ATTACHMENT 10

SAN ONOFRE NUCLEAR GENERATING STATION
PCN-528

CALCULATION N-4080-027 REVISION 1, INCLUDING CCN-4
CONTAINMENT P-T ANALYSIS FOR DESIGN BASIS MSLB

Southern California Edison Company INTERIM CALCULATION CHANGE NOTICE (ICCN)/ CALCULATION CHANGE NOTICE (CCN) COVER PAGE	CALC. NO. N-4080-027	ICCN NO./ PRELIM. CCN NO. N-4	PAGE 1	TOTAL NO. OF PAGES 16
SUMMARY CHANGE ◉ NO ○ YES	BASE CALC. REV. 1 / UNIT 2 & 3	CCN CONVERSION : CCN NO. CCN- 4		CALC. REV. 1
	CALCULATION SUBJECT : CONTAINMENT P-T ANALYSIS FOR DESIGN BASIS MSLB			
CALCULATION CROSS-INDEX ☐ New/Updated index included ☒ Existing index is complete	ENGINEERING SYSTEM NUMBER / PRIMARY STATION SYSTEM DESIGNATOR 1301 / XB1			Q-CLASS II
Site Programs/Procedure Impact? ◉ NO ○ YES, AR No.	CONTROLLED PROGRAM OR DATABASE ACCORDING TO SO123-XXIV-5.1 ☐ PROGRAM ☐ DATA BASE	PROGRAM / DATABASE NAME (S) N/A ☐ ALSO, LISTED BELOW		VERSION/RELEASE NO.(S)

1. BRIEF DESCRIPTION OF ICCN / CCN:

Calculation is revised to delete the modeling of a thermal contact resistance at the interface between elevated floor decking and the overlying concrete slabs in containment. The change affects the modeling description for passive heat sink # 13 in the analysis. Justification for the change is provided in Design Input Section 4.10. No impact on the results reported in Revision 1 to the calculation since the COPATTA model used in the Revision 1 analysis did not include the thermal resistance modeling previously described in the Design Input or in Calculation Section 8.2.13.

Changed Pages: 35, 109, 128, 135, 142, 148, 155, 161, 168, 175, 181, 188, 195, and 201

Added Page: 35A

INITIATING DOCUMENT (DCP, FCN, OTHER) AR000400980 REV. _____

2. OTHER AFFECTED DOCUMENTS (CHECK AS APPLICABLE FOR CCN ONLY):

○ YES ◉ NO OTHER AFFECTED DOCUMENTS EXIST AND ARE IDENTIFIED ON ATTACHED FORM 26-503.

3. APPROVAL : DISCIPLINE / ESC : N. FUELS ENG & ANAL

P. Barbour 5/16/00 — ORIGINATOR (Print name/sign/date)

7-13-00 — FLS (Signature/date)

OTHER (Signature/date)

J. M. Gilmer 6/27/00 — IRE (Print name/sign/date)

OTHER (Signature/date)

OTHER (Signature/date)

4. CONVERSION TO CCN DATE 8/14/00 — SCE CDM - SONGS

SCE 26-122-1 REV 3 8/99 (REFERENCE: SO123-XXIV-7.15)

T:\JETFORM\FORMS\NEDO_GEN\122_1_03.MDF Ver: 03.00.00 8/99
C:\JETDATA\27R1PCCN.DAT DevID: -1.0000 Printed: 05/16/00

Site File Copy

Galvanized steel surfaces are not painted. Zinc galvanizing on carbon steel will not be separately modeled since the galvanized layer is thin and the thermal conductivity of zinc is greater than that of carbon steel.

4.10 Steel liner plate to concrete gap conductance is 50 Btu/hr ft^2 °F as recommended in Bechtel Topical Report BN-TOP-3 (Ref. 6.23, Appendix A], based on Carolinas-Virginia Tube Reactor (CVTR) experimental data. This gap conductance is included by modeling a uniform air gap between the liner plate and the concrete. One-dimensional, conductive heat transfer across a uniform air gap is expressed by the standard relationship:

$$Q/A = (k_{th}/x)(\Delta T)$$ [Ref. 6.24]

Where
- Q/A = heat flux; the energy flow rate (Btu/hr) per unit cross-sectional area (ft^2)
- k_{th} = thermal conductivity of the air (Btu/hr ft^2 °F/ft)
- x = thickness of the air gap (ft)
- ΔT = total temperature drop across the air gap (°F)

For the purposes of the COPATTA heat sink model, k_{th}/x is defined to be the gap conductance (C_g). Thus,

$C_g = k_{th}/x$ or $x = k_{th}/C_g$ with C_g in units of Btu/hr ft^2 °F

Use air properties at 200°F, for convenience, and then solve for the gap thickness to provide the desired gap conductance of 50.

k_{th} = 0.0174 Btu/hr ft^2 °F/ft [Table A-6, Ref. 6.24]

$x = 0.0174/50 = 0.000348$ ft or **0.00035 ft** (rounded)

The gap conductance of 50 Btu/hr ft^2 °F is also included at the boundary between the refueling canal liner plate and concrete, as well as between the containment building liner plate and concrete containment shell and dome.

Note: No gap conductance is modeled at the boundary between galvanized steel decking and the overlying concrete of the elevated floor slabs for the following reasons:

1) The elevated concrete floor slabs are horizontal. Therefore, beginning with the initial floor slab pour, the decking is supporting the concrete which is being pushed down by the action of gravity.
2) The pouring of the concrete floor is accompanied by mechanical vibration/agitation to facilitate the flow of the concrete around the slab reinforcing rods, eliminating voids and assuring the concrete completely fills the decking convolutions. Thus, the mechanics of concrete placement assures intimate contact between the cement and the supporting decking.
3) No enhancement of the thermal conductivity of concrete due to the presence of steel reinforcing rods in the matrix is credited.
4) Given the design configuration and construction process, physical bonding of the concrete to the galvanized steel decking would be expected, providing intimate contact and no significant thermal resistance at the interface between the two materials.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00						

4.11 The thermal conductivity and volumetric heat capacity of the containment structural materials (passive heat sinks) included in the COPATTA model are identified in this Design Input section. These properties are generally well defined in available engineering data bases. Data for the containment epoxy paints are limited, and conservative judgement has been used to determine appropriate values for this calculation to avoid overstating the rate of energy transfer from the vapor region into the painted structures.

a. Carbon Steel

A typical carbon steel thermal conductivity of 25 Btu/hr-ft-°F is recommended by Bechtel Nuclear Standard N2.3.2 [Ref. 6.25, sheet 14]. A typical carbon steel volumetric heat capacity of 54 Btu/ft^3-°F is also recommended by Reference 6.25.

```
$LIST POOL=112300,  0,  0 $END
$LIST POOL=112400,  9,  2,  0,  2 $END
```

8.2.13 HS #13 - Elevated Floor Slabs (Lower Half-Thickness with CS Decking)

This heat sink consists of the bottom half-thickness of the concrete floors at elevations 63'-6", 45', and 30'. These slab floors are concrete poured over Robertson 3" QL 99-16 galvanized steel decking [Ref. 6.41]. The decking is 16 gauge, or 0.0625" thick. The thickness of the zinc galvanizing is neglected since the thermal conductivity of zinc is greater than the conductivity of carbon steel.

The exposed surface area of the heat sink is

A_{13} = **23,240 ft²** [Ref. 6.9]

The effective thickness of the heat sink is

T_{12} = 0.5(1.5) = **0.75 feet** [one half the full floor slab thickness]

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	23240 ft²
Carbon Steel Decking (material 1), thickness	0.00521 ft (1/16 inch)
Concrete (material 2), thickness	0.75 ft (9.0 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (floor midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 13 is entered in the input data file as:

```
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001,  48,  12,  0,  0,  0,  0,  23240 $END
$LIST POOL=113101,  2,  0.00521,  4,  0.00556,  4,  0.00617,  4,  0.00745,
            4,  0.01001,  4,  0.01513,  4,  0.02537,  4,  0.04585,
            4,  0.08681,  4,  0.16873,  4,  0.33257,  5,  0.75521 $END
$LIST POOL=113201,  1,  2,  2,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=113300,  0,  0 $END
$LIST POOL=113400,  9,  2,  0,  2 $END
```

Note: Total thickness of heat sink is 0.00521 + 0.75 = 0.75521 feet; actual floor midplane coordinate used in COPATTA input file is 0.75556 feet. The additional 0.00035 feet of concrete has no significant affect on the results of the calculation.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

```
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
```

Originator's Note:
Right boundary coordinate for HS#13, first concrete region, is 0.00556 ft & right boundary of final concrete region is 0.75521 ft per Sect 8.2.13; errors have no significant effect on results.

```
                    4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                    4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                    4, 4.10850, 4, 8.35833 $END
 $LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=107300, 0, 0 $END
 $LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
 $LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
 $LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                    3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                    4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                    2, 2.01598 $END
 $LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=108300, 0, 0 $END
 $LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
 $LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
 $LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
 $LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=109300, 0, 0 $END
 $LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
 $LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
 $LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 7, 1.71909 $END
 $LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=110300, 0, 0 $END
 $LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
 $LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
 $LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                    4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                    4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
 $LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=111300, 0, 0 $END
 $LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
 $LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                    4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                    4, 0.31417, 6, 0.75417 $END
 $LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=112300, 0, 0 $END
 $LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
 $LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                    4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                    4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
 $LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=113300, 0, 0 $END
 $LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
 $LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
 $LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
 $LIST POOL=114201, 4, 4, 1 $END
 $LIST POOL=114300, 0, 0 $END
 $LIST POOL=114400, 9, 2, 0, 2 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

```
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 00.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
$LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
$LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
$LIST POOL=116201, 4, 4, 1 $END
$LIST POOL=116300, 0, 0 $END
$LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
$LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
$LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
$LIST POOL=117201, 4, 4, 1 $END
$LIST POOL=117300, 0, 0 $END
$LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
$LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
$LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
$LIST POOL=118201, 4, 4, 1 $END
$LIST POOL=118300, 0, 0 $END
$LIST POOL=118400, 9, 2, 0, 2 $END
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
$LIST POOL=119001, 4, 1, 0, 0, 0, 0, 131698 $END
$LIST POOL=119101, 3, 0.00879 $END
$LIST POOL=119201, 1 $END
$LIST POOL=119300, 0, 0 $END
$LIST POOL=119400, 9, 2, 0, 2 $END
* HS #20 - MISCELLANEOUS STAINLESS STEEL
$LIST POOL=120001, 5, 1, 0, 0, 0, 0, 26893 $END
$LIST POOL=120101, 4, 0.01459 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00						

```
 $LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
 $LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
 $LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                    3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                    4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                    2, 2.01598 $END
 $LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=108300, 0, 0 $END
 $LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
 $LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
 $LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
 $LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=109300, 0, 0 $END
 $LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
 $LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
 $LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 7, 1.71909 $END
 $LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=110300, 0, 0 $END
 $LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
 $LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
 $LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                    4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                    4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
 $LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=111300, 0, 0 $END
 $LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
 $LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                    4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                    4, 0.31417, 6, 0.75417 $END
 $LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=112300, 0, 0 $END
 $LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
 $LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                    4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                    4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
 $LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=113300, 0, 0 $END
 $LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
 $LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
 $LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
 $LIST POOL=114201, 4, 4, 1 $END
 $LIST POOL=114300, 0, 0 $END
 $LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
 $LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
 $LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
 $LIST POOL=115201, 4, 4, 1, 1 $END
 $LIST POOL=115300, 0, 0 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

```
 $LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
 $LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                    4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                    4, 0.31417, 6, 0.75417 $END
 $LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=112300, 0, 0 $END
 $LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
 $LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                    4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                    4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
 $LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=113300, 0, 0 $END
 $LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
 $LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
 $LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
 $LIST POOL=114201, 4, 4, 1 $END
 $LIST POOL=114300, 0, 0 $END
 $LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
 $LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
 $LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
 $LIST POOL=115201, 4, 4, 1, 1 $END
 $LIST POOL=115300, 0, 0 $END
 $LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
 $LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
 $LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
 $LIST POOL=116201, 4, 4, 1 $END
 $LIST POOL=116300, 0, 0 $END
 $LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
 $LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
 $LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
 $LIST POOL=117201, 4, 4, 1 $END
 $LIST POOL=117300, 0, 0 $END
 $LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
 $LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
 $LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
 $LIST POOL=118201, 4, 4, 1 $END
 $LIST POOL=118300, 0, 0 $END
 $LIST POOL=118400, 9, 2, 0, 2 $END
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
 $LIST POOL=119001, 4, 1, 0, 0, 0, 0, 131698 $END
 $LIST POOL=119101, 3, 0.00879 $END
 $LIST POOL=119201, 1 $END
 $LIST POOL=119300, 0, 0 $END
 $LIST POOL=119400, 9, 2, 0, 2 $END
* HS #20 - MISCELLANEOUS STAINLESS STEEL
 $LIST POOL=120001, 5, 1, 0, 0, 0, 0, 26893 $END
 $LIST POOL=120101, 4, 0.01459 $END
 $LIST POOL=120201, 3 $END
 $LIST POOL=120300, 0, 0 $END
 $LIST POOL=120400, 9, 2, 0, 2 $END
* HS #21 - REACTOR BUILDING STIFFENED SECTIONS ABOVE ELEV. 30 FT
 $LIST POOL=121001, 44, 10, 0, 0, 0, 0, 3764 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00						

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$LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
$LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                   4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                   4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                   4, 4.10850, 4, 8.35833 $END
$LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=107300, 0, 0 $END
$LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
```

HS#7 right boundary coordinate on sheet 127.

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

```
$LIST POOL=106101, 4, 0.00250, 4, 0.02250, 4, 0.06250, 4, 0.14250,
                   4, 0.30250, 4, 0.62250, 4, 1.26250, 4, 2.54250,
                   4, 5.10250, 5, 10.75250 $END
$LIST POOL=106201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=106300, 0, 0 $END
$LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
$LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
$LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                   4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                   4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                   4, 4.10850, 4, 8.35833 $END
$LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=107300, 0, 0 $END
$LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
```

Note: See Originator's Note for HS#7 right boundary coordinate on sheet 127.

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

```
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
$LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
$LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
$LIST POOL=116201, 4, 4, 1 $END
$LIST POOL=116300, 0, 0 $END
$LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
$LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
$LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
$LIST POOL=117201, 4, 4, 1 $END
$LIST POOL=117300, 0, 0 $END
$LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
$LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
$LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
$LIST POOL=118201, 4, 4, 1 $END
$LIST POOL=118300, 0, 0 $END
$LIST POOL=118400, 9, 2, 0, 2 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

```
$LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
$LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
$LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                   4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                   4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                   4, 4.10850, 4, 8.35833 $END
$LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2  2, 2 $END
$LIST POOL=107300, 0, 0 $END
$LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
```

Note: See Originator's Note for HS#7 right boundary co-ordinate on sheet 127.

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00						

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$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
$LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
$LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
$LIST POOL=116201, 4, 4, 1 $END
$LIST POOL=116300, 0, 0 $END
$LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
$LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
$LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
$LIST POOL=117201, 4, 4, 1 $END
$LIST POOL=117300, 0, 0 $END
$LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
$LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
$LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
$LIST POOL=118201, 4, 4, 1 $END
$LIST POOL=118300, 0, 0 $END
$LIST POOL=118400, 9, 2, 0, 2 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

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 $LIST POOL=109300, 0, 0 $END
 $LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
 $LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
 $LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 7, 1.71909 $END
 $LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=110300, 0, 0 $END
 $LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
 $LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
 $LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                    4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                    4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
 $LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=111300, 0, 0 $END
 $LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
 $LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                    4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                    4, 0.31417, 6, 0.75417 $END
 $LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=112300, 0, 0 $END
 $LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
 $LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                    4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                    4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
 $LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=113300, 0, 0 $END
 $LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
 $LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
 $LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
 $LIST POOL=114201, 4, 4, 1 $END
 $LIST POOL=114300, 0, 0 $END
 $LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
 $LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END2
 $LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
 $LIST POOL=115201, 4, 4, 1, 1 $END
 $LIST POOL=115300, 0, 0 $END
 $LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
 $LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
 $LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
 $LIST POOL=116201, 4, 4, 1 $END
 $LIST POOL=116300, 0, 0 $END
 $LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
 $LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
 $LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
 $LIST POOL=117201, 4, 4, 1 $END
 $LIST POOL=117300, 0, 0 $END
 $LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
 $LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
 $LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

