

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

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Thermal History of Cladding in a 21 PWR SNF WP Loaded with Average Fuel

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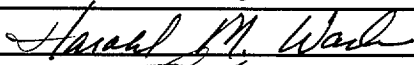
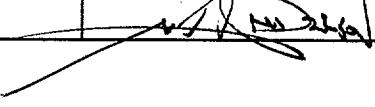
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	Print Name	Signature	Date
6. Originator	Harold M. Wade		01/12/2000
7. Checker	Didier Colmont		01/12/2000
8. Lead	Michael J. Anderson		1/25/00

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1. PURPOSE

The purpose of this calculation is to evaluate a mid-assembly axial fuel cladding temperature profile of a 21 pressurized water reactor (PWR) spent nuclear fuel (SNF) waste package (WP) loaded with average fuel assemblies and emplaced in a monitored geologic repository. This calculation is intended to evaluate Viability Assessment (VA) and Enhanced Design Alternatives (EDA) II design configurations in support of performance assessment. This calculation was developed by Waste Package Operations (WPO) under Office of Civilian Radioactive Waste Management (OCRWM) procedure AP-3.12Q, Revision 0.

The references cited in this document are provided in Attachment XIV (Document Input Reference Sheets [DIRS]).

2. METHOD

The commercial PWR assembly design represented in this calculation is the Babcock and Wilcox (B&W) 15x15 Mark B assembly. Reference 1 provides isotopic compositions for various burnup and enrichment combinations in grams per assembly, for decay times from a few days to one million years. Assembly nodal power is from SCALE Version 4.3 calculations that are representative of an average SNF assembly. Nodal power output is subsequently used to generate a normalized axial thermal profile of the assembly.

A finite element analysis (FEA) representation of the 21 PWR SNF WP with absorber plates evaluates a radial temperature profile based on fuel thermal output and the repository-loading scenario. This calculation is a two-dimensional (2-D) representation of a cross section of the WP. A nodal heat factor from the normalized axial thermal profile is also applied to the heat load. This calculation evaluates a WP that is in repository emplacement for 10,000 years.

The mid-fuel assembly axial fuel cladding temperature profile is calculated using the general heat conduction equation. Inputs to the equation are values from the normalized axial thermal profile and the fuel cladding and WP surface temperatures developed from the FEA calculations previously discussed.

3. ASSUMPTIONS

- 3.1 For the EDA II design configuration, the temperature along the axial surface of the WP is assumed to be constant. The basis for this assumption is that the EDA II configuration involves line-loading WPs. Therefore, small center-to-end WP surface temperature differences would exist due to the increased thermal interaction between WPs (compared to VA design configuration). This assumption is used in Section 5.3.
- 3.2 The gaps between the basket components (e.g., basket plates and tubes, tubes and guides, etc.) are assumed to be 2 mm. This conservative assumption (resulting in higher temperatures) is made to reflect the manufacturing tolerance between adjacent components. Basis: although contact surfaces will exist between the basket components

when the WP is horizontally emplaced, the 2-mm uniform gap is assumed in this calculation to be conservative. This assumption is used in Section 5.2.1.

- 3.3 Modeling only conduction and radiation heat transfer inside the WP is assumed to provide conservative results (resulting in higher temperatures) for this calculation. Basis: the fill gas placed inside the WP will allow natural convective heat transfer to exist. However, since there are few small-enclosed basket cavities present and the temperature gradient in the enclosure is not significant, helium circulation is difficult to form. Thus, modeling the dominant heat transfer modes will maintain only a negligible or conservative impact on the results. This assumption is used in Section 5.2.
- 3.4 The WP inner and outer shells and basket support guides are assumed to be integrally connected. Also, the WP plates are assumed to be integrally connected to each other. Basis: the current design philosophy described on page 30 of Reference 2 is to shrink fit the two shells, and to weld the corner guides and side guides to the inner Shell of the WP. The integral connection between the WP plates reflects a simplification of the representation. This assumption is used in Section 5.2.1.
- 3.5 The properties of helium at atmospheric pressure are assumed to be representative of the conditions that helium in the WP will experience. Basis: one atmosphere fill pressure at ambient temperature is representative of industry standard for storage casks. Page 10 of Reference 6 indicates that the highest pressure to which storage casks are filled is approximately 1.5 atmosphere; also, most industry vendors use substantially lower pressure in their designs. Even though the internal pressure of the WP will increase due to the temperature rise, the thermal conductivities of most gases are pressure independent (Ref. 18, p. 255). Thus, using the thermal conductivity at one atmosphere is reasonable. This assumption is used in Section 5.4.
- 3.6 Calculations performed in SCALE Version 4.3 assumed that the average PWR SNF characteristics upon receipt at the repository are 40 gigawatt-day per metric ton of uranium (GWd/MTU) burnup and 3.5-wt% ²³⁵U initial enrichment. This is compared to an average PWR SNF assembly with 36.7 GWd/MTU burnup and 3.64-wt% ²³⁵U initial enrichment (Ref. 31, Attachment XXXIX, p. 2). Basis: this was the closest assembly available to the average PWR SNF assembly. This assumption is used in Section 5.1.
- 3.7 The radial thermal resistance from WP center to surface is assumed to be constant with respect to the WP axial direction. Basis: while axial heat transfer will occur in the WP, neglecting this heat transfer mechanism will provide conservatively higher temperatures in the axial directions from the center. This assumption is used in Section 5.3.
- 3.8 The B&W 15x15 Mark B4 PWR SNF assembly will adequately represent average PWR assemblies for the purpose of this calculation. Basis: the dimensions and characteristics of the assembly type, given in Table 5-5, are typical for commercial PWR assemblies. This assumption is used in Section 5.2.1.
- 3.9 The use of homogenized SNF material to represent a PWR SNF assembly is assumed reasonable and adequate. The volume of the homogenized SNF is dimensionally based on

the inside width of the basket tube and the active length of an assembly. The specific heat of the homogenized SNF assembly is calculated with a mass-based average, and its thermal conductivity is calculated in Reference 8 (p. 94). The basis for this assumption is to provide a simplification of the representative mesh geometry. This assumption is used in Section 5.5.

- 3.10 The inner shell of the EDA II WP is stainless steel 316 NG. The thermal properties of 316 NG are assumed to be equal to those of 316L. The basis for this assumption is compliance of stainless steel 316 NG with the American Society of Mechanical Engineers (ASME) standard specification for chemical composition of 316 (Ref. 29, p. 931), grouping it in the same category as stainless steel 316. Stainless steel 316 NG is a subset of stainless steel 316. The properties of 316 are also assumed to be the same as those of 316L, based on the availability of thermal property information and the similarity in the chemical composition of the two (Ref. 38, p. 316). This assumption is used in Section 5.4.
- 3.11 Density, thermal conductivity, and specific heat of Neutronit A976 are equivalent to Neutronit A978. Basis: compositions of Neutronit A976 and A978 are similar with the exception that molybdenum is added in Neutronit A978 to 2.2% to increase corrosion resistance. This assumption is used in Section 5.4.
- 3.12 To calculate the specific heat of the PWR SNF assembly, it is assumed that the assembly is composed of only Uranium and Zircaloy. In addition, values for specific heat of these materials are taken at temperatures of 100°C and 400°C, accordingly. Basis: considering only these two materials is a simplification of the assembly cross-sectional geometry and is conservative because it maximizes radiation heat transfer (spacer grids and end fittings are neglected). Furthermore, temperature values in which material properties are accumulated are constrained in the reference. This assumption is used in Section 5.4.

4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 SOFTWARE APPROVED FOR QUALITY ASSURANCE (QA) WORK

The FEA computer code used for this calculation is ANSYS Version 5.4 (hereafter called "ANSYS"), which is identified with the Computer Software Configuration Item (CSCI) 30040 V5.4 and was obtained from Software Configuration Management in accordance with appropriate procedures. ANSYS is a commercially available finite element code and is appropriate for performing thermal analysis of WPs, WP emplacements, and WP environments as utilized in this calculation. ANSYS is located on a Hewlett-Packard Visualize J2240 server. Calculations using ANSYS V5.4 software were executed on Hewlett-Packard workstations (see References 33, 10, 11, and 12 for complete listing of computers). Software qualification of ANSYS V5.4, including problems of the type analyzed in this report, is summarized in the *Software Qualification Report for ANSYS V5.4, A Finite Element Code* (Ref. 33). The evaluations performed in this calculation are fully within the range of the validation for the ANSYS Version 5.4 code used. Access to and use of the code was granted and performed in

accordance with the appropriate procedures. Inputs and outputs to the ANSYS software are included as attachments and are described in the following documentation.

The calculation for the PWR SNF decay heat rates was performed with the SAS2H code sequence, which is a part of the SCALE Version 4.3 code system (CSCI: 30011 V4.3 [Ref. 7]). SAS2H is designed for spent fuel depletion calculations to determine spent fuel isotopic content, decay heat rates, and radiation source terms. Thus, SAS2H is appropriate for the generation of spent fuel decay heat rates for this calculation. The calculations using the SAS2H software were executed on a Hewlett-Packard workstation. The software qualification of the SAS2H software, including benchmark problems related to generation of isotope contents, is summarized in the *Software Qualification Report for the SCALE Modular Code System Version 4.3* (Ref. 7). The SAS2H evaluations performed for this design are fully within the range of the validation for the SAS2H software used. The associated 44-group cross-section library was used for these calculations. Access to and use of the SAS2H software for this calculation was granted by Software Configuration Management and performed in accordance with the appropriate procedures. Inputs and outputs for the SAS2H software are included as attachments as described in Section 7.

4.2 SOFTWARE ROUTINES

Industry standard software used in this calculation is Microsoft Excel 97. This software was executed on an IBM-compatible personal computer. Microsoft Excel 97 is not controlled computer software, has not been qualified under the quality assurance procedures, and will not be qualified under the quality assurance procedures. A software tracking number has not been assigned to the routine. The file names shown in the heading lines serve as names for the routine. Descriptions and equations of mathematical expressions, algorithms, and numerical solution techniques are described with comments in the routines or in the calculation itself, as applicable. Test cases and test results (including input and output files) are not provided because the form of the routines is such that the routines lend themselves to easy verification by visual inspection. Calculations for normalized thermal profiles (profile.xls) and axial temperatures (thermal_VA.xls and thermal_EDAIL.xls) were performed electronically with this spreadsheet software package. The location of the electronic copies of these spreadsheet files is given in Section 7. Attachments I, VIII, and IX provide hard copies of these files. WP surface temperatures were interpolated in Attachment XV (surftemp.xls). All calculations/data manipulations performed in profile.xls are described in Section 5.1 and may also be examined electronically. All calculations/data manipulations performed in thermal_VA.xls and thermal_EDAIL.xls are described in Section 5.3 and may also be examined electronically.

4.3 MODELS

None used.

5. CALCULATION

When converting values from English to metric units, the added digits of significance are an artifact of the conversion process and do not reflect actual precision of the value as expressed in metric.

Two cases are considered in this calculation. Case 1 uses the WP design, boundary conditions, and heat loads expected for the VA repository design configuration. Case 2 uses the WP design, boundary conditions, and heat loads expected for the EDA II repository design configuration.

5.1 FUEL NODAL POWER AND NORMALIZED AXIAL THERMAL PROFILE

SCALE Version 4.3 input decks representing PWR fuel were used to develop the nodal power profile. To do so, the thermal table output option was selected in the 65\$\$ card of the ORIGEN-S module. These files are labeled as A3540N01.input through A3540N18.input and are available in Reference 3. The calculation methodology is presented in Section 5.1 of Reference 1. The PWR SNF assembly characteristics used in this calculation are 3.5-wt% ²³⁵U initial enrichment and 40 GWd/MTU burnup. This assembly type is assumed to represent the expected average PWR fuel assembly of 3.64 wt% ²³⁵U and 36.7 GWd/MTU burnup (see Assumption 3.6). The burnup is slightly higher and the initial enrichment is slightly less than an average assembly. Table 5-1 provides information on the fuel region node spacing that was used in this calculation (Ref. 1, p. 15). Node 1 represents the top of the fuel region, and node 18 represents the bottom. Table 5-2 provides the power output of each node in watts at various times since discharge from the reactor. Figure 5-1, developed from Table 5-3, shows the normalized axial thermal profile for the assembly as a function of time since discharge. Each nodal value in Table 5-3 is the ratio of the normalized local nodal decay heat to the corresponding normalized total assembly power output, expressed as a fraction. Equation 5-1 provides an example for Node 2 at 1 year since discharge.

$$\frac{Local}{Total} = \frac{2.39 \times 10^2 \text{ watts} / 20.00 \text{ cm}}{5.49 \times 10^3 \text{ watts} / 360.17 \text{ cm}} = 0.783$$

(Eq. 5-1)

Table 5-1. Fuel Region Node Spacing

Node	Node Spacing (cm)
1	17.7800
2 to 17	20.0025
18	22.3520
Total	360.17

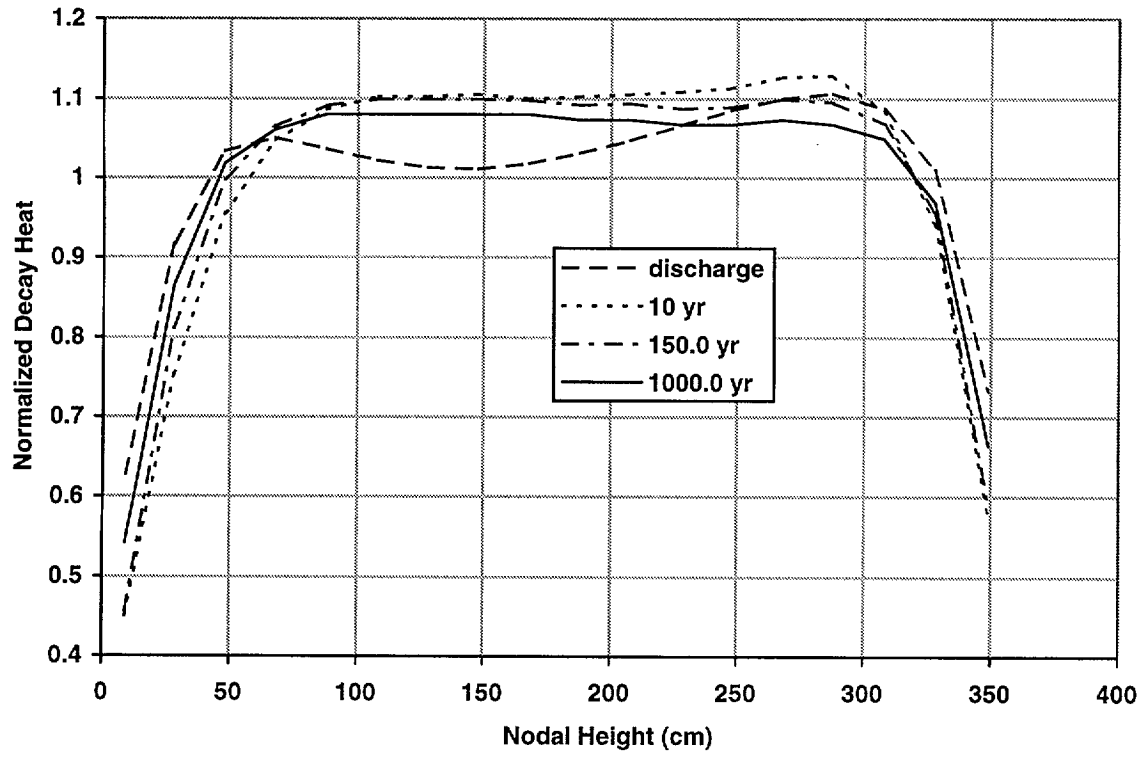


Figure 5-1. Normalized Axial Thermal Profile at Various Times Since Discharge for Average PWR SNF

Table 5-2. Thermal Output of Each Node

Node #	Node Height (cm)	Nodal Power (W) at Various Times													
		Discharge	1.0 Day	1.0 Year	5.0 Years	10.0 Years	20.0 Years	50.0 Years	150.0 Years	250.0 Years	400.0 Years	1000.0 Years	4000.0 Years	8000.0 Years	12000.0 Years
1	8.89	4.51E+04	3.67E+03	1.24E+02	2.18E+01	1.49E+01	1.18E+01	7.10E+00	2.53E+00	1.81E+00	1.44E+00	7.86E-01	3.40E-01	2.68E-01	2.17E-01
2	27.78	7.42E+04	6.35E+03	2.39E+02	4.30E+01	2.79E+01	2.21E+01	1.34E+01	5.05E+00	3.59E+00	2.77E+00	1.41E+00	5.29E-01	4.04E-01	3.20E-01
3	47.78	8.36E+04	7.36E+03	2.98E+02	5.53E+01	3.55E+01	2.76E+01	1.67E+01	6.22E+00	4.36E+00	3.32E+00	1.66E+00	6.00E-01	4.53E-01	3.56E-01
4	67.79	8.49E+04	7.59E+03	3.21E+02	6.08E+01	3.89E+01	3.01E+01	1.80E+01	6.63E+00	4.62E+00	3.48E+00	1.73E+00	6.25E-01	4.70E-01	3.68E-01
5	87.79	8.38E+04	7.55E+03	3.30E+02	6.31E+01	4.03E+01	3.12E+01	1.86E+01	6.80E+00	4.70E+00	3.54E+00	1.76E+00	6.32E-01	4.76E-01	3.71E-01
6	107.79	8.26E+04	7.47E+03	3.31E+02	6.38E+01	4.09E+01	3.16E+01	1.88E+01	6.85E+00	4.73E+00	3.55E+00	1.76E+00	6.35E-01	4.78E-01	3.73E-01
7	127.79	8.19E+04	7.42E+03	3.31E+02	6.40E+01	4.09E+01	3.16E+01	1.88E+01	6.85E+00	4.73E+00	3.55E+00	1.76E+00	6.35E-01	4.77E-01	3.72E-01
8	147.80	8.18E+04	7.40E+03	3.31E+02	6.41E+01	4.10E+01	3.17E+01	1.88E+01	6.85E+00	4.73E+00	3.55E+00	1.76E+00	6.34E-01	4.76E-01	3.71E-01
9	167.80	8.23E+04	7.45E+03	3.31E+02	6.39E+01	4.08E+01	3.16E+01	1.88E+01	6.84E+00	4.72E+00	3.55E+00	1.76E+00	6.34E-01	4.76E-01	3.71E-01
10	187.80	8.34E+04	7.54E+03	3.33E+02	6.41E+01	4.09E+01	3.16E+01	1.88E+01	6.80E+00	4.69E+00	3.52E+00	1.75E+00	6.31E-01	4.74E-01	3.70E-01
11	207.80	8.47E+04	7.66E+03	3.35E+02	6.43E+01	4.10E+01	3.17E+01	1.88E+01	6.81E+00	4.70E+00	3.53E+00	1.75E+00	6.33E-01	4.76E-01	3.71E-01
12	227.81	8.62E+04	7.79E+03	3.38E+02	6.45E+01	4.11E+01	3.17E+01	1.88E+01	6.77E+00	4.66E+00	3.50E+00	1.74E+00	6.30E-01	4.73E-01	3.68E-01
13	247.81	8.77E+04	7.92E+03	3.42E+02	6.49E+01	4.13E+01	3.18E+01	1.89E+01	6.79E+00	4.67E+00	3.50E+00	1.74E+00	6.29E-01	4.72E-01	3.68E-01
14	267.81	8.90E+04	8.03E+03	3.45E+02	6.58E+01	4.18E+01	3.22E+01	1.91E+01	6.85E+00	4.71E+00	3.53E+00	1.75E+00	6.33E-01	4.75E-01	3.70E-01
15	287.81	8.94E+04	8.06E+03	3.45E+02	6.58E+01	4.19E+01	3.23E+01	1.91E+01	6.82E+00	4.68E+00	3.51E+00	1.74E+00	6.32E-01	4.74E-01	3.69E-01
16	307.82	8.79E+04	7.88E+03	3.32E+02	6.32E+01	4.02E+01	3.11E+01	1.84E+01	6.65E+00	4.59E+00	3.44E+00	1.71E+00	6.22E-01	4.68E-01	3.64E-01
17	327.82	8.17E+04	7.19E+03	2.90E+02	5.43E+01	3.50E+01	2.72E+01	1.63E+01	5.96E+00	4.15E+00	3.15E+00	1.58E+00	5.78E-01	4.36E-01	3.41E-01
18	349.00	6.62E+04	5.51E+03	1.98E+02	3.57E+01	2.39E+01	1.90E+01	1.14E+01	4.12E+00	2.93E+00	2.30E+00	1.21E+00	4.88E-01	3.78E-01	3.02E-01
Total		1.46E+06	1.30E+05	5.49E+03	1.04E+03	6.68E+02	5.18E+02	3.09E+02	1.12E+02	7.78E+01	5.88E+01	2.94E+01	1.07E+01	8.10E+00	6.34E+00

Table 5-3. Normalized Axial Thermal Profile for Various Times Since Discharge for Average PWR SNF

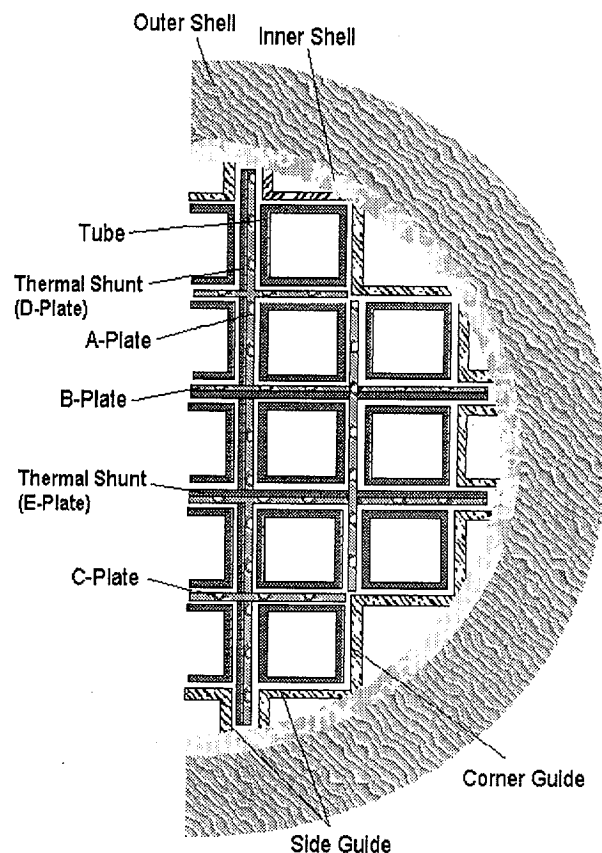
Node #	Node Height (cm)	Normalized Decay Heat Factors													
		Discharge	1.0 day	1.0 year	5.0 years	10.0 years	20.0 years	50.0 years	150.0 years	250.0 years	400.0 years	1000.0 years	4000.0 years	8000.0 years	12000.0 years
1	8.89	0.627	0.572	0.456	0.424	0.450	0.463	0.466	0.456	0.471	0.497	0.542	0.642	0.671	0.682
2	27.78	0.917	0.881	0.783	0.742	0.753	0.767	0.784	0.811	0.831	0.849	0.865	0.888	0.899	0.905
3	47.78	1.033	1.021	0.976	0.955	0.955	0.960	0.974	0.998	1.010	1.018	1.018	1.007	1.008	1.010
4	67.79	1.050	1.053	1.053	1.050	1.047	1.048	1.051	1.065	1.069	1.067	1.061	1.047	1.044	1.044
5	87.79	1.036	1.047	1.080	1.090	1.086	1.084	1.086	1.091	1.088	1.085	1.080	1.059	1.057	1.055
6	107.79	1.022	1.036	1.085	1.102	1.102	1.098	1.099	1.099	1.095	1.088	1.080	1.064	1.062	1.060
7	127.79	1.013	1.029	1.086	1.106	1.102	1.098	1.099	1.099	1.095	1.088	1.080	1.064	1.059	1.057
8	147.80	1.011	1.026	1.086	1.107	1.105	1.101	1.099	1.099	1.095	1.088	1.080	1.063	1.057	1.055
9	167.80	1.018	1.033	1.086	1.104	1.100	1.100	1.098	1.098	1.093	1.088	1.080	1.063	1.057	1.055
10	187.80	1.031	1.046	1.092	1.107	1.102	1.099	1.095	1.092	1.086	1.079	1.073	1.058	1.053	1.051
11	207.80	1.047	1.062	1.099	1.111	1.105	1.102	1.095	1.094	1.088	1.082	1.073	1.061	1.057	1.055
12	227.81	1.066	1.080	1.106	1.114	1.108	1.103	1.093	1.087	1.079	1.073	1.067	1.056	1.050	1.047
13	247.81	1.085	1.098	1.120	1.121	1.113	1.106	1.102	1.089	1.081	1.073	1.067	1.054	1.048	1.046
14	267.81	1.100	1.114	1.131	1.137	1.127	1.120	1.113	1.099	1.091	1.082	1.073	1.061	1.055	1.052
15	287.81	1.106	1.118	1.131	1.137	1.129	1.123	1.111	1.095	1.084	1.076	1.067	1.059	1.053	1.050
16	307.82	1.087	1.093	1.087	1.092	1.084	1.081	1.075	1.068	1.063	1.055	1.049	1.042	1.039	1.036
17	327.82	1.010	0.997	0.951	0.938	0.942	0.947	0.952	0.956	0.961	0.966	0.969	0.970	0.970	0.970
18	349.00	0.733	0.684	0.581	0.551	0.577	0.590	0.596	0.591	0.608	0.631	0.664	0.733	0.753	0.761

5.2 RADIAL TEMPERATURE PROFILE

The ANSYS input deck of a 2-D cross section of the 21 PWR SNF WP will be used to determine the radial temperature profile of the WP with an arbitrary decay heat factor from Section 5.1. One case will be executed for the Case 1 loading scenario and another for Case 2. Each case is referred to as the "base case" of that scenario. This transient calculation will be performed for up to 10,000 years. Only radiation and conduction modes of heat transfer are considered inside the WP (Assumption 3.3). A description of the inputs (case geometry and materials, boundary conditions, and body load conditions) that are required to complete the ANSYS cases is provided below.

5.2.1 Geometry and Materials

The internal structural configuration of the 21 PWR SNF WP that is represented in ANSYS, as shown in Figure 5-2, is based on Attachment II (for VA configuration) and Attachment III (for EDA II configuration). The WP basket is essentially comprised of fuel assembly tubes, basket plates (A, B, and C plates), basket guides, and basket stiffeners, as described in these sketches. Gaps of 2 mm (between basket tubes and plates, and between plates and guides) are represented in ANSYS to account for manufacturing tolerances (Assumption 3.2). The WP inner and outer shells are assumed to be integrally connected to the guides, and the plates are assumed to be integrally connected to each other (Assumption 3.4).



* Figure not to scale

Figure 5-2. 2-D WP Internal Structures Representation

Table 5-4 lists the WP materials used in this calculation. The materials used for the VA scenario (Case 1) are listed in Attachment II. The WP materials used for the EDA II scenario (Case 2) are listed in Attachment III.

Table 5-4. WP Materials Assumed in This Calculation

Component	Case 1		Case 2	
	Material Name	UNS Designation	Material Name	ASME and UNS Designations
Outer Shell	A 516 Grade 70	SA-516 K02700	Alloy 22	SB-575 N06022
Inner Shell	Alloy 22	SB-575 N06022	SS 316 NG	SA-240 (316 NG)
Fuel Basket Tube	A 516 Grade 70	SA-516 K02700	A 516 Grade 70	SA-516 K02700
Fuel Basket Plates (A,B, and C)	Neutronit A 978	N/A	Neutronit A 978	N/A
Fuel Basket Plates (D and E)	Aluminum Alloy 6061	SB-209 A96061 T4	Aluminum Alloy 6061	SB-209 A96061 T4
Fuel Basket Guides	A 516 Grade 70	SA-516 K02700	A 516 Grade 70	SA-516 K02700
Fuel Basket Stiffeners	A 516 Grade 70	SA-516 K02700	A 516 Grade 70	SA-516 K02700
Fill Gas	Helium	N/A	Helium	N/A

N/A – Not Applicable

SS – Stainless Steel

ASME - American Society of Mechanical Engineers

UNS - Unified Number System

Table 5-5 lists the characteristics of an average SNF fuel (see Assumption 3.8). The overall assembly length, the active fuel length, and the overall assembly width (15 · rod pitch) are from page 2A-7 of Reference 13. The assembly mass is from page 28 of Reference 31.

Table 5-5. Average Fuel Dimensions and Characteristics

Overall Assembly Length (m)	4.2069 (165.625 in)
Active Fuel Length (m)	3.602 (141.8 in)
Assembly Mass (kg)	773.4
Overall Assembly Width (m)	0.216 (8.52 in)

5.2.2 Heat Loads

Heat loads are input to ANSYS using files called finalw1.dat and pwravht.dat (for Case 1 and Case 2, accordingly). The finalw1.dat file is listed in Attachment IV and the pwravht.dat file is listed in Attachment V. The finalw1.dat file contains additional heat loads that are not used in this calculation and are therefore not addressed in this section.

Table 5-6 lists the heat output of each average fuel assembly and the total heat output of the WP (21 assemblies). Values for the heat output of an average WP of VA scenario type (Case 1) are from page 46 (ID: 2) and Appendix XXXIX of Reference 31. Values for the heat output of an average WP of EDA II scenario type (Case 2) are from Attachment III of Reference 15. The values provided for Case 2 are averaged (based on the number of assemblies) from the three PWR fuel types in the reference. In addition, values are adjusted for the 50-year preclosure period with logarithmic interpolation.

Table 5-6. Assembly and WP Heat Output

Case 1			Case 2		
Time ^[1] (years)	One PWR SNF Assembly (W)	Waste Package Total (W)	Time ^[2] (years)	One PWR SNF Assembly (W)	Waste Package Total (W)
0	434.3	9119.9	50	208.3	4374.9
0.1	433.0	9092.0	50.1	208.1	4369.5
0.2	431.6	9064.2	50.2	207.8	4364.2
0.3	430.3	9036.9	50.3	207.6	4359.0
0.4	429.0	9009.8	50.4	207.3	4353.5
0.5	427.8	8983.2	50.5	207.1	4348.3
0.6	426.5	8956.7	50.6	206.8	4342.8
0.7	425.3	8930.5	50.7	206.6	4337.6
0.8	424.0	8904.6	50.8	206.3	4332.3
0.9	422.8	8879.0	50.9	206.1	4327.1
1	421.6	8853.8	51	205.8	4321.6
2	410.9	8628.1	52	203.3	4269.1
3	401.2	8424.2	53	200.8	4217.0
4	392.4	8239.6	54	198.4	4165.8
5	384.4	8071.6	55	196.0	4115.0
6	376.2	7899.6	56	193.6	4064.8
7	368.9	7747.1	57	191.2	4015.4
8	362.0	7601.4	58	188.9	3966.5
9	355.4	7462.6	59	186.6	3918.2
10	349.3	7334.7	60	184.8	3881.0
20	294.9	6193.5	70	174.8	3670.6
30	252.7	5305.9	80	165.8	3481.2
40	219.4	4607.6	90	157.6	3308.6
50	192.4	4039.6	100	150.1	3152.7
60	170.7	3584.1	110	119.6	2511.0
70	153.1	3214.5	120	112.8	2369.0
80	138.6	2911.4	130	106.4	2235.0
90	127.0	2666.6	140	100.4	2108.6
100	117.1	2458.7	150	94.7	1989.3
200	73.1	1535.5	250	69.0	1448.6
300	58.3	1223.3	350	62.2	1306.2
400	49.3	1035.9	450	56.8	1193.2
500	43.0	902.4	550	52.5	1101.5
600	37.8	794.2	650	48.9	1025.9
700	33.8	709.6	750	45.6	957.6
800	30.3	636.1	850	42.6	895.4
900	27.5	577.5	950	27.9	586.1
1000	25.2	528.2	1050	25.7	539.9
2000	13.6	285.2	2050	14.3	299.9
3000	10.6	222.8	3050	11.3	236.9
4000	9.5	199.3	4050	10.1	212.1
5000	8.9	185.9	5050	9.4	197.8
6000	8.2	172.2	6050	8.7	183.1
7000	7.7	161.5	7050	8.2	171.6
8000	7.2	151.2	8050	7.7	160.9
9000	6.8	142.8	9050	7.2	151.8
10000	6.5	135.7	10050	6.9	144.1

[1] - Time after initial repository emplacement.

[2] - Time at end of 50-year ventilation period. Includes installation of drip shield and backfill.

5.2.3 Boundary Conditions

Boundary conditions are input to ANSYS using files named wf04d53c.parm and eIIsurav.parm (for Case 1 and Case 2, accordingly). The wf04d53c.parm file is listed in Attachment VI and the eIIsurav.parm file is listed in Attachment VII. The wf04d53c.parm file contains additional boundary conditions that are not used in this calculation and are therefore not addressed in this section.

