50-255 PALISADES CPC

MINIMUM TEMPERATURE OF MULTI-ASSEMBLY SEALED BASKET SHIELD LID PLATE AFTER 20 YEARS AND 50 YEARS

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ATTACHMENT 1

CONSUMERS POWER COMPANY
PALISADES PLANT
DOCKET 50-255

MINIMUM TEMPERATURE OF MULTI-ASSEMBLY SEALED BASKET (MSB) SHIELD LID PLATE AFTER 20 YEARS AND 50 YEARS

69 Pages

Consumers Power
POWERING MICHIGAN'S PROGRESS

PALISADES NUCLEAR PLANT
ENGINEERING ANALYSIS COVER SHEET

EA-SC-93-083-22

Total Number of Sheets 65

Minimum Temperature of MSB Shield Lid Plate After 20 years and 50 years

INITIATION AND REVIEW

Calculation Status: Preliminary ☐ Pending ☐ Final ☒ Superseded ☐

Rev #	Description	Initiated By	Initiated Date	Init Appd By	Review Method: Alt Calc	Review Method: Detail Review	Review Method: Qual Test	Technically Reviewed By	Technically Reviewed Date	Revr Appd By	CPCo Appd
0	Original Issue	P. Hoang	8/18/95					James Wong	8-29-95		

1.0 **OBJECTIVE**

The objective of this engineering analysis is to calculate the minimum temperature of Multi-Assembly Sealed Basket (MSB) shield lid plate of CMSB-01 through 04 after 20 years and 50 years of service when the ambient temperature is at 0°F. This analysis was performed to reinforce the 10°F movement restriction on CMSB-01 through 04.

1.1 **BACKGROUND**

Per the requirements of Section 1.2.13 of the Certificate of Compliance Number 1007 under 10CFR72, movement of a loaded MSB when it is inside the Ventilated Concrete Cask (VCC) is only permitted at an ambient temperature of 0°F or above. This limitation is based on the MSB shell material having a minimum Charpy impact energy of 15 ft-lbs at -50°F. The temperature limit for MSB movement, therefore, is established by adding a margin of 50°F to the above test temperature.

The MSB shield lid plate material of CMSB-01 through 04 was not initially considered to be a structural component by the vendor; therefore, a Charpy impact test was not required. Subsequent Charpy testing indicated that the shield lid plate material of the above CMSBs exhibited at least 15 ft-lbs of impact energy at a test temperature of -40°F. The minimum temperature at which the MSBs can be moved is 50°F above the Charpy test temperature of -40°F. Based on the test data, the future movement of those CMSBs is limited to ambient temperature of 10°F or above to prevent brittle failure.

In this analysis, a calculation similar to those in Chapter 4 of the Safety Analysis Report (SAR) is performed to determine the minimum temperature of the MSB shield lid plate of CMSB-01 through 04 after 20 years and 50 years of operation and with ambient temperature of 0°F. The analysis will first calculate the decay fuel heat generation rate of all four loaded MSBs after 20 years and 50 years of operation. The lowest heat generation rate case will be used in a thermal hydraulic analysis for MSB shell temperature distribution.

Reference/Comment

	Reference/Comment

2.0 **ANALYSIS INPUT**

2.1 **GOVERNING DESIGN PRINCIPLES AND DOCUMENTS**

2.1.1 Safety Analysis Report (SAR) for the Ventilated Storage Cask System, PSN-91-001, Rev. 0

2.1.2 Safety Evaluation Report (SER) for the SAR, dated April 28, 1993

2.1.3 NUREG/CR-2397, "Fuel Inventory and afterheat Powers Studies of Uranium-Fueled Pressurized Water Reactor Fuel Assemblies Using the SAS2 and ORIGEN S Modules of Scale with an ENDF/B-V Updated Cross section Library", September 1982.

2.1.4 ANSYS Computer Program and Users Manual Volume I & II, Version 4.4A

2.1.5 Procedure No 4.43, Attachment 6, Revision 3, 3A (Fuel Data)

2.1.6 E-HAR-94-01, Attachment 9 (Heat Load)

2.2 **DESIGN DRAWINGS**

2.2.1 MSB Drawings Dwg. No.: VEN-C-136C:
Sht. 4, Rev. A
Sht. 7, Rev. A
Sht. 8, Rev. A
Sht. 9, Rev. A

2.2.2 VCC Drawings Dwg. No.: VEN-C-136B,
Sht. 2, Rev. 3A
Sht. 3, Rev. 3A
Sht. 4, Rev. 3A
Sht. 5, Rev. 2A
Sht. 6, Rev. 2A
Sht. 7, Rev. 2A
Sht. 8, Rev. 2A
Sht. 9, Rev. 3A
Sht. 11, Rev. 2A
Sht. 12, Rev. 2A
Sht. 13, Rev. 32A
Sht. 14, Rev. 0A

Reference/Comment

2.3 **EXISTING ANALYSIS**

2.3.1 E-SC-93-083-10, "Heat Transfer Analysis of the Ventilated Storage Cask (VSC)", Rev O

2.4 **REFERENCE**

2.4.1 ANSYS 4.4 A Verification, E-CRW-91-03

2.4.2 ANSYS Verification Manual Version 4.4A

2.4.3 ANSYS Theoretical Manual Version 4.4.A

2.4.4 Graphics Supplement for ANSYS Revision 4.A on Personal Computers, Swanson Analysis Systems, Inc UpdO DN-G103:44A December 1, 1990

2.5 **SOURCE DOCUMENTS**

2.5.1 Principles of Heat Transfer by Frank Kreith, Third Edition

2.6 **PROCEDURES**

2.6.1 FHS-M-32, "Loading and Placing the VSC Into Storage"

2.7 **GEOMETRY AND MATERIALS**

The geometry and the materials used in the analysis were the same VSC model established in the Heat Transfer Analysis of the Ventilated Storage Cask (VSC) (Ref. 2.3.1) which is the same as the model used in SAR (Ref. 2.1.1).

2.8 **PHYSICAL PROPERTIES**

All physical properties of the model are from the generic VSC model established for Heat Transfer Analysis of the Ventilated Storage Cask (Ref. 2.3.1). For 0°F ambient temperature, the density, thermal conductivity and specific heat of air were modified from the generic VCC model.

Reference/Comment

2.9 **HEAT GENERATION RATES**

For the purpose of the calculation, the heat generation rates of CMSB-01, -02, -03 and -04 were calculated based on the "typical" tabulated data given the Appendix C of NUREG/CR-2397. The "conservative" data from the same reference was used in the SAR (Ref. 2.1.1).

2.10 **AMBIENT TEMPERATURE**

Ambient temperature of 0°F is considered in the analysis.

3.0 **ASSUMPTIONS**

3.1 **MAJOR ASSUMPTIONS**

None

3.2 **MINOR ASSUMPTIONS**

3.2.1 The typical heat generation data given in the NUREG CR-2397 Appendix C is applied in this EA. This typical tabulated data may not be the lower bound of the heat generation. Nonetheless, the impact due to the variation of heat generation should not be of any significance.

3.2.2 The minor assumptions identified in the Heat Transfer Analysis of the VSC (Ref. 2.3.1) are applicable for this calculation.

4.0 **ANALYSIS APPROACH**

4.1 **HEAT LOAD CALCULATION**

Afterheat power or heat generation rate of uranium-fueled PWR fuel computed by the SAS2/ORIGEN-S method for typical and conservative irradiation histories are provided in Appendix C of NUREG/CR-2397 (Ref. 2.1.3). A simple procedure for afterheat power calculation by linear interpolation of the tabulated data is also provided. (Pg. 71, Ref. 2.1.3). The conservative data in Appendix C of NUREG/CR-2397 was used in the SAR to calculate maximum heat load for the VSC-24 system. The typical data which provides lower heat rate is used for the purpose of calculating the minimum temperature of the MSB shield lid plate.

Reference/Comment

4.2 **THERMAL HYDRAULIC CALCULATION**

The dry spent fuel assemblies inside the MSB generate heat that is transferred to the MSB outer shell. When the MSB is placed inside a VCC, heat from the MSB shell is convected to the air in the gap between the MSB shell and the VCC inner liner, and radiated to the VCC internal liner. The heat from the VCC internal liner is also convected to the air and a small amount is conducted through the VCC shell to the exterior. The heated air in the gap between the MSB shell and VCC inner liner rises and exits through the top vents and is replaced by the 0°F ambient air entering through the bottom vents (natural convection).

On a sunny day additional heat enters the exterior surfaces of the VCC as solar radiation and is convected and radiated to the environment from the VCC surfaces. However, for the purpose of this EA, the solar energy is conservatively neglected.

5.0 **ANALYSIS**

5.1 **HEAT LOAD CALCULATION**

The detailed heat load calculation is provided in Attachment A and the following is a summary of the Analysis.

5.1.1 Heat Load Curve for a Lower Bound Burnup Value

The burnup value of some fuel cells is lower than the range of burnup value given in the tabulated data of Appendix C of NUREG/CR-2397. However, a plot of afterheat power as a function of burnup (Figure A.1, Attachment A of this report) shows that the heat load is nearly linear with respect to the burnup when the burnup level is low. Therefore, an approximate data for a lower bound burnup value of 10 GWD/MTU could be generated by a linear extrapolation. Plots of afterheat curves of many burnup levels are shown in Figure A.2 of Attachment A of this report

5.1.2 Heat Load Rate Interpolation Functions for a Given Burnup Value at a Given Time

A two dimensional (burnup and time) linear interpolation function for the above afterheat power data is setup using a MATHCAD linear interpolation function. The function KW(t,b)in the attachment A is the afterheat powers of burnup level b (GWD/MTU) at time t (days).

Reference/Comment

5.1.3 Check the Heat Load Rate Interpolation Functions Against the Input Data

A check for the heat load rate function KW(t,b) with the input data was performed in section 4.0 of the Attachment A to verify that the interpolation function reproduces the data given in Appendices C of NUREG/CR-2397. The result indicates that the interpolation function successfully reproduce the input data.

5.1.4 Check the Heat Load Rate Interpolation Functions With the Heat Load of CMBS-04 Provided in Reference 2.1.5

Heat load of CMSB-04 calculated in Reference 2.1.6 is 9.34 KW. This value was based on the conservative data in the Appendix C of NUREG/CR-2397. The total heat load of CMSB-04 calculated in Section A.5 of Attachment A using the interpolation function KW(t,b) is 9.023 KW. The total calculated heat load is 3.8% lower than the total heat load reported in Reference 2.1.6. The deviation is the about the same deviation of the "typical" and "conservative" data in NUREG/CR 2397, Table C.2, Case 3 at cooling time=10 years. This result is an additional validation of the interpolation function.

5.1.5 Heat Generation Rate Calculation

Fuel data of each fuel cell of each loaded CMSB is available in Reference 2.1.5 and is included in the Attachment B of this EA. Data used in heat generation rate calculation includes:

- Initial weight of Uranium (MTU)
- Burn-up (MWD/MTU)
- Discharge date
- MSB loading date

The total cooling time t (day) is the sum of time from the fuel bundle discharge date to the date of loading into MSB plus the storage time period of 20 years and 50 years.

The evaluation period of 20 years and 50 years are based on the minimum design life requirements specified in 10CFR72,236(g) and the design life stated in SAR, respectively.

The total cooling time t (day) and the burn-up b (MWD/MTU) are substituted into the interpolation function KW (t,b) to obtain the afterheat power per unit weight of Uranium. The heat generation rate for each cell is the afterheat power times the initial Uranium weight

Reference/Comment

and converted to Kilowatt. The total heat generation is the sum of heat generation of each of 24 cells of the MSB.

From the fuel data in Attachment B, the total heat load of CMSB-03 is the lowest heat rate of the four CMSBs. The total heat generation rates of CMBS-03 and -04 after 20 years and 50 years in storage are calculated and presented in Tables A.1 through A.4 respectively. The result shows that CMSB-03 has the lowest heat generation rate which is 5.97 KW and 3.883 KW after 20 years and 50 years of storage respectively.

Therefore, the case of CMSB-03 will be analyzed to determine the lowest temperature of the MSB shield lid plate subjected to 0°F ambient temperature.

5.2 THERMAL HYDRAULIC CALCULATION

5.2.1 Analysis Models

A detailed description of the heat transfer mechanism inside a MSB/VCC assembly (VSC-Ventilated Storage Cask), applicable heat transfer models and the governing equations are included in the SAR Section 4.4.1 (Ref. 2.1.1). The SAR Figure 1.1.1 (Ref. 2.1.1) illustrates the VSC and its components.

The MSB contains dry fuel assemblies that generates heat which is transferred to the MSB shell. The heat from the MSB shell is transferred to the air in the gap between the MSB Shell and the concrete cask liner, and to the concrete cask. The hot air in the gap between the MSB shell and the concrete cask liner rises and exits through the air outlet at the top and is replaced by the air entering at the bottom air inlet duct. Most of the heat is transferred to the environment by the above natural convection and a small amount is transferred through the concrete cask.

The heat rate generated by the fuel inside the MSB, any applicable solar radiation, ambient temperature and temperature of the air flowing through the gap between the MSB shell and the concrete cask liner are the main parameters affecting the temperature distribution in the MSB and the VCC. The air temperature in the gap at various elevations is a function of the heat generation rate, the ambient temperature and the convective mass flow rate. The mass flow rate is dependant on the amount of heat removed by natural convection, the flow resistance in the natural convection flow path

Reference/Comment

and the ambient temperature. The relationship among the above variables is defined the SAR Equation 4.1 (Ref. 2.1.1, Section 4.4.1.1).

5.2.2 Convective Air Flow and Temperature Calculations

The air flow up the annular gap between the MSB shell and the VCC inner liner is calculated by determining the sum of the flow pressure losses due to all entrances, bends, straight sections, expansions, contractions and exits and equating to the pressure differential caused by heating the air(i.e. stack or furnace effect). The governing equations are defined in the SAR Section 4.4.1.1 (Ref. 2.1.1). The equation can be iteratively solved by assuming a VCC air outlet temperature and checking to see whether the left hand side of SAR Equation 4.2 (stack pressure) is equal to the right hand side (flow pressure loss). If the left hand side is lower, then the assumed outlet temperature should be increased and if it is higher then the outlet temperature should be reduced. Once the value of air outlet temperature is determined, the air mass flow rate and the air temperature at various elevations of the annular air gap can be easily calculated. Attachment C of Reference 2.1.2 contains the details of the calculation procedure. The final iteration of the air flow and temperature calculation is included in the VCC Body and MSB Exterior Thermal Model discussed below.

5.2.3 VCC Body and MSB Exterior Thermal Model

The heat transfer model of the VSC (including the simplified model of the MSB) is explained in the SAR Section 4.4.1.2 (Ref. 2.1.1). The heat transfer analysis of the VSC is performed using the ANSYS computer program and the applicable VSC ANSYS Thermal Model is shown on the SAR Figure 4.4-2 (Ref. 2.1.1).

The generic ANSYS input data for the above model and the instructions for using the ANSYS model for performing a thermal analysis of the VSC is included in Attachment D of Reference 2.3.1. The above can be used to perform a steady state or transient analysis of the VSC. The final iteration of the Convective Air Flow and Temperature Calculations, similar to those in References 2.3.1 is also included in the ANSYS model. Therefore there is no need for a separate spread sheet calculations to document the convective air flow and bulk air temperature calculations.
The ambient temperature, the MSB heat generation rates at the end of 20 years and 50 years of storage, air flow loss coefficient, average specific heat of air (CPAI), average air density(DENA) and the

Reference/Comment

assumed VCC outlet air temperature (TOAS) are the input to this ANSYS input deck. The ANSYS output must be reviewed to ensure that the flow pressure loss (DP FLOW) is equal to the pressure change due to air heating (DP STACK) and that the calculated air outlet temperature (TOCA) matches to the assumed value (TOAS). The formulas for average specific heat (CPAI) and average density (DENA) are modified to the air properties at 0°F. The temperature distribution in the VCC and the MSB shell outside surface are the output from this analysis.

5.2.4 Computer Input Deck

The ANSYS thermal hydraulic analysis for a VSC is performed in two parts.

They are:

1. the iterative air flow calculations for determining the air mass flow rate and bulk air temperatures,

2. the computer analysis of MSB/VCC using the ANSYS program.

The iterative air flow calculations are explained in Attachment C of EA-SC-93-83-10 (Ref. 2.3.1). The calculations are used to calculate the assumed value of the VCC air outlet temperature for input into the VCC ANSYS Model. The applicable formulas are included in the VCC ANSYS model. However, ANSYS program cannot perform the iterative calculations. The air flow calculations should be manually performed to calculate the value of the VCC air outlet temperature and the value should be input into the VCC ANSYS model. The VCC ANSYS analysis documents the final iteration of the air flow calculation and therefore there is no need to document the air flow calculations separately.

The ANSYS computer model of the VCC includes the final iteration of the air flow calculation is provided in Attachment C of this EA (File MSB3-20 and MSB3-50 dated 08/02/95). These two files are modified from the generic model provided in Attachment C of Reference 2.3.1.

The modification includes:

The heat generation rates
- 5.97 KW for MSB-03 after 20 years of storage
- 3.885 KW for MSB-03 after 50 years of storage

Reference/Comment

and the following air properties which are applicable for 0°F ambient condition:
- Air specific heat CPAI = 0.239
- Air density: DENA= 0.081+ 0.005*(32-TAKE)/32

These values are from SAR (Ref. 2.1.1, page 4-5)

5.3 ANALYSIS PERFORMED

The steady state thermal analysis of a loaded VSC was performed for the combinations of following operating conditions:

a. Heat Gen. 5.97 KW, Amb 0 °F, No Solar Load

b. Heat Gen. 3.885 KW, Amb 0 °F, No Solar Load

5.3.1 List of Computer Input Files

Computer Input Files
(No File Extension)

Input Name	Date	Analysis Description
MSB3-20	08/02/95	Heat Gen. 5.97 KW, Amb 0 °F
MSB3-50	08/02/95	Heat Gen. 3.885 KW, Amb 0 °F

5.3.2 List of Computer Output Files

Table 5.3.2
Computer Output Files

Output Name	Date	Analysis Description
MSB3-20.OUT	08/02/95	Heat Gen. 5.97 KW, Amb 0 °F
MSB3-50.OUT	08/02/95	Heat Gen. 3.883 KW, Amb 0 °F

5.3.3 Summary of MSB Shell Temperatures

The steady state temperature distribution of the MSB shell outside surface are included in the computer output files listed in Section 5.3.2 (Attachment D of this E). The temperature distribution resulted from the above analyses is presented in Figure 1 and 2. The lowest temperature of the MSB shield lid is 22°F after 20 years and 16°F after 50 years when the ambient temperature is 0°F.

