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Design Analysis Cover Sheet

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11. REMARKS

Attachments XXII through XLI have been made independent references for this analysis.

This analysis was started under procedure QAP-3-9, REV 06. During the development of this analysis QAP-3-9 was modified to REV 07. Impact review HAB-IR-002 was performed, and it was determined that this analysis should be completed under procedure QAP-3-9, REV 06, with some procedure modifications as documented in the impact review.

CRWMS/M&O

Design Analysis Revision Record

Complete only applicable items.

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2. DESIGN ANALYSIS TITLE

CRC Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X of Crystal River Unit 3

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1. Purpose

The purpose of this design analysis is to document the SAS2H depletion calculations of certain rodded fuel assemblies from batches 1, 2, 3, and 1X of the Crystal River Unit 3 pressurized water reactor (PWR) that are required for Commercial Reactor Critical (CRC) evaluations to support development of the disposal criticality methodology. A rodded assembly is one that contains a control rod assembly (CRA) or an axial power shaping rod assembly (APSRA) for some period of time during its irradiation history. The objective of this analysis is to provide SAS2H calculated isotopic compositions of depleted fuel and depleted burnable poison for each fuel assembly to be used in subsequent CRC reactivity calculations containing the fuel assemblies.

2. Quality Assurance

The Quality Assurance (QA) program applies to this analysis. The work reported in this document is part of the criticality disposal methodology development that will eventually support the License Application Design phase. This activity, when appropriately confirmed, can impact the proper functioning of the Mined Geologic Disposal System (MGDS) waste package; the waste package has been identified as an MGDS Q-List item important to safety and waste isolation (pp. 4, 15, Ref. 5.6). The waste package is on the Q-List by direct inclusion by the Department of Energy (DOE), without conducting a QAP-2-3 evaluation. As determined by an evaluation performed in accordance with QAP-2-0, *Conduct of Activities*, the work performed for this analysis is subject to *Quality Assurance Requirements and Description* (QARD; Ref. 5.2) requirements. As specified in NLP-3-18, "Documentation of QA Controls on Drawings, Specifications, Design Analyses, and Technical Documents", the development of this analysis is subject to QA controls. The Waste Package Development Department (WPDD) responsible manager has selected the applicable procedural controls for this activity commensurate with the work control activity evaluation entitled "Perform Criticality, Thermal, Structural, and Shielding Analyses" (Ref. 5.1).

The work reported in this document is part of the CRC neutronic analyses to support the development of the disposal criticality methodology. All design parameters utilized in this analysis are from a qualified source (Ref. 5.3) which was developed under a U. S. Nuclear Regulatory Commission approved QA program. Therefore, all design parameters utilized in this analysis are qualified.

3. Method

The method for obtaining fuel and burnable poison isotopic compositions at specific points during each assembly's irradiation history is based upon the use of the SAS2H control module of the SCALE 4.3 modular code system (Ref. 5.4). The effective full-power day (EFPD) times during reactor operation that correspond to a CRC evaluation are called "statepoints". An assembly depletion calculation between two CRC statepoints is called a "statepoint calculation". The depleted fuel and depleted burnable poison compositions may be used in subsequent CRC reactivity calculations. The SAS2H input decks are automatically developed by the CRAFT program which is a software routine documented in Sections 7.4 and 7.5 and Attachment I of this analysis. The SAS2H input decks and depletion models are developed using actual assembly specifications, actual assembly irradiation histories, and actual CRA and APSRA insertion histories. The isotopic results obtained from the SAS2H depletion calculations are reviewed and analyzed to identify any anomalous results which may propagate to subsequent CRC reactivity calculations and ultimately impact the development of the disposal criticality methodology.

4. Design Inputs

The design inputs documented in this analysis describe the design specifications and irradiation histories for certain rodded fuel assemblies in fuel batches 1, 2, 3, and 1X of the Crystal River Unit 3 PWR. All of the design inputs listed in this analysis are obtained from reference 5.3, which is a reference summarizing the necessary input parameters.

4.1 Design Parameters

4.1.1 Fuel Assembly Descriptions

Table 4.1.1-1 contains a description of the rodded fuel assemblies corresponding to fuel batches 1, 2, 3, and 1X of Crystal River Unit 3. All fuel assemblies within a given fuel batch have the same characteristics as identified in Table 4.1.1-1.

Table 4.1.1-1 Fuel Assembly Descriptions for Batches 1, 2, 3, and 1X of Crystal River Unit 3

	Fuel Batch Identifier			
Parameter	**1**	**2**	**3**	**1X**
Assembly Type	Mark-B3	Mark-B3	Mark-B3	Mark-B2
Weight Percent U-235	1.93	2.54	2.83	2.00
kg of U per Assembly	463.63	463.63	463.63	468.62
Fuel Height (cm)	360.172	360.172	360.172	360.172
Fuel Pellet OD[1] (cm)	0.9398	0.9398	0.9398	0.9398
Fuel Rod Clad OD (cm)	1.0922	1.0922	1.0922	1.0922
Fuel Rod Clad ID[2] (cm)	0.95758	0.95758	0.95758	0.95758
Spacer Grid Material	Inconel	Inconel	Inconel	Inconel
Volume Fraction of Spacer Grid in Moderator	0.005757609	0.005757609	0.005757609	0.005757609
Guide Tube Material	Zircaloy	Zircaloy	Zircaloy	Zircaloy
Guide Tube OD (cm)	1.3462	1.3462	1.3462	1.3462

	Fuel Batch Identifier			
Parameter	1	2	3	1X
Guide Tube ID (cm)	1.26492	1.26492	1.26492	1.26492
Instrument Tube Material	Zircaloy	Zircaloy	Zircaloy	Zircaloy
Instrument Tube OD (cm)	1.38193	1.38193	1.38193	1.38193
Instrument Tube ID (cm)	1.12014	1.12014	1.12014	1.12014
Array Size	15x15	15x15	15x15	15x15
Number of Fuel Rods	208	208	208	208
Number of Guide Tubes	16	16	16	16
Number of Instr. Tubes	1	1	1	1
Pin Pitch (cm)	1.44272	1.44272	1.44272	1.44272
Assembly Pitch (cm)	21.81098	21.81098	21.81098	21.81098

[1] OD = Outer Diameter
[2] ID = Inner Diameter

4.1.2 Burnable Poison Rod Assembly (BPRA) Description

Table 4.1.2-1 contains a description of the burnable poison rod assembly utilized in the various fuel assemblies from fuel batches 1, 2, 3, and 1X of Crystal River Unit 3. The rods of the BPRA are inserted into the guide tubes of the fuel assembly during irradiation to produce a lower thermal flux which ultimately allows for longer fuel assembly burnup and better core power distributions.

Table 4.1.2-1 BPRA Descriptions for Use in Batches 1, 2, 3, and 1X of Crystal River Unit 3

Parameter	Value
Burnable Poison (BP) Material	Al_2O_3-B_4C
BP Density (g/cc)	3.7
BP Pellet OD (cm)	0.8636
Burnable Poison Rod (BPR) Cladding Material	Zircaloy
BPR Cladding OD (cm)	1.0922
BPR Cladding ID (cm)	0.9144
Number of BPR's in a BPRA	16

4.1.3 Control Rod Assembly (CRA) Description

Table 4.1.3-1 contains a description of the control rod assembly utilized in the various fuel assemblies from fuel batches 1, 2, 3, and 1X of Crystal River Unit 3. The rods of the CRA are inserted into the guide tubes of the fuel assembly during irradiation to produce a local thermal flux depression which provides a mechanism for controlling the core power distribution (both radially and axially). Operating with CRAs inserted may also allow for extended fuel assembly burnup.

Table 4.1.3-1 CRA Descriptions for Use in Batches 1, 2, 3, and 1X of Crystal River Unit 3

Parameter	Value
Control Rod Neutron Absorbing Material	Ag-In-Cd with a 79.8, 15.0, and 5.0 weight percent by mass composition, respectively
Ag-In-Cd Density (g/cc)	10.17
Absorber Pellet OD (cm)	0.99568
Control Rod (CR) Cladding Material	Stainless Steel 304 (SS304)
CR Cladding OD (cm)	1.11760
CR Cladding ID (cm)	1.01092
Number of CR's in a CRA	16

4.1.4 Axial Power Shaping Rod Assembly (APSRA) Description

Table 4.1.4-1 contains a description of the axial power shaping rod assembly utilized in the various fuel assemblies from fuel batches 1, 2, 3, and 1X of Crystal River Unit 3. The rods of the APSRA are inserted into the guide tubes of the fuel assembly during irradiation to produce a local thermal flux depression which provides a mechanism for controlling the core power distribution (both radially and axially). Operating with APSRAs inserted allows for a more uniform axial burnup which results in longer average fuel assembly burnups. There are two types of APSRAs (black and grey) utilized in Crystal River Unit 3. The black APSRAs utilize Ag-In-Cd as the neutron absorbing material. The grey APSRAs utilize Inconel as the neutron absorbing material. As the names indicate, the black APSRAs have a larger macroscopic neutron absorption cross-section than the grey APSRAs. The grey APSRAs were not inserted in any of the assemblies documented in this analysis.

Table 4.1.4-1 Black APSRA Descriptions for Use in Batches 1, 2, 3, and 1X of Crystal River Unit 3

Parameter	Value
APSRA Neutron Absorbing Material	Ag-In-Cd with a 79.8, 15.0, and 5.0 weight percent by mass composition, respectively

Parameter	Value
Ag-In-Cd Density (g/cc)	10.17
Absorber Pellet OD (cm)	0.99568
Axial Power Shaping Rod (APSR) Cladding Material	Stainless Steel 304 (SS304)
APSR Cladding OD (cm)	1.11760
APSR Cladding ID (cm)	1.01092
Number of APSR's in an APSRA	16

4.1.5 System Pressure

Crystal River Unit 3 is a pressurized water reactor that operates at a constant pressure of 2200 psi (pounds per square inch).

4.1.6 Fuel Assembly Insertion, Burnable Poison Loading, and Control Bank Insertion Histories

The actual irradiation histories of the fuel assemblies in batches 1, 2, 3, and 1X must be used to perform the various assembly depletion calculations relevant to the CRC analyses. Table 4.1.6-1 contains the assembly insertion, burnable poison (BP) loading, and control bank insertion histories for the rodded assemblies in fuel batches 1, 2, 3, and 1X which are required for the CRC analyses of Crystal River Unit 3. For fuel management purposes, some fuel assemblies were removed from the reactor and re-inserted in a later cycle as shown in Table 4.1.6-1.

Table 4.1.6-1 Crystal River Unit 3, Batches 1, 2, 3, and 1X, Rodded Fuel Assembly Insertion, BP Loading, and Control Bank Insertion Histories

Assembly	Assembly Location in Cycle							
Number/Batch	1A	1B	2	3	7	8	9	Comments
A1 / 2	CR7	CR7	X	X				The "A" designation
A4 / 2	1.18	X	CR6					in the assembly
A5 / 1	CR6	CR6						number indicates
A7 / 3	CR4	CR7	CR6	X				that Cycle 1A is the
A14 / 2	1.34	X	X		CR7			assembly's initial
A18 / 1	CR8					X		insertion cycle.
A18a / 1	CR8						X	For BP rods, the wt%
A18b / 1	CR8	CR8						of B4C in the BP
A20 / 3	CR7	X	X	X				material is given.

Assembly Number/Batch	Assembly Location in Cycle 1A	1B	2	3	7	8	9	Comments
A22 / 1	CR6	CR6						CR4=Control Bank 4
A23 / 2	1.01	X	CR7	X				CR6=Control Bank 6
A23a / 2	1.01	X	CR7	X				CR7=Control Bank 7
A25 / 3	X	X	X	CR7				CR8=Control Bank 8
A25a / 3	X	X	X	CR6				CR8=Black APSR
A26 / 1	CR4	CR8						The "X" indicates
A28 / 3	X	X	CR8	X				that the assembly is
A29 / 3	X	X	X	CR7				present in the cycle
O1 / 1X	X[1]	CR7						indicated.

[1] The "O1" assembly has a control rod insertion history from when it was inserted in Cycle 1 of Oconee.

4.1.7 Fuel Assembly Insertion Position Histories

The positions of the various assemblies in the core must be known to correlate the burnup, fuel temperature, and moderator specific volume data with the appropriate assembly. The assembly position data is also used to document the depletion cases so that the isotopic results may be identified at a later time for a specific assembly in a particular position of the core. Table 4.1.7-1 contains the assembly position histories for the rodded assemblies in batches 1, 2, 3, and 1X of Crystal River Unit 3 which are relevant to the CRC analyses. The assembly position identifiers refer to locations in a one-eighth core symmetrical arrangement for Crystal River Unit 3 as shown in Figure 4.1.7-1. The integer values (1-29) shown in Figure 4.1.7-1 are used in the SAS2H depletion calculations to identify the various assembly locations.

