the transient, allowing time to initiate the signal and to fill the headers and weirs and to develop the flow down the containment side walls. The effects of water flowing down the shell from gravitational forces are explicitly considered in the analysis.

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The containment initial conditions of pressure, temperature, and humidity are provided in Table 6.2.1.1-2.

For the LOCA events, two double-ended guillotine reactor coolant system pipe breaks are analyzed. The breaks are postulated to occur in either a hot or a cold leg of the reactor coolant system. The hot leg break results in the highest blowdown peak pressure. The cold leg break results in the higher post-blowdown peak pressure. The cold leg break analysis includes the long term contribution to containment pressure from the sources of stored energy, such as the steam

generators. The LOCA mass and energy releases described in subsection 6.2.1.3 are used for these calculations.

For the MSLB event, a representative pipe break spectrum is analyzed. Various break sizes and power levels are analyzed with the WGOTHIC code. The MSLB mass and energy releases described in subsection 6.2.1.4 are used for these calculations.

The results of the LOCA and MSLB postulated accidents are provided in Table 6.2.1.1-1. A comparison of the containment integrity acceptance criteria to General Design Criteria is provided in Table 6.2.1.1-3.

The containment pressure response for the peak pressure steam line break case is provided in Figure 6.2.1.1-1. The containment temperature response for the peak temperature steam line break case is provided in Figure 6.2.1.1-2.

The passive internal containment heat sink data used in the WGOTHIC analyses is presented in Reference 20, Section 13 and updated in Reference 36. Data for both metallic and concrete heat sinks are presented. Additional heat sink data utilized in the containment peak pressure analysis, as updated in Reference 36, are identified in Table 6.2.1.1-10. These additional heat sinks are characterized as metal gratings with material type and minimum required surface area and volume within the subcompartment defined in Table 6.2.1.1-10. The containment pressure and temperature responses to a double-ended cold leg guillotine are presented in Figures 6.2.1.1-5 and 6.2.1.1-6 for the 24 hour portion of the transient and Figures 6.2.1.1-7 and 6.2.1.1-8 for the 72 hour transient. A separate analysis for the double-ended cold leg guillotine LOCA event, without considering heat conduction from the dry to wet section, results in somewhat higher containment pressure in the long term, but still below 50 percent of design pressure at 24 hours. This separate analysis confirms the assumption in subsection 15.6.5.3.3 of reducing the containment leakage to half its design value at 24 hours. The containment pressure and temperature response to a double-ended hot leg guillotine break are presented in Figures 6.2.1.1-9 and 6.2.1.1-10. The physical properties of the materials corresponding to the heat sink information are presented in Table 6.2.1.1-8.

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The instrumentation provided outside containment to monitor and record the containment pressure and the instrumentation provided inside containment to monitor and record temperature are found in Section 7.5.

6.2.1.1.4 External Pressure Analysis

Certain design basis events and credible inadvertent systems actuation have the potential to result in containment external pressure loads. Evaluations of these events show that a loss of all ac power sources during cold ambient conditions has the potential for creating the worst-case external pressure load on the containment vessel. This event leads to a reduction in the internal containment heat loads from the reactor coolant system and other active components, thus resulting in a temperature reduction within the containment and an accompanying pressure reduction. Evaluations are performed to determine the maximum external pressure to which the containment may be subjected, and to develop the allowable operating temperature bands presented in LCO 3.6.10 of the Technical Specifications.

6.2.1.4.3 Containment Response Analysis

The WGOTHIC Computer Code (Reference 20) is used to determine the containment responses following the steam line break, which is documented in Reference 36. The containment response analysis is described in subsection 6.2.1.1.

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6.2.1.4.3.1 Initial Conditions

The initial containment conditions are discussed in subsection 6.2.1.1.3.

6.2.1.4.3.2 Mass and Energy Release Data

Using References 5, 6, 31 and 32 as a basis, mass and energy release data are developed to determine the containment pressure-temperature response for the spectrum of breaks analyzed. Table 6.2.1.4-2 provides the mass and energy release data for the cases that produce the highest containment pressure and temperature in the containment response analysis. Table 6.2.1.4-4 provides nominal plant data used in the mass and energy releases determination.

6.2.1.4.3.3 Containment Pressure-Temperature Results

The results of the containment pressure-temperature analyses for the postulated secondary system pipe ruptures that produce the highest peak containment pressure and temperature are presented in subsection 6.2.1.1.3.

6.2.1.5 Minimum Containment Pressure Analysis for Performance Capability Studies of Emergency Core Cooling System (PWR)

The containment backpressure used for the AP1000 cold leg guillotine and split breaks for the emergency core cooling system (ECCS) analysis presented in subsection 15.6.5 is described. The minimum containment backpressure for emergency core cooling system performance during a loss-of-coolant accident is computed using the WGOTHIC computer code. Subsection 6.2.1.1 demonstrates that the AP1000 containment pressurizes during large break LOCA events. An analysis is performed to establish a containment pressure boundary condition applied to the WCOBRA/TRAC code (Reference 8). A single-node containment model is used to assess containment pressure response. Containment internal heat sinks used heat transfer correlations of 4 times Tagami during the blowdown phase followed by 1.2 times Uchida for the post-blowdown phase. The calculated containment backpressure is provided in Figure 6.2.1.5-1. Results of the WCOBRA/TRAC analyses demonstrate that the AP1000 meets 10 CFR 50.46 requirements (Reference 7).

6.2.1.5.1 Mass and Energy Release Data

The mass and energy releases to the containment during the blowdown portion only of the double-ended cold-leg guillotine break (DECLG) transient are presented in Table 6.2.1.5-1, as computed by the WCOBRA/TRAC code.

The mathematical models which calculate the mass and energy releases to the containment are described in subsection 15.6.5. A break spectrum analysis is performed (see references in

32. WCAP-15644-P (Proprietary) and WCAP-15644-NP (Non-Proprietary), "AP1000 Code Applicability Report," Revision 2, March 2004.

33. NEI 06-12, "B.5.b Phase 2 & 3 Submittal Guidelines," Revision 2.

34. APP-GW-GLR-138, "Evaluation of the Pressurizer Changes on the AP1000 TMD Analyses," Westinghouse Electric Company LLC, Rev. 0, August 2009.

35. APP-GW-GLR-139, "AP1000 WGOTHIC Containment Models: Disposition of Design Change Proposals," Westinghouse Electric Company LLC, Rev. 0, August 2009.

36. APP-GW-GLR-096, "Evaluation of the Effect of AP1000 Enhanced Shield Building Design on the Containment Response and Safety Analysis," Westinghouse Electric Company LLC, Rev. 3, June 2011

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Table 6.2.1.1-1

SUMMARY OF CALCULATED PRESSURES AND TEMPERATURES

Break	Peak Pressure (psig)	Available[1] Margin (psi)	Peak Temperature (°F)
Double-ended hot leg guillotine	50[4]	8.6	411.3
Double-ended cold leg guillotine	58.3	0.7	295.7
Full main steam line DER, 30% power, MSIV failure	58.2	0.8	373.2
Full main steam line DER, 101% power, MSIV failure	54.2	4.8	374.7

Note:
1. Design Pressure is 59 psig

Table 6.2.1.1-2

INITIAL CONDITIONS

Internal Temperature (°F)	120
Pressure (psia)	15.7
Relative Humidity (%)	0
Net Free Volume (ft^3)	2.06E+06
External Temperature (°F)	115 dry bulb 86.1 wet bulb

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Table 6.2.1.1-3

RESULTS OF POSTULATED ACCIDENTS

Criterion	Acceptance Criterion Value	Lumped DEHLG LOCA Value	Lumped DECLG LOCA Value	30% Power MSLB Value	External Pressurization Value
GDC 16 & GDC 50 Design Pressure	<59.0 psig	50.4	58.3	58.2	
GDC 38 Rapidly Reduce Containment Pressure	< 29.5 psig		22 at 24 hrs		
GDC 38 & 50 External Pressure	< 1.7 psid				1.63
GDC 38 & GDC 50 Containment Heat Removal Single Failure	Most Severe	Two of Three Trains of PCS Water Supply	Two of Three Trains of PCS Water Supply	Two of Three Trains of PCS Supply	