Reference/Comment

5.3.4 Warning Massages

The ANSYS/PREP contain warning messages related to the shape of the Element No. 29 which represents the gap between the MSB bottom plate and the fuel assembly. The effect of these warning messages, if there is any, should only pertain to the Element 29. These warning messages have been reviewed and determined to be inconsequential to the results of this EA. There should be no impact on the predicted temperature of the shield lid.

6.0 RESULTS AND CONCLUSIONS

CMSB-03 had the lowest heat generation rates among CMSB-01 through CMSB-04. The heat generation rates were 5.97KW and 3.883KW after 20 years and 50 years in storage with 0°F ambient temperature.

The result of the ANSYS thermal hydraulic analysis indicates that the lowest temperature of the MSB shield lid plate is 22°F for the case of 20 years and 16°F for the case of 50 years of storage.

The typical tabulated data used in this analysis may not be the lower bound of the heat generation. As stated in Subsection 5.1.3, the deviation of the "typical" and "conservative" data in NUREG/CR2397 is about 3.8%. The lower bound of heat generation and the lowest temperature of the MSB shield lid plate can be predicted by using the deviation between the typical and conservative (3.8%). The impact due to the variation of the heat load data presented in NUREG/CR2397 is not significant.

ANSYS RESULTS VCC THERMAL CHARACTERISTICS FOR 5.97 KW HEAT LOAD (VSC#3)

: Note: VSC#3 = 5.97 KW AFTER 20 Years.

AMBIENT = 0 °F

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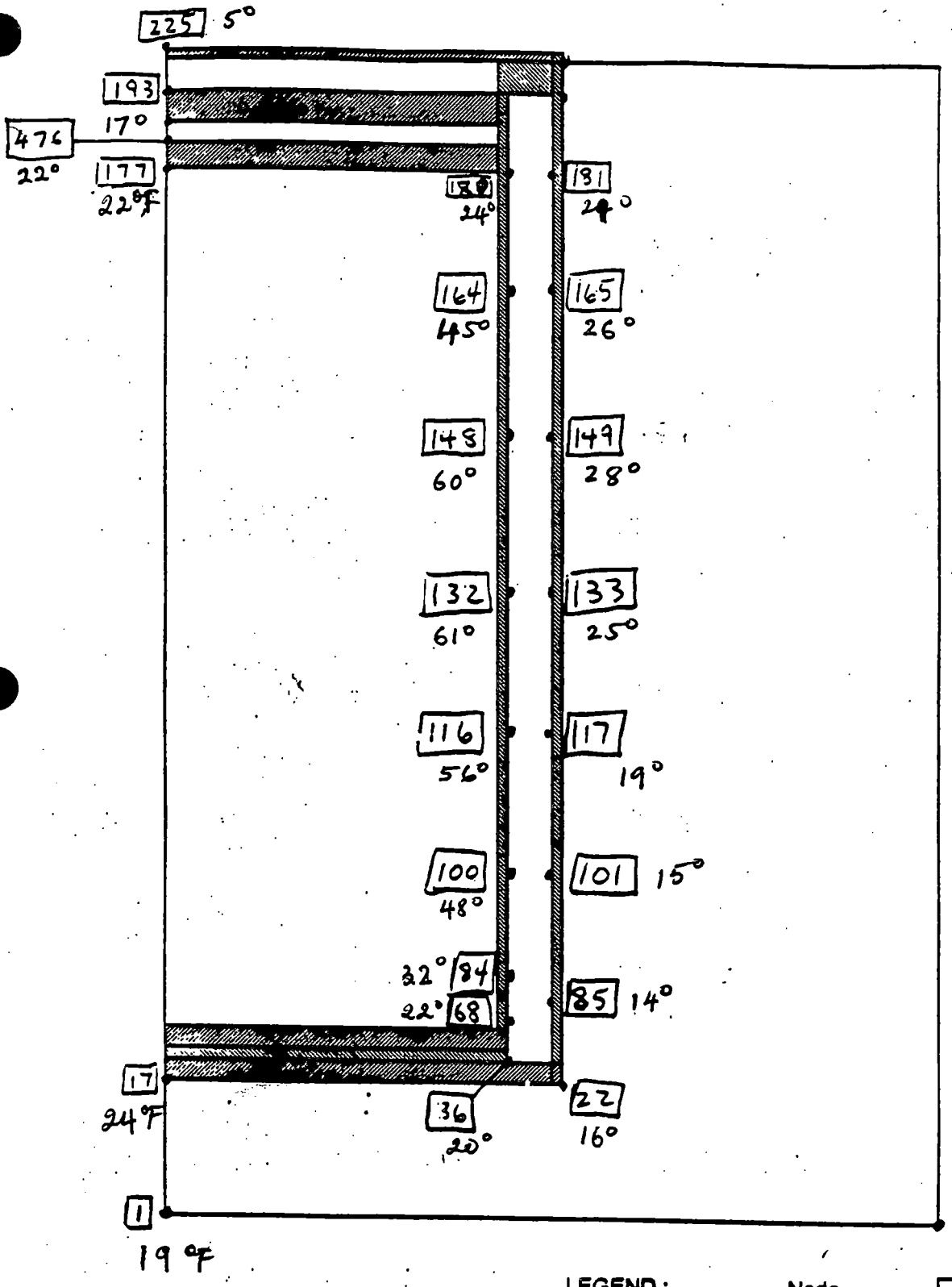
SHEET 13



LEGEND: Node Temperature xxx xxx

ANSYS FILE : MSB3_20.

FIGURE 1 : TEMPERATURE DISTRIBUTION AFTER 20 YEARS

MSB3 VCC THERMAL CHARACTERISTICS FOR 3.885 KW HEAT LOAD (VSC#3)

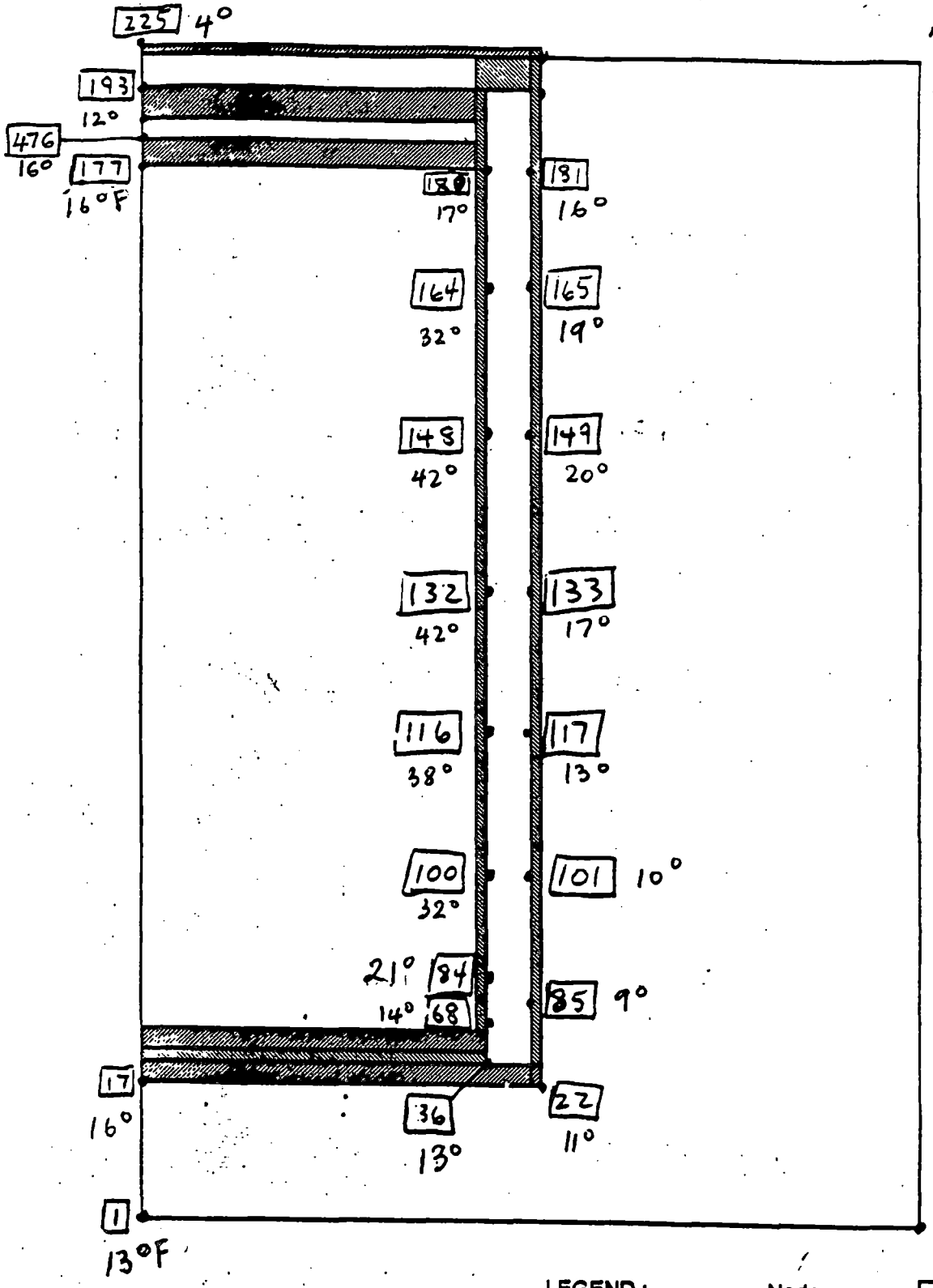
RESULTS

∴ Note: VSC#3 = 3.885 KW AFTER 50 Years

AMBIENT = 0°F

EA-SC-93-083-2

SHEET 14



LEGEND: Node xxx Temperature xxx

ANSYS FILES MSB3_50.

FIGURE 2 : TEMPERATURE DISTRIBUTION AFTER 50 YEARS

Attachment A
(13 pages)

HEAT GENERATION RATE CALCULATION

SPENT FUEL HEAT LOAD CURVES

Spent fuel heat load curves are generated using the interpolation methodology given in NUREG/CR-2397

- The "typical" tabulated data given in the Appendix C of NUREG/CR-2397 was used because it results in a best estimate head load which is appropriate for the purpose of calculating the minimum temperature after 20 years and 50 years of storage.

1.0 Input data :

$$pp := \begin{bmatrix} 2.222\cdot10^6 & 2.165\cdot10^6 & 2.173\cdot10^6 & 2.17\cdot10^6 & 2.149\cdot10^6 & 2.102\cdot10^6 \\ 71832 & 77597 & 80557 & 83617 & 86349 & 90862 \\ 40350 & 44554 & 46852 & 49271 & 51423 & 54968 \\ 26867 & 30426 & 32266 & 34269 & 36151 & 39312 \\ 20814 & 24126 & 25750 & 27546 & 29293 & 32283 \\ 17019 & 20171 & 21648 & 23301 & 24953 & 27834 \\ 12243 & 15124 & 16388 & 17831 & 19333 & 22027 \\ 6338.7 & 8504.7 & 9406.4 & 10470 & 11630 & 13807 \\ 3100.4 & 4418.8 & 5017.8 & 5748 & 6542.7 & 8079.6 \\ 980.81 & 1552.7 & 1893.9 & 2323.7 & 2770.8 & 3643.7 \\ 619.51 & 987.03 & 1233.4 & 1542.1 & 1849.7 & 2437.2 \\ 481.62 & 759.66 & 948.34 & 1183.1 & 1409.6 & 1817 \\ 404.01 & 637.04 & 792.48 & 985.62 & 1168.4 & 1477.8 \\ 345.29 & 545.53 & 676.02 & 838.29 & 989.94 & 1232.1 \\ 298.65 & 473.41 & 584.4 & 722.78 & 851.01 & 1045 \\ 261.07 & 415.52 & 511.03 & 630.52 & 740.68 & 899.42 \\ 230.62 & 368.66 & 451.74 & 556.1 & 652.07 & 784.54 \end{bmatrix}$$

$i := 0 .. (\text{rows}(pp) - 1)$

$j := 0 .. (\text{cols}(pp) - 1)$

Burn-up level data:

$$RL^T = (18 \quad 27 \quad 33 \quad 40 \quad 46 \quad 55)$$

Time interval data:

$RC^T =$

	0	1	2	3	4	5	6	7	8	9	10	11
0	0	10	30	60	90	120	180	365	730	1825	3650	7300

$m := 0..(rows(pp) - 1)$ $n := 0..(cols(pp) - 1)$

2.0 Linear extrapolation to obtain the afterheat power for burn-up level of 10 GWD/MTU

$n := 0..5$ $m := 11$

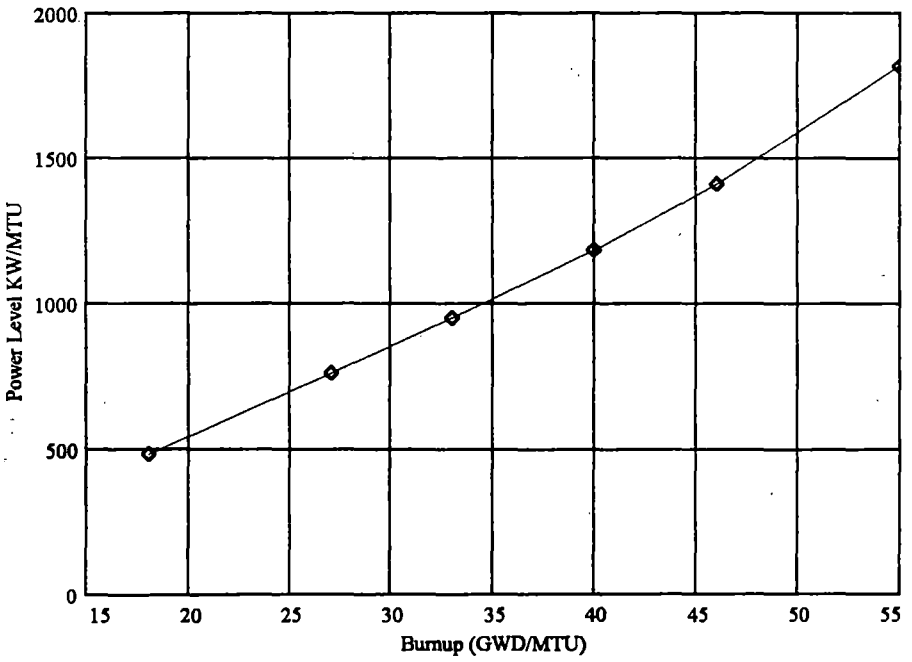


Figure A.1 Plot of Power Level VS. Burnup at time 20 years

The power level is linearly proportional to the burnup level in the lower range of burnup. Therefore, linear extrapolation to obtain the power level for burnup level 10 GWD/MTU is permissible.

$$H_i := \text{linterp}\left[RL, \left(pp^T\right)^{\langle i \rangle}, 10\right]$$

Insert the extrapolation values to the power matrix pp

$$pp := \text{augment}(H, pp)$$

Update burn-up level data:

$$RL^T = (\ 10 \quad 18 \quad 27 \quad 33 \quad 40 \quad 46 \quad 55\ )$$

3.0 Plot the afterheat power curves

$i := 0..(rows(pp) - 1)$

$j := 0..(cols(pp) - 1)$

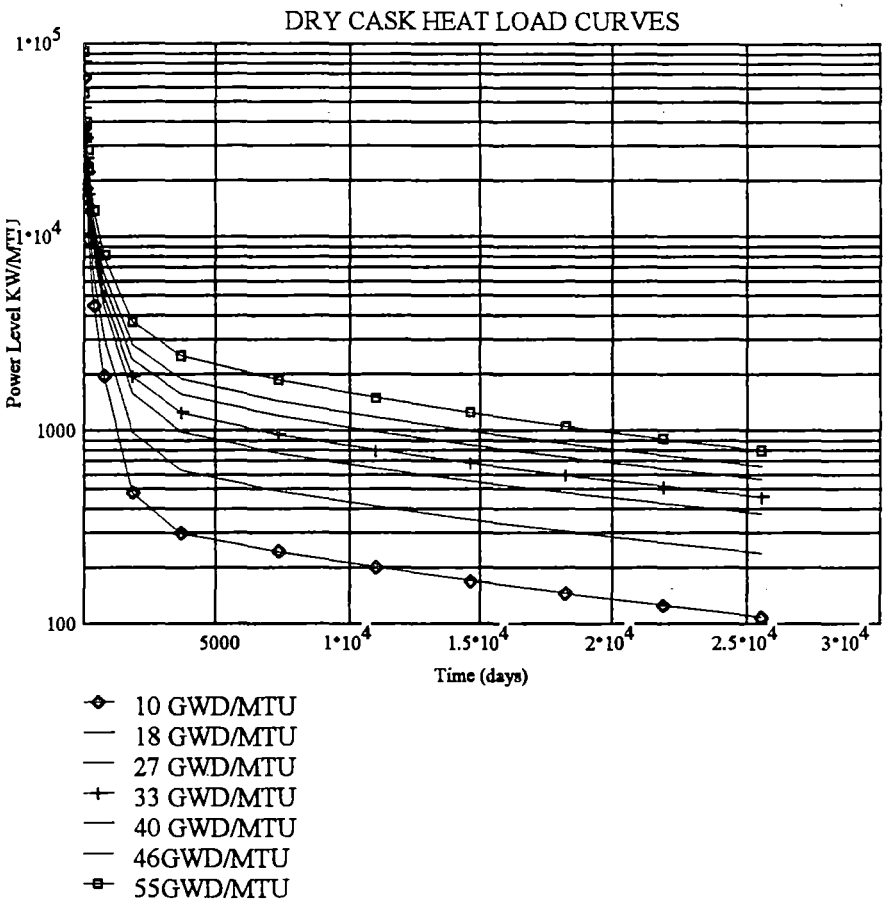


Figure A.2 Power Level curves

4.0 Set up a two dimensional interpolation function using linear interpolation in time and linear interpolation for logarithmic afterheat power values