The surface temperature histories of the WP for Cases 1 and 2 are given in Table 5-7. For Case 1, values relative to the top, side, and bottom of the WP were taken from Attachment XIV of Reference 16 (Case 3, WP4). For Case 2, values relative to the top, side, and bottom of the WP were taken from Reference 35 (filename: avEDA2.out).

Table 5-7. WP Surface Temperature History

Case 1				Case 2			
Time ^[1] (years)	WP Bottom Temperature (°C)	WP Side Temperature (°C)	WP Top Temperature (°C)	Time ^[2] (years)	WP Bottom Temperature (°C)	WP Side Temperature (°C)	WP Top Temperature (°C)
0	79.9	79.3	79.0	50	84.7	109.3	121.7
0.1	112.6	108.0	105.5	50.1	202.8	203.2	201.9
0.2	119.6	115.0	112.5	50.2	228.7	229.1	227.6
0.3	124.0	119.4	116.9	50.3	239.3	239.7	238.2
0.4	127.4	122.7	120.3	50.4	245.4	245.7	244.1
0.5	130.1	125.4	123.0	50.5	249.7	249.9	248.3
0.6	132.4	127.8	125.4	50.6	253.0	253.2	251.6
0.7	134.4	129.8	127.4	50.7	255.9	256.0	254.3
0.8	136.2	131.6	129.2	50.8	258.4	258.5	256.8
0.9	137.7	133.2	130.8	50.9	260.6	260.7	258.9
1	139.1	134.6	132.3	51	262.6	262.6	260.8
2	149.4	145.0	142.8	52	275.0	274.9	273.0
3	157.7	153.5	151.3	53	282.8	282.6	280.8
4	164.2	160.1	158.0	54	287.9	287.7	285.9
5	170.0	166.0	164.0	55	291.7	291.5	289.7
6	174.9	171.1	169.2	56	294.3	294.1	292.4
7	179.1	175.4	173.5	57	296.1	295.9	294.2
8	183.1	179.4	177.6	58	297.4	297.2	295.5
9	186.0	182.4	180.7	59	297.9	297.6	296.0
10	187.9	184.4	182.7	60	297.7	297.5	295.9
20	200.9	198.0	196.6	70	295.6	295.4	293.9
30	200.9	198.4	197.2	80	286.9	286.7	285.3
40	199.3	197.1	196.1	90	277.2	277.0	275.7
50	196.4	194.6	193.6	100	268.2	268.0	266.7
60	193.4	191.7	190.9	110	263.1	262.9	261.6
70	190.1	188.5	187.8	120	258.1	257.9	256.8
80	186.8	185.4	184.8	130	252.5	252.3	251.2
90	184.2	182.9	182.3	140	246.2	246.0	244.9
100	181.7	180.5	179.9	150	239.4	239.3	238.2
200	170.4	169.7	169.3	250	211.1	211.0	210.1
300	164.2	163.6	163.3	350	196.5	196.4	195.7
400	160.1	159.6	159.3	450	186.4	186.3	185.7
500	157.1	156.7	156.4	550	178.0	177.9	177.3
600	154.2	153.8	153.6	650	171.3	171.2	170.7

700	151.8	151.4	151.2	750	165.4	165.3	164.8
800	149.8	149.4	149.3	850	160.3	160.3	159.8
900	148.1	147.8	147.6	950	156.1	156.0	155.6
1000	146.4	146.2	146.0	1050	152.8	152.7	152.3
2000	132.9	132.7	132.6	2050	131.6	131.5	131.3
3000	127.7	127.5	127.5	3050	122.9	122.9	122.7
4000	129.0	128.9	128.8	4050	117.4	117.3	117.1
5000	129.8	129.7	129.7	5050	111.6	111.6	111.4
6000	130.1	130.0	129.9	6050	106.8	106.7	106.5
7000	129.9	129.8	129.8	7050	102.7	102.6	102.5
8000	129.3	129.2	129.2	8050	99.0	99.0	98.8
9000	128.5	128.4	128.3	9050	95.8	95.7	95.6
10000	127.4	127.4	127.3	10050	92.9	92.8	92.7

[1] - Time after initial repository emplacement.

[2] - Time at end of 50-year ventilation period. Includes installation of drip shield and backfill.

5.3 AXIAL TEMPERATURE PROFILE

This calculation determines the time-dependent axial cladding temperature profile along 18 nodes of assembly length. The cladding temperature results from ANSYS (Tables 6-1 and 6-2) along with the normalized axial thermal profile provided in Table 5-3 are used as inputs to this calculation. For Case 1, these calculations are performed with the spreadsheet (filename: thermal_VA.xls) provided in hardcopy in Attachment VIII. For Case 2, these calculations are performed with the spreadsheet (filename: thermal_EDAII.xls) provided in hardcopy in Attachment IX.

Equation 5-3 is derived from solving Equation 5-2, the general heat conduction equation (Ref. 39, Equation 3.6), after its application to the two nodes, f_n and f_m , indicated in Figure 5-3. Hence, Equation 5-3 is a ratio between two successive nodes of interest (in our case f_n and f_m). This equation is a function of WP surface temperature (T_s), WP cladding temperature (T_0), and the corresponding normalized decay heat factor (f) for a given plane. The fuel temperature calculation performed in ANSYS is used as the reference values. Note that throughout these calculations, it is assumed that the radial resistance (resistance from the center of the WP to the end) is constant and there is no axial heat transfer (see Assumption 3.7). Surface temperatures for the VA scenario calculation (Case 1) were linearly interpolated from WP center to end (see Attachment XV). The EDA II scenario (Case 2) consists of line-loading and thus the axial WP surface temperature is assumed constant ($T_{0,n} = T_{0,m} = T_0$, see Assumption 3.1).

$$q \cdot f = \frac{T_0 - T_s}{R} \quad (\text{Eq. 5-2})$$

Where:

- q – Heat rate (W),
- T_0 – WP internal temperature (°C),
- T_s – WP surface temperature (°C),
- R – Internal resistance (K/W),
- f – Axial heat decay heat factor.

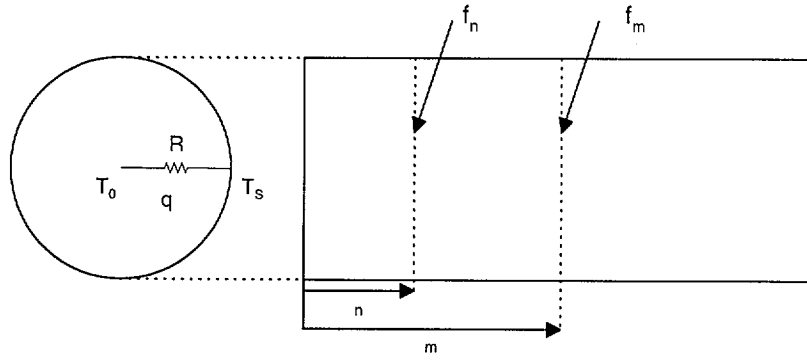


Figure 5-3. Top and Side View of WP

$$\frac{f_n}{f_m} = \frac{T_{0,n} - T_{s,n}}{T_{0,m} - T_{s,m}} \Rightarrow T_{0,m} = \frac{f_m}{f_n} \cdot (T_{0,n} - T_{s,n}) + T_{s,m}$$

(Eq. 5-3)

Where:

- $T_{0,n}$ – WP internal temperature ($^{\circ}\text{C}$) at plane n,
- $T_{s,n}$ – WP surface temperature ($^{\circ}\text{C}$) at plane n,
- f_n – Axial heat decay heat factor at plane n,
- $T_{0,m}$ – WP internal temperature ($^{\circ}\text{C}$) at plane m,
- $T_{s,m}$ – WP surface temperature ($^{\circ}\text{C}$) at plane m,
- f_m – Axial heat decay heat factor at plane m.

5.4 MATERIAL PROPERTIES

The thermal properties are input to ANSYS using a file called propnew03.dat and within the ANSYS input deck. The propnew03.dat file, listed in Attachment X, contains additional material properties that are not used in this calculation and are therefore not addressed in this section.

Table 5-8 lists the density and emissivity of A 516 carbon steel. The density of A 516 (C-Mn-Si) was taken from page 9 of Reference 21. The emissivity (average for smooth oxidized iron) was taken from page 4-68 of Reference 22.

Table 5-9 lists the thermal conductivity and specific heat of A 516 carbon steel. Values for thermal conductivity and thermal diffusivity of A 516 were taken from Table TCD, Section II of Reference 38 and are converted here to conductivity and specific heat in the International System (SI) of units. The conversion of thermal diffusivity (defined in Equation 5-4) to specific heat requires the density listed in Table 5-8.

$$\text{Specific Heat (Btu / lb}^{\circ}\text{F)} = \frac{\text{Thermal Conductivity (Btu / hr} \cdot \text{ft}^{\circ}\text{F)}}{\text{Density (lb / ft}^3\text{)} \times \text{Thermal Diffusivity (ft}^2\text{ / hr)}} \quad (\text{Eq. 5-4})$$

Table 5-8. Density and Emissivity of A 516 Carbon Steel

	Density (kg/m ³)	Emissivity
A 516 Carbon Steel	7850	0.80

Table 5-9. Thermal Conductivity and Specific Heat of A 516 Carbon Steel

Temperature		Thermal Conductivity	Thermal Diffusivity	Thermal Conductivity	Specific Heat
(°F)	(°C)	(Btu/hr-ft-°F)	(ft ² /hr)	(W/m-K)	(J/kg-K)
70	21.11	23.6	0.454	40.84	444.11
100	37.78	23.9	0.443	41.36	460.92
150	65.56	24.2	0.433	41.88	477.48
200	93.33	24.4	0.422	42.23	493.98
250	121.11	24.4	0.414	42.23	503.52
300	148.89	24.4	0.406	42.23	513.45
350	176.67	24.3	0.396	42.06	524.25
400	204.44	24.2	0.386	41.88	535.62
450	232.22	23.9	0.375	41.36	544.50
500	260.00	23.7	0.364	41.02	556.26
550	287.78	23.4	0.355	40.50	563.14
600	315.56	23.1	0.346	39.98	570.38
650	343.33	22.7	0.333	39.29	582.39
700	371.11	22.4	0.320	38.77	598.04
750	398.89	22.0	0.308	38.08	610.24
800	426.67	21.7	0.298	37.56	622.12
850	454.44	21.2	0.286	36.69	633.29
900	482.22	20.9	0.274	36.17	651.67
950	510.00	20.5	0.262	35.48	668.47
1000	537.78	20.0	0.248	34.61	688.98
1050	565.56	19.6	0.237	33.92	706.54
1100	593.33	19.2	0.228	33.23	719.45
1150	621.11	18.7	0.213	32.36	750.06
1200	648.89	18.2	0.197	31.50	789.29
1250	676.67	17.5	0.179	30.29	835.25
1300	704.44	16.7	0.155	28.90	920.48
1350	732.22	15.8	0.119	27.35	1134.34
1400	760.00	15.3	0.077	26.48	1697.59
1450	787.78	15.1	0.154	26.13	837.70
1500	815.56	15.1	0.169	26.13	763.35

Table 5-10 lists the density and emissivity of alloy 22. The density of alloy 22 was taken from page 2 of Reference 24. The emissivity of alloy 22 was taken from page 10-297 of Reference 25.

Table 5-11 lists the thermal conductivity and specific heat of alloy 22. Values for thermal conductivity and specific heat were taken from page 13 of Reference 36.

Table 5-10. Density and Emissivity of Alloy 22

	Density (kg/m ³)	Emissivity
Alloy 22	8690	0.87

Table 5-11. Thermal Conductivity and Specific Heat of Alloy 22

Temperature (°C)	Thermal Conductivity (W/m·K)	Temperature (°C)	Specific Heat (J/kg·K)
48	10.1	52	414
100	11.1	100	423
200	13.4	200	444
300	15.5	300	460
400	17.5	400	476
500	19.5	500	485
600	21.3	600	514

Table 5-12 lists the density and emissivity of stainless steel 316 NG (see Assumption 3.10). The density of stainless steel 316 NG was taken from page 7 of Reference 27. The emissivity of stainless steel 316 NG is from page 4-68 of Reference 22 and is about average for heated stainless steel 316.

Table 5-13 lists the thermal conductivity and specific heat of stainless steel 316 NG. Values for thermal conductivity and thermal diffusivity were taken from Table TCD, Section II of Reference 38. The conversion of thermal diffusivity (defined in Equation 5-4) to specific heat requires the density listed in Table 5-12. Stainless steel 316 NG is listed in Reference 38 by its chemical composition (16Cr-12Ni-2Mo).

Table 5-12. Density and Emissivity of Stainless Steel 316 NG

	Density (kg/m ³)	Emissivity
Stainless Steel 316 NG	7980	0.60

Table 5-13. Thermal Conductivity and Specific Heat of Stainless Steel 316 NG

Temperature		Thermal Conductivity	Thermal Diffusivity	Thermal Conductivity	Specific Heat
(°F)	(°C)	(Btu/hr-ft-°F)	(ft ² /hr)	(W/m-K)	(J/kg-K)
70	21.11	7.7	0.134	13.33	482.93
100	37.78	7.9	0.136	13.67	488.19
150	65.56	8.2	0.138	14.19	499.38
200	93.33	8.4	0.141	14.54	500.68
250	121.11	8.7	0.143	15.06	511.31
300	148.89	9.0	0.145	15.58	521.64
350	176.67	9.2	0.148	15.92	522.43
400	204.44	9.5	0.151	16.44	528.74
450	232.22	9.8	0.153	16.96	538.31
500	260.00	10.0	0.156	17.31	538.73
550	287.78	10.3	0.159	17.83	544.43
600	315.56	10.5	0.162	18.17	544.72
650	343.33	10.7	0.164	18.52	548.33
700	371.11	11.0	0.167	19.04	553.57
750	398.89	11.2	0.170	19.38	553.69
800	426.67	11.5	0.173	19.90	558.66
850	454.44	11.7	0.176	20.25	558.69
900	482.22	12.0	0.178	20.77	566.58
950	510.00	12.2	0.181	21.11	566.47
1000	537.78	12.4	0.184	21.46	566.37
1050	565.56	12.7	0.186	21.98	573.84
1100	593.33	12.9	0.189	22.33	573.62
1150	621.11	13.1	0.191	22.67	576.42
1200	648.89	13.3	0.194	23.02	576.17
1250	676.67	13.6	0.196	23.54	583.15
1300	704.44	13.8	0.199	23.88	582.81
1350	732.22	14.0	0.201	24.23	585.37
1400	760.00	14.2	0.203	24.58	587.88
1450	787.78	14.4	0.206	24.92	587.48
1500	815.56	14.6	0.208	25.27	589.91

Table 5-14 lists the density, emissivity, and specific heat of aluminum alloy 6061. Values for density and specific heat are from Table NF-2, Section II of Reference 38 and are converted to SI units. The emissivity of aluminum was taken from page 10-297 of Reference 25 for rough aluminum plate. Note that conversion errors of less than 0.2% exist in the density (kg/m³) and specific heat (J/kg·K) columns of this table.

Table 5-15 lists the thermal conductivity of aluminum alloy 6061. Values for thermal conductivity are from Table TCD, Section II of Reference 38 and are converted to SI units. Note that conversion errors of less than 0.1% exist in the thermal conductivity (W/m·K) columns of this table.

Table 5-14. Density, Emissivity, and Specific Heat of Aluminum Alloy 6061

	Density (kg/m ³)	Emissivity	Specific Heat (J/kg·K)
Aluminum Alloy 6061	2710	0.07	962.9

Table 5-15. Thermal Conductivity of Aluminum Alloy 6061

Temperature		Thermal Conductivity (Btu/hr·ft·°F)	Thermal Conductivity (W/m·K)
(°F)	(°C)		
70	21.11	96.1	166.25
100	37.78	96.9	167.64
150	65.56	98.0	169.54
200	93.33	99.0	171.27
250	121.11	99.8	172.65
300	148.89	100.6	174.04
350	176.67	101.3	175.25
400	204.44	101.9	176.29

Table 5-16 lists the thermal properties of boron stainless steel Neutronit A978 (see Assumption 3.11). The density of Neutronit A978 was taken from page 17 of Reference 28. The emissivity of Neutronit A978 was taken from page 4-68 of Reference 22, and is about average value for heated stainless steel 316. The thermal conductivity of Neutronit A978 is listed in Table 5-17. Values for the thermal conductivity of Neutronit A978 were taken from page 17 of Reference 28.

Table 5-16. Density, Emissivity, and Specific Heat of Neutronit A978 Stainless Steel

	Density (kg/m ³)	Emissivity	Specific Heat (J/kg·K)
Neutronit A978	7760	0.6	500

Table 5-17. Thermal Conductivity of Neutronit A978 Stainless Steel

Temperature (°C)	Thermal Conductivity (W/m·K)
20	10.3
130	11.7
260	13.4

Table 5-18 lists the density, thermal conductivity, and specific heat of helium (see Assumption 3.5). Values for the density, thermal conductivity, and specific heat of helium are from page 19.71 of Reference 30 and are converted here to SI units. Note that conversion errors of less than 0.4% exist in the temperature (°C) and specific heat (J/kg·K) columns of this table.

Table 5-18. Density, Thermal Conductivity, and Specific Heat of Helium

Temperature		Density (kg/m ³)	Thermal Conductivity	Specific Heat
(°F)	(°C)	(1 atm, 300 K)	(W/m·K)	(J/kg·K)
0	-17.76	0.1909	0.1396	5196.3
40	4.46	0.1756	0.1478	5196.3
80	26.68	0.1626	0.1559	5195.9
120	48.91	0.1514	0.1638	5195.9
160	71.13	0.1416	0.1715	5195.9
200	93.35	0.1331	0.1791	5195.9
280	137.79	0.1187	0.1940	5195.9
320	160.02	0.1126	0.2012	5195.9
360	182.24	0.1072	0.2083	5195.9
400	204.46	0.1020	0.2153	5195.9
440	226.68	0.0976	0.2222	5195.9
480	248.91	0.0934	0.2291	5195.9
520	271.13	0.0895	0.2358	5195.9
560	293.35	0.0860	0.2425	5195.9
600	315.57	0.0828	0.2491	5195.9
640	337.79	0.0798	0.2556	5196.3
720	382.24	0.0745	0.2684	5196.3
800	426.68	0.0697	0.2810	5196.3

5.5 HOMOGENEOUS MATERIAL PROPERTIES

Table 5-19 lists the density and specific heat of a homogenized PWR SNF assembly, as calculated from Equations 5-5 and 5-6 (see Assumption 3.9). Density is approximated from using the total mass of the assembly and the volume of the fuel assembly cavity. The specific heat is calculated from a weight average where the fuel assembly is assumed to be comprised of only uranium oxide (UO₂) and zircaloy (Assumption 3.12). Equation 5-7 calculates the volume of a fuel assembly cavity. Additional supporting inputs are listed and referenced below.

$$\rho_{SNF} = \frac{M_{assy}}{V_{cavity}} = 4190 \frac{kg}{m^3}$$

(Eq. 5-5)

$$C_p^{SNF} = (C_p^{UO_2} - C_p^{Zirc}) \cdot \frac{M^U}{M_{assy}} \cdot \frac{AW^U + 2 \cdot AW^O}{AW^U} + C_p^{Zirc} = 274 \frac{J}{kg \cdot K} \quad (\text{Eq. 5-6})$$

$$V_{cavity} = W^2 \cdot L = 0.1846 m^3 \quad (\text{Eq. 5-7})$$

Where:

- ρ_{SNF} = Density of homogenized PWR SNF,
- C_p^{SNF} = Specific heat of homogenized PWR SNF,
- $C_p^{UO_2}$ = Specific heat of uranium oxide, 247 J/kg·K at 100°C (Ref. 19, Table 8-1),
- C_p^{Zirc} = Specific heat of zircaloy, 330 J/kg·K at 400°C (Ref. 19, Table 8-2),
- M^U = Mass of uranium in the assembly = 464 kg (Ref. 13, Page 2A-7),
- M_{assy} = Mass of entire assembly = 773.4 kg (Ref. 31, p. 28),
- AW^U = Atomic mass of uranium = 238.0289 grams (Ref. 25, p. 1-15),
- AW^O = Atomic mass of oxygen = 15.9994 grams (Ref. 25, p. 1-15),
- V_{cavity} = Volume of fuel assembly cavity,
- W = Fuel assembly cavity width = 0.2264 m (Attachment III),
- L = Active fuel assembly length = 3.602 m (Ref. 13, p. 2A-7).

Table 5-19. Density and Specific Heat of Homogenized PWR SNF

	Density (kg/m ³)	Specific Heat (kg/m ³)
Homogenized PWR SNF	4190	274

Table 5-20 lists the effective thermal conductivity values for PWR SNF in helium gas (Ref. 8, p. 94). These values were developed for explicit representations of PWR SNF assemblies as a simplified homogeneous mesh using the finite element method.

Table 5-20. Effective Thermal Conductivity of a PWR Assembly in Helium

Temperature (°C)	Thermal Conductivity (W/m·K)
25	0.384
50	0.423
100	0.512
150	0.616
200	0.736
250	0.874
300	1.028
350	1.201
400	1.392

5.6 FINITE ELEMENT DEVELOPMENT

The general method used to develop the ANSYS cases for this calculation is to create a separate input file for each case.

The basic layout of an ANSYS input file includes the following:

- a) Introduce and identify the problem represented, additional files read by the input deck, and what information is contained in the data files used in the input deck.
- b) Define the parameters and dimensions that are used repeatedly in the case.
- c) Define the element types that are needed to represent the geometry to perform the calculation.
- d) Define the representative geometry and mesh structure.
- e) Define all radiation surfaces and create the radiation mesh matrix (if necessary).
- f) Apply the internal heat loads (volumetrically) and the boundary conditions to the appropriate components. If the calculation is transient, heat loads and boundary conditions are applied at each time step.
- g) Select the positions where the SNF cladding, WP surface, and drift wall surface temperatures for each time step of the transient are echoed to the output file.

A summary of the ANSYS V5.4 results is provided in Section 6. Attachments XI and XII give depictions of the ANSYS 2-D cross-sectional WP representations.

6. RESULTS

This section contains the results generated from Section 5. The ANSYS output files and the spreadsheet files (Ref. 3) generated with this calculation are listed in Attachment XIII.

Unqualified data were used in the development of the results presented in this section. If the results from this section are used as input into documents directly relied upon for safety or waste isolation issues, then they are required to be identified and controlled in accordance with appropriate procedures.

The fuel cladding temperature was taken from the center of the WP. In Figure 6-1, this is identified with node A. The WP surface temperature is identified with node O. Location names, e.g., "a01o000," are consistent with the names found in the ANSYS output file.

Note that Case 1 refers to VA design and Case 2 refers to EDA II design.

For Case 1, Table 6-1 lists temperature values for the cross-sectional slice of the WP. Node numbers can be cross-referenced with Figure 6-1. The axial fuel cladding temperature distribution is developed with these results and the methodology discussed in Section 5.2. Figure 6-2 depicts the time history for cladding and surface temperatures.

For Case 2, Table 6-2 lists temperature values for the cross-sectional slice of the WP. The axial fuel cladding temperature distribution is developed with these results and the methodology discussed in Section 5.2. Figure 6-3 depicts the time history for cladding and surface temperatures.

For Case 1, Table 6-3 provides values for the axial fuel cladding temperature distribution within the WP loaded with average fuel and loaded in a VA configuration. Temperatures are distributed along the 18 nodes identified in Section 5.1. Figure 6-4 depicts the axial fuel cladding temperature distributions at selected times.

For Case 2, Table 6-4 provides values for the axial fuel cladding temperature distribution within the WP loaded with average fuel and loaded in an EDA II configuration. Temperatures are distributed along the 18 nodes identified in Section 5.1. Figure 6-5 depicts the axial fuel cladding temperature distributions at selected times.

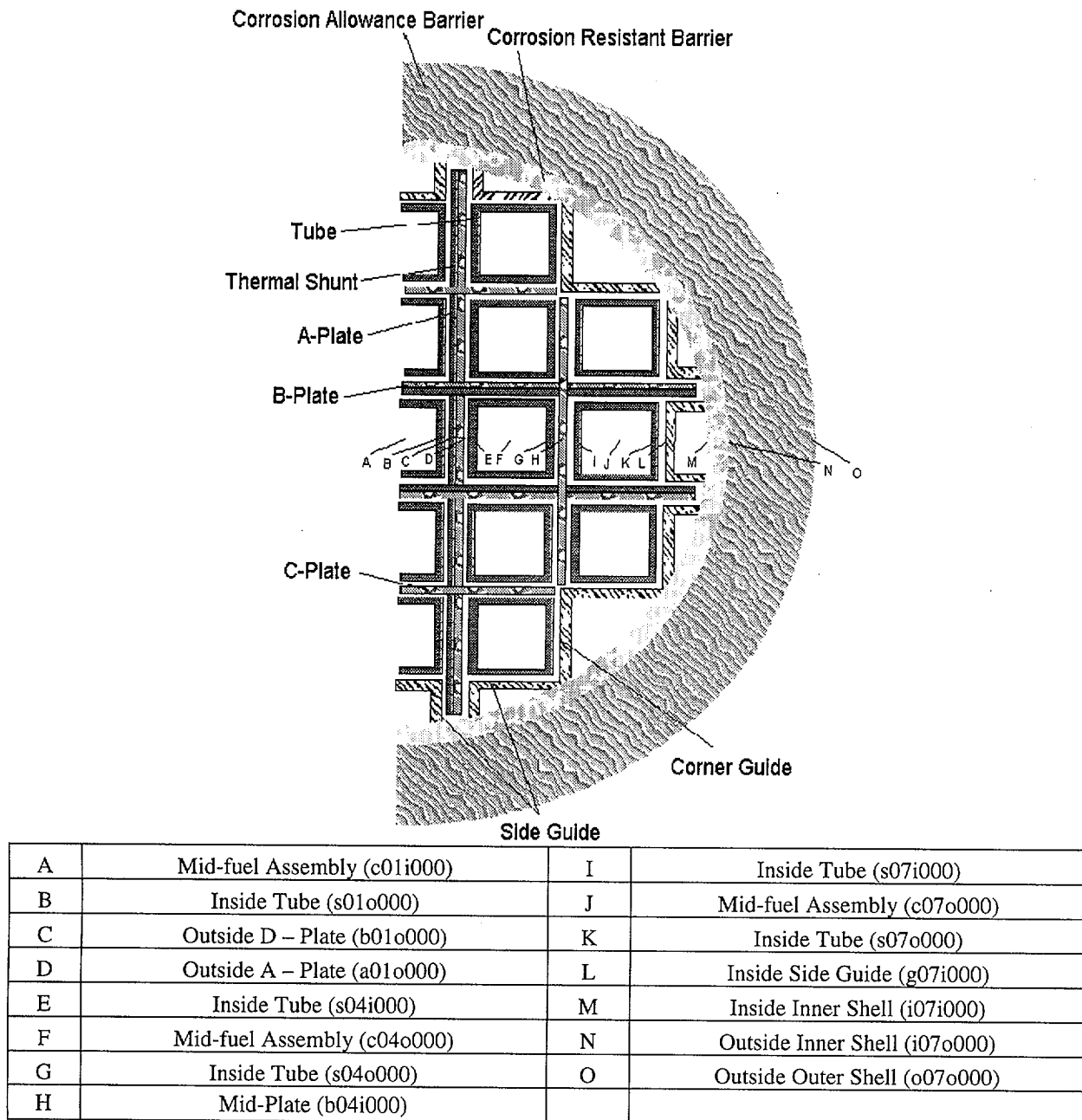


Figure 6-1. Node Identification for 2-D ANSYS FEA Representation of WP

Table 6-1. WP Radial Temperature Distribution at the Decay Heat Factor of 1.102 (Case 1)

Time ^[1] (years)	WP Heat (W)	Node A	Node B	Node C	Node D	Node E	Node F	Node G	Node H	Node I	Node J	Node K	Node L	Node M	Node N	Node O
0.0	9119.9	162.5	147.1	145.7	145.7	146.5	157.0	136.8	135.7	134.9	136.0	103.1	100.2	80.7	80.3	79.3
0.1	9092.0	187.4	173.5	172.1	172.2	172.9	181.9	163.4	162.3	161.6	161.4	130.5	127.7	109.5	109.1	108.0
0.2	9064.2	193.7	180.1	178.8	178.8	179.5	188.2	170.0	168.9	168.2	167.7	137.2	134.5	116.5	116.1	115.0
0.3	9036.9	197.4	184.0	182.7	182.7	183.5	192.0	174.0	172.9	172.2	171.6	141.4	138.6	120.9	120.4	119.4
0.4	9009.8	200.2	187.0	185.7	185.7	186.4	194.8	177.0	175.9	175.2	174.4	144.5	141.8	124.2	123.8	122.7
0.5	8983.2	202.4	189.3	188.1	188.1	188.8	197.0	179.4	178.3	177.6	176.8	147.1	144.4	126.9	126.5	125.4
0.6	8956.7	204.3	191.4	190.1	190.1	190.8	198.9	181.5	180.4	179.7	178.7	149.3	146.6	129.3	128.9	127.8
0.7	8930.5	205.9	193.1	191.8	191.8	192.5	200.5	183.2	182.1	181.4	180.4	151.1	148.5	131.3	130.9	129.8
0.8	8904.6	207.3	194.6	193.3	193.3	194.0	202.0	184.7	183.6	182.9	181.9	152.8	150.1	133.1	132.7	131.6
0.9	8879.0	208.5	195.9	194.6	194.6	195.3	203.2	186.1	185.0	184.3	183.2	154.2	151.6	134.7	134.3	133.2
1	8853.8	209.6	197.0	195.8	195.8	196.5	204.3	187.3	186.2	185.5	184.3	155.6	152.9	136.1	135.7	134.6
2	8628.1	217.1	205.2	204.0	204.1	204.7	212.0	195.8	194.7	194.1	192.6	165.1	162.5	146.5	146.1	145.0
3	8424.2	223.1	211.8	210.6	210.6	211.3	218.1	202.6	201.6	200.9	199.3	172.8	170.3	154.9	154.5	153.5
4	8239.6	227.7	216.8	215.6	215.7	216.3	222.8	207.8	206.8	206.2	204.4	178.7	176.3	161.5	161.1	160.1
5	8071.6	231.8	221.2	220.1	220.2	220.8	227.0	212.4	211.5	210.9	209.0	184.1	181.8	167.4	167.1	166.0
6	7899.6	235.1	224.9	223.8	223.8	224.4	230.4	216.3	215.3	214.8	212.8	188.6	186.3	172.5	172.1	171.1
7	7747.1	237.8	227.9	226.9	226.9	227.4	233.2	219.5	218.6	218.0	216.0	192.4	190.2	176.7	176.4	175.4
8	7601.4	240.4	230.8	229.8	229.8	230.4	235.9	222.5	221.7	221.1	219.0	196.0	193.9	180.8	180.4	179.4
9	7462.6	242.1	232.7	231.7	231.8	232.3	237.7	224.6	223.8	223.2	221.1	198.6	196.5	183.8	183.4	182.4
10	7334.7	243.0	233.8	232.8	232.8	233.3	238.6	225.8	225.0	224.4	222.3	200.3	198.2	185.7	185.4	184.4
20	6193.5	246.9	239.3	238.5	238.5	238.9	243.2	232.6	231.8	231.4	229.4	211.1	209.4	199.1	198.8	198.0
30	5305.9	240.5	233.8	233.1	233.1	233.5	237.3	228.1	227.4	227.0	225.4	209.6	208.2	199.4	199.1	198.4
40	4607.6	233.9	228.0	227.3	227.3	227.7	231.1	222.9	222.4	222.1	220.7	206.9	205.6	197.9	197.7	197.1
50	4039.6	227.0	221.7	221.2	221.2	221.5	224.6	217.3	216.8	216.5	215.4	203.2	202.0	195.3	195.1	194.6
60	3584.1	220.7	215.9	215.4	215.4	215.7	218.5	212.0	211.6	211.3	210.3	199.4	198.4	192.4	192.2	191.7
70	3214.5	214.7	210.3	209.9	209.9	210.1	212.8	206.8	206.4	206.2	205.4	195.5	194.6	189.1	189.0	188.5
80	2911.4	209.3	205.3	204.8	204.9	205.1	207.5	202.1	201.7	201.5	200.8	191.8	191.0	186.0	185.8	185.4
90	2666.6	204.9	201.1	200.7	200.7	200.9	203.2	198.2	197.8	197.6	197.1	188.7	188.0	183.4	183.2	182.9
100	2458.7	200.9	197.3	197.0	197.0	197.2	199.3	194.6	194.3	194.1	193.6	185.9	185.2	180.9	180.8	180.5
200	1535.5	182.7	180.3	180.1	180.1	180.2	181.7	178.6	178.4	178.3	178.1	173.1	172.7	169.9	169.9	169.7
300	1223.3	174.1	172.1	172.0	172.0	172.1	173.3	170.8	170.6	170.5	170.4	166.4	166.0	163.8	163.7	163.6
400	1035.9	168.5	166.9	166.7	166.7	166.8	167.9	165.7	165.6	165.5	165.4	162.0	161.7	159.8	159.7	159.6
500	902.4	164.5	163.0	162.9	162.9	163.0	163.9	162.0	161.9	161.8	161.8	158.7	158.5	156.8	156.8	156.7
600	794.2	160.8	159.5	159.3	159.3	159.4	160.3	158.6	158.5	158.4	158.3	155.7	155.4	154.0	153.9	153.8
700	709.6	157.7	156.5	156.4	156.4	156.4	157.2	155.7	155.6	155.5	155.5	153.1	152.9	151.6	151.5	151.4
800	636.1	155.0	154.0	153.9	153.9	153.9	154.6	153.2	153.2	153.1	153.1	150.9	150.7	149.5	149.5	149.4
900	577.5	152.9	151.9	151.8	151.8	151.8	152.5	151.2	151.1	151.1	151.1	149.1	148.9	147.8	147.8	147.8
1000	528.2	150.8	149.9	149.8	149.8	149.9	150.5	149.3	149.3	149.2	149.2	147.4	147.2	146.2	146.2	146.2

2000	285.2	135.3	134.8	134.7	134.7	134.8	135.1	134.5	134.4	134.4	134.4	133.4	133.3	132.8	132.7	132.7
3000	222.8	129.6	129.2	129.1	129.1	129.1	129.4	128.9	128.9	128.9	128.9	128.1	128.0	127.6	127.6	127.5
4000	199.3	130.7	130.3	130.3	130.3	130.3	130.6	130.1	130.1	130.0	130.1	129.3	129.3	128.9	128.9	128.9
5000	185.9	131.4	131.1	131.1	131.1	131.1	131.3	130.9	130.9	130.8	130.9	130.2	130.1	129.8	129.8	129.7
6000	172.2	131.6	131.2	131.2	131.2	131.2	131.5	131.1	131.0	131.0	131.0	130.4	130.4	130.0	130.0	130.0
7000	161.5	131.3	131.0	131.0	131.0	131.0	131.2	130.8	130.8	130.8	130.8	130.2	130.2	129.8	129.8	129.8
8000	151.2	130.6	130.3	130.3	130.3	130.3	130.5	130.2	130.2	130.1	130.2	129.6	129.6	129.3	129.3	129.2
9000	142.8	129.7	129.4	129.4	129.4	129.4	129.6	129.3	129.2	129.2	129.2	128.7	128.7	128.4	128.4	128.4
10000	135.7	128.6	128.3	128.3	128.3	128.3	128.5	128.2	128.2	128.2	128.2	127.7	127.6	127.4	127.4	127.4

[1] - Time after initial repository emplacement.