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Table 6.2.1.1-8

PHYSICAL PROPERTIES OF PASSIVE HEAT SINKS

Material	Density (lbm/ft^3)	Thermal Conductivity (Btu/hr-ft-°F)	Specific Heat (Btu/lbm-°F)	Dry Emis.	Wet Emis.
Epoxy	105	0.1875	0.25	0.81	0.95
Carbon Steel	490.7	23.6	0.107	0.81	0.95
Concrete	140.	0.83	0.19	0.81	0.95
Stainless Steel	501.	9.4	0.12	0.81	0.95
Inorganic Zinc Coating	207.5	0.302	0.13	0.81	0.95
Inorganic Zinc Coating - Containment Vessel Interior Surface	207.5	0.302	0.13	1e-10	1e-10
Air @ 0°F	0.0864	0.0131	0.240	1e-10	1e-10
Air @ 250°F	0.056	0.0192	0.242	1e-10	1e-10
Air @ 500°F	0.0414	0.0246	0.248	1e-10	1e-10
Carbon Steel – Containment Vessel	483.8	30.0	0.107	0.81	0.95

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Comment [tlw18]: 38
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Table 6.2.1.1-10

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*DATA FOR ADDITIONAL HEAT SINKS CREDITED IN THE CONTAINMENT PEAK PRESSURE EVALUATION**

Containment Subcompartment	*Minimum Required Surface Area (ft^2)*	*Minimum Required Volume (ft^3)*
Vertical Access Tunnel	*865*	*15.1*
PXS-A	*1153*	*20.2*
PXS-B	*1681*	*29.4*
SG East	*1228*	*34.0*
SG West	*1752*	*60.7*
CMT	*12477*	*303.7*
Above Operating Deck	*4068*	*71.1*

Notes:

1. *Heat sink material is carbon steel and coated with epoxy.*
2. *Thermal properties of carbon steel and epoxy are contained in Table 6.2.1.1-8.*
3. *Density for the carbon steel references in this table is 490.7 lbm/ft^3.*

*NRC Staff approval is required prior to implementing a change in this information; see DCD Introduction Section 3.5.

Table 6.2.1.3-8

BASIS FOR LONG-TERM ANALYSIS

Number of Loops	2
Active Core Length (ft)	14.0
Core Power, license application (MWt)	3400
Nominal Vessel Inlet Temperature (°F)	537.2
Nominal Vessel Outlet Temperature (°F)	610.0
Steam Pressure (psia)	881.0
Rod Array	17 x 17
Accumulator Temperature (°F)	120.0
Containment Design Pressure (psia)	73.7

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Table 6.2.1.3-9 (Sheet 1 of 11)

LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
0.00000	0.00	0.00	0.00	1172.85
0.00106	39416.39	533.99	0.00	1172.85
0.00205	39976.70	534.01	0.00	1172.85
0.00303	39846.93	534.01	0.00	1172.85
0.00405	39714.54	533.99	0.00	1172.85
0.00507	39589.59	533.98	0.00	1172.85
0.00612	39451.90	533.96	0.00	1172.85
0.10129	62033.18	536.91	0.00	1172.85
0.20104	73009.07	536.91	0.00	1172.85
0.30113	86432.41	536.87	0.00	1172.85
0.40120	79446.89	536.88	0.00	1172.85
0.50140	77370.88	537.82	0.00	1172.85
0.60106	76904.12	538.37	0.00	1172.85
0.70177	76060.88	538.83	0.00	1172.85
0.80165	75376.28	539.70	0.00	1172.85
0.90141	74246.59	540.87	0.00	1172.85
1.00122	73369.21	542.22	0.00	1172.85
1.10107	72315.43	543.89	0.00	1172.85
1.20142	71305.65	545.78	0.00	1172.85
1.30141	70499.98	547.82	0.00	1172.85
1.40130	69797.20	550.01	0.00	1172.85
1.50139	67976.37	552.07	0.00	1172.85
1.60115	64602.17	553.99	0.00	1172.85

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Table 6.2.1.3-9 (Sheet 2 of 11)

LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
1.70144	62109.77	555.73	0.00	1172.85
1.80127	60497.08	557.14	0.00	1172.85
1.90109	59508.83	558.25	0.00	1172.85
2.00159	58409.53	559.25	0.00	1172.85
2.10125	56888.18	560.17	0.00	1172.85
2.20135	55110.10	561.09	0.00	1172.85
2.30100	53295.89	561.93	0.00	1172.85
2.40127	51285.51	562.69	0.00	1172.85
2.50117	49717.93	563.38	0.00	1172.85
2.60117	48965.37	563.94	0.00	1172.85
2.70140	47917.67	564.17	0.00	1172.85
2.80106	46919.37	564.30	0.00	1172.85
2.90111	45946.26	564.51	0.00	1172.85
3.00117	46189.59	564.85	0.00	1172.85
3.10117	43775.21	565.36	0.00	1172.85
3.20134	42401.87	565.88	0.00	1172.85
3.30120	41200.81	566.38	0.00	1172.85
3.40103	40239.87	566.79	0.00	1172.85
3.50175	36546.17	567.00	0.00	1172.85
3.60139	24505.70	566.44	0.00	1172.85
3.70182	23263.27	567.11	0.00	1172.85
3.80160	24316.00	565.41	0.00	1172.85
3.90144	24369.44	564.02	0.00	1172.85

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Table 6.2.1.3-9 (Sheet 3 of 11)

**LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES**

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
4.00212	24251.95	563.00	0.00	1172.85
4.20107	23573.04	562.04	0.00	1172.85
4.40010	22818.81	561.68	0.00	1172.85
4.60108	22287.56	561.19	0.00	1172.85
4.80022	22107.57	560.54	0.00	1172.85
5.00030	22154.66	560.29	0.00	1172.85
5.20008	21982.49	560.79	0.00	1172.85
5.40054	21706.69	561.53	0.00	1172.85
5.60035	21384.36	561.70	0.00	1172.85
5.80005	21531.49	561.36	0.00	1172.85
6.00025	21449.36	561.24	0.00	1172.85
6.20003	21111.86	561.26	0.00	1172.85
6.40023	21047.40	561.19	0.00	1172.85
6.60025	21232.17	561.57	0.00	1172.85
6.80031	21091.05	561.89	0.00	1172.85
7.00036	20724.78	562.37	0.00	1172.85
7.20014	20684.39	562.84	0.00	1172.85
7.40050	20576.96	563.22	0.00	1172.85
7.60042	20434.16	563.56	0.00	1172.85
7.80042	20332.58	563.86	0.00	1172.85
8.00086	20183.03	564.16	0.00	1172.85
8.20072	20017.61	564.46	0.00	1172.85
8.40061	19843.80	564.84	0.00	1172.85

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Table 6.2.1.3-9 (Sheet 4 of 11)

**LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES**

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
8.60116	19967.02	565.50	0.00	1172.85
8.80017	19944.71	566.66	0.00	1172.85
9.00004	19910.34	568.18	0.00	1172.85
9.20083	20078.99	569.94	0.00	1172.85
9.40081	19954.34	571.57	0.00	1172.85
9.60203	19612.24	573.51	0.00	1172.85
9.80018	19436.45	575.24	0.00	1172.85
10.00057	19192.38	576.99	0.00	1172.85
10.20023	18982.33	579.53	0.00	1172.85
10.40026	19035.40	582.32	0.00	1172.85
10.60066	18966.98	584.39	0.00	1172.85
10.60160	18965.07	584.40	0.00	1172.85
10.60265	18963.01	584.41	0.00	1172.85
10.60374	18960.62	584.42	0.00	1172.85
10.80033	18582.28	586.79	0.00	1172.85
11.00115	18202.83	589.43	0.00	1172.85
11.20104	17769.72	593.05	0.00	1172.85
11.40046	17501.65	596.98	0.00	1172.85
11.60025	17153.51	601.18	0.00	1172.85
11.80072	16840.23	606.51	0.00	1172.85
12.00026	16386.11	613.05	0.00	1172.85
12.20016	15967.55	621.15	0.00	1172.85
12.40094	15659.93	630.30	0.00	1172.85

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Table 6.2.1.3-9 (Sheet 5 of 11)

LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
12.60034	15146.48	641.10	0.00	1172.85
12.80076	14590.31	654.42	0.00	1172.85
13.00099	13763.97	670.42	0.00	1172.85
13.20002	12956.41	688.11	0.00	1172.85
13.40039	12163.43	707.19	0.00	1172.85
13.60078	11447.48	726.91	0.00	1172.85
13.80052	10813.78	745.79	0.00	1172.85
14.00045	10281.84	762.99	0.00	1172.85
14.20056	9855.38	777.70	0.00	1172.85
14.40055	9516.34	788.78	0.00	1172.85
14.60032	9294.01	794.02	0.00	1172.85
14.80061	9114.06	796.99	0.00	1172.85
15.00052	8850.02	805.47	0.00	1172.85
15.20054	8553.39	817.58	0.00	1172.85
15.40027	8269.91	830.19	0.00	1172.85
15.60031	7996.68	843.22	0.00	1172.85
15.80071	7782.09	851.98	0.00	1172.85
16.00025	7542.15	863.42	0.00	1172.85
16.20024	7325.72	874.13	0.00	1172.85
16.40057	7106.64	885.66	0.00	1172.85
16.60056	6922.81	894.38	0.00	1172.85
16.80062	6743.83	903.23	0.00	1172.85
17.00075	6566.78	912.24	0.00	1172.85
17.20051	6393.25	919.45	0.00	1172.85