$p_{i,j} := \ln(pp_{i,j})$ logarithmic value of afterheat power matrix

Linear interpolation in burnup

$n := 0, 1..30$ Setup burnup interval from 10 to 45 GWD/MTU

$B_n := 10 + n$

$K_{n,i} := \text{linterp}\left[RL, \left(p^T\right)^{<i>}, B_n\right]$ Linear interpolation function for decay time

The afterheat power curves as a function of time and burnup

$Kw(t,b) := \exp\left[\text{linterp}\left[RC, \left(K^T\right)^{<\text{round}(b-10)>}, t\right]\right]$

$\text{round}(x) \equiv \text{if}(x - \text{floor}(x) < .5, \text{floor}(x), \text{ceil}(x))$

$t := 0, 500 .. 50 \cdot 365$

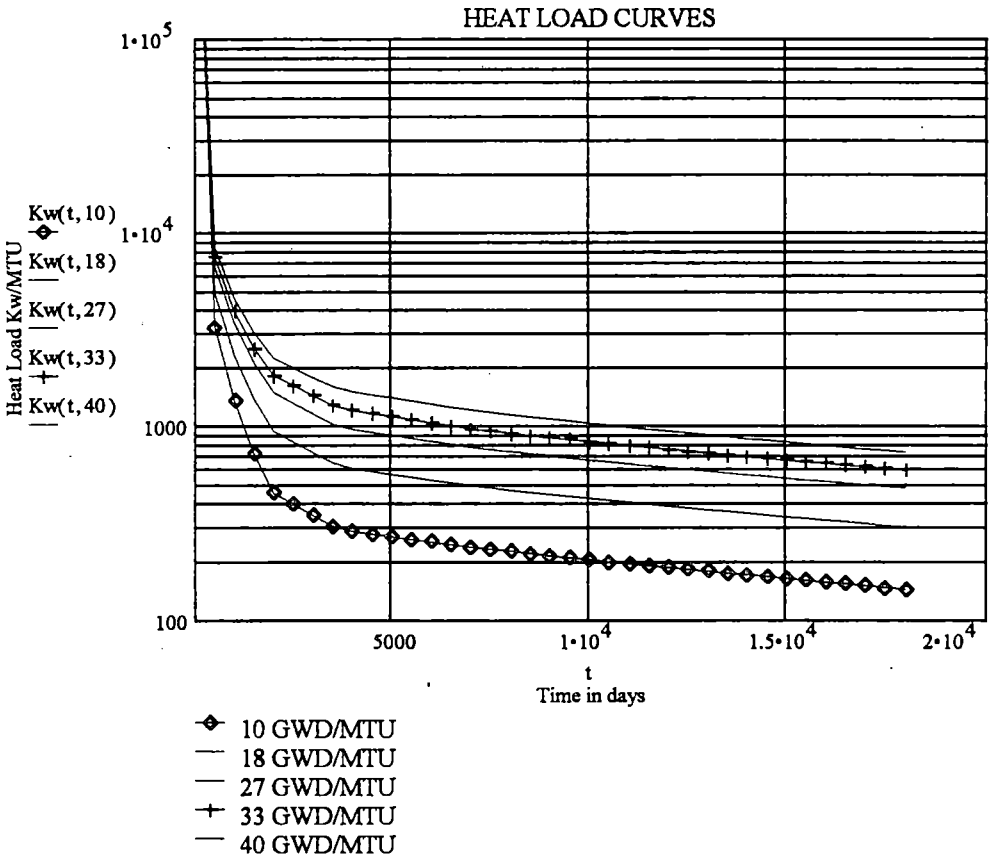


Figure A.3 Plot of interpolation function KW(t,b)

5.0 Check the interpolation NUREG-3697 Appendix C

$Kw(20\cdot365, 18) = 481.62$	$pp_{11,1} = 481.62$	OK
$Kw(20\cdot365, 27) = 759.66$	$pp_{11,2} = 759.66$	OK
$Kw(20\cdot365, 33) = 948.34$	$pp_{11,3} = 948.34$	OK
$Kw(10\cdot365, 40) = 1.542\cdot10^3$	$pp_{10,4} = 1.542\cdot10^3$	OK

6.0 Comparison of heat load calculation for VCC Number 4 (Loading date: 6/21/94)

$i := 0..23$ $\quad LoadMonth := 6$ $\quad LoadDay := 21$ $\quad LoadYear := 94$

Cooling time prior to loading

$$numday(month, day, year) := (LoadMonth - month)\cdot30 + LoadDay - day + (LoadYear - year)\cdot365$$

$$time_i := numday\left(DDate_{i,0}, DDate_{i,1}, DDate_{i,2}\right)$$

Heat load per cell on loading

$$HeatLoad_i := \frac{Kw\left(time_i, BurnUp_i\right)\cdot Initial\_U_i}{1000}$$

Discharge Date

Cell	Wt(MTU)	(MWD/MTU)	month	Day	Year	Cooling Time (Days)	(KW)
$i+1$	$Initial\_U_i$	$BurnUp_i$	$DDate_{i,0}$	$DDate_{i,1}$	$DDate_{i,2}$	$time_i$	$HeatLoad_i$
1	0.415	30.26	8	29	81	4677	0.425
2	0.415	33.027	8	29	81	4677	0.475
3	0.415	33.027	8	29	81	4677	0.475
4	0.387	35.117	8	12	83	3964	0.497
5	0.4	12.99	1	6	78	6005	0.133
6	0.386	35.333	8	29	81	4677	0.471
7	0.385	35.333	8	29	81	4677	0.47
8	0.387	31.414	8	12	83	3964	0.433
9	0.402	13.366	1	6	78	6005	0.134
10	0.402	13.911	1	6	78	6005	0.147
11	0.401	12.99	1	6	78	6005	0.134
12	0.416	28.128	8	29	81	4677	0.396
13	0.416	28.824	8	29	81	4677	0.411
14	0.387	35.117	8	12	83	3964	0.497
15	0.402	13.626	1	6	78	6005	0.147
16	0.401	13.626	1	6	78	6005	0.147
17	0.387	35.117	8	12	83	3964	0.497
18	0.415	30.26	8	29	81	4677	0.425
19	0.416	28.128	8	29	81	4677	0.396
20	0.386	35.173	8	12	83	3964	0.496
21	0.387	35.173	8	12	83	3964	0.497
22	0.416	33.027	8	29	81	4677	0.477
23	0.416	30.26	8	29	81	4677	0.426
24	0.415	30.353	8	29	81	4677	0.425

Total Heat Load

$$TotalHeat := \sum_{i=0}^{23} HeatLoad_i$$

$TotalHeat = 9.034$ Kw

The total heat load for MSB-04 calculated in EA-HAR-94-01, Attachment 9 is 9.38. The deviation of the two calculated value is (9.38-9.034) / 9.034= 3.8%. Note that the conservative data from Appendix C of NUREG/CR-2397 was used in EA-HAR-94-01. The above deviation is in the magnitude of percent difference between conservative and typical data in NUREG/CR- 2397, Table C.2 , case 3, 10 years cooling time. Therefore, the heat load calculation is verified.

7.0 Heat load after 20 years in storage for VCC number 3

$$time_i := time_i + 20 \cdot 365$$

$$HeatLoad_i := \frac{Kw(time_i, BurnUp_i) \cdot Initial\_U_i}{1000}$$

Table A. 1 Heat Load of MSB-3 after 20 years in storage

			Discharge Date				
Cell	Wt(MTU)	(MWD/MTU)	month	Day	Year	Cooling Time (Days)	(KW)
$i + 1$	$Initial\_U_i$	$BurnUp_i$	$DDate_{i,0}$	$DDate_{i,1}$	$DDate_{i,2}$	$time_i$	$HeatLoad_i$
1	0.415	30.26	8	29	81	11977	0.282
2	0.415	33.027	8	29	81	11977	0.314
3	0.415	33.027	8	29	81	11977	0.314
4	0.387	35.117	8	12	83	11264	0.322
5	0.4	12.99	1	6	78	13305	0.093
6	0.386	35.333	8	29	81	11977	0.311
7	0.385	35.333	8	29	81	11977	0.31
8	0.387	31.414	8	12	83	11264	0.281
9	0.402	13.366	1	6	78	13305	0.093
10	0.402	13.911	1	6	78	13305	0.102
11	0.401	12.99	1	6	78	13305	0.093
12	0.416	28.128	8	29	81	11977	0.263
13	0.416	28.824	8	29	81	11977	0.273
14	0.387	35.117	8	12	83	11264	0.322
15	0.402	13.626	1	6	78	13305	0.102
16	0.401	13.626	1	6	78	13305	0.102
17	0.387	35.117	8	12	83	11264	0.322
18	0.415	30.26	8	29	81	11977	0.282
19	0.416	28.128	8	29	81	11977	0.263
20	0.386	35.173	8	12	83	11264	0.321
21	0.387	35.173	8	12	83	11264	0.322
22	0.416	33.027	8	29	81	11977	0.315
23	0.416	30.26	8	29	81	11977	0.283
24	0.415	30.353	8	29	81	11977	0.282

Total Heat Load after 20 years

$$TotalHeat := \sum_{i=0}^{23} HeatLoad_i$$

$$TotalHeat = 5.97 \quad Kw$$

8.0 Heat load after 50 years in storage for MSB number 3

$$time_i := time_i + 30 \cdot 365$$

$$HeatLoad_i := \frac{Kw(time_i, BurnUp_i) \cdot Initial\_U_i}{1000}$$

Table A.2 Heat Load of MSB-3 after 50 years in storage

			Discharge Date				
Cell	Wt(MTU)	(MWD/MTU)	month	Day	Year	Cooling Time (Days)	(KW)
$i+1$	$Initial\_U_i$	$BurnUp_i$	$DDate_{i,0}$	$DDate_{i,1}$	$DDate_{i,2}$	$time_i$	$HeatLoad_i$
1	0.415	30.26	8	29	81	22927	0.185
2	0.415	33.027	8	29	81	22927	0.205
3	0.415	33.027	8	29	81	22927	0.205
4	0.387	35.117	8	12	83	22214	0.208
5	0.4	12.99	1	6	78	24255	0.06
6	0.386	35.333	8	29	81	22927	0.202
7	0.385	35.333	8	29	81	22927	0.202
8	0.387	31.414	8	12	83	22214	0.183
9	0.402	13.366	1	6	78	24255	0.06
10	0.402	13.911	1	6	78	24255	0.066
11	0.401	12.99	1	6	78	24255	0.06
12	0.416	28.128	8	29	81	22927	0.173
13	0.416	28.824	8	29	81	22927	0.179
14	0.387	35.117	8	12	83	22214	0.208
15	0.402	13.626	1	6	78	24255	0.066
16	0.401	13.626	1	6	78	24255	0.066
17	0.387	35.117	8	12	83	22214	0.208
18	0.415	30.26	8	29	81	22927	0.185
19	0.416	28.128	8	29	81	22927	0.173
20	0.386	35.173	8	12	83	22214	0.207
21	0.387	35.173	8	12	83	22214	0.208
22	0.416	33.027	8	29	81	22927	0.205
23	0.416	30.26	8	29	81	22927	0.185
24	0.415	30.353	8	29	81	22927	0.185

Total Heat Load after 50 years

$$TotalHeat := \sum_{i=0}^{23} HeatLoad_i$$

$$TotalHeat = 3.885 \quad Kw$$

9.0 Heat load after 20 years in storage for MSB number 4

$dd := READPRN(msbn4)$

$$Initial\_U := \frac{dd^{<0>}}{10^6} \qquad BurnUp := \frac{dd^{<1>}}{1000}$$

$DDate^{<0>} := dd^{<2>}$

$DDate^{<1>} := dd^{<3>}$

$DDate^{<2>} := dd^{<4>}$

$$time_i := numday\left(DDate_{i,0}, DDate_{i,1}, DDate_{i,2}\right) + 20 \cdot 365$$

Heat load per cell on loading

$$HeatLoad_i := \frac{Kw\left(time_i, BurnUp_i\right) \cdot Initial\_U_i}{1000}$$

Table A.3 Heat Load of MSB-4 after 20 years in storage

			Discharge Date				
Cell	Wt(MTU)	(MWD/MTU)	month	Day	Year	Cooling Time (Days)	(KW)
$i+1$	$Initial\_U_i$	$BurnUp_i$	$DDate_{i,0}$	$DDate_{i,1}$	$DDate_{i,2}$	$time_i$	$HeatLoad_i$
1	0.415	30.343	8	29	81	11977	0.282
2	0.415	30.26	8	29	81	11977	0.282
3	0.416	30.585	8	29	81	11977	0.293
4	0.387	35.117	8	12	83	11264	0.322
5	0.402	13.626	1	6	78	13305	0.102
6	0.416	30.585	8	29	81	11977	0.293
7	0.415	30.343	8	29	81	11977	0.282
8	0.387	35.117	8	12	83	11264	0.322
9	0.401	13.626	1	6	78	13305	0.102
10	0.404	13.366	1	6	78	13305	0.094
11	0.401	13.11	1	6	78	13305	0.093
12	0.415	30.353	8	29	81	11977	0.282
13	0.414	33.629	8	29	81	11977	0.324
14	0.388	33.517	8	12	83	11264	0.313
15	0.401	13.366	1	6	78	13305	0.093
16	0.387	35.333	8	29	81	11977	0.312
17	0.387	34.93	8	12	83	11264	0.322
18	0.415	33.629	8	29	81	11977	0.324
19	0.415	31.787	8	29	81	11977	0.303
20	0.387	33.517	8	12	83	11264	0.312
21	0.387	35.173	8	12	83	11264	0.322
22	0.415	30.26	8	29	81	11977	0.282
23	0.416	30.26	8	29	81	11977	0.283
24	0.401	12.99	1	6	78	13305	0.093

Total Heat Load after 20 years

$$TotalHeat := \sum_{i=0}^{23} HeatLoad_i$$

$TotalHeat = 6.035$ Kw

10.0 Heat load after 50 years in storage for MSB number 4

$$time_i := numday\left(DDate_{i,0}, DDate_{i,1}, DDate_{i,2}\right) + 50 \cdot 365$$

Heat load per cell on loading

$$HeatLoad_i := \frac{Kw\left(time_i, BurnUp_i\right) \cdot Initial\_U_i}{1000}$$

Table A.4 Heat Load of MSB-4 after 50 years in storage

			Discharge Date				
Cell	Wt(MTU)	(MWD/MTU)	month	Day	Year	Cooling Time (Days)	(KW)
i + 1	$Initial\_U_i$	$BurnUp_i$	$DDate_{i,0}$	$DDate_{i,1}$	$DDate_{i,2}$	$time_i$	$HeatLoad_i$
1	0.415	30.343	8	29	81	22927	0.185
2	0.415	30.26	8	29	81	22927	0.185
3	0.416	30.585	8	29	81	22927	0.192
4	0.387	35.117	8	12	83	22214	0.208
5	0.402	13.626	1	6	78	24255	0.066
6	0.416	30.585	8	29	81	22927	0.192
7	0.415	30.343	8	29	81	22927	0.185
8	0.387	35.117	8	12	83	22214	0.208
9	0.401	13.626	1	6	78	24255	0.066
10	0.404	13.366	1	6	78	24255	0.061
11	0.401	13.11	1	6	78	24255	0.06
12	0.415	30.353	8	29	81	22927	0.185
13	0.414	33.629	8	29	81	22927	0.211
14	0.388	33.517	8	12	83	22214	0.202
15	0.401	13.366	1	6	78	24255	0.06
16	0.387	35.333	8	29	81	22927	0.203
17	0.387	34.93	8	12	83	22214	0.208
18	0.415	33.629	8	29	81	22927	0.211
19	0.415	31.787	8	29	81	22927	0.198
20	0.387	33.517	8	12	83	22214	0.202
21	0.387	35.173	8	12	83	22214	0.208
22	0.415	30.26	8	29	81	22927	0.185
23	0.416	30.26	8	29	81	22927	0.185
24	0.401	12.99	1	6	78	24255	0.06

Total Heat Load after 50 years

$$TotalHeat := \sum_{i=0}^{23} HeatLoad_i$$

$$TotalHeat = 3.925 \quad \text{Kw}$$

11.0 **Result Summary**

Table A.5 : Heat Generation Rate of MSB-03 and MSB-04

	20 years	50 years
MSB-03	5.97·KW	3.885·KW
MSB-04	6.035·KW	3.925·KW

Attachment B

(4 pages)

FUEL DATA

VSC-24 STORAGE SHEET

VCC Number: 1 **MSB Number:** 1

Date MSB Loaded: 05-07-93 @ 0034 1st assembly

Storage Pad Position: 1 **Placement Date:** May 12, 1993

Comments:

FUEL ASSEMBLY LISTING

MSB Cell No	Fuel Assembly Parameters					
	ID No	Initial U Enr (w/o)	Initial U Wt (g)	Burnup (MWD/MTU)	Discharge Date	Visual Exam Date
1	G-01	3.00	386,946	33,997.0	08-12-83	09-25-92
2	G-02	3.00	387,078	33,997.0	"	09-25-92
3	G-03	3.00	386,901	33,997.0	"	09-25-92
4	G-04	3.00	387,469	31,413.8	"	09-25-92
5	G-05	3.00	387,077	33,997.0	"	09-25-92
6	G-06	3.00	387,248	33,997.0	"	09-25-92
7	G-07	3.00	387,815	33,997.0	"	09-25-92
8	G-08	3.00	387,372	33,997.0	"	10-05-92
9	G-09	3.00	388,101	33,516.6	"	10-05-92
10	G-10	3.00	387,117	33,997.0	"	10-05-92
11	G-11	3.00	388,019	33,516.6	"	10-05-92
12	G-12	3.00	387,677	31,413.8	"	10-05-92
13	G-13	3.00	387,921	30,972.2	"	10-05-92
14	G-14	3.00	387,670	32,722.6	"	10-05-92
15	G-15	3.00	388,214	32,722.6	"	09-24-92
16	G-16	3.00	387,915	30,972.2	"	10-08-92
17	G-17	3.00	386,138	32,410.2	"	10-08-92
18	G-18	3.00	387,127	34,929.8	"	10-08-92
19	G-20	3.00	387,491	32,410.2	"	10-08-92
20	G-21	3.00	385,931	30,972.2	"	10-09-92
21	G-22	3.00	387,641	32,410.2	"	10-09-92
22	G-23	3.00	387,841	32,410.2	"	10-09-92
23	G-24	3.00	387,677	30,972.2	"	10-09-92
24	G-25	3.00	387,993	32,722.6	"	10-09-92

VSC-24 STORAGE SHEET

VCC Number: 2 **MSB Number:** 2

Date MSB Loaded: 5-14-93

Storage Pad Position: 2 **Placement Date:** 5-18-93

Comments:

FUEL ASSEMBLY LISTING

MSB Cell No	Fuel Assembly Parameters					
	ID No	Initial U Enr (w/o)	Initial U Wt (g)	Burnup (MWD/MTU)	Discharge Date	Visual Exam Date
1	G-27	3.00	386,612	32,722.6	08-12-83	10-09-92
2	G-28	3.00	386,663	31,413.8	"	10-09-92
3	G-29	3.00	386,449	34,929.8	"	09-24-92
4	G-31	3.00	387,923	31,413.8	"	10-09-92
5	G-32	3.00	387,452	33,516.6	"	10-09-92
6	G-33	3.00	388,150	33,516.6	"	10-09-92
7	G-34	3.00	387,834	33,516.6	"	10-09-92
8	G-37	3.00	387,458	31,413.8	"	09-25-92
9	G-38	3.00	386,736	34,929.8	"	10-09-92
10	G-39	3.00	387,441	31,413.8	"	09-25-92
11	G-40	3.00	387,700	32,722.6	"	10-09-92
12	G-41	3.00	387,494	32,722.6	"	09-25-92
13	G-43	3.00	388,586	32,410.2	"	10-09-92
14	G-44	3.00	386,959	32,410.2	"	10-09-92
15	G-45	3.00	388,062	30,972.2	"	10-09-92
16	G-46	3.00	387,235	34,929.8	"	10-09-92
17	G-48	3.00	387,739	32,410.2	"	10-14-92
18	G-50	3.00	387,813	32,410.2	"	09-25-92
19	G-53	3.00	386,913	34,929.8	"	10-14-92
20	G-54	3.00	386,371	34,929.8	"	10-14-92
21	G-57	3.00	387,399	30,972.2	"	10-14-92
22	G-59	3.00	387,242	34,929.8	"	10-14-92
23	G-60	3.00	386,196	32,722.6	"	10-14-92
24	G-63	3.00	386,985	30,972.2	"	10-14-92

VSC-24 STORAGE SHEET

VCC Number: 3 MSB Number: 3

Date MSB Loaded: 6/20-6/21/94

Storage Pad Position: 3 Placement Date: 6/30/94

Comments:

FUEL ASSEMBLY LISTING

MSB Cell No.	Fuel Assembly Parameters					
	ID No	Initial U Enr (w/o)	Initial U Wt (g)	Burnup (MWD/MTU)	Discharge Date	Visual Exam Date
1	EF0000	2.74	415,213	30,260	08/29/81	04/07/94
2	EF0001	2.74	415,470	33,027	08/29/81	04/11/94
3	EF0002	2.74	415,208	33,027	08/29/81	04/11/94
4	G026	3.00	386,826	35,117	08/12/83	01/24/94
5	XF02	1.51	400,106	12,990	01/06/78	04/07/94
6	D102	3.05	385,792	35,333	08/29/81	01/19/94
7	E014	3.05	385,292	35,333	08/29/81	04/06/94
8	G068	3.00	387,137	31,414	08/12/83	03/18/93
9	XF08	1.5	401,697	13,366	01/06/78	01/19/94
10	XF09	1.5	401,583	13,911	01/06/78	04/06/94
11	XF10	1.5	400,690	12,990	01/06/78	04/08/94
12	EF0011	2.74	415,913	28,128	08/29/81	03/21/94
13	EF0013	2.74	416,121	28,824	08/29/81	03/21/94
14	G047	3.00	387,028	35,117	08/12/83	04/07/94
15	XF15	1.5	401,962	13,626	01/06/78	04/05/94
16	XF16	1.51	401,039	13,626	01/06/78	04/08/94
17	G051	3.00	386,875	35,117	08/12/83	03/30/94
18	EF0014	2.74	415,481	30,260	08/29/81	03/21/94
19	EF0016	2.74	415,795	28,128	08/29/81	03/25/94
20	G055	3.00	386,489	35,173	08/12/83	03/31/94
21	G056	3.00	386,901	35,173	08/12/83	04/04/94
22	EF0018	2.74	415,751	33,027	08/29/81	01/13/94
23	EF0019	2.74	415,660	30,260	08/29/81	04/05/94
24	EF000H	2.74	415,432	30,353	08/29/81	04/11/94

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ATTACHMENT B
PAGE 05

VSC-24 STORAGE SHEET

VCC Number: 4 MSB Number:

Date MSB Loaded:

Storage Pad Position: Placement Date:

Comments:

FUEL ASSEMBLY LISTING

MSB Cell No.	Fuel Assembly Parameters						Heat Load (KW)
	ID No	Initial U Enr (w/o)	Initial U Wt (g)	Burnup (MWD/MTU)	Discharge Date	Visual Exam Date	
1	EF000C	2.74	415,192	30,343	08/29/81	03/30/94	0.4152
2	EF000X	2.74	415,199	30,260	08/29/81	03/31/94	0.4152
3	EF000Y	2.75	415,810	30,585	08/29/81	01/10/94	0.4158
4	G061	3.00	387,249	35,117	08/12/83	04/08/94	0.5034
5	XF20	1.50	401,817	13,626	01/06/78	01/18/94	0.2009
6	EF000Z	2.73	415,647	30,585	08/29/81	04/04/94	0.4156
7	EF001G	2.74	415,453	30,343	08/29/81	04/11/94	0.4155
8	G062	3.00	387,358	35,117	08/12/83	01/20/94	0.5036
9	XF22	1.51	401,013	13,626	01/06/78	03/31/94	0.2005
10	XF30	1.50	404,306	13,366	01/06/78	04/07/94	0.2022
11	XF46	1.50	401,473	13,110	01/06/78	01/14/94	0.2007
12	EF001H	2.74	415,333	30,353	08/29/81	04/11/94	0.4153
13	EF001J	2.73	414,477	33,629	08/29/81	04/11/94	0.4559
14	G065	3.00	387,876	33,517	08/12/83	03/28/94	0.5042
15	XF51	1.50	401,056	13,366	01/06/78	04/06/94	0.2005
16	E065	3.05	386,524	35,333	08/29/81	04/05/94	0.4638
17	G066	3.00	386,896	34,930	08/12/83	01/21/94	0.5030
18	EF001K	2.73	415,010	33,629	08/29/81	04/11/94	0.4565
19	EF001R	2.74	414,830	31,787	08/29/81	04/05/94	0.4563
20	G067	3.00	387,422	33,517	08/12/83	03/30/94	0.5036
21	G030	3.00	386,654	35,173	08/12/83	04/08/94	0.5027
22	EF0006	2.74	415,135	30,260	08/29/81	04/11/94	0.4151
23	EF0010	2.74	415,726	30,260	08/29/81	04/11/94	0.4157
24	XF53	1.51	400,975	12,990	01/06/78	01/18/94	0.2005
			E Avg	29585		Total Ht	9.38
			XF Avg	17071			
			G Avg	34562			

Rev. 1

Rev. 1

Attachment C

(25 pages)