Table 4.1.7-1 Assembly Position Histories for the Rodded Assemblies from Batches 1, 2, 3, and 1X of Crystal River Unit 3

Assembly Number	Assembly Location in Cycle 1A	1B	2	3	7	8	9
A1	H8	H8	H8	H8			
A4	H11	H11	N12				
A5	H12	H12					
A7	H14	H14	H10	H11			
A14	K14	K14	K14		H12		
A18	L12					H8	
A18a	L12						H8
A18b	L12	L12					
A20	L14	L14	M12	K12			

Assembly Number	Assembly Location in Cycle 1A	1B	2	3	7	8	9
A22	M11	M11					
A23	M12	M12	H14	H13			
A23a	M12	M12	L10	M11			
A25	M14	M14	K13	H14			
A25a	M14	M14	K13	N12			
A26	N12	L12					
A28	N14	N14	L12	K10			
A29	O13	O13	M11	L10			
O1	K9[1]	N12					

[1] Assembly "O1" in was in location K9 in Cycle 1 of Oconee. There are no CRC statepoints for Oconee. Therefore, an arbitrary assembly position for assembly "O1" in Cycle 1 of Oconee may be documented in the calculations as long as the correct (from "K9") data (i.e., burnups, fuel temperatures, moderator specific volumes, etc.) are utilized in the calculations.

	8	9	10	11	12	13	14	15
H	1	2	3	4	5	6	7	8
K		9	10	11	12	13	14	15
L			16	17	18	19	20	21
M				22	23	24	25	
N					26	27	28	
O						29		

Figure 4.1.7-1 One-Eighth Symmetry Core Layout for Crystal River Unit 3

4.1.8 Reactor Cycle History Data

Table 4.1.8-1 contains a listing of the Crystal River Unit 3 reactor cycle history data that is relevant to the SAS2H depletion calculations documented in this analysis. The time durations other than the days of downtime and the total cycle effective full power days presented in Table 4.1.8-1 are calculated using the appropriate dates from Table 4.1.8-1 and the Lotus 1-2-3 "DATEDIF" function.

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X

Crystal River, Unit-3, Cycle-1A Summary

01/14/77 : Cycle Start Date
03/03/78 : Cycle End Date
413 : Cycle Length (Calendar Days)
268.8 : Cycle Effective Full Power Day (EFPD) Value

195.292 : Calendar Days of Downtime Between Cycle 1A and 1B

Crystal River, Unit-3, Cycle-1B Summary

09/18/78 : Cycle Start Date (09/15/78: Ref. 5.3)
03/03/79 : 411.0 EFPD Shutdown Date
03/18/79 : Restart Date After the 411.0 EFPD Shutdown
04/23/79 : Cycle End Date
166 : Cycle Length to 411.0 EFPD Date
36 : Cycle Length from 411.0 EFPD Restart to End of Cycle (EOC)
217 : Total Cycle Length (Calendar Days)
14.792 : Days of Downtime During Shutdown at 411.0 EFPD
171.3 : Total Cycle Effective Full Power Days

97 : Calendar Days of Downtime Between Cycle 1B and 2

Crystal River, Unit-3, Cycle-2 Summary

07/29/79 : Cycle Start Date
02/26/80 : Cycle End Date
212 : Cycle Length (Calendar Days)
166.5 : Cycle Effective Full Power Days

164 : Calendar Days of Downtime Between Cycle 2 and 3

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X

<u>Crystal River, Unit-3, Cycle-3 Summary</u>

08/08/80 : Cycle Start Date
02/17/81 : 168.5 EFPD Shutdown Date
03/06/81 : Restart Date After the 168.5 EFPD Shutdown
06/30/81 : 250.0 EFPD Shutdown Date
07/13/81 : Restart Date After the 250.0 EFPD Shutdown
09/28/81 : Cycle End Date
193 : Cycle Length to 168.5 EFPD Date
116 : Cycle Length from 168.5 EFPD Restart to 250.0 EFPD Date
77 : Cycle Length from 250.0 EFPD Restart to EOC Date
416 : Total Cycle Length (Calendar Days)
16.792 : Days of Downtime During Shutdown at 168.5 EFPD
12.333 : Days of Downtime During Shutdown at 250.0 EFPD
323 : Total Cycle Effective Full Power Days

73 : Calendar Days of Downtime Between Cycle 3 and 4

<u>Crystal River, Unit-3, Cycle-4 Summary</u>

12/10/81 : Cycle Start Date
10/14/82 : 228.1 EFPD Shutdown Date
10/31/82 : Restart Date After the 228.1 EFPD Shutdown (10/29/82: Ref. 5.3)
11/25/82 : 253.0 EFPD Shutdown Date (11/26/82: Ref. 5.3)
12/20/82 : Restart Date After the 253.0 EFPD Shutdown
03/19/83 : Cycle End Date
308 : Cycle Length to 228.1 EFPD Date
25 : Cycle Length from 228.1 EFPD Restart to 253.0 EFPD Date
89 : Cycle Length from 253.0 EFPD Restart to EOC Date
464 : Total Cycle Length (Calendar Days)
15.167 : Days of Downtime During Shutdown at 228.1 EFPD
24 : Days of Downtime During Shutdown at 253.0 EFPD
336.6 : Total Cycle Effective Full Power Days

127 : Calendar Days of Downtime Between Cycle 4 and 5

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X

Crystal River, Unit-3, Cycle-5 Summary

07/24/83 : Cycle Start Date
11/05/84 : 388.5 EFPD Shutdown Date
11/10/84 : Restart Date After the 388.5 EFPD Shutdown
03/08/85 : Cycle End Date
470 : Cycle Length to 388.5 EFPD Date
118 : Cycle Length from 388.5 EFPD Restart to EOC Date
593 : Total Cycle Length (Calendar Days)
4.958 : Days of Downtime During Shutdown at 388.5 EFPD
484.4 : Total Cycle Effective Full Power Days

163 : Calendar Days of Downtime Between Cycle-5 and 6

Crystal River, Unit-3, Cycle-6 Summary

08/18/85 : Cycle Start Date
01/01/86 : 96.0 EFPD Shutdown Date
06/19/86 : Restart Date After the 96.0 EFPD Shutdown
08/21/87 : 400.0 EFPD Shutdown Date
08/31/87 : Restart Date After the 400.0 EFPD Shutdown (09/01/87: Ref. 5.3)
09/18/87 : Cycle End Date
136 : Cycle Length to 96.0 EFPD Date
428 : Cycle Length from 96.0 EFPD Restart to 400.0 EFPD Date
18 : Cycle Length from 400.0 EFPD Restart to EOC Date
761 : Total Cycle Length (Calendar Days)
168.917 : Days of Downtime During Shutdown at 96.0 EFPD
10.417 : Days of Downtime During Shutdown at 400.0 EFPD
412.07 : Total Cycle Effective Full Power Days

113 : Calendar Days of Downtime Between Cycle 6 and 7

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X

Crystal River, Unit-3, Cycle-7 Summary

01/08/88 : Cycle Start Date
10/09/88 : 260.3 EFPD Shutdown Date
10/28/88 : Restart Date After the 260.3 EFPD Shutdown (10/27/88: Ref. 5.3)
12/07/88 : 291.0 EFPD Shutdown Date
01/16/89 : Restart Date After the 291.0 EFPD Shutdown (01/15/89: Ref. 5.3)
02/26/89 : 319.0 EFPD Shutdown Date
06/16/89 : Restart Date After the 319.0 EFPD Shutdown
01/22/90 : 462.3 EFPD Shutdown Date
01/24/90 : Restart Date After the 462.3 EFPD Shutdown
02/12/90 : 479.0 EFPD Shutdown Date (02/13/90: Ref. 5.3)
02/19/90 : Restart Date After the 479.0 EFPD Shutdown (02/20/90: Ref. 5.3)
03/14/90 : Cycle End Date
275 : Cycle Length to 260.3 EFPD Date
40 : Cycle Length from 260.3 EFPD Restart to 291.0 EFPD Date
41 : Cycle Length from 291.0 EFPD Restart to 319.0 EFPD Date
220 : Cycle Length from 319.0 EFPD Restart to 462.3 EFPD Date
19 : Cycle Length from 462.3 EFPD Restart to 479.0 EFPD Date
23 : Cycle Length from 479.0 EFPD Restart to EOC
796 : Total Cycle Length (Calendar Days)
18.875 : Days of Downtime During Shutdown at 260.3 EFPD
39.5 : Days of Downtime During Shutdown at 291.0 EFPD
109.5 : Days of Downtime During Shutdown at 319.0 EFPD
2.229 : Days of Downtime During Shutdown at 462.3 EFPD
7.208 : Days of Downtime During Shutdown at 479.0 EFPD
497.9 : Total Cycle Effective Full Power Days

99 : Calendar Days of Downtime Between Cycle 7 and 8

Crystal River, Unit-3, Cycle-8 Summary

06/21/90 : Cycle Start Date
10/09/90 : 97.6 EFPD Shutdown Date
10/25/90 : Restart Date After the 97.6 EFPD Shutdown

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X

12/12/90 : 139.8 EFPD Shutdown Date
12/18/90 : Restart Date After the 139.8 EFPD Shutdown
10/14/91 : 404.0 EFPD Shutdown Date
11/27/91 : Restart Date After the 404.0 EFPD Shutdown
12/02/91 : 409.6 EFPD Shutdown Date
12/07/91 : Restart Date After the 409.6 EFPD Shutdown
03/27/92 : 515.5 EFPD Shutdown Date
04/04/92 : Restart Date After the 515.5 EFPD Shutdown
04/30/92 : Cycle End Date
110 : Cycle Length to 97.6 EFPD Date
48 : Cycle Length from 97.6 EFPD Restart to 139.8 EFPD Date
300 : Cycle Length from 139.8 EFPD Restart to 404.0 EFPD Date
5 : Cycle Length from 404.0 EFPD Restart to 409.6 EFPD Date
111 : Cycle Length from 409.6 EFPD Restart to 515.5 EFPD Date
26 : Cycle Length from 515.5 EFPD Restart to EOC
679 : Total Cycle Length (Calendar Days)
15.5 : Days of Downtime During Shutdown at 97.6 EFPD
6.2 : Days of Downtime During Shutdown at 139.8 EFPD
44.4 : Days of Downtime During Shutdown at 404.0 EFPD
4.9 : Days of Downtime During Shutdown at 409.6 EFPD
7.6 : Days of Downtime During Shutdown at 515.5 EFPD
535.9 : Total Cycle Effective Full Power Days

75 : Calendar Days of Downtime Between Cycle 8 and 9

<u>Crystal River, Unit-3, Cycle-9 Summary</u>

07/14/92 : Cycle Start Date
12/29/92 : 158.8 EFPD Shutdown Date
12/31/92 : Restart Date After the 158.8 EFPD Shutdown
03/04/93 : 219.0 EFPD Shutdown Date
04/26/93 : Restart Date After the 219.0 EFPD Shutdown
09/18/93 : 363.1 EFPD Shutdown Date
09/20/93 : Restart Date After the 363.1 EFPD Shutdown
04/07/94 : Cycle End Date

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X

168	: Cycle Length to 158.8 EFPD Date
63	: Cycle Length from 158.8 EFPD Restart to 219.0 EFPD Date
145	: Cycle Length from 219.0 EFPD Restart to 363.1 EFPD Date
199	: Cycle Length from 363.1 EFPD Restart to EOC
632	: Total Cycle Length (Calendar Days)
2.146	: Days of Downtime During Shutdown at 158.8 EFPD
53.125	: Days of Downtime During Shutdown at 219.0 EFPD
1.625	: Days of Downtime During Shutdown at 363.1 EFPD
557.23	: Total Cycle Effective Full Power Days
55	: Calendar Days of Downtime Between Cycle 9 and 10

A number of the dates presented in Table 4.1.8-1 do not correspond directly with the dates presented in reference 5.3. The date contained in reference 5.3, is presented in parentheses next to each inconsistency. Inconsistencies in the restart and shutdown date values do not affect the calculations due to the fact that the depletions are based upon EFPD durations rather than calendar day durations. The various calendar day time periods between statepoints as presented in Table 4.1.8-1 are used for documentation purposes only. The cycle starting and ending dates are the only dates presented in Table 4.1.8-1 which are involved in calculations that are documented in this analysis. A cycle's starting and ending dates are used to calculate calendar day decay durations for fuel assemblies which skip that particular cycle. Cycle-1B is the only cycle relevant to this analysis which used a starting date that does not directly correspond to the dates provided in reference 5.3. There are no assembly depletion and decay calculations documented in this analysis which were in Cycle-1A and skipped Cycle-1B to be inserted at a later time. The days of downtime between cycles are not calculated from the dates presented in Table 4.1.8-1. The days of downtime between cycles are obtained directly from reference 5.3 in units of hours that are converted to days for presentation in Table 4.1.8-1 and use in this analysis. Therefore, no calculations documented in this analysis are affected by the date inconsistencies between Table 4.1.8-1 and reference 5.3.