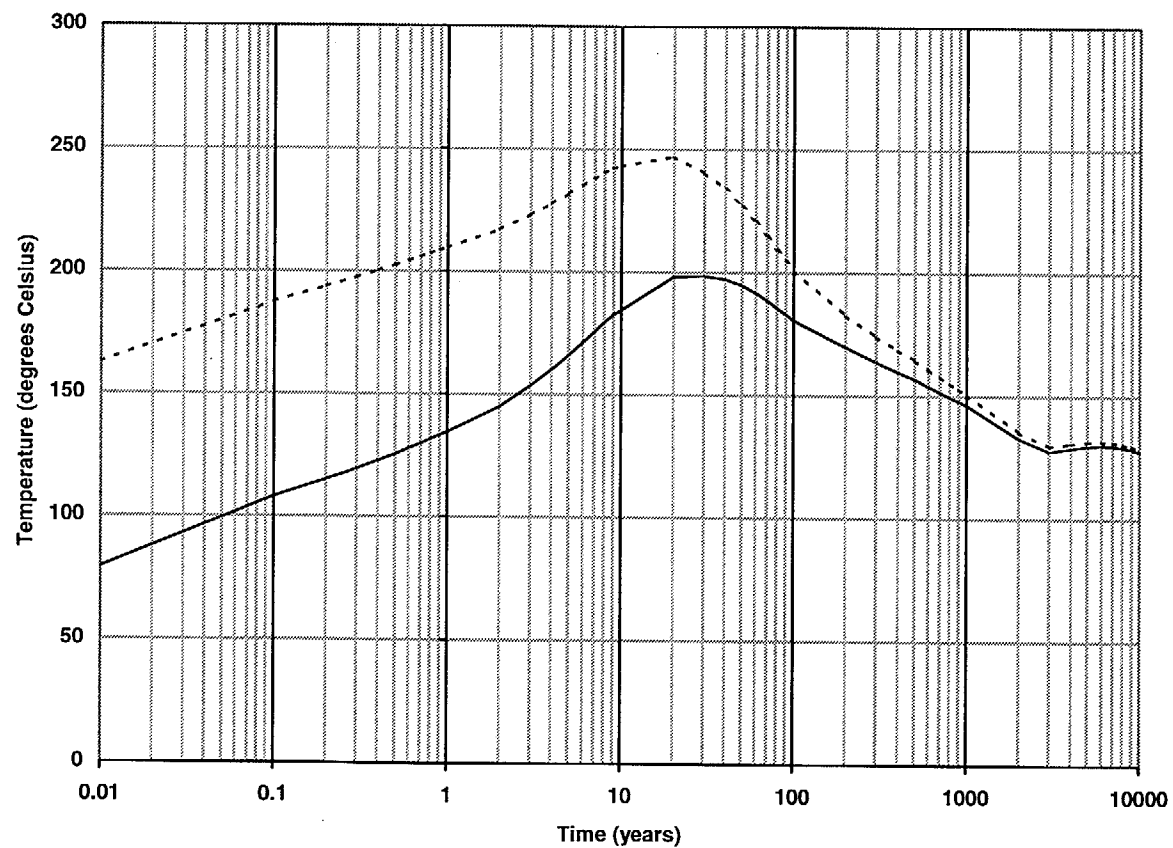


Figure 6-2. Time History of Internal Temperature at the Decay Heat Factor of 1.102 for Average Fuel (Case 1)

Table 6-2. WP Radial Temperature Distribution at the Decay Heat Factor of 1.102 (Case 2)

Time ^[1] (years)	WP Heat (W)	Node A	Node B	Node C	Node D	Node E	Node F	Node G	Node H	Node I	Node J	Node K	Node L	Node M	Node N	Node O
50.0	4374.9	147.5	139.8	139.1	139.1	139.5	145.0	135.3	134.8	134.5	135.1	119.8	118.6	109.8	109.5	109.3
50.1	4369.5	236.9	231.5	230.9	231.0	231.2	234.4	226.9	226.5	226.2	224.9	212.5	211.4	203.9	203.4	203.2
50.2	4364.2	263.0	258.0	257.4	257.4	257.7	260.4	253.2	252.8	252.5	250.7	238.4	237.3	229.8	229.4	229.1
50.3	4359.0	273.0	268.1	267.5	267.6	267.8	270.4	263.4	262.9	262.6	260.8	248.8	247.6	240.4	240.0	239.7
50.4	4353.5	278.8	274.0	273.5	273.5	273.7	276.2	269.3	268.9	268.6	266.7	254.7	253.6	246.4	246.0	245.7
50.5	4348.3	282.9	278.1	277.6	277.6	277.9	280.3	273.4	273.0	272.7	270.7	258.9	257.8	250.7	250.2	249.9
50.6	4342.8	286.0	281.3	280.8	280.8	281.0	283.4	276.6	276.2	275.9	273.9	262.1	261.0	254.0	253.5	253.2
50.7	4337.6	288.7	284.0	283.5	283.5	283.8	286.1	279.4	278.9	278.6	276.5	264.9	263.8	256.8	256.3	256.0
50.8	4332.3	291.0	286.4	285.9	285.9	286.1	288.4	281.8	281.3	281.0	278.9	267.3	266.2	259.3	258.8	258.5
50.9	4327.1	293.0	288.5	288.0	288.0	288.2	290.4	283.8	283.4	283.1	281.0	269.4	268.3	261.4	260.9	260.7
51	4321.6	294.8	290.3	289.8	289.8	290.0	292.2	285.7	285.2	284.9	282.8	271.3	270.2	263.3	262.8	262.6
52	4269.1	306.3	302.0	301.5	301.5	301.7	303.7	297.4	297.0	296.7	294.4	283.3	282.2	275.6	275.1	274.9
53	4217.0	313.4	309.3	308.8	308.8	309.0	310.9	304.8	304.3	304.1	301.8	290.9	289.8	283.4	282.9	282.6
54	4165.8	317.9	313.9	313.4	313.4	313.6	315.4	309.4	309.0	308.7	306.4	295.7	294.7	288.4	287.9	287.7
55	4115.0	321.2	317.3	316.8	316.8	317.0	318.8	312.9	312.5	312.2	309.9	299.4	298.3	292.2	291.7	291.5
56	4064.8	323.4	319.6	319.1	319.1	319.3	321.0	315.2	314.8	314.5	312.2	301.9	300.9	294.8	294.3	294.1
57	4015.4	324.8	321.0	320.5	320.5	320.7	322.4	316.7	316.3	316.0	313.7	303.5	302.5	296.6	296.1	295.9
58	3966.5	325.7	322.0	321.5	321.5	321.7	323.4	317.7	317.3	317.1	314.8	304.8	303.8	297.9	297.4	297.2
59	3918.2	325.8	322.1	321.6	321.7	321.9	323.5	317.9	317.5	317.3	315.0	305.1	304.1	298.3	297.9	297.6
60	3881.0	325.4	321.7	321.3	321.3	321.5	323.1	317.6	317.2	316.9	314.7	304.9	303.9	298.2	297.7	297.5
70	3670.6	320.5	317.2	316.7	316.8	316.9	318.4	313.4	313.1	312.8	310.9	302.0	301.1	296.0	295.6	295.4
80	3481.2	309.7	306.6	306.2	306.2	306.4	307.8	303.2	302.9	302.6	300.9	292.8	292.0	287.2	286.9	286.7
90	3308.6	298.4	295.4	295.1	295.1	295.2	296.7	292.3	292.0	291.8	290.3	282.7	282.0	277.6	277.2	277.0
100	3152.7	287.9	285.1	284.7	284.7	284.9	286.3	282.2	281.9	281.7	280.4	273.3	272.6	268.4	268.1	268.0
110	2511.0	281.8	279.1	278.8	278.8	278.9	280.3	276.4	276.1	275.9	274.7	268.0	267.3	263.3	263.0	262.9
120	2369.0	275.9	273.3	273.0	273.0	273.1	274.5	270.7	270.5	270.3	269.2	262.8	262.2	258.4	258.1	257.9
130	2235.0	269.4	266.9	266.6	266.6	266.7	268.0	264.4	264.2	264.0	263.0	256.9	256.3	252.7	252.4	252.3
140	2108.6	262.3	259.8	259.5	259.5	259.7	261.0	257.5	257.3	257.2	256.3	250.4	249.8	246.4	246.1	246.0
150	1989.3	254.7	252.4	252.1	252.1	252.2	253.5	250.2	250.0	249.9	249.0	243.4	242.9	239.6	239.4	239.3
250	1448.6	222.7	220.8	220.6	220.6	220.7	221.8	219.2	219.0	218.9	218.5	214.2	213.8	211.2	211.0	211.0
350	1306.2	206.3	204.6	204.5	204.5	204.5	205.6	203.3	203.2	203.1	202.8	199.1	198.8	196.6	196.5	196.4
450	1193.2	194.9	193.4	193.3	193.3	193.4	194.3	192.3	192.2	192.1	191.9	188.7	188.4	186.5	186.4	186.3
550	1101.5	185.5	184.1	184.0	184.0	184.1	184.9	183.1	183.0	183.0	182.8	180.0	179.7	178.0	177.9	177.9
650	1025.9	178.1	176.8	176.7	176.7	176.8	177.6	175.9	175.9	175.8	175.7	173.1	172.9	171.4	171.3	171.2
750	957.6	171.5	170.4	170.2	170.3	170.3	171.0	169.6	169.5	169.4	169.3	167.0	166.8	165.4	165.4	165.3
850	895.4	165.9	164.8	164.8	164.8	164.8	165.5	164.1	164.0	164.0	163.9	161.8	161.6	160.4	160.3	160.3
950	586.1	161.2	160.2	160.2	160.2	160.2	160.8	159.6	159.5	159.5	159.4	157.5	157.3	156.1	156.1	156.0
1050	539.9	157.5	156.6	156.5	156.5	156.6	157.2	156.0	155.9	155.9	155.9	154.0	153.9	152.8	152.7	152.7

2050	299.9	134.3	133.7	133.7	133.7	133.7	133.7	134.1	133.4	133.3	133.3	133.3	132.3	132.2	131.6	131.5	131.5
3050	236.9	125.1	124.6	124.6	124.6	124.6	124.6	124.9	124.4	124.3	124.3	124.3	123.5	123.4	122.9	122.9	122.9
4050	212.1	119.3	118.9	118.9	118.9	118.9	118.9	119.2	118.7	118.6	118.6	118.6	117.9	117.8	117.3	117.3	117.3
5050	197.8	113.5	113.1	113.0	113.1	113.1	113.1	113.3	112.9	112.8	112.8	112.8	112.1	112.1	111.6	111.6	111.6
6050	183.1	108.5	108.1	108.1	108.1	108.1	108.1	108.3	107.9	107.9	107.9	107.9	107.2	107.1	106.7	106.7	106.7
7050	171.6	104.3	103.9	103.9	103.9	103.9	103.9	104.2	103.8	103.7	103.7	103.8	103.1	103.1	102.7	102.7	102.6
8050	160.9	100.5	100.2	100.2	100.2	100.2	100.2	100.4	100.0	100.0	100.0	100.0	99.4	99.4	99.0	99.0	99.0
9050	151.8	97.2	96.9	96.9	96.9	96.9	96.9	97.1	96.7	96.7	96.7	96.7	96.1	96.1	95.8	95.7	95.7
10050	144.1	94.2	93.9	93.9	93.9	93.9	93.9	94.1	93.8	93.7	93.7	93.8	93.2	93.2	92.8	92.8	92.8

[1] - Time at end of 50-year ventilation period. Includes installation of drip shield and backfill.

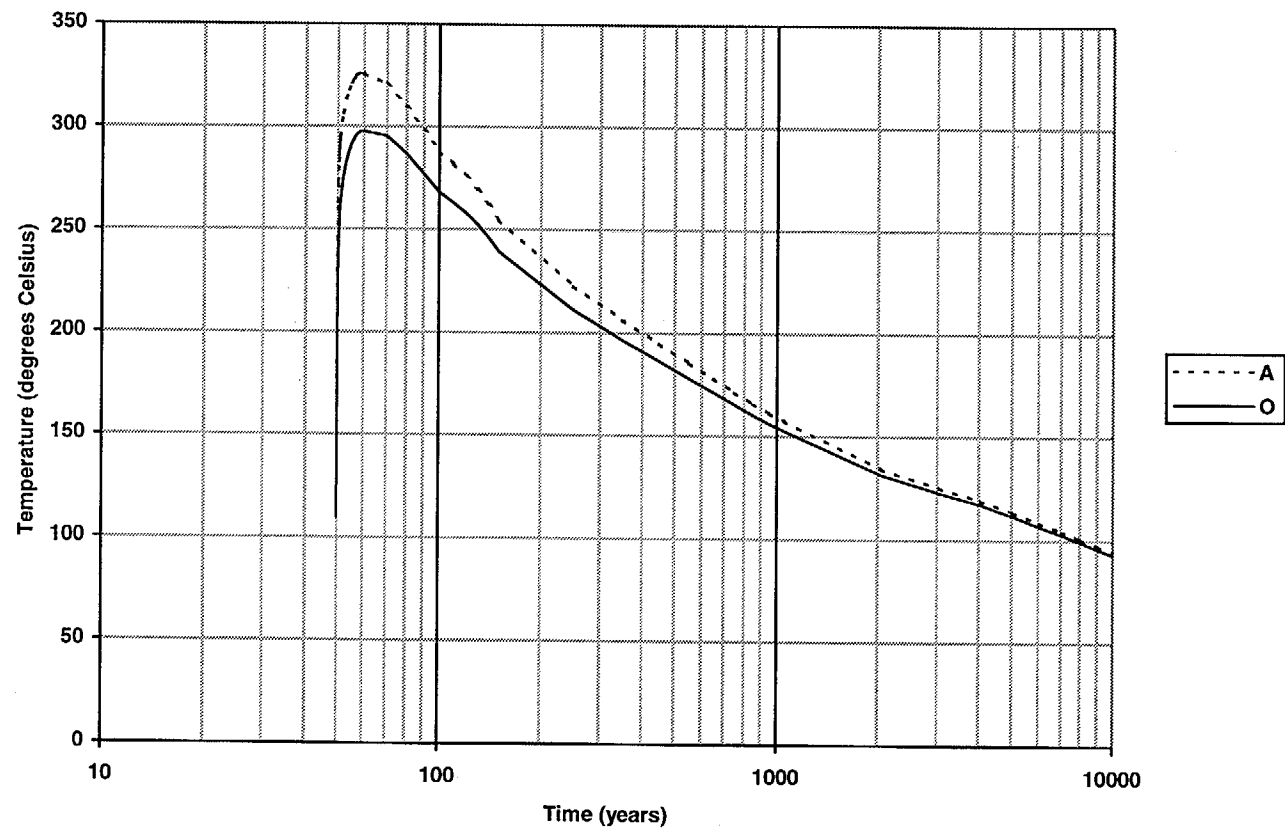


Figure 6-3. Time History of Internal Temperature at the Decay Heat Factor of 1.102 for Average Fuel (Case 2)

Table 6-3. Peak-Fuel Cladding Axial Temperature Profile (Case 1)

Node #	Mid-Fuel Assembly Cladding Temperature (°C)																
	1 Day	1 Year	5 Years	6 Years ^[2]	7 Years ^[2]	8 Years ^[2]	9 Years ^[2]	10 Years	20 Years	50 years	150 Years ^[1]	250 Years ^[1]	400 Years	1000 Years	4000 Years	8000 Years	10000 Years ^[2]
1	109.2	154.5	182.1	187.3	191.6	195.7	198.8	200.8	212.6	204.3	179.8	170.0	162.4	147.8	129.6	129.9	127.9
2	134.2	178.7	202.7	207.2	210.8	214.3	216.8	218.3	227.2	214.4	185.6	174.2	165.5	149.3	130.1	130.2	128.2
3	146.5	193.8	217.1	221.0	224.1	227.2	229.3	230.4	236.9	220.7	188.8	176.4	167.1	150.0	130.3	130.4	128.4
4	150.7	201.0	224.4	228.0	231.0	233.8	235.7	236.7	241.9	223.7	190.2	177.3	167.7	150.3	130.4	130.4	128.4
5	152.0	204.8	228.4	231.9	234.7	237.4	239.2	240.1	244.5	225.5	191.0	177.8	168.0	150.5	130.5	130.5	128.5
6	152.9	207.1	230.8	234.2	237.0	239.7	241.5	242.3	246.3	226.6	191.5	178.1	168.3	150.7	130.6	130.5	128.5
7	154.1	209.1	232.7	235.9	238.6	241.2	242.9	243.7	247.4	227.3	191.9	178.4	168.5	150.8	130.6	130.6	128.6
8	155.6	211.1	234.4	237.6	240.3	242.8	244.5	245.3	248.7	228.1	192.3	178.7	168.7	150.9	130.7	130.6	128.6
9	157.8	213.0	235.9	239.0	241.6	244.0	245.6	246.4	249.7	228.8	192.7	179.0	169.0	151.0	130.7	130.7	128.6
10	157.4	211.8	234.7	237.9	240.5	243.0	244.6	245.3	248.7	228.1	192.3	178.7	168.7	150.9	130.7	130.6	128.6
11	157.3	210.6	233.6	236.7	239.4	241.9	243.6	244.3	248.0	227.5	192.0	178.5	168.6	150.8	130.6	130.6	128.6
12	157.3	209.4	232.4	235.6	238.3	240.9	242.5	243.3	247.1	226.8	191.6	178.1	168.3	150.7	130.6	130.6	128.5
13	157.3	208.6	231.5	234.7	237.4	240.0	241.6	242.4	246.2	226.5	191.3	177.9	168.1	150.6	130.6	130.5	128.5
14	157.1	207.8	231.0	234.3	237.0	239.6	241.2	242.0	246.0	226.2	191.1	177.8	168.0	150.5	130.5	130.5	128.5
15	156.0	206.1	229.7	233.0	235.8	238.4	240.1	241.0	245.2	225.5	190.7	177.5	167.8	150.4	130.5	130.5	128.5
16	152.8	201.4	225.6	229.1	232.0	234.7	236.5	237.4	242.4	223.9	190.0	177.0	167.4	150.2	130.4	130.4	128.4
17	144.2	190.5	215.1	219.0	222.3	225.4	227.5	228.7	235.5	219.6	188.0	175.7	166.5	149.8	130.3	130.3	128.3
18	119.2	163.6	190.7	195.5	199.6	203.5	206.3	208.1	218.7	208.5	182.1	171.7	163.6	148.4	129.8	130.0	128.1
WP Heat (W)	9119.9	8853.8	8071.6	7899.6	7747.1	7601.4	7462.6	7334.7	6193.5	4039.6	3138.2	2125.2	1035.9	528.2	199.3	151.2	135.7

[1] – Base temperatures were linearly interpolated from ANSYS solution. See Attachment VIII.

[2] – Decay heat factor values used for temperature calculations were linearly interpolated from Table 5-3.

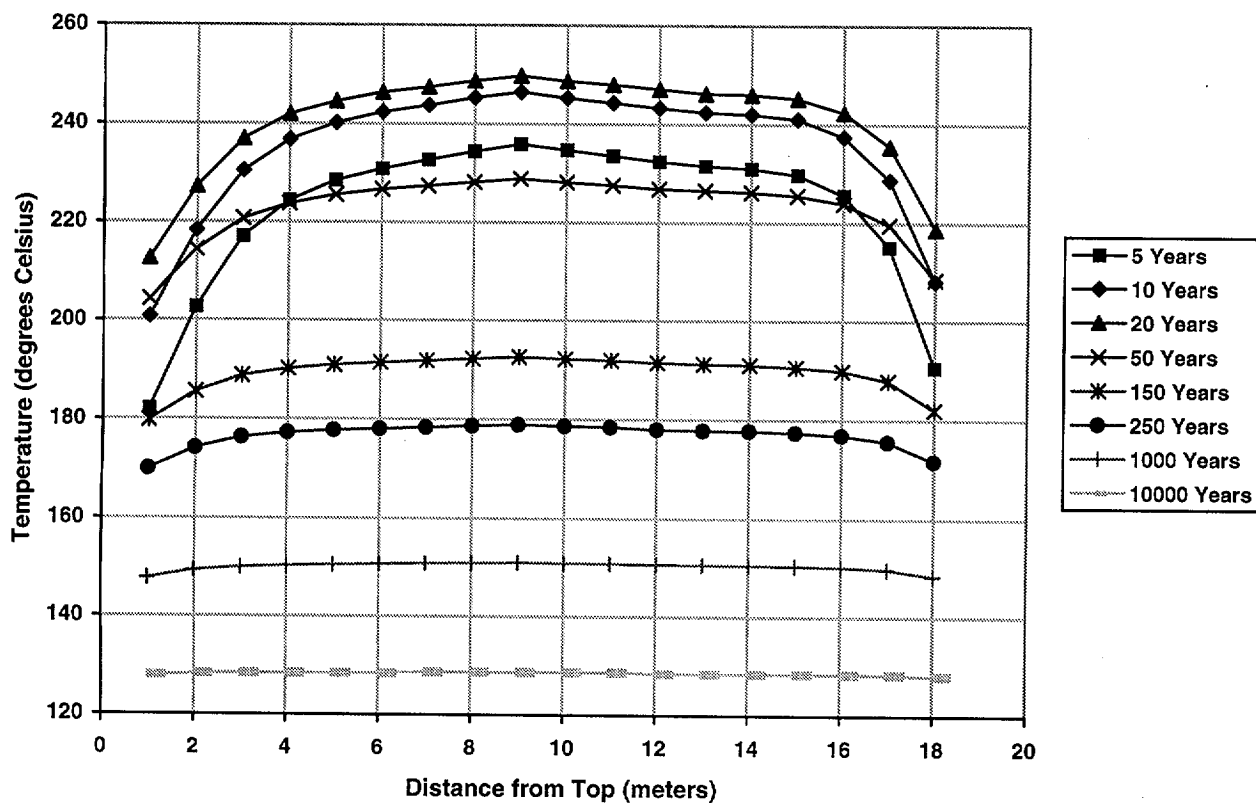


Figure 6-4. Mid-fuel Assembly Axial Cladding Temperature Distribution (Case 1)

Table 6-4. Mid-Fuel Assembly Axial Cladding Temperature Profile (Case 2)

Node #	Mid-fuel Assembly Cladding Temperature (°C)																
	50 Years	51 Year ^[2]	55 Years ^[2]	56 Years ^[2]	57 Years ^[2]	58 Years ^[2]	59 Years ^[2]	60 Years ^[2]	70 Years ^[2]	100 years ^[2]	200 Years ^[1,2]	300 Years ^[1,2]	450 Years ^[2]	1050 Years ^[2]	4050 Years ^[2]	8050 Years ^[2]	10050 Years ^[2]
1	129.1	275.9	302.9	306.5	308.1	309.2	309.5	308.9	305.9	276.4	230.7	208.3	190.2	155.1	118.5	99.9	93.7
2	139.8	285.5	311.5	315.0	316.5	317.5	317.7	316.6	312.9	282.2	235.1	211.8	193.0	156.5	118.9	100.3	94.0
3	144.6	291.1	317.3	320.0	321.4	322.5	322.6	321.7	317.3	285.6	237.4	213.6	194.3	157.1	119.1	100.4	94.1
4	145.7	293.4	319.8	322.1	323.4	324.4	324.5	324.0	319.3	287.0	238.3	214.2	194.7	157.3	119.2	100.5	94.2
5	145.6	294.2	320.9	323.0	324.4	325.3	325.4	325.0	320.1	287.6	238.6	214.4	194.8	157.4	119.2	100.5	94.2
6	145.2	294.3	321.2	323.3	324.7	325.6	325.7	325.4	320.4	287.8	238.7	214.4	194.8	157.4	119.2	100.5	94.2
7	144.9	294.4	321.3	323.3	324.7	325.6	325.7	325.4	320.4	287.8	238.7	214.4	194.8	157.4	119.2	100.5	94.2
8	144.8	294.4	321.4	323.3	324.7	325.6	325.7	325.5	320.5	287.8	238.7	214.4	194.8	157.4	119.2	100.5	94.2
9	145.1	294.4	321.3	323.3	324.6	325.6	325.7	325.4	320.5	287.8	238.7	214.4	194.8	157.4	119.2	100.5	94.2
10	145.5	294.5	321.4	323.2	324.6	325.5	325.6	325.4	320.4	287.8	238.6	214.3	194.8	157.4	119.2	100.5	94.2
11	146.1	294.7	321.5	323.2	324.6	325.5	325.6	325.5	320.5	287.8	238.6	214.4	194.8	157.4	119.2	100.5	94.2
12	146.7	294.9	321.6	323.2	324.5	325.5	325.6	325.6	320.5	287.8	238.5	214.3	194.7	157.3	119.2	100.5	94.2
13	147.3	295.3	321.7	323.4	324.7	325.7	325.8	325.7	320.6	287.9	238.6	214.3	194.7	157.3	119.2	100.5	94.2
14	147.9	295.7	322.2	323.7	325.0	326.0	326.1	326.0	320.9	288.1	238.7	214.4	194.8	157.4	119.2	100.5	94.2
15	148.0	295.7	322.2	323.6	325.0	325.9	326.0	326.1	321.0	288.1	238.6	214.3	194.7	157.3	119.2	100.5	94.2
16	147.1	294.4	321.0	322.7	324.0	325.0	325.1	325.0	320.0	287.4	238.3	214.1	194.6	157.3	119.2	100.4	94.1
17	143.8	290.4	316.8	319.4	320.8	321.9	322.0	321.4	317.0	285.2	236.9	213.1	193.9	156.9	119.1	100.4	94.1
18	133.0	279.6	306.4	310.0	311.5	312.6	312.9	312.1	308.8	278.8	232.4	209.6	191.2	155.6	118.6	100.0	93.8
WP Heat (W)	4374.9	4321.6	4115.0	4064.8	4015.4	3966.5	3918.2	3881.0	3670.6	3152.7	1651.6	1306.3	1193.2	539.9	212.1	160.9	144.1

[1] – Base temperatures linearly interpolated from ANSYS solution. See Attachment IX.

[2] – Decay heat factor values used for temperature calculations were linearly interpolated from Table 5-3.

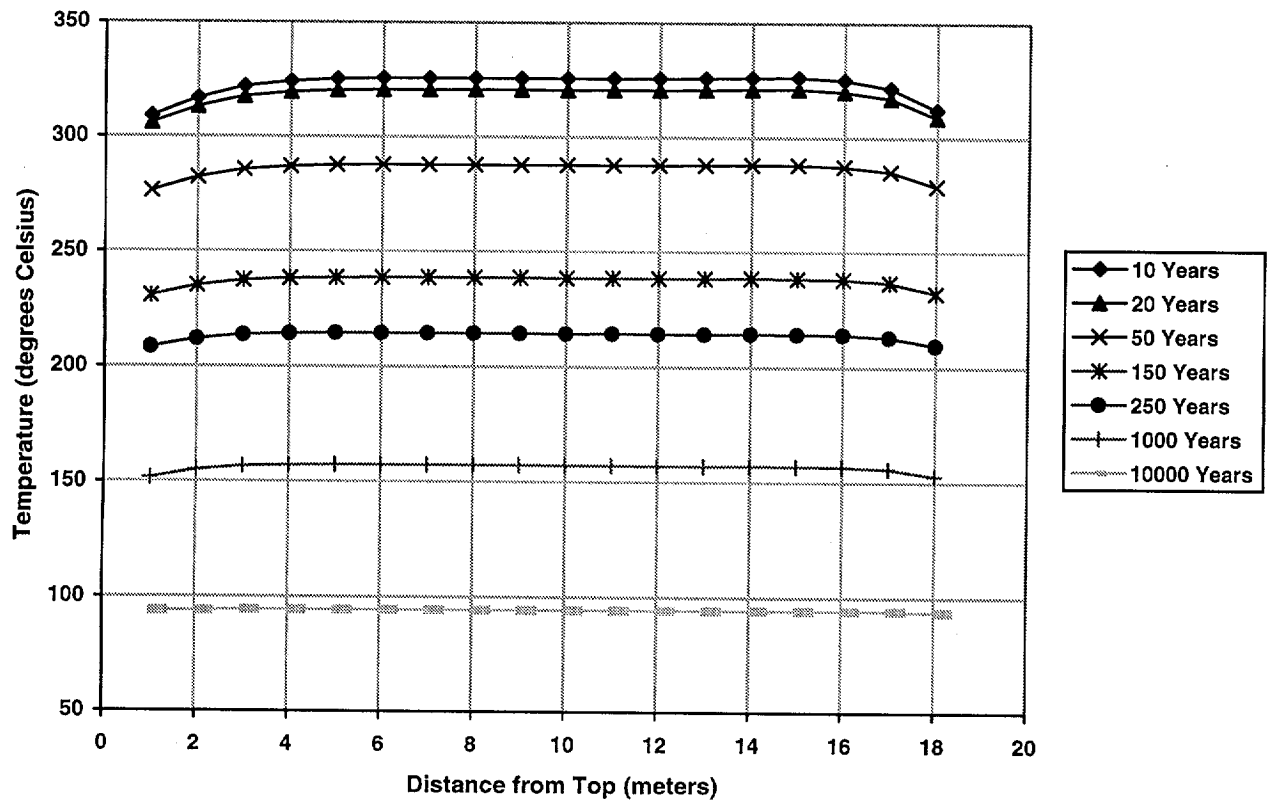


Figure 6-5. Mid-fuel Assembly Axial Cladding Temperature Distribution (Case 2)

7. ATTACHMENTS

The list of attachments is provided in Table 7-1.