ANSYS INPUT DECK

```
/PREP7
/TITLE VCC-MSB-3 AMB= 0.0 F 5.97 KW AFTER 20 YEARS IN STORAGE
/SHOW,BNCHVCC2,GEO,,
/SHRINK,.3
KAN,-1
GGGG=5.97       * Total Heat Generation of MSB assembly KW/MSB
AAAA=0.00       * Ambient Air Temperature F
SOTO=0.0      * Solar Load on Top BTU/hr/ft**2
SOSI=0.0     * Solar Load on Side BTU/hr/ft**2
SOCO=0.0     * Solar Load on Cover Plate BTU/hr/ft**2
SUMK=.61936569 * Cumm. friction Loss K For Air Flow
TOAS=29.846     * Assumed Value; Must match TOCA; Outlet Air temp F
DRHI=13.69167      * Draft Height
T000=AAAA       * Air Temp at Bott of MSB
TAVE=((AAAA+TOAS)/2)
C*** *****************************************************
C*** CALCLATIONS ARE VALID FOR 0 < TAVE <32 F
C*** *****************************************************
HEAT=(GGGG*3412.0)  * Total heat generation BTU/Hr
CPAI=0.2390     * CONSTRAINT 0 < TAVE < 32
MFLO=(HEAT/(3600.0*CPAI*(TOAS-AAAA))) * Air Mass Flowrate through VCC lb/Sec
DENA=(0.081+0.005*(32-TAVE)/32.)  * CONSTRAINT 0 < TAVE < 32
C*** *****************************************************
C*** DP Stack DPST must be equal to DP Flow DPFL
C*** *****************************************************
DPST=(DENA*32.2*DRHI*(TOAS-AAAA)/(32.2*(TAVE+460))) * DP Stack
DPFL=(MFLO*MFLO*SUMK/(2*32.2*DENA))                 * DP Flow
DELT=(MFLO*MFLO*SUMK*(TAVE+460)/(2*32.2*DENA*DENA*DRHI))
C*** ************************************************************************
C*** Calculated Air outlet temp TOCA must be equal to assumed value TOAS
C*** ************************************************************************
TOCA=(AAAA+DELT) * MUST BE EQUAL TO "TOAS" Air outlet Temp F
Q016=(GGGG*3412.0*0.69*16.0/144.0) * Heat Gen El. 0 -16 In  BTU/hr
Q032=(GGGG*3412.0*1.08*16.0/144.0) * Heat Gen El. 16 -32 In   BTU/Hr
Q048=(GGGG*3412.0*1.20*16.0/144.0) * Heat Gen El. 32 -48 In   BTU/Hr
Q064=(GGGG*3412.0*1.19*16.0/144.0) * Heat Gen El. 48 -64 In   BTU/Hr
Q080=(GGGG*3412.0*1.17*16.0/144.0) * Heat Gen El. 64 -80 In   BTU/Hr
Q096=(GGGG*3412.0*1.12*16.0/144.0) * Heat Gen El. 80 -96 In   BTU/Hr
Q112=(GGGG*3412.0*1.05*16.0/144.0) * Heat Gen El. 96 -112 In  BTU/Hr
Q128=(GGGG*3412.0*0.90*16.0/144.0) * Heat Gen El. 112 -128 In BTU/Hr
Q144=(GGGG*3412.0*0.60*16.0/144.0) * Heat Gen El. 128 -144 In BTU/Hr
T016=(T000+Q016/(3600.0*CPAI*MFLO))  * Air Temp at 16 In.
T032=(T016+Q032/(3600.0*CPAI*MFLO))  * Air Temp at 32 In.
T048=(T032+Q048/(3600.0*CPAI*MFLO))  * Air Temp at 48 In.
T064=(T048+Q064/(3600.0*CPAI*MFLO))  * Air Temp at 64 In.
T080=(T064+Q080/(3600.0*CPAI*MFLO))  * Air Temp at 80 In.
T096=(T080+Q096/(3600.0*CPAI*MFLO))  * Air Temp at 96 In.
T112=(T096+Q112/(3600.0*CPAI*MFLO))  * Air Temp at 112 In.
T128=(T112+Q128/(3600.0*CPAI*MFLO))  * Air Temp at 128 In.
T144=(T128+Q144/(3600.0*CPAI*MFLO))  * Air Temp at 144 In.
C*** ELEMENT TYPE MODULE
C*** DEFINES THE ELEMENT TYPES
ET,1,70  * STIF 70 3-D ISOPAR. THERMAL SOLID ELEMENTS
ET,2,31  * STIF 31 RADIATION LINK ELEMENTS
C*** OPTIONS MODULE
C*** DEFINES ANALYSIS OPTIONS
KYPOST,0
TOFFST,460      * Used for Rad. T Abs = T F + 460 F
C*** END OF OPTIONS MODULE
C*** MATERIAL MODULE
C*** DEFINES MATERIAL PROPERTIES  BTU/hr-ft-F
C***   Conduction Elements Kxx=Kyy
MP,KXX,1,26.2     *
MP,KXX,2,0.719    *
MPTEMP,1,-50,0,32,100,200,300
MPTEMP,7,500,700
MPDATA,KXX,3,1,0.0114,0.0130,0.0140,0.0154,0.0174,0.0193
MPDATA,KXX,3,7,0.0231,0.0268
MP,KXX,4,2.38      *
MP,KXX,5,0.10      *
MP,KXX,9,10.0      *
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MP,KXX,10,0.3.0    *
C***   Conduction Elements Density  Lb/FT**3-F
MP,DENS,1,490      *
MP,DENS,2,141.30   *
MPDATA,DENS,3,1,0.094,0.086,0.081,0.071,0.060,0.052
MPDATA,DENS,3,7,0.0412,0.0373
MP,DENS,4,176.80   *
MP,DENS,5,0.0065   *
MP,DENS,9,488      *
MP,DENS,10,106     *
C***   Conduction Elements Spec. Heat BTU/Lb-F
MP,C,1,0.11        *
MP,C,2,0.21        *
MPDATA,C,3,1,0.2385,0.239,0.240,0.240,0.241,0.243
MPDATA,C,3,7,0.247,0.253
MP,C,4,0.0715      *
MP,C,5,1.24      *
MP,C,9,0.11      *
MP,C,10,.22       *
EMIS CARDS
MP,EMIS,1,.8
MP,EMIS,2,.9
MP,EMIS,3,.85
MP,EMIS,6,.85
MP,EMIS,7,.85
MP,EMIS,8,.85
C*** END OF MATERIAL MODULE
C*** REAL CONSTANT MODULE
R,1                * FOR STIF55 Elements
C*** Real Const.For Radiation Area,From Geo.Fact.,Emiss, SBC
R,97,0.4400,0.140,0.9,0.17140E-08
R,98,0.4800,0.140,0.9,0.17140E-08
R,99,0.0500,0.140,0.9,0.17140E-08
R,100,0.0250,0.140,0.9,0.17140E-08
R,101,0.0950,0.140,0.9,0.17140E-08
R,102,0.7188,0.140,0.9,0.17140E-08
R,103,0.9600,0.140,0.9,0.17140E-08
R,104,0.9600,0.140,0.9,0.17140E-08
R,105,1.2793,0.140,0.9,0.17140E-08
R,106,1.2810,0.140,0.9,0.17140E-08
R,107,1.0500,0.140,0.9,0.17140E-08
R,108,0.6590,0.140,0.9,0.17140E-08
R,109,0.3794,0.140,0.9,0.17140E-08
R,110,0.1290,0.140,0.9,0.17140E-08
R,111,0.04895,1.0,0.8,0.17140E-08
R,127,0.0165,1.0,0.8,0.17140E-08
R,128,0.0446,1.0,0.8,0.17140E-08
R,129,0.3380,1.0,0.8,0.17140E-08
R,130,0.4510,1.0,0.8,0.17140E-08
R,131,0.4510,1.0,0.8,0.17140E-08
R,132,0.6000,1.0,0.8,0.17140E-08
R,133,0.6020,1.0,0.8,0.17140E-08
R,134,0.4930,1.0,0.8,0.17140E-08
R,135,0.4270,1.0,0.8,0.17140E-08
R,145,0.0606,1.0,0.8,0.17140E-08
R,146,0.2470,1.0,0.8,0.17140E-08
R,148,0.0606,1.0,0.8,0.17140E-08
R,149,0.1740,1.0,0.8,0.17140E-08
R,151,0.6650,1.0,0.9,0.17140E-08
R,166,0.1620,1.0,0.8,0.17140E-08
R,168,0.2400,1.0,0.9,0.17140E-08
C*** END OF REAL CONSTANT MODULE
C*** NODE MODULE
C*** DEFINES NODES BY DIRECT INPUT
N,1,0.0000,0.00000,0.0000
N,2,1.2500,0.00000,0.0000
N,3,2.5208,0.00000,0.0000
N,4,2.5830,0.00000,0.0000
N,5,2.9170,0.00000,0.0000
N,6,3.0833,0.00000,0.0000
N,7,4.2708,0.00000,0.0000
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N,8,5.5000,0.00000,0.0000
N,9,1.2310,0.21706,0.0000
N,10,2.4825,0.43773,0.0000
N,11,2.5438,0.44853,0.0000
N,12,2.8727,0.50653,0.0000
N,13,3.0365,0.53541,0.0000
N,14,4.2059,0.74162,0.0000
N,15,5.4164,0.95506,0.0000
N,17,0.0000,0.00000,1.8333
N,18,1.2500,0.00000,1.8333
N,19,2.5208,0.00000,1.8333
N,20,2.5830,0.00000,1.8333
N,21,2.9170,0.00000,1.8333
N,22,3.0833,0.00000,1.8333
N,23,4.2708,0.00000,1.8333
N,24,5.5000,0.00000,1.8333
N,25,1.2310,0.21706,1.8333
N,26,2.4825,0.43773,1.8333
N,27,2.5438,0.44853,1.8333
N,28,2.8727,0.50653,1.8333
N,29,3.0365,0.53541,1.8333
N,30,4.2059,0.74162,1.8333
N,31,5.4164,0.95506,1.8333
N,33,0.0000,0.00000,2.0000
N,34,1.2500,0.00000,2.0000
N,35,2.5208,0.00000,2.0000
N,36,2.5830,0.00000,2.0000
N,37,2.9170,0.00000,2.0000
N,38,3.0833,0.00000,2.0000
N,39,4.2708,0.00000,2.0000
N,40,5.5000,0.00000,2.0000
N,41,1.2310,0.21706,2.0000
N,42,2.4825,0.43773,2.0000
N,43,2.5438,0.44853,2.0000
N,44,2.8727,0.50653,2.0000
N,45,3.0365,0.53541,2.0000
N,46,4.2059,0.74162,2.0000
N,47,5.4164,0.95506,2.0000
N,49,0.0000,0.00000,2.0417
N,50,1.2500,0.00000,2.0417
N,51,2.5208,0.00000,2.0417
N,52,2.5830,0.00000,2.0417
N,53,2.9170,0.00000,2.0417
N,54,3.0833,0.00000,2.0417
N,55,4.2708,0.00000,2.0417
N,56,5.5000,0.00000,2.0417
N,57,1.2310,0.21706,2.0417
N,58,2.4825,0.43773,2.0417
N,59,2.5438,0.44853,2.0417
N,60,2.8727,0.50653,2.0417
N,61,3.0365,0.53541,2.0417
N,62,4.2059,0.74162,2.0417
N,63,5.4164,0.95506,2.0417
N,65,0.0000,0.00000,2.1040
N,66,1.2500,0.00000,2.1040
N,67,2.5208,0.00000,2.1040
N,68,2.5830,0.00000,2.1040
N,69,2.9170,0.00000,2.1040
N,70,3.0833,0.00000,2.1040
N,71,4.2708,0.00000,2.1040
N,72,5.5000,0.00000,2.1040
N,73,1.2310,0.21706,2.1040
N,74,2.4825,0.43773,2.1040
N,75,2.5438,0.44853,2.1040
N,76,2.8727,0.50653,2.1040
N,77,3.0365,0.53541,2.1040
N,78,4.2059,0.74162,2.1040
N,79,5.4164,0.95506,2.1040
N,81,0.0000,0.00000,2.4375
N,83,2.5208,0.00000,2.4375
N,84,2.5830,0.00000,2.4375
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N,85,2.9170,0.00000,2.4375
N,86,3.0833,0.00000,2.4375
N,87,4.2708,0.00000,2.4375
N,88,5.5000,0.00000,2.4375
N,90,2.4825,0.43773,2.4375
N,91,2.5438,0.44853,2.4375
N,92,2.8727,0.50653,2.4375
N,93,3.0365,0.53541,2.4375
N,94,4.2059,0.74162,2.4375
N,95,5.4164,0.95506,2.4375
N,97,0.0000,0.00000,5.1042
N,99,2.5208,0.00000,5.1042
N,100,2.5830,0.00000,5.1042
N,101,2.9170,0.00000,5.1042
N,102,3.0833,0.00000,5.1042
N,103,4.2708,0.00000,5.1042
N,104,5.5000,0.00000,5.1042
N,106,2.4825,0.43773,5.1042
N,107,2.5438,0.44853,5.1042
N,108,2.8727,0.50653,5.1042
N,109,3.0365,0.53541,5.1042
N,110,4.2059,0.74162,5.1042
N,111,5.4164,0.95506,5.1042
N,113,0.0000,0.00000,6.4376
N,115,2.5208,0.00000,6.4376
N,116,2.5830,0.00000,6.4376
N,117,2.9170,0.00000,6.4376
N,118,3.0833,0.00000,6.4376
N,119,4.2708,0.00000,6.4376
N,120,5.5000,0.00000,6.4376
N,122,2.4825,0.43773,6.4376
N,123,2.5438,0.44853,6.4376
N,124,2.8727,0.50653,6.4376
N,125,3.0365,0.53541,6.4376
N,126,4.2059,0.74162,6.4376
N,127,5.4164,0.95506,6.4376
N,129,0.0000,0.00000,9.1043
N,131,2.5208,0.00000,9.1043
N,132,2.5830,0.00000,9.1043
N,133,2.9170,0.00000,9.1043
N,134,3.0833,0.00000,9.1043
N,135,4.2708,0.00000,9.1043
N,136,5.5000,0.00000,9.1043
N,138,2.4825,0.43773,9.1043
N,139,2.5438,0.44853,9.1043
N,140,2.8727,0.50653,9.1043
N,141,3.0365,0.53541,9.1043
N,142,4.2059,0.74162,9.1043
N,143,5.4164,0.95506,9.1043
N,144,7.9696,0.69725,9.1043
N,145,0.0000,0.00000,11.771
N,147,2.5208,0.00000,11.771
N,148,2.5830,0.00000,11.771
N,149,2.9170,0.00000,11.771
N,150,3.0833,0.00000,11.771
N,151,4.2708,0.00000,11.771
N,152,5.5000,0.00000,11.771
N,154,2.4825,0.43773,11.771
N,155,2.5438,0.44853,11.771
N,156,2.8727,0.50653,11.771
N,157,3.0365,0.53541,11.771
N,158,4.2059,0.74162,11.771
N,159,5.4164,0.95506,11.771
N,161,0.0000,0.00000,14.438
N,163,2.5208,0.00000,14.438
N,164,2.5830,0.00000,14.438
N,165,2.9170,0.00000,14.438
N,166,3.0833,0.00000,14.438
N,167,4.2708,0.00000,14.438
N,168,5.5000,0.00000,14.438
N,170,2.4825,0.43773,14.438
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N,171,2.5438,0.44853,14.438
N,172,2.8727,0.50653,14.438
N,173,3.0365,0.53541,14.438
N,174,4.2059,0.74162,14.438
N,175,5.4164,0.95506,14.438
N,177,0.0000,0.00000,16.143
N,178,1.2500,0.00000,16.143
N,179,2.5208,0.00000,16.143
N,180,2.5830,0.00000,16.143
N,181,2.9170,0.00000,16.143
N,182,3.0833,0.00000,16.143
N,183,4.2708,0.00000,16.143
N,184,5.5000,0.00000,16.143
N,185,1.2310,0.21706,16.143
N,186,2.4825,0.43773,16.143
N,187,2.5438,0.44853,16.143
N,188,2.8727,0.50653,16.143
N,189,3.0365,0.53541,16.143
N,190,4.2059,0.74162,16.143
N,191,5.4164,0.95506,16.143
N,193,0.0000,0.00000,17.186
N,194,1.2500,0.00000,17.186
N,195,2.5208,0.00000,17.186
N,196,2.5830,0.00000,17.186
N,197,2.9170,0.00000,17.186
N,198,3.0833,0.00000,17.186
N,199,4.2708,0.00000,17.186
N,200,5.5000,0.00000,17.186
N,201,1.2310,0.21706,17.186
N,202,2.4825,0.43773,17.186
N,203,2.5438,0.44853,17.186
N,204,2.8727,0.50653,17.186
N,205,3.0365,0.53541,17.186
N,206,4.2059,0.74162,17.186
N,207,5.4164,0.95506,17.186
N,209,0.0000,0.00000,17.724
N,210,1.2500,0.00000,17.724
N,211,2.5208,0.00000,17.724
N,212,2.5830,0.00000,17.724
N,213,2.9170,0.00000,17.724
N,214,3.0833,0.00000,17.724
N,215,4.2708,0.00000,17.724
N,216,5.5000,0.00000,17.724
N,217,1.2310,0.21706,17.724
N,218,2.4825,0.43773,17.724
N,219,2.5438,0.44853,17.724
N,220,2.8727,0.50653,17.724
N,221,3.0365,0.53541,17.724
N,222,4.2059,0.74162,17.724
N,223,5.4164,0.95506,17.724
N,225,0.0000,0.00000,17.786
N,226,1.2500,0.00000,17.786
N,227,2.5208,0.00000,17.786
N,228,2.5830,0.00000,17.786
N,229,2.9170,0.00000,17.786
N,230,3.0833,0.00000,17.786
N,233,1.2310,0.21706,17.786
N,234,2.4825,0.43773,17.786
N,235,2.5438,0.44853,17.786
N,236,2.8727,0.50653,17.786
N,237,3.0365,0.53541,17.786
N,241,1.7999,0.015708,19.500
N,242,5.4800,0.00000,0.0000
N,243,5.3967,0.95159,0.0000
N,258,5.4800,0.00000,1.8330
N,259,5.3967,0.95159,1.8330
N,274,5.4800,0.00000,2.0000
N,275,5.3967,0.95159,2.0000
N,290,5.4800,0.00000,2.0417
N,291,5.3967,0.95159,2.0417
N,306,5.4800,0.00000,2.1040
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N,307,5.3967,0.95159,2.1040
N,322,5.4800,0.00000,2.4375
N,323,5.3967,0.95159,2.4375
N,338,5.4800,0.00000,5.1042
N,339,5.3967,0.95159,5.1042
N,354,5.4800,0.00000,6.4375
N,355,5.3967,0.95159,6.4375
N,370,5.4800,0.00000,9.1042
N,371,5.3967,0.95159,9.1042
N,386,5.4800,0.00000,11.771
N,387,5.3967,0.95159,11.771
N,402,5.4800,0.00000,14.437
N,403,5.3967,0.95159,14.437
N,418,5.4800,0.00000,16.143
N,419,5.3967,0.95159,16.143
N,434,5.4800,0.00000,17.185
N,435,5.3967,0.95159,17.185
N,450,5.4800,0.00000,17.724
N,451,5.3967,0.95159,17.724
N,468,3.0833,0.00000,17.703
N,469,4.2708,0.00000,17.703
N,470,5.4800,0.00000,17.703
N,471,5.5000,0.00000,17.703
N,472,3.0365,0.53541,17.703
N,473,4.2059,0.74162,17.703
N,474,5.3967,0.95159,17.703
N,475,5.4164,0.95506,17.703
N,476,0.0000,0.00000,16.643
N,477,1.2500,0.00000,16.643
N,478,2.5208,0.00000,16.643
N,479,2.5830,0.00000,16.643
N,480,0.0000,0.00000,16.809
N,481,1.2500,0.00000,16.809
N,482,2.5208,0.00000,16.809
N,483,2.5830,0.00000,16.809
N,484,1.2310,0.21706,16.643
N,485,2.4825,0.43773,16.463
N,486,2.5438,0.44853,16.463
N,487,1.2310,0.21706,16.809
N,488,2.4825,0.43773,16.809
N,489,2.5438,0.44853,16.809
NPLOT
C*** End of Node Module
C*** Element Module
TYPE,1
REAL,1
MAT,2
EN,1,1,2,9,9,17,18,25,25
EN,2,2,3,10,9,18,19,26,25
EN,3,3,4,11,10,19,20,27,26
EN,4,4,5,12,11,20,21,28,27
EN,5,5,6,13,12,21,22,29,28
EN,6,6,7,14,13,22,23,30,29
EN,7,7,242,243,14,23,258,259,30
MAT,1
EN,8,17,18,25,25,33,34,41,41
EN,9,18,19,26,25,34,35,42,41
EN,10,19,20,27,26,35,36,43,42
EN,11,20,21,28,27,36,37,44,43
EN,12,21,22,29,28,37,38,45,44
MAT,2
EN,13,22,23,30,29,38,39,46,45
EN,14,23,258,259,30,39,274,275,46
EN,15,33,34,41,41,49,50,57,57
EN,16,34,35,42,41,50,51,58,57
MAT,1
EN,17,35,36,43,42,51,52,59,58
EN,19,37,38,45,44,53,54,61,60
MAT,2
EN,20,38,39,46,45,54,55,62,61
EN,21,39,274,275,46,55,290,291,62
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MAT,1
EN,22,49,50,57,57,65,66,73,73
EN,23,50,51,58,57,66,67,74,73
EN,24,51,52,59,58,67,68,75,74
EN,26,53,54,61,60,69,70,77,76