4.1.9 Boron Letdown Data

The boron letdown data provided in the Core Operations Reports for Cycles 1, 2, 3, 7, 8, and 9 of Crystal River Unit 3 is used to determine the soluble boron concentration in the moderator at the mid-point of each irradiation step in the various SAS2H depletion calculations performed to deplete the rodded fuel assemblies of batches 1, 2, 3, and 1X. The boron concentrations at the irradiation step mid-point effective full-power day (EFPD) times are determined by linear interpolation between the measured values listed in Tables 4.1.9-1 through 4.1.9-7. The boron letdown data tables presented in this section are obtained from reference 5.3, which is a summary compilation of data pertinent to CRC analyses for Crystal River Unit 3.

Table 4.1.9-1 Boron Letdown Data for Cycle 1A of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm*)
0.0	1147
7.2	968
18.6	912
55.2	934
63.8	909
69.9	909
94.9	884
184.7	705
192.3	683
216.0	627
224.8	610
228.5	666
238.0	584
244.0	575
250.8	614
254.7	588

* The acronym "ppm" means parts per million by mass of moderator.

Table 4.1.9-2 Boron Letdown Data for Cycle 1B of Crystal River Unit 3

EFPD with Cycles 1A & 1B Continuous [EFPD with BOC*-1B set to 0.0 EFPD]	Boron Concentration (ppm)
269.4 [0.6]	843
269.8 [1.0]	783
272.0 [3.2]	748
280.2 [11.4]	558
287.2 [18.4]	571

Table 4.1.9-2 Boron Letdown Data for Cycle 1B of Crystal River Unit 3

EFPD with Cycles 1A & 1B Continuous [EFPD with BOC*-1B set to 0.0 EFPD]	Boron Concentration (ppm)
306.2 [37.4]	513
313.2 [44.4]	441
337.2 [68.4]	419
345.7 [76.9]	346
364.2 [95.4]	309
377.6 [108.8]	246
389.5 [120.7]	279
401.7 [132.9]	290
419.3 [150.5]	272
427.1 [158.3]	229
431.8 [163.0]	231
437.1 [168.3]	229
440.1 [171.3]	242

* The acronym "BOC" means beginning of cycle.

Table 4.1.9-3 Boron Letdown Data for Cycle 2 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
0.6	930
0.8	930
0.9	930
2.1	826
3.0	809
4.4	778
11.4	809
15.8	735

Table 4.1.9-3 Boron Letdown Data for Cycle 2 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
22.5	709
29.3	683
35.3	666
42.3	644
50.0	623
55.8	614
60.8	592
69.1	571
75.2	558
83.1	528
89.8	506
97.8	480
104.7	463
116.4	441
122.5	406
129.1	385
135.9	372
139.9	346
148.6	333
156.4	320
161.4	316

Table 4.1.9-4 Boron Letdown Data for Cycle 3 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
0.7	1090
2.0	1020

Table 4.1.9-4 Boron Letdown Data for Cycle 3 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
4.0	947
6.7	951
12.6	908
26.8	891
32.6	843
50.7	822
66.0	757
69.9	746
85.0	692
100.2	666
111.2	636
130.5	562
143.8	528
163.9	467
174.0	432
184.2	394
212.9	324
227.5	272
246.4	229
262.9	250
283.8	190
304.0	130
322.0	86

Table 4.1.9-5 Boron Letdown Data for Cycle 7 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
7.5	1478
41.4	1405
60.3	1367
81.7	1333
102.9	1290
122.3	1245
139.8	1204
160.5	1167
180.8	1102
202.8	1040
230.9	963
251.2	898
306.7	803
317.9	775
345.3	593
412.3	398
459.8	260
485.0	193

Table 4.1.9-6 Boron Letdown Data for Cycle 8 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
11.2	1537
52.4	1455
78	1411
111.4	1332
154.4	1176

Table 4.1.9-6 Boron Letdown Data for Cycle 8 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
194.8	1103
234.6	999
271.5	887
338	701
390.7	522
445.7	394
474	311
513.1	216

Table 4.1.9-7 Boron Letdown Data for Cycle 9 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
22.1	1608
61.5	1535
145.7	1329
192.8	1201
211.3	1157
262	994
303.7	869
345.7	750
397.9	577
432.5	473
452.4	412
495.4	283
543.4	136

4.1.10 Burnup, Fuel Temperature, and Moderator Specific Volume Data

Burnup, fuel temperature, and moderator specific volume data are required for each node of each assembly in each SAS2H depletion calculation. A set of nodal burnup data at the beginning and end of each SAS2H depletion calculation is required. A set of nodal fuel temperature and moderator specific volume data representative of full-power operation during each depletion calculation of interest is required. Tables 4.1.10-1 through 4.1.10-18 contain the burnup, fuel temperature, and moderator specific volume data necessary to perform all depletion calculations for each of the rodded fuel assemblies from batches 1, 2, 3, and 1X of Crystal River Unit 3. The assembly heights corresponding to the axial nodes presented in Tables 4.1.10-1 through 4.1.10-18 are as follow: the top node (node 1) is 17.78 cm, the bottom node (node 18) is 22.352 cm, all other nodes are 20.0025 cm. The top of node 1 begins at the top of the active fuel region. The burnup data is presented in units of gigawatt-days per metric ton of uranium (GWd/MTU). The fuel temperature data is presented in units of degrees Fahrenheit. The moderator specific volume data is presented in units of cubic feet per pound. The statepoint numbers shown in the tables identify the relative reactivity statepoint calculations that fuel and burnable poison isotopic data will be generated to support for the evaluation of that particular assembly. The EFPD statepoint and cycle number corresponding to each set of fuel temperature and moderator specific volume data are presented above their respective columns in the tables. Each set of fuel temperature and moderator specific volume data listed in the tables is applicable to the depletion calculation performed between the statepoint number identified above the particular data and the previous statepoint number.

Table 4.1.10-1 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A1 of Crystal River Unit 3

	Assembly Number A1								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.816	881.9	0.0231	4.819	974.7	0.0230
2	0.0			4.715	1055.5	0.0231	7.860	1135.9	0.0229
3	0.0			6.179	1169.8	0.0230	9.908	1186.3	0.0228
4	0.0	Data not required.		7.134	1222.7	0.0229	11.075	1178.1	0.0227
5	0.0			7.720	1247.6	0.0228	11.694	1153.1	0.0226
6	0.0			8.056	1257.8	0.0228	11.953	1128.4	0.0225
7	0.0			8.232	1262.6	0.0227	12.045	1108.3	0.0225
8	0.0			8.306	1267.6	0.0226	12.060	1094.5	0.0224
9	0.0			8.314	1275.2	0.0225	12.042	1086.6	0.0223
10	0.0			8.275	1285.4	0.0224	12.010	1083.8	0.0222
11	0.0			8.206	1295.9	0.0223	11.979	1085.1	0.0222
12	0.0			8.129	1303.4	0.0222	11.963	1089.7	0.0221
13	0.0			8.077	1305.7	0.0221	11.987	1096.8	0.0220
14	0.0			8.211	1302.6	0.0220	12.208	1104.0	0.0219
15	0.0			9.357	1318.7	0.0219	13.574	1114.5	0.0219
16	0.0			11.135	1561.3	0.0218	16.249	1257.0	0.0218

Table 4.1.10-1 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A1 of Crystal River Unit 3

17	0.0			10.619	1475.9	0.0217	15.740	1271.5	0.0217
18	0.0			6.746	1191.0	0.0216	10.259	1100.7	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	5.191	912.6	0.0237	7.992	974.1	0.0231	10.720	968.2	0.0232
2	8.429	1033.5	0.0236	12.840	1120.5	0.0231	17.114	1107.5	0.0231
3	10.599	1084.4	0.0235	15.827	1189.6	0.0230	20.924	1151.9	0.0230
4	11.995	1168.3	0.0234	17.481	1209.5	0.0229	22.904	1149.8	0.0229
5	12.770	1428.3	0.0233	18.282	1211.3	0.0227	23.812	1138.4	0.0228
6	13.190	1490.9	0.0232	18.646	1205.6	0.0226	24.195	1124.8	0.0227
7	13.318	1501.4	0.0230	18.721	1201.9	0.0225	24.276	1116.0	0.0226
8	13.341	1504.9	0.0229	18.702	1199.5	0.0224	24.275	1112.9	0.0225
9	13.329	1507.4	0.0227	18.662	1196.7	0.0223	24.283	1116.6	0.0224
10	13.308	1510.2	0.0225	18.630	1191.9	0.0222	24.335	1126.7	0.0223
11	13.294	1512.9	0.0224	18.616	1183.6	0.0221	24.424	1140.4	0.0222
12	13.297	1513.2	0.0223	18.619	1171.5	0.0220	24.518	1153.2	0.0221
13	13.332	1505.7	0.0221	18.633	1155.5	0.0219	24.577	1161.0	0.0220
14	13.535	1478.7	0.0220	18.754	1132.8	0.0219	24.659	1158.9	0.0219
15	14.814	1390.7	0.0219	19.753	1084.0	0.0218	25.403	1128.4	0.0218
16	17.321	1233.6	0.0217	21.717	1005.7	0.0217	26.806	1061.8	0.0217
17	16.644	1128.2	0.0217	20.470	957.9	0.0216	24.902	1009.0	0.0216
18	10.859	974.7	0.0216	13.470	866.9	0.0216	16.497	915.6	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	248.4 Cy3	248.4 Cy3						
1	12.280	1006.3	0.0232	No additional statepoints.			No additional statepoints.		
2	19.411	1108.0	0.0231						
3	23.509	1126.5	0.0230						
4	25.524	1111.8	0.0229						
5	26.395	1093.3	0.0228						
6	26.737	1079.3	0.0227						
7	26.797	1071.7	0.0226						
8	26.793	1068.2	0.0225						
9	26.815	1067.3	0.0224						
10	26.893	1068.0	0.0223						
11	27.016	1069.3	0.0222						

Table 4.1.10-1 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A1 of Crystal River Unit 3

12	27.148	1070.6	0.0221						
13	27.247	1072.0	0.0220						
14	27.358	1071.6	0.0219						
15	28.056	1054.6	0.0218						
16	29.285	1012.1	0.0217						
17	27.150	985.7	0.0217						
18	18.111	923.6	0.0216						

Table 4.1.10-2 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A4 of Crystal River Unit 3

	Assembly Number A4								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			4.168	1003.2	0.0239	7.050	1137.0	0.0237
2	0.0			6.942	1223.7	0.0238	11.500	1341.4	0.0235
3	0.0			9.426	1384.5	0.0237	14.855	1424.4	0.0234
4	0.0	Data not required.		11.077	1474.8	0.0235	16.798	1411.0	0.0233
5	0.0			12.048	1512.2	0.0234	17.756	1368.0	0.0231
6	0.0			12.595	1524.8	0.0232	18.176	1327.9	0.0230
7	0.0			12.881	1528.5	0.0231	18.334	1298.2	0.0228
8	0.0			12.996	1534.6	0.0229	18.359	1279.0	0.0227
9	0.0			12.980	1547.3	0.0228	18.295	1268.6	0.0226
10	0.0			12.838	1566.7	0.0226	18.145	1264.8	0.0225
11	0.0			12.582	1587.9	0.0225	17.927	1266.9	0.0224
12	0.0			12.272	1600.7	0.0223	17.714	1275.4	0.0222
13	0.0			11.997	1595.7	0.0222	17.589	1289.5	0.0221
14	0.0			11.757	1573.7	0.0220	17.532	1308.3	0.0220
15	0.0			11.417	1538.3	0.0219	17.355	1330.3	0.0219
16	0.0			10.676	1470.6	0.0218	16.616	1344.4	0.0218
17	0.0			9.098	1347.9	0.0217	14.510	1308.8	0.0217
18	0.0			6.066	1119.1	0.0216	9.593	1109.5	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	7.708	1111.1	0.0234						
2	12.474	1267.6	0.0233						

Table 4.1.10-2 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A4 of Crystal River Unit 3

3	15.921	1288.1	0.0231	No additional statepoints.			No additional statepoints.		
4	17.847	1255.8	0.0230						
5	18.769	1226.7	0.0229						
6	19.161	1209.2	0.0228						
7	19.298	1199.5	0.0227						
8	19.306	1193.5	0.0226						
9	19.230	1188.7	0.0224						
10	19.077	1185.4	0.0223						
11	18.874	1186.3	0.0222						
12	18.692	1191.8	0.0221						
13	18.604	1197.4	0.0220						
14	18.575	1199.5	0.0219						
15	18.406	1196.3	0.0218						
16	17.637	1183.5	0.0217						
17	15.425	1141.3	0.0217						
18	10.199	983.4	0.0216						

Table 4.1.10-3 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A5 of Crystal River Unit 3