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Table 6.2.1.3-9 (Sheet 6 of 11)

LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
17.40063	6240.54	913.83	0.00	1172.85
17.60044	6071.28	895.82	0.00	1172.85
17.80026	5905.23	867.46	0.00	1172.85
18.00064	5938.72	825.82	0.00	1172.85
18.20039	6053.69	780.58	0.00	1172.85
18.40067	5936.43	748.79	0.00	1172.85
18.60058	5636.40	745.76	0.00	1172.85
18.80048	5289.59	756.38	0.00	1172.85
19.00024	4967.25	764.96	0.00	1172.85
19.20011	4713.96	763.33	0.00	1172.85
19.40067	4492.20	756.38	0.00	1172.85
19.60046	4291.21	746.54	0.00	1172.85
19.80071	4155.79	723.01	0.00	1172.85
20.00029	4099.29	685.55	0.00	1172.85
20.20059	4030.29	656.55	0.00	1172.85
20.40018	3966.41	635.51	0.00	1172.85
20.60045	3864.88	620.35	0.00	1172.85
20.80078	3777.01	606.45	0.00	1172.85
21.00050	3702.30	593.76	0.00	1172.85
21.20040	3625.58	582.35	0.00	1172.85
21.40064	3554.22	571.10	0.00	1172.85
21.60050	3482.45	560.27	0.00	1172.85
21.80035	3409.47	549.98	0.00	1172.85
22.00024	3330.23	538.56	0.00	1172.85

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Table 6.2.1.3-9 (Sheet 7 of 11)

**LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES**

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
22.40009	3211.59	510.03	0.00	1172.85
22.60079	3170.54	496.12	0.00	1172.85
22.80007	3115.93	482.66	0.00	1172.85
23.00017	3070.13	468.89	0.00	1172.85
23.20049	2953.19	457.76	0.00	1172.85
23.40029	2850.71	446.64	0.00	1172.85
23.60026	2743.80	441.53	0.00	1172.85
23.80056	2564.31	436.72	0.00	1172.85
24.00011	2312.77	430.33	0.00	1172.85
24.20029	2022.67	391.79	0.00	1172.85
24.40060	1789.45	383.80	0.00	1172.85
24.60056	1562.10	371.67	0.00	1172.85
24.80027	1264.72	364.69	0.00	1172.85
25.00012	807.58	369.35	0.00	1172.85
25.20050	254.59	483.68	0.00	1172.85
25.40008	0.00	0.00	0.00	1172.85
27.980	900.01	155.88	322.31	1172.85
35.282	741.50	167.47	318.12	1172.85
39.990	662.30	175.24	315.48	1172.85
44.262	602.24	182.49	314.70	1172.85
51.113	566.91	190.19	312.63	1172.85
55.330	559.01	193.74	311.09	1172.85
60.087	551.28	197.53	309.28	1172.85
64.616	548.38	200.55	308.04	1172.85

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Table 6.2.1.3-9 (Sheet 8 of 11)

LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
69.760	536.44	204.79	306.80	1172.85
75.648	528.90	208.73	305.14	1172.85
79.698	523.18	211.36	303.97	1172.85
86.426	512.04	215.72	302.73	1172.85
91.000	505.55	218.37	301.80	1172.85
95.000	497.31	220.97	301.05	1172.85
101.000	482.47	225.14	299.97	1172.85
105.000	473.08	227.77	299.48	1172.85
111.000	458.62	231.71	298.74	1172.85
119.000	438.69	236.98	297.73	1172.85
132.233	415.52	243.46	295.45	1172.85
142.632	419.49	243.29	292.35	1172.85
153.031	417.99	243.83	289.39	1172.85
163.430	413.42	244.66	287.28	1172.85
168.629	408.62	245.54	286.33	1172.85
184.228	393.40	248.17	283.48	1172.85
194.627	382.57	249.98	281.59	1172.85
215.040	357.65	254.44	278.09	1172.85
225.145	351.34	255.50	270.23	1172.85
251.346	321.37	260.99	266.35	1172.85
262.107	306.77	264.16	264.97	1172.85
278.625	283.12	269.89	263.01	1172.85
299.449	251.73	278.75	260.85	1172.85
319.815	220.69	289.15	259.03	1172.85

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Table 6.2.1.3-9 (Sheet 9 of 11)

**LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES**

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
341.5580	0.0000	1172.8490	268.74	1172.85
357.3810	12.0055	940.0599	287.75	1172.85
380.0890	32.9991	553.7724	287.75	1172.85
401.3400	30.7774	566.7261	283.29	1172.85
422.8900	103.4044	359.3976	209.22	1172.85
439.2970	104.3732	355.6279	206.06	1172.85
461.7220	105.6001	350.6113	201.85	1172.85
482.5200	106.5179	346.2153	198.06	1172.85
503.3180	107.3398	341.9462	194.37	1172.85
518.9160	107.8976	338.8224	191.67	1172.85
539.7140	108.5566	334.7663	188.14	1172.85
560.5120	109.1380	330.8147	184.70	1172.85
581.3090	108.6867	327.8756	181.46	1172.85
602.1070	107.4965	325.6686	178.38	1172.85
648.9020	107.9551	317.6940	171.71	1172.85
701.6770	107.7743	309.5292	164.65	1172.85
749.3880	107.2554	302.6308	158.63	1172.85
801.3820	106.3264	295.6147	152.43	1172.85
848.6190	104.9430	289.8565	147.34	1172.85
898.3740	103.1431	284.2729	142.28	1172.85
947.8310	101.1513	279.0810	137.49	1172.85
1002.8910	98.6402	273.7811	132.46	1172.85
1129.2100	514.8312	141.7533	111.98	1172.85
1279.9000	524.2230	133.2774	103.22	1172.85

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Table 6.2.1.3-9 (Sheet 10 of 11)

**LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES**

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
1380.020	525.93	128.72	98.03	1172.85
1531.160	526.97	122.83	90.99	1172.85
1984.630	524.92	110.36	74.95	1172.85
3997.770	472.92	94.61	46.88	1172.85
6009.010	416.60	93.23	38.41	1172.85
6512.700	390.70	93.40	37.33	1172.85
7518.200	348.88	93.74	35.43	1172.85
8022.810	326.01	94.01	34.56	1172.85
9980.830	250.94	95.31	32.23	1172.85
10000.000	0.00	1171.70	37.21	1171.70
15005.000	0.00	1171.70	33.26	1171.70
20005.800	0.00	1171.70	30.79	1171.70
26007.300	0.00	1171.70	29.31	1171.70
30007.900	0.00	1171.70	28.32	1171.70
36008.100	0.00	1171.70	26.70	1171.70
40000.00	0.00	1171.70	25.62	1171.70
60000.00	0.00	1171.70	22.92	1171.70
80000.00	0.00	1171.70	21.16	1171.70
100000.00	0.00	1171.70	19.83	1171.70
150000.00	0.00	1171.70	17.53	1171.70
200000.00	0.00	1171.70	15.96	1171.70
400000.00	0.00	1171.70	12.42	1171.70
600000.00	0.00	1171.70	10.54	1171.70
800000.00	0.00	1171.70	9.33	1171.70

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Table 6.2.1.3-9 (Sheet 11 of 11)

LONG-TERM DECL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass (lbm/sec)	Enthalpy (Btu/lbm)	Mass (lbm/sec)	Enthalpy (Btu/lbm)
1000000.00	0.00	1171.70	8.50	1171.70
1500000.00	0.00	1171.70	7.14	1171.70
2000000.00	0.00	1171.70	6.29	1171.70
4000000.00	0.00	1171.70	4.46	1171.70

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Comment [tlw42]: 38

Table 6.2.1.3-10 (Sheet 1 of 5)