Table 7-1. Supporting Documentation

Attachment Number	Description	Size
I	Calculations for Normalized Thermal Profiles (File Name: profile.xls)	4 pages
II	21-PWR Absorber Plates UCF Waste Package (File Name: SK-0081-00.doc)	1 page
III	Single CRM 21-PWR Waste Package (File name: SK-0132-03.doc)	1 page
IV	Heat Loads File for VA Average Fuel – Case 1 (File name: finalw1.dat)	10 pages
V	Heat Loads File for EDA II Average Fuel – Case 2 (File name: pwrvht.dat)	1 page
VI	Boundary Conditions File – Case 1 (File name: wf04d53c.parm)	26 pages
VII	Boundary Conditions File – Case 2 (File name: ellsurav.parm)	6 pages
VIII	Calculations for Axial Temperature Profile – Case 1 (File name: thermal_VA.xls)	5 pages
IX	Calculations for Axial Temperature Profile – Case 2 (File name: thermal_EDAII.xls)	4 pages
X	Material Properties File (File name: propnew03.dat)	6 pages
XI	Case 1 ANSYS FEA Representation (File name: p1102_VA.doc)	1 page
XII	Case 2 ANSYS FEA Representation (File name: p1102_E2.doc)	1 page
XIII	File Listing for ANSYS Output for Thermal History of Cladding in a 21 PWR SNF WP Loaded with Average Fuel (Ref. 3) (File name: outfiles.doc)	1 page
XIV	DIRS (File name: DIRS-000001.doc)	7 pages
XV	WP Surface Temperature Calculations for VA – Case 1 (File name: surftemp.xls)	1 page
XVI	Interpolated Values for (File Name: inter.xls)	1 page

Nominalized Axial Decay Heat Factor

Distance from	Fraction of	Core	charge	discharge	1.0 d	365.3 d	1826.3 d	10yr	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
Top	Height															
8.89	0.975		0.627	0.627	0.572	0.456	0.424	0.450	0.463	0.466	0.456	0.471	0.497	0.542	0.642	0.671
27.78	0.923		0.917	0.917	0.881	0.783	0.742	0.753	0.767	0.784	0.811	0.831	0.849	0.865	0.888	0.899
47.78	0.867		1.033	1.033	1.021	0.976	0.955	0.955	0.960	0.974	0.998	1.010	1.018	1.018	1.007	1.008
67.79	0.812		1.050	1.050	1.053	1.053	1.050	1.047	1.048	1.051	1.085	1.069	1.067	1.061	1.047	1.044
87.79	0.756		1.036	1.036	1.047	1.080	1.090	1.086	1.084	1.086	1.091	1.088	1.085	1.080	1.059	1.057
107.79	0.701		1.022	1.022	1.036	1.085	1.102	1.102	1.098	1.099	1.099	1.095	1.088	1.080	1.064	1.062
127.79	0.645		1.013	1.013	1.029	1.086	1.106	1.102	1.098	1.099	1.099	1.095	1.088	1.080	1.064	1.059
147.80	0.590		1.011	1.011	1.026	1.086	1.107	1.105	1.101	1.099	1.099	1.095	1.088	1.080	1.063	1.057
167.80	0.534		1.018	1.018	1.033	1.086	1.104	1.100	1.100	1.098	1.098	1.093	1.088	1.080	1.063	1.057
187.80	0.479		1.031	1.031	1.046	1.092	1.107	1.102	1.099	1.095	1.092	1.086	1.079	1.073	1.058	1.053
207.80	0.423		1.047	1.047	1.062	1.099	1.111	1.105	1.102	1.095	1.094	1.088	1.082	1.073	1.061	1.057
227.81	0.368		1.066	1.066	1.080	1.106	1.114	1.108	1.103	1.093	1.087	1.079	1.073	1.067	1.056	1.050
247.81	0.312		1.085	1.085	1.098	1.120	1.121	1.113	1.106	1.102	1.089	1.081	1.073	1.067	1.054	1.048
267.81	0.256		1.100	1.100	1.114	1.131	1.137	1.127	1.120	1.113	1.099	1.091	1.082	1.073	1.061	1.055
287.81	0.201		1.106	1.106	1.118	1.131	1.137	1.129	1.123	1.111	1.095	1.084	1.076	1.067	1.059	1.053
307.82	0.145		1.087	1.087	1.093	1.087	1.092	1.084	1.081	1.075	1.068	1.063	1.055	1.049	1.042	1.039
327.82	0.090		1.010	1.010	0.997	0.951	0.938	0.942	0.947	0.952	0.956	0.961	0.966	0.969	0.970	0.970
349.00	0.031		0.733	0.733	0.684	0.581	0.551	0.577	0.590	0.596	0.591	0.608	0.631	0.664	0.733	0.753

% Total Decay Heat per Node

node	charge	discharge	1.0 d	365.3 d	1826.3 d	10yr	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
1	0.031	0.031	0.028	0.023	0.021	0.022	0.023	0.023	0.023	0.023	0.025	0.027	0.032	0.033
2	0.051	0.051	0.049	0.043	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.048	0.049	0.050
3	0.057	0.057	0.057	0.054	0.053	0.053	0.053	0.054	0.055	0.056	0.057	0.057	0.056	0.056
4	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.059	0.059	0.059	0.059	0.058	0.058
5	0.058	0.058	0.058	0.060	0.061	0.060	0.060	0.060	0.061	0.060	0.060	0.060	0.059	0.059
6	0.057	0.057	0.058	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.059	0.059
7	0.056	0.056	0.057	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.059	0.059
8	0.056	0.056	0.057	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.059	0.059
9	0.057	0.057	0.057	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.059	0.059
10	0.057	0.057	0.058	0.061	0.061	0.061	0.061	0.061	0.061	0.060	0.060	0.060	0.059	0.058
11	0.058	0.058	0.059	0.061	0.062	0.061	0.061	0.061	0.061	0.060	0.060	0.060	0.059	0.059
12	0.059	0.059	0.060	0.061	0.062	0.062	0.061	0.061	0.060	0.060	0.060	0.059	0.059	0.058
13	0.060	0.060	0.061	0.062	0.062	0.062	0.061	0.061	0.060	0.060	0.060	0.059	0.059	0.058
14	0.061	0.061	0.062	0.063	0.063	0.063	0.062	0.062	0.061	0.061	0.060	0.060	0.059	0.059
15	0.061	0.061	0.062	0.063	0.063	0.063	0.062	0.062	0.061	0.060	0.060	0.059	0.059	0.058
16	0.060	0.060	0.061	0.060	0.061	0.060	0.060	0.060	0.059	0.059	0.059	0.058	0.058	0.058
17	0.056	0.056	0.055	0.053	0.052	0.052	0.053	0.053	0.053	0.053	0.054	0.054	0.054	0.054
18	0.045	0.045	0.042	0.036	0.034	0.036	0.037	0.037	0.037	0.038	0.039	0.041	0.045	0.047

NODE POWER in watts

node	charge	discharge	1.0 d	365.3 d	1826.3 d	10yr	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
1	4.51E+04	4.51E+04	3.67E+03	1.24E+02	2.18E+01	1.49E+01	1.18E+01	7.10E+00	2.53E+00	1.81E+00	1.44E+00	7.86E-01	3.40E-01	2.68E-01
2	7.42E+04	7.42E+04	6.35E+03	2.39E+02	4.30E+01	2.79E+01	2.21E+01	1.34E+01	5.05E+00	3.59E+00	2.77E+00	1.41E+00	5.29E-01	4.04E-01
3	8.36E+04	8.36E+04	7.36E+03	2.98E+02	5.53E+01	3.55E+01	2.76E+01	1.67E+01	6.22E+00	4.36E+00	3.32E+00	1.66E+00	6.00E-01	4.53E-01
4	8.49E+04	8.49E+04	7.59E+03	3.21E+02	6.08E+01	3.89E+01	3.01E+01	1.80E+01	6.63E+00	4.62E+00	3.48E+00	1.73E+00	6.25E-01	4.70E-01
5	8.38E+04	8.38E+04	7.55E+03	3.30E+02	6.31E+01	4.03E+01	3.12E+01	1.86E+01	6.80E+00	4.70E+00	3.54E+00	1.76E+00	6.32E-01	4.76E-01
6	8.26E+04	8.26E+04	7.47E+03	3.31E+02	6.38E+01	4.09E+01	3.16E+01	1.88E+01	6.85E+00	4.73E+00	3.55E+00	1.76E+00	6.35E-01	4.78E-01
7	8.19E+04	8.19E+04	7.42E+03	3.31E+02	6.40E+01	4.09E+01	3.16E+01	1.88E+01	6.85E+00	4.73E+00	3.55E+00	1.76E+00	6.35E-01	4.77E-01
8	8.18E+04	8.18E+04	7.40E+03	3.31E+02	6.41E+01	4.10E+01	3.17E+01	1.88E+01	6.85E+00	4.73E+00	3.55E+00	1.76E+00	6.34E-01	4.76E-01
9	8.23E+04	8.23E+04	7.45E+03	3.31E+02	6.39E+01	4.08E+01	3.16E+01	1.88E+01	6.84E+00	4.72E+00	3.55E+00	1.76E+00	6.34E-01	4.76E-01
10	8.34E+04	8.34E+04	7.54E+03	3.33E+02	6.41E+01	4.09E+01	3.16E+01	1.88E+01	6.80E+00	4.69E+00	3.52E+00	1.75E+00	6.31E-01	4.74E-01
11	8.47E+04	8.47E+04	7.66E+03	3.35E+02	6.43E+01	4.10E+01	3.17E+01	1.88E+01	6.81E+00	4.70E+00	3.53E+00	1.75E+00	6.33E-01	4.76E-01
12	8.62E+04	8.62E+04	7.79E+03	3.38E+02	6.45E+01	4.11E+01	3.17E+01	1.88E+01	6.77E+00	4.66E+00	3.50E+00	1.74E+00	6.30E-01	4.73E-01
13	8.77E+04	8.77E+04	7.92E+03	3.42E+02	6.49E+01	4.13E+01	3.18E+01	1.89E+01	6.79E+00	4.67E+00	3.50E+00	1.74E+00	6.29E-01	4.72E-01
14	8.90E+04	8.90E+04	8.03E+03	3.45E+02	6.58E+01	4.18E+01	3.22E+01	1.91E+01	6.85E+00	4.71E+00	3.53E+00	1.75E+00	6.33E-01	4.75E-01
15	8.94E+04	8.94E+04	8.06E+03	3.45E+02	6.58E+01	4.19E+01	3.23E+01	1.91E+01	6.82E+00	4.68E+00	3.51E+00	1.74E+00	6.32E-01	4.74E-01
16	8.79E+04	8.79E+04	7.88E+03	3.32E+02	6.32E+01	4.02E+01	3.11E+01	1.84E+01	6.65E+00	4.59E+00	3.44E+00	1.71E+00	6.22E-01	4.68E-01
17	8.17E+04	8.17E+04	7.19E+03	2.90E+02	5.43E+01	3.50E+01	2.72E+01	1.63E+01	5.96E+00	4.15E+00	3.15E+00	1.58E+00	5.78E-01	4.36E-01
18	6.62E+04	6.62E+04	5.51E+03	1.98E+02	3.57E+01	2.39E+01	1.90E+01	1.14E+01	4.12E+00	2.93E+00	2.30E+00	1.21E+00	4.88E-01	3.78E-01
TOTAL	1.46E+06	1.46E+06	1.30E+05	5.49E+03	1.04E+03	6.68E+02	5.18E+02	3.09E+02	1.12E+02	7.78E+01	5.88E+01	2.94E+01	1.07E+01	8.10E+00

SCALE Version 4.3 Output Data

3540N01														
	charge	discharge	1.0 d	365.3 d	1826.3 d	10yr	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
act	1.98E+03	1.98E+03	7.38E+02	3.76E+00	1.62E+00	1.85E+00	2.17E+00	2.45E+00	2.10E+00	1.77E+00	1.44E+00	7.86E-01	3.40E-01	2.68E-01
fp	4.31E+04	4.31E+04	2.93E+03	1.20E+02	2.02E+01	1.30E+01	9.67E+00	4.65E+00	4.27E-01	3.99E-02	1.38E-03	2.15E-04	2.12E-04	2.08E-04
3540N02														
	charge	discharge	1.0 d	365.3 d	1826.3 d	initial	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
act	3.79E+03	3.79E+03	1.43E+03	1.28E+01	4.87E+00	5.14E+00	5.46E+00	5.49E+00	4.32E+00	3.52E+00	2.77E+00	1.41E+00	5.29E-01	4.04E-01
fp	7.04E+04	7.04E+04	4.92E+03	2.26E+02	3.81E+01	2.28E+01	1.66E+01	7.95E+00	7.31E-01	6.85E-02	2.40E-03	4.03E-04	3.96E-04	3.88E-04
3540N03														
	charge	discharge	1.0 d	365.3 d	1826.3 d	initial	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
act	4.58E+03	4.58E+03	1.73E+03	1.97E+01	7.91E+00	7.95E+00	7.91E+00	7.27E+00	5.35E+00	4.28E+00	3.32E+00	1.66E+00	6.00E-01	4.53E-01
fp	7.90E+04	7.90E+04	5.63E+03	2.78E+02	4.74E+01	2.75E+01	1.97E+01	9.43E+00	8.69E-01	8.15E-02	2.88E-03	5.00E-04	4.92E-04	4.82E-04
3540N04														
	charge	discharge	1.0 d	365.3 d	1826.3 d	initial	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
act	4.80E+03	4.80E+03	1.82E+03	2.32E+01	9.60E+00	9.46E+00	9.13E+00	8.02E+00	5.71E+00	4.53E+00	3.48E+00	1.73E+00	6.24E-01	4.69E-01
fp	8.01E+04	8.01E+04	5.77E+03	2.98E+02	5.12E+01	2.94E+01	2.10E+01	1.00E+01	9.24E-01	8.68E-02	3.08E-03	5.39E-04	5.30E-04	5.19E-04
3540N05														

	charge	discharge	1.0 d	365.3 d	1826.3 d	initial	20.0 yr	50.0 yr	150.0 yr	250.0 yr	400.0 yr	1000.0 yr	4000.0 yr	8000.0 yr
act	4.79E+03	4.79E+03	1.82E+03	2.47E+01	1.03E+01	1.01E+01	9.66E+00	8.33E+00	5.85E+00	4.61E+00	3.54E+00	1.76E+00	6.31E-01	4.75E-01
fp	7.90E+04	7.90E+04	5.73E+03	3.05E+02	5.28E+01	3.02E+01	2.15E+01	1.03E+01	9.48E-01	8.90E-02	3.16E-03	5.57E-04	5.47E-04	5.36E-04
3540N06														
act	4.74E+03	4.74E+03	1.80E+03	2.52E+01	1.06E+01	1.04E+01	9.86E+00	8.44E+00	5.89E+00	4.64E+00	3.55E+00	1.76E+00	6.34E-01	4.77E-01
fp	7.79E+04	7.79E+04	5.67E+03	3.06E+02	5.32E+01	3.05E+01	2.17E+01	1.04E+01	9.56E-01	8.98E-02	3.19E-03	5.63E-04	5.54E-04	5.42E-04
3540N07														
act	4.71E+03	4.71E+03	1.79E+03	2.54E+01	1.07E+01	1.04E+01	9.87E+00	8.44E+00	5.89E+00	4.64E+00	3.55E+00	1.76E+00	6.34E-01	4.76E-01
fp	7.72E+04	7.72E+04	5.63E+03	3.06E+02	5.33E+01	3.05E+01	2.17E+01	1.04E+01	9.58E-01	9.00E-02	3.20E-03	5.67E-04	5.57E-04	5.46E-04
3540N08														
act	4.69E+03	4.69E+03	1.78E+03	2.54E+01	1.07E+01	1.04E+01	9.87E+00	8.44E+00	5.89E+00	4.64E+00	3.55E+00	1.76E+00	6.33E-01	4.75E-01
fp	7.71E+04	7.71E+04	5.62E+03	3.06E+02	5.34E+01	3.06E+01	2.18E+01	1.04E+01	9.60E-01	9.01E-02	3.20E-03	5.67E-04	5.57E-04	5.46E-04
3540N09														
act	4.71E+03	4.71E+03	1.79E+03	2.54E+01	1.06E+01	1.03E+01	9.84E+00	8.42E+00	5.88E+00	4.63E+00	3.55E+00	1.76E+00	6.33E-01	4.75E-01
fp	7.76E+04	7.76E+04	5.66E+03	3.06E+02	5.33E+01	3.05E+01	2.18E+01	1.04E+01	9.59E-01	9.00E-02	3.20E-03	5.66E-04	5.57E-04	5.45E-04
3540N10														
act	4.77E+03	4.77E+03	1.81E+03	2.53E+01	1.06E+01	1.03E+01	9.79E+00	8.38E+00	5.84E+00	4.60E+00	3.52E+00	1.75E+00	6.30E-01	4.73E-01
fp	7.86E+04	7.86E+04	5.73E+03	3.08E+02	5.35E+01	3.06E+01	2.18E+01	1.04E+01	9.62E-01	9.03E-02	3.20E-03	5.66E-04	5.56E-04	5.44E-04
3540N11														
act	4.83E+03	4.83E+03	1.84E+03	2.54E+01	1.06E+01	1.03E+01	9.80E+00	8.38E+00	5.85E+00	4.61E+00	3.53E+00	1.75E+00	6.32E-01	4.75E-01
fp	7.99E+04	7.99E+04	5.82E+03	3.10E+02	5.37E+01	3.07E+01	2.19E+01	1.04E+01	9.63E-01	9.04E-02	3.21E-03	5.68E-04	5.58E-04	5.47E-04
3540N12														
act	4.94E+03	4.94E+03	1.88E+03	2.55E+01	1.06E+01	1.04E+01	9.81E+00	8.35E+00	5.81E+00	4.57E+00	3.50E+00	1.74E+00	6.29E-01	4.72E-01
fp	8.13E+04	8.13E+04	5.91E+03	3.12E+02	5.39E+01	3.07E+01	2.19E+01	1.04E+01	9.64E-01	9.05E-02	3.21E-03	5.67E-04	5.57E-04	5.46E-04
3540N13														
act	5.04E+03	5.04E+03	1.91E+03	2.57E+01	1.08E+01	1.05E+01	9.89E+00	8.39E+00	5.82E+00	4.58E+00	3.50E+00	1.74E+00	6.28E-01	4.71E-01
fp	8.27E+04	8.27E+04	6.01E+03	3.16E+02	5.41E+01	3.08E+01	2.19E+01	1.05E+01	9.65E-01	9.06E-02	3.22E-03	5.71E-04	5.61E-04	5.50E-04
3540N14														
act	5.12E+03	5.12E+03	1.94E+03	2.62E+01	1.10E+01	1.06E+01	9.99E+00	8.45E+00	5.87E+00	4.62E+00	3.53E+00	1.75E+00	6.32E-01	4.74E-01
fp	8.39E+04	8.39E+04	6.09E+03	3.19E+02	5.48E+01	3.12E+01	2.22E+01	1.06E+01	9.77E-01	9.18E-02	3.26E-03	5.77E-04	5.67E-04	5.55E-04
3540N15														
act	5.14E+03	5.14E+03	1.95E+03	2.61E+01	1.09E+01	1.06E+01	9.99E+00	8.45E+00	5.84E+00	4.59E+00	3.51E+00	1.74E+00	6.31E-01	4.73E-01
fp	8.43E+04	8.43E+04	6.11E+03	3.19E+02	5.49E+01	3.13E+01	2.23E+01	1.06E+01	9.81E-01	9.21E-02	3.26E-03	5.77E-04	5.67E-04	5.55E-04
3540N16														
act	4.99E+03	4.99E+03	1.90E+03	2.47E+01	1.02E+01	9.93E+00	9.47E+00	8.14E+00	5.70E+00	4.50E+00	3.44E+00	1.71E+00	6.21E-01	4.67E-01
fp	8.29E+04	8.29E+04	5.98E+03	3.07E+02	5.30E+01	3.03E+01	2.16E+01	1.03E+01	9.54E-01	8.95E-02	3.17E-03	5.59E-04	5.49E-04	5.38E-04
3540N17														
act	4.42E+03	4.42E+03	1.68E+03	1.92E+01	7.50E+00	7.55E+00	7.52E+00	6.92E+00	5.09E+00	4.07E+00	3.15E+00	1.58E+00	5.78E-01	4.36E-01
fp	7.73E+04	7.73E+04	5.51E+03	2.71E+02	4.68E+01	2.74E+01	1.97E+01	9.41E+00	8.67E-01	8.13E-02	2.87E-03	4.96E-04	4.88E-04	4.78E-04
3540N18														
act	3.04E+03	3.04E+03	1.14E+03	8.08E+00	3.07E+00	3.41E+00	3.85E+00	4.17E+00	3.45E+00	2.87E+00	2.30E+00	1.21E+00	4.88E-01	3.78E-01
fp	6.32E+04	6.32E+04	4.37E+03	1.90E+02	3.26E+01	2.05E+01	1.51E+01	7.26E+00	6.67E-01	6.23E-02	2.16E-03	3.48E-04	3.42E-04	3.36E-04

12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
0.694	0.712	0.723	0.733	0.745	0.753	0.760	0.794	0.790	0.781	0.721	0.605	0.596
0.910	0.915	0.919	0.925	0.930	0.933	0.935	0.946	0.943	0.935	0.898	0.828	0.841
1.013	1.013	1.013	1.016	1.017	1.018	1.016	1.019	1.018	1.015	1.001	0.983	0.992
1.044	1.044	1.043	1.040	1.039	1.043	1.038	1.038	1.037	1.038	1.039	1.044	1.049
1.053	1.050	1.050	1.049	1.049	1.048	1.044	1.042	1.043	1.044	1.052	1.072	1.068
1.058	1.054	1.054	1.053	1.049	1.048	1.049	1.044	1.045	1.047	1.059	1.077	1.074
1.056	1.054	1.050	1.049	1.049	1.048	1.044	1.039	1.040	1.042	1.056	1.077	1.075
1.053	1.050	1.050	1.049	1.044	1.043	1.044	1.038	1.039	1.042	1.056	1.083	1.081
1.053	1.050	1.050	1.049	1.044	1.043	1.044	1.038	1.039	1.040	1.053	1.077	1.074
1.050	1.047	1.043	1.041	1.040	1.038	1.038	1.033	1.034	1.035	1.049	1.077	1.074
1.053	1.050	1.047	1.045	1.044	1.043	1.044	1.036	1.036	1.039	1.053	1.077	1.075
1.044	1.040	1.039	1.036	1.035	1.033	1.033	1.026	1.027	1.030	1.043	1.066	1.068
1.044	1.040	1.039	1.036	1.035	1.033	1.033	1.024	1.025	1.028	1.043	1.072	1.068
1.050	1.047	1.043	1.041	1.040	1.038	1.033	1.029	1.031	1.034	1.053	1.083	1.081
1.047	1.044	1.039	1.041	1.035	1.033	1.033	1.026	1.028	1.032	1.050	1.077	1.075
1.033	1.030	1.028	1.028	1.026	1.023	1.022	1.017	1.017	1.020	1.034	1.055	1.056
0.970	0.973	0.972	0.970	0.971	0.973	0.973	0.972	0.971	0.970	0.963	0.956	0.961
0.769	0.780	0.789	0.794	0.804	0.808	0.812	0.836	0.832	0.824	0.774	0.682	0.684

12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
0.034	0.035	0.036	0.036	0.037	0.037	0.038	0.039	0.039	0.039	0.036	0.030	0.029
0.051	0.051	0.051	0.051	0.052	0.052	0.052	0.053	0.052	0.052	0.050	0.046	0.047
0.056	0.056	0.056	0.056	0.056	0.057	0.056	0.057	0.057	0.056	0.056	0.055	0.055
0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058
0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.060	0.059
0.059	0.059	0.059	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.059	0.060	0.060
0.059	0.059	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.059	0.060	0.060
0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.059	0.060	0.060
0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.060	0.060
0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.057	0.057	0.057	0.058	0.060	0.060
0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.058	0.060	0.060
0.058	0.058	0.058	0.058	0.057	0.057	0.057	0.057	0.057	0.057	0.058	0.059	0.059
0.058	0.058	0.058	0.058	0.057	0.057	0.057	0.057	0.057	0.057	0.058	0.060	0.059
0.058	0.058	0.058	0.058	0.058	0.058	0.057	0.057	0.057	0.057	0.058	0.060	0.060
0.058	0.058	0.058	0.058	0.057	0.057	0.057	0.057	0.057	0.057	0.058	0.060	0.060
0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.056	0.056	0.057	0.057	0.059	0.059
0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.053	0.053	0.053
0.048	0.048	0.049	0.049	0.050	0.050	0.050	0.052	0.052	0.051	0.048	0.042	0.042

12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
2.17E-01	1.88E-01	1.72E-01	1.58E-01	1.46E-01	1.35E-01	1.25E-01	6.68E-02	5.13E-02	4.03E-02	2.02E-02	9.82E-03	8.42E-03
3.20E-01	2.72E-01	2.46E-01	2.24E-01	2.05E-01	1.88E-01	1.73E-01	8.95E-02	6.88E-02	5.42E-02	2.83E-02	1.51E-02	1.34E-02
3.56E-01	3.01E-01	2.71E-01	2.46E-01	2.24E-01	2.05E-01	1.88E-01	9.65E-02	7.43E-02	5.89E-02	3.16E-02	1.80E-02	1.58E-02
3.68E-01	3.11E-01	2.79E-01	2.52E-01	2.29E-01	2.10E-01	1.92E-01	9.82E-02	7.57E-02	6.02E-02	3.28E-02	1.91E-02	1.67E-02
3.71E-01	3.13E-01	2.82E-01	2.55E-01	2.32E-01	2.11E-01	1.93E-01	9.86E-02	7.61E-02	6.05E-02	3.32E-02	1.96E-02	1.70E-02
3.73E-01	3.14E-01	2.83E-01	2.56E-01	2.32E-01	2.12E-01	1.94E-01	9.88E-02	7.62E-02	6.07E-02	3.34E-02	1.97E-02	1.71E-02
3.72E-01	3.14E-01	2.82E-01	2.55E-01	2.32E-01	2.12E-01	1.93E-01	9.84E-02	7.59E-02	6.04E-02	3.33E-02	1.97E-02	1.71E-02
3.71E-01	3.13E-01	2.82E-01	2.55E-01	2.31E-01	2.11E-01	1.93E-01	9.83E-02	7.58E-02	6.04E-02	3.33E-02	1.98E-02	1.72E-02
3.71E-01	3.13E-01	2.82E-01	2.55E-01	2.31E-01	2.11E-01	1.93E-01	9.82E-02	7.58E-02	6.03E-02	3.32E-02	1.97E-02	1.71E-02
3.70E-01	3.12E-01	2.80E-01	2.53E-01	2.30E-01	2.10E-01	1.92E-01	9.77E-02	7.54E-02	6.00E-02	3.31E-02	1.97E-02	1.71E-02
3.71E-01	3.13E-01	2.81E-01	2.54E-01	2.31E-01	2.11E-01	1.94E-01	9.81E-02	7.56E-02	6.02E-02	3.32E-02	1.97E-02	1.71E-02
3.68E-01	3.10E-01	2.79E-01	2.52E-01	2.29E-01	2.09E-01	1.91E-01	9.72E-02	7.49E-02	5.97E-02	3.29E-02	1.95E-02	1.70E-02
3.68E-01	3.10E-01	2.79E-01	2.52E-01	2.29E-01	2.09E-01	1.92E-01	9.70E-02	7.48E-02	5.96E-02	3.29E-02	1.96E-02	1.70E-02
3.70E-01	3.12E-01	2.80E-01	2.53E-01	2.30E-01	2.10E-01	1.92E-01	9.74E-02	7.52E-02	5.99E-02	3.32E-02	1.98E-02	1.72E-02
3.69E-01	3.11E-01	2.79E-01	2.53E-01	2.29E-01	2.09E-01	1.92E-01	9.72E-02	7.50E-02	5.98E-02	3.31E-02	1.97E-02	1.71E-02
3.64E-01	3.07E-01	2.76E-01	2.50E-01	2.27E-01	2.06E-01	1.89E-01	9.62E-02	7.42E-02	5.91E-02	3.26E-02	1.93E-02	1.68E-02
3.41E-01	2.89E-01	2.60E-01	2.35E-01	2.14E-01	1.96E-01	1.80E-01	9.20E-02	7.09E-02	5.63E-02	3.04E-02	1.75E-02	1.53E-02
3.02E-01	2.59E-01	2.36E-01	2.15E-01	1.98E-01	1.82E-01	1.68E-01	8.84E-02	6.79E-02	5.34E-02	2.73E-02	1.39E-02	1.21E-02
6.34E+00	5.36E+00	4.83E+00	4.37E+00	3.98E+00	3.64E+00	3.34E+00	1.70E+00	1.31E+00	1.04E+00	5.69E-01	3.29E-01	2.86E-01

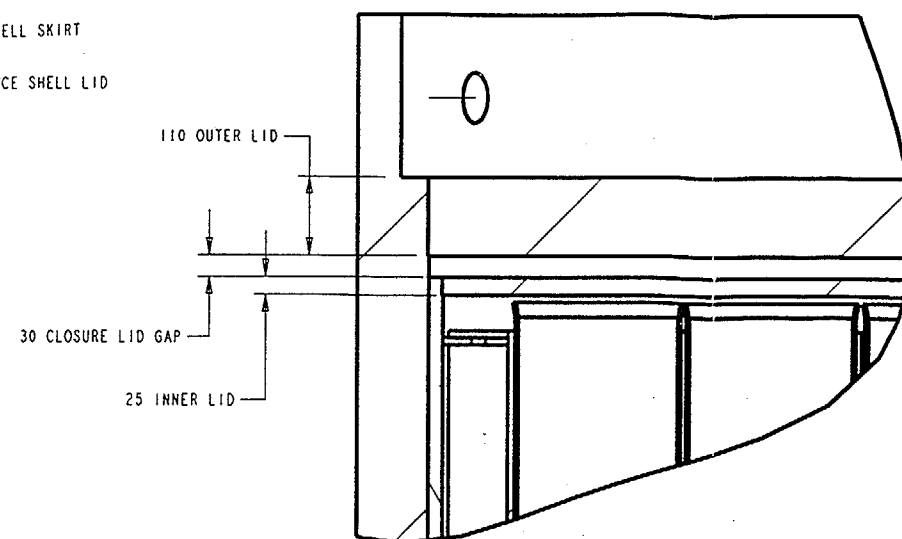
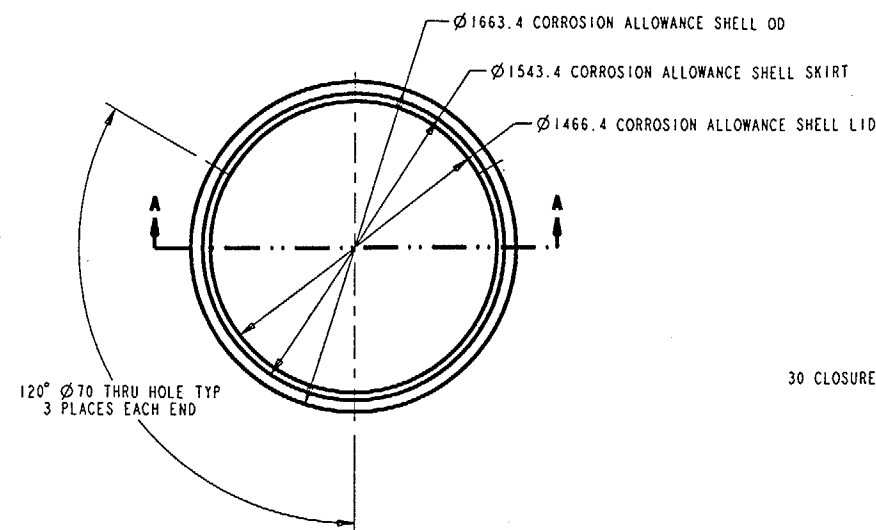
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2.17E-01	1.88E-01	1.72E-01	1.58E-01	1.46E-01	1.35E-01	1.25E-01	6.66E-02	5.11E-02	4.01E-02	2.01E-02	9.75E-03	8.39E-03
2.04E-04	2.01E-04	1.99E-04	1.97E-04	1.95E-04	1.93E-04	1.91E-04	1.73E-04	1.65E-04	1.58E-04	1.34E-04	7.07E-05	2.95E-05

12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.20E-01	2.72E-01	2.46E-01	2.24E-01	2.05E-01	1.88E-01	1.73E-01	8.92E-02	6.85E-02	5.39E-02	2.81E-02	1.50E-02	1.33E-02
3.80E-04	3.75E-04	3.71E-04	3.67E-04	3.63E-04	3.60E-04	3.56E-04	3.22E-04	3.06E-04	2.92E-04	2.46E-04	1.26E-04	5.06E-05