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                    4, 0.30250, 4, 0.62250, 4, 1.26250, 4, 2.54250,
                    4, 5.10250, 5, 10.75250 $END
 $LIST POOL=106201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=106300, 0, 0 $END
 $LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
 $LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
 $LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                    4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                    4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                    4, 4.10850, 4, 8.35833 $END
 $LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=107300, 0, 0 $END
 $LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
 $LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
 $LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                    3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                    4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                    2, 2.01598 $END
 $LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=108300, 0, 0 $END
 $LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
 $LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
 $LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
 $LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=109300, 0, 0 $END
 $LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
 $LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
 $LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 7, 1.71909 $END
 $LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=110300, 0, 0 $END
 $LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
 $LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
 $LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                    4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                    4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
 $LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=111300, 0, 0 $END
 $LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
 $LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                    4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                    4, 0.31417, 6, 0.75417 $END
 $LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=112300, 0, 0 $END
 $LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
 $LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                    4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                    4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
 $LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
```

Note: See Originator's Note for HS#7 right boundary co-ordinate on sheet 127.

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

CALCULATION TITLE PAGE

ICCN NO./ PRELIM. CCN NO.	PAGE OF

CCN CONVERSION: CCN NO. CCN-

Calc No. N-4080-027 DCP/FIDCN/ FCN No. & Rev. N/A

Subject : CONTAINMENT P-T ANALYSIS FOR DESIGN BASIS MSLB Sheet 1 of 312

System Number/Primary Station System Designators 1301 / XB1 SONGS Unit 2 & 3 Q-Class II

Tech. Spec./LCS Affecting? ○ NO ◉ YES Section No. B3.6.1, .2, .4, Equipment Tag No. N/A

Site Programs/Procedure Impact? ○ NO ◉ YES, AR No. AR991001327

CONTROLLED COMPUTER PROGRAM/ DATABASE	☒ PROGRAM ☐ DATABASE According to SO123-XXIV-5.1	PROGRAM/ DATABASE NAME(S) NE100/COPATTA ☐ ALSO, LISTED BELOW	VERSION/ RELEASE NO. (S) G1-15

RECORD OF ISSUES

REV. DISC	DESCRIPTION	TOTAL SHTS. LAST SHT	PREPARED (Print name/sign/date)	APPROVED (Signature/date)	
1	GENERAL REVISION Replaces Rev. 0 including CCN1 & CCN 2; Incorporates CCN 3	312	ORIG. P. BARBOUR 11/1/99	FLS 11/2/99	OTHER
NFM		312	IRE J. Gilmer 11/1/99	OTHER	OTHER
			ORIG.	FLS	OTHER
			IRE	OTHER	OTHER
			ORIG.	FLS	OTHER
			IRE	OTHER	OTHER
			ORIG.	FLS	OTHER
			IRE	OTHER	OTHER

Space for RPE Stamp, identify use of an alternate calc., and notes as applicable.

NOTE: This calculation is complete. Copies of the COPATTA Code input files are included for each case. All required output values are included to support the results and conclusions, including all plots. The complete COPATTA output files have been archived on CD-ROM, in addition, and are provided to CDM. 12/16/99

RECEIVED COM

JAN 13 2000

SITE FILE COPY

This calculation was prepared using "Word Perfect 6.1" word processing sorfware. The WP6.1 software was not used for any computational portions of this calculation.

This calc. was prepared for the identified DCP/FCN. DCP/FCN completion and turnover acceptance to be verified by receipt of a memorandum directing DCN Conversion. Upon receipt, this calc. represents the as-built condition. Memo date. _____ by _____

Site File Copy

CALCULATION TITLE PAGE

ICCN NO./ PRELIM CCN NO.	PAGE ___ OF ___

Calc. No. N-4080-027 DCP/MMP/FIDCN/FCN No. & Rev. N/A

CCN CONVERSION: CCN NO. CCN

Subject CONTAINMENT P/T ANALYSIS FOR DESIGN BASIS MSLB Sheet 1

System Number/Primary Station System Designator ~~BEDG~~ 1301 XB1 SONGS Unit 2&3 Q-Class II

Tech Spec Affecting? [ ] NO [X] YES, Section No. LCO 3.6.1.1/2/3 & B3.6.1.4/6 Equipment Tag No. N/A

CONTROLLED COMPUTER PROGRAM/ DATABASE	[X] PROGRAM [ ] DATABASE IN ACCORDANCE WITH NES&L 41-6-1	PROGRAM/DATABASE NAME(S) [X] ALSO LISTED BELOW 'COPATTA" MAP-175	VERSION/RELEASE NO(S). Version G1/14

RECORD OF ISSUES

REV. / DISC	DESCRIPTION	TOTAL SHTS / LAST SHT.	PREPARED (Print name/initial)	APPROVED (Signature)	
0	SEE NOTE 1 BELOW ISSUED FOR USE	155	ORIG Stephen Oliver	GS	Other IPRG
BPC N		155	IRE John Elliott	DM	DATE 1-13-94
			ORIG	GS	Other
			IRE	DM	DATE
			ORIG	GS	Other
			IRE	DM	DATE
			ORIG	GS	Other
			IRE	DM	DATE

Space for RPE stamp, identify use of an alternate calc., and notes as applicable.

Note 1:

The purpose of Revision 0 is as follows:

Open Item Reports 92-069, 92-059, 92-057, 92-054, 92-045, and 92-015 indicate discrepancies in Calculation N-4080-007 Revisions 0, 1 and 2. Revision 0 to this calculation (N-4080-027) will incorporate the recommended changes specified by these Open Item Reports in an effort to improve documentation and accuracy of the MSLB P-T calculation.

Disclaimer: This calculation was prepared using Word Perfect 5.1 software. However, WP 5.1 was not used for any computations in the calculation.

This calc. was prepared for the identified DCP/MMP. DCP completion and turnover acceptance to be verified by reciept of a memorandum directing DCN conversion. Upon receipt, this calc. represents the as-built condition. Memo date _____ by _____.

CALCULATION CROSS-INDEX

ICCN NO./ PRELIM. CCN NO.	PAGE ____ OF ____
	CCN CONVERSION: CCN NO. CCN-

Calculation No. N-4080-027 Sheet No. 3 of 312

Calc. rev. number and responsible FLS initials and date	INPUTS These interfacing calculations and/or documents provide input to the subject calculation and if revised may require revision of the subject calculation.		OUTPUTS Results and conclusions of the subject calculation are used in these interfacing calculations and/or documents.		Does the output interface calc/ document require revision?	Identify output interface calc/document CCN, DCN, TCN/Rev., FIDCN, or tracking number.
	Calc / Document No.	Rev. No.	Calc / Document No.	Rev. No.	YES / NO	
1	Calculations:					
Sef 11-17-99	09/10-ST98-C-20 (ABB-CE)	0	UFSAR Section 6.2.1	14	YES	AR991001327 Assmt 5
	N-4080-003	5	UFSAR Section 3.11	14	YES	AR991001327 Assmt 3
	N-4080-004	1	DBD-SO23-TR-AA	1	YES	AR991001327 Assmt 5
	N-4080-005	0	DBD-SO23-TR-EQ	5	YES	AR991001327 Assmt 3
	N-4080-007	2				
	N-4060-030	0				
1	C-257-01.06.01	2	Units 2 & 3 Technical Spec's (Bases to 3.6.1, .2, .4, ..5, & 6.1)		YES	AR991001327 Assmt 1
	M-0014-009	0				
	M-0072-036	0				
	M-DSC-334	1	Units 2 & 3 Technical Spec's (5.5.2.15)		YES	AR991001327 Assmt 1
	M-DSC-362	0				
			Licensee Controlled Technical Spec's (Bases to 3.6.100)		YES	AR991001327 Assmt 2
1	Miscellaneous:		M-DSC-243	0	YES	AR991001327 Assmt 4
	DBD-SO23-TR-ST	0	M-DSC-267	0	YES	AR991001327 Assmt 4
	RGR-U2-C10	2				
	RGR-U3-C10	1				
	SO23-I-1.11.1	0				
	AR980101683					
	AR980502634					

CALCULATION CROSS-INDEX

ICCN NO./ PRELIM. CCN NO.	PAGE ____ OF ____
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Calculation No. N-4080-027 Sheet No. 4 of 312

Calc. rev. number and responsible FLS initials and date	INPUTS These interfacing calculations and/or documents provide input to the subject calculation and if revised may require revision of the subject calculation.		OUTPUTS Results and conclusions of the subject calculation are used in these interfacing calculations and/or documents.		Does the output interface calc/ document require revision?	Identify output interface calc/document CCN, DCN, TCN/Rev., FIDCN, or tracking number.
	Calc / Document No.	Rev. No.	Calc / Document No.	Rev. No.	YES / NO	
1	Drawings:					
Def 11-17-99	40141C	33				
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	40141F	23				
	40141CSO3	31				
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	CCN CONVERSION: CCN NO. CCN-

Calculation No. N-4080-027 Sheet No. 5 of 312

Calc. rev. number and responsible FLS initials and date	INPUTS These interfacing calculations and/or documents provide input to the subject calculation and if revised may require revision of the subject calculation.		OUTPUTS Results and conclusions of the subject calculation are used in these interfacing calculations and/or documents.		Does the output interface calc/ document require revision?	Identify output interface calc/document CCN, DCN, TCN/Rev., FIDCN, or tracking number.
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1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

1 PURPOSE

1.1 OBJECTIVE

The objective of this calculation is to evaluate the containment pressure and temperature response to a spectrum of large main steam line break events (MSLBs) for SONGS Units 2 and 3, and to identify the limiting MSLB event from the standpoint of maximum containment pressure and temperature for containment functional design as described in Section 6.2 of the UFSAR. The calculation also provides an analysis for the bounding containment post-MSLB temperature response for Environmental Qualification (EQ) as described in Section 3.11 of the UFSAR.

The analysis utilizes new MSLB mass-energy release data from ABB-CE [Refs. 6.1 and 6.2] and updated passive (structural) heat sink data, incorporates applicable instrument total loop uncertainties (TLUs), and includes transient containment spray flow modeling not previously used in SONGS containment P-T response analyses. The results of this calculation will be used to update MSLB accident analyses reported in Sections 6.2 and 3.11 of the UFSAR, and the Accident Analysis and Environmental Qualification DBD Topical Reports..

This Revision 1 issue completely replaces Revision 0 of the calculation, including Supplements A and B (CCNs 1 and 2, respectively), and incorporates main steam backflow into containment through inter-connected steam piping supplying the turbine-driven auxiliary feedwater pump P-140 addressed in CCN 3.

Issue of this calculation completes Assignment 2 of AR980502634 [Ref. 6.50] and allows closure of this Action Request,

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1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

1.2 CRITERIA, CODES AND STANDARDS

The containment structure is designed such that it is capable of withstanding the adverse effects of a postulated MSLB. Applicable regulatory design criteria are provided in Appendix A to 10CFR Part 50 [Ref. 6.3]. These criteria include:

- General Design Criterion 16, "Containment Design"
- General Design Criterion 38, "Containment Heat Removal"
- General Design Criterion 50, "Containment Design Basis"

General Design Criterion 16 requires that a reactor containment and associated systems shall be provided to establish an essentially leak tight barrier to assure that the containment design conditions important to safety are not exceeded for as long as the conditions require. Per Standard Review Plan 6.2.1.1.A [Ref. 6.4], to satisfy the requirements of this criterion, the calculated containment peak pressure after an MSLB should be less than the design containment peak pressure.

General Design Criterion 38 requires that the containment heat removal systems function to rapidly reduce the containment pressure following any LOCA, and maintain the pressure at an acceptably low level. Although not explicitly applied to the case of the MSLB, the requirements of GDC 38 can be considered to be applicable to the containment peak pressure analysis (be it LOCA or MSLB).

General Design Criterion 50 requires that the reactor containment structure, including access openings, penetrations, and the containment heat removal system, shall be designed so that the containment structure and its internal components can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure condition resulting from a LOCA. As with Criterion 16, per Standard Review Plan 6.2.1.1.A, to satisfy the requirements of Criterion 50, the calculated containment peak pressure after a LOCA should be less than the design containment peak pressure. Although GDC 50 specifically addresses a LOCA, and not an MSLB, SRP 6.2.1.1.A indicates that the requirements of GDC 50 can be considered to be applicable to the containment peak pressure analysis (be it LOCA, steam or feedwater line break).

The containment design pressure is 60 psig and the design temperature for the containment liner plate is 300°F per the containment structure DBD (Ref. 6.5, Section 4.1.1.5.2).

2 RESULTS/CONCLUSIONS & RECOMMENDATIONS

2.1 Results/Conclusions

2.1.1 Overview of Results for all MSLB Cases Analyzed

The Results and Conclusions section is divided into two overview sub-sections addressing the MSLB results applicable to UFSAR Section 6 (containment functional design) and UFSAR Section 3.11 (containment environmental qualification), respectively. The overview sub-sections are followed by two detailed results sections containing figures and tables supporting an update of the affected sections of the UFSAR (6.2 and 3.11)

2.1.1.1 MSLB Results for UFSAR Section 6.2

Table 2.1.1.1-1 provides a summary of the analysis results for the 10 MSLB cases run for inclusion in UFSAR Section 6.2. The peak pressures have been rounded up to the next 0.1 psig. Peak temperatures are rounded up to the next degree Farenheit. The timing of the peak pressure and temperatures are rounded (up or down) to the nearest second. The integrated energy release to the end of blowdown is reported in millions of Btu with 3 decimal places.

The results show that the limiting MSLB for containment peak pressure and vapor temperature is the 102% power MSLB with MSIV failure (Case 7). This case produces a peak containment pressure of 56.5 psig and a peak vapor temperature of 409°F. The peak sump temperature for this case, at 264°F, is only 1°F lower than the highest peak sump temperature of 265°F calculated for Case 13, the 0% power MSLB with MSIV failure.

Figures 2.1.1.1-1 and 2.1.1.1-2 are composite graphs of containment pressure as a function of time for each of the 5 cases with cooling train failure and MSIV failure, respectively, Figures 2.1.1.1-3 and 2.1.1.1-4 are composite graphs of containment vapor temperature as a function of time for each of the 5 cases with cooling train failure and MSIV failure, respectively.

It should be noted that this revision shows the maximum calculated peak containment pressure resulting from a MSLB in containment to be 56.5 psig with the containment initial pressure at 2.1 psig, the Technical Specification maximum value including instrument uncertainty. This value is less than the previously calculated values of 56.6 psig or 58.7 psig with the initial containment pressure at zero psig or at 1.5 psig, respectively. The primary reasons for the lower calculated pressures is the crediting of a ramped containment spray beginning when the water first appears at the lower ring header nozzles and a significant increase in identified containment passive heat sink exposed surfaces, primarily electrical conduits, cable trays and supports.

2.1.1.2 Reactor Trip Time

Table 2.1.1.2-1 provides a comparison of the time the containment pressure reaches the analysis setpoint for reactor trip (5.0 psig) with the time credited in the ABB-CE mass-energy release calculation. In all cases, the time of reactor trip conditions met (before adding instrument delay time) used by ABB-CE bounds the value calculated in the COPATTA containment pressure response analysis.

Table 2.1.1.1 - 1
Summary of Calculated Containment Peak Pressures and Temperatures

Case Number and Description	Peak Pressure		Peak Vapor Temperature		Peak Sump Temperature		Energy Release to End of Blowdown* (10^6 Btu)
	Value (psig)	Time (sec)	Value (°F)	Time (sec)	Value (°F)	Time (sec)	
Case 1 - 0% Power, 3.45 ft² Slot w/Cooling Train Failure	51.7	139	378	42	263	280	378.402
Case 2 - 20% Power, 5.30 ft² Slot w/Cooling Train Failure	44.5	95	377	35	256	240	343.503
Case 3 - 50% Power, 7.05 ft² Slot w/Cooling Train Failure	52.4	76	394	35	260	144	321.710
Case 4 - 80% Power, 8.10 ft² Slot w/Cooling Train Failure	54.9	61	402	35	261	108	310.706
Case 5 - 102% Power, 8.85 ft² Slot w/Cooling Train Failure	56.1	52	408	35	262	98	302.725
Case 13 - 0% Power, 3.45 ft² Slot w/MSIV Failure	52.0	139	374	33	265	240	387.072
Case 14 - 20% Power, 5.30 ft² Slot w/MSIV Failure	45.1	111	378	31	258	200	355.476
Case 15 - 50% Power, 7.05 ft² Slot w/MSIV Failure	50.1	61	395	31	262	136	334.149
Case 16 - 80% Power, 8.10 ft² Slot w/MSIV Failure	54.0	58	403	31	263	108	322.156
Case 7 - 102% Power, 8.85 ft² Slot w/MSIV Failure	56.5	52	409	31	264	91	314.417

* Includes steam backflow from intact SG through check valve bypass lines in main steam supply to turbine drive for AFW pump P-140 (all cases) and steam backflow through open MSIV bypass isolation valves (zero power cases only).

Table 2.1.1.2 - 1
Comparison of Timing of Containment Pressure at Reactor Trip Analysis Value

Case Number	1	2	3	4	5	13	14	15	16	7
ABB-CE Timing (seconds)	1.84	1.28	1.0	0.9	0.85	1.84	1.28	1.0	0.9	0.85
SCE Timing (seconds)	1.46	1.01	0.80	0.71	0.68	1.46	1.01	0.80	0.71	0.68

Figure 2.1.1.1-1

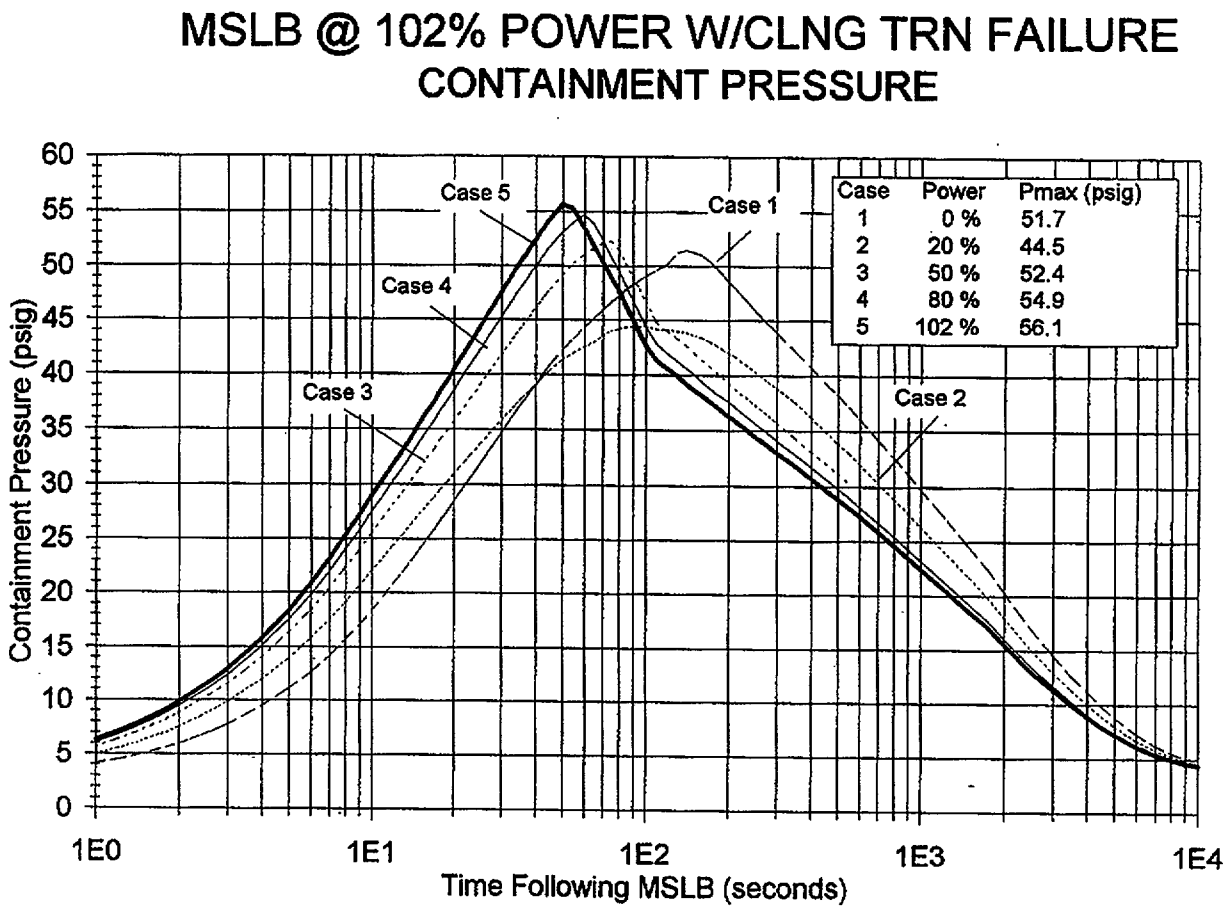


Figure 2.1.1.1-2

MSLB @ 102% POWER W/MSIV FAILURE
CONTAINMENT PRESSURE

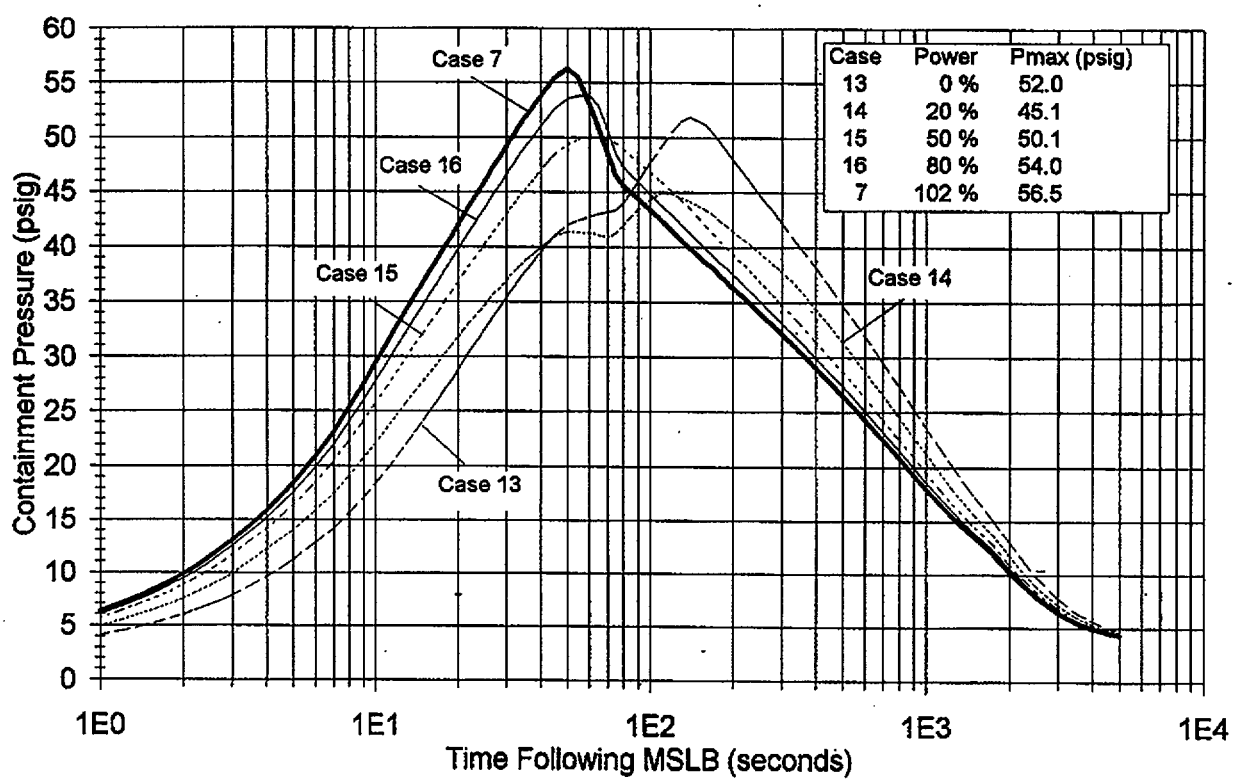


Figure 2.1.1.1-3

MSLB @ 102% POWER W/CLNG TRN FAILURE
CONTAINMENT VAPOR TEMPERATURE

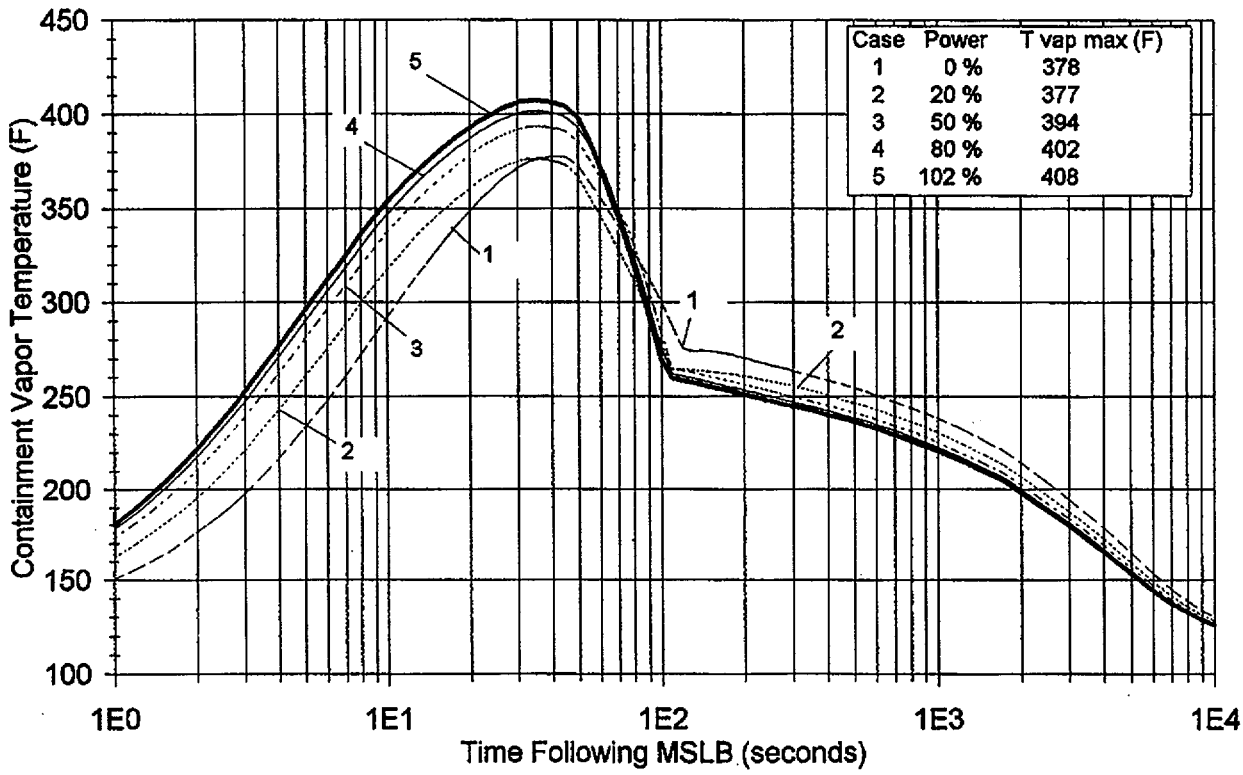
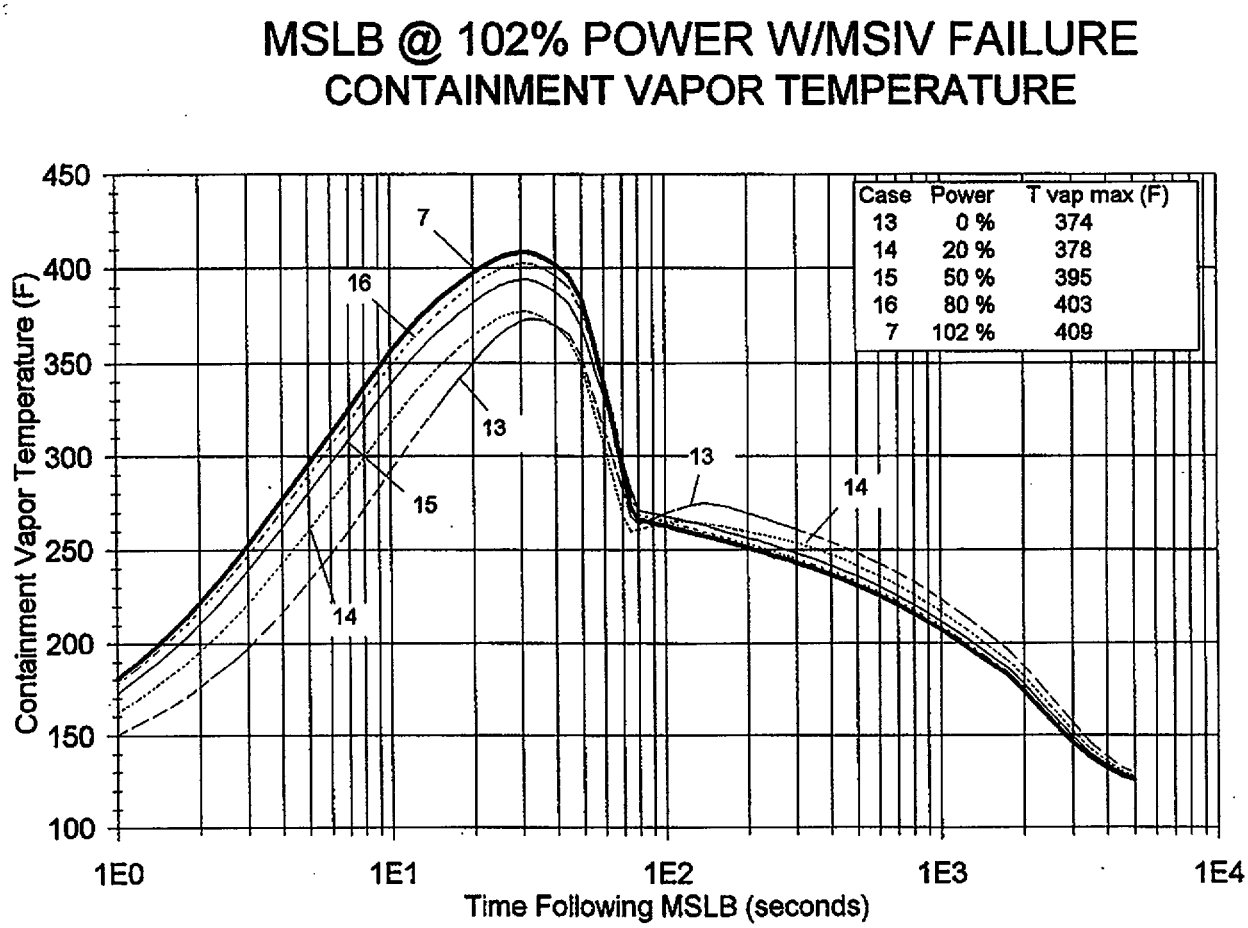


Figure 2.1.1.1-4



2.1.1.3 MSLB Results for Environmental Qualification

The environmental qualification runs are performed with the containment initial pressure at the Technical Specification minimum value of (-) 0.3 psig plus an effective total (instrument) loop uncertainty (TLU) for 3 of 4 narrow range containment pressure instruments operating of (-) 0.6 psig for an analysis initial pressure of (-) 0.9 psig. Analysis at a minimum initial pressure maximizes the calculated peak vapor temperature by minimizing the amount of air (and associated heat capacity) in containment. The environmental qualification analyses also include up to 8% condensate revaporization allowed by NUREG-0588 [Ref. 6.49] which has the effect of lowering the calculated vapor temperature during the initial portion of the transient when the containment atmosphere is superheated.

Table 2.1.1.3-1 provides the key results for the two full power MSLB cases re-run for environmental qualification. The peak pressures have been rounded up to the next 0.1 psig. Peak temperatures are rounded up to the next degree Farenheit. The timing of the peak pressure and temperatures are rounded (up or down) to the nearest second. The integrated energy release to the end of blowdown is reported in millions of Btu with 3 decimal places.

The102% power MSLB with MSIV failure is the more limiting of the two cases analyzed for maximum containment vapor temperature, with a peak value of 405°F for environmental qualification. Although included in the table, the values for containment pressure and sump temperature, calculated in the environmental qualification runs are not as limiting as the higher values calculated with the containment initial pressure at the Technical Specification maximum plus TLU shown in Table 2.1.1.1-1. The higher values for pressure and sump water temperature cited in Table 2.1.1.1-1 should be considered applicable to environmental qualification. Only the peak vapor temperature in Table 2.1.1.3-1 should be used for environmental qualification.

As was seen in the reanalysis for peak containment pressure (section 2.1.1.1), the reanalysis of the MSLB for peak containment vapor temperature for environmental qualification has produced a lower maximum vapor temperature (405°F) than was determined in the prior revision of this calculation (407.1°F). The ramped containment spray and increased passive heat sink surface areas are the primary reasons for this improved result.

Figure 2.1.1.3-1 provides a comparison plot of the containment vapor temperature as a function of time for the full power MSLB with cooling train failure (Case 5EQ) and with MSIV failure (Case 7EQ). The full power MSLB with MSIV failure creates the higher post accident vapor temperature in containment and is therefore designated the design basis MSLB event for in-containment environmental qualification. The post-peak containment cooldown for this case is more rapid than that for Case 5EQ because operation of both trains of ECUs and containment sprays are credited when the single failure is that of an MSIV failure to close.

Table 2.1.1.3 - 1
Summary of Calculated Containment Peak Pressures and Temperatures For Environmental Qualification

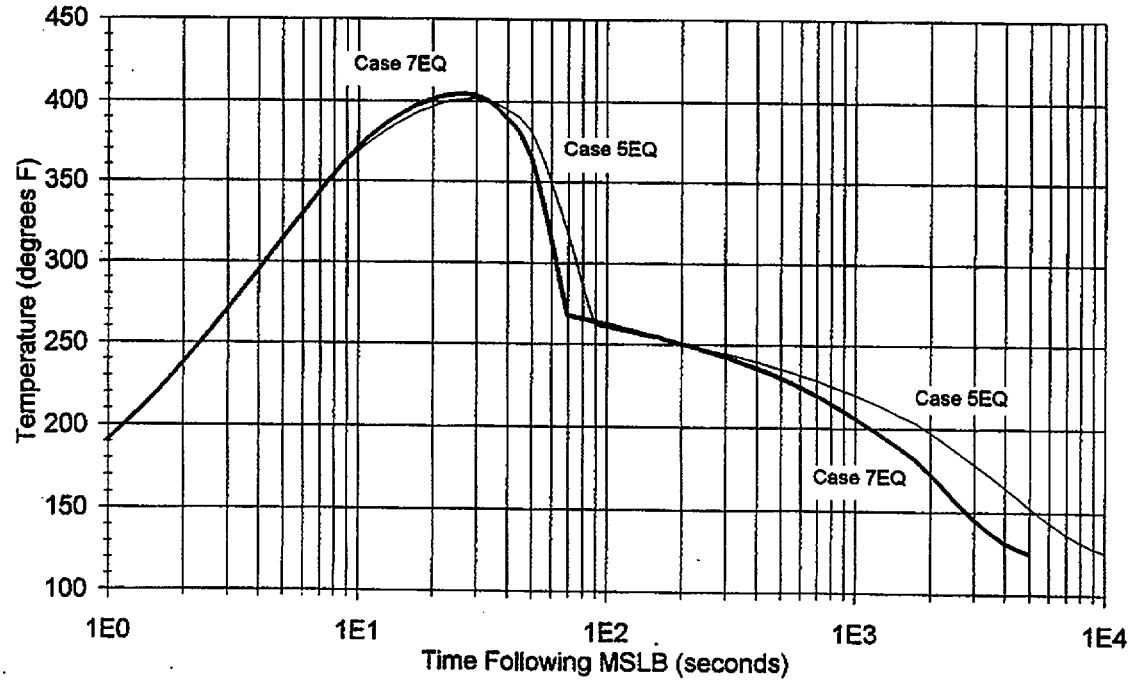
Case Number and Description	Peak Pressure		Peak Vapor Temperature		Peak Sump Temperature		Energy Release to End of Blowdown* (10^6 Btu)
	Value (psig)	Time (sec)	Value (°F)	Time (sec)	Value (°F)	Time (sec)	
Case 5EQ - 102% Power, 8.85 ft² Slot w/Cooling Train Failure	50.4	52	402	29	261	98	302.725
Case 7EQ - 102% Power, 8.85 ft² Slot w/MSIV Failure	50.7	52	405	26	263	97	314.417

* Includes steam backflow from intact SG through check valve bypass lines in main steam supply to turbine drive for AFW pump P-140 (both cases).

Figure 2.1.1.3-1

MSLB @ 102% PWR CONTAINMENT VAPOR TEMP ENVIRONMENTAL QUALIFICATION

Case 5EQ (Cooling Train Failure) : Tvapor max = 402F @ 29 seconds
Case 7EQ (MSIV Failure) : Tvapor max = 405F @ 26 seconds



2.1.2 Detailed Results for Bounding MSLB Event for UFSAR Section 6.2

The bounding MSLB event for containment peak pressure and temperature is Case 7, an 8.85 ft^2 slot break with the reactor at 102% power and closure failure of one main steam isolation valve (MSIV). For this limiting case:

Figure 2.1.2-1 presents the containment gauge pressure as a function of time. Table 9.1-19 contains the data used to prepare this figure.

Figure 2.1.2-2 presents the containment vapor temperature, saturation temperature, and sump water temperature as a function of time. Table 9.1-19 contains the data used to prepare this figure.

Figure 2.1.2-3 presents the containment air energy, steam energy, sump water energy and total vapor and sump water energy as a function of time. Table 9.1-19 contains the data used to prepare this figure.

Figure 2.1.2-4 presents the energy content of the containment passive (structural) heat sinks, the integrated energy removed from the containment vapor region by the emergency air cooling units (ECUs), and the energy transferred from the containment vapor region to the containment sump by the containment sprays, all as a function of time. Table 9.1-19 contains the data used to prepare this figure.

Figure 2.1.2-5 presents the Uchida condensing heat transfer coefficient used for condensation heat transfer at the passive heat sink surfaces exposed to the containment vapor region as a function of time. Table 9.1-20 contains the data used to prepare this figure.

Figure 2.1.2-6 presents the surface temperature of a representative selection of passive heat sinks as a function of time. The specific heat sinks included in this plot are the containment liner plate (from heat sink 2); the unlined internal concrete walls (from heat sink 10); miscellaneous carbon steel with a thickness </= to 0.5 inches (from heat sink 18); and electrical hardware and other galvanized carbon steel material (from heat sink 19). Table 9.1-20 contains the data used to prepare this figure.

A chronology of events for the full power MSLB with MSIV failure is provided in Table 2.1.2-1.

Figure 2.1.2-1

MSLB @ 102% POWER W/MSIV FAILURE
CONTAINMENT PRESSURE
CASE 7

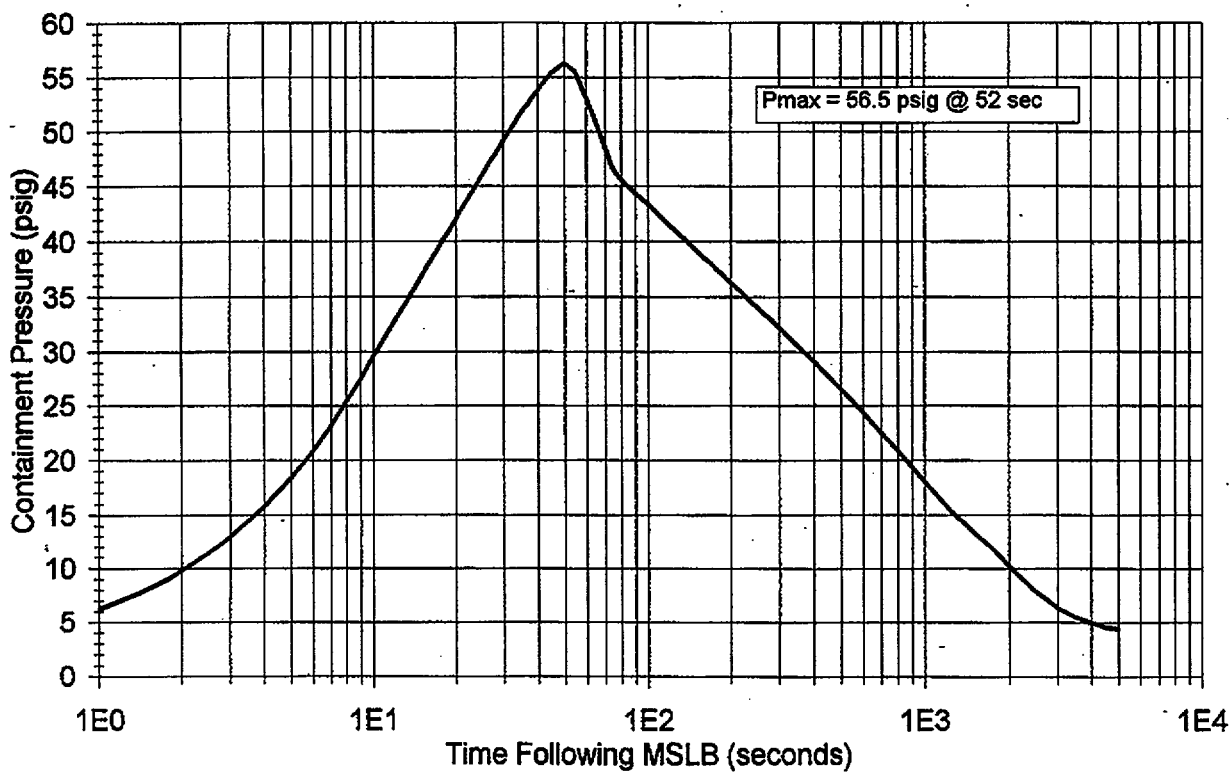


Figure 2.1.2-2

MSLB @ 102% PWR W/MSIV FAILURE
CONTAINMENT TEMPERATURES

CASE 7

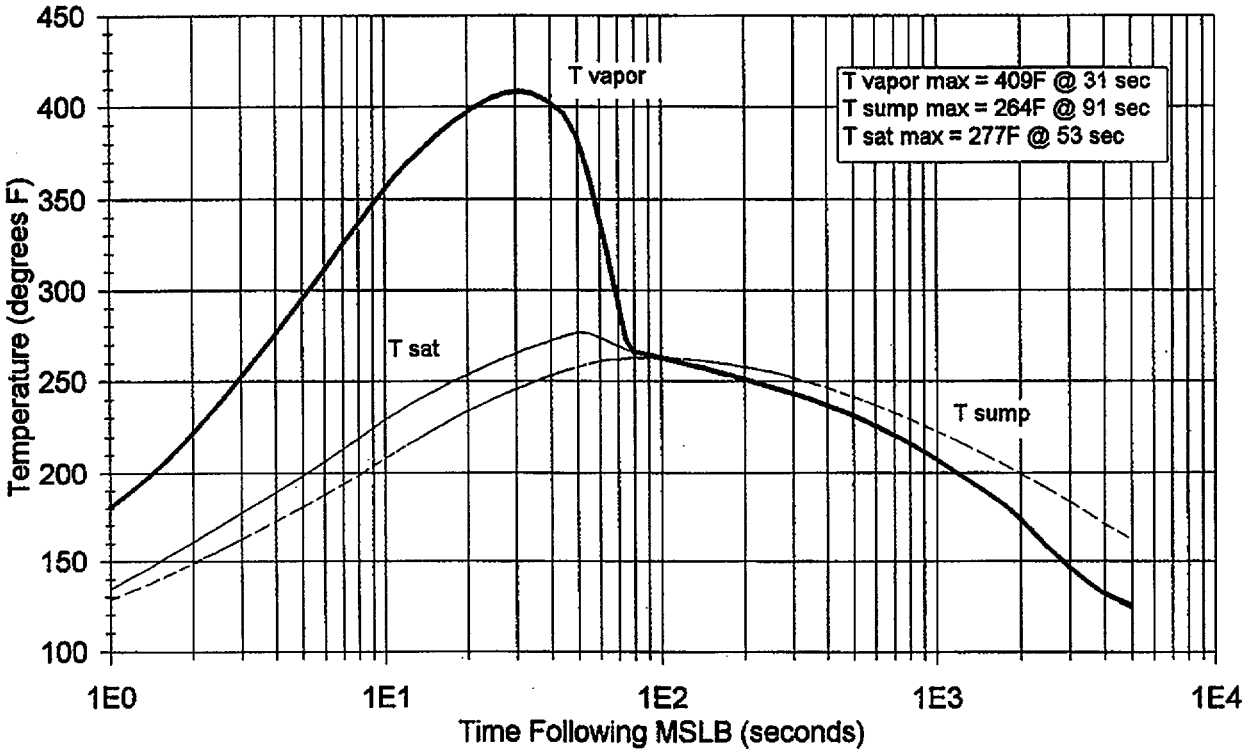


Figure 2.1.2-3

MSLB @ 102% POWER W/MSIV FAILURE
CONTAINMENT ENERGY DISTRIBUTION
CASE 7

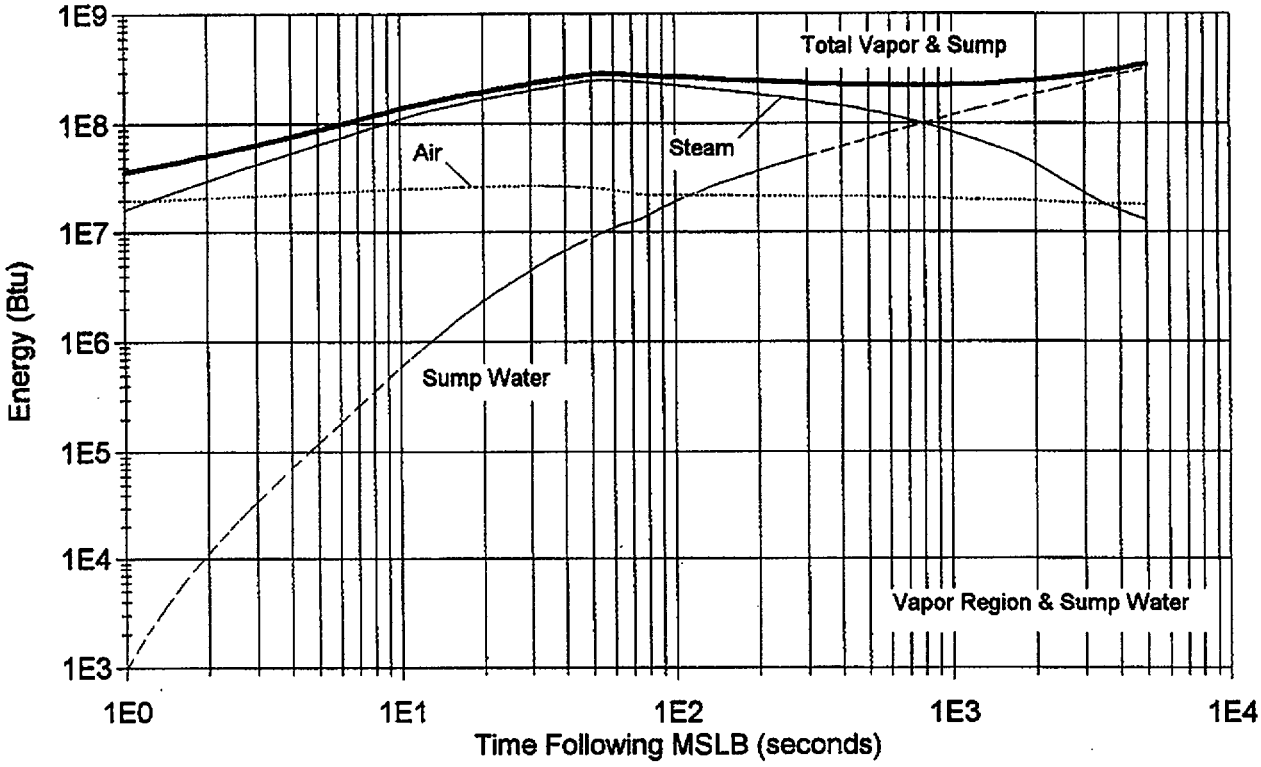


Figure 2.1.2-4

MSLB @ 102% POWER W/MSIV FAILURE
CONTAINMENT ENERGY DISTRIBUTION
CASE 7

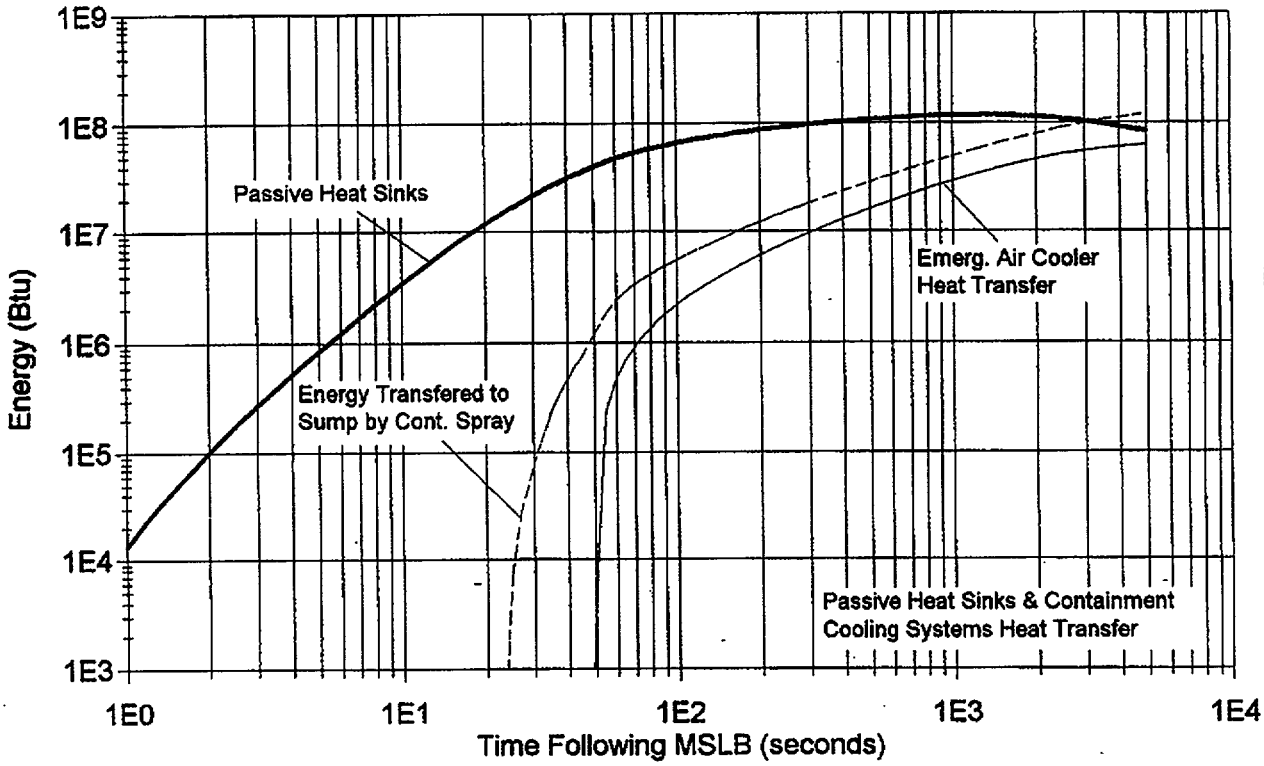


Figure 2.1.2-5

MSLB @ 102% POWER W/MSIV FAILURE
UCHIDA CONDENSING HEAT TRANSFER COEF.
CASE 7

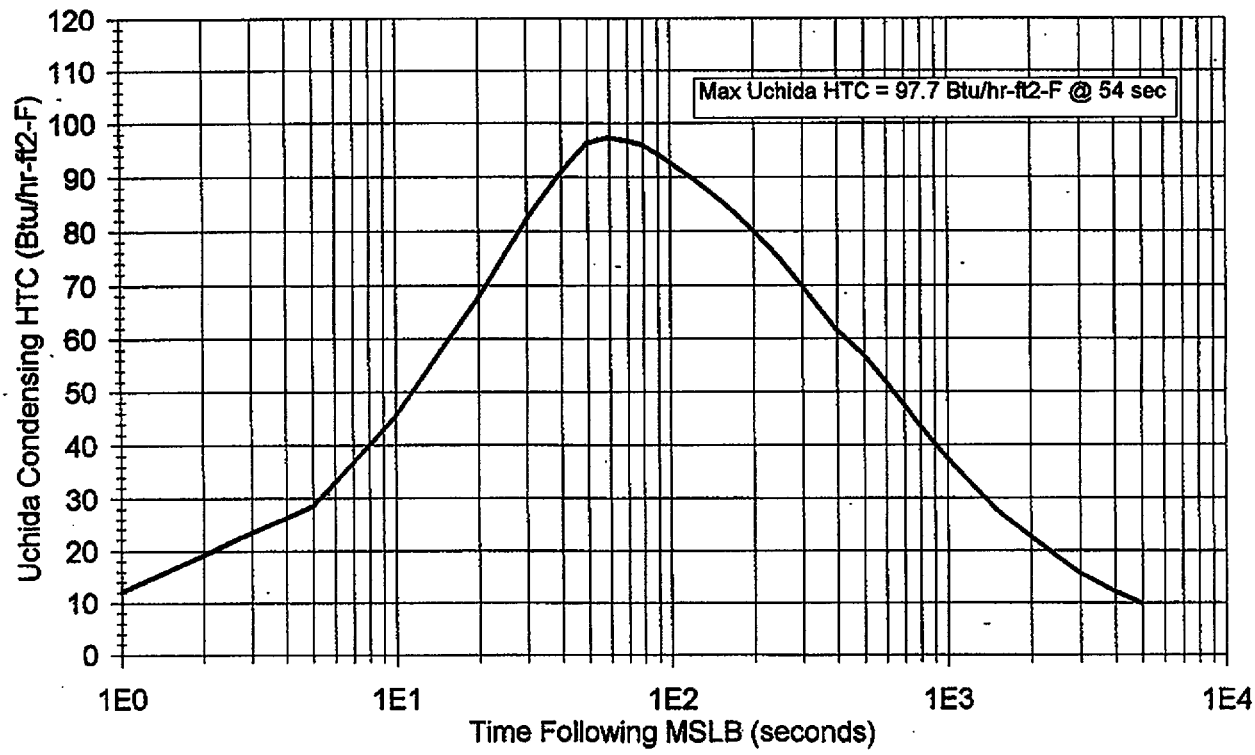


Figure 2.1.2-6

MSLB @ 102% PWR W/MSIV FAILURE
HEAT SINK SURFACE TEMPERATURES

CASE 7

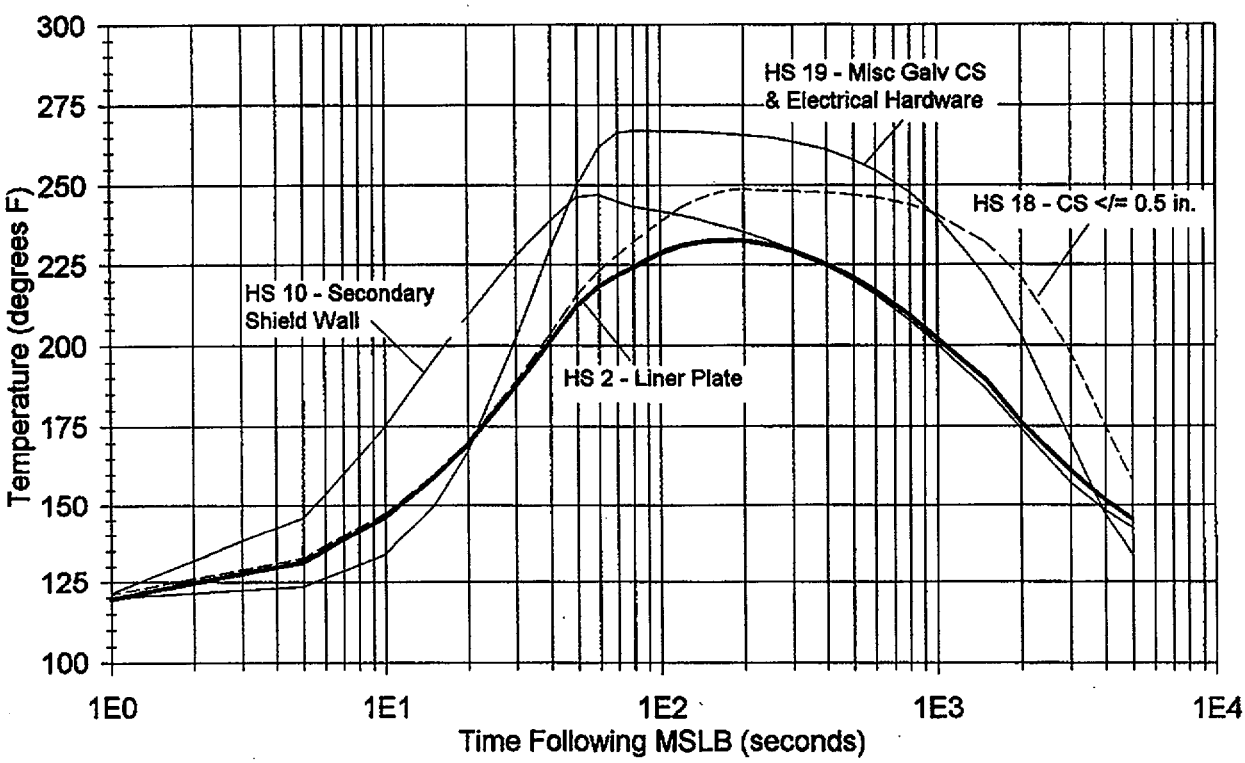


Table 2.1.2-1
Chronology of Events for 102% Power MSLB with MSIV Failure
Case 7

Time (seconds)	Event
0.0	MSLB occurs
0.85	Reactor trip conditions met Safety injection actuation conditions met Containment isolation actuation conditions met
1.75	Containment isolation Actuation Signal generated Main feedwater isolation valves start closing Main steam isolation valves start closing
9.75	Main steam isolation valves closed (1 of 2)
11.75	Main feedwater isolation valves closed
23	Start containment spray injection
31	Containment peak vapor temperature occurs (409°F) *
50	Containment spray reaches full flow
50	Containment emergency air cooling units in operation
52	Containment peak pressure occurs (56.5 psig)
180	Maximum containment liner plate temperature (233°F)
200	End ABB-CE supplied mass-energy release (blowdown)
1800	Termination of steam backflow from intact SG to break location through turbine-driven AFW steam supply piping
5000	End of analysis

* Peak vapor temperature for in-containment environmental qualification is 405°F based on analysis with 8% condensate revaporization (see Section 2.1.3)

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

2.1.3 Detailed Results for MSLB Event for in-Containment Environmental Qualification

The bounding MSLB event for containment peak vapor temperature is Case 7EQ, an 8.85 ft^2 slot break with the reactor at 102% power and closure failure of one main steam isolation valve (MSIV). Figure 2.1.3-1 presents the containment vapor temperature, saturation temperature, and the sump water temperature as a function of time. Table 9.2-3 contains the data used to prepare this figure.

The peak vapor temperature for Case 5EQ at 402°F is only 3°F less than that for Case 7EQ, and, because of the cooling train failure, the vapor temperature for Case 5EQ remains above 300°F about 14 seconds longer than occurs with Case 7EQ. Figure 2.1.3-2 is included showing the containment vapor temperature, saturation temperature, and sump water temperature for the full power MSLB with cooling train failure as a function of time to facilitate future electrical component transient thermal response analyses ("thermal lag calculations") should the greater time duration of elevated vapor temperature be of concern. Table 9.2-1 contains the data used to prepare this figure.

A chronology of events for the full power MSLB with MSIV failure (Case 7EQ) is provided in Table 2.1.3-1.

Figure 2.1.3-1

MSLB @ 102% PWR W/MSIV FAILURE CONTAINMENT TEMPERATURES

CASE 7EQ - Environmental Qualification

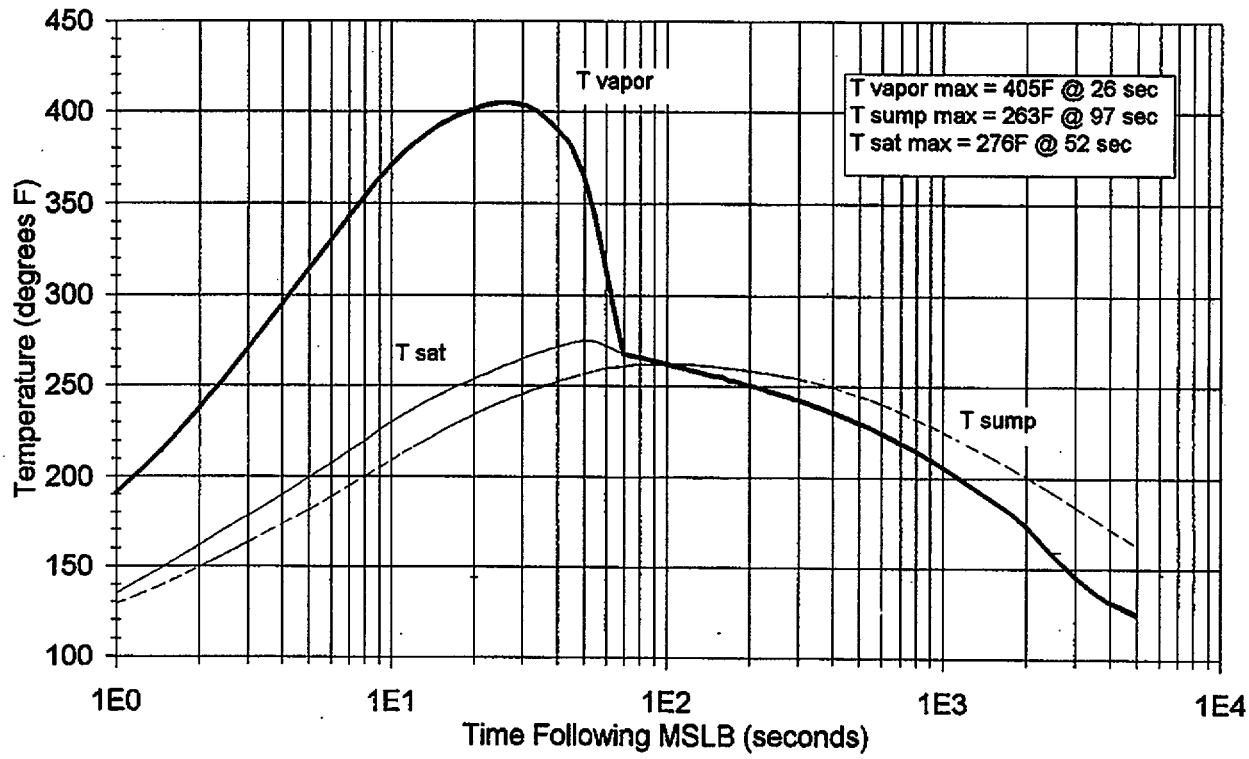


Figure 2.1.3-2

MSLB @ 102% PWR W/CLNG TRN FAILURE
CONTAINMENT TEMPERATURES
CASE 5EQ - Environmental Qualification

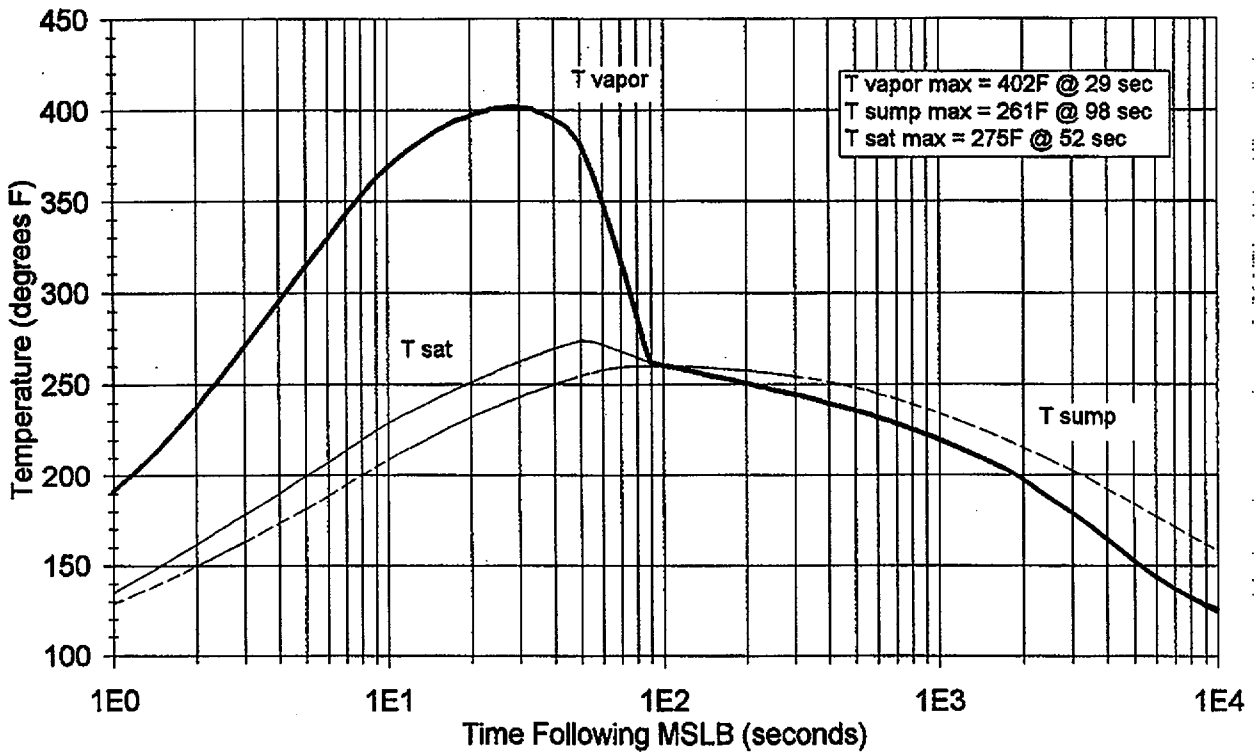


Table 2.1.3-1
Chronology of Events for 102% Power MSLB with MSIV Failure
Case 7EQ - Environmental Qualification Analysis

Time (seconds)	Event
0.0	MSLB occurs
0.85	Reactor trip conditions met Safety injection actuation conditions met Containment isolation actuation conditions met
1.75	Containment Isolation Actuation Signal generated Main feedwater isolation valves start closing Main steam isolation valves start closing
9.75	Main steam isolation valves closed (1 of 2)
11.75	Main feedwater isolation valves closed
23	Start containment spray injection
26	Containment peak vapor temperature occurs (405°F)
50	Containment spray reaches full flow
50	Containment emergency air cooling units in operation
52	Containment peak pressure occurs (50.7 psig)
160	Maximum containment liner plate temperature (236°F)
200	End ABB-CE supplied mass-energy release (blowdown)
1800	Termination of steam backflow from intact SG to break location through turbine-driven AFW steam supply piping
5000	End of analysis

2.2 Recommendations

The following changes/actions are required to be performed as a result of the issue of this calculation. AR991001327 has been generated to track the completion of these actions, listed by responsible group, below:

Licensing

Revise the "Applicable Safety Analyses" of Unit 2 and 3 Station Technical Specification Bases Sections B 3.6.1, B 3.6.2, B 3.6.4, and B 3.6.6.1 to change the cited peak post-MSLB containment pressure from 56.6 psig to 56.5 psig. In B 3.6.4, also revise the discussion to clarify that the calculated peak pressure of 56.5 psig applies to plant operation with the initial containment pressure at the Technical Specification LCO upper limit plus instrumentation total loop uncertainty. Revise Bases Sections B 3.6.5 and B 3.6.6.1 to change the cited peak post-MSLB containment vapor temperature from 428°F to 409°F.

Revise Section 5.5.2.15 of the Technical Specifications to change the calculated peak containment pressure from 56.6 psig to 56.5 psig.

Revise the Bases for the Licensee-Controlled Specification 3.6.100 to change the Peak post-MSLB containment pressure from 56.6 psig to 56.5 psig.

NEDO, Environmental Qualification

Revise UFSAR Section 3.11 to include the results of the containment MSLB response analysis.

Revise DBD-SO23-TR-EQ to include the results of the containment MSLB response analysis.

NEDO, Mechanical Analysis

Review/CCN thermal lag calculations M-DSC-243 and M-DSC-267 to incorporate the results of the containment MSLB response analysis, as appropriate.

NFM

Revise UFSAR Section 6.2.1 to include the results of the containment MSLB response analysis.

Revise DBD-SO23-TR-AA , Sections 4.4.5 (Containment Peak Pressure Analysis) and 4.4.8 (Mass and Energy Release Analysis for Postulated Secondary System Pipe Ruptures Inside Containment) to incorporate the results of the containment MSLB response analysis.

Since the calculated post-MSLB peak containment pressure in this current revision of the calculation is less than the peak pressure identified in plant procedures applicable to containment integrated and local leak rate testing, no revisions to the leak rate testing procedures are considered necessary as a result of issuance of this revised MSLB containment P-T response calculation.

A copy of this calculation revision will be provided to the Nuclear Training Simulator Group for review and incorporation into simulator training and/or other training modules as appropriate.

3 ASSUMPTIONS

3.1 Two different single failure scenarios are included. One scenario assumes a power-related failure to one safety train preventing operation of both one train of containment spray (CS) and one train of emergency air cooling units (ECUs). This single failure is termed "cooling train failure". The second scenario assumes the main steam isolation valve (MSIV) closest to the failed steam generator fails to close, maximizing the release of secondary side steam into containment. This single failure is termed "MSIV failure". Prior analyses during original SONGS Units 2 and 3 licensing [Ref. 6.6] demonstrated that a single failure of a Main Feedwater Isolation Valve (MFWIV) produced less severe containment conditions than either a cooling train failure or an MSIV failure. Therefore, the MFWIV single failure scenario is not included in this reanalysis.

3.2 This analysis is applicable to both Unit 2 and Unit 3. All references for significant input parameters are either applicable to both units, or, where unit-specific references are cited, differences between units have either been determined to not significantly impact the containment pressure-temperature transient response analysis, or else the more limiting unit-specific parameter is incorporated into the calculation.

4 DESIGN INPUT

4.1 The following initial conditions taken from the Unit 2 and Unit 3 Cycle 10 Reload Ground Rules (RGR) [Refs. 6.7 and 6.8, Section IX] are used for the MSLB P-T analyses for Section 6.2 of the UFSAR:

Containment maximum average vapor temperature	120°F	RGR Sect. IX.001
Containment maximum pressure	16.8 psia (2.1 psig)	RGR Sect. IX.002
Containment minimum average relative humidity	5%	RGR Sect. IX.003

These values are consistent with applicable technical specification limits, including instrumentation total loop uncertainties (TLUs), where appropriate. A minimum initial relative humidity is appropriate for maximizing containment pressure response. COPATTA Code steam table limitations prevent use of 0% relative humidity. The use of 5% RH is conservative based on the minimum value achievable with the normal containment air coolers using the chilled water cooling system.

The calculation of the post-MSLB containment vapor temperature response for EQ is performed with the containment initial pressure at a conservative minimum value of 13.8 psia (- 0.9 psig) [Refs. 6.7 and 6.8, Section IX.002]. Minimizing the amount of air in containment reduces the heat capacity of the vapor region and maximizes the temperature response of containment to the MSLB event.

4.2 The minimum containment free volume is 2.305×10^6 ft^3 [Ref. 6.9].

4.3 Outside ambient air conditions are modeled as:

Air temperature	100°F
Pressure	14.7 psia
Relative humidity	50%

The outside air temperature is taken from the Unit 2 and 3 RGR [Refs. 6.7 and 6.8, Section IX.016]. A high value is used to conservatively maximize the initial temperature of the concrete containment building. Ambient pressure and relative humidity are typical values for the coastal location. The choice of pressure and relative humidity are actually irrelevant to this analysis, since no containment leakage or air inflow is modeled in this analysis.

4.4 The maximum analysis duration for the MSLB event is 10,000 seconds (2.78 hours) with one train of containment spray operating or 5,000 seconds with 2 trains of containment spray operating. This analysis time is based on the 300,000 gallon minimum available RWST volume credited in the containment P-T response analyses [Refs. 6.7 and 6.8, Section VII.019] combined with the analysis minimum containment spray flow rate of 1,600 gpm per train [Refs. 6.7 and 6.8, Section IX.008]. Since sump recirculation is not modeled in the MSLB event, modeling details for the shutdown cooling heat exchanger are not included in the input data set.

4.5 No Loss of Power (LOP) is modeled for the MSLB event. A prior calculation [Ref. 6.11] determined that the mass and energy release rates are greater and calculated peak containment temperatures

and pressures are more severe if the reactor primary coolant pumps continue to operate during the event. The primary coolant pumps can operate only if off-site power remains available.

4.6 Emergency Air Cooling Unit (ECU) operation is conservatively not credited until 50 seconds following the MSLB when the containment spray system is at, or very nearly at, full flow. Per Reference 6.12, with no loss of power, the ECUs should actually be fully functional 39 seconds post-MSLB. Heat removal capability of each ECU (2 ECUs per train) is taken from calculation M-0072-036 [Ref. 6.13] and also are shown in RGR Table IX-2 in References 6.7 and 6.8. Once started, ECUS are modeled to operate for the duration of the MSLB analysis.

4.7 Mass and energy release data are provided in Reference 6.2. The following cases from the ABB-CE calculation [Ref. 6.2] are included in this containment P-T response calculation:

ABB Case Number	MSLB Case Description
1	3.45 ft^2 Slot MSLB @ 0% Power w/cooling train failure
2	5.30 ft^2 Slot MSLB @ 20% Power w/cooling train failure
3	7.05 ft^2 Slot MSLB @ 50% Power w/cooling train failure
4	8.10 ft^2 Slot MSLB @ 80% Power w/cooling train failure
5	8.85 ft^2 Slot MSLB @ 102% Power w/cooling train failure
13	3.45 ft^2 Slot MSLB @ 0% Power w/MSIV failure
14	5.30 ft^2 Slot MSLB @ 20% Power w/MSIV failure
15	7.05 ft^2 Slot MSLB @ 50% Power w/MSIV failure
16	8.10 ft^2 Slot MSLB @ 80% Power w/MSIV failure
7	8.85 ft^2 Slot MSLB @ 102% Power w/MSIV failure

The time dependent mass and energy flow rates, break flow enthalpies, integrated break mass and energy flows are tabulated in Appendix A of the referenced ABB-CE calculation. These mass and energy releases for these 10 cases were all calculated with the ABB-CE SGNIII code using methodology reviewed and approved by the NRC for this purpose and described in Appendix 6B of the CESSAR System 80 PSAR [Ref. 6.14]. The ABB-CE mass and energy release calculation also includes a number of additional MSLB cases using a modified methodology providing an early onset of superheated steam break flow and suggested for use to provide a more conservative containment analysis for environmental qualification. An evaluation of the augmented, early superheat break flow data was performed [Ref. 6.15], and it was concluded that the data is excessively conservative and inappropriate for use for SONGS Units 2 and 3. Use of the mass and energy release data included in the 10 cases listed above for containment environmental qualification analyses (UFSAR Section 3.11) as well as containment functional design (UFSAR Section 6.2) is acceptable and consistent with SONGS Units 2 and 3 licensing basis.

In addition to the break mass and energy releases calculated by ABB-CE, the following additional saturated steam mass and energy flow rates are included as a parallel input to the MSLB break flow:

1) Main steam backflow from the intact steam generator through worn check valves and small bore check valve bypass piping in the steam supply piping to the turbine-driven auxiliary feedwater pump (P-140). The backflow will occur in the event that both isolation valves HV8200 and HV8201 are open. The isolation valve on the intact steam generator will be opened by the emergency feedwater system to supply steam to the turbine-driven auxiliary feedwater pump. These isolation valves are air operated, fail open, valves. The instrument air system is non-seismic, and the isolation valve on the failed steam generator is presumed to be open. Operator action at 30 minutes to manually close one of the open isolation valves is credited to terminate the steam back flow. The steam back flow is calculated in Reference 6.16 to be 23,550 lb_m/hr @ 1000 psia. This containment P-T response calculation uses a conservative bounding backflow of 29,000 lb_m/hr saturated steam @ 1000 psia. This backflow is included for all cases analyzed from time equal zero to 1800 seconds (30 minutes) when operator action to terminate the backflow is credited.

2) Additional main steam backflow into containment through slow-closing air-operated 4" main steam isolation bypass valves HV8202 and HV8203. These valves are used for preheating the secondary system piping downstream of the 40" MSIVs and equalize pressure across the MSIVs prior to opening the large valves. The valves are normally opened only during plant start-up, and are closed during plant operation. The valves have an inservice testing (IST) closure stroke time criterion of 40 seconds [Ref. 6.10]. In this containment P-T response calculation, these valves are assumed to be open only for the case of zero power, with and without MSIV failure. The expected steam flow through the valves is determined in the body of this calculation. These valves close only on an MSIS. Using an analysis setpoint of 675 psia steam generator pressure [Refs. 6.7 & 6.8, section VIB.019] and reviewing the failed steam generator pressure vs time history from the SGNIII run output file for the zero power MSLB provided by ABB-CE (on CDROM) with the Reference 6.2 calculation, the MSIS condition will be reached in less than 19 seconds. Allowing 1 second for instrumentation response, the main steam isolation signal will be generated in less than 20 seconds and the steam bypass isolation valves will be fully closed within an additional 40 seconds, or a total of 60 seconds following the zero power MSLB event. The isolation valves are assumed to remain fully open for 60 seconds following the MSLB and then instantaneously close.

4.8. The containment spray flow rate is modeled as a ramped input from 0 to 1600 gpm per train over a 27-second interval with the timing of start of the ramp technically dependent upon the specific MSLB event being analyzed. A ramped input is supported by a spray piping system transient filling analysis [Ref. 6.17]. The development of the transient spray flow rates used in this P-T calculation and the initial spray start times are provided in the body of the calculation. As shown in the Reference 6.17 calculation (pages A14-4 & A14-8), a maximum of 30 seconds is required to reach full spray flow at the top ring header with Unit 3 filling in 29 seconds and Unit 2 filling in 30 seconds. Based on spray nozzle group (link) flow plots on pages A15-86 and A16-81 of Reference 6.17, spray water first appears at the nozzles in the lower ring header of Unit 3 at 2.45 seconds and at 2.23 seconds in Unit 2. Thus, an initial spray flow from the first nozzles in the lower header may

conservatively modeled in this P-T analysis as appearing within 3 seconds of the start of the CS pump. The maximum single train spray flow rate of 1600 gpm is taken from References 6.7 and 6.8 (section IX.008) and conservatively bounds the minimum plant value of 1606 gpm calculated in Supplement A to calculation M-0014-009 [Ref. 6.17, pg. A6]. The temperature of the spray water drawn from the RWST is 100°F per References 6.7 and 6.8 (section IX.011). A variable containment spray heat transfer efficiency factor, dependent on the containment water vapor to air mass ratio is included in the COPATTA analysis with the efficiency taken from Figure 2 of Reference 6.23 as recommended by Reference 6.25.

4.9 Analysis values for the coating (paint) thickness on exposed surfaces of concrete and carbon steel passive (structural) heat sinks are listed below:

Carbon Steel	10 mils	SO23-I-1.11.1, current in-containment painting procedure specifies 8-10 mils [Ref. 6.19, Attmt. 4]. The analysis value is consistent with Bechtel Architectural Construction Spec CS-A7, R0 [Ref. 6.20] and supported by Unit 2 liner plate paint thickness survey performed during U2C9 midcycle outage [Ref. 6.21].
Carbon Steel Lifting Devices	15 mils	Refueling machine, CEA change mechanism, vessel head lifting device, polar crane, and maintenance crane (vendor-supplied and/or previously identified with 15 mil paint thickness in Reference 6.22).
Concrete Floors	50 mils	Conservative with respect to 8-12 mils per current painting procedure SO23-I-1.11.1 [Ref. 6.19, Attmt. 4]. The analysis value selected allows future heavier coatings or local application of epoxy fillers which may be required to support floor decontamination and address ALARA concerns.
Concrete Walls	30 mils	SO23-I-1.11.1 Current in-containment painting procedure specifies 8-12 mils [Ref. 6.19, Attmt. 4]. The analysis value increased to 30 mils to be conservative with respect to Bechtel Architectural Construction Spec CS-A7, R0 [Ref. 6.20] which allowed total epoxy coating thickness of 13 to 28 mils plus local use of epoxy filler in original construction. Although largely unpainted, the steam generator compartment walls (secondary shield) are conservatively modeled as painted.

Modeling the paint thickness at larger than actual values inhibits heat transfer from the containment vapor region into the building structure and results in a conservative calculation of containment peak pressure and temperature.

Galvanized steel surfaces are not painted. Zinc galvanizing on carbon steel will not be separately modeled since the galvanized layer is thin and the thermal conductivity of zinc is greater than that of carbon steel.

4.10 Steel liner plate to concrete gap conductance is 50 Btu/hr ft^2 °F as recommended in Bechtel Topical Report BN-TOP-3 (Ref. 6.23, Appendix A], based on Carolinas-Virginia Tube Reactor (CVTR) experimental data. This gap conductance is included by modeling a uniform air gap between the liner plate and the concrete. One-dimensional, conductive heat transfer across a uniform air gap is expressed by the standard relationship:

$$Q/A = (k_{th}/x)(\Delta T)$$ [Ref. 6.24]

Where
- Q/A = heat flux; the energy flow rate (Btu/hr) per unit cross-sectional area (ft^2)
- k_{th} = thermal conductivity of the air (Btu/hr ft^2 °F/ft)
- x = thickness of the air gap (ft)
- ΔT = total temperature drop across the air gap (°F)

For the purposes of the COPATTA heat sink model, k_{th}/x is defined to be the gap conductance (C_g). Thus,

$$C_g = k_{th}/x \quad \text{or} \quad x = k_{th}/C_g \quad \text{with } C_g \text{ in units of Btu/hr ft}^2\ °F$$

Use air properties at 200°F, for convenience, and then solve for the gap thickness to provide the desired gap conductance of 50.

$$k_{th} = 0.0174 \text{ Btu/hr ft}^2\ °F/ft$$ [Table A-6, Ref. 6.24]

$$x = 0.0174/50 = 0.000348 \text{ ft or } \mathbf{0.00035\ ft} \text{ (rounded)}$$

The gap conductance of 50 Btu/hr ft^2 °F is also included at the boundary between the refueling canal liner plate and concrete, as well as between the containment building liner plate and concrete containment shell and dome.

Note: No gap conductance is modeled at the boundary between galvanized steel decking and the overlying concrete of the elevated floor slabs for the following reasons:

1) The elevated concrete floor slabs are horizontal. Therefore, beginning with the initial floor slab pour, the decking is supporting the concrete which is being pushed down by the action of gravity.
2) The pouring of the concrete floor is accompanied by mechanical vibration/agitation to facilitate the flow of the concrete around the slab reinforcing rods, eliminating voids and assuring the concrete completely fills the decking convolutions. Thus, the mechanics of concrete placement assures intimate contact between the cement and the supporting decking.
3) No enhancement of the thermal conductivity of concrete due to the presence of steel reinforcing rods in the matrix is credited.
4) Given the design configuration and construction process, physical bonding of the concrete to the galvanized steel decking would be expected, providing intimate contact and no significant thermal resistance at the interface between the two materials.

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1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00						

4.11 The thermal conductivity and volumetric heat capacity of the containment structural materials (passive heat sinks) included in the COPATTA model are identified in this Design Input section. These properties are generally well defined in available engineering data bases. Data for the containment epoxy paints are limited, and conservative judgement has been used to determine appropriate values for this calculation to avoid overstating the rate of energy transfer from the vapor region into the painted structures.

a. Carbon Steel

A typical carbon steel thermal conductivity of 25 Btu/hr-ft-°F is recommended by Bechtel Nuclear Standard N2.3.2 [Ref. 6.25, sheet 14]. A typical carbon steel volumetric heat capacity of 54 Btu/ft^3-°F is also recommended by Reference 6.25.

b. Concrete

Typical values for concrete thermal conductivity and volumetric heat capacity are 0.8 Btu/hr-ft-°F and 30 Btu/ft^3-°F, respectively, as recommended by Reference 6.25.

c. Stainless Steel

Typical values for stainless steel thermal conductivity and volumetric heat capacity are 10 Btu/hr-ft-°F and 54 Btu/ft^3-°F, respectively, as recommended by Reference 6.25.

d. Epoxy Paint

The properties of the epoxy coatings applied to structural materials inside containment are not as well-defined as they are for the steel and concrete itself. Data available on the original coating materials and the epoxy coating currently used at SONGS for repainting surfaces and repair work is described below.

Mobil Chemical Company epoxy coatings were originally specified for in-containment application on both concrete and carbon steel surfaces. Mobil Chemical's coating product line was acquired by Valspar Corporation, and the Mobil product numbers were retained by Valspar.

Architectural Construction Specification CS-A7, Revision 1 [Ref. 6.20] identifies the products applied in the field to the steel and concrete surfaces in containment. Specifically, new concrete floors (coating system FN-16) were thinly coated with an unspecified and unmeasured thickness of sealer (Valspar 84-V-200). Next, an epoxy filler (Valspar 46-X-2900) was applied as needed to fill depressions and holes and provide a smoother surface for finish coating. The epoxy filler was followed by two finish coats of Valspar 89-W-900. AR980101683 (Ref. 6.26), assignment 5 provides thermal conductivity values for the epoxy filler (46-X-2900) and the epoxy finish coat (89-W-900) of 0.18 Btu/hr-ft-°F and 0.23 Btu/hr-ft-°F, respectively. No data on the properties of the Valspar 84-V-200 concrete sealer have been found.

Reference 6.20 identifies the coating of concrete (coating system FN-14) to provide a more decontaminable surface to consist of a thin seal coat of 84-V-200, an epoxy filler application to fill holes and depressions using 46-X-2900, a second application of 46-X-2900 filler as a general coat, and a single finish coat of 84-W-900 epoxy paint (*versus* 89-W-900 used on the floors). No information on the properties of Valspar 84-W-900 have been found.

According to Reference 6.20, field coating of most bare steel (coating system FN-12) in containment, including the containment liner plate, consisted of two applications of Valspar 78-W-300 epoxy coating. No data on the properties of Valspar 78-W-300 have been found.

The current procedure for in-containment painting [Ref. 6.19] specifies the use of only Ameron International Corporation's Amerlock 400NT epoxy paint for field application inside

containment. Ameron indicates that no measurement of thermal conductivity for Amerlock 400NT has been made. However, Ameron has said that the conductivity of the 400NT coating should be similar to that measured for their Amercoat 66 (k_{th} = 0.23 Btu/hr-ft-°F) and Amercoat 90 (k_{th} = 0.38 Btu/hr-ft-°F), [Ref. 6.27]. The same reference (6.27) also indicates the volumetric specific heat of Amercoat 66 and 90 to be 47.1 and 49.9 Btu/ft^3-°F, respectively.

The table below summarizes the available information on the properties of the epoxy fillers and coatings used for field application inside containment. "ND" means not determined.

Summary of Available Data on Containment Coating Properties

Coating Material	Thermal Conductivity (Btu/hr-ft-°F)	Volumetric Heat Capacity (Btu/ft^3-°F)	Comment
Valspar 84-V-200	ND	ND	Raw concrete sealer, thin application
Valspar 46-X-2900	0.18	ND	Filler for concrete walls and floors (conductivity from Ref. 6.26)
Valspar 89-W-900	0.23	ND	Floor intermediate and finish coat (conductivity from Ref. 6.26)
Valspar 84-W-900	ND	ND	Wall finish coat
Valspar 78-W-300	ND	ND	C/S coating
Ameron Amercoat 400NT	0.23 to 0.38	47.1 to 49.9	All new and replacement painting (properties based on Ref. 6.27)

The thermal conductivity of the concrete sealer is not considered to be significant in the modeling of the total paint system applied to the concrete. The thickness is judged to be very thin and the conductivity should be similar to those of the other coatings. The wall finish coat and carbon steel coating materials are expected to have thermal conductivities similar to that of the Valspar 89-W-900 or the Ameron 400NT coatings. The Valspar epoxy filler material has the lowest thermal conductivity identified. To provide a conservative coating model for the containment P-T calculation, a thermal conductivity of 0.15 Btu/hr-ft-°F will be used for all epoxy coatings used on all painted surfaces in containment. This value is about 17% less than the value provided for the Valspar 46-X-2900 material.

The value of the volumetric specific heat for the paint is not a significant parameter due to the very small total volume of paint compared to that of the concrete and steel in containment. A small value is recommended to minimize the energy storage capability of the paint. Based on the values cited for a variety of coating products in Reference 6.27, a value of 20 Btu/ft^3-°F will be used in this calculation. This value also happens to be the number recommended in Bechtel Nuclear Standard N2.3.2 [Ref. 6.25].

e. Air (modeled in the liner plate-to-concrete air gap)

As identified in Design Input 4.10, regarding liner plate gap conductance, the thermal conductivity of air is modeled as 0.0174 Btu/hr-ft-°F [Ref. 6.24]. The volumetric heat capacity for air in a confined volume is given by the product of the air density (ρ) and the specific heat at constant volume (C_v). The specific heat at constant volume is calculated from the specific heat at constant pressure (C_p) and the C_p to C_v ratio for air. From Reference 6.24, Appendix A, table A-6, the density of air at 200°F (assumed typical average temperature) is 0.060 lb_m/ft^3, and Cp is equal to 0.241 Btu/lb_m-°F. From Crane Technical Paper 410 [Ref. 6.29, page A-22] the value of the specific heat ratio for air is 1.4. Therefore, the value of C_v is

$$C_v = (k)(C_p) = 0.241/1.4 = 0.172 \text{ Btu/lb}_m\text{-°F}$$

The volumetric specific heat is

$$\rho C_v = (0.060)(0.172) = 0.0103 \text{ Btu/ft}^3\text{-°F}$$

4.12 The Uchida condensing heat transfer coefficient (HTC) correlation is used for calculating condensation heat transfer from the vapor region to the passive heat sinks when performing main steam line break analyses [Ref. 6.25].

5 METHODOLOGY

This calculation uses the Bechtel COPATTA computer program [Ref. 6.18] to model the containment building response to a spectrum of postulated large main steam line breaks (MSLBs). The program is normally used to analyze the containment response to loss of coolant accident (LOCA) and MSLB events. The COPATTA program was used by Bechtel to support the initial design and licensing of SONGS Units 2 and 3, and has continued to be used by SONGS to perform subsequent evaluations, new calculations and calculation revisions. The COPATTA program is installed and validated on the Nuclear Fuels Department RISC 6000 computer system as described in the COPATTA Software Installation Report, Revision 2 [Ref. 6.28].

The COPATTA program calculates pressure and temperature conditions in two separate regions of the containment building: the containment atmosphere (vapor region) and the containment sump (liquid region). These regions are open systems in a thermodynamic sense since the COPATTA code permits mass flow across region boundaires. Mass and energy are transferred between the liquid and vapor regions by boiling, condensation, or liquid dropout. Each region is assumed homogeneous, but a temperature difference can exist between regions. Any moisture condensed in the vapor region during a time increment is assumed to immediately fall into the liquid region. Non-condensible gas (air) is included in the vapor region. The program models heat transfer to containment structural heat sink materials from the vapor and liquid regions. The performance of containment spray and emergency air cooling unit containment heat removal systems are also modeled.

The mass and energy input into the building from the broken steam line is provided by a separate ABB-CE calculation [Ref. 6.2], and input into the COPATTA program as a tabular function of time. Additional steam mass and energy backflow through leaking check valves and small bore check valve bypass piping in the steam supply piping to the turbine drive for AFW pump P-140 is separately input in parallel with the MSL break flows provided by ABB-CE to assure a conservative containment analysis. In addition, steam backflow through air-operated 4-inch main steam isolation valve bypass valves (HV8202 and HV8203) is included for the zero power MSLB event since these valves could be open for pressure equalization and line preheating during plant startup operations.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

6 REFERENCES

6.1 Letter, G. Singh (ABB-CE) to D. Pilmer (SCE), ST-98-740, "Transmittal of Final Main Steam Line Break Mass & Energy Release Data for Containment Pressure & Temperature Calculation to Support SCE Tcold Reduction Program" [SONGS Units 2&3], Includes Enclosure 1, 12/9/98

6.2 ABB-CE Calculation 09/10-ST98-C-020, Revision 00, "SONGS Units 2 & 3 MSLB Mass and Energy Release Data for Tcold Reduction Analysis", 12/9/98 (Enclosure 1 to Reference 6.1)

6.3 10CFR Part 50, "Domestic Licensing of Production and Utilization Facilities", Revised as of January 1, 1999

6.4 NUREG-0800, "US Nuclear Regulatory Commission Standard Review Plan", Section 6.2.1.1.A, PWR Dry Containments, Including Subatmospheric Containments, Revision 2, July 1981

6.5 DBD-SO23-TR-ST, Revision 0, "Containment Structure Topical Report", 9/25/98

6.6 Calculation N-4080-007, Revision 2, including CCN 1 and CCN 2, "Containment Temperature and Pressure From MSLB at Various Power Levels (NRC Question 022.7)", 4/21/83

6.7 RGR-U2-C10, Revision 2, "SONGS Unit 2 Cycle 10 Reload Ground Rules", 2/22/99

6.8 RGR-U3-C10, Revision 1, "SONGS Unit 3 Cycle 10 Reload Ground Rules", 2/19/99

6.9 Calculation C-257-01.06.01, Revision 2, including CCN Preliminary CCN N-3, " Containment Shell Analysis - Containment Passive Heat Sink", 4/30/99

6.10 Document 90055, Revision 4, "Pump and Valve Inservice Testing Database, SONGS 2 & 3", 11/24/98 (accessed through NCDB)

6.11 Calculation N-4080-004, Revision 1, including CCN 1, CCNNT 2, and CCN 3, "Equipment Qualification Thermal Analysis", 11/6/78

6.12 Calculation N-4080-003, Revision 5, including CCN 1 and CCN 2, "Containment Spray (CS) and Emergency Cooling Unit (ECU) Actuation Times", 6/10/97

6.13 Calculation M-0072-036, Revision 0, "Containment Emergency Cooler Performance Verification", 12/9/93

6.14 CESSAR System 80 PSAR, Thru Amendment 8, 10/7/74, Appendix 6B, "Description of the SGNIII Digital Computer Code Used in Developing Main Steam Line Break Mass/Energy Release Data for Containment Analysis"

6.15 Memorandum For File, "Main Steam Line Break Mass-Energy Release Data for Equipment Qualification in Containment, SONGS Units 2 and 3", Paul Barbour, March 8, 1999 (copy included in Appendix B)

6.16 Calculation M-DSC-334, Revision 1, "Reverse Flow Through Check-Valve in AFW Pump Turbine Line", 1/31/97

6.17 Calculation M-0014-009, Revision 0, including CCN 1, CCN 2, and CCN 3, "Containment Spray Pumps In Service Testing Minimum Requirements", 1/22/99

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6.19 Maintenance Procedure SO23-I-1.11.1, Revision 0, including TCN 0-1, "Site Painting Procedure for Systems, Structures and Components Inside Containment", 3/31/98

6.20 Architectural Construction Specification CS-A7, Revision 1, "Field Coatings", 12/16/86

6.21 "Unit 2 Floor and Liner Plate Coating Thickness Survey", Performed 2/19-20/98 during U2C9 Midcycle Outage by Maintenance Support Services (copy included as Appendix D to this calculation)

6.22 Calculation N-4080-005, Revision 0, "MSLB Analysis for Equipment Qualification", 3/15/78

6.23 Topical Report BN-TOP-3, Revision 4, "Performance and Sizing of Dry Pressure Containments", Bechtel Corporation, March 1983

6.24 Hsu, S. T., *Engineering Heat Transfer*, D. Van Nostrand Company, Inc, New York (1963)

6.25 Bechtel Nuclear Standard N2.3.2, Revision 0, "Containment Analysis", July, 1975

6.26 AR980101683, Containment Paint Thickness (and thermal conductivity), 1/27/98

6.27 Letter, G. Keesler, Ameron, to Pat Young, SCE, "DBA & Thermal Conductivity On Amerlock 400NT", May 27, 1998 (copy included in Appendix E to this calculation)

6.28 NE100 (COPATTA) Computer Program Software Installation Report, Revision 2, 8/31/98

6.29 Crane Technical Paper 410, "Flow of Fluids", 1976

6.30 ASME Steam Tables, 1967

6.31 P & ID Drawings, Main Steam System
6.31a. 40141C, Rev. 33 (Unit 2) 6.31b. 40141D, Rev. 39 (Unit 2)
6.31c. 40141E, Rev. 37 (Unit 2) 6.31d. 40141F, Rev. 23 (Unit 2)

6.31e. 40141CSO3, Rev. 31 (Unit 3) 6.31f. 40141DSO3, Rev. 39 (Unit 3)
6.31g. 40141ESO3, Rev. 38 (Unit 3) 6.31h. 40141FSO3, Rev. 20 (Unit 3)

6.32 NUREG/CR-4041, Revision 1, "Systems Analysis Handbook", EG and G Idaho, November 1985

6.33 Civil Drawing 23000, Revision 5

6.34 Calculation N-4060-030, Revision 0, "Containment Flooding Level", 2/11/94

6.35a Civil Drawing 23110, Revision 15

6.35b Civil Drawing 23111, Revision 24

6.36 Civil Drawing 23118, Revision 8

6.37 Civil Drawing 23119, Revision 7

6.38a Civil Drawing 23116, Revision 12

6.38b Civil Drawing 23117, Revision 18.

6.39a Civil Drawing 23114, Revision 9

6.39b Civil Drawing 23115, Revision 13

6.40a Civil Drawing 23112, Revision 13

6.40b Civil Drawing 23113, Revision 9

6.41 Civil Drawing 23211, Revision 25

6.42 Waterford Steam Electric Station Unit No. 3, Updated Final Safety Analysis Report, Louisiana Power and Light Company (Entergy), thru Revision 8, 5/96

6.43 Letter, R.W. DeVane, Jr. (CE) to J. D. Houchen (Bechtel), S-CE-2895, "FSAR Mass/Energy Release Data for Containment Design LOCA and MSLB, Revised CE Supplied Heat Sink List", 5/21/76 (CDCC # 85587)

6.44 Vendor Drawing, SO23-904-11, Revision 4, "CSB & UGS Lift Rig Materials"

6.45 CE Power Systems Internal Memorandum, W. A. Borchers to R. W. DeVane, C-RPE-236, "Heat Sink Data - San Onofre 2/3 Refueling Equipment", 7/14/77 (CDCC # 32996)

6.46 Calculation M-DSC-362, Revision 0, "Piping and Pipe Supports Surface Area Calculation", 9/25/98

6.47a Vendor Drawing, SO23-936-37, Revision 0, "Pool Seal Ring Details" (Unit 3)

6.47b Vendor Drawing, SO23-936-23, Revision 3, "Pool Seal Ring Details" (Unit 2)

6.48 Drawing 90004, Revision 62, "Piping Material Classification"

6.49 NUREG-0588, Revision 1, "Interim Staff Position on Environmental Qualification of Safety-Related Electric Equipment", USNRC, July, 1981

6.50 AR980502634, Preliminary Equipment Qualification Calculations for Containment Temperature Response to the Full Power MSLB, 5/29/98

7 NOMENCLATURE

A	area (ft^2 or in^2)
AFW	Auxiliary Feedwater
ALARA	As Low As Reasonably Achievable
AOR	analysis of record
Btu	British thermal unit
CEA	Control Element Assembly
CEDM	Control Element Drive Mechanism
C_p	Heat capacity (or specific heat) at constant pressure (Btu/lb_m-°F)
CS	carbon steel or Containment Spray
CT	Cooling Train
C_v	heat capacity (or specific heat) at constant volume (Btu/lb_m-°F)
D, d	diameter (feet or inches)
ECU	Emergency (air) Cooling Unit
EQ	environmental qualification
ESF	engineered safety features
F	degree Fahrenheit
ft	feet
gpm	gallons per minute
hr	hour
H	height (feet)
HELB	high energy line break
HTC	heat transfer coefficient
HVAC	heating, ventilating, (and) air conditioning
in	inches
k_{th}	thermal conductivity (Btu/hr-ft^2/ft of thickness)
lb_f	pound force
lb_m	pound mass
k	specific heat ratio, dimensionless
LOCA	Loss of Coolant Accident
min	minute
MFWIV	Main Feedwater Isolation Valve
MFWLB	Main Feedwater Line Break
MSIS	Main Steam Isolation Signal (or System)
MSIV	Main Steam Isolation Valve
MSLB	Main Steam Line Break
OSA	outside air (HVAC terminology)
P	pressure (psia)
psia	pound force/square inch, absolute
psig	pound force/square inch, gauge
P&ID	piping and instrumentation diagram
P-T	pressure-temperature (transient analysis)
q	energy flow rate (Btu/hr)
RGR	Reload Ground Rules

RWST	Refueling Water Storage Tank
ρ	Greek Rho, density (lb_m/ft^3)
sec	seconds
T or x	Heat Sink material thickness (feet or inches)
TLU	Total Loop Uncertainty (for instrumentation)
V	volume (ft^3)
w	mass flow rate (lb_m/sec)

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

8 CALCULATIONS

This section of the calculation identifies and develops the input data required to perform the COPATTA program analysis of the containment pressure-temperature response to the various MSLB events analyzed. Input data is developed and presented for the peak P-T analyses reported in Section 6.2 of the UFSAR. Additional, or changed input data to support the containment peak temperature response calculations provided for in-containment environmental qualification (UFSAR Section 3.11) are also identified in the affected sections of the COPATTA input data presentation which follow.

8.1 COPATTA Variable Input Data

8.1.1 Title Card

The title card is unique to each case of the calculation.

The title cards for the 10 cases run to define the P-T response for containment functional design (UFSAR Section 6.2) are:

* Case 1 - 3.45 ft2 Slot MSLB @ 0% Power w/CT Failure: N-4080-027R1
* Case 2 - 5.30 ft2 Slot MSLB @ 20% Power w/CT Failure: N-4080-027R1
* Case 3 - 7.05 ft2 Slot MSLB @ 50% Power w/CT Failure: N-4080-027R1
* Case 4 - 8.10 ft2 Slot MSLB @ 80% Power w/CT Failure: N-4080-027R1
* Case 5 - 8.85 ft2 Slot MSLB @ 102% Power w/CT Failure: N-4080-027R1
* Case 13 - 3.45 ft2 Slot MSLB @ 0% Power w/MSIV Failure: N-4080-027R1
* Case 14 - 5.30 ft2 Slot MSLB @ 20% Power w/MSIV Failure: N-4080-027R1
* Case 15 - 7.05 ft2 Slot MSLB @ 50% Power w/MSIV Failure: N-4080-027R1
* Case 16 - 8.10 ft2 Slot MSLB @ 80% Power w/MSIV Failure: N-4080-027R1
* Case 7 - 8.85 ft2 Slot MSLB @ 102% Power w/MSIV Failure: N-4080-027R1

The case numbers reflect the ABB-CE case numbers for the mass/energy release data sets.

The title cards for the two cases run to define the bounding P-T response for containment environmental qualification (UFSAR Section 3.11) are:

* Case 5EQ - 8.85 ft2 Slot MSLB @ 102% Power w/CT Failure N-4080-027R1
* Case 7EQ - 8.85 ft2 Slot MSLB @ 102% Power w/MSIV Failure N-4080-027R1

8.1.2 Card Series 0

This card is identical for all cases.

$LIST POOL=0,0,1,0,1$END

The card contains the following items:

Item 1:	Card series identifier = 0	
Item 2:	IHEAT = 0	No spray heat exchanger modeling is used for the MSLB.
Item 3:	NOIT = 1	No iteration for time to blowdown (initial) peak pressure.
Item 4:	NPTOP = 0	Normal set of output data printed at each printout time.
Item 5:	LAST = 1	Single case submission. Sequential change case option is not available.

8.1.3 Card Series 1

This card is identical for all cases except for item 2 (TFNL) which is the analysis run time duration, item 3 (PAIR) which is the initial total pressure in containment, and item 11 (EVAP) which is the fraction of the heat sink condensate which is allowed to revaporize while the containment atmosphere is superheated.

$LIST POOL=1,TFNL,PAIR,2.305E6,120,0.05,21,0,1,1,EVAP,14.7,0.5$END

The card contains the following items:

Item 1:	Card series identifier = 1	
Item 2:	TFNL	This value is the computer analysis run time in seconds (See Design Input 4.4)
	TFNL = 10000 sec	For all cases with cooling train single failure (only one CS train operating).
	TFNL = 5000 sec	For all cases with MSIV single failure (two CS trains operating).
Item 3:	PAIR	Initial containment pressure (see Design Input 4.1).
	PAIR = 16.8 psia	For 10 cases run for containment functional design (see Design Input 4.1).

	PAIR = 13.8 psia	For containment EQ cases (see Design Input 4.1).
Item 4:	VOL = 2.305E6 ft^3	Containment net free volume (see Design Input 4.2).
Item 5:	TAIR = 120°F	Containment initial average air temperature (see Design Input 4.1).
Item 6:	HUM = 0.05	Containment initial average relative humidity, 5% expressed as a decimal fraction (see Design Input 4.1).
Item 7:	NSL = 21	Number of heat conducting regions (passive heat sinks) in the problem (see Section 8.2).
Item 8:	TBOIL = 0	Average temperature of primary coolant before the MSLB occurs. This value sets the initial temperature of all heat conducting regions in contact with the coolant. The value cited is not used in this calculation, since the COPATTA analysis does not calculate heat transfer from the hot RCS components. Energy extraction from the RCS is modeled by ABB-CE in their mass-energy release calculations.
Item 9:	TCHECK = 1	Variable is not used since the option to iterate for peak pressure is disabled
Item 10:	THSDD = 1	This variable is used only if the Tagami condensing heat transfer coefficient (HTC) model is used. For MSLB analyses, only the Uchida condensing HTC model is used (see Design Input 4.12). A value of 1 is arbitrarily entered; the value is not used in the calculation.
Item 11:	EVAP	Fraction of heat sink condensate which will be allowed to revaporize (0 to 0.08). This variable is used only for environmental qualification analyses with main steam line breaks consistent with NUREG 0588 [Ref. 6.49, App. B].
	EVAP = 0.00	For 10 cases run for containment functional design (UFSAR Section 6.2).
	EVAP = 0.08	For containment EQ cases (UFSAR Section 3.11).
Item 12:	ENVRNP = 14.7 psia	Outside containment ambient pressure (see Design Input 4.3)
Item 13:	ENVRH = 0.5	Outside containment ambient relative humidity, 50% expressed as a decimal fraction (see Design Input 4.3).

8.1.4 Card Series 2

This card is identical for all cases.

$LIST POOL=2,0,0,0,0,0,2,2E7 $END

The card contains the following items:

Item 1: Card Series Identifier = 2

Item 2: MWATR = 0 lb_m — Mass of water added to containment as a step input at time zero

Item 3: UTOT = 0 Btu — Energy associated with the water added by item 2, above

Item 4: MLEFT = 0 lb_m — Mass of water in the reactor vessel available for decay heat removal at the time COPATTA reactor heat transfer calculations are initiated with a LOCA analysis. This variable is not used in a MSLB analysis.

Item 5: REVOL = 0 ft^3 — RCS volume below the reactor coolant nozzles. This variable is not used in a MSLB analysis.

Item 6: HAB = 0 Btu/hr ft^2 — Total heat transfer rate between the surface of the containment sump water and containment vapor region; a value of 0 is recommended by Reference 6.25.

Item 7: TCONT = 2 — Used only if the temperature boundary control for either the right or left boundary of a heat sink shown on Card 1XX400 equals zero. No heat sinks in this calculation specify zero as a surface temperature boundary condition; therefore, any positive value may be entered for TCONT.

Item 8: PHELP = 2E7 sec — The time at which COPATTA begins performing mass and energy balance calculations for water within the reactor vessel. These calculations are not performed with a MSLB analysis; therefore, a large value is entered to prevent the code from trying to perform these balances during the run.

8.1.5 Card Series 3

This card provides for modeling HVAC systems adding outside air to containment or removing air/steam from containment as a function of time. This option is not used in this calculation; therefore, zero entries are provided for items 3 - 6 and 8 - 11.