	Assembly Number A5								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.445	825.3	0.0236	4.124	925.7	0.0233
2	0.0			5.137	993.2	0.0235	7.935	1131.7	0.0233
3	0.0			8.442	1279.6	0.0234	12.475	1344.4	0.0232
4	0.0	Data not required.		10.198	1403.0	0.0233	15.090	1340.7	0.0230
5	0.0			11.117	1443.2	0.0232	16.172	1300.8	0.0229
6	0.0			11.623	1456.5	0.0230	16.599	1265.2	0.0228
7	0.0			11.884	1462.9	0.0229	16.758	1238.8	0.0227
8	0.0			11.985	1472.1	0.0228	16.782	1221.7	0.0226
9	0.0			11.956	1488.3	0.0226	16.708	1212.1	0.0225
10	0.0			11.795	1511.8	0.0225	16.527	1207.7	0.0224
11	0.0			11.501	1534.7	0.0224	16.247	1208.0	0.0223
12	0.0			11.149	1545.9	0.0222	15.966	1214.4	0.0222
13	0.0			10.864	1535.9	0.0221	15.807	1226.6	0.0221
14	0.0			10.663	1503.9	0.0220	15.768	1243.8	0.0220
15	0.0			10.418	1458.5	0.0219	15.684	1265.3	0.0219
16	0.0			9.841	1393.7	0.0217	15.130	1279.9	0.0218

Table 4.1.10-3 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A5 of Crystal River Unit 3

17	0.0			8.445	1283.3	0.0217	13.267	1245.7	0.0217
18	0.0			5.210	1040.6	0.0216	8.365	1073.7	0.0216

Table 4.1.10-4 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A7 of Crystal River Unit 3

	Assembly Number A7								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			3.645	975.5	0.0236	5.260	897.9	0.0228
2	0.0			6.341	1202.1	0.0236	8.891	1024.9	0.0227
3	0.0			8.389	1328.9	0.0235	11.451	1066.6	0.0227
4	0.0	Data not required.		9.750	1397.0	0.0233	13.043	1066.3	0.0226
5	0.0			10.606	1429.2	0.0232	13.979	1048.5	0.0225
6	0.0			11.121	1443.3	0.0231	14.462	1028.6	0.0224
7	0.0			11.414	1451.7	0.0229	14.706	1012.6	0.0224
8	0.0			11.561	1461.8	0.0228	14.817	1002.0	0.0223
9	0.0			11.597	1476.9	0.0227	14.839	996.2	0.0222
10	0.0			11.542	1495.3	0.0225	14.791	994.3	0.0222
11	0.0			11.417	1513.4	0.0224	14.695	995.7	0.0221
12	0.0			11.273	1525.1	0.0223	14.602	1000.0	0.0221
13	0.0			11.175	1525.5	0.0221	14.569	1006.5	0.0220
14	0.0			11.168	1515.8	0.0220	14.652	1016.2	0.0219
15	0.0			11.291	1498.4	0.0219	15.074	1047.3	0.0219
16	0.0			10.892	1458.3	0.0218	15.739	1232.9	0.0218
17	0.0			9.417	1357.3	0.0217	14.395	1279.6	0.0217
18	0.0			5.813	1103.7	0.0216	9.214	1109.5	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	5.593	874.2	0.0236	7.656	871.5	0.0233	10.803	1020.4	0.0234
2	9.400	973.4	0.0236	12.915	977.1	0.0232	17.876	1176.9	0.0233
3	12.075	1022.8	0.0235	17.273	1121.4	0.0232	23.097	1200.7	0.0232
4	13.887	1101.7	0.0234	19.795	1241.2	0.0230	25.889	1188.3	0.0231
5	14.978	1337.1	0.0233	21.042	1250.0	0.0229	27.189	1167.2	0.0230
6	15.622	1403.6	0.0232	21.673	1239.1	0.0228	27.785	1145.2	0.0228
7	15.911	1423.0	0.0230	21.905	1232.8	0.0227	27.950	1126.3	0.0227

Table 4.1.10-4 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A7 of Crystal River Unit 3

8	16.036	1432.8	0.0229	21.966	1229.6	0.0226	27.922	1111.6	0.0226
9	16.067	1439.7	0.0227	21.942	1226.0	0.0224	27.817	1106.1	0.0225
10	16.034	1446.6	0.0226	21.868	1218.8	0.0223	27.726	1113.7	0.0224
11	15.964	1454.5	0.0224	21.778	1206.9	0.0222	27.706	1133.0	0.0223
12	15.902	1460.8	0.0223	21.716	1190.9	0.0221	27.779	1158.1	0.0222
13	15.891	1458.6	0.0221	21.714	1172.9	0.0220	27.934	1180.9	0.0221
14	15.970	1439.1	0.0220	21.789	1154.5	0.0219	28.121	1191.9	0.0220
15	16.335	1385.4	0.0219	22.075	1132.7	0.0218	28.346	1181.1	0.0219
16	16.879	1288.2	0.0218	22.359	1101.9	0.0217	28.278	1143.6	0.0218
17	15.372	1195.1	0.0217	20.344	1073.3	0.0217	25.590	1094.2	0.0217
18	9.856	1021.7	0.0216	13.277	963.8	0.0216	16.831	980.9	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3						
1	12.512	1041.4	0.0233	No additional statepoints.			No additional statepoints.		
2	20.413	1147.0	0.0232						
3	25.906	1150.4	0.0231						
4	28.701	1121.7	0.0230						
5	29.947	1098.0	0.0229						
6	30.492	1081.9	0.0228						
7	30.624	1071.6	0.0227						
8	30.571	1063.9	0.0225						
9	30.449	1058.6	0.0224						
10	30.361	1057.7	0.0223						
11	30.371	1061.0	0.0222						
12	30.497	1066.9	0.0222						
13	30.727	1074.6	0.0221						
14	30.894	1082.8	0.0220						
15	31.250	1082.9	0.0219						
16	31.101	1066.6	0.0218						
17	28.192	1044.3	0.0217						
18	18.697	973.0	0.0216						

Table 4.1.10-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A14 of Crystal River Unit 3

	Assembly Number A14								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			3.042	898.5	0.0232	5.483	1066.3	0.0234
2	0.0	Data not required.		4.939	1070.7	0.0231	8.892	1268.6	0.0233
3	0.0			6.561	1193.8	0.0230	11.299	1338.5	0.0232
4	0.0			7.668	1260.2	0.0230	12.673	1340.7	0.0231
5	0.0			8.361	1294.1	0.0229	13.401	1318.5	0.0229
6	0.0			8.770	1310.7	0.0228	13.759	1292.8	0.0228
7	0.0			8.995	1320.6	0.0226	13.920	1272.1	0.0227
8	0.0			9.097	1330.3	0.0225	13.980	1258.7	0.0226
9	0.0			9.105	1342.9	0.0224	13.977	1252.1	0.0225
10	0.0			9.030	1358.2	0.0223	13.922	1250.9	0.0224
11	0.0			8.888	1372.4	0.0222	13.831	1254.2	0.0223
12	0.0			8.731	1378.6	0.0221	13.759	1261.6	0.0222
13	0.0			8.635	1372.7	0.0220	13.768	1271.6	0.0221
14	0.0			8.663	1358.8	0.0219	13.903	1282.7	0.0220
15	0.0			8.790	1348.7	0.0218	14.142	1299.2	0.0219
16	0.0			8.660	1334.6	0.0217	14.055	1319.4	0.0218
17	0.0			7.628	1251.7	0.0217	12.572	1284.6	0.0217
18	0.0			5.173	1049.6	0.0216	8.373	1088.6	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy7	89.8 Cy2+dt	89.8 Cy2+dt	260.3 Cy7	180.5 Cy7	180.5 Cy7
1	5.980	1002.2	0.0236	8.374	927.3	0.0230	11.725	981.7	0.0232
2	9.666	1160.9	0.0235	13.458	1061.1	0.0229	19.446	1100.8	0.0231
3	12.216	1226.2	0.0234	16.706	1115.0	0.0228	24.253	1123.5	0.0230
4	13.671	1270.2	0.0233	18.408	1126.9	0.0227	26.522	1126.8	0.0229
5	14.457	1323.1	0.0232	19.258	1127.2	0.0226	27.588	1121.4	0.0228
6	14.858	1357.9	0.0230	19.659	1126.4	0.0225	28.078	1114.2	0.0227
7	15.044	1374.9	0.0229	19.822	1126.8	0.0225	28.285	1108.0	0.0226
8	15.113	1384.7	0.0228	19.857	1127.4	0.0224	28.349	1103.6	0.0225
9	15.116	1391.5	0.0226	19.812	1125.5	0.0223	28.328	1100.7	0.0224
10	15.072	.1397.8	0.0225	19.713	1118.0	0.0222	28.244	1098.8	0.0223
11	15.005	1405.1	0.0224	19.598	1104.3	0.0221	28.131	1097.4	0.0222
12	14.962	1410.8	0.0222	19.528	1087.2	0.0220	28.041	1095.5	0.0221

Table 4.1.10-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A14 of Crystal River Unit 3

13	14.994	1407.9	0.0221	19.554	1069.7	0.0219	28.005	1091.8	0.0220
14	15.127	1386.9	0.0220	19.696	1053.7	0.0218	28.008	1083.9	0.0219
15	15.321	1340.3	0.0219	19.899	1041.6	0.0218	27.941	1068.7	0.0218
16	15.142	1273.1	0.0218	19.649	1035.0	0.0217	27.219	1044.7	0.0217
17	13.506	1186.3	0.0217	17.597	1013.6	0.0216	24.303	1008.4	0.0216
18	8.974	1002.4	0.0216	11.653	889.8	0.0216	16.167	907.6	0.0216

	Statepoint 18 (291.0 Cycle 7)			Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	291.0 Cy7	345.3 Cy7	345.3 Cy7	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7
1	12.243	1001.0	0.0232	12.775	1001.0	0.0232	15.529	1014.2	0.0232
2	20.297	1074.7	0.0231	21.119	1074.7	0.0231	25.257	1079.0	0.0231
3	25.222	1077.8	0.0230	26.141	1077.8	0.0230	30.701	1075.1	0.0230
4	27.518	1063.7	0.0229	28.452	1063.7	0.0229	33.047	1062.0	0.0229
5	28.581	1051.3	0.0228	29.505	1051.3	0.0228	34.037	1049.6	0.0228
6	29.061	1041.6	0.0227	29.969	1041.6	0.0227	34.436	1039.4	0.0227
7	29.260	1036.2	0.0226	30.154	1036.2	0.0226	34.579	1033.0	0.0226
8	29.319	1034.4	0.0225	30.204	1034.4	0.0225	34.611	1029.6	0.0225
9	29.297	1035.2	0.0224	30.175	1035.2	0.0224	34.584	1028.4	0.0224
10	29.214	1037.9	0.0223	30.090	1037.9	0.0223	34.512	1028.8	0.0223
11	29.105	1042.1	0.0222	29.979	1042.1	0.0222	34.426	1030.4	0.0222
12	29.019	1047.5	0.0221	29.895	1047.5	0.0221	34.378	1033.0	0.0221
13	28.989	1053.7	0.0220	29.867	1053.7	0.0220	34.397	1036.7	0.0220
14	28.996	1059.5	0.0219	29.876	1059.5	0.0219	34.457	1040.9	0.0219
15	28.925	1062.7	0.0218	29.799	1062.7	0.0218	34.416	1044.2	0.0218
16	28.177	1059.9	0.0218	29.030	1059.9	0.0218	33.614	1042.5	0.0218
17	25.179	1045.6	0.0217	25.962	1045.6	0.0217	30.269	1028.2	0.0217
18	16.777	963.2	0.0216	17.325	963.2	0.0216	20.436	957.4	0.0216

	Statepoint 21 (479.0 Cycle 7)			Statepoint 22			Statepoint 23		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	479.0 Cy7	402.3 Cy7	402.3 Cy7						
1	15.897	1014.2	0.0232	No additional statepoints.			No additional statepoints.		
2	25.756	1079.0	0.0231						
3	31.236	1075.1	0.0230						
4	33.579	1062.0	0.0229						
5	34.559	1049.6	0.0228						
6	34.949	1039.4	0.0227						
7	35.087	1033.0	0.0226						

Table 4.1.10-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A14 of Crystal River Unit 3

8	35.118	1029.6	0.0225						
9	35.091	1028.4	0.0224						
10	35.021	1028.8	0.0223						
11	34.938	1030.4	0.0222						
12	34.893	1033.0	0.0221						
13	34.917	1036.7	0.0220						
14	34.984	1040.9	0.0219						
15	34.950	1044.2	0.0218						
16	34.150	1042.5	0.0218						
17	30.781	1028.2	0.0217						
18	20.815	957.4	0.0216						

Table 4.1.10-6 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A18 of Crystal River Unit 3