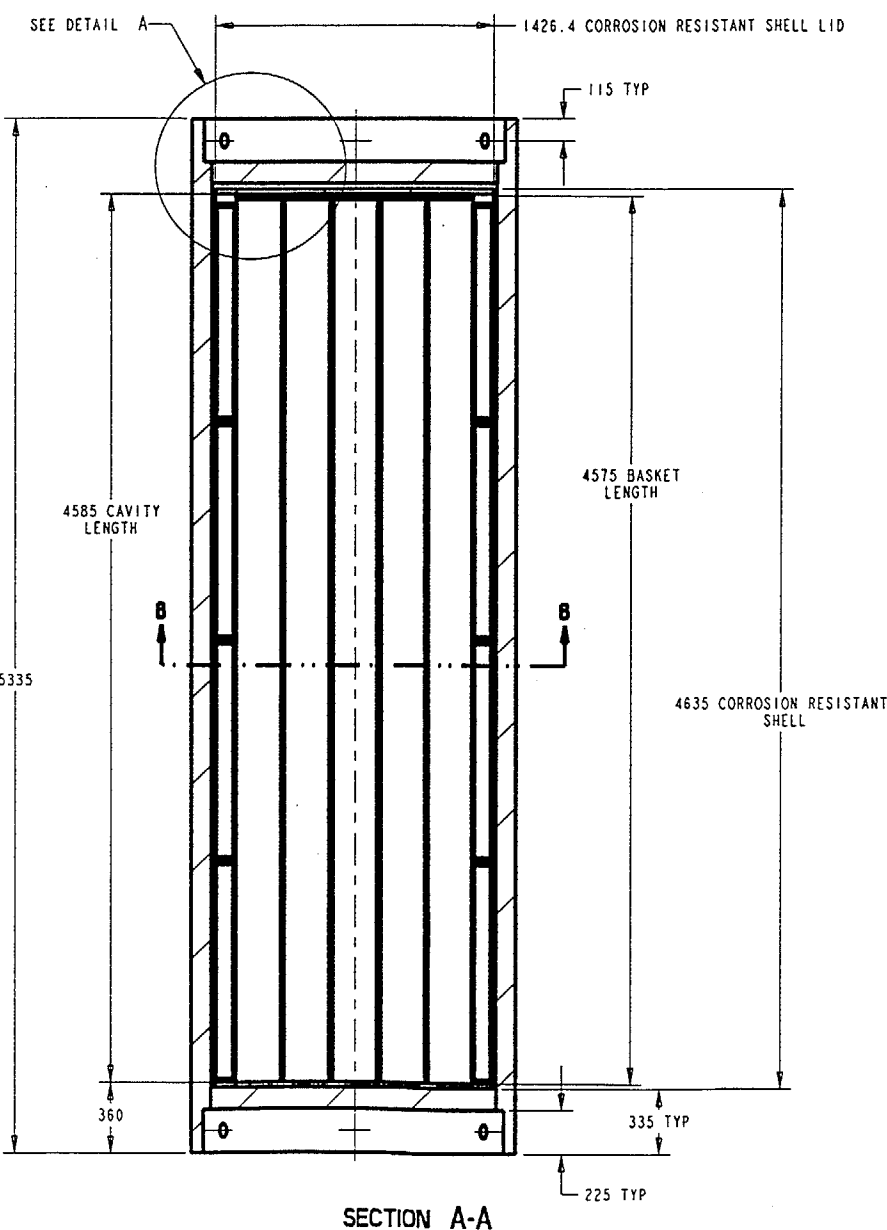
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3.56E-01	3.01E-01	2.71E-01	2.46E-01	2.24E-01	2.05E-01	1.88E-01	9.61E-02	7.39E-02	5.85E-02	3.13E-02	1.78E-02	1.57E-02
4.72E-04	4.64E-04	4.59E-04	4.55E-04	4.50E-04	4.45E-04	4.41E-04	3.98E-04	3.78E-04	3.60E-04	3.03E-04	1.53E-04	6.01E-05

12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.67E-01	3.10E-01	2.79E-01	2.52E-01	2.29E-01	2.10E-01	1.92E-01	9.78E-02	7.53E-02	5.98E-02	3.25E-02	1.89E-02	1.66E-02
5.08E-04	5.00E-04	4.95E-04	4.90E-04	4.85E-04	4.80E-04	4.75E-04	4.28E-04	4.07E-04	3.87E-04	3.25E-04	1.63E-04	6.37E-05

12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.70E-01	3.12E-01	2.81E-01	2.54E-01	2.31E-01	2.11E-01	1.93E-01	9.82E-02	7.57E-02	6.01E-02	3.29E-02	1.94E-02	1.69E-02
5.25E-04	5.16E-04	5.11E-04	5.06E-04	5.00E-04	4.95E-04	4.90E-04	4.42E-04	4.20E-04	3.99E-04	3.35E-04	1.68E-04	6.55E-05
12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
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3.71E-01	3.13E-01	2.81E-01	2.54E-01	2.31E-01	2.11E-01	1.93E-01	9.79E-02	7.55E-02	6.00E-02	3.30E-02	1.95E-02	1.70E-02
5.34E-04	5.26E-04	5.20E-04	5.15E-04	5.10E-04	5.04E-04	4.99E-04	4.50E-04	4.27E-04	4.06E-04	3.41E-04	1.71E-04	6.65E-05
12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.70E-01	3.12E-01	2.81E-01	2.54E-01	2.30E-01	2.10E-01	1.93E-01	9.78E-02	7.54E-02	6.00E-02	3.30E-02	1.96E-02	1.71E-02
5.34E-04	5.26E-04	5.20E-04	5.15E-04	5.09E-04	5.04E-04	4.99E-04	4.50E-04	4.27E-04	4.06E-04	3.41E-04	1.71E-04	6.66E-05
12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.70E-01	3.12E-01	2.81E-01	2.54E-01	2.30E-01	2.10E-01	1.93E-01	9.78E-02	7.54E-02	5.99E-02	3.29E-02	1.95E-02	1.70E-02
5.34E-04	5.25E-04	5.20E-04	5.14E-04	5.09E-04	5.04E-04	4.98E-04	4.49E-04	4.27E-04	4.06E-04	3.41E-04	1.71E-04	6.64E-05
12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
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3.70E-01	3.12E-01	2.80E-01	2.53E-01	2.30E-01	2.10E-01	1.93E-01	9.76E-02	7.52E-02	5.98E-02	3.29E-02	1.95E-02	1.70E-02
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3.67E-01	3.09E-01	2.78E-01	2.51E-01	2.28E-01	2.08E-01	1.91E-01	9.65E-02	7.44E-02	5.92E-02	3.26E-02	1.94E-02	1.69E-02
5.38E-04	5.30E-04	5.24E-04	5.19E-04	5.13E-04	5.08E-04	5.03E-04	4.53E-04	4.31E-04	4.09E-04	3.44E-04	1.72E-04	6.69E-05
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3.69E-01	3.11E-01	2.79E-01	2.52E-01	2.29E-01	2.09E-01	1.91E-01	9.69E-02	7.48E-02	5.95E-02	3.29E-02	1.96E-02	1.71E-02
5.43E-04	5.35E-04	5.29E-04	5.24E-04	5.18E-04	5.13E-04	5.08E-04	4.58E-04	4.35E-04	4.13E-04	3.47E-04	1.74E-04	6.75E-05
12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.68E-01	3.10E-01	2.78E-01	2.52E-01	2.28E-01	2.08E-01	1.91E-01	9.67E-02	7.46E-02	5.94E-02	3.28E-02	1.95E-02	1.70E-02
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12000.0 yr	15000.0 yr	17000.0 yr	19000.0 yr	21000.0 yr	23000.0 yr	25000.0 yr	45000. yr	55000. yr	65000. yr	100000. yr	250000. yr	500000. yr
3.63E-01	3.06E-01	2.75E-01	2.49E-01	2.26E-01	2.06E-01	1.89E-01	9.58E-02	7.38E-02	5.87E-02	3.23E-02	1.91E-02	1.67E-02
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3.41E-01	2.89E-01	2.60E-01	2.35E-01	2.14E-01	1.96E-01	1.80E-01	9.16E-02	7.05E-02	5.59E-02	3.01E-02	1.73E-02	1.52E-02
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DETAIL A



SECTION A-A

FUEL BASKET D-PLATE (THERMAL SHUNT)

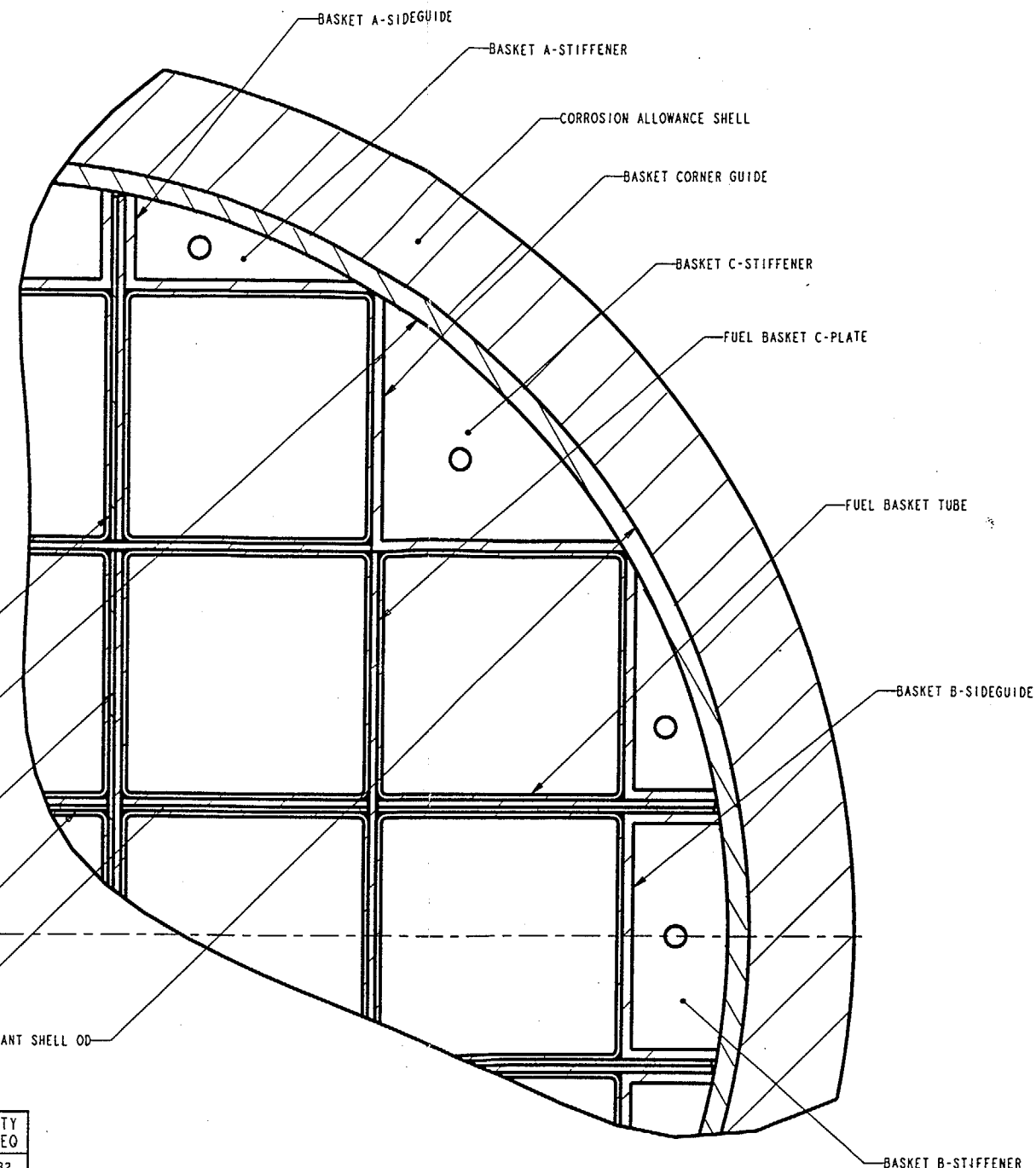
$\phi 1423.4$ CORROSION RESISTANT SHELL ID

FUEL BASKET A-PLATE

FUEL BASKET E-PLATE (THERMAL SHUNT)

FUEL BASKET B-PLATE

$\phi 1463.4$ CORROSION RESISTANT SHELL OD



SECTION B-B

COMPONENT NAME	MATERIAL	THICKNESS	MASS (kg)	QTY REQ
BASKET A-SIDEGUIDE	SA-516 K02700	10	27	32
BASKET A-STIFFENER	SA-516 K02700	10	1	64
BASKET B-SIDEGUIDE	SA-516 K02700	10	36	16
BASKET B-STIFFENER	SA-516 K02700	10	1	32
BASKET C-STIFFENER	SA-516 K02700	10	2	32
BASKET CORNER GUIDE	SA-516 K02700	10	42	16
CORROSION ALLOWANCE SHELL	SA-516 K02700	100	19879	1
CORROSION ALLOWANCE SHELL LID	SA-516 K02700	110	1458	2
CORROSION RESISTANT SHELL	SB-575 N06022	20	3650	1
CORROSION RESISTANT SHELL LID	SB-575 N06022	25	347	2
FUEL BASKET A-PLATE	NEUTRONIT A 978	7	85	8
FUEL BASKET B-PLATE	NEUTRONIT A 978	7	85	8
FUEL BASKET C-PLATE	NEUTRONIT A 978	7	44	16
FUEL BASKET D-PLATE	SB-209 A96061 T4	5	21	8
FUEL BASKET E-PLATE	SB-209 A96061 T4	5	21	8
FUEL BASKET TUBE	SA-516 K02700	5	164	21

DO NOT SCALE FROM SKETCH

UNITS:mm

"FOR INFORMATION ONLY"

21-PWR ABSORBER PLATES
UCF WASTE PACKAGE ASSEMBLY

SKETCH NUMBER: SK-0081.Rev00

SKETCHED BY: GENE CONNELL *89C* *5MB* *DCU For TWD*

DATE: 5/27/98 *7/28/98* *7/28/98* *07/28/98*

FILE: /users/pro_library/checkout/21pwr_mox/SK-0081.dwg


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/COM, ** Output of WPBIN00D, SCSI: B00000000-01717-1200-3000X Rev.00D **
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/COM, ** Executable File Name: WPBIN00D.EXE **
/COM, ** Input File Name: case1.wsm **
/COM, ** Output File Name: finalw1.dat **
/COM, ** Execution Date: 08/11/97 **
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/COM, ** Assembly Type: PWR **
/COM, ** Decay Period (years): 900000 **
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/COM, *****

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*DIM,BIN1, TABLE, 135, 1,

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BIN1(13,1)=	486.92,	486.37,	485.82,	485.28,	484.74,	484.20,
BIN1(19,1)=	483.67,	483.13,	482.60,	482.07,	481.54,	481.02,
BIN1(25,1)=	480.49,	479.97,	479.45,	478.93,	478.42,	473.40,
BIN1(31,1)=	468.57,	463.84,	459.27,	454.81,	450.48,	446.22,
BIN1(37,1)=	442.08,	437.90,	433.83,	429.90,	426.07,	422.25,
BIN1(43,1)=	418.53,	414.84,	411.25,	407.70,	404.24,	371.65,
BIN1(49,1)=	343.09,	317.69,	295.20,	275.10,	257.14,	240.98,
BIN1(55,1)=	226.51,	213.50,	201.78,	191.24,	181.78,	173.09,
BIN1(61,1)=	165.26,	158.17,	151.72,	145.78,	140.39,	105.93,
BIN1(67,1)=	88.03,	77.14,	69.39,	63.26,	58.32,	54.26,
BIN1(73,1)=	50.59,	47.30,	44.46,	42.00,	39.68,	37.51,
BIN1(79,1)=	35.59,	33.87,	32.32,	30.92,	29.57,	20.38,
BIN1(85,1)=	16.07,	13.80,	12.57,	11.83,	11.22,	10.82,
BIN1(91,1)=	10.46,	10.04,	9.67,	9.34,	9.04,	8.73,
BIN1(97,1)=	8.46,	8.20,	7.97,	7.76,	7.55,	5.53,
BIN1(103,1)=	4.43,	3.47,	2.83,	2.39,	2.06,	1.81,
BIN1(109,1)=	1.61,	1.41,	1.25,	1.12,	1.01,	0.923,
BIN1(115,1)=	0.845,	0.778,	0.719,	0.668,	0.622,	0.357,
BIN1(121,1)=	0.241,	0.177,	0.138,	0.112,	0.093,	0.079,
BIN1(127,1)=	0.069,	0.060,	0.053,	0.048,	0.043,	0.039,
BIN1(133,1)=	0.036,	0.033,	0.031,			
BIN1(1,0)=	0.000001,	0.01,	0.02,	0.03,	0.04,	0.05,
BIN1(7,0)=	0.06,	0.07,	0.08,	0.09,	0.10,	0.15,
BIN1(13,0)=	0.20,	0.25,	0.30,	0.35,	0.40,	0.45,
BIN1(19,0)=	0.50,	0.55,	0.60,	0.65,	0.70,	0.75,
BIN1(25,0)=	0.80,	0.85,	0.90,	0.95,	1.00,	1.50,
BIN1(31,0)=	2.00,	2.50,	3.00,	3.50,	4.00,	4.50,
BIN1(37,0)=	5.00,	5.50,	6.00,	6.50,	7.00,	7.50,

```

BIN1(43,0)=      8.00,      8.50,      9.00,      9.50,      10.00,      15.00,
BIN1(49,0)=     20.00,     25.00,     30.00,     35.00,     40.00,     45.00,
BIN1(55,0)=     50.00,     55.00,     60.00,     65.00,     70.00,     75.00,
BIN1(61,0)=     80.00,     85.00,     90.00,     95.00,    100.00,    150.00,
BIN1(67,0)=    200.00,    250.00,    300.00,    350.00,    400.00,    450.00,
BIN1(73,0)=    500.00,    550.00,    600.00,    650.00,    700.00,    750.00,
BIN1(79,0)=    800.00,    850.00,    900.00,    950.00,   1000.00,   1500.00,
BIN1(85,0)=   2000.00,   2500.00,   3000.00,   3500.00,   4000.00,   4500.00,
BIN1(91,0)=   5000.00,   5500.00,   6000.00,   6500.00,   7000.00,   7500.00,
BIN1(97,0)=   8000.00,   8500.00,   9000.00,   9500.00,  10000.00,  15000.00,
BIN1(103,0)=  20000.00,  25000.00,  30000.00,  35000.00,  40000.00,  45000.00,
BIN1(109,0)=  50000.00,  55000.00,  60000.00,  65000.00,  70000.00,  75000.00,
BIN1(115,0)=  80000.00,  85000.00,  90000.00,  95000.00, 100000.00, 150000.00,
BIN1(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN1(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN1(133,0)= 800000.00, 850000.00, 900000.00,
BIN1( 0,1)=1.0

```

```

/COM, ****
/COM, **
/COM, **      Assembly Type:          PWR
/COM, **      Decay Period (years):    900000
/COM, **      Number of assemblies:    55455
/COM, **      Assemblies/pkg:          21
/COM, **      Max Heat (Watts/assy):    850.00
/COM, **      Min Heat (Watts/assy):    0.00
/COM, **      Max Kinf:                 1.130
/COM, **      Min Kinf:                 1.000
/COM, **      Ave Age:                  26.340
/COM, **      Ave Burnup:               36662.111
/COM, **      Ave Enrichment:           3.638
/COM, **      Ave MTU/assy:             0.431
/COM, **
/COM, ****

```

```
*SET,BIN2,
```

```
*DIM,BIN2, TABLE,135,1,
```

```

BIN2( 1,1)=   434.28,   434.15,   434.01,   433.88,   433.75,   433.61,
BIN2( 7,1)=   433.48,   433.35,   433.22,   433.08,   432.95,   432.29,
BIN2(13,1)=   431.63,   430.98,   430.33,   429.68,   429.04,   428.40,
BIN2(19,1)=   427.77,   427.14,   426.51,   425.88,   425.26,   424.65,
BIN2(25,1)=   424.03,   423.42,   422.81,   422.21,   421.61,   416.10,
BIN2(31,1)=   410.86,   405.90,   401.15,   396.67,   392.36,   388.29,
BIN2(37,1)=   384.36,   380.19,   376.17,   372.48,   368.91,   365.38,
BIN2(43,1)=   361.97,   358.62,   355.36,   352.27,   349.27,   319.85,
BIN2(49,1)=   294.93,   272.45,   252.66,   235.01,   219.41,   205.05,
BIN2(55,1)=   192.36,   180.95,   170.67,   161.41,   153.07,   145.49,
BIN2(61,1)=   138.64,   132.44,   126.98,   121.74,   117.08,    87.72,
BIN2(67,1)=    73.12,    64.39,    58.25,    53.34,    49.33,    46.00,
BIN2(73,1)=    42.97,    40.20,    37.82,    35.75,    33.79,    31.93,
BIN2(79,1)=    30.29,    28.82,    27.50,    26.30,    25.15,    17.27,
BIN2(85,1)=    13.58,    11.65,    10.61,     9.99,     9.49,     9.15,
BIN2(91,1)=     8.85,     8.51,     8.20,     7.93,     7.69,     7.43,
BIN2(97,1)=     7.20,     6.99,     6.80,     6.62,     6.46,     4.78,
BIN2(103,1)=     3.85,     3.02,     2.48,     2.09,     1.81,     1.59,
BIN2(109,1)=     1.42,     1.24,     1.10,     0.980,    0.883,    0.801,
BIN2(115,1)=     0.732,    0.672,    0.620,    0.574,    0.534,    0.302,
BIN2(121,1)=     0.201,    0.147,    0.114,    0.092,    0.076,    0.064,
BIN2(127,1)=     0.055,    0.049,    0.043,    0.038,    0.035,    0.031,

```

```

BIN2(133,1)= 0.029, 0.026, 0.024,
BIN2( 1,0)= 0.000001, 0.01, 0.02, 0.03, 0.04, 0.05,
BIN2( 7,0)= 0.06, 0.07, 0.08, 0.09, 0.10, 0.15,
BIN2(13,0)= 0.20, 0.25, 0.30, 0.35, 0.40, 0.45,
BIN2(19,0)= 0.50, 0.55, 0.60, 0.65, 0.70, 0.75,
BIN2(25,0)= 0.80, 0.85, 0.90, 0.95, 1.00, 1.50,
BIN2(31,0)= 2.00, 2.50, 3.00, 3.50, 4.00, 4.50,
BIN2(37,0)= 5.00, 5.50, 6.00, 6.50, 7.00, 7.50,
BIN2(43,0)= 8.00, 8.50, 9.00, 9.50, 10.00, 15.00,
BIN2(49,0)= 20.00, 25.00, 30.00, 35.00, 40.00, 45.00,
BIN2(55,0)= 50.00, 55.00, 60.00, 65.00, 70.00, 75.00,
BIN2(61,0)= 80.00, 85.00, 90.00, 95.00, 100.00, 150.00,
BIN2(67,0)= 200.00, 250.00, 300.00, 350.00, 400.00, 450.00,
BIN2(73,0)= 500.00, 550.00, 600.00, 650.00, 700.00, 750.00,
BIN2(79,0)= 800.00, 850.00, 900.00, 950.00, 1000.00, 1500.00,
BIN2(85,0)= 2000.00, 2500.00, 3000.00, 3500.00, 4000.00, 4500.00,
BIN2(91,0)= 5000.00, 5500.00, 6000.00, 6500.00, 7000.00, 7500.00,
BIN2(97,0)= 8000.00, 8500.00, 9000.00, 9500.00, 10000.00, 15000.00,
BIN2(103,0)= 20000.00, 25000.00, 30000.00, 35000.00, 40000.00, 45000.00,
BIN2(109,0)= 50000.00, 55000.00, 60000.00, 65000.00, 70000.00, 75000.00,
BIN2(115,0)= 80000.00, 85000.00, 90000.00, 95000.00, 100000.00, 150000.00,
BIN2(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN2(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN2(133,0)= 800000.00, 850000.00, 900000.00,
BIN2( 0,1)=1.0

```

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/COM, ****
/COM, **
/COM, ** Assembly Type: PWR **
/COM, ** Decay Period (years): 900000 **
/COM, ** Number of assemblies: 2520 **
/COM, ** Assemblies/pkg: 21 **
/COM, ** Max Heat (Watts/assy): 850.00 **
/COM, ** Min Heat (Watts/assy): 0.00 **
/COM, ** Max Kinf: 1.450 **
/COM, ** Min Kinf: 1.130 **
/COM, ** Ave Age: 35.694 **
/COM, ** Ave Burnup: 17417.637 **
/COM, ** Ave Enrichment: 3.462 **
/COM, ** Ave MTU/assy: 0.388 **
/COM, **
/COM, ****

```

*SET,BIN3,

*DIM,BIN3, TABLE,135,1,

```

BIN3( 1,1)= 138.32, 138.29, 138.26, 138.23, 138.20, 138.16,
BIN3( 7,1)= 138.13, 138.10, 138.07, 138.04, 138.01, 137.85,
BIN3(13,1)= 137.69, 137.54, 137.38, 137.23, 137.08, 136.92,
BIN3(19,1)= 136.77, 136.62, 136.47, 136.32, 136.17, 136.02,
BIN3(25,1)= 135.87, 135.73, 135.58, 135.43, 135.29, 133.86,
BIN3(31,1)= 132.49, 131.16, 129.88, 128.64, 127.43, 126.21,
BIN3(37,1)= 125.04, 123.87, 122.75, 121.63, 120.54, 119.47,
BIN3(43,1)= 118.42, 117.39, 116.39, 115.37, 114.37, 105.15,
BIN3(49,1)= 97.02, 89.76, 83.27, 77.48, 72.29, 67.63,
BIN3(55,1)= 63.47, 59.73, 56.38, 53.36, 50.63, 48.19,
BIN3(61,1)= 46.00, 44.01, 42.24, 40.62, 39.17, 30.27,
BIN3(67,1)= 26.03, 23.60, 21.81, 20.37, 19.12, 18.04,
BIN3(73,1)= 17.00, 16.05, 15.22, 14.49, 13.77, 13.10,
BIN3(79,1)= 12.51, 11.97, 11.48, 11.04, 10.61, 7.67,

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```

BIN3(85,1)= 6.29, 5.55, 5.15, 4.90, 4.69, 4.55,
BIN3(91,1)= 4.42, 4.27, 4.14, 4.02, 3.91, 3.80,
BIN3(97,1)= 3.69, 3.60, 3.51, 3.43, 3.36, 2.58,
BIN3(103,1)= 2.14, 1.70, 1.41, 1.20, 1.05, 0.931,
BIN3(109,1)= 0.836, 0.725, 0.637, 0.565, 0.506, 0.457,
BIN3(115,1)= 0.415, 0.379, 0.348, 0.322, 0.298, 0.163,
BIN3(121,1)= 0.106, 0.076, 0.058, 0.046, 0.038, 0.032,
BIN3(127,1)= 0.027, 0.024, 0.021, 0.019, 0.017, 0.015,
BIN3(133,1)= 0.014, 0.012, 0.011,
BIN3( 1,0)= 0.000001, 0.01, 0.02, 0.03, 0.04, 0.05,
BIN3( 7,0)= 0.06, 0.07, 0.08, 0.09, 0.10, 0.15,
BIN3(13,0)= 0.20, 0.25, 0.30, 0.35, 0.40, 0.45,
BIN3(19,0)= 0.50, 0.55, 0.60, 0.65, 0.70, 0.75,
BIN3(25,0)= 0.80, 0.85, 0.90, 0.95, 1.00, 1.50,
BIN3(31,0)= 2.00, 2.50, 3.00, 3.50, 4.00, 4.50,
BIN3(37,0)= 5.00, 5.50, 6.00, 6.50, 7.00, 7.50,
BIN3(43,0)= 8.00, 8.50, 9.00, 9.50, 10.00, 15.00,
BIN3(49,0)= 20.00, 25.00, 30.00, 35.00, 40.00, 45.00,
BIN3(55,0)= 50.00, 55.00, 60.00, 65.00, 70.00, 75.00,
BIN3(61,0)= 80.00, 85.00, 90.00, 95.00, 100.00, 150.00,
BIN3(67,0)= 200.00, 250.00, 300.00, 350.00, 400.00, 450.00,
BIN3(73,0)= 500.00, 550.00, 600.00, 650.00, 700.00, 750.00,
BIN3(79,0)= 800.00, 850.00, 900.00, 950.00, 1000.00, 1500.00,
BIN3(85,0)= 2000.00, 2500.00, 3000.00, 3500.00, 4000.00, 4500.00,
BIN3(91,0)= 5000.00, 5500.00, 6000.00, 6500.00, 7000.00, 7500.00,
BIN3(97,0)= 8000.00, 8500.00, 9000.00, 9500.00, 10000.00, 15000.00,
BIN3(103,0)= 20000.00, 25000.00, 30000.00, 35000.00, 40000.00, 45000.00,
BIN3(109,0)= 50000.00, 55000.00, 60000.00, 65000.00, 70000.00, 75000.00,
BIN3(115,0)= 80000.00, 85000.00, 90000.00, 95000.00, 100000.00, 150000.00,
BIN3(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN3(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN3(133,0)= 800000.00, 850000.00, 900000.00,
BIN3( 0,1)=1.0
/COM, ****
/COM, **
/COM, ** Assembly Type: PWR **
/COM, ** Decay Period (years): 900000 **
/COM, ** Number of assemblies: 4674 **
/COM, ** Assemblies/pkg: 12 **
/COM, ** Max Heat (Watts/assy): 1500.00 **
/COM, ** Min Heat (Watts/assy): 850.00 **
/COM, ** Max Kinf: 1.020 **
/COM, ** Min Kinf: 0.000 **
/COM, ** Ave Age: 10.369 **
/COM, ** Ave Burnup: 52965.737 **
/COM, ** Ave Enrichment: 4.247 **
/COM, ** Ave MTU/assy: 0.453 **
/COM, **
/COM, ****
*SET,BIN4,
*DIM,BIN4, TABLE,135,1,
BIN4( 1,1)= 935.91, 935.50, 935.08, 934.67, 934.26, 933.85,
BIN4( 7,1)= 933.44, 933.03, 932.63, 932.22, 931.81, 929.78,
BIN4(13,1)= 927.77, 925.77, 923.79, 921.81, 919.86, 917.91,
BIN4(19,1)= 915.98, 914.06, 912.16, 910.26, 908.38, 906.52,
BIN4(25,1)= 904.66, 902.82, 900.99, 899.17, 897.36, 881.27,
BIN4(31,1)= 866.12, 852.16, 838.95, 826.77, 815.19, 804.67,