```
$LIST POOL=3,0,0,0,0,0,2E7,0,0,0,0 $END
```

This card contains the following items:

Item 1: Card Series Number = 3

Item 2: Time, seconds

Item 3: Volume addition rate, ft^3/min

Item 4: Temperature of volume added, °F

Item 5: Relative humidity of volume added, decimal fraction

Item 6: Volume removal rate ft^3/min

Items 7-11 2nd set of input data, items 2-6, etc.

Minimum of 2 sets of values; maximum of 25 sets of values

8.1.6 Card Series 4

This card provides for the modeling of heat exchangers for long-term cooling of containment spray water following the onset of sump water recirculation. Since long-term sump water recirculation and cooling is not modeled for the MSLB events, no heat exchanger input data is required. Card series 4 also allows for a step-function startup of the containment spray (CS) system a finite time following the containment reaching a containment spray actuation pressure setpoint. This CS start option is not used in this calculation; instead, card series 801 is used to initiate spray in this calculation.

```
$LIST POOL=4,0,0,0,0,0,0,0,0,0,0,0,0 $END
```

This card contains the following items:

Item 1: Card Series Identifier = 4

Item 2: IHEX = 0 Type of primary heat exchanger.

Item 3: HEX(1) = 0 ft^2 Primary HX surface area.

Item 4:	HEX(2) = 0 Btu/hr ft^2 °F	Overall primary HX heat transfer coefficient.
Item 5:	HEX(3) = 0°F	Primary heat exchanger coolant inlet temperature.
Item 6:	HEX(4) = 0 lb_m/hr	Primary HX cooling water flow rate.
Items 7 - 11	IHIX & HIX(1) thru HIX(4)	Secondary HX parameters analogous to Items 2 thru 6. Not used (input zeros).
Item 12:	CS Actuation pressure setpoint, psia	Not used (input zero).
Item 13:	Instrumentation and equipment delay time, sec	Not used (input zero).

8.1.7 Card Series 5

This card series provides information on the number of emergency air cooling units (ECUs) operating, the start and stop times for the ECUs, and also allows for ECU startup at a specified containment pressure plus a specified delay time. All items in this card series are identical for each case except the number of ECUs operating. Each emergency air cooling train contains 2 ECUs.

$LIST POOL=5,N,50,2E7,0,0 $END

This card contains the following items:

Item 1:	Card Series Identifier = 5	
Item 2:	N	Number of ECUs operating
	N = 2	For all cases with cooling train single failure (only one emergency air cooling train operating).
	N = 4	For all cases with MSIV single failure (two emergency air cooling trains operating).
Item 3:	ECU start time = 50 sec	ECU start time (see Design Input 4.6).
Item 4:	ECU stop time = 2E7 sec	ECU stop time. A large value is used to assure the ECUs continue running for the duration of the analysis.
Item 5:	ECU Actuation pressure setpoint, psia	Not used (input zero).

Item 6:	Instrumentation and equipment delay time, sec	Not used (input zero).

8.1.8 Card Series 6

This card series provides for the instantaneous release of a specified amount of energy at any one time during the problem. All energy input to the MSLB problem is added through the blowdown tables (Card Series 301 and 501). Consequently the card series 6 entries are all zeros.

```
$LIST POOL=6,0,0,0 $END
```

This card contains the following items:

Item 1:	Card Series Identifier = 6	
Item 2:	TPULSE = 0 sec	The time at which the impulse of energy is released.
Item 3:	IPULSE = 0	An indicator designating the location of the energy release.
Item 4:	UPULSE = 0 Btu	The amount of energy released at the specified time and location.

8.1.9 Card Series Leak

This is a namelist input set which allows modeling of containment atmosphere leakage. This option is not used for the MSLB analysis and only a simple entry of NOPEN=0 is required.

```
$LEAK NOPEN=0 $END
```

8.1.10 Card Series 101

This card series is used to provide reactor core decay heat as a tabular function of time for use in long-term LOCA calculations. This data is used in conjunction with information provided in card series 401 and 701 to direct the energy either into the reactor vessel water or into the containment vapor region. In the case of an MSLB containment analysis, core decay heat energy is already effectively included in the ABB-CE mass-energy release calculation which provides the break flow into containment, and no energy addition through card series 101 is required. A minimum of two data entries are required which consist of zero energy input at time zero and at time 2E7 seconds.

```
$LIST POOL=101,     0,     0,
                   2E7,     0 $END
```

8.1.11 Card Series 201

Card series 201 is used to input metal-water reaction energy or other energy inputs (other than decay heat) as a function of time in a LOCA analysis. This data is also used in conjunction with card series 401 and 701 to direct the energy terms either into the reactor vessel water or into the containment vapor region. As with the decay heat (Card Series 101) input, these other energy input terms are already included, as appropriate, in the ABB-CE mass-energy release rate calculations, and no additional energy inputs are needed in card series 201. COPATTA requires a minimum of two entries for this card, which in this case, consist of zero energy input at time zero and at time 2E7 seconds.