BLOWDOWN DEHL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass Flow (lbm/sec)	Average Enthalpy (Btu/lbm)	Mass Flow (lbm/sec)	Enthalpy (Btu/lbm)
0.00	0.00	0.00	0.00	1175.70
.00106	1.0472857E+05	634.46	0.00	1175.70
.00210	1.0325730E+05	634.40	0.00	1175.70
.10148	7.3009123E+04	643.85	0.00	1175.70
.20165	6.8864739E+04	643.25	0.00	1175.70
.30138	6.5481087E+04	642.70	0.00	1175.70
.40100	6.2335330E+04	641.84	0.00	1175.70
.50142	6.0949874E+04	639.93	0.00	1175.70
.60102	6.0214627E+04	638.05	0.00	1175.70
.70129	5.9290581E+04	637.06	0.00	1175.70
.80149	5.8541050E+04	636.72	0.00	1175.70
.90118	5.7882765E+04	637.71	0.00	1175.70
1.00134	5.7049473E+04	639.31	0.00	1175.70
1.10143	5.6060274E+04	640.94	0.00	1175.70
1.20110	5.5129172E+04	642.91	0.00	1175.70
1.30126	5.4333519E+04	645.35	0.00	1175.70
1.40143	5.3626880E+04	647.68	0.00	1175.70
1.50123	5.2863252E+04	649.02	0.00	1175.70
1.60132	5.1884060E+04	648.33	0.00	1175.70
1.70124	5.0733241E+04	646.50	0.00	1175.70
1.80130	4.9539729E+04	645.28	0.00	1175.70
1.90186	4.8416888E+04	646.97	0.00	1175.70
2.00207	4.7522841E+04	647.55	0.00	1175.70
2.10122	4.6730052E+04	647.65	0.00	1175.70
2.20102	4.5964386E+04	647.24	0.00	1175.70

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Table 6.2.1.3-10 (Sheet 2 of 5)

BLOWDOWN DEHL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass Flow (lbm/sec)	Average Enthalpy (Btu/lbm)	Mass Flow (lbm/sec)	Enthalpy (Btu/lbm)
2.30175	4.5194131E+04	646.36	0.00	1175.70
2.40124	4.4466339E+04	645.15	0.00	1175.70
2.50163	4.3818315E+04	644.56	0.00	1175.70
2.60110	4.3241249E+04	643.98	0.00	1175.70
2.70114	4.2713371E+04	643.36	0.00	1175.70
2.80168	4.2204445E+04	642.87	0.00	1175.70
2.90107	4.1720541E+04	642.57	0.00	1175.70
3.00139	4.1246706E+04	642.48	0.00	1175.70
3.10145	4.0783182E+04	642.53	0.00	1175.70
3.20114	4.0343865E+04	642.61	0.00	1175.70
3.30119	3.9933129E+04	642.50	0.00	1175.70
3.40127	3.9576939E+04	642.21	0.00	1175.70
3.50170	3.9223318E+04	641.40	0.00	1175.70
3.60107	3.8980889E+04	638.54	0.00	1175.70
3.70199	3.8850339E+04	635.63	0.00	1175.70
3.80146	3.8773539E+04	632.86	0.00	1175.70
3.90127	3.8735175E+04	630.16	0.00	1175.70
4.00131	3.8691696E+04	627.56	0.00	1175.70
4.20091	3.8648194E+04	623.11	0.00	1175.70
4.40172	3.8688978E+04	619.44	0.00	1175.70
4.60164	3.8961243E+04	612.36	0.00	1175.70
4.80135	3.9496069E+04	604.95	0.00	1175.70
5.00064	3.9996688E+04	597.49	0.00	1175.70
5.20003	3.2619385E+04	635.27	0.00	1175.70
5.40018	3.3396422E+04	631.40	0.00	1175.70

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Table 6.2.1.3-10 (Sheet 3 of 5)

BLOWDOWN DEHL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass Flow (lbm/sec)	Average Enthalpy (Btu/lbm)	Mass Flow (lbm/sec)	Enthalpy (Btu/lbm)
5.60030	3.3535612E+04	626.87	0.00	1175.70
5.80024	3.3536109E+04	621.79	0.00	1175.70
6.00050	3.3539833E+04	617.55	0.00	1175.70
6.20071	3.3480513E+04	612.96	0.00	1175.70
6.40041	3.3116853E+04	611.87	0.00	1175.70
6.60070	3.2829941E+04	611.09	0.00	1175.70
6.80066	3.2276303E+04	612.66	0.00	1175.70
7.00012	3.1821538E+04	611.97	0.00	1175.70
7.20077	3.1481152E+04	610.09	0.00	1175.70
7.40195	3.1174078E+04	608.12	0.00	1175.70
7.60202	3.0845163E+04	606.66	0.00	1175.70
7.80324	3.0457254E+04	605.83	0.00	1175.70
8.00088	3.0011559E+04	605.56	0.00	1175.70
8.20197	2.9412544E+04	605.95	0.00	1175.70
8.40194	2.8503385E+04	607.44	0.00	1175.70
8.60004	2.7108284E+04	610.67	0.00	1175.70
8.80080	2.5646875E+04	614.84	0.00	1175.70
9.00254	2.4567453E+04	618.72	0.00	1175.70
9.20111	2.3734022E+04	625.11	0.00	1175.70
9.40041	2.2948447E+04	625.75	0.00	1175.70
9.60145	2.2264465E+04	629.35	0.00	1175.70
9.80270	2.1345812E+04	637.57	0.00	1175.70
10.00134	2.0701374E+04	638.31	0.00	1175.70
10.20182	1.9763504E+04	650.12	0.00	1175.70
10.20367	1.9754964E+04	650.21	0.00	1175.70

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Table 6.2.1.3-10 (Sheet 4 of 5)

BLOWDOWN DEHL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass Flow (lbm/sec)	Average Enthalpy (Btu/lbm)	Mass Flow (lbm/sec)	Enthalpy (Btu/lbm)
10.40170	1.8972361E+04	651.65	0.00	1175.70
10.60000	1.8098140E+04	664.95	0.00	1175.70
10.80010	1.7185009E+04	670.29	0.00	1175.70
11.00204	1.6448122E+04	684.57	0.00	1175.70
11.20050	1.5413417E+04	700.86	0.00	1175.70
11.40159	1.4795759E+04	706.65	0.00	1175.70
11.60189	1.3770572E+04	734.17	0.00	1175.70
11.80214	1.3005983E+04	742.10	0.00	1175.70
12.00084	1.2196029E+04	773.31	0.00	1175.70
12.20180	1.1199467E+04	807.86	0.00	1175.70
12.40173	1.0564109E+04	818.12	0.00	1175.70
12.60042	9.6889715E+03	870.24	0.00	1175.70
12.80116	8.7223448E+03	923.39	0.00	1175.70
13.00011	7.9349069E+03	951.19	0.00	1175.70
13.20029	7.7003327E+03	924.64	0.00	1175.70
13.40046	7.0267400E+03	962.01	0.00	1175.70
13.60018	6.5913280E+03	984.03	0.00	1175.70
13.80054	6.3863751E+03	962.75	0.00	1175.70
14.00007	6.1411967E+03	989.03	0.00	1175.70
14.20060	5.6037212E+03	1032.55	0.00	1175.70
14.40098	5.2091092E+03	1049.52	0.00	1175.70
14.60003	5.2400852E+03	988.43	0.00	1175.70
14.80020	4.8129799E+03	1042.80	0.00	1175.70
15.00047	4.4143954E+03	1078.20	0.00	1175.70
15.20047	4.0928075E+03	1101.17	0.00	1175.70

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Table 6.2.1.3-10 (Sheet 5 of 5)

BLOWDOWN DEHL BREAK
MASS AND ENERGY RELEASES

Time (sec)	Two-Phase		Steam	
	Mass Flow (lbm/sec)	Average Enthalpy (Btu/lbm)	Mass Flow (lbm/sec)	Enthalpy (Btu/lbm)
15.40040	4.0730341E+03	1036.73	0.00	1175.70
15.60041	3.6883949E+03	1117.78	0.00	1175.70
15.80063	3.2664683E+03	1182.02	0.00	1175.70
16.00039	2.9907188E+03	1207.15	0.00	1175.70
16.20005	2.7847928E+03	1220.90	0.00	1175.70
16.40089	2.5640037E+03	1228.55	0.00	1175.70
16.60062	2.3707725E+03	1233.97	0.00	1175.70
16.80023	2.2017889E+03	1238.45	0.00	1175.70
17.00050	2.0386489E+03	1242.27	0.00	1175.70
17.20017	1.8646346E+03	1245.21	0.00	1175.70
17.40063	1.6920100E+03	1247.03	0.00	1175.70
17.60104	1.5257772E+03	1248.88	0.00	1175.70
17.80003	1.3706741E+03	1250.77	0.00	1175.70
18.00000	1.2540191E+03	1249.41	0.00	1175.70
18.20064	1.1533549E+03	1251.39	0.00	1175.70
18.40001	9.8416016E+02	1259.51	0.00	1175.70
18.60052	8.2114511E+02	1265.36	0.00	1175.70
18.80084	6.7216213E+02	1268.83	0.00	1175.70
19.00052	5.0509715E+02	1273.94	0.00	1175.70
19.20017	3.0559956E+02	1280.30	0.00	1175.70
19.40074	1.3560178E+02	1282.56	0.00	1175.70
19.60010	.0000000E+00	.00	0.00	1175.70