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```
BIN4(37,1)= 794.62, 783.24, 772.36, 763.10, 754.22, 745.49,
BIN4(43,1)= 737.09, 728.94, 721.09, 714.10, 707.34, 637.55,
BIN4(49,1)= 580.88, 530.05, 486.31, 447.57, 414.19, 382.89,
BIN4(55,1)= 355.88, 331.71, 310.06, 290.64, 273.18, 257.45,
BIN4(61,1)= 243.26, 230.46, 219.63, 208.67, 199.14, 139.54,
BIN4(67,1)= 111.31, 94.75, 84.02, 75.71, 69.19, 64.02,
BIN4(73,1)= 59.64, 55.63, 52.21, 49.24, 46.59, 44.09,
BIN4(79,1)= 41.86, 39.88, 38.09, 36.47, 34.96, 24.45,
BIN4(85,1)= 19.53, 16.90, 15.45, 14.54, 13.81, 13.30,
BIN4(91,1)= 12.86, 12.32, 11.85, 11.43, 11.06, 10.67,
BIN4(97,1)= 10.32, 10.00, 9.71, 9.44, 9.19, 6.65,
BIN4(103,1)= 5.29, 4.12, 3.36, 2.82, 2.43, 2.13,
BIN4(109,1)= 1.89, 1.67, 1.49, 1.34, 1.22, 1.11,
BIN4(115,1)= 1.02, 0.942, 0.874, 0.814, 0.761, 0.447,
BIN4(121,1)= 0.306, 0.228, 0.180, 0.147, 0.123, 0.106,
BIN4(127,1)= 0.092, 0.081, 0.072, 0.065, 0.059, 0.054,
BIN4(133,1)= 0.050, 0.046, 0.043,
BIN4( 1,0)= 0.000001, 0.01, 0.02, 0.03, 0.04, 0.05,
BIN4( 7,0)= 0.06, 0.07, 0.08, 0.09, 0.10, 0.15,
BIN4(13,0)= 0.20, 0.25, 0.30, 0.35, 0.40, 0.45,
BIN4(19,0)= 0.50, 0.55, 0.60, 0.65, 0.70, 0.75,
BIN4(25,0)= 0.80, 0.85, 0.90, 0.95, 1.00, 1.50,
BIN4(31,0)= 2.00, 2.50, 3.00, 3.50, 4.00, 4.50,
BIN4(37,0)= 5.00, 5.50, 6.00, 6.50, 7.00, 7.50,
BIN4(43,0)= 8.00, 8.50, 9.00, 9.50, 10.00, 15.00,
BIN4(49,0)= 20.00, 25.00, 30.00, 35.00, 40.00, 45.00,
BIN4(55,0)= 50.00, 55.00, 60.00, 65.00, 70.00, 75.00,
BIN4(61,0)= 80.00, 85.00, 90.00, 95.00, 100.00, 150.00,
BIN4(67,0)= 200.00, 250.00, 300.00, 350.00, 400.00, 450.00,
BIN4(73,0)= 500.00, 550.00, 600.00, 650.00, 700.00, 750.00,
BIN4(79,0)= 800.00, 850.00, 900.00, 950.00, 1000.00, 1500.00,
BIN4(85,0)= 2000.00, 2500.00, 3000.00, 3500.00, 4000.00, 4500.00,
BIN4(91,0)= 5000.00, 5500.00, 6000.00, 6500.00, 7000.00, 7500.00,
BIN4(97,0)= 8000.00, 8500.00, 9000.00, 9500.00, 10000.00, 15000.00,
BIN4(103,0)= 20000.00, 25000.00, 30000.00, 35000.00, 40000.00, 45000.00,
BIN4(109,0)= 50000.00, 55000.00, 60000.00, 65000.00, 70000.00, 75000.00,
BIN4(115,0)= 80000.00, 85000.00, 90000.00, 95000.00, 100000.00, 150000.00,
BIN4(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN4(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN4(133,0)= 800000.00, 850000.00, 900000.00,
BIN4( 0,1)=1.0
/COM, *****
/COM, **
/COM, ** Assembly Type: STx **
/COM, ** Decay Period (years): 900000 **
/COM, ** Number of assemblies: 1800 **
/COM, ** Assemblies/pkg: 12 **
/COM, ** Max Heat (Watts/assy): 1500.00 **
/COM, ** Min Heat (Watts/assy): 0.00 **
/COM, ** Max Kinf: 1.130 **
/COM, ** Min Kinf: 0.000 **
/COM, ** Ave Age: 15.944 **
/COM, ** Ave Burnup: 44782.169 **
/COM, ** Ave Enrichment: 3.887 **
/COM, ** Ave MTU/assy: 0.539 **
/COM, **
/COM, *****
```

*SET, BIN5,

*DIM, BIN5, TABLE, 135, 1,

BIN5(1,1)=	873.09,	872.79,	872.49,	872.19,	871.89,	871.59,
BIN5(7,1)=	871.29,	870.99,	870.69,	870.39,	870.09,	868.61,
BIN5(13,1)=	867.14,	865.67,	864.22,	862.77,	861.34,	859.91,
BIN5(19,1)=	858.49,	857.08,	855.67,	854.28,	852.89,	851.51,
BIN5(25,1)=	850.14,	848.78,	847.42,	846.08,	844.74,	832.25,
BIN5(31,1)=	820.42,	809.40,	798.90,	788.88,	779.31,	770.38,
BIN5(37,1)=	761.82,	752.77,	744.08,	736.05,	728.31,	720.77,
BIN5(43,1)=	713.49,	706.26,	699.28,	692.78,	686.49,	624.22,
BIN5(49,1)=	572.08,	525.37,	484.76,	448.62,	417.16,	387.96,
BIN5(55,1)=	362.48,	339.65,	319.14,	300.69,	284.12,	269.11,
BIN5(61,1)=	255.59,	243.29,	232.77,	222.25,	213.02,	154.41,
BIN5(67,1)=	125.26,	107.58,	95.72,	86.31,	78.91,	72.95,
BIN5(73,1)=	67.81,	63.13,	59.12,	55.66,	52.51,	49.52,
BIN5(79,1)=	46.88,	44.52,	42.40,	40.49,	38.69,	26.24,
BIN5(85,1)=	20.45,	17.43,	15.79,	14.83,	14.04,	13.52,
BIN5(91,1)=	13.07,	12.53,	12.06,	11.64,	11.26,	10.88,
BIN5(97,1)=	10.53,	10.21,	9.92,	9.65,	9.40,	6.85,
BIN5(103,1)=	5.47,	4.29,	3.51,	2.96,	2.56,	2.25,
BIN5(109,1)=	2.00,	1.77,	1.59,	1.43,	1.30,	1.19,
BIN5(115,1)=	1.10,	1.02,	0.946,	0.883,	0.827,	0.493,
BIN5(121,1)=	0.342,	0.257,	0.204,	0.168,	0.141,	0.122,
BIN5(127,1)=	0.106,	0.094,	0.084,	0.076,	0.069,	0.064,
BIN5(133,1)=	0.059,	0.054,	0.050,			
BIN5(1,0)=	0.000001,	0.01,	0.02,	0.03,	0.04,	0.05,
BIN5(7,0)=	0.06,	0.07,	0.08,	0.09,	0.10,	0.15,
BIN5(13,0)=	0.20,	0.25,	0.30,	0.35,	0.40,	0.45,
BIN5(19,0)=	0.50,	0.55,	0.60,	0.65,	0.70,	0.75,
BIN5(25,0)=	0.80,	0.85,	0.90,	0.95,	1.00,	1.50,
BIN5(31,0)=	2.00,	2.50,	3.00,	3.50,	4.00,	4.50,
BIN5(37,0)=	5.00,	5.50,	6.00,	6.50,	7.00,	7.50,
BIN5(43,0)=	8.00,	8.50,	9.00,	9.50,	10.00,	15.00,
BIN5(49,0)=	20.00,	25.00,	30.00,	35.00,	40.00,	45.00,
BIN5(55,0)=	50.00,	55.00,	60.00,	65.00,	70.00,	75.00,
BIN5(61,0)=	80.00,	85.00,	90.00,	95.00,	100.00,	150.00,
BIN5(67,0)=	200.00,	250.00,	300.00,	350.00,	400.00,	450.00,
BIN5(73,0)=	500.00,	550.00,	600.00,	650.00,	700.00,	750.00,
BIN5(79,0)=	800.00,	850.00,	900.00,	950.00,	1000.00,	1500.00,
BIN5(85,0)=	2000.00,	2500.00,	3000.00,	3500.00,	4000.00,	4500.00,
BIN5(91,0)=	5000.00,	5500.00,	6000.00,	6500.00,	7000.00,	7500.00,
BIN5(97,0)=	8000.00,	8500.00,	9000.00,	9500.00,	10000.00,	15000.00,
BIN5(103,0)=	20000.00,	25000.00,	30000.00,	35000.00,	40000.00,	45000.00,
BIN5(109,0)=	50000.00,	55000.00,	60000.00,	65000.00,	70000.00,	75000.00,
BIN5(115,0)=	80000.00,	85000.00,	90000.00,	95000.00,	100000.00,	150000.00,
BIN5(121,0)=	200000.00,	250000.00,	300000.00,	350000.00,	400000.00,	450000.00,
BIN5(127,0)=	500000.00,	550000.00,	600000.00,	650000.00,	700000.00,	750000.00,
BIN5(133,0)=	800000.00,	850000.00,	900000.00,			
BIN5(0,1)=	1.0					

/COM, ****

/COM, **

/COM, ** Assembly Type: BWR **

/COM, ** Decay Period (years): 900000 **

/COM, ** Number of assemblies: 30587 **

/COM, ** Assemblies/pkg: 44 **

/COM, ** Max Heat (Watts/assy): 400.00 **

/COM, ** Min Heat (Watts/assy): 0.00 **

```

/COM, **      Max Kinf:                1.000          **
/COM, **      Min Kinf:                0.000          **
/COM, **      Ave Age:                 18.753          **
/COM, **      Ave Burnup:              42164.201       **
/COM, **      Ave Enrichment:          3.319           **
/COM, **      Ave MTU/assy:            0.174           **
/COM, **

```

```

/COM, *****

```

```

*SET, BIN6,

```

```

*DIM, BIN6, TABLE, 135, 1,

```

```

BIN6( 1,1)= 264.20, 264.11, 264.02, 263.93, 263.85, 263.76,
BIN6( 7,1)= 263.67, 263.58, 263.49, 263.40, 263.31, 262.87,
BIN6(13,1)= 262.43, 261.99, 261.55, 261.12, 260.69, 260.26,
BIN6(19,1)= 259.84, 259.42, 259.00, 258.58, 258.16, 257.75,
BIN6(25,1)= 257.34, 256.93, 256.53, 256.12, 255.72, 252.01,
BIN6(31,1)= 248.49, 245.18, 242.04, 239.06, 236.21, 233.53,
BIN6(37,1)= 230.96, 228.25, 225.64, 223.22, 220.89, 218.59,
BIN6(43,1)= 216.37, 214.22, 212.14, 210.16, 208.25, 189.56,
BIN6(49,1)= 173.87, 159.83, 147.65, 136.84, 127.40, 118.67,
BIN6(55,1)= 111.06, 104.24, 98.12, 92.63, 87.71, 83.22,
BIN6(61,1)= 79.19, 75.54, 72.39, 69.25, 66.50, 48.97,
BIN6(67,1)= 40.12, 34.68, 30.95, 27.99, 25.64, 23.73,
BIN6(73,1)= 22.06, 20.54, 19.24, 18.12, 17.08, 16.11,
BIN6(79,1)= 15.24, 14.47, 13.78, 13.15, 12.56, 8.47,
BIN6(85,1)= 6.57, 5.59, 5.05, 4.74, 4.49, 4.32,
BIN6(91,1)= 4.17, 4.00, 3.85, 3.72, 3.60, 3.47,
BIN6(97,1)= 3.36, 3.26, 3.17, 3.08, 3.00, 2.19,
BIN6(103,1)= 1.75, 1.37, 1.12, 0.942, 0.813, 0.714,
BIN6(109,1)= 0.635, 0.561, 0.501, 0.451, 0.410, 0.375,
BIN6(115,1)= 0.345, 0.318, 0.296, 0.275, 0.258, 0.152,
BIN6(121,1)= 0.105, 0.078, 0.062, 0.051, 0.043, 0.037,
BIN6(127,1)= 0.032, 0.028, 0.025, 0.023, 0.021, 0.019,
BIN6(133,1)= 0.017, 0.016, 0.015,
BIN6( 1,0)= 0.000001, 0.01, 0.02, 0.03, 0.04, 0.05,
BIN6( 7,0)= 0.06, 0.07, 0.08, 0.09, 0.10, 0.15,
BIN6(13,0)= 0.20, 0.25, 0.30, 0.35, 0.40, 0.45,
BIN6(19,0)= 0.50, 0.55, 0.60, 0.65, 0.70, 0.75,
BIN6(25,0)= 0.80, 0.85, 0.90, 0.95, 1.00, 1.50,
BIN6(31,0)= 2.00, 2.50, 3.00, 3.50, 4.00, 4.50,
BIN6(37,0)= 5.00, 5.50, 6.00, 6.50, 7.00, 7.50,
BIN6(43,0)= 8.00, 8.50, 9.00, 9.50, 10.00, 15.00,
BIN6(49,0)= 20.00, 25.00, 30.00, 35.00, 40.00, 45.00,
BIN6(55,0)= 50.00, 55.00, 60.00, 65.00, 70.00, 75.00,
BIN6(61,0)= 80.00, 85.00, 90.00, 95.00, 100.00, 150.00,
BIN6(67,0)= 200.00, 250.00, 300.00, 350.00, 400.00, 450.00,
BIN6(73,0)= 500.00, 550.00, 600.00, 650.00, 700.00, 750.00,
BIN6(79,0)= 800.00, 850.00, 900.00, 950.00, 1000.00, 1500.00,
BIN6(85,0)= 2000.00, 2500.00, 3000.00, 3500.00, 4000.00, 4500.00,
BIN6(91,0)= 5000.00, 5500.00, 6000.00, 6500.00, 7000.00, 7500.00,
BIN6(97,0)= 8000.00, 8500.00, 9000.00, 9500.00, 10000.00, 15000.00,
BIN6(103,0)= 20000.00, 25000.00, 30000.00, 35000.00, 40000.00, 45000.00,
BIN6(109,0)= 50000.00, 55000.00, 60000.00, 65000.00, 70000.00, 75000.00,
BIN6(115,0)= 80000.00, 85000.00, 90000.00, 95000.00, 100000.00, 150000.00,
BIN6(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN6(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN6(133,0)= 800000.00, 850000.00, 900000.00,
BIN6( 0,1)=1.0

```

```

/COM, *****
/COM, **
/COM, **      Assembly Type:          BWR
/COM, **      Decay Period (years):    900000
/COM, **      Number of assemblies:    92689
/COM, **      Assemblies/pkg:          44
/COM, **      Max Heat (Watts/assy):    400.00
/COM, **      Min Heat (Watts/assy):    0.00
/COM, **      Max Kinf:                 1.370
/COM, **      Min Kinf:                 1.000
/COM, **      Ave Age:                  29.878
/COM, **      Ave Burnup:                29420.945
/COM, **      Ave Enrichment:           2.910
/COM, **      Ave MTU/assy:             0.179
/COM, **

```

```

/COM, *****

```

```

*SET, BIN7,

```

```

*DIM, BIN7, TABLE, 135, 1,

```

BIN7(1,1)=	146.37,	146.33,	146.29,	146.25,	146.21,	146.17,
BIN7(7,1)=	146.13,	146.10,	146.06,	146.02,	145.98,	145.79,
BIN7(13,1)=	145.60,	145.41,	145.22,	145.03,	144.85,	144.66,
BIN7(19,1)=	144.48,	144.29,	144.11,	143.93,	143.75,	143.57,
BIN7(25,1)=	143.39,	143.21,	143.03,	142.85,	142.68,	141.03,
BIN7(31,1)=	139.45,	137.94,	136.50,	135.11,	133.77,	132.49,
BIN7(37,1)=	131.26,	129.97,	128.73,	127.54,	126.40,	125.26,
BIN7(43,1)=	124.15,	123.07,	122.02,	121.01,	120.02,	110.50,
BIN7(49,1)=	102.28,	94.90,	88.39,	82.58,	77.42,	72.69,
BIN7(55,1)=	68.51,	64.74,	61.36,	58.30,	55.55,	53.03,
BIN7(61,1)=	50.76,	48.70,	46.88,	45.13,	43.56,	33.55,
BIN7(67,1)=	28.33,	25.09,	22.72,	20.81,	19.24,	17.92,
BIN7(73,1)=	16.71,	15.60,	14.66,	13.83,	13.04,	12.30,
BIN7(79,1)=	11.64,	11.05,	10.53,	10.05,	9.58,	6.44,
BIN7(85,1)=	4.97,	4.22,	3.82,	3.58,	3.40,	3.27,
BIN7(91,1)=	3.16,	3.04,	2.93,	2.84,	2.75,	2.66,
BIN7(97,1)=	2.58,	2.50,	2.43,	2.37,	2.31,	1.71,
BIN7(103,1)=	1.38,	1.08,	0.888,	0.751,	0.650,	0.572,
BIN7(109,1)=	0.510,	0.446,	0.395,	0.354,	0.319,	0.290,
BIN7(115,1)=	0.265,	0.243,	0.225,	0.209,	0.194,	0.111,
BIN7(121,1)=	0.074,	0.054,	0.042,	0.034,	0.028,	0.024,
BIN7(127,1)=	0.021,	0.018,	0.016,	0.015,	0.013,	0.012,
BIN7(133,1)=	0.011,	0.010,	0.009,			
BIN7(1,0)=	0.000001,	0.01,	0.02,	0.03,	0.04,	0.05,
BIN7(7,0)=	0.06,	0.07,	0.08,	0.09,	0.10,	0.15,
BIN7(13,0)=	0.20,	0.25,	0.30,	0.35,	0.40,	0.45,
BIN7(19,0)=	0.50,	0.55,	0.60,	0.65,	0.70,	0.75,
BIN7(25,0)=	0.80,	0.85,	0.90,	0.95,	1.00,	1.50,
BIN7(31,0)=	2.00,	2.50,	3.00,	3.50,	4.00,	4.50,
BIN7(37,0)=	5.00,	5.50,	6.00,	6.50,	7.00,	7.50,
BIN7(43,0)=	8.00,	8.50,	9.00,	9.50,	10.00,	15.00,
BIN7(49,0)=	20.00,	25.00,	30.00,	35.00,	40.00,	45.00,
BIN7(55,0)=	50.00,	55.00,	60.00,	65.00,	70.00,	75.00,
BIN7(61,0)=	80.00,	85.00,	90.00,	95.00,	100.00,	150.00,
BIN7(67,0)=	200.00,	250.00,	300.00,	350.00,	400.00,	450.00,
BIN7(73,0)=	500.00,	550.00,	600.00,	650.00,	700.00,	750.00,
BIN7(79,0)=	800.00,	850.00,	900.00,	950.00,	1000.00,	1500.00,
BIN7(85,0)=	2000.00,	2500.00,	3000.00,	3500.00,	4000.00,	4500.00,
BIN7(91,0)=	5000.00,	5500.00,	6000.00,	6500.00,	7000.00,	7500.00,

```

BIN7(97,0)= 8000.00, 8500.00, 9000.00, 9500.00, 10000.00, 15000.00,
BIN7(103,0)= 20000.00, 25000.00, 30000.00, 35000.00, 40000.00, 45000.00,
BIN7(109,0)= 50000.00, 55000.00, 60000.00, 65000.00, 70000.00, 75000.00,
BIN7(115,0)= 80000.00, 85000.00, 90000.00, 95000.00, 100000.00, 150000.00,
BIN7(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN7(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN7(133,0)= 800000.00, 850000.00, 900000.00,

```

```

BIN7( 0,1)=1.0

```

```

/COM, *****

```

```

/COM, **

```

```

/COM, ** Assembly Type: BWR

```

```

/COM, ** Decay Period (years): 900000

```

```

/COM, ** Number of assemblies: 993

```

```

/COM, ** Assemblies/pkg: 24

```

```

/COM, ** Max Heat (Watts/assy): 520.00

```

```

/COM, ** Min Heat (Watts/assy): 0.00

```

```

/COM, ** Max Kinf: 1.540

```

```

/COM, ** Min Kinf: 0.000

```

```

/COM, ** Ave Age: 18.139

```

```

/COM, ** Ave Burnup: 8835.600

```

```

/COM, ** Ave Enrichment: 3.468

```

```

/COM, ** Ave MTU/assy: 0.165

```

```

/COM, **

```

```

/COM, *****

```

```

*SET,BIN8,

```

```

*DIM,BIN8, TABLE, 135, 1,

```

```

BIN8( 1,1)= 38.88, 38.87, 38.86, 38.85, 38.84, 38.83,
BIN8( 7,1)= 38.82, 38.81, 38.80, 38.79, 38.78, 38.72,
BIN8(13,1)= 38.67, 38.62, 38.56, 38.51, 38.46, 38.41,
BIN8(19,1)= 38.35, 38.30, 38.25, 38.20, 38.15, 38.10,
BIN8(25,1)= 38.05, 38.00, 37.95, 37.90, 37.85, 37.37,
BIN8(31,1)= 36.91, 36.46, 36.04, 35.62, 35.22, 34.81,
BIN8(37,1)= 34.42, 34.03, 33.66, 33.29, 32.95, 32.60,
BIN8(43,1)= 32.27, 31.94, 31.62, 31.29, 30.97, 28.07,
BIN8(49,1)= 25.54, 23.31, 21.36, 19.62, 18.08, 16.71,
BIN8(55,1)= 15.49, 14.40, 13.43, 12.57, 11.80, 11.11,
BIN8(61,1)= 10.50, 9.96, 9.47, 9.02, 8.63, 6.36,
BIN8(67,1)= 5.40, 4.90, 4.56, 4.29, 4.06, 3.85,
BIN8(73,1)= 3.66, 3.47, 3.31, 3.17, 3.04, 2.92,
BIN8(79,1)= 2.80, 2.70, 2.60, 2.52, 2.44, 1.88,
BIN8(85,1)= 1.62, 1.48, 1.40, 1.35, 1.30, 1.26,
BIN8(91,1)= 1.23, 1.20, 1.16, 1.13, 1.11, 1.08,
BIN8(97,1)= 1.05, 1.03, 1.01, 0.986, 0.966, 0.762,
BIN8(103,1)= 0.644, 0.518, 0.434, 0.373, 0.328, 0.292,
BIN8(109,1)= 0.264, 0.229, 0.201, 0.178, 0.160, 0.144,
BIN8(115,1)= 0.131, 0.119, 0.110, 0.101, 0.094, 0.051,
BIN8(121,1)= 0.033, 0.024, 0.018, 0.014, 0.012, 0.010,
BIN8(127,1)= 0.008, 0.007, 0.006, 0.006, 0.005, 0.005,
BIN8(133,1)= 0.004, 0.004, 0.004,
BIN8( 1,0)= 0.000001, 0.01, 0.02, 0.03, 0.04, 0.05,
BIN8( 7,0)= 0.06, 0.07, 0.08, 0.09, 0.10, 0.15,
BIN8(13,0)= 0.20, 0.25, 0.30, 0.35, 0.40, 0.45,
BIN8(19,0)= 0.50, 0.55, 0.60, 0.65, 0.70, 0.75,
BIN8(25,0)= 0.80, 0.85, 0.90, 0.95, 1.00, 1.50,
BIN8(31,0)= 2.00, 2.50, 3.00, 3.50, 4.00, 4.50,
BIN8(37,0)= 5.00, 5.50, 6.00, 6.50, 7.00, 7.50,
BIN8(43,0)= 8.00, 8.50, 9.00, 9.50, 10.00, 15.00,

```

```
BIN8(49,0)= 20.00, 25.00, 30.00, 35.00, 40.00, 45.00,
BIN8(55,0)= 50.00, 55.00, 60.00, 65.00, 70.00, 75.00,
BIN8(61,0)= 80.00, 85.00, 90.00, 95.00, 100.00, 150.00,
BIN8(67,0)= 200.00, 250.00, 300.00, 350.00, 400.00, 450.00,
BIN8(73,0)= 500.00, 550.00, 600.00, 650.00, 700.00, 750.00,
BIN8(79,0)= 800.00, 850.00, 900.00, 950.00, 1000.00, 1500.00,
BIN8(85,0)= 2000.00, 2500.00, 3000.00, 3500.00, 4000.00, 4500.00,
BIN8(91,0)= 5000.00, 5500.00, 6000.00, 6500.00, 7000.00, 7500.00,
BIN8(97,0)= 8000.00, 8500.00, 9000.00, 9500.00, 10000.00, 15000.00,
BIN8(103,0)= 20000.00, 25000.00, 30000.00, 35000.00, 40000.00, 45000.00,
BIN8(109,0)= 50000.00, 55000.00, 60000.00, 65000.00, 70000.00, 75000.00,
BIN8(115,0)= 80000.00, 85000.00, 90000.00, 95000.00, 100000.00, 150000.00,
BIN8(121,0)= 200000.00, 250000.00, 300000.00, 350000.00, 400000.00, 450000.00,
BIN8(127,0)= 500000.00, 550000.00, 600000.00, 650000.00, 700000.00, 750000.00,
BIN8(133,0)= 800000.00, 850000.00, 900000.00,
BIN8( 0,1)=1.0
/COM, *****
/EOF
```