```
$LIST POOL=201,     0,      0,
                   2E7,     0 $END
```

8.1.12 Card Series 301

Card series 301 is a tabular input of pipe break mass and energy input into containment as a function of time. The basic data is supplied by ABB-CE in Reference 6.2 as identified in Design Input 4.7. The vendor data includes mass flow rate in lb_m/sec and break flow enthalpy in Btu/lb_m, both as a function of time in seconds. The COPATTA input table requires the mass flow rate to be in units of lb_m/hr; therefore, the mass flow rates from Reference 6.2 have been multiplied by 3600 seconds/hour to provide the correct data for the COPATTA analysis. The break flow data from the ABB-CE calculation was entered from an output table diskette provided by ABB-CE with their calculation and includes significant figures beyond those shown in the Reference 6.2 output tables.

The series 301 tables for the 10 cases (5 power levels with either cooling train failure or MSIV failure) are provided on the following pages. Equipment Qualification cases 5EQ and 7EQ use the same mass-energy release data used for cases 5 and 7, respectively.

CASE 1 - 3.45 ft^2 Slot @ 0% Power w/CT Failure

```
$LIST POOL=301,
        0.00,   2.64912E+07,    1192.20,
        0.10,   2.63068E+07,    1192.45,
        0.20,   2.61355E+07,    1192.69,
        0.30,   2.59609E+07,    1192.92,
        0.40,   2.57942E+07,    1193.15,
        0.50,   2.56227E+07,    1193.36,
        0.60,   2.54645E+07,    1193.57,
        0.70,   2.52908E+07,    1193.77,
        0.80,   2.51365E+07,    1193.97,
        0.90,   2.49976E+07,    1194.16,
        1.00,   2.48428E+07,    1194.34,
        1.99,   2.35615E+07,    1195.91,
```

```
 2.99,  2.25144E+07,  1197.13,
 3.99,  2.16661E+07,  1198.09,
 4.99,  2.09605E+07,  1198.85,
 5.99,  2.03757E+07,  1199.46,
 6.99,  1.98386E+07,  1199.98,
 7.99,  1.93509E+07,  1200.45,
 8.99,  1.88601E+07,  1200.83,
 9.99,  1.81721E+07,  1201.20,
10.99,  1.72870E+07,  1202.40,
11.99,  1.64599E+07,  1203.01,
12.99,  1.57267E+07,  1203.47,
13.99,  1.50835E+07,  1203.83,
14.99,  1.45090E+07,  1204.09,
15.99,  1.39868E+07,  1204.29,
16.99,  1.34999E+07,  1204.43,
17.99,  1.30422E+07,  1204.52,
18.99,  1.26219E+07,  1204.57,
19.99,  1.22349E+07,  1204.60,
20.99,  1.18893E+07,  1204.59,
21.99,  1.15710E+07,  1204.56,
22.99,  1.12748E+07,  1204.52,
23.99,  1.10031E+07,  1204.46,
24.99,  1.07574E+07,  1204.39,
25.99,  1.05228E+07,  1204.31,
26.99,  1.03038E+07,  1204.22,
27.99,  1.00964E+07,  1204.12,
28.99,  9.89809E+06,  1204.03,
29.99,  9.72331E+06,  1203.92,
30.99,  9.55289E+06,  1203.82,
31.99,  9.39276E+06,  1203.71,
32.99,  9.24559E+06,  1203.60,
33.99,  9.10271E+06,  1203.49,
34.99,  8.96544E+06,  1203.38,
35.99,  8.83472E+06,  1203.27,
36.99,  8.70941E+06,  1203.15,
37.99,  8.59540E+06,  1203.04,
38.99,  8.47699E+06,  1202.93,
39.99,  8.37191E+06,  1202.81,
40.99,  8.26301E+06,  1202.70,
41.99,  8.16102E+06,  1202.58,
42.99,  8.07768E+06,  1202.48,
43.99,  8.01324E+06,  1202.40,
44.99,  7.94556E+06,  1202.32,
45.99,  7.87853E+06,  1202.23,
46.99,  7.80581E+06,  1202.14,
47.99,  7.74061E+06,  1202.05,
48.99,  7.66955E+06,  1201.95,
```

E&TS DEPARTMENT

CALCULATION SHEET

ICCN NO./ PRELIM. CCN NO.	PAGE__ OF__
CCN CONVERSION: CCN NO. CCN –	

Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 55 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

```
49.99,   7.59816E+06,   1201.86,
50.99,   7.53282E+06,   1201.76,
51.99,   7.46366E+06,   1201.65,
52.99,   7.39544E+06,   1201.55,
53.99,   7.32506E+06,   1201.45,
54.99,   7.25630E+06,   1201.34,
55.99,   7.19377E+06,   1201.23,
56.99,   7.12832E+06,   1201.13,
57.99,   7.06158E+06,   1201.02,
58.99,   7.00092E+06,   1200.91,
59.99,   6.93857E+06,   1200.80,
60.99,   6.87319E+06,   1200.69,
61.99,   6.81109E+06,   1200.57,
62.99,   6.75382E+06,   1200.46,
63.99,   6.69776E+06,   1200.35,
64.99,   6.63386E+06,   1200.23,
65.99,   6.57983E+06,   1200.12,
66.99,   6.51841E+06,   1200.00,
67.99,   6.46416E+06,   1199.88,
68.99,   6.40098E+06,   1199.75,
69.99,   6.34514E+06,   1199.62,
70.99,   6.28754E+06,   1199.49,
71.99,   6.22044E+06,   1199.36,
72.99,   6.16756E+06,   1199.22,
73.99,   6.10571E+06,   1199.08,
74.99,   6.04642E+06,   1198.94,
75.99,   5.98630E+06,   1198.80,
76.99,   5.93114E+06,   1198.66,
77.99,   5.87164E+06,   1198.51,
78.99,   5.81296E+06,   1198.37,
79.99,   5.75507E+06,   1198.22,
80.99,   5.69722E+06,   1198.08,
81.99,   5.64336E+06,   1197.93,
82.99,   5.58882E+06,   1197.79,
83.99,   5.53514E+06,   1197.64,
84.99,   5.48363E+06,   1197.50,
85.99,   5.42797E+06,   1197.35,
86.99,   5.38031E+06,   1197.20,
87.99,   5.32386E+06,   1197.05,
88.99,   5.27407E+06,   1196.91,
89.99,   5.22374E+06,   1196.76,
90.99,   5.17262E+06,   1196.61,
91.99,   5.13166E+06,   1196.46,
92.99,   5.08064E+06,   1196.31,
93.99,   5.02952E+06,   1196.16,
94.99,   4.98989E+06,   1196.01,
95.99,   4.94348E+06,   1195.86,
```

```
 96.99,   4.89416E+06,   1195.72,
 97.99,   4.85514E+06,   1195.57,
 98.99,   4.80856E+06,   1195.42,
 99.99,   4.76489E+06,   1195.27,
104.95,   4.56091E+06,   1194.53,
109.95,   4.37090E+06,   1193.78,
114.95,   4.18946E+06,   1193.05,
119.95,   4.00882E+06,   1192.24,
124.95,   4.24681E+06,   1190.48,
129.95,   3.30992E+06,   1188.20,
134.95,   2.33614E+06,   1185.67,
139.95,   1.63824E+06,   1183.87,
144.95,   1.15694E+06,   1182.77,
149.95,   8.58650E+05,   1182.17,
154.95,   7.02842E+05,   1181.89,
159.95,   5.63422E+05,   1181.67,
164.95,   4.43549E+05,   1181.48,
169.95,   3.43526E+05,   1181.33,
174.95,   2.62594E+05,   1181.21,
179.95,   3.09569E+05,   1200.25,
184.95,   1.20657E+04,   1222.01,
189.95,   6.99106E+03,   1222.72,
194.95,   5.69358E+03,   1222.94,
199.95,   5.98500E+03,   1223.11,
204.95,   5.69470E+03,   1223.23,
209.95,   5.13194E+03,   1223.36,
214.95,   5.40194E+03,   1223.46,
219.95,   5.04918E+03,   1223.57,
224.95,   4.92984E+03,   1223.67,
229.95,   4.97819E+03,   1223.77,
234.95,   4.66657E+03,   1223.86,
239.95,   4.33688E+03,   1223.96,
244.95,   4.66078E+03,   1224.05,
249.95,   4.12085E+03,   1224.14,
250.00,   4.56217E+03,   1224.14,
250.00,         0.0,        0.0,
  2.0E7,        0.0,        0.0 $END
```

CASE 2 - 5.30 ft^2 Slot @ 20% Power w/CT Failure

```
$LIST POOL=301,
  0.00,   3.88660E+07,   1193.65,
  0.10,   3.83245E+07,   1194.10,
  0.20,   3.78144E+07,   1194.53,
  0.30,   3.73291E+07,   1194.93,
  0.40,   3.68539E+07,   1195.31,
  0.50,   3.64057E+07,   1195.67,
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E&TS DEPARTMENT

CALCULATION SHEET

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Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 57 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

0.60,	3.59845E+07,	1196.01,
0.70,	3.55802E+07,	1196.34,
0.80,	3.51815E+07,	1196.65,
0.90,	3.48040E+07,	1196.95,
1.00,	3.44309E+07,	1197.24,
1.99,	3.12098E+07,	1199.52,
2.99,	2.87336E+07,	1201.00,
3.99,	2.68275E+07,	1202.07,
4.99,	2.52129E+07,	1202.84,
5.99,	2.38544E+07,	1203.40,
6.99,	2.27126E+07,	1203.81,
7.99,	2.15349E+07,	1203.96,
8.99,	2.01969E+07,	1204.01,
9.99,	1.86861E+07,	1204.46,
10.99,	1.72032E+07,	1204.51,
11.99,	1.59607E+07,	1204.28,
12.99,	1.49516E+07,	1203.96,
13.99,	1.40957E+07,	1203.59,
14.99,	1.33573E+07,	1203.19,
15.99,	1.27104E+07,	1202.76,
16.99,	1.21386E+07,	1202.32,
17.99,	1.16317E+07,	1201.88,
18.99,	1.11801E+07,	1201.44,
19.99,	1.07758E+07,	1201.01,
20.99,	1.04150E+07,	1200.58,
21.99,	1.00918E+07,	1200.18,
22.99,	9.80334E+06,	1199.79,
23.99,	9.54468E+06,	1199.42,
24.99,	9.30751E+06,	1199.06,
25.99,	9.08939E+06,	1198.72,
26.99,	8.88610E+06,	1198.39,
27.99,	8.69072E+06,	1198.06,
28.99,	8.51216E+06,	1197.76,
29.99,	8.34887E+06,	1197.47,
30.99,	8.20084E+06,	1197.19,
31.99,	8.06360E+06,	1196.93,
32.99,	7.93606E+06,	1196.68,
33.99,	7.81474E+06,	1196.43,
34.99,	7.69723E+06,	1196.20,
35.99,	7.58923E+06,	1195.97,
36.99,	7.48490E+06,	1195.74,
37.99,	7.39066E+06,	1195.53,
38.99,	7.30012E+06,	1195.32,
39.99,	7.20986E+06,	1195.12,
40.99,	7.12922E+06,	1194.93,
41.99,	7.05103E+06,	1194.74,
42.99,	6.97399E+06,	1194.56,

43.99,	6.90095E+06,	1194.37,
44.99,	6.82924E+06,	1194.19,
45.99,	6.76037E+06,	1194.02,
46.99,	6.69240E+06,	1193.85,
47.99,	6.63124E+06,	1193.68,
48.99,	6.56939E+06,	1193.52,
49.99,	6.50952E+06,	1193.36,
50.99,	6.45325E+06,	1193.20,
51.99,	6.39637E+06,	1193.04,
52.99,	6.33985E+06,	1192.88,
53.99,	6.27678E+06,	1192.70,
54.99,	6.21227E+06,	1192.52,
55.99,	6.14894E+06,	1192.33,
56.99,	6.08436E+06,	1192.13,
57.99,	6.01834E+06,	1191.93,
58.99,	5.95087E+06,	1191.72,
59.99,	5.88154E+06,	1191.50,
60.99,	5.81422E+06,	1191.29,
61.99,	5.74711E+06,	1191.07,
62.99,	5.67864E+06,	1190.85,
63.99,	5.61406E+06,	1190.63,
64.99,	5.55242E+06,	1190.42,
65.99,	5.49029E+06,	1190.20,
66.99,	5.42671E+06,	1189.98,
67.99,	6.49361E+06,	1189.69,
68.99,	6.15053E+06,	1189.12,
69.99,	5.87610E+06,	1188.66,
70.99,	5.65420E+06,	1188.27,
71.99,	5.46710E+06,	1187.95,
72.99,	5.31932E+06,	1187.68,
73.99,	5.19059E+06,	1187.45,
74.99,	5.07056E+06,	1187.24,
75.99,	4.97167E+06,	1187.06,
76.99,	4.87260E+06,	1186.89,
77.99,	4.79236E+06,	1186.73,
78.99,	4.71074E+06,	1186.59,
79.99,	4.63082E+06,	1186.45,
80.99,	4.55584E+06,	1186.32,
81.99,	4.49604E+06,	1186.20,
82.99,	4.42714E+06,	1186.08,
83.99,	4.37108E+06,	1185.97,
84.99,	4.30146E+06,	1185.86,
85.99,	4.24256E+06,	1185.75,
86.99,	4.18507E+06,	1185.64,
87.99,	4.13554E+06,	1185.53,
88.99,	4.07938E+06,	1185.43,
89.99,	4.02649E+06,	1185.34,

E&TS DEPARTMENT

CALCULATION SHEET

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Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 59 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

90.99,	3.98045E+06,	1185.24,
91.99,	3.93138E+06,	1185.15,
92.99,	3.88364E+06,	1185.06,
93.99,	3.83638E+06,	1184.97,
94.99,	3.78320E+06,	1184.88,
95.99,	3.74346E+06,	1184.79,
96.99,	3.69857E+06,	1184.71,
97.99,	3.65717E+06,	1184.63,
98.99,	3.61926E+06,	1184.55,
99.99,	3.57004E+06,	1184.47,
104.95,	3.31816E+06,	1183.98,
109.95,	1.94087E+06,	1181.29,
114.95,	1.59055E+06,	1180.66,
119.95,	1.49394E+06,	1180.51,
124.95,	1.36367E+06,	1180.33,
129.95,	1.24061E+06,	1180.14,
134.95,	1.11036E+06,	1179.98,
139.95,	9.88420E+05,	1179.83,
144.95,	8.84484E+05,	1179.70,
149.95,	7.93688E+05,	1179.60,
154.95,	7.15266E+05,	1179.50,
159.95,	6.48198E+05,	1179.41,
164.95,	5.89439E+05,	1179.33,
169.95,	5.38456E+05,	1179.25,
174.95,	4.93632E+05,	1179.18,
179.95,	4.53992E+05,	1179.11,
184.95,	4.18900E+05,	1179.05,
189.95,	3.87526E+05,	1178.98,
194.95,	3.59441E+05,	1178.92,
199.95,	3.34164E+05,	1178.86,
204.95,	3.11319E+05,	1178.80,
209.95,	2.90621E+05,	1178.74,
214.95,	2.71800E+05,	1178.68,
219.95,	2.54672E+05,	1178.62,
224.95,	2.39009E+05,	1178.56,
229.95,	2.24648E+05,	1178.51,
234.95,	2.11451E+05,	1178.45,
239.95,	1.99295E+05,	1178.39,
244.95,	1.89130E+05,	1178.34,
249.95,	1.78192E+05,	1178.28,
254.95,	1.69525E+05,	1178.23,
259.95,	1.61281E+05,	1178.17,
264.95,	1.53435E+05,	1178.12,
269.95,	1.45974E+05,	1178.07,
274.95,	1.38880E+05,	1178.01,
279.95,	1.32135E+05,	1177.96,
284.95,	1.25725E+05,	1177.91,

```
289.95,   1.19633E+05,   1177.86,
294.95,   1.13844E+05,   1177.81,
299.95,   1.08344E+05,   1177.76,
304.95,   1.03119E+05,   1177.70,
309.95,   9.81558E+04,   1177.65,
314.95,   9.34416E+04,   1177.60,
319.95,   8.89650E+04,   1177.56,
324.95,   8.47138E+04,   1177.51,
329.95,   8.06771E+04,   1177.46,
334.95,   1.14330E+05,   1196.10,
339.95,   4.99583E+04,   1215.50,
344.95,   3.12519E+04,   1221.71,
349.95,   2.55891E+04,   1223.95,
354.95,   2.35051E+04,   1225.06,
359.95,   2.24027E+04,   1225.84,
364.95,   2.15866E+04,   1226.51,
369.95,   2.08820E+04,   1227.14,
374.95,   2.02250E+04,   1227.73,
379.95,   1.96087E+04,   1228.29,
384.95,   1.90250E+04,   1228.83,
389.95,   1.84697E+04,   1229.34,
394.95,   1.79455E+04,   1229.84,
399.95.   1.74453E+04,   1230.32,
400.00,   1.74405E+04,   1230.32,
400.00,   0.0,           0.0,
2.0E7,    0.0,           0.0 $END
```

CASE 3 - 7.05 ft^2 Slot @ 50% Power w/CT Failure

```
$LIST POOL=301,
0.00,   4.98355E+07,   1194.65,
0.10,   4.88336E+07,   1195.23,
0.20,   4.79520E+07,   1195.78,
0.30,   4.71312E+07,   1196.30,
0.40,   4.63381E+07,   1196.78,
0.50,   4.55857E+07,   1197.23,
0.60,   4.48607E+07,   1197.65,
0.70,   4.41641E+07,   1198.04,
0.80,   4.34941E+07,   1198.41,
0.90,   4.28497E+07,   1198.76,
1.00,   4.22266E+07,   1199.09,
1.99,   3.71761E+07,   1201.46,
2.99,   3.38955E+07,   1202.71,
3.99,   3.13708E+07,   1203.49,
4.99,   2.93736E+07,   1203.97,
5.99,   2.77907E+07,   1204.26,
6.99,   2.62811E+07,   1204.35,
7.99,   2.47186E+07,   1204.23,
```

```
8.99,   2.30279E+07,   1204.12,
9.99,   2.11423E+07,   1204.30,
10.99,  1.95152E+07,   1203.90,
11.99,  1.82047E+07,   1203.44,
12.99,  1.71805E+07,   1202.97,
13.99,  1.63286E+07,   1202.51,
14.99,  1.56101E+07,   1202.06,
15.99,  1.49851E+07,   1201.62,
16.99,  1.44204E+07,   1201.18,
17.99,  1.39128E+07,   1200.74,
18.99,  1.34460E+07,   1200.31,
19.99,  1.30326E+07,   1199.89,
20.99,  1.26711E+07,   1199.50,
21.99,  1.23502E+07,   1199.14,
22.99,  1.20660E+07,   1198.81,
23.99,  1.18001E+07,   1198.48,
24.99,  1.15444E+07,   1198.17,
25.99,  1.13019E+07,   1197.85,
26.99,  1.10709E+07,   1197.55,
27.99,  1.08586E+07,   1197.25,
28.99,  1.06744E+07,   1196.98,
29.99,  1.05048E+07,   1196.74,
30.99,  1.03464E+07,   1196.50,
31.99,  1.01970E+07,   1196.27,
32.99,  1.00522E+07,   1196.04,
33.99,  9.90911E+06,   1195.80,
34.99,  9.77076E+06,   1195.57,
35.99,  9.63551E+06,   1195.34,
36.99,  9.50789E+06,   1195.12,
37.99,  9.38776E+06,   1194.90,
38.99,  9.26827E+06,   1194.69,
39.99,  9.14173E+06,   1194.45,
40.99,  9.01066E+06,   1194.21,
41.99,  8.87746E+06,   1193.95,
42.99,  8.74127E+06,   1193.68,
43.99,  8.60641E+06,   1193.40,
44.99,  8.47228E+06,   1193.12,
45.99,  8.33944E+06,   1192.84,
46.99,  8.20948E+06,   1192.55,
47.99,  8.08618E+06,   1192.27,
48.99,  7.96313E+06,   1191.99,
49.99,  8.82090E+06,   1191.48,
50.99,  8.55832E+06,   1190.91,
51.99,  8.33314E+06,   1190.40,
52.99,  8.13182E+06,   1189.94,
53.99,  7.79994E+06,   1189.56,
54.99,  7.55327E+06,   1189.27,
```

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55.99,   7.34274E+06,   1189.03,
56.99,   7.16569E+06,   1188.82,
57.99,   7.00052E+06,   1188.62,
58.99,   6.84529E+06,   1188.44,
59.99,   6.69971E+06,   1188.26,
60.99,   6.55754E+06,   1188.10,
61.99,   6.42272E+06,   1187.94,
62.99,   6.29546E+06,   1187.79,
63.99,   6.17904E+06,   1187.66,
64.99,   6.07280E+06,   1187.53,
65.99,   5.96509E+06,   1187.40,
66.99,   5.85666E+06,   1187.27,
67.99,   5.74794E+06,   1187.15,
68.99,   5.64977E+06,   1187.02,
69.99,   5.54792E+06,   1186.91,
70.99,   5.45929E+06,   1186.80,
71.99,   5.37005E+06,   1186.69,
72.99,   5.28775E+06,   1186.59,
73.99,   5.20265E+06,   1186.50,
74.99,   5.08466E+06,   1186.32,
75.99,   4.22528E+06,   1185.19,
76.99,   1.23842E+06,   1181.86,
77.99,   6.71393E+05,   1181.54,
78.99,   6.60780E+05,   1181.48,
79.99,   6.33470E+05,   1181.42,
80.99,   6.00570E+05,   1181.35,
81.99,   5.72980E+05,   1181.29,
82.99,   5.55624E+05,   1181.22,
83.99,   5.47114E+05,   1181.17,
84.99,   5.42020E+05,   1181.11,
85.99,   5.34305E+05,   1181.05,
86.99,   5.20492E+05,   1180.99,
87.99,   5.01098E+05,   1180.93,
88.99,   4.79581E+05,   1180.87,
89.99,   4.59925E+05,   1180.81,
90.99,   4.44571E+05,   1180.75,
91.99,   4.33537E+05,   1180.69,
92.99,   4.24926E+05,   1180.63,
93.99,   4.16221E+05,   1180.57,
94.99,   4.05623E+05,   1180.51,
95.99,   3.92861E+05,   1180.45,
96.99,   3.79012E+05,   1180.39,
97.99,   3.65695E+05,   1180.34,
98.99,   3.54130E+05,   1180.28,
99.99,   3.44621E+05,   1180.22,
104.95,  3.35952E+05,   1179.94,
109.95,  2.87618E+05,   1179.65,
```

```
114.95,   2.32187E+05,   1179.48,
119.95,   1.95119E+05,   1179.37,
124.95,   1.62496E+05,   1179.27,
129.95,   6.01384E+04,   1235.78,
134.95,   1.51383E+04,   1244.03,
139.95,   9.56732E+03,   1245.33,
144.95,   8.87915E+03,   1245.78,
149.95,   8.33069E+03,   1246.11,
154.95,   8.07206E+03,   1246.44,
159.95,   7.79663E+03,   1246.73,
164.95,   7.50614E+03,   1247.03,
169.95,   7.30325E+03,   1247.31,
174.95,   7.07018E+03,   1247.58,
179.95,   6.90073E+03,   1247.85,
184.95,   6.72404E+03,   1248.11,
189.95,   6.54919E+03,   1248.37,
194.95,   6.39076E+03,   1248.63,
199.95,   6.23192E+03,   1248.89,
200.00,   6.23045E+03,   1248.89,
200.00,   0.0,           0.0,
2.0E7,    0.0,           0.0 $END
```

CASE 4 - 8.10 ft^2 Slot @ 80% Power w/CT Failure

```
$LIST POOL=301,
0.00,   5.56351E+07,   1195.39,
0.10,   5.43438E+07,   1196.02,
0.20,   5.31950E+07,   1196.63,
0.30,   5.21208E+07,   1197.20,
0.40,   5.11009E+07,   1197.73,
0.50,   5.01361E+07,   1198.21,
0.60,   4.92098E+07,   1198.66,
0.70,   4.83278E+07,   1199.07,
0.80,   4.74872E+07,   1199.46,
0.90,   4.66787E+07,   1199.82,
1.00,   4.59036E+07,   1200.15,
1.99,   4.00396E+07,   1202.37,
2.99,   3.64633E+07,   1203.38,
3.99,   3.37869E+07,   1203.96,
4.99,   3.17606E+07,   1204.28,
5.99,   3.01463E+07,   1204.44,
6.99,   2.85380E+07,   1204.39,
7.99,   2.68565E+07,   1204.17,
8.99,   2.49985E+07,   1204.02,
9.99,   2.28259E+07,   1204.06,
10.99,  2.11655E+07,   1203.60,
11.99,  1.98540E+07,   1203.11,
12.99,  1.88164E+07,   1202.64,
```

13.99,	1.79554E+07,	1202.18,
14.99,	1.72086E+07,	1201.72,
15.99,	1.65385E+07,	1201.27,
16.99,	1.59269E+07,	1200.82,
17.99,	1.53707E+07,	1200.37,
18.99,	1.48731E+07,	1199.93,
19.99,	1.44348E+07,	1199.53,
20.99,	1.40496E+07,	1199.14,
21.99,	1.37055E+07,	1198.78,
22.99,	1.33892E+07,	1198.44,
23.99,	1.30810E+07,	1198.09,
24.99,	1.27862E+07,	1197.76,
25.99,	1.25092E+07,	1197.43,
26.99,	1.22530E+07,	1197.11,
27.99,	1.20189E+07,	1196.81,
28.99,	1.18052E+07,	1196.53,
29.99,	1.16071E+07,	1196.26,
30.99,	1.14190E+07,	1195.99,
31.99,	1.12363E+07,	1195.73,
32.99,	1.10521E+07,	1195.46,
33.99,	1.08545E+07,	1195.16,
34.99,	1.06546E+07,	1194.85,
35.99,	1.04576E+07,	1194.53,
36.99,	1.02646E+07,	1194.21,
37.99,	1.00751E+07,	1193.88,
38.99,	9.88837E+06,	1193.55,
39.99,	9.70477E+06,	1193.22,
40.99,	9.52546E+06,	1192.89,
41.99,	9.35165E+06,	1192.55,
42.99,	9.18428E+06,	1192.22,
43.99,	9.02351E+06,	1191.90,
44.99,	8.86853E+06,	1191.58,
45.99,	8.71841E+06,	1191.26,
46.99,	8.57225E+06,	1190.94,
47.99,	8.42969E+06,	1190.62,
48.99,	8.29098E+06,	1190.30,
49.99,	8.15645E+06,	1189.98,
50.99,	8.02645E+06,	1189.67,
51.99,	7.90099E+06,	1189.36,
52.99,	7.77967E+06,	1189.06,
53.99,	7.66206E+06,	1188.76,
54.99,	7.45279E+06,	1188.48,
55.99,	7.24421E+06,	1188.27,
56.99,	7.07018E+06,	1188.09,
57.99,	6.91528E+06,	1187.94,
58.99,	6.77232E+06,	1187.80,
59.99,	6.63570E+06,	1187.67,

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

60.99,	6.50650E+06,	1187.54,
61.99,	2.51789E+06,	1183.21,
62.99,	2.23399E+05,	1181.99,
63.99,	2.28696E+05,	1181.92,
64.99,	2.25015E+05,	1181.85,
65.99,	4.09493E+05,	1194.68,
66.99,	2.59193E+05,	1210.98,
67.99,	1.68017E+05,	1221.65,
68.99,	1.18678E+05,	1228.67,
69.99,	9.32540E+04,	1233.65,
70.99,	7.76959E+04,	1237.50,
71.99,	6.37988E+04,	1240.48,
72.99,	4.93168E+04,	1242.58,
73.99,	3.63154E+04,	1243.73,
74.99,	2.77801E+04,	1244.12,
75.99,	2.52152E+04,	1244.14,
76.99,	2.76312E+04,	1244.17,
77.99,	3.20140E+04,	1244.49,
78.99,	3.50593E+04,	1245.10,
79.99,	3.47908E+04,	1245.84,
80.99,	3.14001E+04,	1246.47,
81.99,	2.68055E+04,	1246.80,
82.99,	2.33396E+04,	1246.85,
83.99,	2.24332E+04,	1246.74,
84.99,	2.39935E+04,	1246.67,
85.99,	2.66630E+04,	1246.78,
86.99,	2.86965E+04,	1247.09,
87.99,	2.89331E+04,	1247.50,
88.99,	2.73411E+04,	1247.88,
89.99,	2.48802E+04,	1248.11,
90.99,	2.28446E+04,	1248.17,
91.99,	2.21254E+04,	1248.14,
92.99,	2.27989E+04,	1248.12,
93.99,	2.42007E+04,	1248.20,
94.99,	2.53763E+04,	1248.39,
95.99,	2.56253E+04,	1248.66,
96.99,	2.48405E+04,	1248.91,
97.99,	2.34842E+04,	1249.09,
98.99,	2.22613E+04,	1249.18,
99.99,	2.17098E+04,	1249.20,
104.95,	2.30190E+04,	1249.81,
109.95,	1.36872E+04,	1250.65,
114.95,	8.89351E+03,	1251.76,
119.95,	8.73590E+03,	1252.15,
124.95,	8.00694E+03,	1252.58,
129.95,	7.91968E+03,	1252.99,
134.95,	7.57937E+03,	1253.37,

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139.95,   7.27870E+03,   1253.77,
144.95,   7.09474E+03,   1254.15,
149.95,   6.82045E+03,   1254.53,
154.95,   6.62598E+03,   1254.90,
159.95,   6.42776E+03,   1255.26,
164.95,   6.23794E+03,   1255.62,
169.95,   6.09901E+03,   1255.98,
174.95,   5.94353E+03,   1256.33,
179.95,   5.79971E+03,   1256.68,
184.95,   5.66132E+03,   1257.02,
189.95,   5.52672E+03,   1257.37,
194.95,   5.39975E+03,   1257.71,
199.95,   5.27656E+03,   1258.04,
200.00,   5.27537E+03,   1258.04,
200.00,          0.0,       0.0,
 2.0E7,          0.0,       0.0 $END
```

CASE 5 - 8.85 ft^2 Slot @ 102% Power w/CT Failure

```
$LIST POOL=301,
0.00,   5.98327E+07,   1195.73,
0.10,   5.75122E+07,   1196.41,
0.20,   5.57370E+07,   1197.03,
0.30,   5.43010E+07,   1197.60,
0.40,   5.30896E+07,   1198.12,
0.50,   5.20330E+07,   1198.61,
0.60,   5.10912E+07,   1199.06,
0.70,   5.02333E+07,   1199.48,
0.80,   4.94377E+07,   1199.87,
0.90,   4.86918E+07,   1200.24,
1.00,   4.79844E+07,   1200.58,
1.99,   4.22996E+07,   1202.77,
2.99,   3.84905E+07,   1203.67,
3.99,   3.57314E+07,   1204.14,
4.99,   3.36987E+07,   1204.38,
5.99,   3.21819E+07,   1204.47,
6.99,   3.06681E+07,   1204.37,
7.99,   2.90095E+07,   1204.12,
8.99,   2.70729E+07,   1203.99,
9.99,   2.29676E+07,   1204.09,
10.99,  2.16059E+07,   1203.74,
11.99,  2.04900E+07,   1203.36,
12.99,  1.95249E+07,   1202.97,
13.99,  1.87289E+07,   1202.59,
14.99,  1.80316E+07,   1202.22,
15.99,  1.73815E+07,   1201.83,
16.99,  1.67603E+07,   1201.43,
17.99,  1.61774E+07,   1201.01,
```

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

```
18.99,  1.56523E+07,  1200.60,
19.99,  1.51968E+07,  1200.22,
20.99,  1.48069E+07,  1199.87,
21.99,  1.44651E+07,  1199.55,
22.99,  1.41495E+07,  1199.24,
23.99,  1.38443E+07,  1198.93,
24.99,  1.35450E+07,  1198.61,
25.99,  1.32542E+07,  1198.29,
26.99,  1.29749E+07,  1197.97,
27.99,  1.27237E+07,  1197.68,
28.99,  1.24763E+07,  1197.39,
29.99,  1.22311E+07,  1197.08,
30.99,  1.19873E+07,  1196.77,
31.99,  1.17414E+07,  1196.44,
32.99,  1.14929E+07,  1196.10,
33.99,  1.12458E+07,  1195.75,
34.99,  1.10060E+07,  1195.39,
35.99,  1.07786E+07,  1195.04,
36.99,  1.05648E+07,  1194.70,
37.99,  1.03630E+07,  1194.37,
38.99,  1.01693E+07,  1194.05,
39.99,  9.98021E+06,  1193.72,
40.99,  9.79430E+06,  1193.39,
41.99,  9.61243E+06,  1193.05,
42.99,  9.43618E+06,  1192.72,
43.99,  9.26734E+06,  1192.39,
44.99,  9.10652E+06,  1192.07,
45.99,  8.95306E+06,  1191.75,
46.99,  8.80538E+06,  1191.44,
47.99,  8.66192E+06,  1191.13,
48.99,  8.52192E+06,  1190.83,
49.99,  8.38548E+06,  1190.52,
50.99,  8.25329E+06,  1190.21,
51.99,  8.12606E+06,  1189.91,
52.99,  3.07284E+05,  1182.22,
53.99,  3.02816E+05,  1182.15,
54.99,  3.00139E+05,  1182.08,
55.99,  5.14544E+05,  1201.24,
56.99,  2.89176E+05,  1221.55,
57.99,  1.64058E+05,  1233.36,
58.99,  1.04379E+05,  1240.07,
59.99,  8.05626E+04,  1244.35,
60.99,  7.10334E+04,  1247.71,
61.99,  6.25986E+04,  1250.58,
62.99,  5.04353E+04,  1252.82,
63.99,  3.65296E+04,  1254.11,
64.99,  2.54870E+04,  1254.48,
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 65.99,  2.08439E+04,  1254.28,
 66.99,  2.29110E+04,  1254.01,
 67.99,  2.88660E+04,  1254.07,
 68.99,  3.44710E+04,  1254.61,
 69.99,  3.63668E+04,  1255.46,
 70.99,  3.37101E+04,  1256.31,
 71.99,  2.83194E+04,  1256.86,
 72.99,  2.31342E+04,  1257.00,
 73.99,  2.06463E+04,  1256.85,
 74.99,  2.15527E+04,  1256.65,
 75.99,  2.46976E+04,  1256.63,
 76.99,  2.79326E+04,  1256.89,
 77.99,  2.93707E+04,  1257.35,
 78.99,  2.83503E+04,  1257.85,
 79.99,  2.56214E+04,  1258.21,
 80.99,  2.27397E+04,  1258.36,
 81.99,  2.11168E+04,  1258.32,
 82.99,  2.13001E+04,  1258.25,
 83.99,  2.28169E+04,  1258.25,
 84.99,  2.45679E+04,  1258.41,
 85.99,  2.54895E+04,  1258.70,
 86.99,  2.51105E+04,  1259.02,
 87.99,  2.37197E+04,  1259.28,
 88.99,  2.21028E+04,  1259.43,
 89.99,  2.10531E+04,  1259.47,
 90.99,  2.09517E+04,  1259.48,
 91.99,  2.16289E+04,  1259.52,
 92.99,  2.25324E+04,  1259.64,
 93.99,  2.30715E+04,  1259.84,
 94.99,  2.29338E+04,  1260.07,
 95.99,  2.22108E+04,  1260.27,
 96.99,  2.12922E+04,  1260.41,
 97.99,  2.06157E+04,  1260.50,
 98.99,  2.04293E+04,  1260.55,
 99.99,  2.06889E+04,  1260.62,
104.95,  2.04373E+04,  1261.35,
109.95,  9.66391E+03,  1262.41,
114.95,  7.91564E+03,  1263.06,
119.95,  7.90682E+03,  1263.56,
124.95,  7.47364E+03,  1264.03,
129.95,  7.20695E+03,  1264.51,
134.95,  7.00866E+03,  1264.97,
139.95,  6.71947E+03,  1265.43,
144.95,  6.53353E+03,  1265.88,
149.95,  6.31908E+03,  1266.33,
154.95,  6.12371E+03,  1266.77,
159.95,  5.95894E+03,  1267.20,
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164.95,   5.80817E+03,   1267.63,
169.95,   5.66867E+03,   1268.05,
174.95,   5.52964E+03,   1268.47,
179.95,   5.39597E+03,   1268.89,
184.95,   5.26957E+03,   1269.30,
189.95,   5.14678E+03,   1269.70,
194.95,   5.02981E+03,   1270.11,
199.95,   4.91735E+03,   1270.51,
200.00,   4.91627E+03,   1270.51,
200.00,          0.0,       0.0,
  2.0E7,         0.0,       0.0 $END
```

CASE 13 - 3.45 ft^2 Slot @ 0% Power w/MSIV Failure

```
$LIST POOL=301,
   0.00,   2.64912E+07,   1192.20,
   0.10,   2.63068E+07,   1192.45,
   0.20,   2.61355E+07,   1192.69,
   0.30,   2.59609E+07,   1192.92,
   0.40,   2.57942E+07,   1193.15,
   0.50,   2.56227E+07,   1193.36,
   0.60,   2.54645E+07,   1193.57,
   0.70,   2.52908E+07,   1193.77,
   0.80,   2.51365E+07,   1193.97,
   0.90,   2.49976E+07,   1194.16,
   1.00,   2.48428E+07,   1194.34,
   1.99,   2.35615E+07,   1195.91,
   2.99,   2.25144E+07,   1197.13,
   3.99,   2.16661E+07,   1198.09,
   4.99,   2.09605E+07,   1198.85,
   5.99,   2.03757E+07,   1199.46,
   6.99,   1.98386E+07,   1199.98,
   7.99,   1.93509E+07,   1200.45,
   8.99,   1.88875E+07,   1200.87,
   9.99,   1.84180E+07,   1201.35,
  10.99,   1.78090E+07,   1201.99,
  11.99,   1.70267E+07,   1202.60,
  12.99,   1.63133E+07,   1203.11,
  13.99,   1.56760E+07,   1203.51,
  14.99,   1.50985E+07,   1203.82,
  15.99,   1.45651E+07,   1204.07,
  16.99,   1.40764E+07,   1204.26,
  17.99,   1.36237E+07,   1204.40,
  18.99,   1.31803E+07,   1204.50,
  19.99,   1.27851E+07,   1204.56,
  20.99,   1.24135E+07,   1204.59,
  21.99,   1.20765E+07,   1204.59,
  22.99,   1.17601E+07,   1204.58,
```

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23.99,   1.14701E+07,   1204.55,
24.99,   1.12019E+07,   1204.50,
25.99,   1.09520E+07,   1204.44,
26.99,   1.07089E+07,   1204.37,
27.99,   1.04906E+07,   1204.29,
28.99,   1.02785E+07,   1204.21,
29.99,   1.00896E+07,   1204.12,
30.99,   9.89762E+06,   1204.03,
31.99,   9.73418E+06,   1203.93,
32.99,   9.56520E+06,   1203.83,
33.99,   9.43060E+06,   1203.73,
34.99,   9.26892E+06,   1203.62,
35.99,   9.12424E+06,   1203.51,
36.99,   8.98675E+06,   1203.40,
37.99,   8.85582E+06,   1203.29,
38.99,   8.74598E+06,   1203.18,
39.99,   8.62567E+06,   1203.07,
40.99,   8.51098E+06,   1202.96,
41.99,   8.40121E+06,   1202.85,
42.99,   8.29822E+06,   1202.74,
43.99,   8.22838E+06,   1202.66,
44.99,   8.17301E+06,   1202.58,
45.99,   8.07930E+06,   1202.49,
46.99,   8.00618E+06,   1202.40,
47.99,   7.92511E+06,   1202.31,
48.99,   7.86384E+06,   1202.21,
49.99,   7.78486E+06,   1202.11,
50.99,   7.71322E+06,   1202.01,
51.99,   7.64888E+06,   1201.91,
52.99,   7.56137E+06,   1201.81,
53.99,   7.49200E+06,   1201.71,
54.99,   7.42964E+06,   1201.60,
55.99,   7.36193E+06,   1201.50,
56.99,   7.29724E+06,   1201.39,
57.99,   7.23568E+06,   1201.29,
58.99,   7.15457E+06,   1201.18,
59.99,   7.10633E+06,   1201.07,
60.99,   7.02263E+06,   1200.96,
61.99,   6.96002E+06,   1200.85,
62.99,   6.91081E+06,   1200.74,
63.99,   6.83834E+06,   1200.63,
64.99,   6.79057E+06,   1200.51,
65.99,   6.71551E+06,   1200.40,
66.99,   6.67386E+06,   1200.29,
67.99,   6.61385E+06,   1200.17,
68.99,   6.54347E+06,   1200.06,
69.99,   6.47852E+06,   1199.93,
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70.99,	6.44623E+06,	1199.81,
71.99,	6.38737E+06,	1199.68,
72.99,	6.29561E+06,	1199.55,
73.99,	6.25579E+06,	1199.42,
74.99,	6.17753E+06,	1199.28,
75.99,	6.14923E+06,	1199.15,
76.99,	6.08800E+06,	1199.01,
77.99,	6.00332E+06,	1198.87,
78.99,	5.95184E+06,	1198.73,
79.99,	5.90886E+06,	1198.59,
80.99,	5.83286E+06,	1198.45,
81.99,	5.77591E+06,	1198.30,
82.99,	5.74470E+06,	1198.16,
83.99,	5.69207E+06,	1198.02,
84.99,	5.61146E+06,	1197.87,
85.99,	5.56848E+06,	1197.73,
86.99,	5.52578E+06,	1197.58,
87.99,	5.45026E+06,	1197.44,
88.99,	5.40421E+06,	1197.29,
89.99,	5.34694E+06,	1197.15,
90.99,	5.31961E+06,	1197.00,
91.99,	5.24617E+06,	1196.85,
92.99,	5.20956E+06,	1196.71,
93.99,	5.16895E+06,	1196.56,
94.99,	5.12359E+06,	1196.41,
95.99,	5.05782E+06,	1196.26,
96.99,	5.01163E+06,	1196.12,
97.99,	4.97542E+06,	1195.97,
98.99,	4.91879E+06,	1195.82,
99.99,	4.87638E+06,	1195.68,
104.95,	4.61030E+06,	1194.70,
109.95,	4.38970E+06,	1193.87,
114.95,	4.20977E+06,	1193.07,
119.95,	4.03142E+06,	1192.29,
124.95,	4.43196E+06,	1190.90,
129.95,	3.53199E+06,	1188.83,
134.95,	2.54314E+06,	1186.29,
139.95,	1.75374E+06,	1184.27,
144.95,	1.15190E+06,	1182.93,
149.95,	8.77306E+05,	1182.22,
154.95,	6.43313E+05,	1181.91,
159.95,	4.99946E+05,	1181.67,
164.95,	3.52833E+05,	1181.48,
169.95,	2.49737E+05,	1181.33,
174.95,	3.69810E+05,	1181.24,
179.95,	2.15153E+05,	1181.14,
184.95,	2.51717E+04,	1220.96,

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189.95,   8.44438E+03,   1222.54,
194.95,   7.59215E+03,   1222.85,
199.95,   7.03447E+03,   1223.02,
204.95,   6.89051E+03,   1223.17,
209.95,   6.78676E+03,   1223.31,
214.95,   6.59567E+03,   1223.43,
219.95,   6.40246E+03,   1223.55,
224.95,   6.53965E+03,   1223.66,
229.95,   6.10139E+03,   1223.78,
234.95,   5.96923E+03,   1223.89,
239.95,   6.12342E+03,   1223.99,
244.95,   6.01981E+03,   1224.10,
249.95,   5.89111E+03,   1224.20,
250.00,   5.59202E+03,   1224.21,
250.00,          0.0,        0.0,
2.0E7,           0.0,        0.0 $END.
```

CASE 14 - 5.30 ft^2 Slot @ 20% Power w/MSIV Failure