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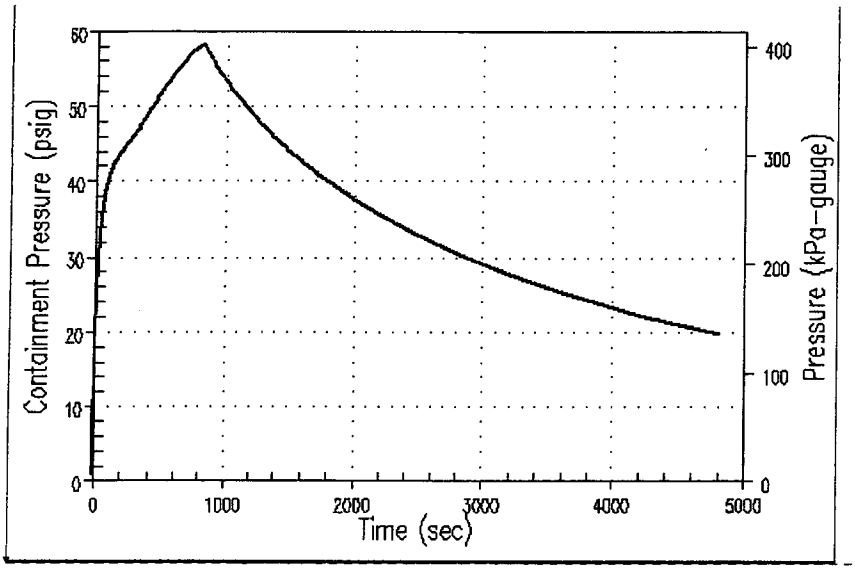

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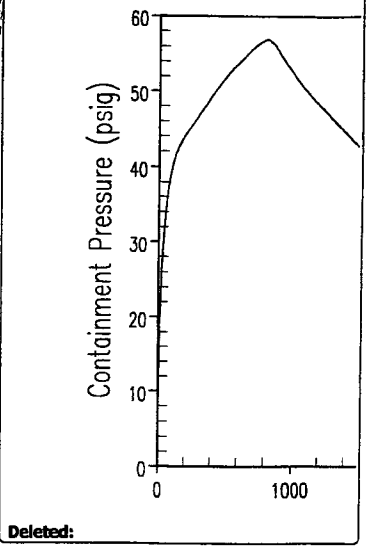

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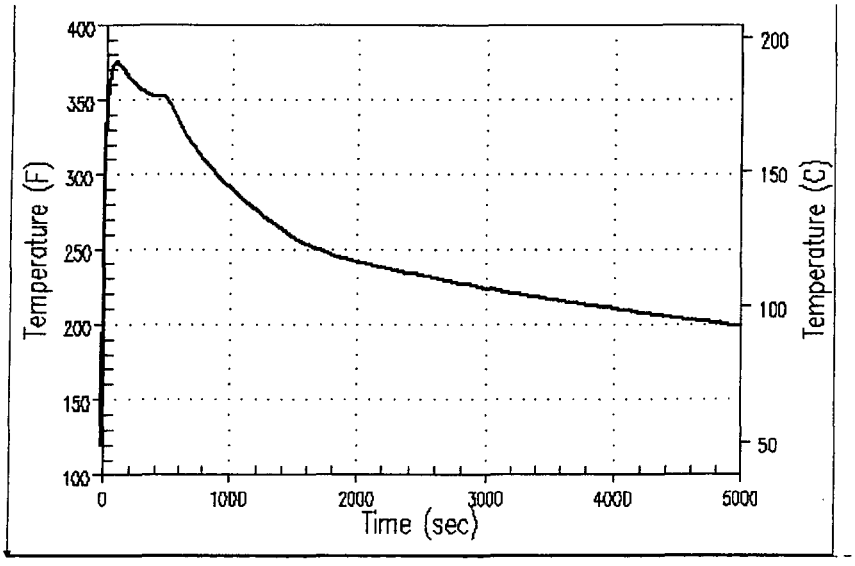
Figure 6.2.1.1-1

AP1000 Containment Response for Full DER MSLB – 30% Power



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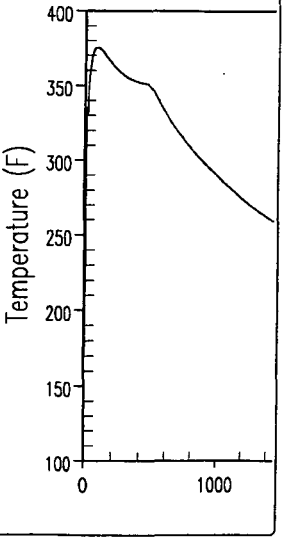

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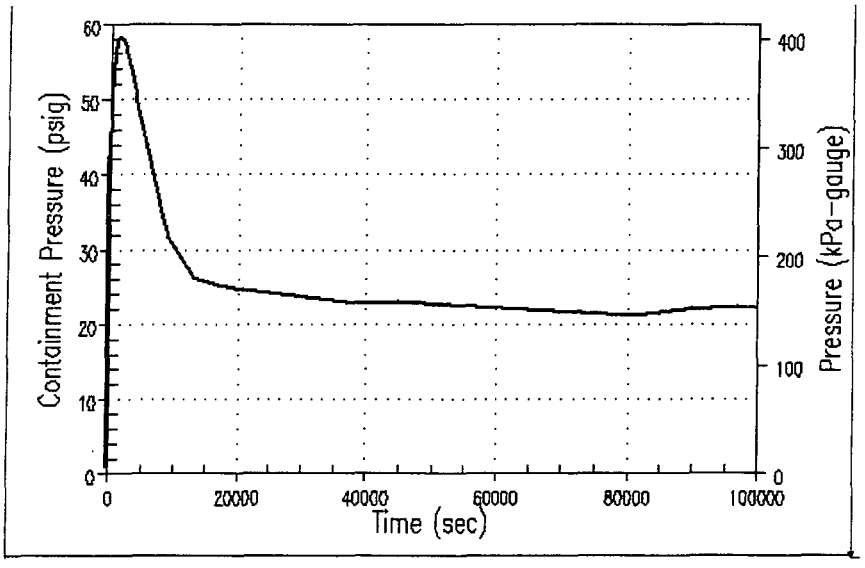
Figure 6.2.1.1-2

AP1000 Containment Response for Full DER MSLB – 101% Power



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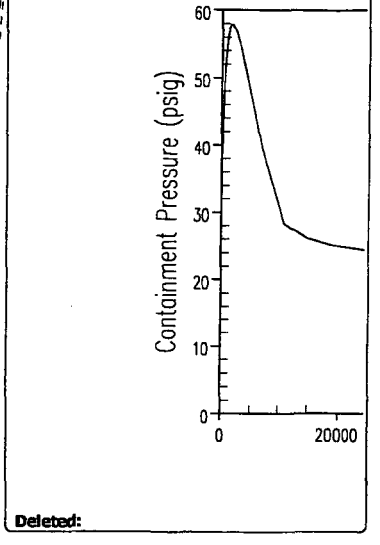