```
/COM, *****
/COM, ** Thermal History of 21 PWR WP Average Assembly **
/COM, ** Calculated in B000000-01717-0210-00092 REV 00 **
/COM, ** Adjusted for 50 year preclosure by Harold M. Wade 07/16/99 **
/COM, ** FOR 21 PWR Average **
/COM, ** Start Age (years): 0.0 **
/COM, ** Decay Period (years): 10000 **
/COM, ** Enrichment (MTU UO2): 0.43 **
/COM, ** Burnup (MWd/MTHM): N.A. **
/COM, ** Assembly Type: PWR **
/COM, **
/COM, ** ASSY(#,1) is the Pour Cainster heat in Watts. **
/COM, ** ASSY(#,0) is the time post emplacement in years. **
/COM, *****
*SET, ASSY,
*DIM, ASSY, TABLE, 47, 1,
ASSY( 1,1)= 208.33, 208.07, 207.82, 207.57, 207.31, 207.06,
ASSY( 7,1)= 206.80, 206.55, 206.30, 206.05, 205.79, 203.29,
ASSY(13,1)= 200.81, 198.37, 195.95, 193.56, 191.21, 188.88,
ASSY(19,1)= 186.58, 184.81, 174.79, 165.77, 157.55, 150.13,
ASSY(25,1)= 119.57, 112.81, 106.43, 100.41, 94.73, 68.98,
ASSY(31,1)= 62.20, 56.82, 52.45, 48.85, 45.60, 42.64,
ASSY(37,1)= 27.91, 25.71, 14.28, 11.28, 10.10, 9.42,
ASSY(43,1)= 8.72, 8.17, 7.66, 7.23, 6.86,
ASSY( 1,0)= 1E-6, 0.1, 0.2, 0.3, 0.4, 0.5,
ASSY( 7,0)= 0.6, 0.7, 0.8, 0.9, 1.0, 2.0,
ASSY(13,0)= 3.0, 4.0, 5.0, 6.0, 7.0, 8.0,
ASSY(19,0)= 9.0, 10, 20, 30, 40, 50,
ASSY(25,0)= 60, 70, 80, 90, 100, 200,
ASSY(31,0)= 300, 400, 500, 600, 700, 800,
ASSY(37,0)= 900, 1000, 2000, 3000, 4000, 5000,
ASSY(43,0)= 6000, 7000, 8000, 9000, 10000,
ASSY(0,1) = 0,
/COM, *****
/EOF
```

/NOPR

*DIM,W1BOT	,TABLE,	65,	1,	1
*SET,W1BOT	(1,	0, 1),	94.672800000000	
*SET,W1BOT	(2,	0, 1),	3155854.672800	
*SET,W1BOT	(3,	0, 1),	6311614.672800	
*SET,W1BOT	(4,	0, 1),	9467374.672800	
*SET,W1BOT	(5,	0, 1),	12623134.67280	
*SET,W1BOT	(6,	0, 1),	15778894.67280	
*SET,W1BOT	(7,	0, 1),	18934654.67280	
*SET,W1BOT	(8,	0, 1),	22090414.67280	
*SET,W1BOT	(9,	0, 1),	25246174.67280	
*SET,W1BOT	(10,	0, 1),	28401934.67280	
*SET,W1BOT	(11,	0, 1),	31557694.67280	
*SET,W1BOT	(12,	0, 1),	63115294.67280	
*SET,W1BOT	(13,	0, 1),	94672894.67280	
*SET,W1BOT	(14,	0, 1),	126230494.6728	
*SET,W1BOT	(15,	0, 1),	157788094.6728	
*SET,W1BOT	(16,	0, 1),	189345694.6728	
*SET,W1BOT	(17,	0, 1),	220903294.6728	
*SET,W1BOT	(18,	0, 1),	252460894.6728	
*SET,W1BOT	(19,	0, 1),	284018494.6728	
*SET,W1BOT	(20,	0, 1),	315576094.6728	
*SET,W1BOT	(21,	0, 1),	631152094.6728	
*SET,W1BOT	(22,	0, 1),	946728094.6728	
*SET,W1BOT	(23,	0, 1),	1262304094.673	
*SET,W1BOT	(24,	0, 1),	1577880094.673	
*SET,W1BOT	(25,	0, 1),	1893456094.673	
*SET,W1BOT	(26,	0, 1),	2209032094.673	
*SET,W1BOT	(27,	0, 1),	2524608094.673	
*SET,W1BOT	(28,	0, 1),	2840184094.673	
*SET,W1BOT	(29,	0, 1),	3155760094.673	
*SET,W1BOT	(30,	0, 1),	6311520094.673	
*SET,W1BOT	(31,	0, 1),	9467280094.673	
*SET,W1BOT	(32,	0, 1),	12623040094.67	
*SET,W1BOT	(33,	0, 1),	15778800094.67	
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*SET, W4TOP	(	57,	0, 1),	631152000094.7
*SET, W4TOP	(	58,	0, 1),	946728000094.7
*SET, W4TOP	(	59,	0, 1),	1262304000095.
*SET, W4TOP	(	60,	0, 1),	1577880000095.
*SET, W4TOP	(	61,	0, 1),	1893456000095.
*SET, W4TOP	(	62,	0, 1),	2209032000095.
*SET, W4TOP	(	63,	0, 1),	2524608000095.
*SET, W4TOP	(	64,	0, 1),	2840184000095.
*SET, W4TOP	(	65,	0, 1),	3155760000095.
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*SET, W4TOP	(	4,	1, 1),	116.9064517040
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*SET, W4TOP	(	6,	1, 1),	123.0324006357
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*SET, W4TOP	(	9,	1, 1),	129.2235579993
*SET, W4TOP	(	10,	1, 1),	130.8153040451
*SET, W4TOP	(	11,	1, 1),	132.2549325635
*SET, W4TOP	(	12,	1, 1),	142.7563558783
*SET, W4TOP	(	13,	1, 1),	151.3141096298
*SET, W4TOP	(	14,	1, 1),	158.0090603470
*SET, W4TOP	(	15,	1, 1),	164.0306752320
*SET, W4TOP	(	16,	1, 1),	169.1722605384

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*SET,W4TOP ( 54, 1, 1), 128.3400350833
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*SET,WBOT( 3, 0, 1), 6.311520E+06! 0.2
*SET,WBOT( 4, 0, 1), 9.467280E+06! 0.3
*SET,WBOT( 5, 0, 1), 1.262304E+07! 0.4
*SET,WBOT( 6, 0, 1), 1.577880E+07! 0.5
*SET,WBOT( 7, 0, 1), 1.893456E+07! 0.6
*SET,WBOT( 8, 0, 1), 2.209032E+07! 0.7
*SET,WBOT( 9, 0, 1), 2.524608E+07! 0.8
*SET,WBOT( 10, 0, 1), 2.840184E+07! 0.9
*SET,WBOT( 11, 0, 1), 3.155760E+07! 1
*SET,WBOT( 12, 0, 1), 6.311520E+07! 2
*SET,WBOT( 13, 0, 1), 9.467280E+07! 3
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*SET,WBOT( 16, 0, 1), 1.893456E+08! 6
*SET,WBOT( 17, 0, 1), 2.209032E+08! 7
*SET,WBOT( 18, 0, 1), 2.524608E+08! 8
*SET,WBOT( 19, 0, 1), 2.840184E+08! 9
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*SET,WBOT( 27, 0, 1), 2.524608E+09! 80
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*SET,WBOT( 36, 0, 1), 2.524608E+10! 800
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*SET,WSID( 7, 0, 1), 1.893456E+07! 0.6
*SET,WSID( 8, 0, 1), 2.209032E+07! 0.7
*SET,WSID( 9, 0, 1), 2.524608E+07! 0.8
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*SET,WSID( 16, 0, 1), 1.893456E+08! 6
*SET,WSID( 17, 0, 1), 2.209032E+08! 7
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*SET,WTOP( 4, 0, 1), 9.467280E+06! 0.3
*SET,WTOP( 5, 0, 1), 1.262304E+07! 0.4
*SET,WTOP( 6, 0, 1), 1.577880E+07! 0.5
*SET,WTOP( 7, 0, 1), 1.893456E+07! 0.6
*SET,WTOP( 8, 0, 1), 2.209032E+07! 0.7
*SET,WTOP( 9, 0, 1), 2.524608E+07! 0.8
*SET,WTOP( 10, 0, 1), 2.840184E+07! 0.9
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*SET,WTOP( 18, 0, 1), 2.524608E+08! 8
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*SET,WTOP( 33, 0, 1), 1.577880E+10! 500
*SET,WTOP( 34, 0, 1), 1.893456E+10! 600
*SET,WTOP( 35, 0, 1), 2.209032E+10! 700
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*SET, WTOP( 41, 0, 1), 1.262304E+11! 4000
*SET, WTOP( 42, 0, 1), 1.577880E+11! 5000
*SET, WTOP( 43, 0, 1), 1.893456E+11! 6000
*SET, WTOP( 44, 0, 1), 2.209032E+11! 7000
*SET, WTOP( 45, 0, 1), 2.524608E+11! 8000
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*SET, WTOP( 47, 1, 1), 92.679  
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ANSYS Case @ Peaking Factor 1.102	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)
Node	1.0 Day			1.0 Year			5.0 Years			6.0 Years		
Node 1	0.572	109.2	66.1	0.456	154.5	123.4	0.424	182.1	156.8	0.429	187.3	162.4
Node 2	0.881	134.2	67.8	0.783	178.7	125.4	0.742	202.7	158.4	0.744	207.2	163.9
Node 3	1.021	146.5	69.5	0.976	193.8	127.4	0.955	217.1	160.1	0.955	221.0	165.5
Node 4	1.053	150.7	71.3	1.053	201.0	129.3	1.050	224.4	161.7	1.050	228.0	167.1
Node 5	1.047	152.0	73.0	1.080	204.8	131.3	1.090	228.4	163.4	1.089	231.9	168.6
Node 6	1.036	152.9	74.7	1.085	207.1	133.3	1.102	230.8	165.0	1.102	234.2	170.2
Node 7	1.029	154.1	76.4	1.086	209.1	135.2	1.106	232.7	166.7	1.105	235.9	171.8
Node 8	1.026	155.6	78.2	1.086	211.1	137.2	1.107	234.4	168.3	1.107	237.6	173.4
Node 9	1.033	157.8	79.9	1.086	213.0	139.1	1.104	235.9	170.0	1.103	239.0	174.9
Node 10	1.046	157.4	78.5	1.092	211.8	137.5	1.107	234.7	168.6	1.106	237.9	173.6
Node 11	1.062	157.3	77.2	1.099	210.6	135.8	1.111	233.6	167.3	1.110	236.7	172.3
Node 12	1.080	157.3	75.8	1.106	209.4	134.1	1.114	232.4	165.9	1.113	235.6	171.0
Node 13	1.098	157.3	74.4	1.120	208.6	132.5	1.121	231.5	164.6	1.120	234.7	169.7
Node 14	1.114	157.1	73.1	1.131	207.8	130.8	1.137	231.0	163.2	1.135	234.3	168.4
Node 15	1.118	156.0	71.7	1.131	206.1	129.1	1.137	229.7	161.8	1.135	233.0	167.1
Node 16	1.093	152.8	70.4	1.087	201.4	127.4	1.092	225.6	160.5	1.090	229.1	165.8
Node 17	0.997	144.2	69.0	0.951	190.5	125.8	0.938	215.1	159.1	0.939	219.0	164.5
Node 18	0.684	119.2	67.6	0.581	163.6	124.1	0.551	190.7	157.8	0.556	195.5	163.2
Peak Fuel Temperature	162.473			209.582			231.780			235.070		
Surface Temperature	79.34			134.59			166.03			171.087		

* - Bolded numbers indicate values that are linearly interpolated

Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor
7.0 Years			8.0 Years			9.0 Years			10.0 Years			
0.435	191.6	167.0	0.440	195.7	171.4	0.445	198.8	174.7	0.450	200.8	176.8	0.463
0.747	210.8	168.5	0.749	214.3	172.8	0.751	216.8	176.1	0.753	218.3	178.2	0.767
0.955	224.1	170.0	0.955	227.2	174.3	0.955	229.3	177.5	0.955	230.4	179.6	0.960
1.049	231.0	171.5	1.049	233.8	175.8	1.048	235.7	178.9	1.047	236.7	181.0	1.048
1.088	234.7	173.0	1.088	237.4	177.2	1.087	239.2	180.3	1.086	240.1	182.4	1.084
1.102	237.0	174.5	1.102	239.7	178.7	1.102	241.5	181.7	1.102	242.3	183.8	1.098
1.104	238.6	176.1	1.104	241.2	180.2	1.103	242.9	183.2	1.102	243.7	185.1	1.098
1.106	240.3	177.6	1.106	242.8	181.6	1.105	244.5	184.6	1.105	245.3	186.5	1.101
1.102	241.6	179.1	1.101	244.0	183.1	1.100	245.6	186.0	1.100	246.4	187.9	1.100
1.105	240.5	177.8	1.104	243.0	181.9	1.103	244.6	184.8	1.102	245.3	186.8	1.099
1.108	239.4	176.6	1.107	241.9	180.6	1.106	243.6	183.6	1.105	244.3	185.6	1.102
1.112	238.3	175.3	1.110	240.9	179.4	1.109	242.5	182.4	1.108	243.3	184.4	1.103
1.118	237.4	174.1	1.116	240.0	178.2	1.115	241.6	181.3	1.113	242.4	183.3	1.106
1.133	237.0	172.8	1.131	239.6	177.0	1.129	241.2	180.1	1.127	242.0	182.1	1.120
1.134	235.8	171.5	1.132	238.4	175.8	1.131	240.1	178.9	1.129	241.0	181.0	1.123
1.089	232.0	170.3	1.087	234.7	174.6	1.086	236.5	177.7	1.084	237.4	179.8	1.081
0.940	222.3	169.0	0.940	225.4	173.3	0.941	227.5	176.5	0.942	228.7	178.7	0.947
0.562	199.6	167.8	0.567	203.5	172.1	0.572	206.3	175.3	0.577	208.1	177.5	0.590
237.803			240.433			242.128			242.981			
175.352			179.437			182.427			184.41			

Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)
20.0 Years		50.0 Years			150.0 Years			250.0 Years			400.0 Years	
212.6	192.0	0.466	204.3	190.5	0.456	179.8	172.9	0.471	170.0	165.0	0.497	162.4
227.2	193.1	0.784	214.4	191.3	0.811	185.6	173.3	0.831	174.2	165.3	0.849	165.5
236.9	194.2	0.974	220.7	192.0	0.998	188.8	173.7	1.010	176.4	165.6	1.018	167.1
241.9	195.3	1.051	223.7	192.8	1.065	190.2	174.1	1.069	177.3	165.9	1.067	167.7
244.5	196.5	1.086	225.5	193.5	1.091	191.0	174.5	1.088	177.8	166.2	1.085	168.0
246.3	197.6	1.099	226.6	194.2	1.099	191.5	174.9	1.095	178.1	166.5	1.088	168.3
247.4	198.7	1.099	227.3	195.0	1.099	191.9	175.3	1.095	178.4	166.7	1.088	168.5
248.7	199.8	1.099	228.1	195.7	1.099	192.3	175.7	1.095	178.7	167.0	1.088	168.7
249.7	200.9	1.098	228.8	196.4	1.098	192.7	176.1	1.093	179.0	167.3	1.088	169.0
248.7	200.0	1.095	228.1	195.8	1.092	192.3	175.7	1.086	178.7	167.1	1.079	168.7
248.0	199.0	1.095	227.5	195.2	1.094	192.0	175.4	1.088	178.5	166.9	1.082	168.6
247.1	198.1	1.093	226.8	194.6	1.087	191.6	175.1	1.079	178.1	166.6	1.073	168.3
246.2	197.2	1.102	226.5	194.0	1.089	191.3	174.8	1.081	177.9	166.4	1.073	168.1
246.0	196.3	1.113	226.2	193.4	1.099	191.1	174.5	1.091	177.8	166.2	1.082	168.0
245.2	195.3	1.111	225.5	192.8	1.095	190.7	174.1	1.084	177.5	165.9	1.076	167.8
242.4	194.4	1.075	223.9	192.2	1.068	190.0	173.8	1.063	177.0	165.7	1.055	167.4
235.5	193.5	0.952	219.6	191.6	0.956	188.0	173.5	0.961	175.7	165.5	0.966	166.5
218.7	192.5	0.596	208.5	191.0	0.591	182.1	173.2	0.608	171.7	165.2	0.631	163.6
246.920		227.015			191.781			178.375			168.543	
198.01		194.55			175.08			166.62			159.59	

WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	WP Surface Temperature (degrees C)
1000.0 Years			4000.0 Years			8000.0 Years			10000.0 Years			
158.3	0.542	147.8	145.5	0.642	129.6	128.6	0.671	129.9	129.0	0.662	127.9	127.2
158.6	0.865	149.3	145.6	0.888	130.1	128.6	0.899	130.2	129.1	0.905	128.2	127.2
158.8	1.018	150.0	145.7	1.007	130.3	128.7	1.008	130.4	129.1	1.010	128.4	127.2
159.0	1.061	150.3	145.8	1.047	130.4	128.7	1.044	130.4	129.1	1.044	128.4	127.3
159.2	1.080	150.5	145.9	1.059	130.5	128.8	1.057	130.5	129.2	1.055	128.5	127.3
159.5	1.080	150.7	146.1	1.064	130.6	128.8	1.062	130.5	129.2	1.060	128.5	127.3
159.7	1.080	150.8	146.2	1.064	130.6	128.9	1.059	130.6	129.3	1.057	128.6	127.4
159.9	1.080	150.9	146.3	1.063	130.7	128.9	1.057	130.6	129.3	1.055	128.6	127.4
160.1	1.080	151.0	146.4	1.063	130.7	129.0	1.057	130.7	129.3	1.055	128.6	127.4
159.9	1.073	150.9	146.3	1.058	130.7	128.9	1.053	130.6	129.3	1.051	128.6	127.4
159.8	1.073	150.8	146.2	1.061	130.6	128.9	1.057	130.6	129.3	1.055	128.6	127.4
159.6	1.067	150.7	146.1	1.056	130.6	128.9	1.050	130.6	129.2	1.047	128.5	127.4
159.4	1.067	150.6	146.0	1.054	130.6	128.8	1.048	130.5	129.2	1.046	128.5	127.3
159.2	1.073	150.5	146.0	1.061	130.5	128.8	1.055	130.5	129.2	1.052	128.5	127.3
159.1	1.067	150.4	145.9	1.059	130.5	128.7	1.053	130.5	129.2	1.050	128.5	127.3
158.9	1.049	150.2	145.8	1.042	130.4	128.7	1.039	130.4	129.1	1.036	128.4	127.3
158.7	0.969	149.8	145.7	0.970	130.3	128.7	0.970	130.3	129.1	0.970	128.3	127.2
158.5	0.664	148.4	145.6	0.733	129.8	128.6	0.753	130.0	129.1	0.761	128.1	127.2
	150.834			130.681			130.623			128.595		
	146.15			128.86			129.24			127.35		

Time (s)	Time (years)	Node A	Node B	Node C	Node D	Node E	Node F	Node G	Node H	Node I	Node J	Node K	Node L	Node M	Node N	Node O
31.558	0.0	162.5	147.1	145.7	145.7	146.5	157.0	136.8	135.7	134.9	136.0	103.1	100.2	80.7	80.3	79.3
3.16E+06	0.1	187.4	173.5	172.1	172.2	172.9	181.9	163.4	162.3	161.6	161.4	130.5	127.7	109.5	109.1	108.0
6.31E+06	0.2	193.7	180.1	178.8	178.8	179.5	188.2	170.0	168.9	168.2	167.7	137.2	134.5	116.5	116.1	115.0
9.47E+06	0.3	197.4	184.0	182.7	182.7	183.5	192.0	174.0	172.9	172.2	171.6	141.4	138.6	120.9	120.4	119.4
1.26E+07	0.4	200.2	187.0	185.7	185.7	186.4	194.8	177.0	175.9	175.2	174.4	144.5	141.8	124.2	123.8	122.7
1.58E+07	0.5	202.4	189.3	188.1	188.1	188.8	197.0	179.4	178.3	177.6	176.8	147.1	144.4	126.9	126.5	125.4
1.89E+07	0.6	204.3	191.4	190.1	190.1	190.8	198.9	181.5	180.4	179.7	178.7	149.3	146.6	129.3	128.9	127.8
2.21E+07	0.7	205.9	193.1	191.8	191.8	192.5	200.5	183.2	182.1	181.4	180.4	151.1	148.5	131.3	130.9	129.8
2.52E+07	0.8	207.3	194.6	193.3	193.3	194.0	202.0	184.7	183.6	182.9	181.9	152.8	150.1	133.1	132.7	131.6
2.84E+07	0.9	208.5	195.9	194.6	194.6	195.3	203.2	186.1	185.0	184.3	183.2	154.2	151.6	134.7	134.3	133.2
3.16E+07	1	209.6	197.0	195.8	195.8	196.5	204.3	187.3	186.2	185.5	184.3	155.6	152.9	136.1	135.7	134.6
6.31E+07	2	217.1	205.2	204.0	204.1	204.7	212.0	195.8	194.7	194.1	192.6	165.1	162.5	146.5	146.1	145.0
9.47E+07	3	223.1	211.8	210.6	210.6	211.3	218.1	202.6	201.6	200.9	199.3	172.8	170.3	154.9	154.5	153.5
1.26E+08	4	227.7	216.8	215.6	215.7	216.3	222.8	207.8	206.8	206.2	204.4	178.7	176.3	161.5	161.1	160.1
1.58E+08	5	231.8	221.2	220.1	220.2	220.8	227.0	212.4	211.5	210.9	209.0	184.1	181.8	167.4	167.1	166.0
1.89E+08	6	235.1	224.9	223.8	223.8	224.4	230.4	216.3	215.3	214.8	212.8	188.6	186.3	172.5	172.1	171.1
2.21E+08	7	237.8	227.9	226.9	226.9	227.4	233.2	219.5	218.6	218.0	216.0	192.4	190.2	176.7	176.4	175.4
2.52E+08	8	240.4	230.8	229.8	229.8	230.4	235.9	222.5	221.7	221.1	219.0	196.0	193.9	180.8	180.4	179.4
2.84E+08	9	242.1	232.7	231.7	231.8	232.3	237.7	224.6	223.8	223.2	221.1	198.6	196.5	183.8	183.4	182.4
3.16E+08	10	243.0	233.8	232.8	232.8	233.3	238.6	225.8	225.0	224.4	222.3	200.3	198.2	185.7	185.4	184.4
6.31E+08	20	246.9	239.3	238.5	238.5	238.9	243.2	232.6	231.8	231.4	229.4	211.1	209.4	199.1	198.8	198.0
9.47E+08	30	240.5	233.8	233.1	233.1	233.5	237.3	228.1	227.4	227.0	225.4	209.6	208.2	199.4	199.1	198.4
1.26E+09	40	233.9	228.0	227.3	227.3	227.7	231.1	222.9	222.4	222.1	220.7	206.9	205.6	197.9	197.7	197.1
1.58E+09	50	227.0	221.7	221.2	221.2	221.5	224.6	217.3	216.8	216.5	215.4	203.2	202.0	195.3	195.1	194.6
1.89E+09	60	220.7	215.9	215.4	215.4	215.7	218.5	212.0	211.6	211.3	210.3	199.4	198.4	192.4	192.2	191.7
2.21E+09	70	214.7	210.3	209.9	209.9	210.1	212.8	206.8	206.4	206.2	205.4	195.5	194.6	189.1	189.0	188.5
2.52E+09	80	209.3	205.3	204.8	204.9	205.1	207.5	202.1	201.7	201.5	200.8	191.8	191.0	186.0	185.8	185.4
2.84E+09	90	204.9	201.1	200.7	200.7	200.9	203.2	198.2	197.8	197.6	197.1	188.7	188.0	183.4	183.2	182.9
3.16E+09	100	200.9	197.3	197.0	197.0	197.2	199.3	194.6	194.3	194.1	193.6	185.9	185.2	180.9	180.8	180.5
6.31E+09	150	191.8	188.8	188.5	188.6	188.7	190.5	186.8	186.4	186.2	185.9	179.5	178.9	175.4	175.3	175.1
6.31E+09	200	182.7	180.3	180.1	180.1	180.2	181.7	178.6	178.4	178.3	178.1	173.1	172.7	169.9	169.9	169.7
6.31E+09	250	179.4	176.2	176.0	176.0	176.1	177.5	174.7	174.5	174.4	174.2	169.7	169.3	166.9	166.8	166.6
9.47E+09	300	174.1	172.1	172.0	172.0	172.1	173.3	170.8	170.6	170.5	170.4	166.4	166.0	163.8	163.7	163.6
1.26E+10	400	168.5	166.9	166.7	166.7	166.8	167.9	165.7	165.6	165.5	165.4	162.0	161.7	159.8	159.7	159.6
1.58E+10	500	164.5	163.0	162.9	162.9	163.0	163.9	162.0	161.9	161.8	161.8	158.7	158.5	156.8	156.8	156.7
1.89E+10	600	160.8	159.5	159.3	159.3	159.4	160.3	158.6	158.5	158.4	158.3	155.7	155.4	154.0	153.9	153.8
2.21E+10	700	157.7	156.5	156.4	156.4	156.4	157.2	155.7	155.6	155.5	155.5	153.1	152.9	151.6	151.5	151.4
2.52E+10	800	155.0	154.0	153.9	153.9	153.9	154.6	153.2	153.2	153.1	153.1	150.9	150.7	149.5	149.5	149.4
2.84E+10	900	152.9	151.9	151.8	151.8	151.8	152.5	151.2	151.1	151.1	151.1	149.1	148.9	147.8	147.8	147.8
3.16E+10	1000	150.8	149.9	149.8	149.8	149.9	150.5	149.3	149.3	149.2	149.2	147.4	147.2	146.2	146.2	146.2
6.31E+10	2000	135.3	134.8	134.7	134.7	134.8	135.1	134.5	134.4	134.4	134.4	133.4	133.3	132.8	132.7	132.7
9.47E+10	3000	129.6	129.2	129.1	129.1	129.1	129.4	128.9	128.9	128.9	128.9	128.1	128.0	127.6	127.6	127.5
1.26E+11	4000	130.7	130.3	130.3	130.3	130.3	130.6	130.1	130.1	130.1	130.1	129.3	129.3	128.9	128.9	128.9
1.58E+11	5000	131.4	131.1	131.1	131.1	131.1	131.3	130.9	130.9	130.9	130.8	130.2	130.2	129.8	129.8	129.7
1.89E+11	6000	131.6	131.2	131.2	131.2	131.2	131.5	131.1	131.0	131.0	131.0	130.4	130.4	130.0	130.0	130.0
2.21E+11	7000	131.3	131.0	131.0	131.0	131.0	131.2	130.8	130.8	130.8	130.8	130.2	130.2	129.8	129.8	129.8
2.52E+11	8000	130.6	130.3	130.3	130.3	130.3	130.5	130.2	130.2	130.2	130.1	130.2	129.6	129.6	129.3	129.2
2.84E+11	9000	129.7	129.4	129.4	129.4	129.4	129.6	129.3	129.2	129.2	129.2	128.7	128.7	128.4	128.4	128.4
3.16E+11	10000.0	128.6	128.3	128.3	128.3	128.3	128.5	128.2	128.2	128.2	128.2	127.7	127.6	127.4	127.4	127.4

* - Bolded numbers indicate values that are linearly interpolated

ANSYS Case @ peaking factor 1.102	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor
Axial Node	50.0 Years		51.0 Years		55.0 Years		56.0 Years		57.0 Years		58.0`
Node 1	0.572	129.1	0.466	276.2	0.465	304.0	0.465	306.5	0.465	308.1	0.465
Node 2	0.881	139.8	0.784	285.5	0.785	312.7	0.785	315.0	0.786	316.5	0.786
Node 3	1.021	144.6	0.974	291.1	0.975	317.8	0.975	320.0	0.976	321.4	0.976
Node 4	1.053	145.7	1.051	293.3	1.052	319.9	1.052	322.1	1.052	323.4	1.052
Node 5	1.047	145.6	1.086	294.4	1.087	320.8	1.087	323.0	1.087	324.4	1.087
Node 6	1.036	145.2	1.099	294.7	1.099	321.1	1.099	323.3	1.099	324.7	1.099
Node 7	1.029	144.9	1.099	294.7	1.099	321.1	1.099	323.3	1.099	324.7	1.099
Node 8	1.026	144.8	1.099	294.7	1.099	321.1	1.099	323.3	1.099	324.7	1.099
Node 9	1.033	145.1	1.098	294.7	1.098	321.1	1.098	323.3	1.098	324.6	1.098
Node 10	1.046	145.5	1.095	294.6	1.095	321.0	1.095	323.2	1.095	324.6	1.095
Node 11	1.062	146.1	1.095	294.6	1.095	321.0	1.095	323.2	1.095	324.6	1.095
Node 12	1.080	146.7	1.093	294.6	1.093	321.0	1.093	323.2	1.093	324.5	1.093
Node 13	1.098	147.3	1.101	294.8	1.101	321.2	1.101	323.4	1.101	324.7	1.101
Node 14	1.114	147.9	1.113	295.2	1.113	321.5	1.112	323.7	1.112	325.0	1.112
Node 15	1.118	148.0	1.111	295.1	1.110	321.4	1.110	323.6	1.110	325.0	1.110
Node 16	1.093	147.1	1.075	294.0	1.075	320.5	1.075	322.7	1.075	324.0	1.075
Node 17	0.997	143.8	0.952	290.4	0.952	317.2	0.953	319.4	0.953	320.8	0.953
Node 18	0.684	133.0	0.596	280.0	0.596	307.6	0.596	310.0	0.596	311.5	0.596
Peak Fuel Temperature	147.5		294.8		321.2		323.4		324.8		324
Surface Temperature	109.3		262.6		291.5		294.1		295.9		294

* - Bolded numbers indicate those that are linearly interpolated

Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor
Years	59.0 Years		60.0 Years		70.0 Years		100.0 Years		200.0 Years		300.0
309.2	0.465	309.5	0.465	309.3	0.464	305.9	0.461	276.3	0.464	230.8	0.480
317.5	0.786	317.7	0.786	317.4	0.789	313.4	0.797	282.4	0.821	235.2	0.837
322.5	0.976	322.6	0.976	322.2	0.979	317.7	0.986	285.8	1.004	237.5	1.012
324.4	1.052	324.5	1.052	324.2	1.054	319.4	1.058	287.1	1.067	238.3	1.068
325.3	1.087	325.4	1.087	325.0	1.087	320.2	1.089	287.7	1.090	238.6	1.087
325.6	1.099	325.7	1.099	325.3	1.099	320.4	1.099	287.8	1.097	238.6	1.093
325.6	1.099	325.7	1.099	325.3	1.099	320.4	1.099	287.9	1.097	238.7	1.093
325.6	1.099	325.7	1.099	325.3	1.099	320.4	1.099	287.9	1.097	238.7	1.093
325.6	1.098	325.7	1.098	325.3	1.098	320.4	1.098	287.8	1.095	238.6	1.091
325.5	1.095	325.6	1.095	325.2	1.095	320.3	1.093	287.8	1.089	238.5	1.084
325.5	1.095	325.6	1.095	325.2	1.095	320.3	1.094	287.8	1.091	238.6	1.086
325.5	1.093	325.6	1.093	325.2	1.092	320.3	1.090	287.7	1.083	238.5	1.077
325.7	1.100	325.8	1.100	325.4	1.099	320.4	1.095	287.8	1.085	238.5	1.079
326.0	1.112	326.1	1.112	325.7	1.110	320.7	1.106	288.0	1.095	238.6	1.088
325.9	1.109	326.0	1.109	325.6	1.108	320.6	1.103	287.9	1.089	238.6	1.081
325.0	1.075	325.1	1.075	324.7	1.074	319.9	1.072	287.4	1.065	238.3	1.060
321.9	0.953	322.0	0.953	321.6	0.953	317.1	0.954	285.2	0.959	236.9	0.963
312.6	0.596	312.9	0.596	312.6	0.595	308.9	0.594	278.7	0.599	232.5	0.615
5.7	325.8		325.4		320.5		287.9		238.7		21.
7.2	297.6		297.5		295.4		268.0		225.1		20.

Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)	Axial Peaking Factor	Peak Fuel Temperature (degrees C)
Years	450.0 Years		1050.0 Years		4050.0 Years		8050.0 Years		10050.0 Years	
208.4	0.501	190.2	0.544	155.1	0.642	118.5	0.671	99.9	0.683	93.7
211.9	0.851	193.0	0.865	156.5	0.888	118.9	0.899	100.3	0.905	94.0
213.6	1.018	194.3	1.018	157.1	1.007	119.1	1.008	100.4	1.010	94.1
214.2	1.066	194.7	1.061	157.3	1.047	119.2	1.044	100.5	1.044	94.2
214.3	1.085	194.8	1.079	157.4	1.059	119.2	1.057	100.5	1.055	94.2
214.4	1.088	194.8	1.079	157.4	1.064	119.2	1.062	100.5	1.060	94.2
214.4	1.088	194.8	1.079	157.4	1.064	119.2	1.059	100.5	1.057	94.2
214.4	1.088	194.8	1.079	157.4	1.063	119.2	1.057	100.5	1.055	94.2
214.4	1.088	194.8	1.079	157.4	1.063	119.2	1.057	100.5	1.055	94.2
214.3	1.079	194.7	1.073	157.4	1.057	119.2	1.053	100.5	1.051	94.2
214.3	1.082	194.8	1.073	157.4	1.061	119.2	1.057	100.5	1.055	94.2
214.2	1.073	194.7	1.067	157.3	1.056	119.2	1.050	100.5	1.047	94.2
214.3	1.073	194.7	1.067	157.3	1.054	119.2	1.048	100.5	1.046	94.2
214.4	1.082	194.8	1.073	157.4	1.061	119.2	1.055	100.5	1.052	94.2
214.3	1.075	194.7	1.067	157.3	1.059	119.2	1.053	100.5	1.050	94.2
214.1	1.054	194.6	1.049	157.3	1.042	119.2	1.039	100.4	1.036	94.1
213.1	0.966	193.9	0.969	156.9	0.970	119.1	0.970	100.4	0.970	94.1
209.7	0.634	191.3	0.665	155.6	0.733	118.6	0.753	100.0	0.761	93.8
4.5	194.9		157.5		119.3		100.5		94.2	
3.7	186.3		152.7		117.3		99.0		92.8	

Time (s)	Time (years)	Node A	Node B	Node C	Node D	Node E	Node F	Node G	Node H	Node I	Node J	Node K	Node L	Node M	Node N	Node O
31.558	50.0	147.5	139.8	139.1	139.1	139.5	145.0	135.3	134.8	134.5	135.1	119.8	118.6	109.8	109.5	109.3
3.16E+06	50.1	236.9	231.5	230.9	231.0	231.2	234.4	226.9	226.5	226.2	224.9	212.5	211.4	203.9	203.4	203.2
6.31E+06	50.2	263.0	258.0	257.4	257.4	257.7	260.4	253.2	252.8	252.5	250.7	238.4	237.3	229.8	229.4	229.1
9.47E+06	50.3	273.0	268.1	267.5	267.6	267.8	270.4	263.4	262.9	262.6	260.8	248.8	247.6	240.4	240.0	239.7
1.26E+07	50.4	278.8	274.0	273.5	273.5	273.7	276.2	269.3	268.9	268.6	266.7	254.7	253.6	246.4	246.0	245.7
1.58E+07	50.5	282.9	278.1	277.6	277.6	277.9	280.3	273.4	273.0	272.7	270.7	258.9	257.8	250.7	250.2	249.9
1.89E+07	50.6	286.0	281.3	280.8	280.8	281.0	283.4	276.6	276.2	275.9	273.9	262.1	261.0	254.0	253.5	253.2
2.21E+07	50.7	288.7	284.0	283.5	283.5	283.8	286.1	279.4	278.9	278.6	276.5	264.9	263.8	256.8	256.3	256.0
2.52E+07	50.8	291.0	286.4	285.9	285.9	286.1	288.4	281.8	281.3	281.0	278.9	267.3	266.2	259.3	258.8	258.5
2.84E+07	50.9	293.0	288.5	288.0	288.0	288.2	290.4	283.8	283.4	283.1	281.0	269.4	268.3	261.4	260.9	260.7
3.16E+07	51	294.8	290.3	289.8	289.8	290.0	292.2	285.7	285.2	284.9	282.8	271.3	270.2	263.3	262.8	262.6
6.31E+07	52	306.3	302.0	301.5	301.5	301.7	303.7	297.4	297.0	296.7	294.4	283.3	282.2	275.6	275.1	274.9
9.47E+07	53	313.4	309.3	308.8	308.8	309.0	310.9	304.8	304.3	304.1	301.8	290.9	289.8	283.4	282.9	282.6
1.26E+08	54	317.9	313.9	313.4	313.4	313.6	315.4	309.4	309.0	308.7	306.4	295.7	294.7	288.4	287.9	287.7
1.58E+08	55	321.2	317.3	316.8	316.8	317.0	318.8	312.9	312.5	312.2	309.9	299.4	298.3	292.2	291.7	291.5
1.89E+08	56	323.4	319.6	319.1	319.1	319.3	321.0	315.2	314.8	314.5	312.2	301.9	300.9	294.8	294.3	294.1
2.21E+08	57	324.8	321.0	320.5	320.5	320.7	322.4	316.7	316.3	316.0	313.7	303.5	302.5	296.6	296.1	295.9
2.52E+08	58	325.7	322.0	321.5	321.5	321.7	323.4	317.7	317.3	317.1	314.8	304.8	303.8	297.9	297.4	297.2
2.84E+08	59	325.8	322.1	321.6	321.7	321.9	323.5	317.9	317.5	317.3	315.0	305.1	304.1	298.3	297.9	297.6
3.16E+08	60	325.4	321.7	321.3	321.3	321.5	323.1	317.6	317.2	316.9	314.7	304.9	303.9	298.2	297.7	297.5