```
$LIST POOL=301,
0.00,   3.88660E+07,   1193.65,
0.10,   3.83245E+07,   1194.10,
0.20,   3.78144E+07,   1194.53,
0.30,   3.73291E+07,   1194.93,
0.40,   3.68539E+07,   1195.31,
0.50,   3.64057E+07,   1195.67,
0.60,   3.59845E+07,   1196.01,
0.70,   3.55802E+07,   1196.34,
0.80,   3.51815E+07,   1196.65,
0.90,   3.48040E+07,   1196.95,
1.00,   3.44309E+07,   1197.24,
1.99,   3.12098E+07,   1199.52,
2.99,   2.87336E+07,   1201.00,
3.99,   2.68275E+07,   1202.07,
4.99,   2.52129E+07,   1202.84,
5.99,   2.38544E+07,   1203.40,
6.99,   2.27099E+07,   1203.81,
7.99,   2.17183E+07,   1204.09,
8.99,   2.08122E+07,   1204.33,
9.99,   1.97569E+07,   1204.53,
10.99,  1.84747E+07,   1204.59,
11.99,  1.72015E+07,   1204.51,
12.99,  1.61353E+07,   1204.32,
13.99,  1.52083E+07,   1204.05,
14.99,  1.43999E+07,   1203.73,
15.99,  1.36905E+07,   1203.37,
16.99,  1.30519E+07,   1202.98,
17.99.  1.24821E+07,   1202.58,
```

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18.99,  1.19687E+07,  1202.17,
19.99,  1.15137E+07,  1201.75,
20.99,  1.11041E+07,  1201.34,
21.99,  1.07349E+07,  1200.94,
22.99,  1.03951E+07,  1200.55,
23.99,  1.00926E+07,  1200.17,
24.99,  9.81997E+06,  1199.80,
25.99,  9.56336E+06,  1199.44,
26.99,  9.33300E+06,  1199.09,
27.99,  9.12564E+06,  1198.75,
28.99,  8.91047E+06,  1198.42,
29.99,  8.72028E+06,  1198.11,
30.99,  8.54712E+06,  1197.81,
31.99,  8.38886E+06,  1197.53,
32.99,  8.23471E+06,  1197.25,
33.99,  8.09057E+06,  1196.99,
34.99,  7.96349E+06,  1196.73,
35.99,  7.83428E+06,  1196.48,
36.99,  7.72034E+06,  1196.24,
37.99,  7.60550E+06,  1196.01,
38.99,  7.50701E+06,  1195.79,
39.99,  7.40549E+06,  1195.57,
40.99,  7.31347E+06,  1195.36,
41.99,  7.22956E+06,  1195.16,
42.99,  7.14060E+06,  1194.96,
43.99,  7.05791E+06,  1194.77,
44.99,  6.99055E+06,  1194.58,
45.99,  6.90667E+06,  1194.39,
46.99,  6.84490E+06,  1194.21,
47.99,  6.76800E+06,  1194.04,
48.99,  6.70698E+06,  1193.87,
49.99,  6.64042E+06,  1193.70,
50.99,  6.57274E+06,  1193.53,
51.99,  6.52680E+06,  1193.36,
52.99,  6.46376E+06,  1193.20,
53.99,  6.38507E+06,  1193.04,
54.99,  6.33272E+06,  1192.86,
55.99,  6.26609E+06,  1192.68,
56.99,  6.19823E+06,  1192.49,
57.99,  6.13285E+06,  1192.30,
58.99,  6.06517E+06,  1192.10,
59.99,  5.99954E+06,  1191.89,
60.99,  5.92999E+06,  1191.68,
61.99,  5.86793E+06,  1191.47,
62.99,  5.80122E+06,  1191.26,
63.99,  5.73541E+06,  1191.04,
64.99,  5.67065E+06,  1190.83,
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Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 74 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

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65.99,   5.62151E+06,   1190.61,
66.99,   5.54209E+06,   1190.39,
67.99,   5.47945E+06,   1190.18,
68.99,   5.41649E+06,   1189.96,
69.99,   5.36015E+06,   1189.74,
70.99,   6.37045E+06,   1189.41,
71.99,   6.07108E+06,   1188.89,
72.99,   5.82145E+06,   1188.45,
73.99,   5.61316E+06,   1188.08,
74.99,   5.43312E+06,   1187.75,
75.99,   5.29200E+06,   1187.48,
76.99,   5.16499E+06,   1187.24,
77.99,   5.05224E+06,   1187.02,
78.99,   4.95144E+06,   1186.82,
79.99,   4.86140E+06,   1186.64,
80.99,   4.77558E+06,   1186.46,
81.99,   4.71805E+06,   1186.30,
82.99,   4.61812E+06,   1186.14,
83.99,   4.56214E+06,   1186.00,
84.99,   4.47984E+06,   1185.86,
85.99,   4.40784E+06,   1185.74,
86.99,   4.31888E+06,   1185.63,
87.99,   4.28677E+06,   1185.51,
88.99,   4.20358E+06,   1185.41,
89.99,   4.15141E+06,   1185.31,
90.99,   4.07495E+06,   1185.21,
91.99,   4.02952E+06,   1185.11,
92.99,   3.96144E+06,   1185.03,
93.99,   3.90816E+06,   1184.94,
94.99,   3.86741E+06,   1184.86,
95.99,   3.82190E+06,   1184.78,
96.99,   3.78144E+06,   1184.70,
97.99,   3.74677E+06,   1184.63,
98.99,   3.66556E+06,   1184.55,
99.99,   3.62513E+06,   1184.48,
104.95,  3.36330E+06,   1184.00,
109.95,  2.28521E+06,   1182.00,
114.95,  1.48936E+06,   1180.70,
119.95,  1.39448E+06,   1180.56,
124.95,  1.29973E+06,   1180.39,
129.95,  1.16502E+06,   1180.22,
134.95,  1.00842E+06,   1180.05,
139.95,  9.08014E+05,   1179.88,
144.95,  8.16401E+05,   1179.74,
149.95,  7.32787E+05,   1179.61,
154.95,  6.51380E+05,   1179.50,
159.95,  5.85763E+05,   1179.40,
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Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 75 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

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164.95,  5.14534E+05,  1179.29,
169.95,  4.99630E+05,  1179.20,
174.95,  4.31064E+05,  1179.11,
179.95,  4.08928E+05,  1179.02,
184.95,  3.15313E+05,  1178.93,
189.95.  3.27646E+05,  1178.85,
194.95,  4.81216E+05,  1178.80,
199.95,  4.36921E+05,  1178.72,
204.95,  4.11347E+05,  1178.64,
209.95,  3.72352E+05,  1178.56,
214.95,  4.19882E+05,  1178.48,
219.95,  3.44843E+05,  1178.40,
224.95,  3.28062E+05,  1178.32,
229.95,  3.12198E+05,  1178.25,
234.95,  2.98795E+05,  1178.17,
239.95,  2.34238E+05,  1178.09,
244.95,  2.27598E+05,  1178.01,
249.95,  2.15730E+05,  1177.94,
254.95,  2.39205E+05,  1177.86,
259.95,  3.12279E+05,  1177.80,
264.95,  1.88045E+05,  1177.71,
269.95,  1.83509E+05,  1177.64,
274.95,  1.87524E+05,  1177.56,
279.95,  1.85453E+05,  1177.49,
284.95,  2.26424E+05,  1177.41,
289.95,  2.44470E+05,  1177.34,
294.95,  2.38031E+05,  1177.27,
299.95,  2.11985E+05,  1177.20,
304.95,  2.19795E+05,  1177.13,
309.95,  2.09271E+05,  1177.06,
314.95,  1.98798E+05,  1176.98,
319.95,  2.07655E+05,  1176.91,
324.95,  1.80132E+05,  1176.84,
329.95,  8.13661E+04,  1176.77,
334.95,  8.20429E+04,  1176.70,
339.95,  7.82698E+04,  1206.86,
344.95,  4.00190E+04,  1218.98,
349.95,  2.90006E+04,  1222.93,
354.95,  2.54396E+04,  1224.55,
359.95,  2.38839E+04,  1225.51,
364.95,  2.29112E+04,  1226.27,
369.95,  2.21032E+04,  1226.95,
374.95,  2.13791E+04,  1227.59,
379.95,  2.07019E+04,  1228.20,
384.95,  2.00596E+04,  1228.78,
389.95,  1.94547E+04,  1229.34,
394.95,  1.88778E+04,  1229.87,
```

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399.95,   1.83307E+04,   1230.38,
400.00,   1.83253E+04,   1230.39,
400.00,          0.0,       0.0,
2.0E7,           0.0,       0.0 $END
```

CASE 15 - 7.05 ft^2 Slot @ 50% Power w/MSIV Failure

```
$LIST POOL=301,
0.00,   4.98355E+07,   1194.65,
0.10,   4.88336E+07,   1195.23,
0.20,   4.79520E+07,   1195.78,
0.30,   4.71312E+07,   1196.30,
0.40,   4.63381E+07,   1196.78,
0.50,   4.55857E+07,   1197.23,
0.60,   4.48607E+07,   1197.65,
0.70,   4.41641E+07,   1198.04,
0.80,   4.34941E+07,   1198.41,
0.90,   4.28497E+07,   1198.76,
1.00,   4.22266E+07,   1199.09,
1.99,   3.71761E+07,   1201.46,
2.99,   3.38955E+07,   1202.71,
3.99,   3.13708E+07,   1203.49,
4.99,   2.93736E+07,   1203.97,
5.99,   2.77907E+07,   1204.26,
6.99,   2.64815E+07,   1204.43,
7.99,   2.53949E+07,   1204.52,
8.99,   2.42941E+07,   1204.58,
9.99,   2.29264E+07,   1204.53,
10.99,  2.12987E+07,   1204.31,
11.99,  1.98075E+07,   1203.97,
12.99,  1.86026E+07,   1203.57,
13.99,  1.75923E+07,   1203.15,
14.99,  1.67243E+07,   1202.72,
15.99,  1.59732E+07,   1202.27,
16.99,  1.53021E+07,   1201.83,
17.99,  1.47079E+07,   1201.38,
18.99,  1.41641E+07,   1200.94,
19.99,  1.36846E+07,   1200.51,
20.99,  1.32585E+07,   1200.10,
21.99,  1.28885E+07,   1199.72,
22.99,  1.25424E+07,   1199.35,
23.99,  1.22519E+07,   1199.00,
24.99,  1.19556E+07,   1198.66,
25.99,  1.16845E+07,   1198.32,
26.99,  1.14335E+07,   1198.00,
27.99,  1.11855E+07,   1197.69,
28.99,  1.09624E+07,   1197.39,
29.99,  1.07656E+07,   1197.11,
```

30.99,	1.05908E+07,	1196.86,
31.99,	1.04266E+07,	1196.62,
32.99,	1.02687E+07,	1196.37
33.99,	1.01174E+07,	1196.13,
34.99,	9.97268E+06,	1195.90,
35.99,	9.82724E+06,	1195.66,
36.99,	9.69426E+06,	1195.43,
37.99,	9.56772E+06,	1195.21,
38.99,	9.44532E+06,	1195.00,
39.99,	9.31964E+06,	1194.77,
40.99,	9.19598E+06,	1194.53,
41.99,	9.06286E+06,	1194.28,
42.99,	8.91688E+06,	1194.02,
43.99,	8.78371E+06,	1193.75,
44.99,	8.64349E+06,	1193.48,
45.99,	8.51522E+06,	1193.20,
46.99,	8.37900E+06,	1192.92,
47.99,	8.25412E+06,	1192.65,
48.99,	8.12952E+06,	1192.37,
49.99,	8.01803E+06,	1192.09,
50.99,	7.89671E+06,	1191.81,
51.99,	9.09475E+06,	1191.31,
52.99,	8.60933E+06,	1190.71,
53.99,	8.22053E+06,	1190.20,
54.99,	7.88213E+06,	1189.81,
55.99,	7.61843E+06,	1189.49,
56.99,	7.39778E+06,	1189.22,
57.99,	7.21044E+06,	1189.00,
58.99,	7.04704E+06,	1188.79,
59.99,	6.88862E+06,	1188.60,
60.99,	6.74010E+06,	1188.41,
61.99,	6.60017E+06,	1188.22,
62.99,	6.48101E+06,	1188.05,
63.99,	6.34280E+06,	1187.89,
64.99,	6.22325E+06,	1187.73,
65.99,	6.12230E+06,	1187.59,
66.99,	6.02878E+06,	1187.44,
67.99,	5.91844E+06,	1187.30,
68.99,	5.82415E+06,	1187.16,
69.99,	5.71100E+06,	1187.03,
70.99,	5.62885E+06,	1186.89,
71.99,	5.53975E+06,	1186.76,
72.99,	5.45101E+06,	1186.64,
73.99,	5.36346E+06,	1186.52,
74.99,	5.27591E+06,	1186.41,
75.99,	5.19451E+06,	1186.28,
76.99,	4.78080E+06,	1185.65,

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Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 78 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

```
77.99,   2.42911E+06,   1182.60,
78.99,   1.00003E+06,   1181.28,
79.99,   7.09625E+05,   1181.05,
80.99,   6.74885E+05,   1180.95,
81.99,   6.43266E+05,   1180.84,
82.99,   6.09440E+05,   1180.74,
83.99,   5.87761E+05,   1180.64,
84.99,   5.79143E+05,   1180.54,
85.99,   5.60408E+05,   1180.46,
86.99,   5.07442E+05,   1180.43,
87.99,   5.27544E+05,   1180.40,
88.99,   5.13223E+05,   1180.37,
89.99,   4.93967E+05,   1180.34,
90.99,   4.75369E+05,   1180.31,
91.99,   4.17892E+05,   1180.27,
92.99,   4.42472E+05,   1180.24,
93.99,   4.35553E+05,   1180.22,
94.99,   4.24742E+05,   1180.19,
95.99,   4.24066E+05,   1180.16,
96.99,   4.14947E+05,   1180.13,
97.99,   3.99924E+05,   1180.10,
98.99,   3.85117E+05,   1180.07,
99.99,   3.72010E+05,   1180.04,
104.95,  4.67266E+05,   1179.91,
109.95,  2.65444E+05,   1179.77,
114.95,  3.02634E+05,   1179.65,
119.95,  3.97318E+05,   1179.53,
124.95,  3.20147E+05,   1179.40,
129.95,  6.52136E+04,   1234.80,
134.95,  1.74158E+04,   1243.44,
139.95,  1.15998E+04,   1244.84,
144.95,  1.07532E+04,   1245.30,
149.95,  1.01251E+04,   1245.66,
154.95,  9.88646E+03,   1246.00,
159.95,  9.52420E+03,   1246.31,
164.95,  9.23598E+03,   1246.62,
169.95,  9.01307E+03,   1246.91,
174.95,  8.75988E+03,   1247.20,
179.95,  8.55796E+03,   1247.48,
184.95,  8.34372E+03,   1247.76,
189.95,  8.14421E+03,   1248.04,
194.95,  7.95715E+03,   1248.31,
199.95,  7.77107E+03,   1248.57,
200.00,  7.76930E+03,   1248.57,
200.00,  0.0,           0.0,
2.0E7,   0.0,           0.0 $END
```

CASE 16 - 8.10 ft^2 Slot @ 80% Power w/MSIV Failure

```
$LIST POOL=301,
        0.00,  5.56351E+07,  1195.39,
        0.10,  5.43438E+07,  1196.02,
        0.20,  5.31950E+07,  1196.63,
        0.30,  5.21208E+07,  1197.20,
        0.40,  5.11009E+07,  1197.73,
        0.50,  5.01361E+07,  1198.21,
        0.60,  4.92098E+07,  1198.66,
        0.70,  4.83278E+07,  1199.07,
        0.80,  4.74872E+07,  1199.46,
        0.90,  4.66787E+07,  1199.82,
        1.00,  4.59036E+07,  1200.15,
        1.99,  4.00396E+07,  1202.37,
        2.99,  3.64633E+07,  1203.38,
        3.99,  3.37869E+07,  1203.96,
        4.99,  3.17606E+07,  1204.28,
        5.99,  3.01806E+07,  1204.44,
        6.99,  2.89407E+07,  1204.52,
        7.99,  2.78720E+07,  1204.56,
        8.99,  2.66760E+07,  1204.56,
        9.99,  2.51132E+07,  1204.41,
       10.99,  2.32979E+07,  1204.11,
       11.99,  2.16796E+07,  1203.70,
       12.99,  2.03429E+07,  1203.24,
       13.99,  1.92484E+07,  1202.78,
       14.99,  1.83280E+07,  1202.31,
       15.99,  1.75189E+07,  1201.84,
       16.99,  1.67946E+07,  1201.37,
       17.99,  1.61436E+07,  1200.91,
       18.99,  1.55697E+07,  1200.46,
       19.99,  1.50678E+07,  1200.03,
       20.99,  1.46219E+07,  1199.62,
       21.99,  1.42191E+07,  1199.23,
       22.99,  1.38526E+07,  1198.86,
       23.99,  1.35114E+07,  1198.49,
       24.99,  1.31816E+07,  1198.14,
       25.99,  1.28777E+07,  1197.79,
       26.99,  1.25876E+07,  1197.47,
       27.99,  1.23320E+07,  1197.15,
       28.99,  1.20972E+07,  1196.86,
       29.99,  1.18879E+07,  1196.57,
       30.99,  1.16702E+07,  1196.29,
       31.99,  1.14825E+07,  1196.02,
       32.99,  1.12945E+07,  1195.75,
       33.99,  1.10913E+07,  1195.46,
```

34.99,	1.08911E+07,	1195.16,
35.99,	1.06913E+07,	1194.85,
36.99,	1.04966E+07,	1194.53,
37.99,	1.03022E+07,	1194.21,
38.99,	1.01114E+07,	1193.89,
39.99,	9.92408E+06,	1193.56,
40.99,	9.74833E+06,	1193.22,
41.99,	9.56992E+06,	1192.89,
42.99,	9.38372E+06,	1192.56,
43.99,	9.72526E+06,	1192.10,
44.99,	9.11628E+06,	1191.84,
45.99,	8.88354E+06,	1191.52,
46.99,	8.72618E+06,	1191.19,
47.99,	8.57772E+06,	1190.86,
48.99,	8.43941E+06,	1190.53,
49.99,	8.29854E+06,	1190.21,
50.99,	8.14820E+06,	1189.90,
51.99,	8.04049E+06,	1189.59,
52.99,	7.91215E+06,	1189.28,
53.99,	7.76700E+06,	1188.97,
54.99,	7.53343E+06,	1188.74,
55.99,	7.36006E+06,	1188.54,
56.99,	7.17102E+06,	1188.36,
57.99,	7.03274E+06,	1188.19,
58.99,	6.89990E+06,	1188.03,
59.99,	6.73873E+06,	1187.88,
60.99,	6.63188E+06,	1187.74,
61.99,	6.50023E+06,	1187.60,
62.99,	2.71007E+06,	1183.63,
63.99,	4.41202E+05,	1182.11,
64.99,	2.14531E+05,	1181.97,
65.99,	2.77861E+05,	1181.87,
66.99,	4.63694E+05,	1196.70,
67.99,	3.24327E+05,	1210.16,
68.99,	1.82254E+05,	1221.77,
69.99,	1.28134E+05,	1228.39,
70.99,	1.04730E+05,	1233.18,
71.99,	8.96011E+04,	1236.91,
72.99,	7.54772E+04,	1239.77,
73.99,	6.10106E+04,	1241.72,
74.99,	4.84790E+04,	1242.75,
75.99,	4.08042E+04,	1243.07,
76.99,	3.91090E+04,	1243.08,
77.99,	4.19746E+04,	1243.16,
78.99,	4.62485E+04,	1243.55,
79.99,	4.87307E+04,	1244.23,
80.99,	4.77835E+04,	1245.00,

```
 81.99,   4.39531E+04,   1245.62,
 82.99,   3.93304E+04,   1245.93,
 83.99,   2.61482E+04,   1246.04,
 84.99,   1.91581E+04,   1246.76,
 85.99,   1.73690E+04,   1247.17,
 86.99,   1.80031E+04,   1247.57,
 87.99,   1.86574E+04,   1248.04,
 88.99,   1.79562E+04,   1248.53,
 89.99,   1.58372E+04,   1248.92,
 90.99,   1.32302E+04,   1249.13,
 91.99,   1.13216E+04,   1249.16,
 92.99,   1.08351E+04,   1249.11,
 93.99,   1.16870E+04,   1249.09,
 94.99,   1.31257E+04,   1249.17,
 95.99,   1.42066E+04,   1249.36,
 96.99,   1.43128E+04,   1249.61,
 97.99,   1.34366E+04,   1249.84,
 98.99,   1.20995E+04,   1249.99,
 99.99,   1.09990E+04,   1250.05,
104.95,   1.24410E+04,   1250.42,
109.95,   1.04682E+04,   1250.88,
114.95,   1.05964E+04,   1251.40,
119.95,   1.02259E+04,   1251.77,
124.95,   9.57496E+03,   1252.23,
129.95,   9.50270E+03,   1252.64,
134.95,   9.03982E+03,   1253.04,
139.95,   8.78148E+03,   1253.45,
144.95,   8.53553E+03,   1253.84,
149.95,   8.23612E+03,   1254.23,
154.95,   8.03322E+03,   1254.61,
159.95,   7.81207E+03,   1254.99,,
164.95,   7.62376E+03,   1255.36,
169.95,   7.44793E+03,   1255.72,
174.95,   7.26818E+03,   1256.08,
179.95,   7.10446E+03,   1256.44,
184.95,   6.94343E+03,   1256.80,
189.95,   6.78906E+03,   1257.15,
194.95,   6.64218E+03,   1257.50,
199.95,   6.49951E+03,   1257.84,
200.00,   6.49814E+03,   1257.84,
200.00,          0.0,        0.0,
  2.0E7,         0.0,        0.0 $END
```

CASE 7 - 8.85 ft^2 Slot @ 102% Power w/MSIV Failure

```
$LIST POOL=301,
```

E&TS DEPARTMENT

CALCULATION SHEET

ICCN NO./ PRELIM. CCN NO.	PAGE__ OF__
	CCN CONVERSION: CCN NO. CCN --

Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 82 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

0.00,	5.98327E+07,	1195.73,
0.10,	5.75122E+07,	1196.41,
0.20,	5.57370E+07,	1197.03,
0.30,	5.43010E+07,	1197.60,
0.40,	5.30896E+07,	1198.12,
0.50,	5.20330E+07,	1198.61,
0.60,	5.10912E+07,	1199.06,
0.70,	5.02333E+07,	1199.48,
0.80,	4.94377E+07,	1199.87,
0.90,	4.86918E+07,	1200.24,
1.00,	4.79844E+07,	1200.58,
1.99.	4.22996E+07,	1202.77,
2.99.	3.84905E+07,	1203.67,
3.99.	3.57314E+07,	1204.14,
4.99.	3.36987E+07,	1204.38,
5.99.	3.22780E+07,	1204.49,
6.99.	3.12150E+07,	1204.54,
7.99.	3.02675E+07,	1204.56,
8.99.	2.90136E+07,	1204.56,
9.99.	2.72875E+07,	1204.41,
10.9.9,	2.52859E+07,	1204.10,
11.99,	2.31050E+07,	1203.71,
12.99,	2.14734E+07,	1203.29,
13.99,	2.02301E+07,	1202.88,
14.99,	1.92300E+07,	1202.46,
15.99,	1.83844E+07,	1202.05,
16.99,	1.76321E+07,	1201.62,
17.99,	1.69480E+07,	1201.18,
18.99,	1.63347E+07,	1200.76,
19.99,	1.57910E+07,	1200.37,
20.99,	1.53147E+07,	1200.00,
21.99,	1.48990E+07,	1199.67,
22.99,	1.45314E+07,	1199.34,
23.99,	1.41958E+07,	1199.02,
24.99,	1.38684E+07,	1198.69,
25.99,	1.35715E+07,	1198.37,
26.99,	1.32724E+07,	1198.05,
27.99,	1.29986E+07,	1197.76,
28.99,	1.27477E+07,	1197.47,
29.99,	1.24979E+07,	1197.16,
30.99,	1.22491E+07,	1196.85,
31.99,	1.20009E+07,	1196.52,
32.99,	1.17508E+07,	1196.18,
33.99,	1.15086E+07,	1195.83,
34.99,	1.12624E+07,	1195.47,
35.99,	1.10236E+07,	1195.12,
36.99,	1.07968E+07,	1194.78,

37.99,	1.05819E+07,	1194.45,
38.99,	1.03779E+07,	1194.12,
39.99,	1.09174E+07,	1193.56,
40.99,	1.00225E+07,	1193.42,
41.99,	9.70326E+06,	1193.14,
42.99,	9.52574E+06,	1192.81,
43.99,	9.35935E+06,	1192.48,
44.99,	9.18911E+06,	1192.16,
45.99,	9.01588E+06,	1191.85,
46.99,	8.89207E+06,	1191.53,
47.99,	8.73400E+06,	1191.22,
48.99,	8.58726E+06,	1190.91,
49.99,	8.45867E+06,	1190.60,
50.99,	8.32622E+06,	1190.30,
51.99,	8.19641E+06,	1190.00,
52.99,	3.65717E+06,	1184.74,
53.99,	6.83237E+05,	1182.70,
54.99,	3.68528E+05,	1182.53,
55.99,	6.18599E+05,	1191.10,
56.99,	3.37910E+05,	1208.76,
57.99,	2.69605E+05,	1221.42,
58.99,	1.36503E+05,	1236.78,
59.99,	1.02371E+05,	1241.74,
60.99,	8.92084E+04,	1245.39,
61.99,	8.08884E+04,	1248.49,
62.99,	6.97244E+04,	1251.03,
63.99,	5.55962E+04,	1252.71,
64.99,	4.26834E+04,	1253.43,
65.99,	3.53102E+04,	1253.42,
66.99,	3.50379E+04,	1253.14,
67.99,	4.00255E+04,	1253.08,
68.99,	4.61833E+04,	1253.47,
69.99,	4.95709E+04,	1254.27,
70.99,	4.83487E+04,	1255.18,
71.99,	4.34754E+04,	1255.89,
72.99,	3.77662E+04,	1256.19,
73.99,	3.40761E+04,	1256.14,
74.99,	3.37815E+04,	1255.94,
75.99,	3.62981E+04,	1255.86,
76.99,	3.96734E+04,	1256.04,
77.99,	4.17902E+04,	1256.47,
78.99,	4.15062E+04,	1257.01,
79.99,	3.91316E+04,	1257.46,
80.99,	3.60540E+04,	1257.69,
81.99,	3.38323E+04,	1257.73,
82.99,	2.15769E+04,	1257.79,
83.99,	1.68380E+04,	1258.41,

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

```
 84.99,  1.58215E+04,  1258.82,
 85.99,  1.57703E+04,  1259.21,
 86.99,  1.52111E+04,  1259.59,
 87.99,  1.38181E+04,  1259.91,
 88.99,  1.20753E+04,  1260.10,
 89.99,  1.07364E+04,  1260.16,
 90.99,  1.03087E+04,  1260.15,
 91.99,  1.07857E+04,  1260.16,
 92.99,  1.17064E+04,  1260.24,
 93.99,  1.24519E+04,  1260.40,
 94.99,  1.25882E+04,  1260.62,
 95.99,  1.20702E+04,  1260.82,
 96.99,  1.12037E+04,  1260.97,
 97.99,  1.04381E+04,  1261.05,
 98.99,  1.01073E+04,  1261.10,
 99.99,  1.02701E+04,  1261.14,
104.95,  1.05164E+04,  1261.79,
109.95,  1.01719E+04,  1262.22,
114.95,  9.42246E+03,  1262.79,
119.95,  9.40644E+03,  1263.28,
124.95,  8.89672E+03,  1263.76,
129.95,  8.63748E+03,  1264.26,
134.95,  8.38825E+03,  1264.73,
139.95,  8.07574E+03,  1265.20,
144.95,  7.86686E+03,  1265.66,
149.95,  7.62509E+03,  1266.11,
154.95,  7.41622E+03,  1266.56,
159.95,  7.24896E+03,  1267.00,
164.95,  7.06982E+03,  1267.44,
169.95,  6.90764E+03,  1267.87,
174.95,  6.74752E+03,  1268.30,
179.95,  6.59416E+03,  1268.72,
184.95,  6.44746E+03,  1269.14,
189.95,  6.30508E+03,  1269.56,
194.95,  6.16925E+03,  1269.97,
199.95,  6.03828E+03,  1270.38,
200.00,  6.03702E+03,  1270.38,
200.00,            0.0,      0.0,
  2.0E7,           0.0,      0.0 $END
```

8.1.13 Card Series 401

Card series 401 is a table that is used to apportion energy into the reactor vessel water from the core decay heat table (card series 101) and any energy in the metal-water reaction table (card series 201). The card series 401 table consists of decay heat multiplier and metal-water reaction multiplier versus time in seconds. A minimum of two data sets are required. Since neither decay heat nor metal-water reaction energy additions are being specifically modeled by the COPATTA program, two sets of zero multipliers are provided.

```
$LIST POOL=401,   0,    0,    0,
                 2E7,   0,    0 $END
```

8.1.14 Card Series 501

Card series 501 is a data input table which can be used to provide additional mass and energy break flow into containment either following the end of the series 301 table or in parallel with the 301 table input. Parallel break flow input is acceptable only if no special component thermal response (thermal lag) environmental (instrumentation) qualification heat sink calculations are being performed with the COPATTA program. Erroneous enhanced forced convection heat transfer coefficients will be calculated with simultaneous mass and energy flows in both the series 301 and 501 tables. In this MSLB containment P-T calculation, special component heat sink models are not used, and parallel break flow in the card series 301 and 501 tables is acceptable.

The card series 501 table will be used to model steam back flow from the intact steam generator back into containment through worn check valves and small bore check valve bypass piping in the main steam lines feeding the turbine-driven auxiliary feedwater pump as described in Design Input 4.7. This back flow will be included for 30 minutes for all cases run.

In addition, per Design Input 4.7, the cases at zero power will also include steam flow through the slow-closing air-operated 4" main steam isolation bypass valves HV8202 and HV8203 for 60 seconds following the MSLB.

a. Check Valve Leakage and Bypass Steam Flow

As identified in Design Input 4.7, the check valve leakage and bypass flow will be modeled at 29,000 lb_m/hr saturated steam at 1000 psia. The enthalpy of saturated steam at 1000 psia is 1192.9 Btu/lb_m [Ref. 6.30]. Card series 501 input consists of a table of mass flow rate in lb_m/hr and energy flow rate in Btu/hr as a function of time in seconds.

The energy flow rate, q, is the product of the mass flow rate and the steam enthalpy. Thus,

$$q = (29000)(1192.9) = 34.5941\times10^6 \text{ Btu/hr or } \mathbf{34.6\times10^6 \text{ Btu/hr}} \text{ (rounded)}$$

The series 501 input table for this leakage and bypass flow, used for cases 2, 3, 4, 5, 14, 15, 16, and 7 (all except those at zero power) is

```
$LIST POOL=501,     0,     29E3,     34.6E6,
                 1800,     29E3,     34.6E6,
                 1800,        0,          0,
                   2E7,       0,          0 $END
```

b. MSIV Bypass Valve Steam Backflow

Per Design Input 4.7, this additional mass-energy input term will be included only for the zero power MSLB events (cases 1 and 13). Although the MSIV bypass valves HV8202 and HV8203 are 4" globe valves, the valves are located in 2" HK1 piping per piping and instrumentation diagrams (P&IDs) for Units 2 and 3 [Refs. 6.31a thru 6.31h]. The HK1 piping is schedule 160 according to the piping materials classification document 90004 [Ref. 6.48, sheet 60]. The steam flow through the open bypass valve will be conservatively calculated based on choked flow from an infinite reservoir of saturated steam at 1000 psia, flowing through an opening with an area equal to that of 2" schedule 160 pipe. Per Crane [Ref. 6.29] the flow area for this pipe is 0.01556 ft^2. Using Figure 2-2 from the Systems Analysis Handbook [Ref. 6.32], the critical mass flux of saturated steam at 1000 psia is about 2000 $lb_m/sec\text{-}ft^2$. Multiplying the critical mass flux by the pipe area yields the MSIV bypass flow, w_b:

$$w_b = (2000)(0.01556)(3600\ sec/hr) = 1.120\times10^5\ lb_m/hr\ \text{(rounded)}$$

The saturated bypass steam at 1000psia has an enthalpy of 1192.9 Btu/lbm. Therefore, the energy flow rate, q_b, is:

$$q_b = (1.120\times10^5)(1192.9) = \mathbf{133.6\times10^6\ Btu/hr}\ \text{(rounded)}$$

As specified in Design Input 4.7, the MSIV bypass steam flow will last for 60 seconds, and terminate as a step function (instantaneously close). The series 501 table input for the zero power MSLB events will be the combination of the check valve leakage and bypass flow from part (a) above and the MSIV bypass flow calculated in this part (b). The series 501 table becomes:

```
$LIST POOL=501,     0,     141E3,     168.2E6,
                   60,     141E3,     168.2E6,
                   60,      29E3,      34.6E6,
                 1800,      29E3,      34.6E6,
                 1800,         0,           0,
                   2E7,        0,           0 $END
```

8.1.15 Card Series 601

This card series is used to add water and/or energy directly to the containment sump as a tabular function of time. The table is generally used to model spillage of safety injection water during a LOCA event. For MSLB events the table is normally zeroed out. However, in some cases, MSLB events may fail to run on COPATTA unless a small amount of water and energy is added to the sump at the beginning of the run. Typically, adding 1 pound of water at an enthalpy corresponding to 120°F liquid during the first calculation time step is sufficient to assure the COPATTA run begins to run properly. This mass and energy addition is completely insignificant and has no impact on containment conditions.

The input units are water flow rate in lb_m/hr and energy flow rate in Btu/hr as a function of time in seconds. The calculational time step used at the beginning of the analysis is 0.05 seconds. Adding 1 pound of water over 0.05 seconds equates to a mass flow rate of 72,000 lb_m/hr. Assuming a water temperature of 120°F (the initial containment temperature), the water enthalpy is 88 Btu/lb_m and the energy flow rate is 72000 lb_m/hr times the enthalpy of 88 Btu/lb_m, or 6.336×10^6 Btu/hr for a duration of 0.05 seconds.

Thus, if needed to assure COPATTA run initiation with an MSLB, the following input file is used:

```
$LIST POOL=601,    0,     7.2E4,     6.336E6,
                0.05,     7.2E4,     6.336E6,
                0.05,        0,           0,
                 2E7,        0,           0 $END
```

8.1.16 Card Series 701

Card series 701 is a table that is used to apportion energy into the containment vapor region from the core decay heat table (card series 101) and energy from the metal-water reaction table (card series 201). The table also provides for the arbitrary addition of water mass to the containment atmosphere. The card series 701 table consists of decay heat multiplier and metal-water reaction multiplier, and a water mass flow rate in lb_m/hr versus time in seconds. A minimum of two data sets are required. Since neither decay heat nor metal-water reaction energy additions are being specifically modeled by the COPATTA program, and no direct water addition to the containment atmosphere is required in this table, two sets of zero multipliers are provided.

```
$LIST POOL=701,  0,     0,     0,     0,
                2E7,    0,     0,     0 $END
```

8.1.17 Card Series 801

Card series 801 is a table which provides information on the characteristics of the containment spray system, the core safety injection system and source of water for these systems, all as a function of time. The series 801 table consists of 6 columns containing:

1. Time (seconds)
2. Containment spray flow rate (lb_m/hr)
3. Reactor vessel safety injection water flow rate (lb_m/hr)
4. Fraction of the SI flow spilled directly into the containment sump (dimensionless)
5. Water temperature of containment spray during the injection phase (°F)
   100°F per Design Input 4.8
6. Water temperature of the SI flow during the injection phase (°F)

For the MSLB analyses, only information on the containment spray system is provided. Safety injection system data is normally only provided for LOCA analyses.

The containment spray flow as a function of time is developed using a Quattro Pro spreadsheet and nozzle group flow rates from a transient spray header filling transient analysis documented in Reference 6.17. The transient header filling analysis for Unit 2 is conservatively used since the header fill time is 30 seconds following pump start compared with 29 seconds for Unit 3. The transient analysis also shows that initial spray from the first nozzles in the lower ring header begins within 3 seconds following the start of the containment spray pump. Appendix C contains the spread sheets developed to determine the flow for the individual ring headers and the total system spray flow as a function of time from the start of the filling transient. The total system spray flow is normalized to a maximum injection spray flow rate of 1600 gpm. The maximum injection mode flow rate of 1600 gpm is conservatively bounded by the minimum spray flow of 1606 gpm identified (Case 6) in Table 1 of Supplement A to calculation M-0014-009, Rev. 0 [Ref. 6.17].

Based on the results of the analysis in Appendix C, the following table represents the containment spray flow rate as a function of time following the start of the filling transient:

Time Following Start of Fill Transient (sec)	Single Train Spray Flow (gpm)	Single Train Spray Flow @ 100°F (lb_m/hr)*	Double Train Spray Flow @ 100°F (lb_m/hr)*
0	0	0	0
3	0	0	0
5	100	0.4973E5	0.9946E5
10	245	1.2184E5	2.4368E5
15	530	2.6357E5	5.2714E5
20	615	3.0584E5	6.1168E5
25	675	3.3567E5	15.9134E5
30	1600	7.9567E5	15.9134E5

* mass flow rate (lbm/hr) = (flow in gpm)(1 ft^3/7.48 gal)(60 min/hr)(1 lb_m/0.016130 ft^3) = 497.296 x (flow in gpm)

Consistent with the methodology of CCN 1 to N-4080-003, Rev. 5 [Ref. 6.12], the timing of the start of the fill transient with respect to the occurrence of the MSLB with no loss of power (no LOP) is determined as follows:

Time = 0 seconds	MSLB occurs.
Time = 2 seconds	Containment pressure reaches or exceeds analysis high pressure setpoint (5 psig) for all MSLB cases run.
Time = 3 seconds	SIAS generated; ESF sequencing begins.
Time = 15.5 seconds	CS pump motor breaker coils energize (includes a conservative 2.5 second margin on time delay relay sequencing setting of 10 seconds).
Time = 15.9 seconds (say 16 seconds, rounded)	CS pump motor breaker closes & CS pump starts and filling transient begins as CS block valves open.

The time to reach the containment high-high pressure setpoint for containment spray actuation (CS block valve opening) depends upon the specific break because the break area (and thus break flow rate) varies with reactor power level. The initial containment pressure (16.8 psia for max. pressure analysis & 13.8 psia for max. temperature (EQ) analysis) also has a minor effect on the time to the high-high pressure setpoint. Again, using the methodology of Reference 6.12, with a block valve stroke time of 12 seconds, and preliminary MSLB results, the times to fully open the CS block valves are as follows:

Cases	Power Level (%)	Time to Hi-Hi Pressure Analysis Setpoint of 20 psig (sec)	CS Block Valves Begin to Open(sec)	CS Block Valves Full Open (sec)
1 & 13	0	11.3	12.3	24.3
2 & 14	20	8.6	9.6	21.6
3 & 15	50	6.8	7.8	19.8
4 & 16	80	6.1	7.1	19.1
5 & 7	102	5.7	6.7	18.7
5EQ & 7EQ	102	7.1	8.1	20.1

In all cases, the spray block valves are in the process of opening at the time the containment spray pump is started at 16 seconds. To provide additional conservatism for the higher power, more limiting breaks, and to simplify the containment spray input table, all cases will be run as if the spray pump start (and the filling transient begins) at 20 seconds post-MSLB. This simplification will neglect any spray header filling which will occur between 16 and 20 seconds when the pump starts and comes up to speed with the block valves in various stages of opening. At 20 seconds, the block valves are fully open for the cases at 50, 80 and 102% power (non-EQ), and the block valves are 64% and 87% open for the cases at 0 and 20% power, respectively. The non-conservatism of applying a valves wide open filling transient analysis to the 0 and 20% power cases when the valves are initially more than half

open, is balanced by not including the filling which will occur between the actual pump start at 16 seconds versus the modeled pump start at 20 seconds. The 0 and 20% power cases are neither limiting from a peak containment pressure nor temperature standpoint, and this simplification does not significantly impact the results of the analysis. The two full power EQ cases are run with a lower initial containment pressure to maximize the calculated peak vapor temperature. However, these cases still reach the CS actuation analysis setpoint of 20 psig early enough that the spray block valves will be essentially full open at 20 seconds when the spray system filling transient is modeled to begin. Therefore, the same spray start-up ramp can be used for both the EQ and non-EQ COPATTA runs.

Card series 801 input for all loss of cooling train cases (1, 2, 3, 4, 5, and 5EQ) is:

```
$LIST POOL=801,
     0,          0,   0,   0,   100,   100,
    23,          0,   0,   0,   100,   100,
    25,     0.4973E5, 0,   0,   100,   100,
    30,     1.2184E5, 0,   0,   100,   100,
    35,     2.6357E5, 0,   0,   100,   100,
    40,     3.0584E5, 0,   0,   100,   100,
    45,     3.3567E5, 0,   0,   100,   100,
    50,     7.9567E5, 0,   0,   100,   100,
   1E4,     7.9567E5, 0,   0,   100,   100,
   1E4,          0,   0,   0,   100,   100,
   2E7,          0,   0,   0,   100,   100 $END
```

Card series 801input for all MSIV failure cases (13, 14, 15, 16, 7, and 7EQ) is:

```
$LIST POOL=801,
     0,          0,   0,   0,   100,   100,
    23,          0,   0,   0,   100,   100,
    25,     0.9946E5, 0,   0,   100,   100,
    30,     2.4368E5, 0,   0,   100,   100,
    35,     5.2714E5, 0,   0,   100,   100,
    40,     6.1168E5, 0,   0,   100,   100,
    45,     6.7134E5, 0,   0,   100,   100,
    50,    15.9134E5, 0,   0,   100,   100,
   1E4,    15.9134E5, 0,   0,   100,   100,
   1E4,          0,   0,   0,   100,   100,
   2E7,          0,   0,   0,   100,   100 $END
```

8.1.18 Card Series 901

Card series 901 provides for the arbitrary addition of air to the containment atmosphere. The air addition table can include up to 20 sets of data consisting of time in seconds, air addition rate in lb_m/hr, and temperature of the added air in °F. A minimum of two sets of data are required. Since no arbitrary air addition is modeled for the MSLB analysis, the input data for card series 901 is:

```
$LIST POOL=901,    0,    0,    0,
                  2E7,   0,    0 $END
```

8.1.19 Card Series 1001

Card series 1001 models the outside ambient air temperature and the convective heat transfer coefficient at the external surface of passive heat sinks exposed to the outside air environment. This information is specifically used for heat transfer calculations at the outside surface of heat sinks # 1 and #2 (containment building dome and cylindrical walls above grade level) described in Sections 8.1.2.1 and 8.1.2.2, respectively.

The data in the table covers a 24-hour period post accident and may have up to 25 data sets. A minimum of 2 data sets is required. For the containment peak P-T response analyses following the MSLB event, a constant outside air temperature of 100°F is modeled (Design Input 4.3). The outside containment surface convective heat transfer coefficient is specified as 2 Btu/hr-ft^2-°F as recommended by Reference 6.25. The data table for the 1001 series card is:

```
$LIST POOL=1001,   0,   100,   2.0,
                  24,   100,   2.0 $END
```

8.1.20 Card Series 1101

Card series 1101 is used to provide the heat removal capability of an individual emergency air cooling unit (ECU) as a function of containment atmosphere saturation temperature. A maximum of 40 sets of data may be supplied; a minimum of 2 sets of data is required. As described in Design Input 4.6, the ECU performance data is taken from RGR Table IX-2 [References 6.7 and 6.8], and reflects a constant Component Cooling Water (CCW) supply temperature of 105°F. The units of the data are temperature in °F and heat removal rate in Btu/hr. The card series 1101 data input set is:

```
$LIST POOL=1101,  105,      0,
                  120,   1.67E6,
                  130,   3.02E6,
                  140,   4.57E6,
                  150,   6.32E6,
                  160,   8.27E6,
                  170,  10.40E6,
                  180,  12.73E6,
                  190,  15.23E6,
                  200,  17.88E6,
                  210,  20.68E6,
                  220,  23.61E6,
                  230,  26.64E6,
                  240,  29.74E6,
                  250,  32.91E6,
```

```
                    260,        36.11E6,
                    270,        39.31E6,
                    280,        42.52E6,
                    290,        45.69E6,
                    300,        48.82E6 $END
```

8.1.21 Card Series 1201

Card series 1201 provides the containment spray efficiency as a function of the containment water vapor to air mass ratio. Per Design Input 4.8, this parameter is taken from Figure 2 of Reference 6.23. The input table may consist of up to 40 data sets; a minimum of 1 data set is required. The data table for the 1201 series card is:

```
$LIST POOL=1201,    0,        0.729,
                  0.1,        0.737,
                  0.2,        0.747,
                  0.3,        0.757,
                  0.4,        0.771,
                  0.5,        0.788,
                  0.6,        0.809,
                  0.7,        0.832,
                  0.8,        0.863,
                  0.9,        0.912,
                  1.0,        0.961,
                  1.2,        0.995,
                  1.3,        1.000 $END
```

8.1.22 Card Series 9001

Card series 9001 is used to specify the calculational time intervals and the data printout intervals. The following data is included in each input line:

1. Time (seconds)
2. Calculational Interval (seconds)
3. Energy Balance/Containment Conditions Printout Interval (seconds)
4. Heat Sink Temperature Distribution & Details Printout Frequency (dimensionless)

The selection of calculational time steps is based on guidance provided in the COPATTA User's Manual and Reference 6.25. This calculation uses smaller time steps than suggested to assure an accurate analysis. The frequency of output data and detailed heat sink printouts is selected to provide smooth output plots for results presentation. The run control table may contain up to 50 input lines with a minimum requirement of one input line. The card series 9001 data input set is:

```
$LIST POOL=9001,    5,    0.05,    0.1,  50,
                   20,    0.05,    1.0,   5,
```

```
100,   0.10,    1.0,  10,
150,   0.50,    2.0,   5,
200,    1.0,    5.0,   2,
600,    1.0,   10.0,   5,
800,    2.0,   20.0,   5,
1E3,    5.0,   50.0,   2,
5E3,   10.0,  250.0,   4,
2E4,   25.0,    1E3,   5,
2E5,   50.0,    5E3,   2 $END
```

8.1.23 Variable End Card

This card must follow the group of variable data cards. The entry contains the following fixed information in columns 2 through 21:

```
$LIST POOL=9999 $END
```

8.2 COPATTA Passive Heat Sink Data

The heat sink data series describes the physical characteristics of passive structural heat sink in containment. Twenty-one specific heat sinks are modeled (Card Series 1, item 7). Each heat sink (number XX) is detailed in the COPATTA Code as a set of heat sink data cards. Each set of heat sink data cards includes:

Title Card
Card Series 1XX001 - general information on the heat sink
Card Series 1XX101 - identifies the mesh point spacing in each region of the heat sink
Card Series 1XX201 - identifies the material in each region of the heat sink
Card Series 1XX300 - specifies decay heat generation within heat sink regions
Card Series 1XX400 - specifies boundary conditions for left and right surfaces of the heat sink

The specific heat sinks modeled in the analysis are:

1 Reactor Building Dome
2 Reactor Building Cylinder Wall above grade level @ Elev. 30 ft.
3 Reactor Building Cylinder Wall below grade level @ Elev. 30 ft.
4 Reactor Building Basemat (excluding Rx Cavity Basemat)
5 Reactor Cavity Basemat & Steam Generator Pedestals
6 Reactor Cavity Wall below Containment Floor @ Elev. *ca* 17' - 6"
7 Reactor Cavity Wall above Containment Floor @ Elev. *ca*. 17' - 6"
8 Lined Refueling Canal Walls and Floor
9 Un-lined, Exterior Faces of Refueling Canal Walls
10 Steam Generator Compartment Walls and Missile Shields
11 Steam Generator Compartment Walls With Embeds
12 Elevated Floor Slabs (Top Half Thickness)
13 Elevated Floor Slabs (Lower Half-Thickness with Carbon Steel Decking)
14 Lifting Devices (carbon steel)
15 Miscellaneous Carbon Steel (thickness > 2.5 inches)
16 Miscellaneous Carbon Steel (1.0 inches < thickness </= 2.5 inches)
17 Miscellaneous Carbon Steel (0.5 inches < thickness </= 1.0 inches)
18 Miscellaneous Carbon Steel (thickness </= 0.5 inches)
19 Electrical Equipment & Other Galvanized Steel
20 Miscellaneous Stainless Steel
21 Reactor Building Stiffened Sections

8.2.1 HS #1 - Reactor Building Dome

The reactor building dome is a concrete hemisphere with inside radius of 75 feet. The concrete thickness varies from 4'-4" at the springline to 3'-9" at the top of the dome, with an average thickness of 48.5". The inside surface of the concrete dome is covered by carbon steel liner plate of 0.25" minimum thickness [Ref. 6.9] with the interior surface coated with an epoxy paint.

The gross inside exposed surface area is calculated to be

$$A_1 = (2)(\pi)[75 - (0.25/12)]^2 = (2)(\pi)(74.979)^2 = 35{,}323 \text{ ft}^2$$

Of this area, 2,306 ft^2 is stiffened by attachment to embedded steel structural shapes [Ref. 6.9, Sect. 8.2.10]. The stiffened dome area is included separately in heat sink # 21.

The net exposed surface area for heat sink #1 is

$$A_{1\,net} = 35323 - 2306 = \mathbf{33{,}017\ ft^2}$$

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	33017 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.9; consistent with Ref. 6.21)
Carbon Steel (material 1) Liner Plate, thickness	0.02083 ft (0.25 inches)
Air Gap Interface (material 5), thickness	0.00035 ft (4.2 mils, see Design Input 4.10)
Concrete (material 2), thickness	4.04167 ft (48.5 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC
Right (outside cont'nm't) Boundary Condition	Exposed to outside environment with natural convection to OSA.

The nodal spacing selected for the various heat sink materials and regions within an individual material is based on the methodology described in Reference 6.25 (pages 20-22). The maximum initial node spacing in the paint exposed to the containment atmosphere is defined by the expression:

$$\Delta x_{max} = 4k/10000 \text{ feet}$$

where k is the paint thermal conductivity (0.15 Btu/hr-ft^2-°F/ft, per Design Input 4.11). For heat sink #1, the initial nodal spacing is 0.00006 feet. Per guidance in the design standard, this spacing is maintained for up to 4 nodes and then doubled and used for 5 nodes to model

the 10-mil paint thickness. Also, per Reference 6.25, the maximum initial nodal spacing in the steel at the paint interface is set by the relation:

$$\Delta x_{CS} = [(k_{CS})/(k_{PNT})]\,(\Delta x_{PNT})$$

For heat sink #1, the initial steel nodal spacing (k_{CS} = 25 Btu/hr-ft^2-°F/ft)should be no greater than:

$$\Delta x_{CS} = [(25)/(0.15)](0.00012) = 0.02 \text{ feet}$$

Since the thickness of the liner plate is 0.02083 feet thick, a smaller nodal spacing is chosen in this case by specifying 2 nodes in the steel to provide an additional temperature data point at the liner plate mid-plane. Application of the methodology is continued in this manner until the entire heat sink thickness has been nodalized. The process is also repeated for the other heat sinks.

The card series set defining Heat Sink 1 is entered in the input data file as:

```
* HS #1 - REACTOR BUILDING DOME
$LIST POOL=101001,  57,  14,  0,  0,  0,  0,  33017 $END
$LIST POOL=101101,  4,  0.00024,  5,  0.00083,  2,  0.02166,  4,  0.02170,
                    5,  0.02201,  4,  0.03001,  4,  0.04601,  4,  0.07801,
                    4,  0.14201,  4,  0.27001,  4,  0.52601,  4,  1.03801,
                    4,  2.06201,  4,  4.06368 $END
$LIST POOL=101201,  4,  4,  1,  5,  5,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=101300,  0,  0 $END
$LIST POOL=101400,  9,  2,  1,  1 $END
```

8.2.2 HS #2 - Reactor Building Cylinder Wall above Grade Level @ Elev. 30 Ft

The reactor building cylinder wall has an inside concrete wall diameter of 150 feet, and the cylinder extends to the springline at elevation 112'-0" [Ref. 6.33]. The wall thickness is 4'-4" [Ref. 6.9]. The additional thickness at the exterior buttress sections is conservatively neglected. As with the dome section, the inside surface of the concrete cylinder is lined by carbon steel with a minimum thickness of 0.25 inches [Ref. 6.9] coated with an epoxy paint. The Reference 6.9 calculation also identifies 5,765 ft^2 of cylindrical liner plate in areas of penetrations and major attachments which is 0.5 inches thick rather than 0.25 inches thick. This additional steel mass corresponding to the liner plate thickness in excess of 0.25 inches is conservatively not included in this P-T calculation.

The gross inside exposed surface area is calculated to be

$$A_2 = (\pi)(150)(112 - 30) = 38{,}642 \text{ ft}^2$$

Of this area, 1,458 ft^2 is stiffened by attachment to embedded steel structural shapes [Ref. 6.9, Sect. 8.2.10]. Although a portion of the cylindrical wall stiffeners extend below the grade elevation at 30 feet, for convenience, it is all considered as being located above grade. The

stiffened cylindrical area is included separately in heat sink # 21.

In addition, the exposed surface area of the cylindrical wall is reduced by the presence of containment penetrations, the equipment hatch, the personnel and emergency locks, and by the 40 polar crane circumferential girder supports. The area of these items is calculated in Reference 6.9 (Sect. 8.2.10). The hatch and lock covers, penetration flanges and polar crane girder brackets are included elsewhere with other heat sinks. The area allowed for the equipment hatch and personnel and emergency lock penetrations included the thickened annular flange around the penetration at the inside concrete surface.

Component	Exposed Area (ft^2)
Containment Pen. Sleeves in ½"LP	1088
Containment Pen. Sleeves in 1/4"LP	426
Equipment Hatch	363
Personnel Lock	138
Emergency Lock	53
Polar Crane Girder Supports	1187
TOTAL (liner plate deletions)	3117

The net exposed surface area for heat sink #2 is

$A_{2\,net}$ = 38642 - 1458 - 3117 = **34,067 ft^2**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	34067 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.9; consistent with Ref. 6.21)
Carbon Steel (material 1) Liner Plate, thickness	0.02083 ft (0.25 inches)
Air Gap Interface (material 5), thickness	0.00035 ft (4.2 mils, see Design Input 4.10)
Concrete (material 2), thickness	4.33333 ft (52 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC
Right (outside containment) Boundary Condition	Exposed to outside environment with natural convection to outside air (OSA).

The card series set defining Heat Sink 2 is entered in the input data file as:

```
* HS #2 - REACTOR BUILDING CYLINDER ABOVE 30 Ft
$LIST POOL=102001,  58,  14,  0,  0,  0,  0,  34067 $END
$LIST POOL=102101,  4,  0.00024,  5,  0.00083,  2,  0.02166,  4,  0.02170,
                    5,  0.02201,  4,  0.03001,  4,  0.04601,  4,  0.07801,
                    4,  0.14201,  4,  0.27001,  4,  0.52601,  4,  1.03801,
                    4,  2.06201,  5,  4.35534 $END
$LIST POOL=102201,  4,  4,  1,  5,  5,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=102300,  0,  0 $END
$LIST POOL=102400,  9,  2,  1,  1 $END
```

8.2.3 HS #3 - Reactor Building Cylinder Wall Below Grade Level @ Elev. 30 Ft

The reactor building cylinder wall below grade is a continuation of heat sink # 2 from elevation 30' down to elevation 17.5 - 18', the top of the sloped concrete filler slab poured over the basemat liner plate at elevation 15'. The exterior of the cylinder next to the earth is conservatively modeled as an insulated boundary. As with heat sinks 1 and 2, the inside surface of this heat sink is modeled as exposed to the containment vapor region. The containment maximum flood level is elevation 25' for a LOCA event per calculation N-4060-030 [Ref. 6.34]. However, maximum flood level is not reached until time of recirculation at 20 to 40 minutes post-LOCA, depending on the number of safety injection and containment spray trains operating, and even later following a MSLB event. Since peak containment pressure occurs within 4 minutes for design basis LOCAs and within 1 minute for design basis main steam line breaks (MSLBs), essentially all of heat sink #3 is available for heat transfer from the vapor region, and is therefore modeled as exposed to the vapor region through-out the transient analysis.

The vertical length of the cylinder depends upon the elevation of the top of the filler slab at the junction with the cylinder wall. Per plan drawings 23110 and 23111 [Refs. 6.35a & b], this elevation varies from about 17'-5" @ azimuth ~ 205° (Unit 2) to 18'-3" between azimuths 30° to 90° (Unit 2). Reference 6.9 conservatively assumes a filler slab thickness of 3 feet at the junction with the cylinder wall.

Per Reference 6.9, the net exposed area of unstiffened liner plate (thicknesses of 0.25 inches and 0.50 inches is the sum of 66,854 ft^2 and 5,765 ft^2, or 72,619 ft^2. The net exposed unstiffened liner plate surface area modeled in heat sinks 1 and 2 is the sum of 33,017 ft^2 plus 34,067 ft^2, or 67,084 ft^2. Thus, the net liner plate area of the containment cylinder below grade is:

A_3 = 72,619 - 67,084 = **5,535 ft^2**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	5535 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design

	Input 4.9)
Carbon Steel (material 1) Liner Plate, thickness	0.02083 ft (0.25 inches)
Air Gap Interface (material 5), thickness	0.00035 ft (4.2 mils, see Design Input 4.10)
Concrete (material 2), thickness	4.33333 ft (52 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC
Right (outside containment) Boundary Condition	Exposed to earth; modeled as insulated. The temperature citation is irrelevant.

The card series set defining Heat Sink 3 is entered in the input data file as:

```
* HS #3 - REACTOR BUILDING CYLINDER BELOW 30 Ft
$LIST POOL=103001, 58 14, 0, 0, 0, 0, 5535 $END
$LIST POOL=103101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                   5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                   4, 0.14201, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                   4, 2.06201, 5, 4.35534 $END
$LIST POOL=103201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=103300, 0, 0 $END
$LIST POOL=103400, 9, 2, 0, 1 $END
```

8.2.4 HS #4 - Reactor Building Basemat (Excluding Rx Cavity Basemat; see HS #5)

The reactor building basemat consists of the 9' thick basemat covered by carbon steel liner plate and finished with a nominal 2' thick concrete filler slab (Ref. 6.9), sloped to drain to the containment building sumps. The top surface of the filler slab is covered with an epoxy coating. The bottom of the basemat is exposed to earth and modeled as an insulated boundary. The top surface of the basemat is modeled as exposed to accumulated post-accident water from the RCS (if a LOCA has occurred) or the secondary system (if a MSLB or MFWLB has occurred) and from the refueling water storage tank via the containment spray system and the safety injection system (for LOCAs). The exposed surface area of the basemat is 12,773 ft^2 (Ref. 6.9). Since the basemat liner plate is covered by the thick concrete filler slab, the heat sink model is simplified by not including the steel liner plate.

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	12773 ft^2
Epoxy Paint (material 4), thickness	0.00417 ft (50 mils, see Design Input 4.9)
Concrete (material 2), thickness	11.0 ft (132 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't sump water with a natural convection HTC of 0.4 Btu/hr ft^2 °F.

Right (outside containment) Boundary Condition — Exposed to earth; modeled as insulated. The temperature citation is irrelevant.

The methodology for selecting heat sink material nodal spacing for a heat sink submerged in post accident water is the same as that described for heat sink #1. However, in the case of heat sinks covered by the sump water, the heat transfer rate from the water to the surface is limited to only 0.4 Btu/hr-ft^2-°F per recommendation of BN-TOP-3 [Ref. 6.23, page 3-12]. Since this value is at least 100 time less than the typical condensing heat transfer coefficients existing on the surfaces exposed to the vapor region, the equation to set the maximum initial nodal spacing in a material exposed to the containment post-accident sump water is increased by a factor of 100 to:

$$\Delta x_{max} = 100[4k/10000] = 4k/100 \text{ feet}$$

Thus, for the painted reactor basemat, the maximum initial nodal spacing for the paint layer is:

$$\Delta x_{max} = 4(0.150/100) = 0.006 \text{ feet}$$

With the adjustment in the value for the initial nodal spacing, the analysis continues as described for heat sink #1.

The card series set defining Heat Sink 4 is entered in the input data file as:

```
* HS #4 - REACTOR BUILDING BASEMAT (Excluding Rx Cavity Basemat)
$LIST POOL=104001,  42, 10,  0,  0,  0,  0,  12773 $END
$LIST POOL=104101,  4,  0.00417,  4,  0.02417,  4,  0.06417,  4,  0.14417,
                    4,  0.30417,  4,  0.62417,  4,  1.26417,  4,  2.54417,
                    4,  5.10417,  5,  11.00417 $END
$LIST POOL=104201,  4,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=104300,  0,  0 $END
$LIST POOL=104400,  3,  3,  0,  1 $END
```

8.2.5 HS #5 - Reactor Cavity Basemat & Steam Generator Pedestals

This heat sink combines the 8' thick reactor cavity basemat (Ref. 6.9) with the 8.59' half-thickness steam generator pedestals (Ref. 6.9). The reactor cavity basemat consists of a 1' thick concrete filler slab poured over the steel liner plate on the 7' thick cavity basemat (Ref. 6.6). As with the main containment basemat (heat sink # 4), the liner plate is omitted from the heat sink model. The top of the basemat is modeled as covered by a 50-mil epoxy coating (Design Input 4.9). The exposed surface area of the reactor basemat is 434 ft^2 (Ref. 6.9). The steam generator pedestals are concrete with a total exposed surface area of 1,210 ft^2 (Ref. 6.9). The pedestals are modeled with a half-thickness of 103", or 8.58333 feet (Ref. 6.9). The exposed surfaces of the pedestals are modeled as covered by a 30 mil epoxy coating (Design Input 4.9). When the two heat sinks are combined, one face of the slab is

modeled as insulated and the exposed face (epoxy coated) is modeled as exposed to the containment sump water.

The total exposed surface for the combined heat sink is:

$A_5 = 434 + 1210 =$ **1,644 ft²**

The effective concrete thickness for the combined heat sink is calculated as:

$t_{conc\ eff} = (434/1644)(8.0) + (1210/1644)(8.58333) =$ **8.39254 feet**

The effective epoxy coating thickness for the combined heat sink is calculated as:

$t_{coat\ eff} = (434/1644)(50) + (1210/1644)(30) = 35.3$ mils or **0.00294 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	1644 ft^2
Epoxy Paint (material 4), thickness	0.00294 ft (35.3 mils)
Concrete (material 2), thickness	8.39254 ft (100.71 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't sump water with a natural convection HTC of 0.4 Btu/hr ft^2 °F.
Right (outside containment) Boundary Condition	Exposed to earth; modeled as insulated. Temperature citation is irrelevant.

The card series set defining Heat Sink 5 is entered in the input data file as:

```
* HS #5 - REACTOR CAVITY BASEMAT & STEAM GENERATOR PEDESTALS
$LIST POOL=105001,  40, 10,  0,  0,  0,  0,  1644 $END
$LIST POOL=105101,  4,  0.00294,  4,  0.02294,  4,  0.06294,  4,  0.14294
                    4,  0.30294,  4,  0.62294,  4,  1.26294,  4,  2.54294,
                    4,  5.10294,  3,  8.39548 $END
$LIST POOL=105201,  4,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=105300,  0,  0 $END
$LIST POOL=105400,  3,  3,  0,  1 $END
```

8.2.6 HS #6 - Reactor Cavity Wall Below Containment Floor @ Elev. Approx. 17' - 6"

The reactor cavity below 17' - 6" elevation is taken from the total reactor cavity modeling contained in Reference 6.9 (Sect. 8.2.1) which covers the entire reactor cavity from elevation 37'-6" (Ref. 6.36) down approximately 42 feet to the top of the filler slab at the bottom of the cavity at elevation (-) 5'-0". The interior of the reactor cavity is modeled as flooded. The outside surface of the cavity is modeled as insulated.

The exposed inside surface area of the reactor cavity is the sum of the area calculated below elevation 15' plus a fraction of the area identified between elevation 15' and elevation 22' proportional to the 2.5' elevation difference between 15' and 17' - 6". Using the data from Reference 6.9 (Sect. 8.2.1),

A_6 = 1361 + (17.5 - 15)(516.8)/7 = 1361 + 185 = **1,546 ft^2**

The thickness of the cavity wall will simply be modeled as equal to the thickness identified for the reactor cavity wall below elevation 15', or 129 inches [Ref. 6.9].

T_6 = 129/12 = **10.75 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	1546 ft^2
Epoxy Paint (material 4), thickness	0.0025 ft (30 mils per Design Input 4.9)
Concrete (material 2), thickness	10.75 ft (129 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't sump water with a natural convection HTC of 0.4 Btu/hr ft^2 °F.
Right (outside containment) Boundary Condition	Exposed to earth; modeled as insulated. Temperature citation is irrelevant.

The card series set defining Heat Sink 6 is entered in the input data file as:

```
* HS #6 - REACTOR CAVITY BELOW ELEV. 17'- 6"
$LIST POOL=106001,  42, 10,  0,  0,  0,  0,  1546 $END
$LIST POOL=106101,  4,  0.00250,  4,  0.02250,  4,  0.06250,  4,  0.14250,
                    4,  0.30250,  4,  0.62250,  4,  1.26250,  4,  2.54250,
                    4,  5.10250,  5,  10.75250 $END
$LIST POOL=106201,  4,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=106300,  0,  0 $END
$LIST POOL=106400,  3,  3,  0,  1 $END
```

8.2.7 HS #7 - Reactor Cavity Walls Above Containment Floor @ Elev. Approx. 17' - 6"

The reactor cavity walls above elevation 17' - 6 ' are modeled in Reference 6.9 (Sect. 8.2.1). The exposed surface area will be taken as the Reference 6.9 value (1,496 ft^2) less the 185 ft^2 area between elevations 15' and 17' - 6 ' included in heat sink # 6. Only the inside reactor cavity surface area will be modeled for heat sink # 7. Some of the external surfaces of the reactor cavity above 17' - 6" are included in other heat sinks such as the refueling canal or the steam generator compartment walls. Based on the relatively small area involved, this simplification will not significantly affect the results of the P-T analysis. The exposed surface

of heat sink #7 will be modeled as exposed to the containment atmosphere, and the thickness of the heat sink will be the 106 inches shown in Reference 6.9. As discussed with heat sink #3, the gradual flooding of the lower few feet of this heat sink will be ignored as having no significant impact on the short-term peak pressure-temperature response of the containment building to the design basis pipe break events.

The exposed surface area of the heat sink is

A_7 = 1496 - 185 = **1,311 ft²**

The effective thickness of the heat sink is

T_7 = 106/12 = **8.83333 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	1311 ft²
Epoxy Paint (material 4), thickness	0.0025 ft (30 mils per Design Input 4.9)
Concrete (material 2), thickness	8.83333 ft (106 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 7 is entered in the input data file as:

```
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17' - 6"
$LIST POOL=107001,  61,  14,  0,  0,  0,  0,  1311 $END
$LIST POOL=107101,  4,   0.00024,  4,   0.00060,  8,   0.00250,  4,   0.00650,
                    4,   0.01450,  4,   0.03050,  4,   0.06250,  4,   0.12650,
                    4,   0.26850,  4,   0.52450,  4,   1.03650,  4,   2.06050,
                    4,   4.10850,  4,   8.83583 $END
$LIST POOL=107201,  4, 4, 4, 2,  2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=107300,  0,  0 $END
$LIST POOL=107400,  9,  2,  0,  2 $END
```

8.2.8 HS #8 - Lined Refueling Canal Walls and Floor

The lined refueling canal walls are primarily 4-foot thick [Ref. 6.9, Sect. 8.3] and the canal floor is 5 to 7 foot thick concrete poured on top of the containment building base mat [Ref 6.37]. The liner plate is 3/16 inch thick stainless steel with an exposed surface area of 9,192 ft² [Ref. 6.9]. The lined concrete walls and floor are modeled with a concrete thickness of 2 feet, corresponding to the center of the nominal 4 foot thick walls. The boundary condition at the wall mid-thickness is modeled as insulated. For convenience, the thick floor of the refueling canal is included with the lined walls with a thickness of 2 feet rather than with its

actual larger thickness. Modeling the canal floor with less than its actual thickness is conservative for the containment peak pressure-temperature analysis. The lower refueling canal floor, at elevations 20 and 22 feet, may eventually become flooded. However, as discussed for heat sink #3, flooding, if it occurs, is delayed until well after peak pressure and temperature conditions have occurred. Including the canal floor as exposed to the containment atmosphere provides a more conservative long term containment analysis.

The outer half of the 4-foot thick concrete canal walls is separately modeled in HS #9 with an area of 11,050 ft^2 [Ref. 6.9]. The liner plate is confined to pool wall surfaces below elevation 63'-6".

The exposed surface area of the heat sink is

A_8 = **9,192 ft^2**

The effective thickness of the heat sink is

T_8 = 0.5(4.0) = **2.0 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	9192 ft^2
S/Steel Liner Plate (material 3), thickness	0.01563 ft (3/16 inch)
Air Gap Interface (material 5), thickness	0.00035 ft (4.2 mils, see Design Input 4.10; use same as cont'nment liner plate)
Concrete (material 2), thickness	2.0 ft (24.0 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (wall midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 8 is entered in the input data file as:

```
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
$LIST POOL=108001,  50, 13,  0,  0,  0,  0,  9192 $END
$LIST POOL=108101,  4,   0.01563,  4,   0.01566,  4,   0.01571,  4,   0.01583,
                    3,   0.01598,  4,   0.02598,  4,   0.04598,  4,   0.08598,
                    4,   0.16598,  4,   0.32698,  4,   0.64598,  4,   1.28598,
                    2,   2.01598 $END
$LIST POOL=108201,  3,  5,  5,  5,  5,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=108300,  0,  0 $END
$LIST POOL=108400,  9,  2,  0,  2 $END
```

8.2.9 HS #9 - Un-Lined Exterior Faces of Refueling Canal Walls

The un-lined outside half-thickness of the refueling canal walls is 2 ft with an exposed surface area of 11,050 ft^2 (see discussion for heat sink #8, above). The exposed surface is coated with epoxy filler and paint modeled with a thickness of 30 mils to conservatively bound original coatings applications (Design Input 4.9).

The exposed surface area of the heat sink is

A_9 = **11,050 ft^2**

The effective thickness of the heat sink is

T_9 = 0.5(4.0) = **2.0 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	11050 ft^2
Epoxy Paint (material 4), thickness	0.0025 ft (30 mils per Design Input 4.9
Concrete (material 2), thickness	2.0 ft (24.0 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (wall midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 9 is entered in the input data file as:

```
* HS #9 - UN-LINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001,  45, 12,  0,  0,  0,  0,  11050 $END
$LIST POOL=109101,  4,  0.00024,  4,  0.00072,  4,  0.00168,  2,  0.00250,
                    4,  0.01250,  4,  0.03250,  4,  0.07250,  4,  0.15250
                    4,  0.31250,  4,  0.63250,  4,  1.27250,  2,  2.00250 $END
$LIST POOL=109201,  4,  4,  4,  4,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=109300,  0,  0 $END
$LIST POOL=109400,  9,  2,  0,  1 $END
```

8.2.10 HS #10 - Steam Generator Compartment Walls and Missile Shields

This heat sink combines the steam generator compartment walls which extend from the containment basemat at about elevation 17' - 6" up to the top of the shield extensions around each steam generator at elevation 95' - 6" [Ref. 6.37]. Those portions of the steam generator compartment walls which are common with the refueling canal have been included in heat sinks #8 and #9. This heat sink also includes the reactor missile shields which are positioned above the reactor vessel. The steam generator compartment walls contain a significant

surface area (6,914 ft^2) with heavy (0.98 inch thick) steel embeds. The S/G compartment walls with embeds are modeled separately as heat sink # 11. The specific constituents of heat sink # 10 are:

Heat Sink Constituent	Total Exposed Surface Area (ft^2)	Average Thickness (ft)	Reference
Steam Generator Compartment	34,561	3.54	6.9 (Sect. 8.3)
Refueling Canal Wall Extensions Above elevation 63'-6"	5504	3.00	6.9 (Sect. 8.3)
Missile Shields	3020	3.00	6.9 (Sect. 8.3)

The combined total exposed surface area for this heat sink is

$$A_{10} = 34{,}561 + 5{,}504 + 3{,}020 = \mathbf{43{,}085\ ft^2}$$

The average total thickness is

$$T_{avg} = [(34561)(3.54) + (5504)(3.00) + (3020)(3.00)]/43085 = 3.43317 \text{ feet}$$

Since the total surface area represents both sides of the slab heat sinks, the appropriate thickness to be used in the COPATTA model is one-half the average thickness and model one boundary as insulated. Thus,

$$T_{10} = (0.5)(3.43317) = \mathbf{1.71659\ ft}$$

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	43085 ft^2
Epoxy Paint (material 4), thickness	0.0025 ft (30 mils per Design Input 4.9)
Concrete (material 2), thickness	1.71659 ft (~ 20.60 inch half-thickness)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (wall midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 10 is entered in the input data file as:

```
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS & MISSILE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250
```

```
                                  4,  0.31250,  4,  0.63250,  7,  1.71909 $END
$LIST POOL=110201,  4,  4,  4,  4,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=110300,  0,  0 $END
$LIST POOL=110400,  9,  2,  0,  2 $END
```

8.2.11 HS #11 - Steam Generator Compartment Walls With Embeds

This heat sink models the S/G compartment walls with the 0.98 inch thick steel embeds. The exposed surface area of the embeds is 6,914 ft2, and the total wall thickness is the same as that of the concrete S/G compartment wall modeled in heat sink # 10 [Ref. 6.9]. The exposed surface of 0.98 inch thick steel embeds is assumed to be flush with the adjacent concrete surface. The exposed surface of the steel embed is coated with a 10 mil thickness of epoxy paint per Design Input 4.9.

The exposed surface area for this heat sink is

A_{11} = **6,914 ft²**

The steel embed thickness per Reference 6.9 is

T_{steel} = 0.98/12 = **0.08167 feet**

The concrete thickness is

T_{conc} = [(42.5/2) - 0.98]/12 = 20.27/12 = **1.68917 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	6914 ft²
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils per Design Input 4.9)
Carbon Steel Embed (material 1), thickness	0.08167 ft (0.98 inches)
Concrete (material 2), thickness	1.68917 ft (~ 20.27 inch half-thickness)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (wall midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 11 is entered in the input data file as:

```
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001,  53,  12,  0,  0,  0,  0,  6914 $END
$LIST POOL=111101,  4,  0.00024,  5,  0.00083,  4,  0.08250,  4,  0.08490,
                    4,  0.08970,  4,  0.09930,  4,  0.11850,  4,  0.15690,
```

```
                                4,  0.23370,  4,  0.38730,  4,  0.69450,  7,  1.77167 $END
$LIST POOL=111201,  4,  4,  1,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=111300,  0,  0 $END
$LIST POOL=111400,  9,  2,  0,  2 $END
```

8.2.12 HS #12 - Elevated Floor Slabs (Top Half-Thickness)

This heat sink consists of the top half-thickness of the concrete floors at elevations 63'-6", 45', and 30'. These slab floors are concrete poured over galvanized steel decking with the top surface of the concrete covered by epoxy coatings. The floor slab thickness at the 63'-6" elevation are mostly 1'-6" with some 1'-9" thick sections [Ref. 6.38a & b]; floor slabs at elevation 45' are mostly 1'-6" with some sections 1'-3" or 3'-0" thick [Ref. 6.39a & b]; and the small amount of floor slabs at the 30' elevation are all 1'-3" thick [Ref. 6.40a & b]. The average slab thickness exceeds 1'-6' and 1'-6" will be conservatively used for all floor slabs. The concrete half-thickness modeled in heat sink 12 is half the total thickness, or 9 inches. The combined top (or smooth floor) surface area of the slabs for all three elevations is 17,474 ft^2 [Ref. 6.9]. The underside of the floor slabs with the galvanized steel decking and lower one-half of the concrete slab is modeled in heat sink #13.

The exposed surface area of the heat sink is

A_{12} = **17,474 ft^2**

The effective thickness of the heat sink is

T_{12} = 0.5(1.5) = **0.75 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	17474 ft^2
Epoxy Paint (material 4), thickness	0.00417 ft (50 mils for floor slabs per Design Input 4.9)
Concrete (material 2), thickness	0.75 ft (9.0 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (floor midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 12 is entered in the input data file as:

```
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001,  44,  10,  0,  0,  0,  0,  17474 $END
$LIST POOL=112101,  4,  0.00024,  4,  0.00072,  4,  0.00168,  5,  0.00417,
                    4,  0.01417,  4,  0.03417,  4,  0.07417,  4,  0.15417,
                    4,  0.31417,  6,  0.75417 $END
$LIST POOL=112201,  4,  4,  4,  4,  2,  2,  2,  2,  2,  2 $END
```

```
$LIST POOL=112300,  0,  0 $END
$LIST POOL=112400,  9,  2,  0,  2 $END
```

8.2.13 HS #13 - Elevated Floor Slabs (Lower Half-Thickness with CS Decking)

This heat sink consists of the bottom half-thickness of the concrete floors at elevations 63'-6", 45', and 30'. These slab floors are concrete poured over Robertson 3" QL 99-16 galvanized steel decking [Ref. 6.41]. The decking is 16 gauge, or 0.0625" thick. The thickness of the zinc galvanizing is neglected since the thermal conductivity of zinc is greater than the conductivity of carbon steel.

The exposed surface area of the heat sink is

A_{13} = **23,240 ft²** [Ref. 6.9]

The effective thickness of the heat sink is

T_{12} = 0.5(1.5) = **0.75 feet** [one half the full floor slab thickness]

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	23240 ft²
Carbon Steel Decking (material 1), thickness	0.00521 ft (1/16 inch)
Concrete (material 2), thickness	0.75 ft (9.0 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right (floor midplane) Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 13 is entered in the input data file as:

```
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001,  48,  12,  0,  0,  0,  0,  23240 $END
$LIST POOL=113101,  2,  0.00521,  4,  0.00556,  4,  0.00617,  4,  0.00745,
            4,  0.01001,  4,  0.01513,  4,  0.02537,  4,  0.04585,
            4,  0.08681,  4,  0.16873,  4,  0.33257,  5,  0.75521 $END
$LIST POOL=113201,  1,  2,  2,  2,  2,  2,  2,  2,  2,  2,  2,  2 $END
$LIST POOL=113300,  0,  0 $END
$LIST POOL=113400,  9,  2,  0,  2 $END
```

Note: Total thickness of heat sink is 0.00521 + 0.75 = 0.75521 feet; actual floor midplane coordinate used in COPATTA input file is 0.75556 feet. The additional 0.00035 feet of concrete has no significant affect on the results of the calculation.

8.2.14 HS #14 - Lifting Devices (Carbon Steel)

Carbon steel lifting devices include the polar crane, the refueling machine and control element assembly (CEA) change mechanism, and the vessel head lifting rig.

The polar crane is the major component in this category. Reference 6.9 determines the surface area of the polar crane primarily by taking the mass or volume of steel and calculating the single face area of a slab of 1 inch thickness which has the same volume. The assumption of an average steel thickness of 1 inch is reasonable based on a review of vendor and Bechtel drawings. However, the polar crane bridge and trolley box structures include access openings allowing exposure of both faces of most of the steel structure to the containment atmosphere. Therefore, for modeling purposes, the surface area from Reference 6.9, which represents the total exposed surface area, is directly used and one half the total average thickness is used as an effective thickness to preserve the correct steel mass. Heat transfer will be from one side only, with an insulated boundary modeled at the other face of the slab, simulating symmetrical heat transfer into the 1" thick material. The polar crane surface area and effective thickness modeled in this calculation compare favorably with values for Entergy's Waterford 3 nuclear power plant which has a CE nuclear steam supply system comparable to that in SONGS Units 2 and 3 in a containment diameter of 140 feet *versus* 150 feet for SONGS [Ref. 6.42].

Consistent with the methodology of Reference 6.9, one half the average thickness for the refueling machine and CEA change mechanism structure is the appropriate effective thickness to be used with the total exposed surface area provided in the civil calculation.

The thickness provided by ABB-CE in Reference 6.43 for the vessel head lifting rig is identified in the document as an effective thickness to be used with the exposed surface area cited without modification.

The table below identifies the exposed areas and effective steel thickness for the lifting devices. As described in Design Input 4.9, all lifting devices are modeled with a 15-mil thickness of epoxy coating.

Heat Sink Constituent	Total Exposed Surface Area (ft^2)	Effective Thickness (in)	Reference
Polar Crane	52636	0.5	Ref. 6.9
Refueling Machine and CEA Change Mechanism	4716	0.26	Ref. 6.9
Vessel Head Lifting Rig	1913	0.5	Ref. 6.43

The total exposed surface area of the lifting devices is

A_{14} = 52636 + 4716 + 1913 = **59,265 ft²**

The effective thickness of the heat sink, T_{14}, is calculated as follows:

T_{14} = (52636/59265)(0.5) + (4716/59265)(0.26) + (1913/59265)(0.5)
= 0.4441 + 0.0207 + 0.0161 = 0.4809 inches or **0.04008 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	59265 ft²
Epoxy Paint (material 4), thickness	0.00125 ft (15 mils, see Design Input 4.9)
Carbon Steel (material 1), thickness	0.04008 ft (0.4809 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 14 is entered in the input data file as:

```
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
```

8.2.15 HS #15 - Miscellaneous Carbon Steel (thickness > 2.5 inches)

This heat sink contains painted carbon steel commodities which have an effective thickness greater than 2.5 inches. Table 8.2.15 - 1 identifies these thick steel items as supports for the reactor vessel, steam generators and the reactor coolant pumps. From this table, the total exposed surface area is 2,248 ft^2 and the total metal volume is 495.75 ft^3. From these two values, an effective heat sink thickness is calculated as the volume divided by the exposed surface area.

T_{EFF} = (495.75 ft^3)/(2248 ft^2) = **0.22053 feet** or about 2.6464 inches

Table 8.2.15 - 1 Miscellaneous Carbon Steel (thickness > 2.5 inches)

Component	Eff. Th. (inches)	Eff. Th. (feet)	Exp. Area (sq ft)	Volume cu ft)	Reference
Steam Generator Supports	3.705*	0.30875	415	128.13	6.9
Reactor Vessel Supports	2.43*	0.2025	692	140.13	6.9
Reactor Coolant Pump Supports	2.3925*	0.199375	1141	227.49	6.9
Area and Volume Summations			2248	495.75	

* The effective thickness is ½ the average material thickness identified in the reference to provide the correct heat sink mass consistent with the exposed surface area.

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	2248 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.9; consistent with Ref. 6.21)
Carbon Steel (material 1), thickness	0.22053 ft (2.6464 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 15 is entered in the input data file as:

```
* HS #15 - MISCELLANEOUS CARBON STEEL (TH > 2.5 INCHES)
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
```

8.2.16 HS #16 - Miscelaneous Carbon Steel (1.0 < thickness </= 2.5 inches)

This heat sink contains painted carbon steel commodities which have an effective thick-ness between 1 and 2.5 inches. Table 8.2.16 - 1 identifies these items as the safety injection tanks, pipe support embedment plates, the equipment hatch, and the personnel and emergency escape hatches. From this table, the total exposed surface area is 9,230 ft^2 and the total metal volume is 1,202.64 ft^3. From these two values, an effective heat sink thickness is calculated as the volume divided by the exposed surface area.

T_{EFF} = (1202.64 ft^3)/(9230 ft^2) = **0.13130 feet** or about 1.5756 inches

Table 8.2.16 - 1 Miscellaneous Carbon Steel (1.0 < thickness </= 2.5 inches)

Component	Eff. Th. (inches)	Eff. Th. (feet)	Exp. Area (sq ft)	Volume cu ft)	Reference
Pipe Support Embedment Plates	1.17	0.09750	4102	399.94	6.9
Equipment Hatch	2	0.16667	453	75.50	6.9
Personnel Lock	1.25	0.10417	170	17.71	6.9
Escape Lock	1.25	0.10417	73	7.60	6.9
Safety Injection Tank Shells	1.865	0.15542	3560	553.28	6.43
Safety Injection Tank Heads	2.045	0.17042	872	148.60	6.43
Area and Volume Summations			9230	1202.64	

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	9230 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.9; consistent with Ref. 6.21)
Carbon Steel (material 1), thickness	0.13030ft (1.5756 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 16 is entered in the input data file as:

```
* HS #16 - MISCELLANEOUS CARBON STEEL (1.0 < TH </= 2.5 INCHES)
$LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
$LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
$LIST POOL=116201, 4, 4, 1 $END
$LIST POOL=116300, 0, 0 $END
$LIST POOL=116400, 9, 2, 0, 2 $END
```

8.2.17 HS #17 - Miscellaneous Carbon Steel (0.5 < thickness </= 1.0 inches)

This heat sink contains painted carbon steel commodities which have an effective thickness between 0.5 and 1.0 inches. Table 8.2.17 - 1 identifies these items as the pressurizer supports, pipe restraints, reactor cavity plug embeds, penetration sleeves at the containment liner plate, and the reactor coolant pump motors. From this table, the total exposed surface area is 8,718 ft^2 and the total metal volume is 548.19 ft^3. From these two values, an effective heat sink thickness is calculated as the volume divided by the exposed surface area.

T_{EFF} = (548.19 ft^3)/(8718 ft^2) = **0.06288 feet** or about 0.7546 inches

Table 8.2.17 - 1 Miscellaneous Carbon Steel (0.5 < thickness </= 1.0 inches)

Component	Eff. Th. (inches)	Eff. Th. (feet)	Exp. Area (sq ft)	Volume cu ft)	Reference
Pressurizer Support	0.737*	0.06142	976	59.94	6.9
Pipe Restraints	0.75*	0.06250	2189	136.81	6.9
Reactor Cavity Plug Embeds	1	0.08333	142	11.83	6.9
Penetration Sleeves (@ cont. liner plate)	0.76	0.06333	1691	107.10	6.9
Reactor Coolant Pump Motors	0.75	0.06250	3720	232.50	6.43
Area and Volume Summations			8718	548.19	

* The effective thickness is ½ the average material thickness identified in the reference to provide the correct heat sink mass consistent with the exposed surface area.

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	8718 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.9; consistent with Ref. 6.21)
Carbon Steel (material 1), thickness	0.06288ft (0.7546 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 17 is entered in the input data file as:

```
* HS #17 - MISCELLANEOUS CARBON STEEL (0.5 < TH </= 1.0 INCHES)
$LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
$LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
$LIST POOL=117201, 4, 4, 1 $END
$LIST POOL=117300, 0, 0 $END
$LIST POOL=117400, 9, 2, 0, 2 $END
```

8.2.18 HS #18 - Miscellaneous Carbon Steel (thickness </= 0.5 inches)

This heat sink contains painted carbon steel commodities which have an effective thickness

of 0.5 inches, or less. Table 8.2.18 - 1 contains an inventory of the painted carbon steel items. From this table, the total exposed surface area is 158,855 ft^2 and the total metal volume is 3,523.06 ft^3. From these two values, an effective heat sink thickness is calculated as the volume divided by the exposed surface area.

T_{EFF} = (3523.06 ft^3)/(158855 ft^2) = **0.02218 feet** or about 0.2662 inches

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	158855 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.9; consistent with Ref. 6.21)
Carbon Steel (material 1), thickness	0.02218 ft (0.2662 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 18 is entered in the input data file as:

```
* HS #18 - MISCELLANEOUS CARBON STEEL (TH </= 0.5 INCHES)
$LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158855 $END
$LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02301 $END
$LIST POOL=118201, 4, 4, 1 $END
$LIST POOL=118300, 0, 0 $END
$LIST POOL=118400, 9, 2, 0, 2 $END
```

Table 8.2.18 - 1 Miscellaneous Carbon Steel (thickness </= 0.5 inches)

Component	Eff. Th. (inches)	Eff. Th. (feet)	Exp. Area (sq ft)	Volume cu ft)	Reference
Safety Injection Tank Supports					
Base (ABB-CE)	0.5	0.04167	1532	63.83	6.43
Upper Seismic Restraint (Bechtel)	0.3125*	0.02604	228	5.94	6.9
Quench Tank Supports	0.295*	0.02458	115	2.83	6.9
Reactor Coolant Drain Tank Supports	0.265*	0.02208	96	2.12	6.9
Rx Coolant Drain Tank Pump Supports	0.154*	0.01283	28	0.36	6.9
Stud Storage Rack	0.25*	0.02083	25	0.52	6.43
Cable Bulkhead Connector Plates	0.5	0.04167	140	5.83	6.9
Pipe Supports	0.1875*	0.01563	22970	358.91	6.46
Fan Coolers (normal)	0.101	0.00842	2873	24.18	6.9
Fan Coolers (emergency)	0.101	0.00842	2183	18.37	6.9
Reactor Cavity Cooling Units	0.311	0.02592	170	4.41	6.9
CEDM Cooling Units	0.101	0.00842	2758	23.21	6.9
Dome Circulators	0.311	0.02592	433	11.22	6.9
Piping Pen. Sleeves (interior structures)	0.44	0.03667	2619	96.03	6.9
Reactor Cavity Shield Plug Liner Plate	0.1875	0.01563	156	2.44	6.9
Air Filtration Units	0.101	0.00842	1083	9.12	6.9
HVAC Ducting & Dampers (CS)	0.113	0.00942	5371	50.58	6.9
Reactor Cavity Ventilator Tunnel Liners	0.375	0.03125	1127	35.22	6.9
Portable Sump Pump Support Assy	0.155*	0.01292	18	0.23	6.9
Scaffold Racks (painted CS parts)	0.197*	0.01642	2410	39.56	6.9
Storage Metal Containers	0.202	0.01683	416	7.00	6.9
Emergency Sump Top Deck	0.125*	0.01042	463	4.82	6.9
Emergency Sump Trash Rack	0.167*	0.01392	295	4.11	6.9
Cable Tray Spprt @ Rx Ves Hd (CS)	0.153*	0.01275	6400	81.60	6.9
Duct Support Steel	0.129*	0.01075	8595	92.40	6.9
Cable Termination Enclosures	0.135	0.01125	2724	30.65	6.9
Instrument Mounting Plates	0.1875	0.01563	1018	15.91	6.9
Instruments	0.125	0.01042	339	3.53	6.9
Metal Parts of Lighting Fixtures	0.125	0.01042	476	4.96	6.9
Component Cooling Water Piping	0.247	0.02058	2799	57.61	6.46
Fire Protection Piping	0.194	0.01617	1011	16.34	6.46
Service Air Piping	0.184	0.01533	556	8.53	6.46
Structural Members (exposed)	0.335*	0.02792	87428	2440.70	6.9
Area and Volume Summations			158855	3523.06	

* The effective thickness is ½ the average material thickness identified in the reference to provide the correct heat sink mass consistent with the exposed surface area.

8.2.19 HS #19 - Electrical Equipment & Other Galvanized Steel

This heat sink includes galvanized steel commodities. Roughly two-thirds of the material are galvanized steel electrical items and one-third consists of gratings, platforms, ladders, stairs, railings and similar items. Electrical commodities such as the glass part of lighting fixtures and electrical cabling are conservatively omitted from this P-T analysis. The exposed metal part of the lighting fixtures is painted carbon steel and included in heat sink #18. The scaffold racks added to containment to store scaffolding used during reactor outages are included. The actual outage scaffolding itself is not included in the containment peak P-T analyses. This scaffolding could be removed following an outage; therefore, it is more conservative to omit it from this analysis.

Table 8.2.19 -1 contains an inventory of exposed galvanized material in containment modeled in this analysis. From this table, the total exposed surface area is 131,698 ft^2 and the total metal volume is 1,158.40 ft^3. From these two values, an effective heat sink thickness is calculated as the volume divided by the exposed surface area. The thin layer of zinc on the surface of the steel is ignored (Design Input 4.9).

T_{EFF} = (1158.40 ft^3)/(131698 ft^2) = **0.00879 ft** or about 0.1055 inches

Table 8.2.19 - 1 Electrical Equipment and Other Galvanized Steel

Component	Eff. Thkns (inches)	Eff. Thkns (feet)	Area (sq ft)	Volume cu ft)	Reference
Cable Trays	0.0598	0.00498	19347	96.41	6.9
Cable Tray Hangers	0.109	0.00908	34958	317.54	6.9
Junction & Pull Boxes	0.108	0.00900	1502	13.52	6.9
Cable Terminal Boxes	0.108	0.00900	921	8.29	6.9
Conduits (incl. flex conduit)	0.166	0.01383	22312	308.65	6.9
Conduit Supports & Clamps	0.109	0.00908	4792	43.53	6.9
Cable Support Frame @ Rx Ves Hd	0.0488	0.00407	879	3.57	6.9
Grating - Heavy Duty	0.0937	0.00781	34046	265.84	6.9
Grating - Light Weight	0.0937	0.00781	8399	65.58	6.9
Ladders, Stairs & Railings	0.0937	0.00781	3390	26.47	6.9
Scaffold Racks (Galv. Parts)	0.0937	0.00781	404	3.15	6.9
Emergency Sump Coarse Screen	0.0937	0.00781	748	5.84	6.9
Area and Volume Summations			131698	1158.40	

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	131698 ft^2
Carbon Steel (material 1), thickness	0.00879 ft (0.1055 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere

Right Boundary Condition	with Uchida condensing HTC. Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 19 is entered in the input data file as:

```
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
$LIST POOL=119001,  4,  1,  0,  0,  0,  0,  131698 $END
$LIST POOL=119101,  3,    0.00879 $END
$LIST POOL=119201,  1 $END
$LIST POOL=119300,  0,  0 $END
$LIST POOL=119400,  9,  2,  0,  2 $END
```

8.2.20 HS #20 - Miscellaneous Stainless Steel

This heat sink contains identified exposed cool stainless steel in containment. A few of the components are located between the containment floor at elevation 17' - 6" and the maximum flood level at elevation 25 feet. However, as justified in Section 8.2.3 (heat sink # 3), these lower elevation components are included and modeled as exposed to the containment atmosphere throughout the entire transient analysis. The containment sump pumps (P007 and P008) are normally submerged in the normal containment sump water and are not included in this heat sink inventory. The portable reactor cavity sump pump (P005) which is mounted to a roll-around dolly has been included.

Table 8.2.12 - 1 contains an inventory of exposed stainless steel in containment included in this heat sink for the containment peak pressure and temperature transient analysis. From this table, the total exposed surface area is 26,893 ft^2 and the total stainless steel volume is 392.51 ft^3. From these two values, an effective heat sink thickness is calculated as the volume divided by the exposed surface area.

T_{EFF} = (392.51 ft^3)/(26893 ft^2) = **0.01459 feet** or about 0.1751 inches

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	26893 ft^2
Stainless Steel (material 3), thickness	0.01459 ft (0.1751 inches)
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC.
Right Boundary Condition	Modeled as insulated; temperature citation is irrelevant.

The card series set defining Heat Sink 20 is entered in the input data file as:

```
* HS #20 - MISCELLANEOUS STAINLESS STEEL
$LIST POOL=120001,  5,  1,  0,  0,  0,  0,  26893 $END
$LIST POOL=120101,  4,    0.01459 $END
```

```
$LIST POOL=120201,  3 $END
$LIST POOL=120300,  0,  0 $END
$LIST POOL=120400,  9,  2,  0,  2 $END
```

Table 8.2.20 - 1 Miscellaneous Stainless Steel in Containment

Component	Eff. Thkns (inches)	Eff. Thkns (feet)	Area (sq ft)	Volume cu ft)	Reference
Internals Lifting Rig	0.358	0.02983	1504	44.87	6.43 & 6.44
Fuel Transfer Uprighter System	0.25*	0.02083	205	4.27	6.45
Rx. Head Laydown Area Liner Plate	0.25	0.02083	288	6.00	6.9
Refueling Pool Seal	1.0 *	0.08333	508	42.33	6.9 & 6.47a&b
Trash Rack (SS portion)	0.0625*	0.00521	18	0.09	6.9
TSP Baskets	0.0938*	0.00782	1550	12.12	6.9
Emergency Sump Fine Screen	0.015*	0.00125	105	0.13	6.9
Elect. Penetrations Blank Sealing Flange	1.5	0.12500	74	9.25	6.9
Wire Mesh Scaffold Enclosure	0.0825*	0.006875	946	6.50	6.9
Instruments (SS)	0.125	0.01042	17	0.18	6.9
Instrument Sensing Lines	0.065	0.00542	483	2.62	6.9
Hydrogen Recombiners	0.125	0.01042	382	3.98	6.9
Quench Tank Shell	0.375	0.03125	190	5.94	6.43
Quench Tank Heads	0.625	0.05208	70	3.65	6.43
Reactor Coolant Drain Tank	0.27	0.02250	259	5.83	6.9
Reactor Coolant Drain Tank Pumps	0.5	0.04167	26	1.08	6.9
Sump Pump (portable)	0.25	0.02083	7	0.15	6.9
Nuclear Service Water System Piping	0.128	0.01067	611	6.52	6.46
Nitrogen System Piping	0.187	0.01558	568	8.85	6.46
Sump and Drain System Piping	0.142	0.01183	245	2.90	6.46
Containment Spray System Piping (wet)	0.159	0.01325	936	12.40	6.46
Containment Spray System Piping (dry)	0.159	0.01325	2076	27.51	6.46
Safety Injection System Piping	0.411	0.03425	1258	43.09	6.46
Volume Control System Piping	0.586	0.04883	21	1.03	6.46
Fuel Pool Cooling System Piping	0.136	0.01133	581	6.58	6.46
Gaseous Radwaste System Piping	0.136	0.01133	156	1.77	6.46
Instrument Air System Piping	0.125	0.01042	588	6.13	6.46
HVAC Ducting & Dampers (SS)	0.101	0.00842	4668	39.29	6.9
Rx Cavity Supply Fan Ducts	0.11	0.00917	920	8.43	6.9
Dome Air Circulator Ducts	0.11	0.00917	3183	29.18	6.9
CEDM Cooling Ducts	0.135	0.01125	4221	47.49	6.9
Fan Cooler Supports	0.125*	0.01042	229	2.39	6.9
Area and Volume Summations			26893	392.51	

* The effective thickness is ½ the average material thickness identified in the reference to provide the correct heat sink mass consistent with the exposed surface area.

8.2.21 HS #21 - Reactor Building Stiffened Sections

The reactor building cylinder and dome walls contain vertically and horizontally oriented stiffeners. The stiffeners are embedded carbon steel structural shapes welded to the back side of the liner plate. Reference 6.9 develops the effective liner plate area backed up by the stiffeners and also the effective thickness of the stiffener projection into the concrete wall. Since a portion of the stiffeners are in the dome region, an effective total concrete wall thickness is calculated based on the proportion of stiffened area in the dome and cylindrical sections of containment. The effective thickness of the concrete in the stiffened sections is the calculated average wall total thickness less the effective thickness of the stiffeners.

The stiffened areas are 2,306 ft^2 in the dome and 1,458 ft^2 in the cylinder [Ref. 6.9. Sect 8.2.10]. From the same reference, the effective stiffener thickness is 6.25 inches, of which 0.25 inches represents the liner plate itself. The total stiffened area is

A_{21} = 2,306 + 1,458 = **3,764 ft^2**

The average wall thickness (concrete plus steel) is calculated as

T_{avg} = (2306/3764)(48.5) + (1458/3764)(52) = 29.713 + 20.142
= 49.855 inches or **4.15458 feet**

The net thickness of the concrete is the T_{avg} less the net thickness of the steel stiffener over and above the 0.25 inch basic liner plate thickness, or 6 inches (0.5 feet). Thus,

$T_{avg\ conc}$ = 4.15458 - 0.5 = **3.65458 feet**

This heat sink is modeled as follows:

Geometry	Slab
Surface Area	3764 ft^2
Epoxy Paint (material 4), thickness	0.00083 ft (10 mils, see Design Input 4.8; consistent with Ref. 6.15)
Carbon Steel (material 1) Liner Plate, thickness	0.52083 ft (6.25 inches)
Air Gap Interface (material 5), thickness	0.00035 ft (4.2 mils, see Design Input 4.9)
Concrete (material 2), thickness	3.65458 ft (49.855" - 6.00000")
Left (inside containment) Boundary Condition	Exposed to cont'nm't atmosphere with Uchida condensing HTC
Right (outside containment) Boundary Condition	Exposed to outside environment with natural convection to OSA.

The card series set defining Heat Sink 21 is entered in the input data file as:

```
* HS #21 - REACTOR BUILDING STIFFENED SECTIONS ABOVE EL. 30'
$LIST POOL=121001,  44, 10,  0,  0,  0,  0,  3764 $END
$LIST POOL=121101,  4,  0.00024,  5,  0.00083,  4,  0.08083,  4,  0.24083,
                    4,  0.52166,  4,  0.52201,  4,  0.54201,  4,  0.94201,
                    4,  1.74201,  6,  4.17659 $END
$LIST POOL=121201,  4,  4,  1,  1,  1,  5,  2,  2,  2,  2 $END
$LIST POOL=121300,  0,  0 $END
$LIST POOL=121400,  9,  2,  1,  1 $END
```

8.2.22 Card Series 410001

Card series 410001 is a table which provides the material properties used in the passive heat sink heat transfer calculations. The data card contains entries of thermal conductivity (Btu/hr-ft^2-°F/ft) and volumetric heat capacity (Btu/ft^3-°F). In this tabular set of data, the first data pair is for heat sink material 1 (carbon steel), followed by data for material 2 (concrete), material 3 (stainless steel), material 4 (epoxy paint), and material 5 (air in the air gap between liner plate and concrete). The material properties are provided in Design Input 4.11. The card series data table defining heat sink material properties input to the COPATTA input file is:

```
$LIST POOL=410001,    25,        54,
                     0.8,        30,
                      10,        54,
                    0.15,        20,
                  0.0174,    0.0103 $END
```

8.2.23 Card Series 420001

Card series 420001 is used to specify arbitrary constant non-condensing heat transfer coefficients to be used at any heat sink surface. This feature of the COPATTA program is invoked by specifying a heat transfer coefficient control value of "10" or "11" on the 1XX400 heat sink data card. Since this type of heat transfer coefficient control is not specified for any heat sinks in this calculation, this data card may be omitted from the input file.

8.2.24 Card Series 430001

Card series 430001 is used to specify a time-dependent condensing heat transfer coefficients to be used at any heat sink surface. This feature of the COPATTA program is invoked by specifying a heat transfer coefficient control value of "5" or "8" on the 1XX400 heat sink data card. Since this type of heat transfer coefficient control is not specified for any heat sinks in this calculation, this data card may be omitted from the input file.

8.2.25 Card Series 440001

Card series 440001 is used to specify an additional set of time-dependent condensing heat

transfer coefficients to be used at any heat sink surface. This feature of the COPATTA program is invoked by specifying a heat transfer coefficient control value of "6" on the 1XX400 heat sink data card. Since this type of heat transfer coefficient control is not specified for any heat sinks in this calculation, this data card may be omitted from the input file.

8.2.26 Card Series 450001

Card series 450001 is used to specify a temperature-dependent non-condensing heat transfer coefficients to be used at any heat sink surface. This feature of the COPATTA program is invoked by specifying a heat transfer coefficient control value of "7" on the 1XX400 heat sink data card. Since this type of heat transfer coefficient control is not specified for any heat sinks in this calculation, this data card may be omitted from the input file.

8.2.27 Card Series 500000: End Card

If heat sink data is used, this card must follow the complete set of base case data. If heat sink data is not included (i.e., no passive heat sink calculations are performed), the series 500000 card may be omitted. This card contains the following fixed information in columns 2 through 23:

```
$LIST POOL=500000 $END
```

8.3 COPATTA Input Files

8.3.1 Cases for UFSAR Section 6.2 (Containment Functional Design)

Case 1 - MSLB @ 0% Power w/Cooling Train Failure

```
*CASE 1 - 3.45 FT2 SLOT MSLB @ ZERO POWER W/CT FAILURE: N-4080-027R1
 $LIST POOL=0,0,1,0,1 $END
 $LIST POOL=1,1E4,16.8,2.305E6,120,0.05,21,0.0,1,1,0.00,14.7,0.5 $END
 $LIST POOL=2,0,0,0,0,0,2.0,2E7 $END
 $LIST POOL=3,0,0,0,0,0,2E7,0,0,0,0 $END
 $LIST POOL=4,0,0,0,0,0,0,0,0,0,0,0,0 $END
 $LIST POOL=5,2,50,2E7,0,0 $END
 $LIST POOL=6,0,0,0 $END
 $LEAK NOPEN=0 $END
 $LIST POOL=101,    0,     0,
                  2E7,     0 $END
 $LIST POOL=201,    0,     0,
                  2E7,     0 $END
 $LIST POOL=301,
          0.00, 2.64912E+07, 1192.20,
          0.10, 2.63068E+07, 1192.45,
          0.20, 2.61355E+07, 1192.69,
          0.30, 2.59609E+07, 1192.92,
          0.40, 2.57942E+07, 1193.15,
          0.50, 2.56227E+07, 1193.36,
          0.60, 2.54645E+07, 1193.57,
          0.70, 2.52908E+07, 1193.77,
          0.80, 2.51365E+07, 1193.97,
          0.90, 2.49976E+07, 1194.16,
          1.00, 2.48428E+07, 1194.34,
          1.99, 2.35615E+07, 1194.91,
          2.99, 2.25144E+07, 1197.13,
          3.99, 2.16661E+07, 1198.09,
          4.99, 2.09605E+07, 1198.85,
          5.99, 2.03757E+07, 1199.46,
          6.99, 1.98386E+07, 1199.98,
          7.99, 1.93509E+07, 1200.45,
          8.99, 1.88601E+07, 1200.83,
          9.99, 1.81721E+07, 1201.20,
         10.99, 1.72870E+07, 1202.40,
         11.99, 1.64599E+07, 1203.01,
         12.99, 1.57267E+07, 1203.47,
         13.99, 1.50835E+07, 1203.83,
         14.99, 1.45090E+07, 1204.09,
         15.99, 1.39868E+07, 1204.29,
         16.99, 1.34999E+07, 1204.43,
         17.99, 1.30422E+07, 1204.52,
         18.99, 1.26219E+07, 1204.57,
         19.99, 1.22349E+07, 1204.60,
         20.99, 1.18893E+07, 1204.59,
         21.99, 1.15710E+07, 1204.56,
         22.99, 1.12748E+07, 1204.52,
         23.99, 1.10031E+07, 1204.46,
         24.99, 1.07574E+07, 1204.39,
         25.99, 1.05228E+07, 1204.31,
         26.99, 1.03038E+07, 1204.22,
         27.99, 1.00964E+07, 1204.12,
         28.99, 9.89809E+06, 1204.03,
```

```
29.99, 9.72331E+06, 1203.92,
30.99, 9.59976E+06, 1203.82,
31.99, 9.39276E+06, 1203.71,
32.99, 9.24559E+06, 1203.60,
33.99, 9.10271E+06, 1203.49,
34.99, 8.96544E+06, 1203.38,
35.99, 8.83472E+06, 1203.27,
36.99, 8.70941E+06, 1203.15,
37.99, 8.59540E+06, 1203.04,
38.99, 8.47699E+06, 1202.93,
39.99, 8.37191E+06, 1202.81,
40.99, 8.26301E+06, 1202.70,
41.99, 8.16102E+06, 1202.58,
42.99, 8.07768E+06, 1202.48,
43.99, 8.01324E+06, 1202.40,
44.99, 7.94556E+06, 1202.32,
45.99, 7.87853E+06, 1202.23,
46.99, 7.80581E+06, 1202.14,
47.99, 7.74061E+06, 1202.05,
48.99, 7.66955E+06, 1201.95,
49.99, 7.59816E+06, 1201.86,
50.99, 7.53282E+06, 1201.76,
51.99, 7.46366E+06, 1201.65,
52.99, 7.39544E+06, 1201.55,
53.99, 7.32506E+06, 1201.45,
54.99, 7.25630E+06, 1201.34,
55.99, 7.19377E+06, 1201.23,
56.99, 7.12832E+06, 1201.13,
57.99, 7.06158E+06, 1201.02,
58.99, 7.00092E+06, 1200.91,
59.99, 6.93857E+06, 1200.80,
60.99, 6.87319E+06, 1200.69,
61.99, 6.81109E+06, 1200.57,
62.99, 6.75382E+06, 1200.46,
63.99, 6.69776E+06, 1200.35,
64.99, 6.63386E+06, 1200.23,
65.99, 6.57983E+06, 1200.12,
66.99, 6.51841E+06, 1200.00,
67.99, 6.46416E+06, 1199.88,
68.99, 6.40098E+06, 1199.75,
69.99, 6.34514E+06, 1199.62,
70.99, 6.28754E+06, 1199.49,
71.99, 6.22044E+06, 1199.36,
72.99, 6.16756E+06, 1199.22,
73.99, 6.10571E+06, 1199.08,
74.99, 6.04642E+06, 1198.94,
75.99, 5.98630E+06, 1198.80,
76.99, 5.93114E+06, 1198.66,
77.99, 5.87164E+06, 1198.51,
78.99, 5.81296E+06, 1198.37,
79.99, 5.75507E+06, 1198.22,
80.99, 5.69722E+06, 1198.08,
81.99, 5.64336E+06, 1197.93,
82.99, 5.58882E+06, 1197.79,
83.99, 5.53514E+06, 1197.64,
84.99, 5.48363E+06, 1197.50,
85.99, 5.42797E+06, 1197.35,
86.99, 5.38031E+06, 1197.20,
87.99, 5.32386E+06, 1197.05,
88.99, 5.27407E+06, 1196.91,
89.99, 5.22374E+06, 1196.76,
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          90.99, 5.17262E+06, 1196.61,
          91.99, 5.13166E+06, 1196.46,
          92.99, 5.08064E+06, 1196.31,
          93.99, 5.02952E+06, 1196.16,
          94.99, 4.98989E+06, 1196.01,
          95.99, 4.94348E+06, 1195.86,
          96.99, 4.89416E+06, 1195.72,
          97.99, 4.85514E+06, 1195.57,
          98.99, 4.80856E+06, 1195.42,
          99.99, 4.76489E+06, 1195.27,
         104.95, 4.56091E+06, 1194.53,
         109.95, 4.37090E+06, 1193.78,
         114.95, 4.18946E+06, 1193.05,
         119.95, 4.00882E+06, 1192.24,
         124.95, 4.24681E+06, 1190.48,
         129.95, 3.30992E+06, 1188.20,
         134.95, 2.33614E+06, 1185.67,
         139.95, 1.63824E+06, 1183.87,
         144.95, 1.15694E+06, 1182.77,
         149.95, 8.58650E+05, 1182.17,
         154.95, 7.02842E+05, 1181.89,
         159.95, 5.63422E+05, 1181.67,
         164.95, 4.43549E+05, 1181.48,
         169.95, 3.43526E+05, 1181.33,
         174.95, 2.62594E+05, 1181.21,
         179.95, 3.09569E+05, 1200.25,
         184.95, 1.20657E+04, 1222.01,
         189.95, 6.99106E+03, 1222.72,
         194.95, 5.69358E+03, 1222.94,
         199.95, 5.98500E+03, 1223.11,
         204.95, 5.69470E+03, 1223.23,
         209.95, 5.13194E+03, 1223.36,
         214.95, 5.40194E+03, 1223.46,
         219.95, 5.04918E+03, 1223.57,
         224.95, 4.92984E+03, 1223.67,
         229.95, 4.97819E+03, 1223.77,
         234.95, 4.66657E+03, 1223.86,
         239.95, 4.33688E+03, 1223.96,
         244.95, 4.66078E+03, 1224.05,
         249.95, 4.12085E+03, 1224.14,
         250.00, 4.56217E+03, 1224.14,
         250.00,          0,       0,
            2E7,          0,       0 $END
$LIST POOL=401,    0,        0,       0,
                  2E7,       0,       0 $END
$LIST POOL=501,    0,       141E3,   168.2E6,
                  60,       141E3,   168.2E6,
                  60,        29E3,    34.6E6,
                1800,        29E3,    34.6E6,
                1800,         0,          0,
                 2E7,         0,          0 $END
$LIST POOL=601,    0,     7.2E4,     6.336E6,
                0.05,     7.2E4,     6.336E6,
                0.05,       0.0,       0.0,
                 2E7,         0,          0 $END
$LIST POOL=701,    0,     0,     0,     0,
                  2E7,     0,     0,     0 $END
$LIST POOL=801,
      0,        0,   0,   0,   100,   100,
     23,        0,   0,   0,   100,   100,
     25,  0.4973E5,  0,   0,   100,   100,
```

```
      30,  1.2184E5,   0,   0,   100,   100,
      35,  2.6357E5,   0,   0,   100,   100,
      40,  3.0584E5,   0,   0,   100,   100,
      45,  3.3567E5,   0,   0,   100,   100,
      50,  7.9567E5,   0,   0,   100,   100,
     1E4,  7.9567E5,   0,   0,   100,   100,
     1E4,       0.0,   0,   0,   100,   100,
     1E7,       0.0,   0,   0,   100,   100 $END
$LIST POOL=901,     0,     0,     0,
                   2E7,     0,     0 $END
$LIST POOL=1001,    0,   100,   2.0,
                   24,   100,   2.0 $END
$LIST POOL=1101,  105,       0,
                  120,  1.67E6,
                  130,  3.02E6,
                  140,  4.57E6,
                  150,  6.32E6,
                  160,  8.27E6,
                  170, 10.40E6,
                  180, 12.73E6,
                  190, 15.23E6,
                  200, 17.88E6,
                  210, 20.68E6,
                  220, 23.61E6,
                  230, 26.64E6,
                  240, 29.74E6,
                  250, 32.91E6,
                  260, 36.11E6,
                  270, 39.31E6,
                  280, 42.52E6,
                  287, 44.74E6,
                  290, 45.69E6,
                  300, 48.82E6 $END
$LIST POOL=1201,   0,  0.729,
                 0.1,  0.737,
                 0.2,  0.747,
                 0.3,  0.757,
                 0.4,  0.771,
                 0.5,  0.788,
                 0.6,  0.809,
                 0.7,  0.832,
                 0.8,  0.863,
                 0.9,  0.912,
                 1.0,  0.961,
                 1.1,  0.983,
                 1.2,  0.995,
                 1.3,  1.000 $END
$LIST POOL=9001,   1,  0.05,    0.1,  10,
                   5,  0.05,    0.2,  20,
                  20,  0.05,    1.0,   5,
                 100,  0.10,    1.0,  10,
                 160,  0.50,    2.0,  10,
                 200,   1.0,    5.0,   4,
                 300,   1.0,   10.0,   5,
                 600,   1.0,   25.0,   4,
                 1E3,   5.0,   50.0,   4,
                 2E3,  10.0,  250.0,   2,
                 5E3,  10.0,  250.0,   4,
                 1E4,  25.0,  500.0,   5,
                 1E5,  50.0,    5E3,   2 $END
$LIST POOL=9999 $END
```

```
* HS #1 - REACTOR BUILDING DOME
 $LIST POOL=101001, 57, 14, 0, 0, 0, 0, 33017 $END
 $LIST POOL=101101,  4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                     5, 0.02201, 4, 0.03001, 4, 0.04601, 4. 0.07801,
                     4, 0.14201, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                     4, 2.06201, 4, 4.06368 $END
 $LIST POOL=101201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=101300, 0, 0 $END
 $LIST POOL=101400, 9, 2, 1, 1 $END
* HS #2 - REACTOR BUILDING CYLINDER ABOVE 30 FT
 $LIST POOL=102001,  58, 14, 0, 0, 0, 0, 34067 $END
 $LIST POOL=102101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                    4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 5, 4.35534 $END
 $LIST POOL=102201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=102300, 0, 0 $END
 $LIST POOL=102400, 9, 2, 1, 1 $END
* HS #3 - REACTOR BUIDING CYLINDER WALL BELOW 30 FT
 $LIST POOL=103001,  58, 14, 0, 0, 0, 0, 5535 $END
 $LIST POOL=103101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                    4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 5, 4.35534 $END
 $LIST POOL=103201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=103300, 0, 0 $END
 $LIST POOL=103400, 9, 2, 0, 1 $END
* HS #4 - REACTOR BUILDING BASEMAT (Excluding Rx Cavity Basemat)
 $LIST POOL=104001, 42, 10, 0, 0, 0, 0, 12773 $END
 $LIST POOL=104101, 4, 0.00417, 4, 0.02417, 4, 0.06417, 4, 0.14417,
                    4, 0.30417, 4, 0.62417, 4, 1.26417, 4, 2.54417,
                    4, 5.10417, 5, 11.00417 $END
 $LIST POOL=104201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=104300, 0, 0 $END
 $LIST POOL=104400, 3, 3, 0, 1 $END
* HS #5 - REACTOR CAVITY BASEMAT & STEAM GENERATOR PEDESTALS
 $LIST POOL=105001, 40, 10, 0, 0, 0, 0, 1644 $END
 $LIST POOL=105101, 4, 0.00294, 4, 0.02294, 4, 0.06294, 4, 0.14294,
                    4, 0.30294, 4, 0.62294, 4, 1.26294, 4, 2.54294,
                    4, 5.10294, 3, 8.39548 $END
 $LIST POOL=105201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=105300, 0, 0 $END
 $LIST POOL=105400, 3, 3, 0, 1 $END
* HS #6 - REACTOR CAVITY BELOW ELEV. 17' - 6"
 $LIST POOL=106001, 42, 10, 0, 0, 0, 0, 1546 $END
 $LIST POOL=106101, 4, 0.00250, 4, 0.02250, 4, 0.06250, 4, 0.14250,
                    4, 0.30250, 4, 0.62250, 4, 1.26250, 4, 2.54250,
                    4, 5.10250, 5, 10.75250 $END
 $LIST POOL=106201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=106300, 0, 0 $END
 $LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
 $LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
 $LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                    4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                    4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                    4, 4.10850, 4, 8.35833 $END
 $LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=107300, 0, 0 $END
 $LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
```

Originator's Note:
Right boundary coordinate for HS#7 is 8.83583 ft per Sect. 8.2.7; error has no significant effect on results.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00						

```
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
```

Originator's Note:
Right boundary coordinate for HS#13, first concrete region, is 0.00556 ft & right boundary of final concrete region is 0.75521 ft per Sect 8.2.13; errors have no significant effect on results.

```
$LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
$LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
$LIST POOL=116201, 4, 4, 1 $END
$LIST POOL=116300, 0, 0 $END
$LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
$LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
$LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
$LIST POOL=117201, 4, 4, 1 $END
$LIST POOL=117300, 0, 0 $END
$LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
$LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
$LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
$LIST POOL=118201, 4, 4, 1 $END
$LIST POOL=118300, 0, 0 $END
$LIST POOL=118400, 9, 2, 0, 2 $END
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
$LIST POOL=119001, 4, 1, 0, 0, 0, 0, 131698 $END
$LIST POOL=119101, 3, 0.00879 $END
$LIST POOL=119201, 1 $END
$LIST POOL=119300, 0, 0 $END
$LIST POOL=119400, 9, 2, 0, 2 $END
* HS #20 - MISCELLANEOUS STAINLESS STEEL
$LIST POOL=120001, 5, 1, 0, 0, 0, 0, 26893 $END
$LIST POOL=120101, 4, 0.01459 $END
$LIST POOL=120201, 3 $END
$LIST POOL=120300, 0, 0 $END
$LIST POOL=120400, 9, 2, 0, 2 $END
* HS #21 - REACTOR BUILDING STIFFENED SECTIONS ABOVE ELEV. 30 FT
$LIST POOL=121001, 44, 10, 0, 0, 0, 0, 3764 $END
$LIST POOL=121101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.24083,
                   4, 0.52166, 4, 0.52201, 4, 0.54201, 4, 0.94201,
                   4, 1.74201, 6, 4.17659 $END
$LIST POOL=121201, 4, 4, 1, 1, 1, 5, 2, 2, 2, 2 $END
$LIST POOL=121300, 0, 0 $END
$LIST POOL=121400, 9, 2, 1, 1 $END
$LIST POOL=410001,
          25,     54,
         0.8,     30,
          10,     54,
        0.15,     20,
      0.0174, 0.0103 $END
$LIST POOL=500000 $END
```

Originator's Note:
Area & right boundary coordinate for HS#18 are 158855 sq ft and 0.02301 ft, respectively, per Sect 8.2.18; error has no significant effect on results.

Case 2 - MSLB @ 20% Power w/Cooling Train Failure

```
*CASE 2 - 5.30 FT2 SLOT MSLB @ 20% POWER W/CT FAILURE: N-4080-027R1
$LIST POOL=0,0,1,0,1 $END
$LIST POOL=1,1E4,16.8,2.305E6,120,0.05,21,0.0,1,1,0.00,14.7,0.5 $END
$LIST POOL=2,0,0,0,0,0,2.0,2E7 $END
$LIST POOL=3,0,0,0,0,0,2E7,0,0,0,0 $END
$LIST POOL=4,0,0,0,0,0,0,0,0,0,0,0,0 $END
$LIST POOL=5,2,50,2E7,0,0 $END
$LIST POOL=6,0,0,0 $END
$LEAK NOPEN=0 $END
$LIST POOL=101,    0,     0,
                 2E7,     0 $END
$LIST POOL=201,    0,     0,
                 2E7,     0 $END
```

E&TS DEPARTMENT

CALCULATION SHEET

ICCN NO./ PRELIM. CCN NO.	PAGE__ OF__
	CCN CONVERSION: CCN NO. CCN --

Project or DCP/FCN SONGS 2 & 3 **Calc. No.** N-4080-027

Subject Containment P/T Analysis for Design Basis MSLB Events **Sheet No.** 130 of 312

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE	REV ⇓
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99						

```
$LIST POOL=301,
        0.00, 3.88660E+07, 1193.65,
        0.10, 3.83245E+07, 1194.10,
        0.20, 3.78144E+07, 1194.53,
        0.30, 3.73291E+07, 1194.93,
        0.40, 3.68539E+07, 1195.31,
        0.50, 3.64057E+07, 1195.67,
        0.60, 3.59845E+07, 1196.01,
        0.70, 3.55802E+07, 1196.34,
        0.80, 3.51815E+07, 1196.65,
        0.90, 3.48040E+07, 1196.95,
        1.00, 3.44309E+07, 1197.24,
        1.99, 3.12098E+07, 1199.52,
        2.99, 2.87336E+07, 1201.00,
        3.99, 2.68275E+07, 1202.07,
        4.99, 2.52129E+07, 1202.84,
        5.99, 2.38544E+07, 1203.40,
        6.99, 2.27126E+07, 1203.81,
        7.99, 2.15349E+07, 1203.96,
        8.99, 2.01969E+07, 1204.01,
        9.99, 1.86861E+07, 1204.46,
       10.99, 1.72032E+07, 1204.51,
       11.99, 1.59607E+07, 1204.28,
       12.99, 1.49516E+07, 1203.96,
       13.99, 1.40957E+07, 1203.59,
       14.99, 1.33573E+07, 1203.19,
       15.99, 1.27104E+07, 1202.76,
       16.99, 1.21386E+07, 1202.32,
       17.99, 1.16317E+07, 1201.88,
       18.99, 1.11801E+07, 1201.44,
       19.99, 1.07758E+07, 1201.01,
       20.99, 1.04150E+07, 1200.58,
       21.99, 1.00918E+07, 1200.18,
       22.99, 9.80334E+06, 1199.79,
       23.99, 9.54468E+06, 1199.42,
       24.99, 9.30751E+06, 1199.06,
       25.99, 9.08939E+06, 1198.72,
       26.99, 8.88610E+06, 1198.39,
       27.99, 8.69072E+06, 1198.06,
       28.99, 8.51216E+06, 1197.76,
       29.99, 8.34887E+06, 1197.47,
       30.99, 8.20084E+06, 1197.19,
       31.99, 8.06360E+06, 1196.93,
       32.99, 7.93606E+06, 1196.68,
       33.99, 7.81474E+06, 1196.43,
       34.99, 7.69723E+06, 1196.20,
       35.99, 7.58923E+06, 1195.97,
       36.99, 7.48490E+06, 1195.74,
       37.99, 7.39066E+06, 1195.53,
       38.99, 7.30012E+06, 1195.32,
       39.99, 7.20986E+06, 1195.12,
       40.99, 7.12922E+06, 1194.93,
       41.99, 7.05103E+06, 1194.74,
       42.99, 6.97399E+06, 1194.56,
       43.99, 6.90095E+06, 1194.37,
       44.99, 6.82924E+06, 1194.19,
       45.99, 6.76037E+06, 1194.02,
       46.99, 6.69240E+06, 1193.85,
       47.99, 6.63124E+06, 1193.68,
       48.99, 6.56939E+06, 1193.52,
       49.99, 6.50952E+06, 1193.36,
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50.99, 6.45325E+06, 1193.20,
51.99, 6.39637E+06, 1193.04,
52.99, 6.33985E+06, 1192.88,
53.99, 6.27678E+06, 1192.70,
54.99, 6.21227E+06, 1192.52,
55.99, 6.14894E+06, 1192.33,
56.99, 6.08436E+06, 1192.13,
57.99, 6.01834E+06, 1191.93,
58.99, 5.95087E+06, 1191.72,
59.99, 5.88154E+06, 1191.50,
60.99, 5.81422E+06, 1191.29,
61.99, 5.74711E+06, 1191.07,
62.99, 5.67864E+06, 1190.85,
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69.99, 5.87610E+06, 1188.66,
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71.99, 5.46710E+06, 1187.95,
72.99, 5.31932E+06, 1187.68,
73.99, 5.19059E+06, 1187.45,
74.99, 5.07056E+06, 1187.24,
75.99, 4.97167E+06, 1187.06,
76.99, 4.87260E+06, 1186.89,
77.99, 4.79236E+06, 1186.73,
78.99, 4.71074E+06, 1186.59,
79.99, 4.63082E+06, 1186.45,
80.99, 4.55584E+06, 1186.32,
81.99, 4.49604E+06, 1186.20,
82.99, 4.42714E+06, 1186.08,
83.99, 4.37108E+06, 1185.97,
84.99, 4.30146E+06, 1185.86,
85.99, 4.24256E+06, 1185.75,
86.99, 4.18507E+06, 1185.64,
87.99, 4.13554E+06, 1185.53,
88.99, 4.07938E+06, 1185.43,
89.99, 4.02649E+06, 1185.34,
90.99, 3.98045E+06, 1185.24,
91.99, 3.93138E+06, 1185.25,
92.99, 3.88364E+06, 1185.06,
93.99, 3.83638E+06, 1184.97,
94.99, 3.78320E+06, 1184.88,
95.99, 3.74346E+06, 1184.79,
96.99, 3.69857E+06, 1184.71,
97.99, 3.65717E+06, 1184.63,
98.99, 3.61926E+06, 1184.55,
99.99, 3.57004E+06, 1184.47,
104.95, 3.31816E+06, 1183.98,
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139.95, 9.88420E+05, 1179.83,
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149.95, 7.93688E+05, 1179.60,
154.95, 7.15266E+05, 1179.50,
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184.95, 4.18900E+05, 1179.05,
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194.95, 3.59441E+05, 1178.92,
199.95, 3.34164E+05, 1178.86,
204.95, 3.11319E+05, 1178.80,
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214.95, 2.71800E+05, 1178.68,
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234.95, 2.11451E+05, 1178.45,
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244.95, 1.89130E+05, 1178.34,
249.95, 1.78192E+05, 1178.28,
254.95, 1.69525E+05, 1178.23,
259.95, 1.61281E+05, 1178.17,
264.95, 1.53435E+05, 1178.12,
269.95, 1.45974E+05, 1178.07,
274.95, 1.38880E+05, 1178.01,
279.95, 1.32135E+05, 1177.96,
284.95, 1.25725E+05, 1177.91,
289.95, 1.19633E+05, 1177.86,
294.95, 1.13844E+05, 1177.81,
299.95, 1.08344E+05, 1177.76,
304.95, 1.03119E+05, 1177.70,
309.95, 9.81558E+04, 1177.65,
314.95, 9.34416E+04, 1177.60,
319.95, 8.89650E+04, 1177.56,
324.95, 8.47138E+04, 1177.51,
329.95, 8.06771E+04, 1177.46,
334.95, 1.14330E+05, 1196.10,
339.95, 4.99583E+04, 1215.50,
344.95, 3.12519E+04, 1221.71,
349.95, 2.55891E+04, 1223.95,
354.95, 2.35051E+04, 1225.06,
359.95, 2.24027E+04, 1225.84,
364.95, 2.15866E+04, 1226.51,
369.95, 2.08820E+04, 1227.14,
374.95, 2.02250E+04, 1227.73,
379.95, 1.96087E+04, 1228.29,
384.95, 1.90250E+04, 1228.83,
389.95, 1.84697E+04, 1229.34,
394.95, 1.79455E+04, 1229.84,
399.95, 1.74453E+04, 1230.32,
400.00, 1.74405E+04, 1230.32,
400.00,          0,       0,
   2E7,          0,       0 $END
$LIST POOL=401,   0,       0,       0,
                 2E7,      0,       0 $END
$LIST POOL=501,   0,       29E3,    34.6E6,
               1800,       29E3,    34.6E6,
               1800,          0,         0,
                2E7,          0,         0 $END
$LIST POOL=601,   0,     7.2E4,    6.336E6,
               0.05,     7.2E4,    6.336E6,
               0.05,       0.0,       0.0,
```

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                    2E7,        0,          0 $END
$LIST POOL=701,      0,     0,     0,     0,
                    2E7,     0,     0,     0 $END
$LIST POOL=801,
      0,          0,   0,   0,   100,   100,
     23,        - 0,   0,   0,   100,   100,
     25,   0.4973E5,   0,   0,   100,   100,
     30,   1.2184E5,   0,   0,   100,   100,
     35,   2.6357E5,   0,   0,   100,   100,
     40,   3.0584E5,   0,   0,   100,   100,
     45,   3.3567E5,   0,   0,   100,   100,
     50,   7.9567E5,   0,   0,   100,   100,
    1E4,   7.9567E5,   0,   0,   100,   100,
    1E4,       0.0,   0,   0,   100,   100,
    1E7,       0.0,   0,   0,   100,   100 $END
$LIST POOL=901,      0,     0,     0,
                    2E7,     0,     0 $END
$LIST POOL=1001,     0,   100,   2.0,
                    24,   100,   2.0 $END
$LIST POOL=1101,   105,       0,
                   120,  1.67E6,
                   130,  3.02E6,
                   140,  4.57E6,
                   150,  6.32E6,
                   160,  8.27E6,
                   170, 10.40E6,
                   180, 12.73E6,
                   190, 15.23E6,
                   200, 17.88E6,
                   210, 20.68E6,
                   220, 23.61E6,
                   230, 26.64E6,
                   240, 29.74E6,
                   250, 32.91E6,
                   260, 36.11E6,
                   270, 39.31E6,
                   280, 42.52E6,
                   287, 44.74E6,
                   290, 45.69E6,
                   300, 48.82E6 $END
$LIST POOL=1201,     0,  0.729,
                   0.1,  0.737,
                   0.2,  0.747,
                   0.3,  0.757,
                   0.4,  0.771,
                   0.5,  0.788,
                   0.6,  0.809,
                   0.7,  0.832,
                   0.8,  0.863,
                   0.9,  0.912,
                   1.0,  0.961,
                   1.1,  0.983,
                   1.2,  0.995,
                   1.3,  1.000 $END
$LIST POOL=9001,     1,  0.05,    0.1,  10,
                     5,  0.05,    0.2,  20,
                    20,  0.05,    1.0,   5,
                   100,  0.10,    1.0,  10,
                   160,  0.50,    2.0,  10,
                   200,   1.0,    5.0,   4,
                   300,   1.0,   10.0,   5,
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                    600,   1.0,   25.0,   4,
                    1E3,   5.0,   50.0,   4,
                    2E3,  10.0,  250.0,   2,
                    5E3,  10.0,  250.0,   4,
                    1E4,  25.0,  500.0,   5,
                    1E5,  50.0,    5E3,   2 $END
 $LIST POOL=9999 $END
* HS #1 - REACTOR BUILDING DOME
 $LIST POOL=101001, 57, 14, 0, 0, 0, 0, 33017 $END
 $LIST POOL=101101,  4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                     5, 0.02201, 4, 0.03001, 4, 0.04601, 4. 0.07801,
                     4, 0.14201, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                     4, 2.06201, 4, 4.06368 $END
 $LIST POOL=101201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=101300, 0, 0 $END
 $LIST POOL=101400, 9, 2, 1, 1 $END
* HS #2 - REACTOR BUILDING CYLINDER ABOVE 30 FT
 $LIST POOL=102001,  58, 14, 0, 0, 0, 0, 34067 $END
 $LIST POOL=102101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                    4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 5, 4.35534 $END
 $LIST POOL=102201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=102300, 0, 0 $END
 $LIST POOL=102400, 9, 2, 1, 1 $END
* HS #3 - REACTOR BUIDING CYLINDER WALL BELOW 30 FT
 $LIST POOL=103001,  58, 14, 0, 0, 0, 0, 5535 $END
 $LIST POOL=103101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                    4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 5, 4.35534 $END
 $LIST POOL=103201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=103300, 0, 0 $END
 $LIST POOL=103400, 9, 2, 0, 1 $END
* HS #4 - REACTOR BUILDING BASEMAT (Excluding Rx Cavity Basemat)
 $LIST POOL=104001, 42, 10, 0, 0, 0, 0, 12773 $END
 $LIST POOL=104101, 4, 0.00417, 4, 0.02417, 4, 0.06417, 4, 0.14417,
                    4, 0.30417, 4, 0.62417, 4, 1.26417, 4, 2.54417,
                    4, 5.10417, 5, 11.00417 $END
 $LIST POOL=104201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=104300, 0, 0 $END
 $LIST POOL=104400, 3, 3, 0, 1 $END
* HS #5 - REACTOR CAVITY BASEMAT & STEAM GENERATOR PEDESTALS
 $LIST POOL=105001, 40, 10, 0, 0, 0, 0, 1644 $END
 $LIST POOL=105101, 4, 0.00294, 4, 0.02294, 4, 0.06294, 4, 0.14294,
                    4, 0.30294, 4, 0.62294, 4, 1.26294, 4, 2.54294,
                    4, 5.10294, 3, 8.39548 $END
 $LIST POOL=105201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=105300, 0, 0 $END
 $LIST POOL=105400, 3, 3, 0, 1 $END
* HS #6 - REACTOR CAVITY BELOW ELEV. 17' - 6"
 $LIST POOL=106001, 42, 10, 0, 0, 0, 0, 1546 $END
 $LIST POOL=106101, 4, 0.00250, 4, 0.02250, 4, 0.06250, 4, 0.14250,
                    4, 0.30250, 4, 0.62250, 4, 1.26250, 4, 2.54250,
                    4, 5.10250, 5, 10.75250 $END
 $LIST POOL=106201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=106300, 0, 0 $END
 $LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
 $LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
 $LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
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Note: See Originator's Note for HS#7 right boundary co-ordinate on sheet 127.

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                    4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                    4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                    4, 4.10850, 4, 8.35833 $END
 $LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=107300, 0, 0 $END
 $LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
 $LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
 $LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                    3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                    4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                    2, 2.01598 $END
 $LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=108300, 0, 0 $END
 $LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
 $LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
 $LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
 $LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
 $LIST POOL=109300, 0, 0 $END
 $LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
 $LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
 $LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                    4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                    4, 0.31250, 4, 0.63250, 7, 1.71909 $END
 $LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=110300, 0, 0 $END
 $LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
 $LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
 $LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                    4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                    4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
 $LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=111300, 0, 0 $END
 $LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
 $LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                    4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                    4, 0.31417, 6, 0.75417 $END
 $LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=112300, 0, 0 $END
 $LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
 $LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
 $LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                    4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                    4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
 $LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=113300, 0, 0 $END
 $LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
 $LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
 $LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
 $LIST POOL=114201, 4, 4, 1 $END
 $LIST POOL=114300, 0, 0 $END
 $LIST POOL=114400, 9, 2, 0, 2 $END
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Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

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* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
 $LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
 $LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
 $LIST POOL=115201, 4, 4, 1, 1 $END
 $LIST POOL=115300, 0, 0 $END
 $LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
 $LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
 $LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
 $LIST POOL=116201, 4, 4, 1 $END
 $LIST POOL=116300, 0, 0 $END
 $LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
 $LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
 $LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
 $LIST POOL=117201, 4, 4, 1 $END
 $LIST POOL=117300, 0, 0 $END
 $LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
 $LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
 $LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
 $LIST POOL=118201, 4, 4, 1 $END
 $LIST POOL=118300, 0, 0 $END
 $LIST POOL=118400, 9, 2, 0, 2 $END
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
 $LIST POOL=119001, 4, 1, 0, 0, 0, 0, 131698 $END
 $LIST POOL=119101, 3, 0.00879 $END
 $LIST POOL=119201, 1 $END
 $LIST POOL=119300, 0, 0 $END
 $LIST POOL=119400, 9, 2, 0, 2 $END
* HS #20 - MISCELLANEOUS STAINLESS STEEL
 $LIST POOL=120001, 5, 1, 0, 0, 0, 0, 26893 $END
 $LIST POOL=120101, 4, 0.01459 $END
 $LIST POOL=120201, 3 $END
 $LIST POOL=120300, 0, 0 $END
 $LIST POOL=120400, 9, 2, 0, 2 $END
* HS #21 - REACTOR BUILDING STIFFENED SECTIONS ABOVE ELEV. 30 FT
 $LIST POOL=121001, 44, 10, 0, 0, 0, 0, 3764 $END
 $LIST POOL=121101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.24083,
                    4, 0.52166, 4, 0.52201, 4, 0.54201, 4, 0.94201,
                    4, 1.74201, 6, 4.17659 $END
 $LIST POOL=121201, 4, 4, 1, 1, 1, 5, 2, 2, 2, 2 $END
 $LIST POOL=121300, 0, 0 $END
 $LIST POOL=121400, 9, 2, 1, 1 $END
 $LIST POOL=410001,
            25,     54,
           0.8,     30,
            10,     54,
          0.15,     20,
        0.0174, 0.0103 $END
 $LIST POOL=500000 $END
```