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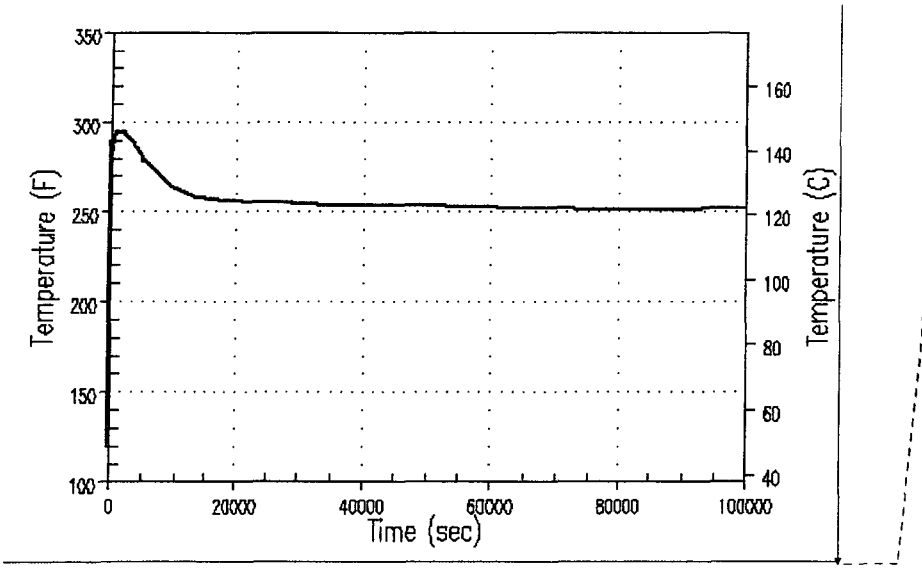
AP1000 Containment Pressure Response for DECLG LOCA



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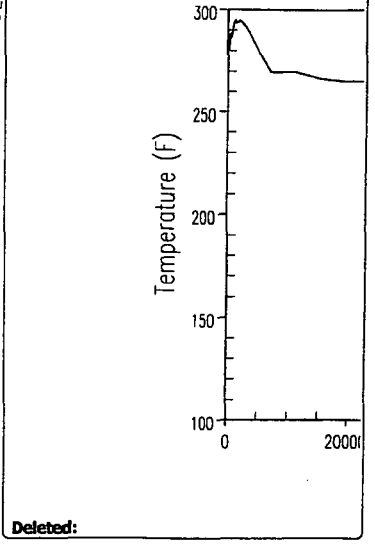

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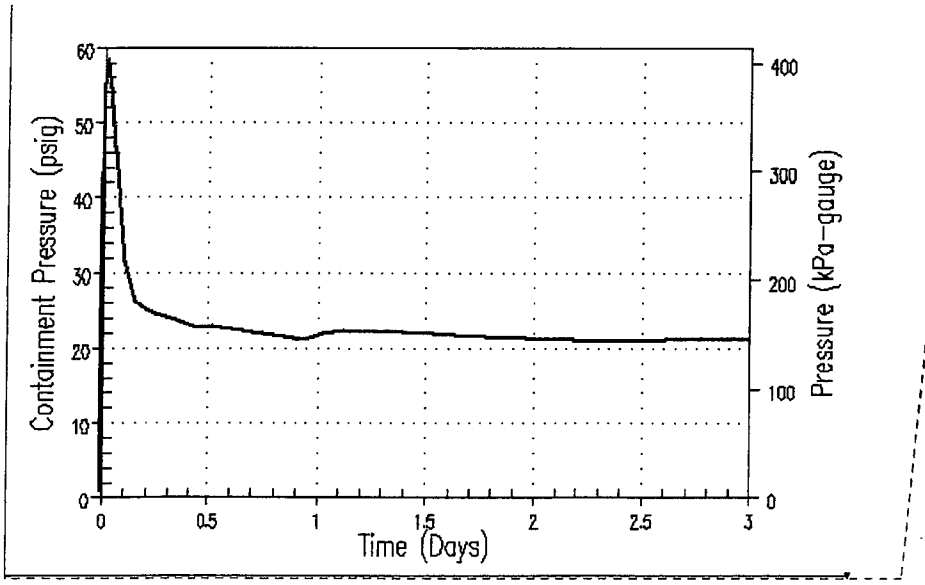
Figure 6.2.1.1-6

AP1000 Containment Temperature Response to DECLG LOCA



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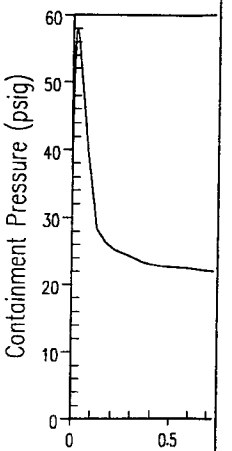

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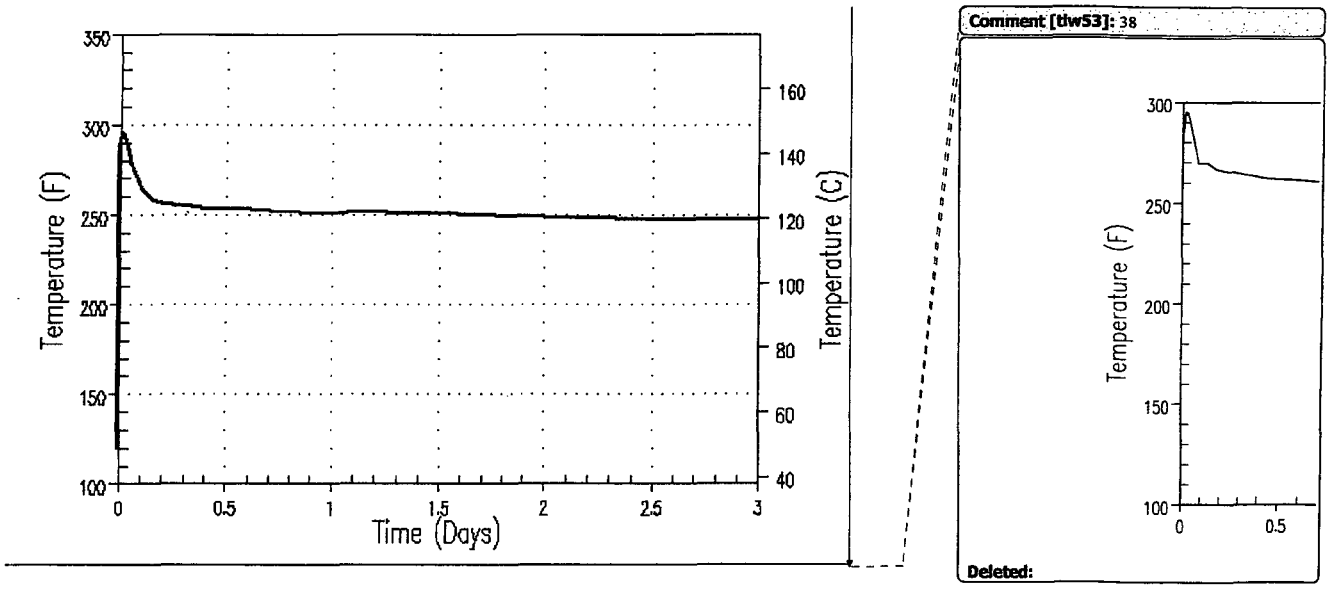
Figure 6.2.1.1-7

AP1000 Containment Pressure Response for DECLG LOCA – 3 Days



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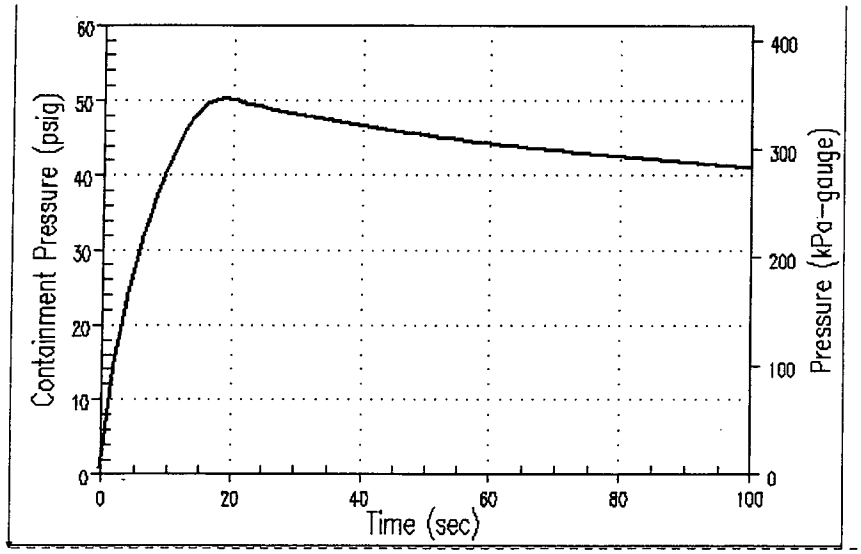
AP1000 Containment Temperature Response for DECLG LOCA – 3 Days