6.31E+08	70	320.5	317.2	316.7	316.8	316.9	318.4	313.4	313.1	312.8	310.9	302.0	301.1	296.0	295.6	295.4
9.47E+08	80	309.7	306.6	306.2	306.2	306.4	307.8	303.2	302.9	302.6	300.9	292.8	292.0	287.2	286.9	286.7
1.26E+09	90	298.4	295.4	295.1	295.1	295.2	296.7	292.3	292.0	291.8	290.3	282.7	282.0	277.6	277.2	277.0
1.58E+09	100	287.9	285.1	284.7	284.7	284.9	286.3	282.2	281.9	281.7	280.4	273.3	272.6	268.4	268.1	268.0
1.89E+09	110	281.8	279.1	278.8	278.8	278.9	280.3	276.4	276.1	275.9	274.7	268.0	267.3	263.3	263.0	262.9
2.21E+09	120	275.9	273.3	273.0	273.0	273.1	274.5	270.7	270.5	270.3	269.2	262.8	262.2	258.4	258.1	257.9
2.52E+09	130	269.4	266.9	266.6	266.6	266.7	268.0	264.4	264.2	264.0	263.0	256.9	256.3	252.7	252.4	252.3
2.84E+09	140	262.3	259.8	259.5	259.5	259.7	261.0	257.5	257.3	257.2	256.3	250.4	249.8	246.4	246.1	246.0
3.16E+09	150	254.7	252.4	252.1	252.1	252.2	253.5	250.2	250.0	249.9	249.0	243.4	242.9	239.6	239.4	239.3
6.31E+09	200	238.7	236.6	236.3	236.3	236.5	237.7	234.7	234.5	234.4	233.8	228.8	228.3	225.4	225.2	225.1
9.47E+09	250	222.7	220.8	220.6	220.6	220.7	221.8	219.2	219.0	218.9	218.5	214.2	213.8	211.2	211.0	211.0
1.26E+10	300	214.5	212.7	212.5	212.5	212.6	213.7	211.2	211.1	211.0	210.6	206.7	206.3	203.9	203.8	203.7
1.58E+10	350	206.3	204.6	204.5	204.5	204.5	205.6	203.3	203.2	203.1	202.8	199.1	198.8	196.6	196.5	196.4
1.89E+10	450	194.9	193.4	193.3	193.3	193.4	194.3	192.3	192.2	192.1	191.9	188.7	188.4	186.5	186.4	186.3
2.21E+10	550	185.5	184.1	184.0	184.0	184.1	184.9	183.1	183.0	183.0	182.8	180.0	179.7	178.0	177.9	177.9
2.52E+10	650	178.1	176.8	176.7	176.7	176.8	177.6	175.9	175.9	175.8	175.7	173.1	172.9	171.4	171.3	171.2
2.84E+10	750	171.5	170.4	170.2	170.3	170.3	171.0	169.6	169.5	169.4	169.3	167.0	166.8	165.4	165.4	165.3
3.16E+10	850	165.9	164.8	164.8	164.8	164.8	165.5	164.1	164.0	164.0	163.9	161.8	161.6	160.4	160.3	160.3
3.48E+10	950	161.2	160.2	160.2	160.2	160.2	160.8	159.6	159.5	159.5	159.4	157.5	157.3	156.1	156.1	156.0
3.80E+10	1050	157.5	156.6	156.5	156.5	156.6	157.2	156.0	155.9	155.9	155.9	154.0	153.9	152.8	152.7	152.7
4.12E+10	2050	134.3	133.7	133.7	133.7	133.7	134.1	133.4	133.3	133.3	133.3	132.3	132.2	131.6	131.5	131.5
4.44E+10	3050	125.1	124.6	124.6	124.6	124.6	124.9	124.4	124.3	124.3	124.3	123.5	123.4	122.9	122.9	122.9
4.76E+10	4050	119.3	118.9	118.9	118.9	118.9	119.2	118.7	118.6	118.6	118.6	117.9	117.8	117.3	117.3	117.3
5.08E+10	5050	113.5	113.1	113.0	113.1	113.1	113.3	112.9	112.8	112.8	112.8	112.1	112.1	111.6	111.6	111.6
5.40E+10	6050	108.5	108.1	108.1	108.1	108.1	108.3	107.9	107.9	107.9	107.9	107.2	107.1	106.7	106.7	106.7
5.72E+10	7050	104.3	103.9	103.9	103.9	103.9	104.2	103.8	103.7	103.7	103.8	103.1	103.1	102.7	102.7	102.6
6.04E+10	8050	100.5	100.2	100.2	100.2	100.2	100.4	100.0	100.0	100.0	100.0	99.4	99.4	99.0	99.0	99.0
6.36E+10	9050	97.2	96.9	96.9	96.9	96.9	97.1	96.7	96.7	96.7	96.7	96.1	96.1	95.8	95.7	95.7
6.68E+10	10050	94.2	93.9	93.9	93.9	93.9	94.1	93.8	93.7	93.7	93.8	93.2	93.2	92.8	92.8	92.8

* - Bolded numbers indicate those that are linearly interpolated

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/COM, 5 Zircaloy 4 SNF Cladding
/COM, 6 Oxidation Layer Stably Oxidized Zircaloy Surface
/COM, 7 Helium Canister Fill Gas
/COM, 9 Nitrogen Alternate Fill Gas
/COM, 10 Argon Alternate Fill Gas
/COM, 14 SNF RESERVED FOR SNF PROPERTIES
/COM, 15 Alloy 22 Carbon Steel Inner Shell (resistant) new
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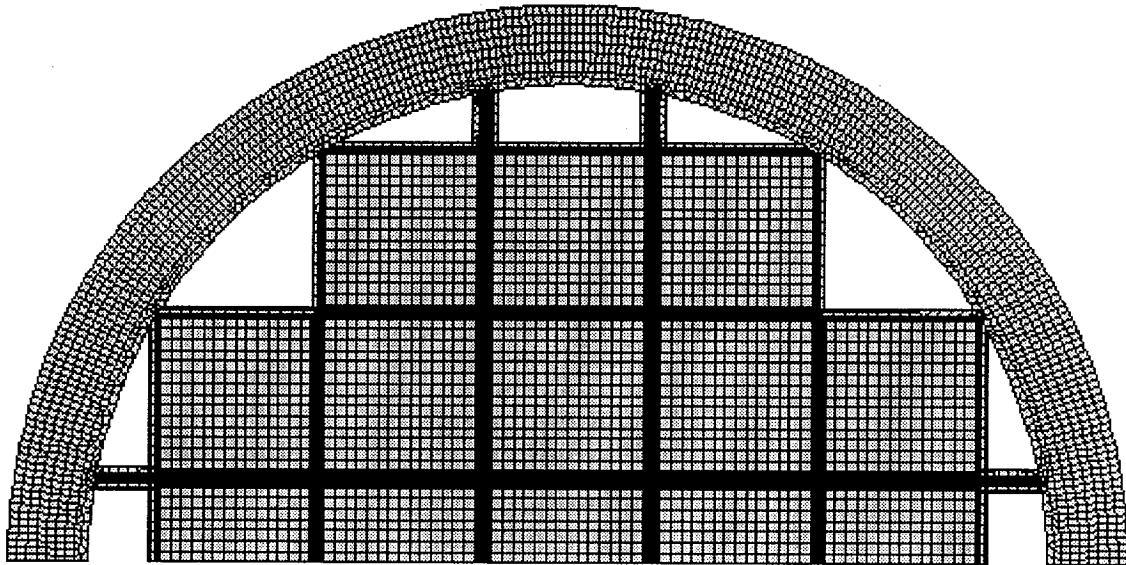
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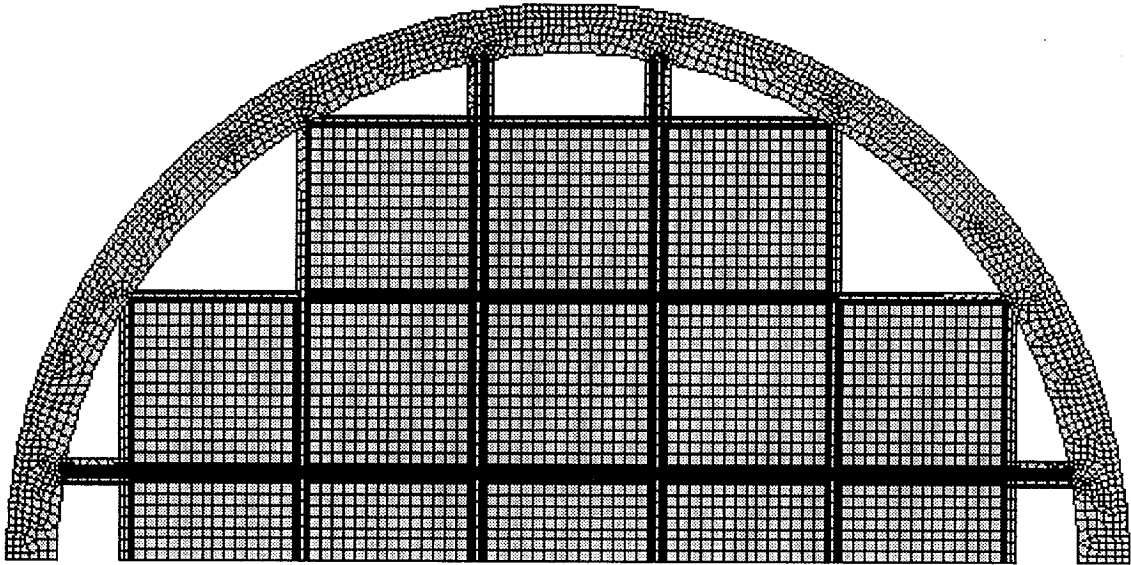
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File Listing for *ANSYS Output for Thermal History of Cladding in a 21 PWR SNF WP Loaded with Average Fuel*. This compact disk (CD) was generated using a Hewlett Packard CD Writer Plus 7200 compact disk read/write system for personal computers. This CD (Ref. 3) is formatted to be read by any standard CD-ROM drive on an IBM compatible personal computer with a Microsoft operating system.

File Name	File Size	Date
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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT DOCUMENT INPUT REFERENCE SYSTEM									
1. Document Identifier No./Rev.: CAL-UDC-ME-000001 Rev. 00		Change:	Title: Thermal History of Cladding in a 21 PWR SNF WP Loaded with Average Fuel						
Input Document			4. Input Status	5. Section Used in	6. Input Description	7. TBV/TBD Priority	8. TBV Due To		
2a.	2. Technical Product Input Source Title and Identifier(s) with Version	3. Section					Unqual.	From Uncontrolled Source	Un-Confirmed
1	CRWMS M&O 1998. <i>Principal Isotope Burnup Credit Loading Curve for the 21 PWR Waste Package.</i> BBA000000-01717-0210-00008 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980825.0003.	Page 15; 5.1	TBV-3643	2, 5.1.	Isotopic compositions for various burnup and enrichment compositions; Fuel Region Node Heights; Thermal conductivity of backfill material	3	X	N/A	N/A
2	CRWMS M&O 1997. <i>Waste Package Fabrication Process Report.</i> BBA000000-01717-2500-00010 REV 02. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19971218.0275.	Page 30	TBV-3644	Assumption 3.4.	CURRENT DESIGN PHILOSOPHY FOR MULTIPLE WP SHELL ASSEMBLY	3	X	N/A	N/A
3	CRWMS M&O 1999. <i>ANSYS Output Files for Thermal History of Cladding in a 21 PWR SNF WP Loaded with Average Fuel.</i> CAL-UDC-ME-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991122.0229.	Entire	N/A - Reference Only	5.1, 6, 7.	Output files from document CAL-UDC-ME-000001 REV 00.	N/A	N/A	N/A	N/A
6	CRWMS M&O 1995. <i>Analysis of Degradation Due to Water and Gases in MPC.</i> BB0000000-01717-0200-00005 REV 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19960419.0202.	Page 10	N/A - Reference Only	Assumption 3.5.	Statement regarding the highest pressure to which storage casks are filled.	N/A	N/A	N/A	N/A

7	CRWMS M&O 1997. <i>Software Qualification Report for THE SCALE Modular Code System Version 4.3.</i> CSCI: 30011 V4.3. DI: 30011-2002, Rev. 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19970731.0884.	Entire	N/A - Reference Only	4.	Software Qualification Report for SCALE Version 4.3.	N/A	N/A	N/A	N/A
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10	Doering, T.W. 1998. "Qualification of ANSYS V5.4 on the WPO HP UNIX Workstations." Interoffice correspondence from T.W. Doering (CRWMS M&O) to G. Carlisle, May 22, 1998, LV.WP.SMB.05/98-100. ACC: MOL.19980730.0147.	Entire	N/A - Reference Only	4.	Applicable Workstations for ANSYS V5.4.	N/A	N/A	N/A	N/A
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15	CRWMS M&O 1999. <i>Commercial Waste Stream Studies to Support Enhanced Design Alternatives</i> . B00000000-01717-0210-00092 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990604.0089.	Attachment III	TBV-3647	5.2.2.	HEAT OUTPUT OF AN AVERAGE WP OF LADS SCENARIO TYPE	3	X	N/A	N/A
16	CRWMS M&O 1998. <i>Multiple WP Emplacement Thermal Response - Suite I</i> . BBA000000-01717-0210-00001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980807.0311.	Attachment XIV	TBV-3648	5.2.3.	BOUNDARY CONDITIONS FOR AVERAGE 21 PWR WP OF VA DESIGN TYPE	3	X	N/A	N/A
18	Bird, R.B; Stewart, W.E.; and Lightfoot, E.N. 1960. <i>Transport Phenomena</i> . New York, New York: John Wiley & Sons. TIC: 208957.	Page 255	N/A - Reference Only	Assumption 3.5.	Statement regarding the pressure independence of thermal conductivities.	N/A	N/A	N/A	N/A
19	Todreas, N.E. and Kazimi, M.S. 1990. <i>Nuclear Systems I, Thermal Hydraulic Fundamentals</i> . New York, New York: Hemisphere Publishing Corporation. TIC: 226511.	Tables 8-1, 8-2	TBV-3649	5.5.	SPECIFIC HEAT OF URANIUM OXIDE; SPECIFIC HEAT OF ZIRCALOY	3	X	N/A	N/A
21	ASTM A 20/A 20M-97a. 1997. <i>Standard Specification for General Requirements for Steel Plates for</i>	Page 9	N/A - Accepted	5.4.	Density of A 516 Carbon Steel	N/A	N/A	N/A	N/A

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22	Avallone, E.A. and Baumeister, T., III, ed. 1987. <i>Marks' Standard Handbook for Mechanical Engineers</i> . 9th Edition. New York, New York: McGraw-Hill. TIC: 206891.	Page 4-68	N/A - Accepted Data (Fact)	5.4.	Emissivity values of common materials	N/A	N/A	N/A	N/A
24	ASTM B 575-97. 1998. <i>Standard Specification for Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Plate, Sheet, and Strip</i> . West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 241816.	Page 2	N/A - Accepted Data (Fact)	5.4.	Density of alloy 22.	N/A	N/A	N/A	N/A
25	Lide, D.R., ed. 1995. <i>CRC Handbook of Chemistry and Physics</i> . 76th Edition. Boca Raton, Florida: CRC Press. TIC: 216194.	Page 10-297	N/A - Accepted Data (Fact)	5.4.	Emissivity values of alloy 22 and aluminum alloy 6061	N/A	N/A	N/A	N/A
		Page 1-15	N/A - Accepted Data (Fact)	5.5.	Atomic weights of Uranium and Oxygen	N/A	N/A	N/A	N/A
27	ASTM G 1-90 (Reapproved 1999). 1990. <i>Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens</i> . West Conshohocken, Pennsylvania: American Society for Testing and	Page 7	N/A - Accepted Data (Fact)	5.4.	Density of stainless steel 316	N/A	N/A	N/A	N/A

	Materials. TIC: 238771.								
28	Kuglar, A. 1996. <i>Bohler Neutronit A976 Sheet and Plate for Nuclear Engineering</i> . Murzzuschlag, Austria: Bohler Bleche GmbH. TIC: 240558.	Page 17	TBV-3743	5.4.	Density of Neutronit A978; Specific Heat of Neutronit A978; Thermal Conductivity of Neutronit A978	3	X	N/A	N/A
29	American Society for Metals 1987. <i>Corrosion</i> . Volume 13 of <i>Metals Handbook</i> . 9th Edition. Metals Park, Ohio: American Society for Metals International. TIC: 209807.	Page 931	N/A - Accepted Data (Fact)	Assumption 3.10.	Similarity in composition of 316 and 316 NG	N/A	N/A	N/A	N/A
30	American Society of Heating, Refrigerating and Air Conditioning Engineers 1997. <i>Fundamentals</i> . 1997 ASHRAE Handbook, Inch-Pound Edition. Atlanta, Georgia: American Society of Heating, Refrigerating and Air Conditioning Engineers. TIC: 240756.	Page 19.71	N/A - Accepted Data (Fact)	5.4.	Density, specific heat, and thermal conductivity of helium.	N/A	N/A	N/A	N/A
31	CRWMS M&O 1997. <i>Preliminary Design Basis for WP Thermal Analysis</i> . BBAA00000-01717-0200-00019 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980203.0529.	Page 28	TBV-3650	5.2.1.	AVERAGE PWR SNF ASSEMBLY MASS	3	X	N/A	N/A
		Attachment XXXIX	TBV-3651	Assumption 3.6;5.2.2	HEAT OUTPUT OF AN AVERAGE WP OF VA TYPE	3	X	N/A	N/A
33	CRWMS M&O 1998. <i>Software Qualification Report for ANSYS V5.4, A Finite Element Code</i> . CSCI: 30040 V5.4. DI: 30040-2003, REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980609.0847.	Entire	N/A - Reference Only	4.	Software Qualification Report for ANSYS Version 5.4.	N/A	N/A	N/A	N/A
35	CRWMS M&O 1999. <i>ANSYS Output for 3-D Repository Scale Thermal Evaluations for EDA Selection</i> .	avEDA2.ou t	TBV-3652	5.2.3.	BOUNDARY CONDITIONS FOR AVERAGE 21 PWR WP OF LADS EDA II DESIGN. THESE	3	X	N/A	N/A

	BBA000000-01717-0210-00061 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990607.0235.				BOUNDARY CONDITION WERE GENERATED IN THE DOCUMENT TITLED REPOSITORY SCALE THERMAL EVALUATIONS FOR EDA SELECTION				
36	Haynes International 1997. <i>Hastelloy C-22 Alloy</i> . Kokomo, Indiana: Haynes International. TIC: 238121.	Page 13	TBV-3744	5.4.	Specific Heat of alloy 22; Thermal conductivity of alloy 22	3	X	N/A	N/A
37	CRWMS M&O 1998. <i>Two Data Cartridges for Multiple WP Emplacement Thermal Response - Suite 1</i> . BBA000000-01717-0210-00001, Revision 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980806.0678.	f04d53c.old .out	TBV-3745	Attachment XV	SURFACE TEMPERATURES FOR PWR AVERAGE WP	3	X	N/A	N/A
38	ASME (American Society of Mechanical Engineers) 1995. "Materials." Section II of 1995 ASME <i>Boiler and Pressure Vessel Code</i> . New York, New York: American Society of Mechanical Engineers. TIC: 245287.	Page 316	N/A - Accepted Data (Fact)	Assumption 3.10.	Chemical composition of stainless steels 316 and 316L.	N/A	N/A	N/A	N/A
		Page 600	N/A - Accepted Data (Fact)	5.4.	Thermal conductivity and thermal diffusivity of A 516 carbon steel.	N/A	N/A	N/A	N/A
		Page 606	N/A - Accepted Data (Fact)	5.4.	Thermal conductivity and thermal diffusivity of stainless steel 316.	N/A	N/A	N/A	N/A
		Page 612	N/A - Accepted Data (Fact)	5.4.	Thermal conductivity and thermal diffusivity of aluminum alloy 6061.	N/A	N/A	N/A	N/A
		Page 619	N/A - Accepted Data (Fact)	5.4.	Density of aluminum alloy 6061.	N/A	N/A	N/A	N/A

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File Name: DIRS-000001.doc CAL-UDC-ME-000001 REV 00

Attachment XIV - Page 7

39	Incropera, F.P. and DeWitt, D.P. 1996. <i>Introduction to Heat Transfer</i> . 3rd Edition. New York, New York: John Wiley & Sons. TIC: 241057.	Equation 3.6	N/A - Accepted Data (Fact)	5.3.	General heat conduction equation.	N/A	N/A	N/A	N/A
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Distance (cm)	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	Node 11	Node 12	Node 13	Node 14	Node 15	Node 16	Node 17	Node 18
Time (y)	17.78	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	22.352
0.0	wwpbsid								wmidslid									wwpsid
0.1	65.8	67.5	69.2	70.9	72.6	74.3	76.0	77.7	79.3	78.0	76.6	75.3	73.9	72.6	71.2	69.9	68.5	67.2
1	93.6	95.4	97.2	99.0	100.8	102.6	104.4	106.2	108.0	106.3	104.7	103.0	101.3	99.7	98.0	96.4	94.7	93.0
5	121.4	123.1	124.7	126.4	128.0	129.7	131.3	132.9	134.6	133.2	131.7	130.3	128.9	127.4	126.0	124.6	123.1	121.7
6	155.1	156.5	157.8	159.2	160.6	161.9	163.3	164.7	166.0	164.9	163.7	162.6	161.5	160.3	159.2	158.0	156.9	155.7
7	160.8	162.0	163.3	164.6	165.9	167.2	168.5	169.8	171.1	170.0	168.9	167.8	166.7	165.6	164.5	163.4	162.3	161.2
8	165.4	166.6	167.9	169.1	170.4	171.6	172.9	174.1	175.4	174.3	173.2	172.2	171.1	170.1	169.0	168.0	166.9	165.9
9	169.9	171.1	172.3	173.5	174.6	175.8	177.0	178.2	179.4	178.4	177.4	176.4	175.4	174.4	173.3	172.3	171.3	170.3
10	173.2	174.3	175.5	176.6	177.8	178.9	180.1	181.3	182.4	181.4	180.5	179.5	178.5	177.5	176.5	175.5	174.5	173.5
20	175.4	176.5	177.7	178.8	179.9	181.0	182.2	183.3	184.4	183.4	182.5	181.5	180.6	179.6	178.6	177.7	176.7	175.7
50	190.9	191.7	192.6	193.5	194.4	195.3	196.2	197.1	198.0	197.2	196.5	195.7	194.9	194.2	193.4	192.6	191.9	191.1
100	189.8	190.4	191.0	191.6	192.2	192.8	193.4	194.0	194.6	194.1	193.5	193.0	192.5	192.0	191.5	191.0	190.5	190.0
1000	177.3	177.7	178.1	178.5	178.9	179.3	179.7	180.1	180.5	180.2	179.8	179.5	179.2	178.9	178.6	178.2	177.9	177.6
150	172.5	172.8	173.1	173.5	173.8	174.1	174.4	174.8	175.1	174.8	174.5	174.3	174.0	173.8	173.5	173.2	173.0	172.7
200	167.6	167.9	168.1	168.4	168.6	168.9	169.2	169.4	169.7	169.5	169.3	169.0	168.8	168.6	168.4	168.2	168.0	167.8
250	164.7	165.0	165.2	165.4	165.7	165.9	166.2	166.4	166.8	166.4	166.2	165.9	165.7	165.5	165.3	165.1	164.9	164.7
300	161.9	162.1	162.3	162.5	162.7	162.9	163.1	163.4	163.6	163.4	163.2	163.1	162.9	162.7	162.5	162.4	162.2	162.0
400	158.1	158.3	158.5	158.7	158.9	159.0	159.2	159.4	159.6	159.4	159.3	159.1	159.0	158.8	158.7	158.5	158.4	158.2
1000	145.4	145.5	145.6	145.7	145.8	145.9	146.0	146.1	146.2	146.1	146.0	145.9	145.8	145.7	145.6	145.5	145.4	145.3
4000	128.5	128.6	128.6	128.6	128.7	128.7	128.8	128.8	128.8	128.8	128.8	128.8	128.7	128.7	128.7	128.6	128.6	128.6
8000	129.0	129.0	129.1	129.1	129.1	129.1	129.2	129.2	129.2	129.2	129.2	129.2	129.1	129.1	129.1	129.1	129.1	129.0
10000	127.1	127.1	127.2	127.2	127.2	127.3	127.3	127.3	127.4	127.3	127.3	127.3	127.3	127.3	127.2	127.2	127.2	127.2

* - Values for wwpbsid, wmidslid, and wwpsid are output values from Reference 37 (File Name: f04d53c.old.out).

Distance (cm)	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	Node 11	Node 12	Node 13	Node 14	Node 15	Node 16	Node 17	Node 18
Time (y)	17.78	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	22.352
0.0	wwpbtot								wmidtot									wwpsot
0.1	65.6	67.3	69.0	70.6	72.3	74.0	75.7	77.4	79.0	77.7	76.4	75.1	73.7	72.4	71.1	69.8	68.4	67.1
1	92.4	94.1	95.7	97.3	99.0	100.6	102.3	103.9	105.5	104.0	102.5	101.0	99.5	98.0	96.4	94.9	93.4	91.9
5	120.3	121.8	123.3	124.8	126.3	127.8	129.3	130.8	132.3	131.0	129.7	128.4	127.1	125.8	124.5	123.2	121.9	120.6
6	154.2	155.5	156.7	157.9	159.1	160.4	161.6	162.8	164.0	163.0	162.0	161.0	160.0	158.9	157.9	156.9	155.9	154.9
7	159.9	161.1	162.2	163.4	164.5	165.7	166.9	168.0	169.2	168.2	167.2	166.2	165.3	164.3	163.3	162.3	161.4	160.4
8	164.6	165.7	166.8	167.9	169.0	170.2	171.3	172.4	173.5	172.6	171.6	170.7	169.7	168.8	167.9	166.9	166.0	165.1
9	169.1	170.1	171.2	172.3	173.4	174.4	175.5	176.6	177.6	176.7	175.8	174.9	174.0	173.1	172.2	171.3	170.4	169.5
10	172.4	173.4	174.5	175.5	176.6	177.6	178.6	179.7	180.7	179.8	178.9	178.1	177.2	176.3	175.4	174.5	173.7	172.8
20	174.7	175.7	176.7	177.7	178.7	179.7	180.7	181.7	182.7	181.9	181.0	180.1	179.3	178.4	177.6	176.7	175.9	175.0
50	190.3	191.1	191.9	192.7	193.5	194.2	195.0	195.8	196.6	196.0	195.3	194.6	193.9	193.2	192.6	191.9	191.2	190.5
100	189.4	189.9	190.4	191.0	191.5	192.0	192.6	193.1	193.6	193.2	192.8	192.3	191.9	191.4	191.0	190.5	190.1	189.6
1000	177.1	177.4	177.8	178.1	178.5	178.8	179.2	179.5	179.9	179.6	179.3	179.0	178.8	178.5	178.2	177.9	177.6	177.3
150	172.3	172.6	172.8	173.1	173.4	173.7	174.0	174.3	174.6	174.4	174.1	173.9	173.7	173.4	173.2	172.9	172.7	172.5
200	167.4	167.7	167.9	168.1	168.4	168.6	168.8	169.1	169.3	169.1	168.9	168.7	168.5	168.4	168.2	168.0	167.8	167.6
250	164.6	164.8	165.0	165.2	165.4	165.6	165.8	166.1	166.3	166.1	165.9	165.8	165.6	165.4	165.3	165.1	164.9	164.7
300	161.7	161.9	162.1	162.3	162.5	162.7	162.9	163.1	163.3	163.1	162.9	162.8	162.6	162.5	162.3	162.2	162.0	161.9
400	158.0	158.2	158.3	158.5	158.7	158.8	159.0	159.2	159.3	159.2	159.1	158.9	158.8	158.7	158.5	158.4	158.3	158.1
1000	145.3	145.4	145.5	145.6	145.7	145.8	145.9	146.0	146.1	146.0	145.9	145.8	145.7	145.6	145.5	145.4	145.3	145.2
4000	128.5	128.5	128.6	128.6	128.6	128.7	128.7	128.8	128.8	128.8	128.7	128.7	128.7	128.7	128.6	128.6	128.6	128.5
8000	129.0	129.0	129.0	129.0	129.1	129.1	129.1	129.2	129.2	129.2	129.1	129.1	129.1	129.1	129.1	129.0	129.0	129.0
10000	127.1	127.1	127.1	127.2	127.2	127.2	127.3	127.3	127.3	127.3	127.3	127.3	127.2	127.2	127.2	127.2	127.2	127.1

* - Values for wwpbtot, wmidtot, and wwpsot are output values from Reference 37 (File Name: f04d53c.old.out).

TIME	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Node 7	Node 8	Node 9	Node 10	Node 11	Node 12	Node 13	Node 14	Node 15	Node 16	Node 17	Node 18
Distance (cm)	17.78	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	20.0025	22.352
Time (y)	wwpbbot								wmidbot									wwpsbot
0.0	66.1	67.8	69.5	71.3	73.0	74.7	76.4	78.2	79.9	78.5	77.2	75.8	74.4	73.1	71.7	70.4	69.0	67.6
0.1	95.7	97.8	99.9	102.0	104.1	106.3	108.4	110.5	112.6	110.7	108.8	106.9	105.0	103.1	101.2	99.3	97.4	95.5
1	123.4	125.4	127.4	129.3	131.3	133.3	135.2	137.2	139.1	137.5	135.8	134.1	132.5	130.8	129.1	127.4	125.8	124.1
5	156.8	158.4	160.1	161.7	163.4	165.0	166.7	168.3	170.0	168.6	167.3	165.9	164.6	163.2	161.8	160.5	159.1	157.8
6.0	162.4	163.9	165.5	167.1	168.6	170.2	171.8	173.4	174.9	173.6	172.3	171.0	169.7	168.4	167.1	165.8	164.5	163.2
7.0	167.0	168.5	170.0	171.5	173.0	174.5	176.1	177.6	179.1	177.8	176.6	175.3	174.1	172.8	171.5	170.3	169.0	167.8
8.0	171.4	172.8	174.3	175.8	177.2	178.7	180.2	181.6	183.1	181.9	180.6	179.4	178.2	177.0	175.8	174.6	173.3	172.1
9.0	174.7	176.1	177.5	178.9	180.3	181.7	183.2	184.6	186.0	184.8	183.6	182.4	181.3	180.1	178.9	177.7	176.5	175.3
10	176.8	178.2	179.6	181.0	182.4	183.8	185.1	186.5	187.9	186.8	185.6	184.4	183.3	182.1	181.0	179.8	178.7	177.5
20	192.0	193.1	194.2	195.3	196.5	197.6	198.7	199.8	200.9	200.0	199.0	198.1	197.2	196.3	195.3	194.4	193.5	192.5
50	190.5	191.3	192.0	192.8	193.5	194.2	195.0	195.7	196.4	195.8	195.2	194.6	194.0	193.4	192.8	192.2	191.6	191.0
100	177.8	178.3	178.8	179.3	179.8	180.2	180.7	181.2	181.7	181.3	180.9	180.5	180.1	179.7	179.4	179.0	178.6	178.2
150	172.9	173.3	173.7	174.1	174.5	174.9	175.3	175.7	176.1	175.7	175.4	175.1	174.8	174.5	174.1	173.8	173.6	173.2
200	167.9	168.2	168.5	168.9	169.2	169.5	169.8	170.1	170.4	170.2	169.9	169.7	169.4	169.2	168.9	168.7	168.4	168.2
250	165.0	165.3	165.6	165.9	166.2	166.5	166.7	167.0	167.3	167.1	166.9	166.8	166.6	166.2	165.9	165.7	165.5	165.2
300	162.1	162.4	162.6	162.9	163.2	163.4	163.7	163.9	164.2	164.0	163.8	163.6	163.4	163.2	162.9	162.7	162.5	162.3
400	158.3	158.6	158.8	159.0	159.2	159.5	159.7	159.9	160.1	159.9	159.8	159.6	159.4	159.2	159.1	158.9	158.7	158.5
1000	145.5	145.6	145.7	145.8	145.9	146.1	146.2	146.3	146.4	146.3	146.2	146.1	146.0	146.0	145.9	145.8	145.7	145.6
4000	128.6	128.6	128.7	128.7	128.8	128.8	128.9	128.9	129.0	128.9	128.9	128.9	128.8	128.8	128.7	128.7	128.7	128.6
8000	129.0	129.1	129.1	129.1	129.2	129.2	129.3	129.3	129.3	129.3	129.3	129.2	129.2	129.2	129.2	129.1	129.1	129.1
10000	127.2	127.2	127.2	127.3	127.3	127.3	127.3	127.4	127.4	127.4	127.4	127.4	127.3	127.3	127.3	127.3	127.2	127.2

Time (years)	Normalized Decay Heat Factors																													
	0	1	5	6	7	8	9	10	20	50	51	55	60	70	100	150	200	250	300	400	450	1000	1050	4000	4050	8000	8050	10000	10050	12000
Node 1	0.572	0.456	0.424	0.429	0.435	0.440	0.445	0.450	0.463	0.466	0.466	0.465	0.465	0.464	0.461	0.456	0.464	0.471	0.480	0.497	0.501	0.542	0.544	0.642	0.642	0.671	0.671	0.682	0.683	0.694
Node 2	0.881	0.783	0.742	0.744	0.747	0.749	0.751	0.753	0.767	0.784	0.784	0.785	0.786	0.789	0.797	0.811	0.821	0.831	0.837	0.849	0.851	0.865	0.865	0.888	0.888	0.899	0.899	0.905	0.905	0.910
Node 3	1.021	0.976	0.955	0.955	0.955	0.955	0.955	0.955	0.960	0.974	0.974	0.975	0.976	0.979	0.986	0.998	1.004	1.010	1.012	1.018	1.018	1.018	1.018	1.007	1.007	1.008	1.008	1.010	1.010	1.013
Node 4	1.053	1.053	1.050	1.050	1.049	1.049	1.048	1.047	1.048	1.051	1.051	1.052	1.052	1.054	1.058	1.065	1.067	1.069	1.068	1.067	1.066	1.061	1.061	1.047	1.047	1.044	1.044	1.044	1.044	1.044
Node 5	1.047	1.080	1.090	1.089	1.088	1.088	1.087	1.086	1.084	1.086	1.086	1.087	1.087	1.087	1.089	1.091	1.090	1.088	1.087	1.085	1.085	1.080	1.079	1.059	1.059	1.057	1.057	1.055	1.055	1.053
Node 6	1.036	1.085	1.102	1.102	1.102	1.102	1.102	1.102	1.098	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.097	1.095	1.093	1.088	1.088	1.080	1.079	1.064	1.064	1.062	1.062	1.060	1.060	1.058
Node 7	1.029	1.086	1.106	1.105	1.104	1.104	1.103	1.102	1.098	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.097	1.095	1.093	1.088	1.088	1.080	1.079	1.064	1.064	1.059	1.059	1.057	1.057	1.056
Node 8	1.026	1.086	1.107	1.107	1.106	1.106	1.105	1.105	1.101	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.097	1.095	1.093	1.088	1.088	1.080	1.079	1.063	1.063	1.057	1.057	1.055	1.055	1.053
Node 9	1.033	1.086	1.104	1.103	1.102	1.101	1.100	1.100	1.098	1.098	1.098	1.098	1.098	1.098	1.098	1.098	1.095	1.093	1.091	1.088	1.088	1.080	1.079	1.063	1.063	1.057	1.057	1.055	1.055	1.053
Node 10	1.046	1.092	1.107	1.106	1.105	1.104	1.103	1.102	1.099	1.095	1.095	1.095	1.095	1.095	1.093	1.092	1.089	1.086	1.084	1.079	1.079	1.073	1.073	1.058	1.057	1.053	1.053	1.051	1.051	1.050
Node 11	1.062	1.099	1.111	1.110	1.108	1.107	1.106	1.105	1.102	1.095	1.095	1.095	1.095	1.095	1.094	1.094	1.091	1.088	1.086	1.082	1.082	1.073	1.073	1.061	1.061	1.057	1.057	1.055	1.055	1.053
Node 12	1.080	1.106	1.114	1.113	1.112	1.110	1.109	1.108	1.103	1.093	1.093	1.093	1.093	1.092	1.090	1.087	1.083	1.079	1.077	1.073	1.073	1.067	1.067	1.056	1.056	1.050	1.050	1.047	1.047	1.044
Node 13	1.098	1.120	1.121	1.120	1.118	1.116	1.115	1.113	1.106	1.102	1.101	1.101	1.100	1.099	1.095	1.089	1.085	1.081	1.079	1.073	1.073	1.067	1.067	1.054	1.054	1.048	1.048	1.046	1.046	1.044
Node 14	1.114	1.131	1.137	1.135	1.133	1.131	1.129	1.127	1.120	1.113	1.113	1.113	1.112	1.110	1.106	1.099	1.095	1.091	1.088	1.082	1.082	1.073	1.073	1.061	1.061	1.055	1.055	1.052	1.052	1.050
Node 15	1.118	1.131	1.137	1.135	1.134	1.132	1.131	1.129	1.123	1.111	1.111	1.110	1.109	1.108	1.103	1.095	1.089	1.084	1.081	1.076	1.075	1.067	1.067	1.059	1.059	1.053	1.053	1.050	1.050	1.047
Node 16	1.093	1.087	1.092	1.090	1.089	1.087	1.086	1.084	1.081	1.075	1.075	1.075	1.075	1.074	1.072	1.068	1.065	1.063	1.060	1.055	1.054	1.049	1.049	1.042	1.042	1.039	1.039	1.036	1.036	1.033
Node 17	0.997	0.951	0.938	0.939	0.940	0.940	0.941	0.942	0.947	0.952	0.952	0.952	0.953	0.953	0.954	0.956	0.959	0.961	0.963	0.966	0.966	0.969	0.969	0.970	0.970	0.970	0.970	0.970	0.970	0.970
Node 18	0.684	0.581	0.551	0.556	0.562	0.567	0.572	0.577	0.590	0.596	0.596	0.596	0.596	0.595	0.594	0.591	0.599	0.608	0.615	0.631	0.634	0.664	0.665	0.733	0.733	0.753	0.753	0.761	0.761	0.769
*- Shaded numbers were interpolated																														

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