EPLOT
MAT,2
EN,27,54,55,62,61,70,71,78,77
EN,28,55,290,291,62,71,306,307,78
MAT,5
EN,29,65,66,73,73,81,83,90,90
EN,30,73,74,90,90,66,67,83,83
MAT,1
EN,31,67,68,75,74,83,84,91,90
EN,33,69,70,77,76,85,86,93,92
MAT,2
EN,34,70,71,78,77,86,87,94,93
EN,35,71,306,307,78,87,322,323,94
MAT,4
EN,37,81,83,90,90,97,99,106,106
MAT,1
EN,38,83,84,91,90,99,100,107,106
EN,40,85,86,93,92,101,102,109,108
MAT,2
EN,41,86,87,94,93,102,103,110,109
EN,42,87,322,323,94,103,338,339,110
MAT,4
EN,44,97,99,106,106,113,115,122,122
MAT,1
EN,45,99,100,107,106,115,116,123,122
EN,47,101,102,109,108,117,118,125,124
MAT,2
EN,48,102,103,110,109,118,119,126,125
EN,49,103,338,339,110,119,354,355,126
EPLOT
MAT,4
EN,51,113,115,122,122,129,131,138,138
MAT,1
EN,52,115,116,123,122,131,132,139,138
EN,54,117,118,125,124,133,134,141,140
MAT,2
EN,55,118,119,126,125,134,135,142,141
EN,56,119,354,355,126,135,370,371,142
MAT,4
EN,58,129,131,138,138,145,147,154,154
MAT,1
EN,59,131,132,139,138,147,148,155,154
EN,61,133,134,141,140,149,150,157,156
MAT,2
EN,62,134,135,142,141,150,151,158,157
EN,63,135,370,371,142,151,386,387,158
MAT,4
EN,65,145,147,154,154,161,163,170,170
EN,66,147,148,155,154,163,164,171,170
MAT,1
EN,68,149,150,157,156,165,166,173,172
MAT,2
EN,69,150,151,158,157,166,167,174,173
EN,70,151,386,387,158,167,402,403,174
EPLOT
MAT,5
EN,71,161,163,170,170,177,178,185,185
EN,72,185,170,186,186,178,163,179,179
MAT,1
EN,73,163,164,171,170,179,180,187,186
EN,75,165,166,173,172,181,182,189,188
MAT,2
EN,76,166,167,174,173,182,183,190,189
EN,77,167,402,403,174,183,418,419,190
MAT,1
EN,78,177,178,185,185,476,477,484,484
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EN,79,178,179,186,185,477,478,485,484
EN,80,179,180,187,186,478,479,486,485
EN,82,181,182,189,188,197,198,205,204
MAT,2
EN,83,182,183,190,189,198,199,206,205
EN,84,183,418,419,190,199,434,435,206
MAT,3
EN,85,193,194,201,201,209,210,217,217
EN,86,194,195,202,201,210,211,218,217
MAT,1
EN,87,195,196,203,202,211,212,219,218
EN,88,196,197,204,203,212,213,220,219
EN,89,197,198,205,204,213,468,472,220
MAT,2
EN,90,198,199,206,205,468,469,473,472
EN,91,199,434,435,206,469,470,474,473
MAT,1
EN,92,209,210,217,217,225,226,233,233
EN,93,210,211,218,217,226,227,234,233
EN,94,211,212,219,218,227,228,235,234
EN,95,212,213,220,219,228,229,236,235
EN,96,213,214,221,220,229,230,237,236
EPLOT
TYPE,2
MAT,3
REAL,97
EN,97,8,144
REAL,98
EN,98,24,144
REAL,99
EN,99,40,144
REAL,100
EN,100,56,144
REAL,101
EN,101,72,144
REAL,102
EN,102,88,144
REAL,103
EN,103,104,144
REAL,104
EN,104,120,144
REAL,105
EN,105,136,144
REAL,106
EN,106,152,144
REAL,107
EN,107,168,144
REAL,108
EN,108,184,144
REAL,109
EN,109,200,144
REAL,110
EN,110,216,144
REAL,111
EN,111,230,241
REAL,97
EN,112,15,144
REAL,98
EN,113,31,144
REAL,99
EN,114,47,144
REAL,100
EN,115,63,144
REAL,101
EN,116,79,144
REAL,102
EN,117,95,144
REAL,103
EN,118,111,144
REAL,104
EN,119,127,144
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REAL,105
EN,120,143,144
REAL,106
EN,121,159,144
REAL,107
EN,122,175,144
REAL,108
EN,123,191,144
REAL,109
EN,124,207,144
REAL,110
EN,125,223,144
REAL,111
EN,126,237,241
REAL,127
EN,127,52,53
REAL,128
EN,128,68,69
REAL,129
EN,129,84,85
REAL,130
EN,130,100,101
REAL,131
EN,131,116,117
REAL,132
EN,132,132,133
REAL,133
EN,133,148,149
REAL,134
EN,134,164,165
REAL,135
EN,135,180,181
REAL,127
EN,136,59,60
REAL,128
EN,137,75,76
REAL,129
EN,138,91,92
REAL,130
EN,139,107,108
REAL,131
EN,140,123,124
REAL,132
EN,141,139,140
REAL,133
EN,142,155,156
REAL,134
EN,143,171,172
REAL,135
EN,144,187,188
REAL,145
EN,145,193,209
REAL,146
EN,146,194,210
REAL,146
EN,147,201,217
REAL,148
EN,148,225,241
REAL,149
EN,149,227,241
REAL,149
EN,150,234,241
REAL,151
EN,151,215,241
REAL,151
EN,152,222,241
EPLOT
TYPE,1
REAL,1
MAT,2
EN,153,242,8,15,243,258,24,31,259
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EN,154,258,24,31,259,274,40,47,275
EN,155,274,40,47,275,290,56,63,291
EN,156,290,56,63,291,306,72,79,307
EN,157,306,72,79,307,322,88,95,323
EN,158,322,88,95,323,338,104,111,339
EN,159,338,104,111,339,354,120,127,355
EN,160,354,120,127,355,370,136,143,371
EN,161,370,136,143,371,386,152,159,387
EN,162,386,152,159,387,402,168,175,403
EN,163,402,168,175,403,418,184,191,419
EN,164,418,184,191,419,434,200,207,435
EN,165,434,200,207,435,450,216,223,451
EPLOT
TYPE,2
MAT,3
REAL,166
EN,166,226,241
REAL,166
EN,167,233,241
REAL,168
EN,168,214,241
REAL,168
EN,169,221,241
EPLOT
TYPE,1
REAL,1
MAT,1
EN,170,221,472,220,220,214,468,213,213
MAT,2
EN,171,468,469,473,472,214,215,222,221
EN,172,469,470,474,473,215,450,451,222
EN,173,470,471,475,474,450,216,223,451
MAT,10
EN,174,476,477,484,484,480,481,487,487
EN,175,477,478,485,484,481,482,488,487
MAT,1
EN,176,478,479,486,485,482,483,489,488
EN,177,480,481,487,487,193,194,201,201
EN,178,481,482,488,487,194,195,202,201
EN,179,482,483,489,488,195,196,203,202
EPLOT
C*** END of Element Module
C*** LOAD MODULE
C*** DEFINE INITIAL TEMPERATURES AND HEAT TRANSFER COEFFICIENTS
TIME,0.0
ITER,12,3,3
POSTR,,1,3,2,3
LPRINT,0
KTEMP,-1
C*** CONVECTIVE HEAT TRANSFER
C*** h=2 BTU/ft*Ft-F-Hr
EC,17,3,2.000,AAAA
EC,24,3,2.000,AAAA
EC,31,3,2.000,AAAA
EC,38,3,2.000,(0.5*T016+0.5*T032)
EC,45,3,2.000,T048
EC,52,3,2.000,(0.5*T064+0.5*T080)
EC,59,3,2.000,(0.5*T096+0.5*T112)
EC,66,3,2.000,(0.5*T128+0.5*T144)
EC,73,3,2.000,T144
EC,80,3,2.000,T144
EC,19,5,2.000,AAAA
EC,26,5,2.000,AAAA
EC,33,5,2.000,AAAA
EC,40,5,2.000,(0.5*T016+0.5*T032)
EC,47,5,2.000,T048
EC,54,5,2.000,(0.5*T064+0.5*T080)
EC,61,5,2.000,(0.5*T096+0.5*T112)
EC,68,5,2.000,(0.5*T128+0.5*T144)
EC,75,5,2.000,T144
EC,82,5,2.000,T144
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EC,171,6,2.000,AAAA
EC,172,6,2.000,AAAA
EC,164,3,2.000,AAAA
EC,96,6,2.000,AAAA
EC,95,6,2.000,AAAA
EC,94,6,2.000,AAAA
EC,93,6,2.000,AAAA
EC,92,6,2.000,AAAA
EC,153,3,2.000,AAAA
EC,154,3,2.000,AAAA
EC,155,3,2.000,AAAA
EC,156,3,2.000,AAAA
EC,157,3,2.000,AAAA
EC,158,3,2.000,AAAA
EC,159,3,2.000,AAAA
EC,160,3,2.000,AAAA
EC,161,3,2.000,AAAA
EC,162,3,2.000,AAAA
EC,163,3,2.000,AAAA
EC,165,3,2.000,AAAA
EC,173,3,2.000,AAAA
EC,173,6,2.000,AAAA
EC,179,3,2.000,T144
EC,176,3,2.000,T144
NT,144,TEMP,AAAA
NT,241,TEMP,AAAA
C*** ELEMENT TEMPERATURE MODULE
C*** INPUT HEAT GENERATION LOADS BTU/hr-ft*ft*ft
QE,37,(336.2*0.97*GGGG/24.00)
QE,44,(336.2*1.20*GGGG/24.00)
QE,51,(336.2*1.17*GGGG/24.00)
QE,58,(336.2*1.10*GGGG/24.00)
QE,65,(336.2*0.77*GGGG/24.00)
QE,92,SOCO
QE,93,SOCO
QE,94,SOCO
QE,95,SOCO
QE,96,SOCO
QE,153,SOSI
QE,154,SOSI
QE,155,SOSI
QE,156,SOSI
QE,157,SOSI
QE,158,SOSI
QE,159,SOSI
QE,160,SOSI
QE,161,SOSI
QE,162,SOSI
QE,163,SOSI
QE,164,SOSI
QE,165,SOSI
QE,171,SOTO
QE,172,SOTO
QE,173,SOTO
ETLIST,ALL
MPLIST,ALL
RLIST,ALL
NLIST,ALL
ELIST,ALL
ECLIST,ALL
NTLIST,ALL
QELIST,ALL
LWRITE
TIME,0.0
ITER,-20,20,20
LWRITE
TIME,0.0
ITER,-40,20,20
LWRITE
AFWRITE
FINISH
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/INPUT,27
FINISH
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/PREP7
/TITLE VCC-MSB-3 AMB= 0.0 F 3.885 KW AFTER 50 YEARS IN STORAGE
/SHOW,BNCHVCC2,GEO,,
/SHRINK,.3
KAN,-1
GGGG=3.885       * Total Heat Generation of MSB assembly KW/MSB
AAAA=0.00      * Ambient Air Temperature F
SOTO=0.0     * Solar Load on Top BTU/hr/ft**2
SOSI=0.0    * Solar Load on Side BTU/hr/ft**2
SOCO=0.0    * Solar Load on Cover Plate BTU/hr/ft**2
SUMK=.61936569 * Cumm. friction Loss K For Air Flow
TOAS=22.254    * Assumed Value; Must match TOCA; Outlet Air temp F
DRHI=13.69167     * Draft Height
T000=AAAA      * Air Temp at Bott of MSB
TAVE=((AAAA+TOAS)/2)
C*** *****************************************************
C*** CALCLATIONS ARE VALID FOR 0 < TAVE <32 F
C*** *****************************************************
HEAT=(GGGG*3412.0)  * Total heat generation BTU/Hr
CPAI=0.239    * CONSTRAINT 0 < TAVE < 32
MFLO=(HEAT/(3600.0*CPAI*(TOAS-AAAA))) * Air Mass Flowrate through VCC lb/Sec
DENA=(0.081+0.005*(32-TAVE)/32.)  * CONSTRAINT 0 < TAVE < 32
C*** *****************************************************
C*** DP Stack DPST must be equal to DP Flow DPFL
C*** *****************************************************
DPST=(DENA*32.2*DRHI*(TOAS-AAAA)/(32.2*(TAVE+460))) * DP Stack
DPFL=(MFLO*MFLO*SUMK/(2*32.2*DENA))                 * DP Flow
DELT=(MFLO*MFLO*SUMK*(TAVE+460)/(2*32.2*DENA*DENA*DRHI))
C*** ************************************************************************
C*** Calculated Air outlet temp TOCA must be equal to assumed value TOAS
C*** ************************************************************************
TOCA=(AAAA+DELT) * MUST BE EQUAL TO "TOAS" Air outlet Temp F
Q016=(GGGG*3412.0*0.69*16.0/144.0) * Heat Gen El. 0 -16 In  BTU/hr
Q032=(GGGG*3412.0*1.08*16.0/144.0) * Heat Gen El. 16 -32 In   BTU/Hr
Q048=(GGGG*3412.0*1.20*16.0/144.0) * Heat Gen El. 32 -48 In   BTU/Hr
Q064=(GGGG*3412.0*1.19*16.0/144.0) * Heat Gen El. 48 -64 In   BTU/Hr
Q080=(GGGG*3412.0*1.17*16.0/144.0) * Heat Gen El. 64 -80 In   BTU/Hr
Q096=(GGGG*3412.0*1.12*16.0/144.0) * Heat Gen El. 80 -96 In   BTU/Hr
Q112=(GGGG*3412.0*1.05*16.0/144.0) * Heat Gen El. 96 -112 In  BTU/Hr
Q128=(GGGG*3412.0*0.90*16.0/144.0) * Heat Gen El. 112 -128 In BTU/Hr
Q144=(GGGG*3412.0*0.60*16.0/144.0) * Heat Gen El. 128 -144 In BTU/Hr
T016=(T000+Q016/(3600.0*CPAI*MFLO))  * Air Temp at 16 In.
T032=(T016+Q032/(3600.0*CPAI*MFLO))  * Air Temp at 32 In.
T048=(T032+Q048/(3600.0*CPAI*MFLO))  * Air Temp at 48 In.
T064=(T048+Q064/(3600.0*CPAI*MFLO))  * Air Temp at 64 In.
T080=(T064+Q080/(3600.0*CPAI*MFLO))  * Air Temp at 80 In.
T096=(T080+Q096/(3600.0*CPAI*MFLO))  * Air Temp at 96 In.
T112=(T096+Q112/(3600.0*CPAI*MFLO))  * Air Temp at 112 In.
T128=(T112+Q128/(3600.0*CPAI*MFLO))  * Air Temp at 128 In.
T144=(T128+Q144/(3600.0*CPAI*MFLO))  * Air Temp at 144 In.
C*** ELEMENT TYPE MODULE
C*** DEFINES THE ELEMENT TYPES
ET,1,70  * STIF 70 3-D ISOPAR. THERMAL SOLID ELEMENTS
ET,2,31  * STIF 31 RADIATION LINK ELEMENTS
C*** OPTIONS MODULE
C*** DEFINES ANALYSIS OPTIONS
KYPOST,0
TOFFST,460      * Used for Rad. T Abs = T F + 460 F
C*** END OF OPTIONS MODULE
C*** MATERIAL MODULE
C*** DEFINES MATERIAL PROPERTIES  BTU/hr-ft-F
C***   Conduction Elements Kxx=Kyy
MP,KXX,1,26.2     *
MP,KXX,2,0.719    *
MPTEMP,1,-50,0,32,100,200,300
MPTEMP,7,500,700
MPDATA,KXX,3,1,0.0114,0.0130,0.0140,0.0154,0.0174,0.0193
MPDATA,KXX,3,7,0.0231,0.0268
MP,KXX,4,2.38      *
MP,KXX,5,0.10      *
MP,KXX,9,10.0      *
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MP,KXX,10,0.3.0    *
C***   Conduction Elements Density  Lb/FT**3-F
MP,DENS,1,490      *
MP,DENS,2,141.30   *
MPDATA,DENS,3,1,0.094,0.086,0.081,0.071,0.060,0.052
MPDATA,DENS,3,7,0.0412,0.0373
MP,DENS,4,176.80   *
MP,DENS,5,0.0065   *
MP,DENS,9,488      *
MP,DENS,10,106     *
C***   Conduction Elements Spec. Heat BTU/Lb-F
MP,C,1,0.11        *
MP,C,2,0.21        *
MPDATA,C,3,1,0.2385,0.239,0.240,0.240,0.241,0.243
MPDATA,C,3,7,0.247,0.253
MP,C,4,0.0715      *
MP,C,5,1.24      *
MP,C,9,0.11      *
MP,C,10,.22       *
EMIS CARDS
MP,EMIS,1,.8
MP,EMIS,2,.9
MP,EMIS,3,.85
MP,EMIS,6,.85
MP,EMIS,7,.85
MP,EMIS,8,.85
C*** END OF MATERIAL MODULE
C*** REAL CONSTANT MODULE
R,1                * FOR STIF55 Elements
C*** Real Const.For Radiation Area,From Geo.Fact.,Emiss, SBC
R,97,0.4400,0.140,0.9,0.17140E-08
R,98,0.4800,0.140,0.9,0.17140E-08
R,99,0.0500,0.140,0.9,0.17140E-08
R,100,0.0250,0.140,0.9,0.17140E-08
R,101,0.0950,0.140,0.9,0.17140E-08
R,102,0.7188,0.140,0.9,0.17140E-08
R,103,0.9600,0.140,0.9,0.17140E-08
R,104,0.9600,0.140,0.9,0.17140E-08
R,105,1.2793,0.140,0.9,0.17140E-08
R,106,1.2810,0.140,0.9,0.17140E-08
R,107,1.0500,0.140,0.9,0.17140E-08
R,108,0.6590,0.140,0.9,0.17140E-08
R,109,0.3794,0.140,0.9,0.17140E-08
R,110,0.1290,0.140,0.9,0.17140E-08
R,111,0.04895,1.0,0.8,0.17140E-08
R,127,0.0165,1.0,0.8,0.17140E-08
R,128,0.0446,1.0,0.8,0.17140E-08
R,129,0.3380,1.0,0.8,0.17140E-08
R,130,0.4510,1.0,0.8,0.17140E-08
R,131,0.4510,1.0,0.8,0.17140E-08
R,132,0.6000,1.0,0.8,0.17140E-08
R,133,0.6020,1.0,0.8,0.17140E-08
R,134,0.4930,1.0,0.8,0.17140E-08
R,135,0.4270,1.0,0.8,0.17140E-08
R,145,0.0606,1.0,0.8,0.17140E-08
R,146,0.2470,1.0,0.8,0.17140E-08
R,148,0.0606,1.0,0.8,0.17140E-08
R,149,0.1740,1.0,0.8,0.17140E-08
R,151,0.6650,1.0,0.9,0.17140E-08
R,166,0.1620,1.0,0.8,0.17140E-08
R,168,0.2400,1.0,0.9,0.17140E-08
C*** END OF REAL CONSTANT MODULE
C*** NODE MODULE
C*** DEFINES NODES BY DIRECT INPUT
N,1,0.0000,0.00000,0.0000
N,2,1.2500,0.00000,0.0000
N,3,2.5208,0.00000,0.0000
N,4,2.5830,0.00000,0.0000
N,5,2.9170,0.00000,0.0000
N,6,3.0833,0.00000,0.0000
N,7,4.2708,0.00000,0.0000
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N,8,5.5000,0.00000,0.0000
N,9,1.2310,0.21706,0.0000
N,10,2.4825,0.43773,0.0000
N,11,2.5438,0.44853,0.0000
N,12,2.8727,0.50653,0.0000
N,13,3.0365,0.53541,0.0000
N,14,4.2059,0.74162,0.0000
N,15,5.4164,0.95506,0.0000
N,17,0.0000,0.00000,1.8333
N,18,1.2500,0.00000,1.8333
N,19,2.5208,0.00000,1.8333
N,20,2.5830,0.00000,1.8333
N,21,2.9170,0.00000,1.8333
N,22,3.0833,0.00000,1.8333
N,23,4.2708,0.00000,1.8333
N,24,5.5000,0.00000,1.8333
N,25,1.2310,0.21706,1.8333
N,26,2.4825,0.43773,1.8333
N,27,2.5438,0.44853,1.8333
N,28,2.8727,0.50653,1.8333
N,29,3.0365,0.53541,1.8333
N,30,4.2059,0.74162,1.8333
N,31,5.4164,0.95506,1.8333
N,33,0.0000,0.00000,2.0000
N,34,1.2500,0.00000,2.0000
N,35,2.5208,0.00000,2.0000
N,36,2.5830,0.00000,2.0000
N,37,2.9170,0.00000,2.0000
N,38,3.0833,0.00000,2.0000
N,39,4.2708,0.00000,2.0000
N,40,5.5000,0.00000,2.0000
N,41,1.2310,0.21706,2.0000
N,42,2.4825,0.43773,2.0000
N,43,2.5438,0.44853,2.0000
N,44,2.8727,0.50653,2.0000
N,45,3.0365,0.53541,2.0000
N,46,4.2059,0.74162,2.0000
N,47,5.4164,0.95506,2.0000
N,49,0.0000,0.00000,2.0417
N,50,1.2500,0.00000,2.0417
N,51,2.5208,0.00000,2.0417
N,52,2.5830,0.00000,2.0417
N,53,2.9170,0.00000,2.0417
N,54,3.0833,0.00000,2.0417