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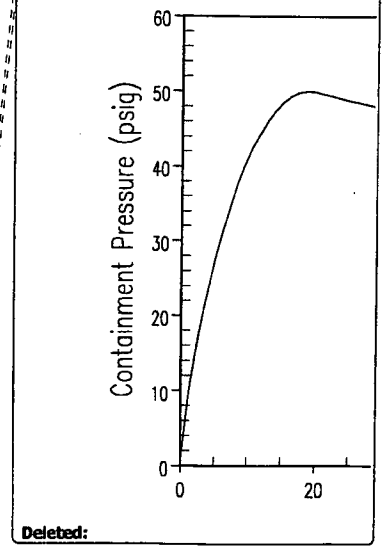

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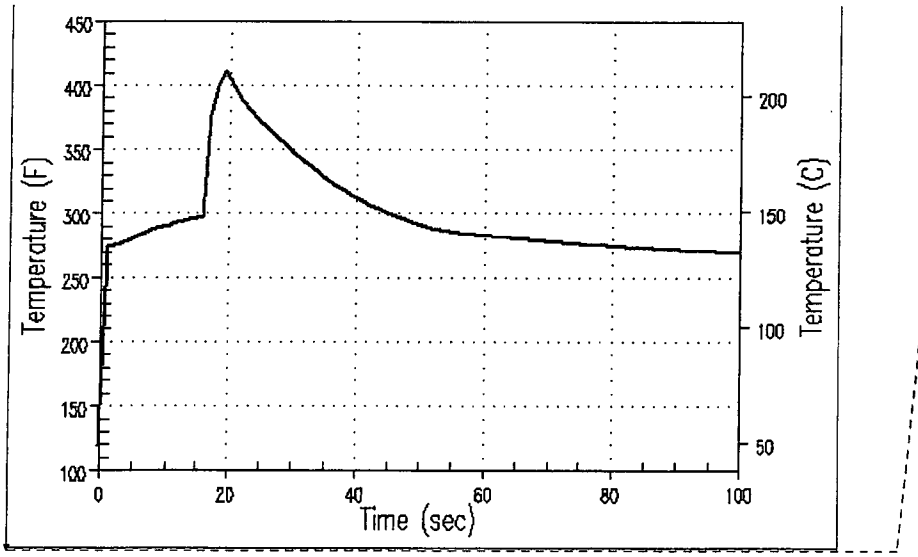
Figure 6.2.1.1-9

AP1000 Containment Pressure Response – DEHLG LOCA



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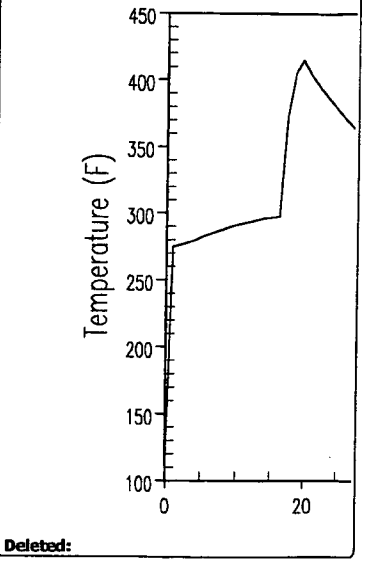

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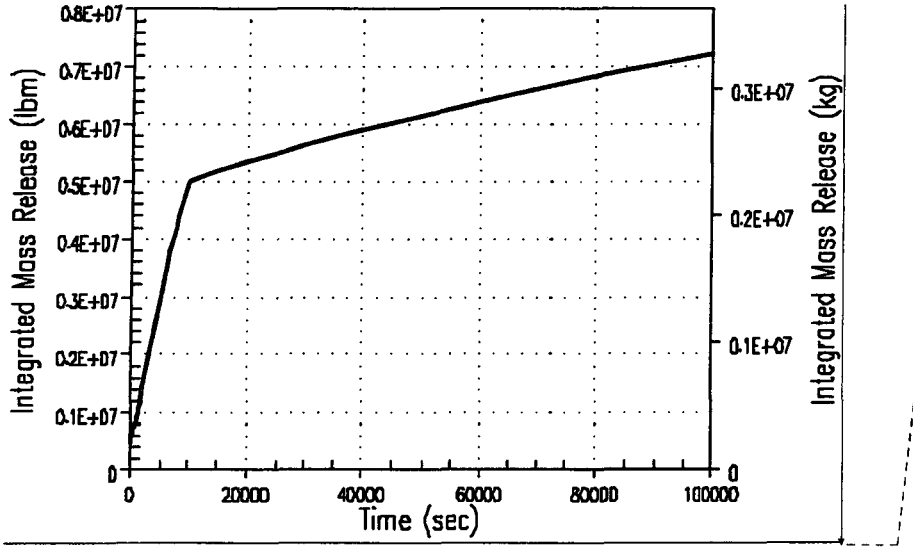
AP1000 Containment Response for DEHLG LOCA



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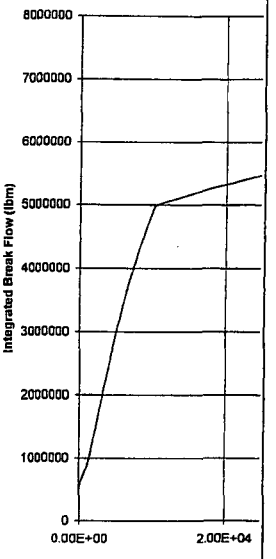

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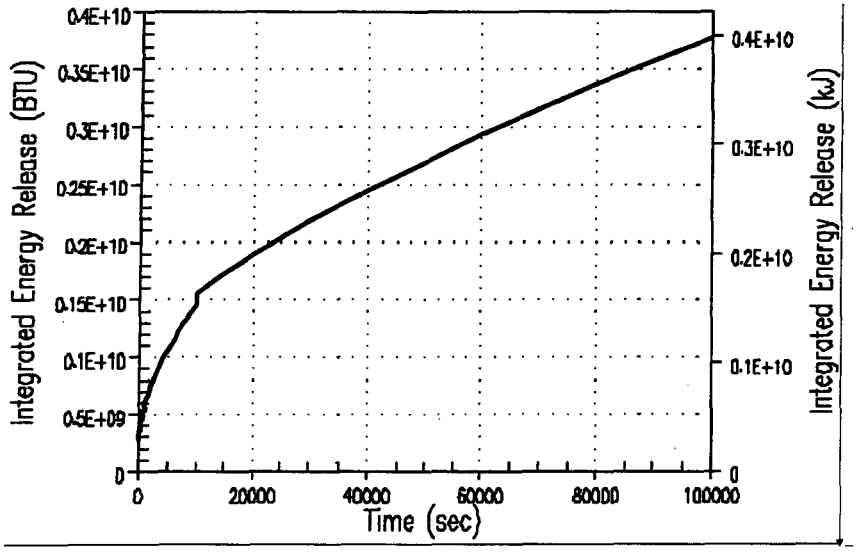
Figure 6.2.1.3-1

AP1000 DECLG Integrated Break Flow



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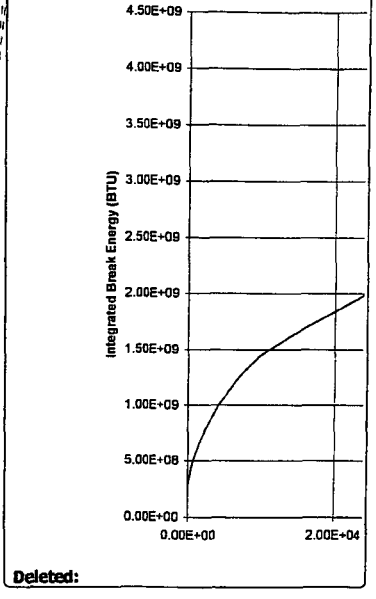