	Assembly Number A18								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 22 (BOC Cycle 8)			Statepoint 23 (97.6 Cycle 8)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				BOC Cy8	184.7 Cy1A+	184.7 Cy1A+	97.6 Cy8	111.4 Cy8	111.4 Cy8
1	0.0			3.416	929.4	0.0232	4.858	975.0	0.0231
2	0.0			6.039	1153.1	0.0232	8.345	1124.6	0.0230
3	0.0			8.119	1287.8	0.0231	10.833	1168.5	0.0229
4	0.0	Data not required.		9.507	1364.2	0.0230	12.370	1173.9	0.0228
5	0.0			10.341	1399.1	0.0229	13.263	1168.5	0.0227
6	0.0			10.809	1413.1	0.0227	13.759	1162.1	0.0226
7	0.0			11.047	1421.0	0.0226	14.013	1156.8	0.0225
8	0.0			11.116	1431.8	0.0225	14.095	1153.4	0.0224
9	0.0			10.998	1451.4	0.0224	13.994	1153.4	0.0223
10	0.0			10.622	1482.1	0.0222	13.650	1158.8	0.0223
11	0.0			9.391	1531.2	0.0221	12.517	1184.1	0.0222
12	0.0			6.666	1591.7	0.0220	10.008	1246.7	0.0221
13	0.0			5.922	1390.6	0.0219	9.284	1259.9	0.0220
14	0.0			5.786	1185.1	0.0218	9.078	1252.9	0.0219
15	0.0			5.910	1122.0	0.0217	9.058	1230.6	0.0218
16	0.0			6.969	1052.3	0.0217	9.803	1165.4	0.0217
17	0.0			7.477	969.8	0.0216	9.821	1073.4	0.0216
18	0.0			4.839	927.0	0.0216	6.305	926.3	0.0216

Table 4.1.10-6 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A18 of Crystal River Unit 3

	Statepoint 24 (139.8 Cycle 8)			Statepoint 25 (404.0 Cycle 8)			Statepoint 26 (409.6 Cycle 8)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	139.8 Cy8	111.4 Cy8	111.4 Cy8	404.0 Cy8	234.6 Cy8	234.6 Cy8	409.6 Cy8	234.6 Cy8	234.6 Cy8
1	5.507	975.0	0.0231	9.904	977.2	0.0230	10.003	977.2	0.0230
2	9.362	1124.6	0.0230	15.935	1101.7	0.0230	16.078	1101.7	0.0230
3	12.012	1168.5	0.0229	19.409	1134.2	0.0229	19.566	1134.2	0.0229
4	13.600	1173.9	0.0228	21.159	1128.2	0.0228	21.317	1128.2	0.0228
5	14.507	1168.5	0.0227	22.042	1116.0	0.0227	22.198	1116.0	0.0227
6	15.006	1162.1	0.0226	22.481	1105.3	0.0226	22.634	1105.3	0.0226
7	15.259	1156.8	0.0225	22.681	1097.4	0.0225	22.833	1097.4	0.0225
8	15.341	1153.4	0.0224	22.729	1092.3	0.0224	22.880	1092.3	0.0224
9	15.243	1153.4	0.0223	22.627	1090.9	0.0223	22.778	1090.9	0.0223
10	14.908	1158.8	0.0223	22.331	1094.6	0.0222	22.483	1094.6	0.0222
11	13.810	1184.1	0.0222	21.408	1115.0	0.0221	21.563	1115.0	0.0221
12	11.380	1246.7	0.0221	19.386	1166.1	0.0221	19.548	1166.1	0.0221
13	10.668	1259.9	0.0220	18.788	1178.9	0.0220	18.953	1178.9	0.0220
14	10.445	1252.9	0.0219	18.573	1178.4	0.0219	18.739	1178.4	0.0219
15	10.384	1230.6	0.0218	18.427	1169.2	0.0218	18.595	1169.2	0.0218
16	11.023	1165.4	0.0217	18.657	1129.3	0.0217	18.820	1129.3	0.0217
17	10.854	1073.4	0.0216	17.588	1063.3	0.0216	17.737	1063.3	0.0216
18	6.967	926.3	0.0216	11.499	931.6	0.0216	11.603	931.6	0.0216

	Statepoint 27 (515.5 Cycle 8)			Statepoint 28 (BOC Cycle 9)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	515.5 Cy8	470.7 Cy8	470.7 Cy8	BOC Cy9	470.7 Cy8	470.7 Cy8
1	11.964	983.9	0.0230			
2	18.845	1074.1	0.0229	No additional statepoints.		
3	22.566	1076.1	0.0228			
4	24.308	1058.8	0.0227			
5	25.131	1041.2	0.0226			
6	25.516	1027.9	0.0225			
7	25.678	1018.7	0.0225			
8	25.702	1012.7	0.0224			
9	25.591	1009.9	0.0223			
10	25.302	1010.8	0.0222			
11	24.433	1022.9	0.0221			
12	22.549	1055.0	0.0221			
13	22.002	1064.7	0.0220			

Table 4.1.10-6 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A18 of Crystal River Unit 3

14	21.820	1068.9	0.0219			
15	21.698	1071.7	0.0218			
16	21.858	1058.6	0.0217			
17	20.539	1030.9	0.0216			
18	13.607	944.7	0.0216			

Table 4.1.10-7 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A18a of Crystal River Unit 3

	Assembly Number A18a								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 28 (BOC Cycle 9)			Statepoint 29 (158.8 Cycle 9)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				BOC Cy9	184.7 Cy1A+	184.7 Cy1A+	158.8 Cy9	110.5 Cy9	110.5 Cy9
1	0.0			3.416	929.4	0.0232	5.836	983.5	0.0231
2	0.0			6.039	1153.1	0.0232	9.936	1142.6	0.0231
3	0.0			8.119	1287.8	0.0231	12.740	1195.4	0.0230
4	0.0	Data not required.		9.507	1364.2	0.0230	14.408	1206.0	0.0229
5	0.0			10.341	1399.1	0.0229	15.354	1203.0	0.0228
6	0.0			10.809	1413.1	0.0227	15.868	1197.2	0.0227
7	0.0			11.047	1421.0	0.0226	16.124	1191.6	0.0226
8	0.0			11.116	1431.8	0.0225	16.202	1187.6	0.0225
9	0.0			10.998	1451.4	0.0224	16.102	1187.1	0.0224
10	0.0			10.622	1482.1	0.0222	15.770	1192.5	0.0223
11	0.0			9.391	1531.2	0.0221	14.700	1219.6	0.0222
12	0.0			6.666	1591.7	0.0220	12.336	1286.7	0.0221
13	0.0			5.922	1390.6	0.0219	11.651	1300.8	0.0220
14	0.0			5.786	1185.1	0.0218	11.434	1295.2	0.0219
15	0.0			5.910	1122.0	0.0217	11.352	1273.0	0.0218
16	0.0			6.969	1052.3	0.0217	11.911	1205.9	0.0218
17	0.0			7.477	969.8	0.0216	11.595	1107.5	0.0217
18	0.0			4.839	927.0	0.0216	7.424	949.6	0.0216

	Statepoint 30 (219.0 Cycle 9)			Statepoint 31 (363.1 Cycle 9)			Statepoint 32 (BOC Cycle 10)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	219.0 Cy9	192.8 Cy9	192.8 Cy9	363.1 Cy9	303.7 Cy9	303.7 Cy9	BOC Cy10	452.4 Cy9	452.4 Cy9
1	6.823	988.8	0.0231	9.342	995.4	0.0231			
2	11.468	1127.7	0.0231	15.254	1119.6	0.0230			
3	14.512	1173.1	0.0230	18.790	1145.0	0.0229	No additional statepoints.		
4	16.251	1173.5	0.0229	20.633	1134.0	0.0228			

Table 4.1.10-7 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A18a of Crystal River Unit 3

5	17.210	1164.3	0.0228	21.580	1118.7	0.0227			
6	17.721	1154.7	0.0227	22.052	1106.7	0.0226			
7	17.969	1147.0	0.0226	22.265	1098.1	0.0226			
8	18.040	1141.7	0.0225	22.313	1092.4	0.0225			
9	17.939	1140.2	0.0224	22.207	1090.2	0.0224			
10	17.617	1144.4	0.0223	21.908	1092.6	0.0223			
11	16.594	1167.4	0.0222	20.985	1111.4	0.0222			
12	14.339	1225.0	0.0221	18.963	1160.3	0.0221			
13	13.681	1239.4	0.0220	18.383	1174.5	0.0220			
14	13.458	1238.3	0.0219	18.182	1177.8	0.0219			
15	13.339	1225.9	0.0218	18.034	1174.5	0.0218			
16	13.768	1177.6	0.0218	18.247	1143.6	0.0218			
17	13.197	1099.4	0.0217	17.168	1088.5	0.0217			
18	8.469	953.8	0.0216	11.149	957.9	0.0216			

Table 4.1.10-8 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A18b of Crystal River Unit 3

	Assembly Number A18b								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			3.416	929.4	0.0232	5.861	1064.3	0.0231
2	0.0			6.039	1153.1	0.0232	9.956	1253.8	0.0231
3	0.0			8.119	1287.8	0.0231	12.792	1321.8	0.0229
4	0.0	Data not required.		9.507	1364.2	0.0230	14.424	1317.4	0.0228
5	0.0			10.341	1399.1	0.0229	15.255	1285.0	0.0227
6	0.0			10.809	1413.1	0.0227	15.627	1251.8	0.0226
7	0.0			11.047	1421.0	0.0226	15.760	1226.7	0.0225
8	0.0			11.116	1431.8	0.0225	15.750	1210.8	0.0224
9	0.0			10.998	1451.4	0.0224	15.564	1202.2	0.0223
10	0.0			10.622	1482.1	0.0222	14.951	1185.3	0.0222
11	0.0			9.391	1531.2	0.0221	12.957	1094.9	0.0221
12	0.0			6.666	1591.7	0.0220	9.795	1048.4	0.0220
13	0.0			5.922	1390.6	0.0219	9.090	1056.4	0.0220
14	0.0			5.786	1185.1	0.0218	9.113	1070.0	0.0219
15	0.0			5.910	1122.0	0.0217	9.779	1102.8	0.0218
16	0.0			6.969	1052.3	0.0217	11.959	1269.7	0.0218
17	0.0			7.477	969.8	0.0216	12.257	1252.8	0.0217
18	0.0			4.839	927.0	0.0216	7.957	1075.8	0.0216

Table 4.1.10-9 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A20 of Crystal River Unit 3

	Assembly Number A20								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			1.929	766.4	0.0226	4.564	1116.6	0.0236
2	0.0			3.349	890.3	0.0226	7.656	1349.1	0.0235
3	0.0			4.454	980.9	0.0225	9.656	1443.2	0.0234
4	0.0	Data not required.		5.176	1034.5	0.0225	10.692	1455.2	0.0232
5	0.0			5.618	1063.3	0.0224	11.186	1437.0	0.0231
6	0.0			5.871	1077.4	0.0224	11.397	1412.9	0.0229
7	0.0			6.003	1085.8	0.0223	11.473	1393.2	0.0228
8	0.0			6.054	1093.3	0.0222	11.490	1380.6	0.0227
9	0.0			6.041	1102.2	0.0222	11.473	1374.8	0.0226
10	0.0			5.965	1112.6	0.0221	11.419	1374.1	0.0224
11	0.0			5.831	1121.4	0.0220	11.340	1377.9	0.0223
12	0.0			5.685	1122.4	0.0220	11.287	1386.3	0.0222
13	0.0			5.608	1112.5	0.0219	11.324	1397.1	0.0221
14	0.0			5.721	1098.0	0.0219	11.522	1403.6	0.0220
15	0.0			6.476	1109.7	0.0218	12.214	1385.3	0.0219
16	0.0			7.826	1298.5	0.0217	13.223	1329.1	0.0218
17	0.0			7.524	1237.3	0.0216	12.242	1253.5	0.0217
18	0.0			4.698	1003.7	0.0216	7.730	1068.4	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	5.094	1038.6	0.0235	8.349	1050.3	0.0236	11.641	1022.2	0.0234
2	8.487	1220.9	0.0235	13.645	1217.7	0.0235	18.735	1167.1	0.0233
3	10.635	1294.5	0.0233	16.910	1311.6	0.0234	22.886	1207.6	0.0232
4	11.730	1327.4	0.0232	18.514	1360.1	0.0232	24.819	1211.1	0.0231
5	12.251	1351.3	0.0231	19.233	1380.6	0.0231	25.637	1201.2	0.0230
6	12.480	1370.9	0.0230	19.520	1389.8	0.0229	25.916	1184.3	0.0228
7	12.568	1385.1	0.0228	19.589	1397.4	0.0228	25.895	1159.4	0.0227
8	12.589	1394.4	0.0227	19.522	1404.3	0.0227	25.615	1126.3	0.0226
9	12.573	1400.1	0.0226	19.319	1404.1	0.0225	25.089	1103.4	0.0225
10	12.528	1404.1	0.0224	18.973	1379.8	0.0224	24.534	1107.0	0.0224
11	12.470	1409.1	0.0223	18.605	1318.8	0.0223	24.168	1130.3	0.0223

Table 4.1.10-9 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A20 of Crystal River Unit 3