N,55,4.2708,0.00000,2.0417
N,56,5.5000,0.00000,2.0417
N,57,1.2310,0.21706,2.0417
N,58,2.4825,0.43773,2.0417
N,59,2.5438,0.44853,2.0417
N,60,2.8727,0.50653,2.0417
N,61,3.0365,0.53541,2.0417
N,62,4.2059,0.74162,2.0417
N,63,5.4164,0.95506,2.0417
N,65,0.0000,0.00000,2.1040
N,66,1.2500,0.00000,2.1040
N,67,2.5208,0.00000,2.1040
N,68,2.5830,0.00000,2.1040
N,69,2.9170,0.00000,2.1040
N,70,3.0833,0.00000,2.1040
N,71,4.2708,0.00000,2.1040
N,72,5.5000,0.00000,2.1040
N,73,1.2310,0.21706,2.1040
N,74,2.4825,0.43773,2.1040
N,75,2.5438,0.44853,2.1040
N,76,2.8727,0.50653,2.1040
N,77,3.0365,0.53541,2.1040
N,78,4.2059,0.74162,2.1040
N,79,5.4164,0.95506,2.1040
N,81,0.0000,0.00000,2.4375
N,83,2.5208,0.00000,2.4375
N,84,2.5830,0.00000,2.4375
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N,85,2.9170,0.00000,2.4375
N,86,3.0833,0.00000,2.4375
N,87,4.2708,0.00000,2.4375
N,88,5.5000,0.00000,2.4375
N,90,2.4825,0.43773,2.4375
N,91,2.5438,0.44853,2.4375
N,92,2.8727,0.50653,2.4375
N,93,3.0365,0.53541,2.4375
N,94,4.2059,0.74162,2.4375
N,95,5.4164,0.95506,2.4375
N,97,0.0000,0.00000,5.1042
N,99,2.5208,0.00000,5.1042
N,100,2.5830,0.00000,5.1042
N,101,2.9170,0.00000,5.1042
N,102,3.0833,0.00000,5.1042
N,103,4.2708,0.00000,5.1042
N,104,5.5000,0.00000,5.1042
N,106,2.4825,0.43773,5.1042
N,107,2.5438,0.44853,5.1042
N,108,2.8727,0.50653,5.1042
N,109,3.0365,0.53541,5.1042
N,110,4.2059,0.74162,5.1042
N,111,5.4164,0.95506,5.1042
N,113,0.0000,0.00000,6.4376
N,115,2.5208,0.00000,6.4376
N,116,2.5830,0.00000,6.4376
N,117,2.9170,0.00000,6.4376
N,118,3.0833,0.00000,6.4376
N,119,4.2708,0.00000,6.4376
N,120,5.5000,0.00000,6.4376
N,122,2.4825,0.43773,6.4376
N,123,2.5438,0.44853,6.4376
N,124,2.8727,0.50653,6.4376
N,125,3.0365,0.53541,6.4376
N,126,4.2059,0.74162,6.4376
N,127,5.4164,0.95506,6.4376
N,129,0.0000,0.00000,9.1043
N,131,2.5208,0.00000,9.1043
N,132,2.5830,0.00000,9.1043
N,133,2.9170,0.00000,9.1043
N,134,3.0833,0.00000,9.1043
N,135,4.2708,0.00000,9.1043
N,136,5.5000,0.00000,9.1043
N,138,2.4825,0.43773,9.1043
N,139,2.5438,0.44853,9.1043
N,140,2.8727,0.50653,9.1043
N,141,3.0365,0.53541,9.1043
N,142,4.2059,0.74162,9.1043
N,143,5.4164,0.95506,9.1043
N,144,7.9696,0.69725,9.1043
N,145,0.0000,0.00000,11.771
N,147,2.5208,0.00000,11.771
N,148,2.5830,0.00000,11.771
N,149,2.9170,0.00000,11.771
N,150,3.0833,0.00000,11.771
N,151,4.2708,0.00000,11.771
N,152,5.5000,0.00000,11.771
N,154,2.4825,0.43773,11.771
N,155,2.5438,0.44853,11.771
N,156,2.8727,0.50653,11.771
N,157,3.0365,0.53541,11.771
N,158,4.2059,0.74162,11.771
N,159,5.4164,0.95506,11.771
N,161,0.0000,0.00000,14.438
N,163,2.5208,0.00000,14.438
N,164,2.5830,0.00000,14.438
N,165,2.9170,0.00000,14.438
N,166,3.0833,0.00000,14.438
N,167,4.2708,0.00000,14.438
N,168,5.5000,0.00000,14.438
N,170,2.4825,0.43773,14.438
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N,171,2.5438,0.44853,14.438
N,172,2.8727,0.50653,14.438
N,173,3.0365,0.53541,14.438
N,174,4.2059,0.74162,14.438
N,175,5.4164,0.95506,14.438
N,177,0.0000,0.00000,16.143
N,178,1.2500,0.00000,16.143
N,179,2.5208,0.00000,16.143
N,180,2.5830,0.00000,16.143
N,181,2.9170,0.00000,16.143
N,182,3.0833,0.00000,16.143
N,183,4.2708,0.00000,16.143
N,184,5.5000,0.00000,16.143
N,185,1.2310,0.21706,16.143
N,186,2.4825,0.43773,16.143
N,187,2.5438,0.44853,16.143
N,188,2.8727,0.50653,16.143
N,189,3.0365,0.53541,16.143
N,190,4.2059,0.74162,16.143
N,191,5.4164,0.95506,16.143
N,193,0.0000,0.00000,17.186
N,194,1.2500,0.00000,17.186
N,195,2.5208,0.00000,17.186
N,196,2.5830,0.00000,17.186
N,197,2.9170,0.00000,17.186
N,198,3.0833,0.00000,17.186
N,199,4.2708,0.00000,17.186
N,200,5.5000,0.00000,17.186
N,201,1.2310,0.21706,17.186
N,202,2.4825,0.43773,17.186
N,203,2.5438,0.44853,17.186
N,204,2.8727,0.50653,17.186
N,205,3.0365,0.53541,17.186
N,206,4.2059,0.74162,17.186
N,207,5.4164,0.95506,17.186
N,209,0.0000,0.00000,17.724
N,210,1.2500,0.00000,17.724
N,211,2.5208,0.00000,17.724
N,212,2.5830,0.00000,17.724
N,213,2.9170,0.00000,17.724
N,214,3.0833,0.00000,17.724
N,215,4.2708,0.00000,17.724
N,216,5.5000,0.00000,17.724
N,217,1.2310,0.21706,17.724
N,218,2.4825,0.43773,17.724
N,219,2.5438,0.44853,17.724
N,220,2.8727,0.50653,17.724
N,221,3.0365,0.53541,17.724
N,222,4.2059,0.74162,17.724
N,223,5.4164,0.95506,17.724
N,225,0.0000,0.00000,17.786
N,226,1.2500,0.00000,17.786
N,227,2.5208,0.00000,17.786
N,228,2.5830,0.00000,17.786
N,229,2.9170,0.00000,17.786
N,230,3.0833,0.00000,17.786
N,233,1.2310,0.21706,17.786
N,234,2.4825,0.43773,17.786
N,235,2.5438,0.44853,17.786
N,236,2.8727,0.50653,17.786
N,237,3.0365,0.53541,17.786
N,241,1.7999,0.015708,19.500
N,242,5.4800,0.00000,0.0000
N,243,5.3967,0.95159,0.0000
N,258,5.4800,0.00000,1.8330
N,259,5.3967,0.95159,1.8330
N,274,5.4800,0.00000,2.0000
N,275,5.3967,0.95159,2.0000
N,290,5.4800,0.00000,2.0417
N,291,5.3967,0.95159,2.0417
N,306,5.4800,0.00000,2.1040
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N,307,5.3967,0.95159,2.1040
N,322,5.4800,0.00000,2.4375
N,323,5.3967,0.95159,2.4375
N,338,5.4800,0.00000,5.1042
N,339,5.3967,0.95159,5.1042
N,354,5.4800,0.00000,6.4375
N,355,5.3967,0.95159,6.4375
N,370,5.4800,0.00000,9.1042
N,371,5.3967,0.95159,9.1042
N,386,5.4800,0.00000,11.771
N,387,5.3967,0.95159,11.771
N,402,5.4800,0.00000,14.437
N,403,5.3967,0.95159,14.437
N,418,5.4800,0.00000,16.143
N,419,5.3967,0.95159,16.143
N,434,5.4800,0.00000,17.185
N,435,5.3967,0.95159,17.185
N,450,5.4800,0.00000,17.724
N,451,5.3967,0.95159,17.724
N,468,3.0833,0.00000,17.703
N,469,4.2708,0.00000,17.703
N,470,5.4800,0.00000,17.703
N,471,5.5000,0.00000,17.703
N,472,3.0365,0.53541,17.703
N,473,4.2059,0.74162,17.703
N,474,5.3967,0.95159,17.703
N,475,5.4164,0.95506,17.703
N,476,0.0000,0.00000,16.643
N,477,1.2500,0.00000,16.643
N,478,2.5208,0.00000,16.643
N,479,2.5830,0.00000,16.643
N,480,0.0000,0.00000,16.809
N,481,1.2500,0.00000,16.809
N,482,2.5208,0.00000,16.809
N,483,2.5830,0.00000,16.809
N,484,1.2310,0.21706,16.643
N,485,2.4825,0.43773,16.463
N,486,2.5438,0.44853,16.463
N,487,1.2310,0.21706,16.809
N,488,2.4825,0.43773,16.809
N,489,2.5438,0.44853,16.809
NPLOT
C*** End of Node Module
C*** Element Module
TYPE,1
REAL,1
MAT,2
EN,1,1,2,9,9,17,18,25,25
EN,2,2,3,10,9,18,19,26,25
EN,3,3,4,11,10,19,20,27,26
EN,4,4,5,12,11,20,21,28,27
EN,5,5,6,13,12,21,22,29,28
EN,6,6,7,14,13,22,23,30,29
EN,7,7,242,243,14,23,258,259,30
MAT,1
EN,8,17,18,25,25,33,34,41,41
EN,9,18,19,26,25,34,35,42,41
EN,10,19,20,27,26,35,36,43,42
EN,11,20,21,28,27,36,37,44,43
EN,12,21,22,29,28,37,38,45,44
MAT,2
EN,13,22,23,30,29,38,39,46,45
EN,14,23,258,259,30,39,274,275,46
EN,15,33,34,41,41,49,50,57,57
EN,16,34,35,42,41,50,51,58,57
MAT,1
EN,17,35,36,43,42,51,52,59,58
EN,19,37,38,45,44,53,54,61,60
MAT,2
EN,20,38,39,46,45,54,55,62,61
EN,21,39,274,275,46,55,290,291,62
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MAT,1
EN,22,49,50,57,57,65,66,73,73
EN,23,50,51,58,57,66,67,74,73
EN,24,51,52,59,58,67,68,75,74
EN,26,53,54,61,60,69,70,77,76
EPLOT
MAT,2
EN,27,54,55,62,61,70,71,78,77
EN,28,55,290,291,62,71,306,307,78
MAT,5
EN,29,65,66,73,73,81,83,90,90
EN,30,73,74,90,90,66,67,83,83
MAT,1
EN,31,67,68,75,74,83,84,91,90
EN,33,69,70,77,76,85,86,93,92
MAT,2
EN,34,70,71,78,77,86,87,94,93
EN,35,71,306,307,78,87,322,323,94
MAT,4
EN,37,81,83,90,90,97,99,106,106
MAT,1
EN,38,83,84,91,90,99,100,107,106
EN,40,85,86,93,92,101,102,109,108
MAT,2
EN,41,86,87,94,93,102,103,110,109
EN,42,87,322,323,94,103,338,339,110
MAT,4
EN,44,97,99,106,106,113,115,122,122
MAT,1
EN,45,99,100,107,106,115,116,123,122
EN,47,101,102,109,108,117,118,125,124
MAT,2
EN,48,102,103,110,109,118,119,126,125
EN,49,103,338,339,110,119,354,355,126
EPLOT
MAT,4
EN,51,113,115,122,122,129,131,138,138
MAT,1
EN,52,115,116,123,122,131,132,139,138
EN,54,117,118,125,124,133,134,141,140
MAT,2
EN,55,118,119,126,125,134,135,142,141
EN,56,119,354,355,126,135,370,371,142
MAT,4
EN,58,129,131,138,138,145,147,154,154
MAT,1
EN,59,131,132,139,138,147,148,155,154
EN,61,133,134,141,140,149,150,157,156
MAT,2
EN,62,134,135,142,141,150,151,158,157
EN,63,135,370,371,142,151,386,387,158
MAT,4
EN,65,145,147,154,154,161,163,170,170
EN,66,147,148,155,154,163,164,171,170
MAT,1
EN,68,149,150,157,156,165,166,173,172
MAT,2
EN,69,150,151,158,157,166,167,174,173
EN,70,151,386,387,158,167,402,403,174
EPLOT
MAT,5
EN,71,161,163,170,170,177,178,185,185
EN,72,185,170,186,186,178,163,179,179
MAT,1
EN,73,163,164,171,170,179,180,187,186
EN,75,165,166,173,172,181,182,189,188
MAT,2
EN,76,166,167,174,173,182,183,190,189
EN,77,167,402,403,174,183,418,419,190
MAT,1
EN,78,177,178,185,185,476,477,484,484
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EN,79,178,179,186,185,477,478,485,484
EN,80,179,180,187,186,478,479,486,485
EN,82,181,182,189,188,197,198,205,204
MAT,2
EN,83,182,183,190,189,198,199,206,205
EN,84,183,418,419,190,199,434,435,206
MAT,3
EN,85,193,194,201,201,209,210,217,217
EN,86,194,195,202,201,210,211,218,217
MAT,1
EN,87,195,196,203,202,211,212,219,218
EN,88,196,197,204,203,212,213,220,219
EN,89,197,198,205,204,213,468,472,220
MAT,2
EN,90,198,199,206,205,468,469,473,472
EN,91,199,434,435,206,469,470,474,473
MAT,1
EN,92,209,210,217,217,225,226,233,233
EN,93,210,211,218,217,226,227,234,233
EN,94,211,212,219,218,227,228,235,234
EN,95,212,213,220,219,228,229,236,235
EN,96,213,214,221,220,229,230,237,236
EPLOT
TYPE,2
MAT,3
REAL,97
EN,97,8,144
REAL,98
EN,98,24,144
REAL,99
EN,99,40,144
REAL,100
EN,100,56,144
REAL,101
EN,101,72,144
REAL,102
EN,102,88,144
REAL,103
EN,103,104,144
REAL,104
EN,104,120,144
REAL,105
EN,105,136,144
REAL,106
EN,106,152,144
REAL,107
EN,107,168,144
REAL,108
EN,108,184,144
REAL,109
EN,109,200,144
REAL,110
EN,110,216,144
REAL,111
EN,111,230,241
REAL,97
EN,112,15,144
REAL,98
EN,113,31,144
REAL,99
EN,114,47,144
REAL,100
EN,115,63,144
REAL,101
EN,116,79,144
REAL,102
EN,117,95,144
REAL,103
EN,118,111,144
REAL,104
EN,119,127,144
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REAL,105
EN,120,143,144
REAL,106
EN,121,159,144
REAL,107
EN,122,175,144
REAL,108
EN,123,191,144
REAL,109
EN,124,207,144
REAL,110
EN,125,223,144
REAL,111
EN,126,237,241
REAL,127
EN,127,52,53
REAL,128
EN,128,68,69
REAL,129
EN,129,84,85
REAL,130
EN,130,100,101
REAL,131
EN,131,116,117
REAL,132
EN,132,132,133
REAL,133
EN,133,148,149
REAL,134
EN,134,164,165
REAL,135
EN,135,180,181
REAL,127
EN,136,59,60
REAL,128
EN,137,75,76
REAL,129
EN,138,91,92
REAL,130
EN,139,107,108
REAL,131
EN,140,123,124
REAL,132
EN,141,139,140
REAL,133
EN,142,155,156
REAL,134
EN,143,171,172
REAL,135
EN,144,187,188
REAL,145
EN,145,193,209
REAL,146
EN,146,194,210
REAL,146
EN,147,201,217
REAL,148
EN,148,225,241
REAL,149
EN,149,227,241
REAL,149
EN,150,234,241
REAL,151
EN,151,215,241
REAL,151
EN,152,222,241
EPLOT
TYPE,1
REAL,1
MAT,2
EN,153,242,8,15,243,258,24,31,259
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EN,154,258,24,31,259,274,40,47,275
EN,155,274,40,47,275,290,56,63,291
EN,156,290,56,63,291,306,72,79,307
EN,157,306,72,79,307,322,88,95,323
EN,158,322,88,95,323,338,104,111,339
EN,159,338,104,111,339,354,120,127,355
EN,160,354,120,127,355,370,136,143,371
EN,161,370,136,143,371,386,152,159,387
EN,162,386,152,159,387,402,168,175,403
EN,163,402,168,175,403,418,184,191,419
EN,164,418,184,191,419,434,200,207,435
EN,165,434,200,207,435,450,216,223,451
EPLOT
TYPE,2
MAT,3
REAL,166
EN,166,226,241
REAL,166
EN,167,233,241
REAL,168
EN,168,214,241
REAL,168
EN,169,221,241
EPLOT
TYPE,1
REAL,1
MAT,1
EN,170,221,472,220,220,214,468,213,213
MAT,2
EN,171,468,469,473,472,214,215,222,221
EN,172,469,470,474,473,215,450,451,222
EN,173,470,471,475,474,450,216,223,451
MAT,10
EN,174,476,477,484,484,480,481,487,487
EN,175,477,478,485,484,481,482,488,487
MAT,1
EN,176,478,479,486,485,482,483,489,488
EN,177,480,481,487,487,193,194,201,201
EN,178,481,482,488,487,194,195,202,201
EN,179,482,483,489,488,195,196,203,202
EPLOT
C*** END of Element Module
C*** LOAD MODULE
C*** DEFINE INITIAL TEMPERATURES AND HEAT TRANSFER COEFFICIENTS
TIME,0.0
ITER,12,3,3
POSTR,,1,3,2,3
LPRINT,0
KTEMP,-1
C*** CONVECTIVE HEAT TRANSFER
C*** h=2 BTU/ft*Ft-F-Hr
EC,17,3,2.000,AAAA
EC,24,3,2.000,AAAA
EC,31,3,2.000,AAAA
EC,38,3,2.000,(0.5*T016+0.5*T032)
EC,45,3,2.000,T048
EC,52,3,2.000,(0.5*T064+0.5*T080)
EC,59,3,2.000,(0.5*T096+0.5*T112)
EC,66,3,2.000,(0.5*T128+0.5*T144)
EC,73,3,2.000,T144
EC,80,3,2.000,T144
EC,19,5,2.000,AAAA
EC,26,5,2.000,AAAA
EC,33,5,2.000,AAAA
EC,40,5,2.000,(0.5*T016+0.5*T032)
EC,47,5,2.000,T048
EC,54,5,2.000,(0.5*T064+0.5*T080)
EC,61,5,2.000,(0.5*T096+0.5*T112)
EC,68,5,2.000,(0.5*T128+0.5*T144)
EC,75,5,2.000,T144
EC,82,5,2.000,T144
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EC,171,6,2.000,AAAA
EC,172,6,2.000,AAAA
EC,164,3,2.000,AAAA
EC,96,6,2.000,AAAA
EC,95,6,2.000,AAAA
EC,94,6,2.000,AAAA
EC,93,6,2.000,AAAA
EC,92,6,2.000,AAAA
EC,153,3,2.000,AAAA
EC,154,3,2.000,AAAA
EC,155,3,2.000,AAAA
EC,156,3,2.000,AAAA
EC,157,3,2.000,AAAA
EC,158,3,2.000,AAAA
EC,159,3,2.000,AAAA
EC,160,3,2.000,AAAA
EC,161,3,2.000,AAAA
EC,162,3,2.000,AAAA
EC,163,3,2.000,AAAA
EC,165,3,2.000,AAAA
EC,173,3,2.000,AAAA
EC,173,6,2.000,AAAA
EC,179,3,2.000,T144
EC,176,3,2.000,T144
NT,144,TEMP,AAAA
NT,241,TEMP,AAAA
C*** ELEMENT TEMPERATURE MODULE
C*** INPUT HEAT GENERATION LOADS BTU/hr-ft*ft*ft
QE,37,(336.2*0.97*GGGG/24.00)
QE,44,(336.2*1.20*GGGG/24.00)
QE,51,(336.2*1.17*GGGG/24.00)
QE,58,(336.2*1.10*GGGG/24.00)
QE,65,(336.2*0.77*GGGG/24.00)
QE,92,SOCO
QE,93,SOCO
QE,94,SOCO
QE,95,SOCO
QE,96,SOCO
QE,153,SOSI
QE,154,SOSI
QE,155,SOSI
QE,156,SOSI
QE,157,SOSI
QE,158,SOSI
QE,159,SOSI
QE,160,SOSI
QE,161,SOSI
QE,162,SOSI
QE,163,SOSI
QE,164,SOSI
QE,165,SOSI
QE,171,SOTO
QE,172,SOTO
QE,173,SOTO
ETLIST,ALL
MPLIST,ALL
RLIST,ALL
NLIST,ALL
ELIST,ALL
ECLIST,ALL
NTLIST,ALL
QELIST,ALL
LWRITE
TIME,0.0
ITER,-20,20,20
LWRITE
TIME,0.0
ITER,-40,20,20
LWRITE
AFWRITE
FINISH
```

```
/INPUT,27
FINISH
```