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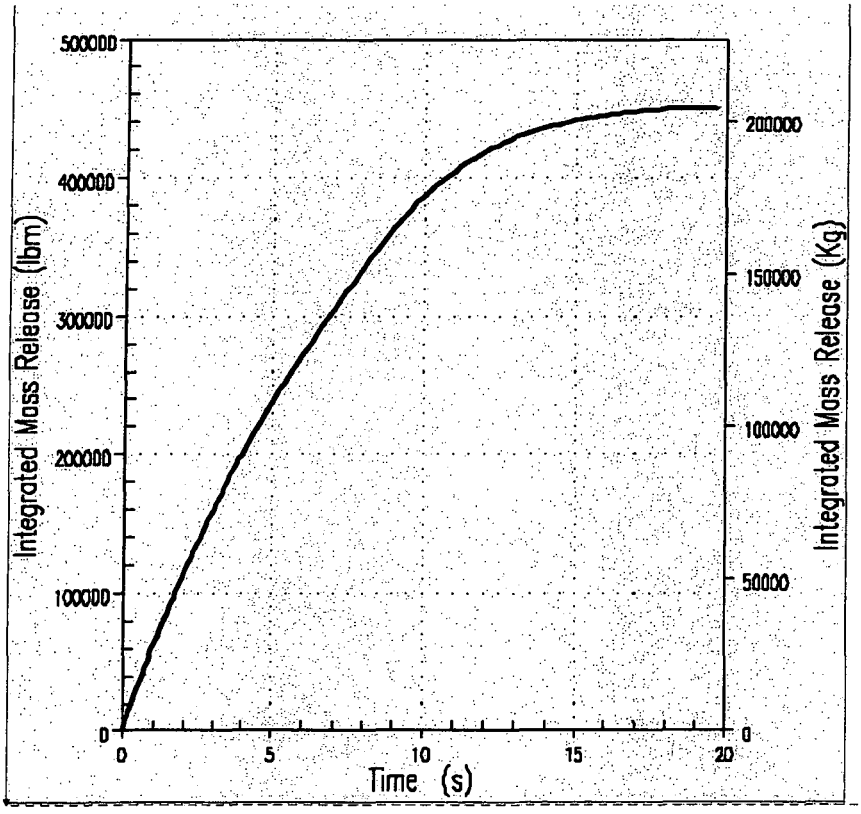
Figure 6.2.1.3-2

AP1000 DECLG LOCA Integrated Energy Released



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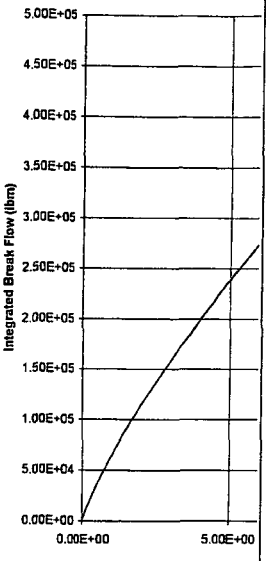

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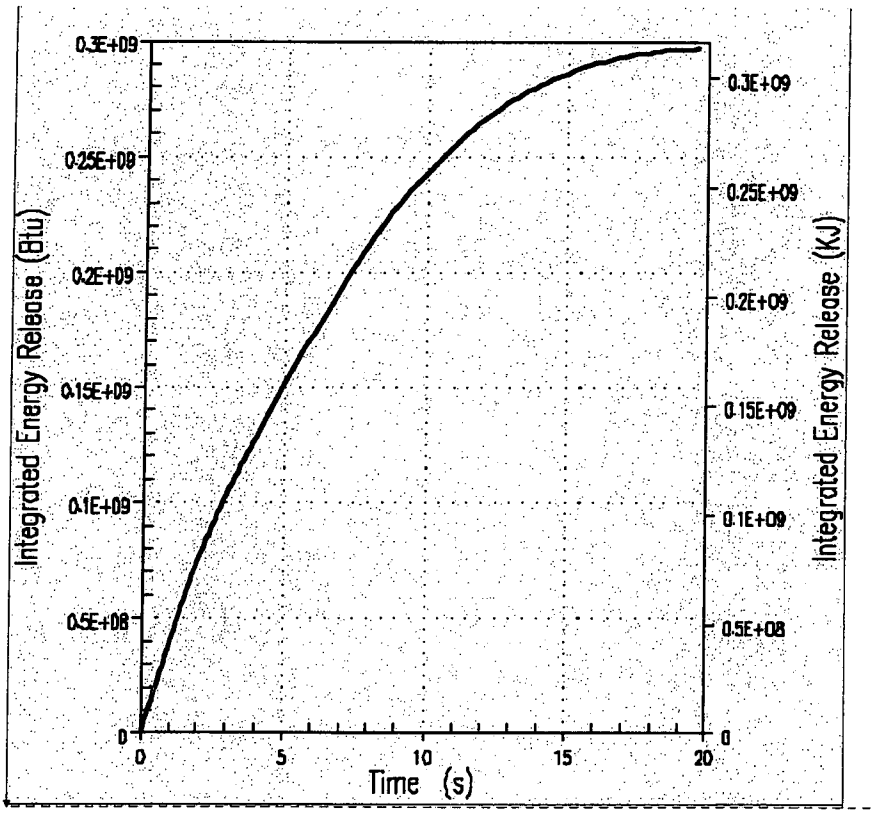
Figure 6.2.1.3-3

AP1000 DEHLG Integrated Break Flow



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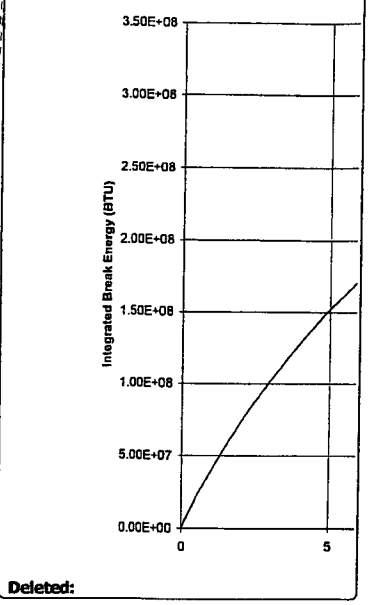

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Figure 6.2.1.3-4

AP1000 DEHLG LOCA Integrated Energy Released

B 3.6 CONTAINMENT SYSTEMS

B 3.6.4 Containment Pressure

BASES

BACKGROUND

The containment pressure is limited during normal operation to preserve the initial conditions assumed in the accident analyses for a loss of coolant accident (LOCA) or steam line break (SLB). These limits also prevent the containment pressure from exceeding the containment design negative pressure differential with respect to the outside atmosphere in the event of transients which result in a negative pressure.

Containment pressure is a process variable that is monitored and controlled. The containment pressure limits are derived from the operating band of conditions used in the containment pressure analyses for the Design Basis Events which result in internal or external pressure loads on the containment vessel. Should operation occur outside these limits, the initial containment pressure would be outside the range used for containment pressure analyses.

APPLICABLE SAFETY ANALYSES

Containment internal pressure is an initial condition used in the DBA analyses to establish the maximum peak containment internal pressure. The limiting DBAs considered, relative to containment pressure, are the LOCA and SLB, which are analyzed using computer pressure transients. The worst case LOCA generates larger mass and energy release than the worst cast SLB. Thus, the LOCA event bounds the SLB event from the containment peak pressure standpoint (Ref. 1).

The initial pressure condition used in the containment analysis was 15.7 psia (1.0 psig). This resulted in a maximum peak pressure from a LOCA, P_a, of 58.3 psig. The containment analysis (Ref. 1) shows that the maximum peak calculated containment pressure results from the limiting LOCA. The maximum containment pressure resulting from the worst case LOCA does not exceed the containment design pressure, 59 psig.

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The containment was also designed for an external pressure load equivalent to 1.7 psid. The limiting negative pressure transient is a loss of all AC power sources coincident with extreme cold weather conditions which cool the external surface of the containment vessel. The initial pressure condition used in this analysis was -0.2 psig. This resulted in a minimum pressure inside containment, as illustrated in Reference 1,

5.5 Programs and Manuals

5.5.7 Safety Function Determination Program (continued)

A loss of safety function exists when, assuming no concurrent single failure, a safety function assumed in the accident analysis cannot be performed. For the purpose of this program, a loss of safety function may exist when a support system is inoperable, and:

a. A required system redundant to the system(s) supported by the inoperable support system is also inoperable; or

b. A required system redundant to the system(s) in turn supported by the inoperable supported system is also inoperable; or

c. A required system redundant to the support system(s) for the supported systems (a) and (b) above is also inoperable.

The SFDP identifies where a loss of safety function exists. If a loss of safety function is determined to exist by this program, the appropriate Conditions and Required Actions of the LCO in which the loss of safety function exists are required to be entered. When a loss of safety function is caused by the inoperability of a single Technical Specification support system, the appropriate Conditions and Required Actions to enter are those of the support system.

5.5.8 Containment Leakage Rate Testing Program

a. A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54(o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions. This program shall be in accordance with the guidelines contained in Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program, dated September 1995," as modified by approved exceptions.

b. The calculated peak containment internal pressure for the design basis loss of coolant accident, P_a, is 58.3 psig. The containment design pressure is 59 psig.

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c. The maximum allowable primary containment leakage rate, L_a, at P_a, shall be 0.10% of primary containment air weight per day.