12	12.449	1414.7	0.0222	18.406	1260.1	0.0221	24.130	1169.9	0.0222
13	12.515	1412.9	0.0221	18.467	1220.0	0.0220	24.503	1221.0	0.0221
14	12.718	1393.5	0.0220	18.792	1193.8	0.0219	25.199	1248.4	0.0220
15	13.362	1337.7	0.0218	19.541	1179.2	0.0218	26.016	1234.1	0.0219
16	14.259	1244.4	0.0217	20.283	1168.9	0.0217	26.402	1185.8	0.0218
17	13.123	1150.2	0.0217	18.570	1141.1	0.0217	23.960	1126.2	0.0217
18	8.299	985.1	0.0216	11.970	1005.6	0.0216	15.579	999.8	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3						
1	13.385	1044.7	0.0233	No additional statepoints.			No additional statepoints.		
2	21.262	1137.9	0.0233						
3	25.705	1153.8	0.0231						
4	27.687	1140.6	0.0230						
5	28.483	1125.2	0.0229						
6	28.733	1113.4	0.0228						
7	28.682	1103.9	0.0227						
8	28.343	1090.3	0.0226						
9	27.715	1071.2	0.0225						
10	27.095	1065.2	0.0224						
11	26.738	1070.7	0.0223						
12	26.761	1081.5	0.0222						
13	27.260	1099.8	0.0221						
14	28.139	1121.4	0.0220						
15	29.033	1120.3	0.0219						
16	29.332	1098.5	0.0218						
17	26.649	1075.1	0.0217						
18	17.494	995.2	0.0216						

Table 4.1.10-10 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A22 of Crystal River Unit 3

	Assembly Number A22								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.356	817.6	0.0235	3.912	901.0	0.0232
2	0.0			4.987	984.0	0.0234	7.595	1099.8	0.0231

Table 4.1.10-10 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A22 of Crystal River Unit 3

3	0.0			8.232	1269.2	0.0233	12.009	1302.3	0.0230
4	0.0	Data not required.		9.957	1391.9	0.0232	14.545	1300.9	0.0229
5	0.0			10.858	1432.1	0.0231	15.588	1261.8	0.0228
6	0.0			11.352	1445.9	0.0230	15.992	1226.2	0.0227
7	0.0			11.601	1453.4	0.0228	16.133	1200.1	0.0226
8	0.0			11.681	1464.5	0.0227	16.129	1183.4	0.0225
9	0.0			11.603	1484.2	0.0226	15.985	1173.3	0.0224
10	0.0			11.320	1514.1	0.0224	15.619	1164.2	0.0223
11	0.0			10.761	1546.4	0.0223	14.973	1154.9	0.0222
12	0.0			10.054	1559.1	0.0222	14.263	1154.6	0.0221
13	0.0			9.553	1523.6	0.0220	13.875	1166.3	0.0220
14	0.0			9.311	1454.6	0.0219	13.841	1187.8	0.0219
15	0.0			9.181	1384.7	0.0218	14.005	1223.7	0.0219
16	0.0			8.884	1306.8	0.0217	13.923	1262.0	0.0218
17	0.0			7.816	1200.9	0.0216	12.514	1240.6	0.0217
18	0.0			4.869	981.4	0.0216	7.959	1072.3	0.0216

Table 4.1.10-11 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A23 of Crystal River Unit 3

	Assembly Number A23								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			3.449	938.7	0.0235	5.805	1052.6	0.0233
2	0.0			5.866	1149.6	0.0234	9.673	1250.7	0.0232
3	0.0			8.075	1304.2	0.0233	12.706	1331.4	0.0231
4	0.0	Data not required.		9.565	1395.0	0.0232	14.516	1329.1	0.0230
5	0.0			10.449	1436.6	0.0231	15.410	1292.3	0.0229
6	0.0			10.949	1454.3	0.0230	15.800	1255.8	0.0228
7	0.0			11.206	1464.9	0.0228	15.948	1229.3	0.0226
8	0.0			11.291	1478.0	0.0227	15.955	1213.1	0.0225
9	0.0			11.214	1498.6	0.0226	15.819	1204.0	0.0224
10	0.0			10.922	1526.7	0.0224	15.443	1195.3	0.0223
11	0.0			10.308	1557.5	0.0223	14.716	1183.6	0.0222
12	0.0			9.490	1567.9	0.0222	13.885	1182.9	0.0222
13	0.0			8.973	1520.3	0.0220	13.484	1195.7	0.0221
14	0.0			8.769	1441.6	0.0219	13.499	1217.9	0.0220
15	0.0			8.724	1372.0	0.0218	13.812	1260.9	0.0219
16	0.0			8.565	1295.7	0.0217	14.009	1322.0	0.0218

Table 4.1.10-11 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A23 of Crystal River Unit 3

17	0.0			7.653	1192.2	0.0216	12.790	1307.0	0.0217
18	0.0			5.186	1005.8	0.0216	8.552	1110.7	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	6.376	1048.6	0.0234	7.865	788.9	0.0224	10.524	939.6	0.0231
2	10.542	1200.9	0.0233	12.836	864.6	0.0224	16.971	1065.8	0.0230
3	13.698	1242.4	0.0232	16.381	892.7	0.0223	21.207	1094.9	0.0229
4	15.549	1249.2	0.0231	18.343	894.4	0.0223	23.400	1090.8	0.0228
5	16.458	1266.8	0.0230	19.264	891.3	0.0222	24.380	1080.2	0.0227
6	16.855	1274.6	0.0229	19.645	889.0	0.0222	24.747	1066.7	0.0226
7	16.997	1274.3	0.0227	19.764	888.1	0.0221	24.805	1051.9	0.0225
8	16.982	1271.8	0.0226	19.724	887.9	0.0221	24.668	1038.6	0.0224
9	16.807	1264.4	0.0225	19.524	887.4	0.0220	24.366	1033.2	0.0224
10	16.392	1249.6	0.0224	19.089	886.2	0.0220	23.889	1041.7	0.0223
11	15.663	1242.7	0.0223	18.356	884.8	0.0219	23.219	1065.6	0.0222
12	14.867	1261.5	0.0222	17.572	882.2	0.0219	22.586	1098.9	0.0221
13	14.529	1281.9	0.0221	17.243	875.2	0.0218	22.437	1127.2	0.0220
14	14.621	1296.4	0.0220	17.361	865.7	0.0218	22.707	1140.4	0.0219
15	14.972	1303.3	0.0219	17.917	861.2	0.0217	23.302	1134.9	0.0218
16	15.122	1274.3	0.0218	18.555	908.1	0.0217	23.728	1109.1	0.0217
17	13.767	1198.0	0.0217	17.404	973.2	0.0216	21.941	1054.6	0.0217
18	9.189	1015.0	0.0216	11.711	872.0	0.0216	14.702	930.3	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	248.4 Cy3	248.4 Cy3						
1	11.962	974.7	0.0231	No additional statepoints.			No additional statepoints.		
2	19.074	1066.7	0.0230						
3	23.549	1074.2	0.0229						
4	25.776	1058.6	0.0228						
5	26.735	1043.2	0.0227						
6	27.077	1032.4	0.0226						
7	27.114	1024.9	0.0225						
8	26.957	1019.4	0.0224						
9	26.639	1016.6	0.0224						
10	26.167	1020.0	0.0223						
11	25.535	1031.2	0.0222						

Table 4.1.10-11 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A23 of Crystal River Unit 3

12	24.973	1046.7	0.0221						
13	24.914	1060.4	0.0220						
14	25.305	1074.7	0.0219						
15	26.011	1086.1	0.0218						
16	26.384	1072.9	0.0217						
17	24.346	1041.8	0.0217						
18	16.375	953.9	0.0216						

Table 4.1.10-12 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A23a of Crystal River Unit 3

	Assembly Number A23a								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			3.449	938.7	0.0235	5.805	1052.6	0.0233
2	0.0			5.866	1149.6	0.0234	9.673	1250.7	0.0232
3	0.0			8.075	1304.2	0.0233	12.706	1331.4	0.0231
4	0.0	Data not required.		9.565	1395.0	0.0232	14.516	1329.1	0.0230
5	0.0			10.449	1436.6	0.0231	15.410	1292.3	0.0229
6	0.0			10.949	1454.3	0.0230	15.800	1255.8	0.0228
7	0.0			11.206	1464.9	0.0228	15.948	1229.3	0.0226
8	0.0			11.291	1478.0	0.0227	15.955	1213.1	0.0225
9	0.0			11.214	1498.6	0.0226	15.819	1204.0	0.0224
10	0.0			10.922	1526.7	0.0224	15.443	1195.3	0.0223
11	0.0			10.308	1557.5	0.0223	14.716	1183.6	0.0222
12	0.0			9.490	1567.9	0.0222	13.885	1182.9	0.0222
13	0.0			8.973	1520.3	0.0220	13.484	1195.7	0.0221
14	0.0			8.769	1441.6	0.0219	13.499	1217.9	0.0220
15	0.0			8.724	1372.0	0.0218	13.812	1260.9	0.0219
16	0.0			8.565	1295.7	0.0217	14.009	1322.0	0.0218
17	0.0			7.653	1192.2	0.0216	12.790	1307.0	0.0217
18	0.0			6.186	1005.8	0.0216	8.552	1110.7	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	6.365	1048.6	0.0234	8.331	850.2	0.0227	11.155	964.8	0.0232
2	10.522	1200.9	0.0233	13.523	942.5	0.0226	17.963	1104.5	0.0231

Table 4.1.10-12 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A23a of Crystal River Unit 3

3	13.671	1242.4	0.0232	17.174	977.7	0.0225	22.439	1139.5	0.0230
4	15.519	1249.2	0.0231	19.167	982.5	0.0225	24.749	1139.8	0.0229
5	16.427	1266.8	0.0230	20.086	980.3	0.0224	25.766	1127.7	0.0228
6	16.824	1274.6	0.0229	20.451	977.5	0.0223	26.121	1109.7	0.0227
7	16.966	1274.3	0.0227	20.549	976.0	0.0223	26.117	1083.8	0.0226
8	16.953	1271.8	0.0226	20.485	975.6	0.0222	25.827	1051.6	0.0225
9	16.782	1264.4	0.0225	20.252	974.3	0.0221	25.283	1029.5	0.0224
10	16.376	1249.6	0.0224	19.783	969.5	0.0221	24.606	1032.5	0.0223
11	15.664	1242.7	0.0223	19.033	961.4	0.0220	23.864	1060.1	0.0222
12	14.889	1261.5	0.0222	18.259	952.1	0.0220	23.291	1108.6	0.0222
13	14.563	1281.9	0.0221	17.958	940.4	0.0219	23.337	1163.0	0.0221
14	14.661	1296.4	0.0220	18.129	929.4	0.0218	23.895	1194.5	0.0220
15	15.010	1303.3	0.0219	18.816	928.8	0.0218	24.731	1188.6	0.0219
16	15.145	1274.3	0.0218	19.682	994.1	0.0217	25.340	1148.7	0.0218
17	13.769	1198.0	0.0217	18.652	1087.9	0.0217	23.595	1083.3	0.0217
18	9.184	1015.0	0.0216	12.650	976.3	0.0216	15.922	956.3	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	248.4 Cy3	248.4 Cy3						
1	12.699	996.5	0.0232	No additional statepoints.			No additional statepoints.		
2	20.238	1092.0	0.0231						
3	24.987	1103.4	0.0230						
4	27.335	1086.1	0.0229						
5	28.325	1068.4	0.0228						
6	28.647	1055.5	0.0227						
7	28.606	1044.8	0.0226						
8	28.252	1030.4	0.0225						
9	27.612	1013.5	0.0224						
10	26.872	1008.6	0.0223						
11	26.143	1018.5	0.0222						
12	25.648	1037.7	0.0221						
13	25.835	1061.7	0.0220						
14	26.583	1086.2	0.0219						
15	27.535	1092.6	0.0218						
16	28.085	1073.5	0.0217						
17	26.085	1041.6	0.0217						
18	17.667	957.0	0.0216						

Table 4.1.10-13 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A25 of Crystal River Unit 3