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

Case 3 - MSLB @ 50% Power w/Cooling Train Failure

```
*CASE 3 - 7.05 FT2 SLOT MSLB @ 50% POWER W/CT FAILURE: N-4080-027R1
 $LIST POOL=0,0,1,0,1 $END
 $LIST POOL=1,1E4,16.8,2.305E6,120,0.05,21,0.0,1,1,0.00,14.7,0.5 $END
 $LIST POOL=2,0,0,0,0,0,2.0,2E7 $END
 $LIST POOL=3,0,0,0,0,0,2E7,0,0,0,0 $END
 $LIST POOL=4,0,0,0,0,0,0,0,0,0,0,0,0 $END
```

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$LIST POOL=5,2,50,2E7,0,0 $END
$LIST POOL=6,0,0,0 $END
$LEAK NOPEN=0 $END
$LIST POOL=101,    0,     0,
                  2E7,    0 $END
$LIST POOL=201,    0,     0,
                  2E7,    0 $END
$LIST POOL=301,
        0.00, 4.98355E+07, 1194.65,
        0.10, 4.88336E+07, 1195.23,
        0.20, 4.79520E+07, 1195.78,
        0.30, 4.71312E+07, 1196.30,
        0.40, 4.63381E+07, 1196.78,
        0.50, 4.55857E+07, 1197.23,
        0.60, 4.48607E+07, 1197.65,
        0.70, 4.41641E+07, 1198.04,
        0.80, 4.34941E+07, 1198.41,
        0.90, 4.28497E+07, 1198.76,
        1.00, 4.22266E+07, 1199.09,
        1.99, 3.71761E+07, 1201.46,
        2.99, 3.38955E+07, 1202.71,
        3.99, 3.13708E+07, 1203.49,
        4.99, 2.93736E+07, 1203.97,
        5.99, 2.77907E+07, 1204.26,
        6.99, 2.62811E+07, 1204.35,
        7.99, 2.47186E+07, 1204.23,
        8.99, 2.30279E+07, 1204.12,
        9.99, 2.11423E+07, 1204.30,
       10.99, 1.95152E+07, 1203.90,
       11.99, 1.82047E+07, 1203.44,
       12.99, 1.71805E+07, 1202.97,
       13.99, 1.63286E+07, 1202.51,
       14.99, 1.56101E+07, 1202.06,
       15.99, 1.49851E+07, 1201.62,
       16.99, 1.44204E+07, 1201.18,
       17.99, 1.39128E+07, 1200.74,
       18.99, 1.34460E+07, 1200.31,
       19.99, 1.30326E+07, 1199.89,
       20.99, 1.26711E+07, 1199.50,
       21.99, 1.23502E+07, 1199.14,
       22.99, 1.20660E+07, 1198.81,
       23.99, 1.18001E+07, 1198.48,
       24.99, 1.15444E+07, 1198.17,
       25.99, 1.13019E+07, 1197.85,
       26.99, 1.10709E+07, 1197.55,
       27.99, 1.08586E+07, 1197.25,
       28.99, 1.06744E+07, 1196.98,
       29.99, 1.05048E+07, 1196.74,
       30.99, 1.03464E+07, 1196.50,
       31.99, 1.01970E+07, 1196.27,
       32.99, 1.00522E+07, 1196.04,
       33.99, 9.90911E+06, 1195.80,
       34.99, 9.77076E+06, 1195.57,
       35.99, 9.63551E+06, 1195.34,
       36.99, 9.50789E+06, 1195.12,
       37.99, 9.38776E+06, 1194.90,
       38.99, 9.26827E+06, 1194.69,
       39.99, 9.14173E+06, 1194.45,
       40.99, 9.01066E+06, 1194.21,
       41.99, 8.87746E+06, 1193.95,
       42.99, 8.74127E+06, 1193.68,
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 43.99, 8.60641E+06, 1193.40,
 44.99, 8.47228E+06, 1193.12,
 45.99, 8.33944E+06, 1192.84,
 46.99, 8.20948E+06, 1192.55,
 47.99, 8.08618E+06, 1192.27,
 48.99, 7.96313E+06, 1191.99,
 49.99, 8.82090E+06, 1191.48,
 50.99, 8.55832E+06, 1190.91,
 51.99, 8.33314E+06, 1190.40,
 52.99, 8.13182E+06, 1189.94,
 53.99, 7.79994E+06, 1189.56,
 54.99, 7.55327E+06, 1189.27,
 55.99, 7.34274E+06, 1189.03,
 56.99, 7.16569E+06, 1188.82,
 57.99, 7.00052E+06, 1188.62,
 58.99, 6.84529E+06, 1188.44,
 59.99, 6.69971E+06, 1188.26,
 60.99, 6.55754E+06, 1188.10,
 61.99, 6.42272E+06, 1187.94,
 62.99, 6.29546E+06, 1187.79,
 63.99, 6.17904E+06, 1187.66,
 64.99, 6.07280E+06, 1187.53,
 65.99, 5.96509E+06, 1187.40,
 66.99, 5.85666E+06, 1187.27,
 67.99, 5.74794E+06, 1187.15,
 68.99, 5.64977E+06, 1187.02,
 69.99, 5.54792E+06, 1186.91,
 70.99, 5.45929E+06, 1186.80,
 71.99, 5.37005E+06, 1186.69,
 72.99, 5.28775E+06, 1186.59,
 73.99, 5.20265E+06, 1186.50,
 74.99, 5.06466E+06, 1186.32,
 75.99, 4.22528E+06, 1186.19,
 76.99, 1.23842E+06, 1181.86,
 77.99, 6.71393E+05, 1181.54,
 78.99, 6.60780E+05, 1181.48,
 79.99, 6.33470E+05, 1181.42,
 80.99, 6.00570E+05, 1181.35,
 81.99, 5.72980E+05, 1181.29,
 82.99, 5.55624E+05, 1181.22,
 83.99, 5.47114E+05, 1181.17,
 84.99, 5.42020E+05, 1181.11,
 85.99, 5.34305E+05, 1181.05,
 86.99, 5.20492E+05, 1180.99,
 87.99, 5.01098E+05, 1180.93,
 88.99, 4.79581E+05, 1180.87,
 89.99, 4.59925E+05, 1180.81,
 90.99, 4.44571E+05, 1180.75,
 91.99, 4.33537E+05, 1180.69,
 92.99, 4.24926E+05, 1180.63,
 93.99, 4.16221E+05, 1180.57,
 94.99, 4.05623E+05, 1180.51,
 95.99, 3.92861E+05, 1180.45,
 96.99, 3.79012E+05, 1180.39,
 97.99, 3.65695E+05, 1180.34,
 98.99, 3.54130E+05, 1180.28,
 99.99, 3.44621E+05, 1180.22,
104.95, 3.35952E+05, 1179.94,
109.95, 2.87618E+05, 1179.65,
114.95, 2.32187E+05, 1179.48,
119.95, 1.95119E+05, 1179.37,
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        124.95, 1.62496E+05, 1179.27,
        129.95, 6.01384E+04, 1235.78,
        134.95, 1.51383E+04, 1244.03,
        139.95, 9.56732E+03, 1245.33,
        144.95, 8.87915E+03, 1245.78,
        149.95, 8.33069E+03, 1246.11,
        154.95, 8.07206E+03, 1246.44,
        159.95, 7.79663E+03, 1246.73,
        164.95, 7.50614E+03, 1247.03,
        169.95, 7.30325E+03, 1247.31,
        174.95, 7.07018E+03, 1247.58,
        179.95, 6.90073E+03, 1247.85,
        184.95, 6.72404E+03, 1248.11,
        189.95, 6.54919E+03, 1248.37,
        194.95, 6.39076E+03, 1248.63,
        199.95, 6.23192E+03, 1248.89,
        200.00, 6.23045E+03, 1248.89,
        200.00,           0,       0,
           2E7,           0,       0 $END
$LIST POOL=401,    0,        0,       0,
                 2E7,        0,       0 $END
$LIST POOL=501,    0,       29E3,    34.6E6,
                1800,       29E3,    34.6E6,
                1800,          0,        0,
                 2E7,          0,        0 $END
$LIST POOL=601,    0,     7.2E4,    6.336E6,
                0.05,     7.2E4,    6.336E6,
                0.05,       0.0,       0.0,
                 2E7,         0,         0 $END
$LIST POOL=701,    0,     0,     0,     0,
                 2E7,     0,     0,     0 $END
$LIST POOL=801,
      0,         0,   0,   0,   100,   100,
     23,         0,   0,   0,   100,   100,
     25,   0.4973E5,  0,   0,   100,   100,
     30,   1.2184E5,  0,   0,   100,   100,
     35,   2.6357E5,  0,   0,   100,   100,
     40,   3.0584E5,  0,   0,   100,   100,
     45,   3.3567E5,  0,   0,   100,   100,
     50,   7.9567E5,  0,   0,   100,   100,
    1E4,   7.9567E5,  0,   0,   100,   100,
    1E4,       0.0,   0,   0,   100,   100,
    1E7,       0.0,   0,   0,   100,   100 $END
$LIST POOL=901,    0,     0,     0,
                 2E7,     0,     0 $END
$LIST POOL=1001,   0,   100,   2.0,
                  24,   100,   2.0 $END
$LIST POOL=1101,  105,     0,
                  120,  1.67E6,
                  130,  3.02E6,
                  140,  4.57E6,
                  150,  6.32E6,
                  160,  8.27E6,
                  170, 10.40E6,
                  180, 12.73E6,
                  190, 15.23E6,
                  200, 17.88E6,
                  210, 20.68E6,
                  220, 23.61E6,
                  230, 26.64E6,
                  240, 29.74E6,
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                    250, 32.91E6,
                    260, 36.11E6,
                    270, 39.31E6,
                    280, 42.52E6,
                    287, 44.74E6,
                    290, 45.69E6,
                    300, 48.82E6 $END
$LIST POOL=1201,   0,  0.729,
                  0.1,  0.737,
                  0.2,  0.747,
                  0.3,  0.757,
                  0.4,  0.771,
                  0.5,  0.788,
                  0.6,  0.809,
                  0.7,  0.832,
                  0.8,  0.863,
                  0.9,  0.912,
                  1.0,  0.961,
                  1.1,  0.983,
                  1.2,  0.995,
                  1.3,  1.000 $END
$LIST POOL=9001,   1,  0.05,    0.1,  10,
                   5,  0.05,    0.2,  20,
                  20,  0.05,    1.0,   5,
                 100,  0.10,    1.0,  10,
                 160,  0.50,    2.0,  10,
                 200,   1.0,    5.0,   4,
                 300,   1.0,   10.0,   5,
                 600,   1.0,   25.0,   4,
                 1E3,   5.0,   50.0,   4,
                 2E3,  10.0,  250.0,   2,
                 5E3,  10.0,  250.0,   4,
                 1E4,  25.0,  500.0,   5,
                 1E5,  50.0,    5E3,   2 $END
$LIST POOL=9999 $END
* HS #1 - REACTOR BUILDING DOME
$LIST POOL=101001, 57, 14, 0, 0, 0, 0, 33017 $END
$LIST POOL=101101,  4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4. 0.07801,
                    4, 0.14201, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 4, 4.06368 $END
$LIST POOL=101201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=101300, 0, 0 $END
$LIST POOL=101400, 9, 2, 1, 1 $END
* HS #2 - REACTOR BUILDING CYLINDER ABOVE 30 FT
$LIST POOL=102001,  58, 14, 0, 0, 0, 0, 34067 $END
$LIST POOL=102101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                   5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                   4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                   4, 2.06201, 5, 4.35534 $END
$LIST POOL=102201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=102300, 0, 0 $END
$LIST POOL=102400, 9, 2, 1, 1 $END
* HS #3 - REACTOR BUIDING CYLINDER WALL BELOW 30 FT
$LIST POOL=103001,  58, 14, 0, 0, 0, 0, 5535 $END
$LIST POOL=103101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                   5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                   4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                   4, 2.06201, 5, 4.35534 $END
$LIST POOL=103201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=103300, 0, 0 $END
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$LIST POOL=103400, 9, 2, 0, 1 $END
* HS #4 - REACTOR BUILDING BASEMAT (Excluding Rx Cavity Basemat)
$LIST POOL=104001, 42, 10, 0, 0, 0, 0, 12773 $END
$LIST POOL=104101, 4, 0.00417, 4, 0.02417, 4, 0.06417, 4, 0.14417,
                   4, 0.30417, 4, 0.62417, 4, 1.26417, 4, 2.54417,
                   4, 5.10417, 5, 11.00417 $END
$LIST POOL=104201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=104300, 0, 0 $END
$LIST POOL=104400, 3, 3, 0, 1 $END
* HS #5 - REACTOR CAVITY BASEMAT & STEAM GENERATOR PEDESTALS
$LIST POOL=105001, 40, 10, 0, 0, 0, 0, 1644 $END
$LIST POOL=105101, 4, 0.00294, 4, 0.02294, 4, 0.06294, 4, 0.14294,
                   4, 0.30294, 4, 0.62294, 4, 1.26294, 4, 2.54294,
                   4, 5.10294, 3, 8.39548 $END
$LIST POOL=105201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=105300, 0, 0 $END
$LIST POOL=105400, 3, 3, 0, 1 $END
* HS #6 - REACTOR CAVITY BELOW ELEV. 17' - 6"
$LIST POOL=106001, 42, 10, 0, 0, 0, 0, 1546 $END
$LIST POOL=106101, 4, 0.00250, 4, 0.02250, 4, 0.06250, 4, 0.14250,
                   4, 0.30250, 4, 0.62250, 4, 1.26250, 4, 2.54250,
                   4, 5.10250, 5, 10.75250 $END
$LIST POOL=106201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=106300, 0, 0 $END
$LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
$LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
$LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                   4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                   4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                   4, 4.10850, 4, 8.35833 $END
$LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=107300, 0, 0 $END
$LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
```

Note: See Originator's Note for HS#7 right boundary co-ordinate on sheet 127.

REV	ORIGINATOR	DATE	IRE	DATE	REV	ORIGINATOR	DATE	IRE	DATE
1	P. Barbour	11/01/99	J. M. Gilmer	11/01/99					
	P.Barbour	05/16/00	J. M. Gilmer	6/27/00					

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$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 00.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
$LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
$LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
$LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
$LIST POOL=116201, 4, 4, 1 $END
$LIST POOL=116300, 0, 0 $END
$LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
$LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
$LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
$LIST POOL=117201, 4, 4, 1 $END
$LIST POOL=117300, 0, 0 $END
$LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
$LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
$LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
$LIST POOL=118201, 4, 4, 1 $END
$LIST POOL=118300, 0, 0 $END
$LIST POOL=118400, 9, 2, 0, 2 $END
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
$LIST POOL=119001, 4, 1, 0, 0, 0, 0, 131698 $END
$LIST POOL=119101, 3, 0.00879 $END
$LIST POOL=119201, 1 $END
$LIST POOL=119300, 0, 0 $END
$LIST POOL=119400, 9, 2, 0, 2 $END
* HS #20 - MISCELLANEOUS STAINLESS STEEL
$LIST POOL=120001, 5, 1, 0, 0, 0, 0, 26893 $END
$LIST POOL=120101, 4, 0.01459 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

```
$LIST POOL=120201, 3 $END
$LIST POOL=120300, 0, 0 $END
$LIST POOL=120400, 9, 2, 0, 2 $END
* HS #21 - REACTOR BUILDING STIFFENED SECTIONS ABOVE ELEV. 30 FT
$LIST POOL=121001, 44, 10, 0, 0, 0, 0, 3764 $END
$LIST POOL=121101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.24083,
                   4, 0.52166, 4, 0.52201, 4, 0.54201, 4, 0.94201,
                   4, 1.74201, 6, 4.17659 $END
$LIST POOL=121201, 4, 4, 1, 1, 1, 5, 2, 2, 2, 2 $END
$LIST POOL=121300, 0, 0 $END
$LIST POOL=121400, 9, 2, 1, 1 $END
$LIST POOL=410001,
          25,     54,
         0.8,     30,
          10,     54,
        0.15,     20,
      0.0174, 0.0103 $END
$LIST POOL=500000 $END
```

Case 4 - MSLB @ 80% Power w/Cooling Train Failure

```
*CASE 4 - 8.10 FT2 SLOT MSLB @ 80% POWER W/CT FAILURE: N-4080-027R1
$LIST POOL=0,0,1,0,1 $END
$LIST POOL=1,1E4,16.8,2.305E6,120,0.05,21,0.0,1,1,0.00,14.7,0.5 $END
$LIST POOL=2,0,0,0,0,0,2.0,2E7 $END
$LIST POOL=3,0,0,0,0,0,2E7,0,0,0,0 $END
$LIST POOL=4,0,0,0,0,0,0,0,0,0,0,0,0 $END
$LIST POOL=5,2,50,2E7,0,0 $END
$LIST POOL=6,0,0,0 $END
$LEAK NOPEN=0 $END
$LIST POOL=101,    0,     0,
                 2E7,     0 $END
$LIST POOL=201,    0,     0,
                 2E7,     0 $END
$LIST POOL=301,
         0.00, 5.56351E+07, 1195.39,
         0.10, 5.43438E+07, 1196.02,
         0.20, 5.31950E+07, 1196.63,
         0.30, 5.21208E+07, 1197.20,
         0.40, 5.11009E+07, 1197.73,
         0.50, 5.01361E+07, 1198.21,
         0.60, 4.92098E+07, 1198.66,
         0.70, 4.83278E+07, 1199.07,
         0.80, 4.74872E+07, 1199.46,
         0.90, 4.66787E+07, 1199.82,
         1.00, 4.59036E+07, 1200.15,
         1.99, 4.00396E+07, 1202.37,
         2.99, 3.64633E+07, 1203.38,
         3.99, 3.37869E+07, 1203.96,
         4.99, 3.17606E+07, 1204.28,
         5.99, 3.01463E+07, 1204.44,
         6.99, 2.85380E+07, 1204.39,
         7.99, 2.68565E+07, 1204.17,
         8.99, 2.49985E+07, 1204.02,
         9.99, 2.28259E+07, 1204.06,
        10.99, 2.11655E+07, 1203.60,
        11.99, 1.98540E+07, 1203.11,
        12.99, 1.88164E+07, 1202.64,
        13.99, 1.79554E+07, 1202.18,
        14.99, 1.72086E+07, 1201.72,
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15.99, 1.65385E+07, 1201.27,
16.99, 1.59269E+07, 1200.82,
17.99, 1.53707E+07, 1200.37,
18.99, 1.48731E+07, 1199.93,
19.99, 1.44348E+07, 1199.53,
20.99, 1.40496E+07, 1199.14,
21.99, 1.37055E+07, 1198.78,
22.99, 1.33892E+07, 1198.44,
23.99, 1.30810E+07, 1198.09,
24.99, 1.27862E+07, 1197.76,
25.99, 1.25092E+07, 1197.43,
26.99, 1.22530E+07, 1197.11,
27.99, 1.20189E+07, 1196.81,
28.99, 1.18052E+07, 1196.53,
29.99, 1.16071E+07, 1196.26,
30.99, 1.14190E+07, 1195.99,
31.99, 1.12363E+07, 1195.73,
32.99, 1.10521E+07, 1195.46,
33.99, 1.08545E+07, 1195.16,
34.99, 1.06546E+07, 1194.85,
35.99, 1.04576E+07, 1194.53,
36.99, 1.02646E+07, 1194.21,
37.99, 1.00751E+07, 1193.83,
38.99, 9.88837E+06, 1193.55,
39.99, 9.70477E+06, 1193.22,
40.99, 9.52546E+06, 1192.89,
41.99, 9.35165E+06, 1192.55,
42.99, 9.18428E+06, 1192.22,
43.99, 9.02351E+06, 1191.90,
44.99, 8.86853E+06, 1191.58,
45.99, 8.71841E+06, 1191.26,
46.99, 8.57225E+06, 1190.94,
47.99, 8.42969E+06, 1190.62,
48.99, 8.29098E+06, 1190.30,
49.99, 8.25645E+06, 1189.98,
50.99, 8.02645E+06, 1189.67,
51.99, 7.90099E+06, 1189.36,
52.99, 7.77967E+06, 1189.06,
53.99, 7.66206E+06, 1188.76,
54.99, 7.45279E+06, 1188.48,
55.99, 7.24421E+06, 1188.27,
56.99, 7.07018E+06, 1188.09,
57.99, 6.91528E+06, 1187.94,
58.99, 6.77232E+06, 1187.80,
59.99, 6.63570E+06, 1187.67,
60.99, 6.50650E+06, 1187.54,
61.99, 2.51789E+06, 1183.21,
62.99, 2.23399E+05, 1181.99,
63.99, 2.28696E+05, 1181.92,
64.99, 2.25015E+05, 1181.85,
65.99, 4.09493E+05, 1194.68,
66.99, 2.59193E+05, 1210.98,
67.99, 1.68017E+05, 1221.65,
68.99, 1.18678E+05, 1228.67,
69.99, 9.32540E+04, 1233.65,
70.99, 7.76959E+04, 1237.50,
71.99, 6.37988E+04, 1240.48,
72.99, 4.93168E+04, 1242.58,
73.99, 3.63154E+04, 1243.73,
74.99, 2.77801E+04, 1244.12,
75.99, 2.52152E+04, 1244.14,
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        76.99, 2.76312E+04, 1244.17,
        77.99, 3.20140E+04, 1244.49,
        78.99, 3.50593E+04, 1245.10,
        79.99, 3.47908E+04, 1245.84,
        80.99, 3.08270E+04, 1246.47,
        81.99, 2.68055E+04, 1246.80,
        82.99, 2.33396E+04, 1246.85,
        83.99, 2.24332E+04, 1246.74,
        84.99, 2.39935E+04, 1246.67,
        85.99, 2.66630E+04, 1246.78,
        86.99, 2.86695E+04, 1247.09,
        87.99, 2.89331E+04, 1247.50,
        88.99, 2.73411E+04, 1247.88,
        89.99, 2.48802E+04, 1248.11,
        90.99, 2.28446E+04, 1248.17,
        91.99, 2.21254E+04, 1248.14,
        92.99, 2.27989E+04, 1248.12,
        93.99, 2.42007E+04, 1248.20,
        94.99, 2.53763E+04, 1248.39,
        95.99, 2.56253E+04, 1248.66,
        96.99, 2.48405E+04, 1248.91,
        97.99, 2.34842E+04, 1249.09,
        98.99, 2.22613E+04, 1249.18,
        99.99, 2.17098E+04, 1249.20,
       104.95, 2.30190E+04, 1249.81,
       109.95, 1.36872E+04, 1250.65,
       114.95, 8.89351E+03, 1251.76,
       119.95, 8.73590E+03, 1252.15,
       124.95, 8.00694E+03, 1252.58,
       129.95, 7.91968E+03, 1252.99,
       134.95, 7.57937E+03, 1253.37,
       139.95, 7.27870E+03, 1253.77,
       144.95, 7.09474E+03, 1254.15,
       149.95, 6.82045E+03, 1254.53,
       154.95, 6.62598E+03, 1254.90,
       159.95, 6.42776E+03, 1255.26,
       164.95, 6.23794E+03, 1255.62,
       169.95, 6.09901E+03, 1255.98,
       174.95, 5.94353E+03, 1256.33,
       179.95, 5.79971E+03, 1256.68,
       184.95, 5.66132E+03, 1257.02,
       189.95, 5.52672E+03, 1257.37,
       194.95, 5.39975E+03, 1257.71,
       199.95, 5.27656E+03, 1258.04,
       200.00, 5.27537E+03, 1258.04,
       200.00,           0,       0,
          2E7,           0,       0 $END
$LIST POOL=401,    0,        0,       0,
                 2E7,        0,       0 $END
$LIST POOL=501,    0,        29E3,     34.6E6,
                1800,        29E3,     34.6E6,
                1800,           0,          0,
                 2E7,           0,          0 $END
$LIST POOL=601,    0,     7.2E4,     6.336E6,
                0.05,     7.2E4,     6.336E6,
                0.05,       0.0,         0.0,
                 2E7,        0,          0 $END
$LIST POOL=701,    0,     0,     0,     0,
                 2E7,     0,     0,     0 $END
$LIST POOL=801,
       0,        0,   0,   0,   100,   100,
```

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        23,        0,   0,   0,   100,   100,
        25, 0.4973E5,   0,   0,   100,   100,
        30, 1.2184E5,   0,   0,   100,   100,
        35, 2.6357E5,   0,   0,   100,   100,
        40, 3.0584E5,   0,   0,   100,   100,
        45, 3.3567E5,   0,   0,   100,   100,
        50, 7.9567E5,   0,   0,   100,   100,
       1E4, 7.9567E5,   0,   0,   100,   100,
       1E4,      0.0,   0,   0,   100,   100,
       1E7,      0.0,   0,   0,   100,   100 $END
$LIST POOL=901,     0,     0,     0,
                   2E7,     0,     0 $END
$LIST POOL=1001,    0,   100,   2.0,
                   24,   100,   2.0 $END
$LIST POOL=1101,  105,       0,
                  120,  1.67E6,
                  130,  3.02E6,
                  140,  4.57E6,
                  150,  6.32E6,
                  160,  8.27E6,
                  170, 10.40E6,
                  180, 12.73E6,
                  190, 15.23E6,
                  200, 17.88E6,
                  210, 20.68E6,
                  220, 23.61E6,
                  230, 26.64E6,
                  240, 29.74E6,
                  250, 32.91E6,
                  260, 36.11E6,
                  270, 39.31E6,
                  280, 42.52E6,
                  287, 44.74E6,
                  290, 45.69E6,
                  300, 48.82E6 $END
$LIST POOL=1201,   0,  0.729,
                  0.1,  0.737,
                  0.2,  0.747,
                  0.3,  0.757,
                  0.4,  0.771,
                  0.5,  0.788,
                  0.6,  0.809,
                  0.7,  0.832,
                  0.8,  0.863,
                  0.9,  0.912,
                  1.0,  0.961,
                  1.1,  0.983,
                  1.2,  0.995,
                  1.3,  1.000 $END
$LIST POOL=9001,   1,  0.05,    0.1,  10,
                   5,  0.05,    0.2,  20,
                  20,  0.05,    1.0,   5,
                 100,  0.10,    1.0,  10,
                 160,  0.50,    2.0,  10,
                 200,   1.0,    5.0,   4,
                 300,   1.0,   10.0,   5,
                 600,   1.0,   25.0,   4,
                 1E3,   5.0,   50.0,   4,
                 2E3,  10.0,  250.0,   2,
                 5E3,  10.0,  250.0,   4,
                 1E4,  25.0,  500.0,   5,
```

```
                    1E5,  50.0,    5E3,   2 $END
 $LIST POOL=9999 $END
* HS #1 - REACTOR BUILDING DOME
 $LIST POOL=101001, 57, 14, 0, 0, 0, 0, 33017 $END
 $LIST POOL=101101,  4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                     5, 0.02201, 4, 0.03001, 4, 0.04601, 4. 0.07801,
                     4, 0.14201, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                     4, 2.06201, 4, 4.06368 $END
 $LIST POOL=101201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=101300, 0, 0 $END
 $LIST POOL=101400, 9, 2, 1, 1 $END
* HS #2 - REACTOR BUILDING CYLINDER ABOVE 30 FT
 $LIST POOL=102001,  58, 14, 0, 0, 0, 0, 34067 $END
 $LIST POOL=102101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                    4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 5, 4.35534 $END
 $LIST POOL=102201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=102300, 0, 0 $END
 $LIST POOL=102400, 9, 2, 1, 1 $END
* HS #3 - REACTOR BUIDING CYLINDER WALL BELOW 30 FT
 $LIST POOL=103001,  58, 14, 0, 0, 0, 0, 5535 $END
 $LIST POOL=103101, 4, 0.00024, 5, 0.00083, 2, 0.02166, 4, 0.02170,
                    5, 0.02201, 4, 0.03001, 4, 0.04601, 4, 0.07801,
                    4, 0.14210, 4, 0.27001, 4, 0.52601, 4, 1.03801,
                    4, 2.06201, 5, 4.35534 $END
 $LIST POOL=103201, 4, 4, 1, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=103300, 0, 0 $END
 $LIST POOL=103400, 9, 2, 0, 1 $END
* HS #4 - REACTOR BUILDING BASEMAT (Excluding Rx Cavity Basemat)
 $LIST POOL=104001, 42, 10, 0, 0, 0, 0, 12773 $END
 $LIST POOL=104101, 4, 0.00417, 4, 0.02417, 4, 0.06417, 4, 0.14417,
                    4, 0.30417, 4, 0.62417, 4, 1.26417, 4, 2.54417,
                    4, 5.10417, 5, 11.00417 $END
 $LIST POOL=104201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=104300, 0, 0 $END
 $LIST POOL=104400, 3, 3, 0, 1 $END
* HS #5 - REACTOR CAVITY BASEMAT & STEAM GENERATOR PEDESTALS
 $LIST POOL=105001, 40, 10, 0, 0, 0, 0, 1644 $END
 $LIST POOL=105101, 4, 0.00294, 4, 0.02294, 4, 0.06294, 4, 0.14294,
                    4, 0.30294, 4, 0.62294, 4, 1.26294, 4, 2.54294,
                    4, 5.10294, 3, 8.39548 $END
 $LIST POOL=105201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=105300, 0, 0 $END
 $LIST POOL=105400, 3, 3, 0, 1 $END
* HS #6 - REACTOR CAVITY BELOW ELEV. 17' - 6"
 $LIST POOL=106001, 42, 10, 0, 0, 0, 0, 1546 $END
 $LIST POOL=106101, 4, 0.00250, 4, 0.02250, 4, 0.06250, 4, 0.14250,
                    4, 0.30250, 4, 0.62250, 4, 1.26250, 4, 2.54250,
                    4, 5.10250, 5, 10.75250 $END
 $LIST POOL=106201, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=106300, 0, 0 $END
 $LIST POOL=106400, 3, 3, 0, 1 $END
* HS #7 - REACTOR CAVITY WALLS ABOVE ELEV. 17'- 6"
 $LIST POOL=107001, 61, 14, 0, 0, 0, 0, 1311 $END
 $LIST POOL=107101, 4, 0.00024, 4, 0.00060, 8, 0.00250, 4, 0.00650,
                    4, 0.01450, 4, 0.03050, 4, 0.06250, 4, 0.12650,
                    4, 0.26850, 4, 0.52450, 4, 1.03650, 4, 2.06050,
                    4, 4.10850, 4, 8.35833 $END
 $LIST POOL=107201, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
 $LIST POOL=107300, 0, 0 $END
```

Note: See Originator's Note for HS#7 right boundary co-ordinate on sheet 127.

```
$LIST POOL=107400, 9, 2, 0, 2 $END
* HS #8 - LINED REFUELING CANAL WALLS AND FLOOR
$LIST POOL=108001, 50, 13, 0, 0, 0, 0, 9192 $END
$LIST POOL=108101, 4, 0.01563, 4, 0.01566, 4, 0.01571, 4, 0.01583,
                   3, 0.01598, 4, 0.02598, 4, 0.04598, 4, 0.08598,
                   4, 0.16598, 4, 0.32698, 4, 0.64598, 4, 1.28598,
                   2, 2.01598 $END
$LIST POOL=108201, 3, 5, 5, 5, 5, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=108300, 0, 0 $END
$LIST POOL=108400, 9, 2, 0, 2 $END
* HS #9 - UNLINED EXTERIOR FACES OF REFUELING CANAL WALLS
$LIST POOL=109001, 45, 12, 0, 0, 0, 0, 11050 $END
$LIST POOL=109101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 4, 1.27250, 2, 2.00250 $END
$LIST POOL=109201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2, 2, $END
$LIST POOL=109300, 0, 0 $END
$LIST POOL=109400, 9, 2, 0, 2 $END
* HS #10 - STEAM GENERATOR COMPARTMENT WALLS MISSLE SHIELDS
$LIST POOL=110001, 46, 11, 0, 0, 0, 0, 43085 $END
$LIST POOL=110101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 2, 0.00250,
                   4, 0.01250, 4, 0.03250, 4, 0.07250, 4, 0.15250,
                   4, 0.31250, 4, 0.63250, 7, 1.71909 $END
$LIST POOL=110201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=110300, 0, 0 $END
$LIST POOL=110400, 9, 2, 0, 2 $END
* HS #11 - STEAM GENERATOR COMPARTMENT WALLS WITH EMBEDS
$LIST POOL=111001, 53, 12, 0, 0, 0, 0, 6914 $END
$LIST POOL=111101, 4, 0.00024, 5, 0.00083, 4, 0.08250, 4, 0.08490,
                   4, 0.08970, 4, 0.09930, 4, 0.11850, 4, 0.15690,
                   4, 0.23370, 4, 0.38730, 4, 0.69450, 7, 1.77167 $END
$LIST POOL=111201, 4, 4, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=111300, 0, 0 $END
$LIST POOL=111400, 9, 2, 0, 2 $END
* HS #12 - TOP HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=112001, 44, 10, 0, 0, 0, 0, 17474 $END
$LIST POOL=112101, 4, 0.00024, 4, 0.00072, 4, 0.00168, 5, 0.00417,
                   4, 0.01417, 4, 0.03417, 4, 0.07417, 4, 0.15417,
                   4, 0.31417, 6, 0.75417 $END
$LIST POOL=112201, 4, 4, 4, 4, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=112300, 0, 0 $END
$LIST POOL=112400, 9, 2, 0, 2 $END
* HS #13 - LOWER HALF-THICKNESS OF ELEVATED FLOOR SLABS
$LIST POOL=113001, 48, 12, 0, 0, 0, 0, 23240 $END
$LIST POOL=113101, 2, 0.00521, 4, 0.00553, 4, 0.00617, 4, 0.00745,
                   4, 0.01001, 4, 0.01513, 4, 0.02537, 4, 0.04585,
                   4, 0.08681, 4, 0.16873, 4, 0.33257, 5, 0.75556 $END
$LIST POOL=113201, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2 $END
$LIST POOL=113300, 0, 0 $END
$LIST POOL=113400, 9, 2, 0, 2 $END
* HS #14 - LIFTING DEVICES (CARBON STEEL)
$LIST POOL=114001, 17, 3, 0, 0, 0, 0, 59265 $END
$LIST POOL=114101, 4, 0.00024, 8, 0.00125, 4, 0.04133 $END
$LIST POOL=114201, 4, 4, 1 $END
$LIST POOL=114300, 0, 0 $END
$LIST POOL=114400, 9, 2, 0, 2 $END
* HS #15 - MISCELLANEOUS CARBON STEEL - THICKNESS > 2.50 INCHES
$LIST POOL=115001, 18, 4, 0, 0, 0, 0, 2248 $END
$LIST POOL=115101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.22136 $END
$LIST POOL=115201, 4, 4, 1, 1 $END
$LIST POOL=115300, 0, 0 $END
```

Note: See Originator's Note for HS#13 first and final concrete region right boundary coordinates on sheet 128.

```
 $LIST POOL=115400, 9, 2, 0, 2 $END
* HS #16 - MISCELLANEOUS CARBON STEEL: 1.00"<THICKNESS</=2.50"
 $LIST POOL=116001, 16, 3, 0, 0, 0, 0, 9230 $END
 $LIST POOL=116101, 4, 0.00024, 5, 0.00083, 6, 0.13113 $END
 $LIST POOL=116201, 4, 4, 1 $END
 $LIST POOL=116300, 0, 0 $END
 $LIST POOL=116400, 9, 2, 0, 2 $END
* HS #17 - MISCELLANEOUS CARBON STEEL: 0.50"<THICKNESS</=1.00"
 $LIST POOL=117001, 14, 3, 0, 0, 0, 0, 8718 $END
 $LIST POOL=117101, 4, 0.00024, 5, 0.00083, 4, 0.06371 $END
 $LIST POOL=117201, 4, 4, 1 $END
 $LIST POOL=117300, 0, 0 $END
 $LIST POOL=117400, 9, 2, 0, 2 $END
* HS #18 - MISCELLANEOUS CARBON STEEL: THICKNESS</=0.5"
 $LIST POOL=118001, 14, 3, 0, 0, 0, 0, 158755 $END
 $LIST POOL=118101, 4, 0.00024, 5, 0.00083, 4, 0.02275 $END
 $LIST POOL=118201, 4, 4, 1 $END
 $LIST POOL=118300, 0, 0 $END
 $LIST POOL=118400, 9, 2, 0, 2 $END
* HS #19 - ELECTRICAL EQUIPMENT & OTHER GALVANIZED STEEL
 $LIST POOL=119001, 4, 1, 0, 0, 0, 0, 131698 $END
 $LIST POOL=119101, 3, 0.00879 $END
 $LIST POOL=119201, 1 $END
 $LIST POOL=119300, 0, 0 $END
 $LIST POOL=119400, 9, 2, 0, 2 $END
* HS #20 - MISCELLANEOUS STAINLESS STEEL
 $LIST POOL=120001, 5, 1, 0, 0, 0, 0, 26893 $END
 $LIST POOL=120101, 4, 0.01459 $END
 $LIST POOL=120201, 3 $END
 $LIST POOL=120300, 0, 0 $END
 $LIST POOL=120400, 9, 2, 0, 2 $END
* HS #21 - REACTOR BUILDING STIFFENED SECTIONS ABOVE ELEV. 30 FT
 $LIST POOL=121001, 44, 10, 0, 0, 0, 0, 3764 $END
 $LIST POOL=121101, 4, 0.00024, 5, 0.00083, 4, 0.08083, 4, 0.24083,
                    4, 0.52166, 4, 0.52201, 4, 0.54201, 4, 0.94201,
                    4, 1.74201, 6, 4.17659 $END
 $LIST POOL=121201, 4, 4, 1, 1, 1, 5, 2, 2, 2, 2 $END
 $LIST POOL=121300, 0, 0 $END
 $LIST POOL=121400, 9, 2, 1, 1 $END
 $LIST POOL=410001,
            25,     54,
           0.8,     30,
            10,     54,
          0.15,     20,
        0.0174, 0.0103 $END
 $LIST POOL=500000 $END
```

Note: See Originator's Note for HS#18 area and right boundary coordinate on sheet 129.

Case 5 - MSLB @ 102% Power w/Cooling Train Failure

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*CASE 5 - 8.85 FT2 SLOT MSLB @ 102% POWER W/CT FAILURE: N-4080-027R1
 $LIST POOL=0,0,1,0,1 $END
 $LIST POOL=1,1E4,16.8,2.305E6,120,0.05,21,0.0,1,1,0.00,14.7,0.5 $END
 $LIST POOL=2,0,0,0,0,0,2.0,2E7 $END
 $LIST POOL=3,0,0,0,0,0,2E7,0,0,0,0 $END
 $LIST POOL=4,0,0,0,0,0,0,0,0,0,0,0,0,0 $END
 $LIST POOL=5,2,50,2E7,0,0 $END
 $LIST POOL=6,0,0,0 $END
 $LEAK NOPEN=0 $END
 $LIST POOL=101,    0,     0,
                  2E7,     0 $END
```