ATTACHMENT D
(9 pages)

ANSYS OUPUT

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 16 CONSUMERS POWER MAY 1,1990

FOR SUPPORT CALL LEROY N. REISS PHONE (517) 788-2344 TWX

TITLE 9.2863 AUG 2,1995 CP= 10.770

***** ANSYS ANALYSIS DEFINITION (PREP7) *****

PARAMETERS OUTPUT
MSB3_20.OUT

NEW TITLE= VCC-MSB-3 AMB= 0.0 F 5.97 KW AFTER 20 YEARS IN STORAGE

/SHOW SWITCH PLOTS TO FILE BNCHVCC2.GEO - RASTER MODE.

SHRINK SET TO 0.3000

ANALYSIS TYPE= -1 (THERMAL ANALYSIS)

PARAMETER= GGGG 5.970

PARAMETER= AAAA 0.0000E+00

PARAMETER= SOTO 0.0000E+00

PARAMETER= SOSI 0.0000E+00

PARAMETER= SOCO 0.0000E+00

PARAMETER= SUMK 0.6194

PARAMETER= TOAS 29.85 ≈ TOCA = 29.98

PARAMETER= DRHI 13.69

PARAMETER= TOOO 0.0000E+00

PARAMETER= TAVE 14.92

C*** **********

C*** CALCLATIONS ARE VALID FOR 0 < TAVE <32 F

C*** **********

PARAMETER= HEAT 0.2037E+05

PARAMETER= CPAI 0.2390

PARAMETER= MFLO 0.7932

PARAMETER= DENA 0.8367E-01

C*** **********

C*** DP Stack DPST must be equal to DP Flow DPFL

C*** **********

PARAMETER= DPST 0.7199E-01

PARAMETER= DPFL 0.7233E-01

PARAMETERS OUTPUT
MSB3_20.OUT

```
PARAMETER= DELT     29.98

C*** ********************************************************************

C*** Calculated Air outlet temp TOCA must be equal to assumed value TOAS

C*** ********************************************************************

PARAMETER= TOCA     29.98

PARAMETER= Q016     1562.

PARAMETER= Q032     2444.

PARAMETER= Q048     2716.

PARAMETER= Q064     2693.

PARAMETER= Q080     2648.

PARAMETER= Q096     2535.

PARAMETER= Q112     2376.

PARAMETER= Q128     2037.

PARAMETER= Q144     1358.

PARAMETER= T016     2.288

PARAMETER= T032     5.870

PARAMETER= T048     9.849

PARAMETER= T064     13.80

PARAMETER= T080     17.68

PARAMETER= T096     21.39

PARAMETER= T112     24.87

PARAMETER= T128     27.86

PARAMETER= T144     29.85

C*** ELEMENT TYPE MODULE

C*** DEFINES THE ELEMENT TYPES

ELEMENT TYPE  1 USES STIF 70
 KEYOPT(1-9)=   0   0   0     0   0   0      0   0   0
 INOPR=  0  NUMBER OF NODES=   8

ISOPAR. SOLID THERMAL

CURRENT NODAL DOF SET IS  TEMP
 THREE-DIMENSIONAL STRUCTURE

ELEMENT TYPE  2 USES STIF 31
 KEYOPT(1-9)=   0   0   0     0   0   0      0   0   0
 INOPR=  0  NUMBER OF NODES=   2

RADIATION LINK
```

TEMPERATURE OUTPUT _ MSB3_20.OUT ATTACHMENT D
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ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 16 CONSUMERS POWER MAY 1,1990

VCC-MSB-3 AMB= 0.0 F 5.97 KW AFTER 20 YEARS IN STORAGE 9.3898 AUG 2,1995 CP= 383.490

***** TEMPERATURE SOLUTION ***** TIME = 0.00000E+00 LOAD STEP= 3 ITERATION= 40 CUM. ITER.= 72

NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP
1	19.728	2	18.176	3	13.743	4	13.589	5	12.537
6	11.662	7	6.9164	8	1.4032	9	18.176	10	13.743
11	13.589	12	12.537	13	11.662	14	6.9165	15	1.4033
		17	24.559	18	23.143	19	20.334	20	19.847
21	17.319	22	16.597	23	7.1158	24	1.4351	25	23.143
26	20.334	27	19.847	28	17.319	29	16.597	30	7.1159
31	1.4352			33	24.717	34	23.112	35	20.578
36	20.343	37	16.861	38	16.341	39	7.1548	40	1.4622
41	23.112	42	20.578	43	20.343	44	16.860	45	16.341
46	7.1549	47	1.4623			49	26.087	50	23.668
51	21.613	52	21.023	53	16.397	54	16.223	55	7.1685
56	1.4676	57	23.668	58	21.615	59	21.023	60	16.397
61	16.223	62	7.1686	63	1.4677			65	26.227
66	23.626	67	21.807	68	22.036	69	15.892	70	15.930
71	7.2114	72	1.4675	73	23.626	74	21.810	75	22.029
76	15.892	77	15.930	78	7.2115	79	1.4676		
81	110.63			83	32.369	84	32.175	85	14.278
86	14.322	87	7.3909	88	1.5057			90	32.134
91	31.966	92	14.276	93	14.321	94	7.3912	95	1.5057
		97	136.98			99	48.924	100	48.634
101	15.660	102	15.632	103	8.1923	104	1.6623		
106	48.630	107	48.371	108	15.657	109	15.630	110	8.1928
111	1.6623			113	149.27			115	56.886
116	56.579	117	19.699	118	19.639	119	9.5820	120	1.9897
		122	56.554	123	56.283	124	19.696	125	19.636
126	9.5826	127	1.9898			129	154.81		
131	61.959	132	61.743	133	25.179	134	25.118	135	12.283
136	2.4113			138	61.657	139	61.470	140	25.176
141	25.116	142	12.283	143	2.4114	144	0.00000E+00	145	134.36

TEMPERATURE OUTPUT MSB3_20.OUT

		147	61.315	148	60.802	149	28.695	150
28.608								
151	13.763	152	2.6608			154	60.998	155
60.525								
156	28.691	157	28.606	158	13.764	159	2.6609	
161	115.08			163	46.407	164	45.895	165
26.931								
166	26.855	167	12.750	168	2.4754			170
46.193								
171	45.714	172	26.930	173	26.854	174	12.750	175
2.4755								
		177	22.979	178	22.920	179	24.198	180
24.475								
181	21.928	182	21.812	183	9.7170	184	1.8560	185
22.928								
186	24.179	187	24.450	188	21.928	189	21.812	190
9.7171								
191	1.8561			193	17.504	194	17.944	195
17.433								
196	17.037	197	16.357	198	16.415	199	5.7373	200
1.0331								
201	17.945	202	17.429	203	17.051	204	16.357	205
16.415								
206	5.7374	207	1.0332			209	5.6380	210
7.4616								
211	13.730	212	14.089	213	14.339	214	13.725	215
1.7698								
216	0.76870	217	7.4613	218	13.732	219	14.084	220
14.340								
221	13.725	222	1.7698	223	0.76872			225
5.5853								
226	7.4559	227	13.618	228	13.977	229	14.226	230
13.733								
				233	7.4558	234	13.619	235
13.974								
236	14.226	237	13.734					
241	0.00000E+00	242	1.4827	243	1.4828			
				258	1.5196	259	1.5198	
						274	1.5468	275
1.5469								
								290
1.5531								
291	1.5532							
306	1.5534	307	1.5535					
		322	1.5877	323	1.5878			
				338	1.7610	339	1.7611	
						354	2.0985	355
2.0986								
								370
2.5537								
371	2.5538							
386	2.8198	387	2.8199					
		402	2.6211	403	2.6212			
				418	1.9633	419	1.9635	
						434	1.0805	435
1.0806								
								450
0.81278								
451	0.81280							
				468	13.914	469	1.9460	470
0.83491								
471	0.77589	472	13.914	473	1.9460	474	0.83495	475
0.77591								
476	22.556	477	23.232	478	22.747	479	22.463	480
18.042								
481	17.633	482	18.728	483	19.126	484	23.165	485
23.355								
486	23.213	487	17.635	488	18.711	489	19.003	

MAXIMUM TEMPERATURE= 154.81 AT NODE 129
MINIMUM TEMPERATURE= 0.00000E+00 AT NODE 241

```
          ANSYS - ENGINEERING ANALYSIS SYSTEM  REVISION 4.4      A 16   CONSUMERS POWER  MAY
1,1990
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 TITLE                                                                    9.3978  AUG
2,1995 CP=     10.660

        ***** ANSYS ANALYSIS DEFINITION (PREP7) *****

NEW TITLE= VCC-MSB-3 AMB= 0.0 F 3.885 KW AFTER 50 YEARS IN STORAGE

/SHOW SWITCH PLOTS TO FILE BNCHVCC2.GEO      - RASTER MODE.

SHRINK SET TO    0.3000

ANALYSIS TYPE= -1   (THERMAL ANALYSIS)

PARAMETER= GGGG     3.885

PARAMETER= AAAA     0.0000E+00

PARAMETER= SOTO     0.0000E+00

PARAMETER= SOSI     0.0000E+00

PARAMETER= SOCO     0.0000E+00

PARAMETER= SUMK     0.6194

PARAMETER= TOAS     22.25   ≈ TOCA = 22.3

PARAMETER= DRHI     13.69

PARAMETER= TOOO     0.0000E+00

PARAMETER= TAVE     11.13

C*** ******************************************************

C*** CALCLATIONS ARE VALID FOR 0 < TAVE <32 F

C*** ******************************************************

PARAMETER= HEAT     0.1326E+05

PARAMETER= CPAI     0.2390

PARAMETER= MFLO     0.6923

PARAMETER= DENA     0.8426E-01

C*** ******************************************************

C*** DP Stack DPST must be equal to DP Flow DPFL

C*** ******************************************************

PARAMETER= DPST     0.5449E-01

PARAMETER= DPFL     0.5470E-01
```

PARAMETERS OUT PUT

MSB 3_ 50. OUT

```
PARAMETER= DELT     22.34

C*** ********************************************************************

C*** Calculated Air outlet temp TOCA must be equal to assumed value TOAS

C*** ********************************************************************
```

PARAMETERS OUT PUT
MSB3-50.OUT

```
PARAMETER= TOCA     22.34

PARAMETER= Q016     1016.

PARAMETER= Q032     1591.

PARAMETER= Q048     1767.

PARAMETER= Q064     1753.

PARAMETER= Q080     1723.

PARAMETER= Q096     1650.

PARAMETER= Q112     1546.

PARAMETER= Q128     1326.

PARAMETER= Q144     883.7

PARAMETER= T016     1.706

PARAMETER= T032     4.377

PARAMETER= T048     7.344

PARAMETER= T064     10.29

PARAMETER= T080     13.18

PARAMETER= T096     15.95

PARAMETER= T112     18.55

PARAMETER= T128     20.77

PARAMETER= T144     22.25

C*** ELEMENT TYPE MODULE

C*** DEFINES THE ELEMENT TYPES

ELEMENT TYPE  1 USES STIF 70
 KEYOPT(1-9)=   0   0   0     0   0   0      0   0   0
 INOPR=  0  NUMBER OF NODES=   8

ISOPAR. SOLID THERMAL

CURRENT NODAL DOF SET IS  TEMP
 THREE-DIMENSIONAL STRUCTURE

ELEMENT TYPE  2 USES STIF 31
 KEYOPT(1-9)=   0   0   0     0   0   0      0   0   0
 INOPR=  0  NUMBER OF NODES=   2

RADIATION LINK
```

EA-SC-93-083-22
ATTACHMENT D
PAGE D8

TEMPERATURE OUTPUT MSB3_50.OUT

ANSYS - ENGINEERING ANALYSIS SYSTEM REVISION 4.4 A 16 CONSUMERS POWER MAY 1,1990

VCC-MSB-3 AMB= 0.0 F 3.885 KW AFTER 50 YEARS IN STORAGE 9.5000 AUG 2,1995 CP= 378.330

***** TEMPERATURE SOLUTION ***** TIME = 0.00000E+00 LOAD STEP= 3 ITERATION= 40 CUM. ITER.= 72

NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP	NODE	TEMP
1	13.165	2	12.134	3	9.1846	4	9.0812	5	8.3765
6	7.7927	7	4.6270	8	0.94004	9	12.134	10	9.1846
11	9.0811	12	8.3765	13	7.7926	14	4.6270	15	0.94010
		17	16.349	18	15.424	19	13.582	20	13.260
21	11.589	22	11.110	23	4.7739	24	0.96308	25	15.424
26	13.582	27	13.260	28	11.589	29	11.110	30	4.7739
31	0.96313			33	16.454	34	15.403	35	13.743
36	13.588	37	11.286	38	10.944	39	4.8027	40	0.98226
41	15.403	42	13.743	43	13.588	44	11.286	45	10.944
46	4.8028	47	0.98232			49	17.352	50	15.767
51	14.429	52	14.038	53	10.980	54	10.867	55	4.8125
56	0.98621	57	15.767	58	14.431	59	14.038	60	10.980
61	10.866	62	4.8125	63	0.98627			65	17.444
66	15.738	67	14.558	68	14.709	69	10.647	70	10.674
71	4.8419	72	0.98659	73	15.738	74	14.560	75	14.705
76	10.647	77	10.674	78	4.8419	79	0.98665		
81	72.745			83	21.564	84	21.437	85	9.5939
86	9.6217	87	4.9654	88	1.0166			90	21.411
91	21.301	92	9.5928	93	9.6211	94	4.9655	95	1.0166
		97	90.290			99	32.859	100	32.670
101	10.653	102	10.635	103	5.5953	104	1.1344		
106	32.668	107	32.498	108	10.651	109	10.634	110	5.5955
111	1.1344			113	98.578			115	38.550
116	38.351	117	13.597	118	13.554	119	6.6140	120	1.3779
		122	38.334	123	38.158	124	13.595	125	13.553
126	6.6143	127	1.3780			129	102.86		
131	42.475	132	42.334	133	17.659	134	17.617	135	8.6229
136	1.6946			138	42.279	139	42.157	140	17.657
141	17.616	142	8.6231	143	1.6947	144	0.00000E+00	145	89.937

		147	42.532	148	42.200	149	20.456
150	20.395						
151	9.8200	152	1.8997			154	42.326
155	42.019						
156	20.454	157	20.393	158	9.8203	159	1.8998
161	77.515			163	32.874	164	32.539
165	19.597						
166	19.541	167	9.2646	168	1.7932		
170	32.735						
171	32.422	172	19.596	173	19.540	174	9.2648
175	1.7933						
		177	16.882	178	16.839	179	17.791
180	17.979						
181	16.161	182	16.073	183	7.1284	184	1.3572
185	16.846						
186	17.774	187	17.958	188	16.161	189	16.073
190	7.1285						
191	1.3573			193	12.921	194	13.246
195	12.870						
196	12.580	197	12.083	198	12.125	199	4.2242
200	0.75808						
201	13.246	202	12.867	203	12.590	204	12.083
205	12.125						
206	4.2242	207	0.75813			209	4.1317
210	5.4813						
211	10.144	212	10.408	213	10.593	214	10.141
215	1.3045						
216	0.56534	217	5.4811	218	10.145	219	10.404
220	10.593						
221	10.141	222	1.3045	223	0.56535		
225	4.0928						
226	5.4776	227	10.061	228	10.325	229	10.509
230	10.147						
				233	5.4775	234	10.061
235	10.323						
236	10.509	237	10.147				
241	0.00000E+00	242	0.99322	243	0.99329		
				258	1.0199	259	1.0200
						274	1.0391
275	1.0392						
290	1.0436						
291	1.0437						
306	1.0444	307	1.0445				
		322	1.0716	323	1.0716		
				338	1.2020	339	1.2020
						354	1.4529
355	1.4530						
370	1.7946						
371	1.7947						
386	2.0132	387	2.0133				
		402	1.8991	403	1.8993		
				418	1.4358	419	1.4359
						434	0.79287
435	0.79293						
450	0.59780						
451	0.59781						
				468	10.280	469	1.4344
470	0.61395						
471	0.57063	472	10.280	473	1.4344	474	0.61398
475	0.57064						
476	16.574	477	17.069	478	16.739	479	16.539
480	13.315						
481	13.016	482	13.819	483	14.111	484	17.020
485	17.180						
486	17.082	487	13.018	488	13.807	489	14.021

MAXIMUM TEMPERATURE= 102.86 AT NODE 129
MINIMUM TEMPERATURE= 0.00000E+00 AT NODE 241