	Assembly Number A25								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.109	798.7	0.0227	4.098	983.8	0.0230
2	0.0			3.769	950.4	0.0227	7.024	1172.9	0.0230
3	0.0			5.015	1053.3	0.0226	8.938	1242.8	0.0229
4	0.0	Data not required.		5.823	1106.3	0.0226	9.967	1248.0	0.0228
5	0.0			6.323	1134.1	0.0225	10.484	1231.1	0.0227
6	0.0			6.613	1148.4	0.0224	10.722	1210.0	0.0226
7	0.0			6.765	1157.4	0.0223	10.818	1192.8	0.0225
8	0.0			6.822	1166.3	0.0223	10.840	1181.8	0.0224
9	0.0			6.801	1177.7	0.0222	10.809	1176.7	0.0223
10	0.0			6.704	1191.4	0.0221	10.726	1176.3	0.0222
11	0.0			6.540	1203.4	0.0220	10.605	1180.2	0.0221
12	0.0			6.358	1206.4	0.0220	10.497	1188.0	0.0221
13	0.0			6.239	1195.7	0.0219	10.470	1197.9	0.0220
14	0.0			6.245	1176.9	0.0218	10.555	1206.2	0.0219
15	0.0			6.383	1166.0	0.0217	10.701	1207.2	0.0218
16	0.0			6.393	1160.2	0.0217	10.561	1192.4	0.0217
17	0.0			5.646	1090.4	0.0216	9.314	1140.9	0.0216
18	0.0			3.409	888.4	0.0216	5.732	971.1	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	4.503	928.5	0.0230	7.848	1077.0	0.0234	9.228	762.6	0.0224
2	7.663	1079.4	0.0229	12.816	1241.9	0.0233	14.942	828.4	0.0224
3	9.691	1137.8	0.0229	15.675	1306.2	0.0232	18.205	856.1	0.0223
4	10.762	1160.7	0.0228	16.993	1319.7	0.0231	19.683	861.8	0.0223
5	11.295	1174.0	0.0227	17.562	1320.1	0.0230	20.304	859.6	0.0222
6	11.542	1184.1	0.0226	17.780	1320.1	0.0228	20.526	854.3	0.0222
7	11.642	1191.3	0.0225	17.830	1322.6	0.0227	20.553	847.9	0.0221
8	11.664	1196.0	0.0224	17.779	1326.0	0.0226	20.463	842.4	0.0221
9	11.633	1199.1	0.0223	17.636	1324.7	0.0225	20.281	840.5	0.0221
10	11.557	1202.1	0.0222	17.409	1309.0	0.0223	20.036	844.3	0.0220
11	11.454	1207.3	0.0221	17.162	1275.9	0.0222	19.807	853.5	0.0220
12	11.373	1213.6	0.0220	17.007	1240.4	0.0221	19.702	865.4	0.0219

Table 4.1.10-13 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A25 of Crystal River Unit 3

13	11.371	1215.0	0.0220	17.013	1211.8	0.0220	19.779	876.1	0.0219
14	11.463	1204.0	0.0219	17.177	1191.5	0.0219	20.070	884.4	0.0218
15	11.586	1175.3	0.0218	17.383	1184.6	0.0218	20.741	913.8	0.0218
16	11.382	1128.6	0.0217	17.138	1187.8	0.0217	21.239	1031.6	0.0217
17	10.017	1059.8	0.0216	15.289	1163.2	0.0217	19.155	1017.0	0.0216
18	6.179	910.1	0.0216	9.716	1020.3	0.0216	12.322	898.4	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	248.4 Cy3	248.4 Cy3						
1	10.021	805.0	0.0225	No additional statepoints.			No additional statepoints.		
2	16.110	869.5	0.0225						
3	19.542	885.3	0.0225						
4	21.063	882.6	0.0224						
5	21.685	876.8	0.0224						
6	21.898	871.7	0.0223						
7	21.916	868.0	0.0222						
8	21.819	865.5	0.0222						
9	21.635	864.8	0.0221						
10	21.396	866.4	0.0221						
11	21.186	870.3	0.0220						
12	21.112	875.6	0.0220						
13	21.244	882.5	0.0219						
14	21.712	906.4	0.0219						
15	23.126	1040.8	0.0218						
16	23.701	1060.1	0.0217						
17	21.407	1038.8	0.0217						
18	13.883	950.7	0.0216						

Table 4.1.10-14 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A25a of Crystal River Unit 3

	Assembly Number A25a								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.109	798.7	0.0227	4.098	983.8	0.0230
2	0.0			3.769	950.4	0.0227	7.024	1172.9	0.0230
3	0.0			5.015	1053.3	0.0226	8.938	1242.8	0.0229

Table 4.1.10-14 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A25a of Crystal River Unit 3

4	0.0	Data not required.		6.823	1106.3	0.0226	9.967	1248.0	0.0228
5	0.0			6.323	1134.1	0.0225	10.484	1231.1	0.0227
6	0.0			6.613	1148.4	0.0224	10.722	1210.0	0.0226
7	0.0			6.765	1157.4	0.0223	10.818	1192.8	0.0225
8	0.0			6.822	1166.3	0.0223	10.840	1181.8	0.0224
9	0.0			6.801	1177.7	0.0222	10.809	1176.7	0.0223
10	0.0			6.704	1191.4	0.0221	10.726	1176.3	0.0222
11	0.0			6.540	1203.4	0.0220	10.605	1180.2	0.0221
12	0.0			6.358	1206.4	0.0220	10.497	1188.0	0.0221
13	0.0			6.239	1195.7	0.0219	10.470	1197.9	0.0220
14	0.0			6.245	1176.9	0.0218	10.555	1206.2	0.0219
15	0.0			6.383	1166.0	0.0217	10.701	1207.2	0.0218
16	0.0			6.393	1160.2	0.0217	10.561	1192.4	0.0217
17	0.0			5.646	1090.4	0.0216	9.314	1140.9	0.0216
18	0.0			3.409	888.4	0.0216	5.732	971.1	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	4.503	928.5	0.0230	7.856	1077.0	0.0234	9.710	855.6	0.0234
2	7.663	1079.4	0.0229	12.829	1241.9	0.0233	16.384	1077.9	0.0233
3	9.691	1137.8	0.0229	15.690	1306.2	0.0232	20.857	1183.4	0.0232
4	10.762	1160.7	0.0228	17.010	1319.7	0.0231	22.822	1206.9	0.0231
5	11.295	1174.0	0.0227	17.580	1320.1	0.0230	23.707	1202.7	0.0230
6	11.542	1184.1	0.0226	17.798	1320.1	0.0228	24.005	1190.9	0.0229
7	11.642	1191.3	0.0225	17.847	1322.6	0.0227	24.015	1174.0	0.0227
8	11.664	1196.0	0.0224	17.794	1326.0	0.0226	23.842	1156.6	0.0226
9	11.633	1199.1	0.0223	17.648	1324.7	0.0225	23.542	1147.8	0.0225
10	11.557	1202.1	0.0222	17.414	1309.0	0.0223	23.213	1155.1	0.0224
11	11.454	1207.3	0.0221	17.158	1275.9	0.0222	22.980	1178.1	0.0223
12	11.373	1213.6	0.0220	16.992	1240.4	0.0221	22.947	1210.9	0.0222
13	11.371	1215.0	0.0220	16.991	1211.8	0.0220	23.144	1242.2	0.0221
14	11.463	1204.0	0.0219	17.152	1191.5	0.0219	23.472	1256.6	0.0220
15	11.586	1175.3	0.0218	17.361	1184.6	0.0218	23.667	1245.6	0.0219
16	11.382	1128.6	0.0217	17.123	1187.8	0.0217	23.121	1211.0	0.0218
17	10.017	1059.8	0.0216	15.283	1163.2	0.0217	20.510	1148.8	0.0217
18	6.179	910.1	0.0216	9.715	1020.3	0.0216	13.098	993.2	0.0216

Table 4.1.10-14 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A25a of Crystal River Unit 3

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3						
1	10.832	894.2	0.0233	No additional statepoints.			No additional statepoints.		
2	18.586	1110.1	0.0233						
3	23.555	1151.9	0.0232						
4	25.624	1146.4	0.0230						
5	26.507	1133.1	0.0229						
6	26.787	1123.1	0.0228						
7	26.779	1115.7	0.0227						
8	26.583	1109.0	0.0226						
9	26.256	1104.0	0.0225						
10	25.918	1104.4	0.0224						
11	25.708	1116.2	0.0223						
12	25.727	1118.6	0.0222						
13	25.998	1127.3	0.0221						
14	26.400	1133.2	0.0220						
15	26.626	1132.0	0.0219						
16	26.020	1123.4	0.0218						
17	23.164	1099.7	0.0217						
18	14.939	1003.9	0.0216						

Table 4.1.10-15 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A26 of Crystal River Unit 3

	Assembly Number A26								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.845	894.7	0.0232	5.336	1080.1	0.0231
2	0.0			5.061	1100.1	0.0232	9.077	1285.2	0.0231
3	0.0			6.838	1233.0	0.0231	11.651	1358.8	0.0229
4	0.0	Data not required.		8.044	1305.8	0.0230	13.123	1357.7	0.0228
5	0.0			8.786	1341.5	0.0229	13.869	1325.9	0.0227
6	0.0			9.214	1357.9	0.0228	14.202	1292.0	0.0226
7	0.0			9.439	1368.1	0.0227	14.320	1266.0	0.0225
8	0.0			9.518	1380.0	0.0226	14.314	1248.9	0.0224
9	0.0			9.470	1397.3	0.0224	14.182	1237.5	0.0223
10	0.0			9.282	1420.2	0.0223	13.718	1213.7	0.0222

Table 4.1.10-15 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A26 of Crystal River Unit 3

11	0.0			8.954	1442.6	0.0222	12.512	1097.8	0.0221
12	0.0			8.566	1449.8	0.0221	11.504	999.0	0.0220
13	0.0			8.260	1429.5	0.0220	11.196	993.9	0.0220
14	0.0			8.097	1388.0	0.0219	11.180	1006.5	0.0219
15	0.0			8.098	1336.0	0.0218	11.693	1041.6	0.0218
16	0.0			7.767	1269.4	0.0217	12.576	1238.9	0.0218
17	0.0			6.697	1168.3	0.0216	11.509	1270.0	0.0217
18	0.0			4.116	944.6	0.0216	7.278	1093.8	0.0216

Table 4.1.10-16 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A28 of Crystal River Unit 3

	Assembly Number A28								
	Statepoint 1 (BOC Cycle 1)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			1.510	736.2	0.0224	2.757	833.2	0.0225
2	0.0			2.701	851.2	0.0223	4.779	976.4	0.0224
3	0.0			3.602	931.2	0.0223	6.129	1035.4	0.0224
4	0.0	Data not required.		4.196	978.1	0.0223	6.873	1043.6	0.0223
5	0.0			4.565	1002.3	0.0222	7.250	1031.3	0.0223
6	0.0			4.781	1015.2	0.0222	7.425	1014.9	0.0222
7	0.0			4.893	1023.4	0.0221	7.494	1001.4	0.0221
8	0.0			4.934	1030.9	0.0221	7.506	992.7	0.0221
9	0.0			4.917	1039.7	0.0220	7.480	988.6	0.0220
10	0.0			4.849	1049.5	0.0219	7.421	988.4	0.0220
11	0.0			4.740	1057.3	0.0219	7.341	991.5	0.0219
12	0.0			4.620	1058.6	0.0218	7.271	997.7	0.0219
13	0.0			4.526	1050.4	0.0218	7.242	1006.3	0.0218
14	0.0			4.474	1034.4	0.0217	7.260	1016.4	0.0218
15	0.0			4.414	1013.1	0.0217	7.248	1026.4	0.0217
16	0.0			4.192	979.7	0.0216	6.980	1026.7	0.0217
17	0.0			3.561	912.6	0.0216	6.030	988.9	0.0216
18	0.0			2.121	770.4	0.0216	3.657	845.1	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	3.017	803.4	0.0225	6.700	1138.8	0.0235	9.416	982.8	0.0234

Table 4.1.10-16 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A28 of Crystal River Unit 3

2	5.200	921.9	0.0225	10.966	1342.7	0.0234	15.299	1136.1	0.0233
3	6.634	976.2	0.0224	13.433	1432.2	0.0233	18.714	1199.8	0.0232
4	7.414	999.7	0.0224	14.577	1462.7	0.0231	20.263	1209.1	0.0231
5	7.809	1015.7	0.0223	15.070	1472.3	0.0230	20.898	1199.9	0.0230
6	7.992	1026.8	0.0223	15.248	1477.4	0.0228	21.104	1186.1	0.0229
7	8.065	1032.9	0.0222	15.230	1485.2	0.0227	21.072	1174.0	0.0228
8	8.078	1036.3	0.0221	15.044	1495.6	0.0225	20.869	1168.1	0.0227
9	8.053	1038.7	0.0221	14.610	1502.7	0.0224	20.464	1175.9	0.0226
10	8.000	1041.6	0.0220	13.631	1472.4	0.0223	19.642	1208.6	0.0225
11	7.933	1045.8	0.0219	12.560	1229.1	0.0221	18.816	1256.3	0.0224
12	7.881	1050.5	0.0219	12.045	1101.8	0.0221	18.517	1295.9	0.0222
13	7.870	1051.9	0.0218	12.149	1062.8	0.0220	18.757	1316.0	0.0221
14	7.892	1045.4	0.0218	12.672	1042.4	0.0219	19.343	1316.2	0.0220
15	7.867	1027.7	0.0217	13.627	1072.3	0.0219	20.264	1299.1	0.0219
16	7.558	996.2	0.0217	14.062	1281.0	0.0218	20.525	1282.4	0.0218
17	6.524	941.4	0.0216	12.694	1297.0	0.0217	18.523	1236.5	0.0217
18	3.963	810.7	0.0216	8.065	1114.9	0.0216	11.954	1066.8	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3						
1	10.947	1010.3	0.0234	No additional statepoints.			No additional statepoints.		
2	17.603	1130.6	0.0233						
3	21.346	1156.0	0.0232						
4	22.852	1145.9	0.0230						
5	23.563	1132.6	0.0229						
6	23.738	1121.3	0.0228						
7	23.686	1114.5	0.0227						
8	23.477	1111.8	0.0226						
9	23.089	1115.2	0.0225						
10	22.330	1131.3	0.0224						
11	21.595	1152.6	0.0223						
12	21.379	1166.6	0.0222						
13	21.699	1173.1	0.0221						
14	22.398	1180.6	0.0220						
15	23.432	1187.8	0.0219						
16	23.658	1178.8	0.0218						
17	21.413	1153.8	0.0217						
18	13.987	1049.9	0.0216						

Table 4.1.10-17 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A29 of Crystal River Unit 3

	Assembly Number A29								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	184.7 Cy1A	184.7 Cy1A	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			1.731	765.0	0.0225	2.984	834.9	0.0225
2	0.0			3.056	894.2	0.0225	5.144	977.7	0.0224
3	0.0			4.068	984.8	0.0224	6.608	1035.9	0.0224
4	0.0	Data not required.		4.750	1036.6	0.0224	7.439	1041.2	0.0223
5	0.0			5.179	1064.9	0.0223	7.864	1025.0	0.0223
6	0.0			5.430	1080.0	0.0223	8.060	1005.4	0.0222
7	0.0			5.563	1089.6	0.0222	8.140	990.2	0.0222
8	0.0			5.611	1098.5	0.0221	8.155	980.7	0.0221
9	0.0			5.593	1108.9	0.0221	8.123	976.3	0.0220
10	0.0			5.514	1120.1	0.0220	8.051	975.9	0.0220
11	0.0			5.389	1128.8	0.0219	7.954	979.1	0.0219
12	0.0			5.249	1130.5	0.0219	7.863	985.7	0.0219
13	0.0			5.130	1121.6	0.0218	7.817	995.7	0.0218
14	0.0			5.042	1101.7	0.0218	7.825	1010.4	0.0218
15	0.0			4.920	1071.3	0.0217	7.822	1032.5	0.0217
16	0.0			4.607	1025.1	0.0216	7.567	1052.2	0.0217
17	0.0			3.890	947.7	0.0216	6.588	1026.3	0.0216
18	0.0			2.347	793.9	0.0216	4.052	876.4	0.0216

	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	139.6 Cy1B	139.6 Cy1B	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	3.249	809.5	0.0226	6.778	1114.3	0.0237	8.657	850.5	0.0228
2	5.575	929.2	0.0226	11.124	1309.4	0.0236	14.019	943.4	0.0227
3	7.134	987.1	0.0225	13.736	1401.2	0.0235	17.187	982.9	0.0227
4	8.016	1020.3	0.0225	15.025	1438.2	0.0233	18.694	987.5	0.0226
5	8.471	1051.2	0.0224	15.609	1452.7	0.0232	19.345	980.3	0.0225
6	8.685	1069.8	0.0223	15.841	1459.7	0.0230	19.575	969.2	0.0225
7	8.773	1077.4	0.0223	15.887	1466.4	0.0229	19.583	956.5	0.0224
8	8.790	1080.9	0.0222	15.804	1473.4	0.0227	19.434	945.3	0.0223
9	8.760	1083.5	0.0221	15.584	1473.3	0.0226	19.153	941.9	0.0223
10	8.695	1086.9	0.0221	15.235	1449.3	0.0224	18.801	951.4	0.0222
11	8.612	1092.1	0.0220	14.872	1389.0	0.0223	18.508	971.3	0.0221

Table 4.1.10-17 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly A29 of Crystal River Unit 3

12	8.543	1098.0	0.0219	14.651	1328.2	0.0222	18.403	995.1	0.0221
13	8.516	1100.6	0.0219	14.649	1285.8	0.0221	18.538	1015.8	0.0220
14	8.532	1094.9	0.0218	14.836	1262.9	0.0220	18.925	1029.2	0.0219
15	8.515	1076.5	0.0217	15.050	1267.8	0.0219	19.776	1068.7	0.0219
16	8.216	1042.7	0.0217	14.823	1294.0	0.0218	20.613	1233.3	0.0218
17	7.143	982.2	0.0216	13.246	1277.2	0.0217	18.771	1214.6	0.0217
18	4.398	840.4	0.0216	8.474	1104.7	0.0216	12.244	1051.5	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8			Statepoint 9		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3						
1	9.702	878.7	0.0228	No additional statepoints.			No additional statepoints.		
2	15.545	959.9	0.0228						
3	18.921	978.2	0.0227						
4	20.464	970.4	0.0226						
5	21.099	959.3	0.0225						
6	21.305	950.4	0.0225						
7	21.292	943.7	0.0224						
8	21.122	938.0	0.0223						
9	20.823	934.5	0.0223						
10	20.475	936.6	0.0222						
11	20.212	943.6	0.0222						
12	20.157	952.5	0.0221						
13	20.371	962.9	0.0220						
14	20.890	991.6	0.0220						
15	22.760	1148.8	0.0219						
16	23.682	1166.1	0.0218						
17	21.602	1141.4	0.0217						
18	14.238	1039.3	0.0216						

Table 4.1.10-18 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly O1 of Crystal River Unit 3

	Assembly Number O1								
	Statepoint 1 (BOC Cycle 1A)			Statepoint 2 (0.0 Cycle 1B)			Statepoint 3 (142.2 Cycle 1B)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
				0.0 Cy1B	146.0 Oco1	146.0 Oco1	142.2 Cy1B	89.5 Cy1B	89.5 Cy1B
1	0.0			2.270	825.0	0.0236	3.557	841.6	0.0225
2	0.0			3.977	982.4	0.0236	6.090	981.2	0.0225

Table 4.1.10-18 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly O1 of Crystal River Unit 3

3	0.0			5.373	1099.5	0.0235	7.986	1043.8	0.0224
4	0.0	Data not required.		6.781	1195.7	0.0234	9.617	1037.1	0.0223
5	0.0			10.599	1418.1	0.0233	13.312	961.7	0.0223
6	0.0			12.825	1512.9	0.0232	15.391	918.2	0.0222
7	0.0			13.478	1519.9	0.0230	15.966	898.9	0.0222
8	0.0			13.638	1509.5	0.0228	16.080	888.8	0.0221
9	0.0			13.636	1498.8	0.0227	16.048	882.9	0.0221
10	0.0			13.609	1492.4	0.0226	15.996	878.2	0.0220
11	0.0			13.621	1491.5	0.0224	15.991	873.7	0.0220
12	0.0			13.679	1495.8	0.0223	16.060	871.9	0.0219
13	0.0			13.741	1503.7	0.0221	16.174	875.2	0.0219
14	0.0			13.709	1512.2	0.0220	16.247	885.8	0.0218
15	0.0			13.411	1513.7	0.0219	16.258	920.9	0.0218
16	0.0			12.554	1488.1	0.0218	16.316	1081.4	0.0217
17	0.0			10.596	1388.5	0.0216	14.617	1130.2	0.0217
18	0.0			6.368	1109.9	0.0216	9.061	1000.2	0.0216

4.1.11 Insertion History Data for CRA's and APSRA's

The CRA and APSRA time of insertion in a particular axial position in a fuel assembly is required data for performing appropriate depletion calculations for a rodded assembly. Hardening (locally increasing the average energy of the neutron population due to less local thermalization and increased local capture of neutrons at thermal energies) the neutron spectrum in a particular axial region of an assembly at a time during its irradiation history effects the isotopic composition of the depleted fuel. The CRC depletion calculations of rodded assemblies as performed in this analysis requires rod insertion time input in terms of EFPD's inserted for either a CRA or APSRA in each axial node of each fuel assembly for each statepoint depletion calculation of interest. Tables 4.1.11-1 through 4.1.11-17 present the CRA and APSRA insertion time data relevant to each assembly depletion calculation documented in this analysis. Assembly A04 was located in a control bank 6 location during Cycle-2. Since Cycle-2 was the last cycle of insertion for assembly A04 and there are no CRC statepoints other than the beginning-of-cycle statepoint in Cycle-2, the depletion of assembly A04 through Cycle-2 was not needed. Therefore, no control rod insertion data is presented for assembly A04 in this analysis. The assembly heights corresponding to the axial nodes presented in Tables 4.1.11-1 through 4.1.11-17 are as follow: the top node (node 1) is 17.78 cm, the bottom node (node 18) is 22.352 cm, all other nodes are 20.0025 cm. The top of node 1 begins at the top of the active fuel region.

Table 4.1.11-1 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A1

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD	Cycle-1B 0.0 EFPD to Cycle-1B 142.2 EFPD	Cycle-1B 142.2 EFPD to Cycle-1B.171.3 EFPD
1	268.80	142.20	29.10

2	268.80	142.20	29.10
3	268.80	142.20	29.10
4	268.80	134.91	12.02
5	268.80	127.78	6.57
6	268.80	126.76	0.00
7	268.80	126.28	0.00
8	268.80	125.99	0.00
9	268.80	125.84	0.00
10	268.80	125.83	0.00
11	268.80	125.96	0.00
12	268.80	126.21	0.00
13	268.77	126.67	0.00
14	265.13	127.51	0.00
15	179.03	116.74	0.00
16	41.67	30.17	0.00
17	0.00	4.67	0.00
18	0.00	0.00	0.00

Table 4.1.11-2 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A5

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD	Cycle-1B 0.0 EFPD to Cycle-1B 142.2 EFPD
1	239.78	125.52
2	124.80	117.60
3	5.03	46.54
4	0.00	4.51
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00

8	0.00	0.00
9	0.00	0.00
10	0.00	0.00
11	0.00	0.00
12	0.00	0.00
13	0.00	0.00
14	0.00	0.00
15	0.00	0.00
16	0.00	0.00
17	0.00	0.00
18	0.00	0.00

Table 4.1.11-3 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A7

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD	Cycle-1B 0.0 EFPD to Cycle-1B 142.2 EFPD	Cycle-1B 142.2 EFPD to Cycle-1B 171.3 EFPD	Cycle-2 0.0 EFPD to Cycle-2 166.5 EFPD
1	14.01	142.29	29.10	161.25
2	12.97	142.20	29.10	125.38
3	12.08	142.25	29.10	30.17
4	11.22	134.21	11.83	8.45
5	10.52	126.31	6.47	3.21
6	9.96	125.18	0.00	0.41
7	9.58	124.53	0.00	0.00
8	9.37	124.16	0.00	0.00
9	9.34	123.87	0.00	0.00
10	9.43	123.82	0.00	0.00
11	9.70	123.81	0.00	0.00
12	10.09	124.00	0.00	0.00
13	10.68	124.48	0.00	0.00

14	11.72	125.38	0.00	0.00
15	2.50	114.68	0.00	0.00
16	0.00	28.90	0.00	0.00
17	0.00	4.46	0.00	0.00
18	0.00	0.00	0.00	0.00

Table 4.1.11-4 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A14

Axial Node (1=Top)	Cycle-7 0.0 EFPD to Cycle-7 260.3 EFPD	Cycle-7 260.3 EFPD to Cycle-7 291.0 EFPD	Cycle-7 291.0 EFPD to Cycle-7 319.0 EFPD	Cycle-7 319.0 EFPD to Cycle-7 462.3 EFPD	Cycle-7 462.3 EFPD to Cycle-7 479.0 EFPD
1	146.27	10.13	5.32	27.11	0.23
2	35.38	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00

Table 4.1.11-5 APSRA Insertion Time Data (EFPDs Inserted) for Assembly Number A18

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	0.00
8	0.00
9	2.20
10	4.48
11	31.29
12	238.15
13	261.36
14	257.56
15	250.06
16	122.12
17	4.49
18	0.78

Table 4.1.11-6 APSRA Insertion Time Data (EFPDs Inserted) for Assembly Number A18a

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00

6	0.00
7	0.00
8	0.00
9	2.20
10	4.48
11	31.29
12	238.15
13	261.36
14	257.56
15	250.06
16	122.12
17	4.49
18	0.78

Table 4.1.11-7 APSRA Insertion Time Data (EFPDs Inserted) for Assembly Number A18b

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD	Cycle-1B 0.0 EFPD to Cycle-1A 142.2 EFPD
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
5	0.00	0.00
6	0.00	0.00
7	0.00	0.21
8	0.00	0.46
9	2.20	0.44
10	4.48	6.34
11	31.29	71.70

12	238.15	140.47
13	261.36	140.05
14	257.56	139.51
15	250.06	109.34
16	122.12	16.84
17	4.49	0.00
18	0.78	0.00

Table 4.1.11-8 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A20

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD
1	224.35
2	225.46
3	227.76
4	230.06
5	232.01
6	233.45
7	234.37
8	234.74
9	234.54
10	233.79
11	232.47
12	230.64
13	228.83
14	225.25
15	164.24
16	37.78
17	0.00
18	0.00

Table 4.1.11-9 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A22

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD	Cycle-1B 0.0 EFPD to Cycle-1A 142.2 EFPD
1	240.16	125.38
2	125.32	117.34
3	5.03	46.31
4	0.00	4.49
5	0.00	0.00
6	0.00	0.00
7	0.00	0.00
8	0.00	0.00
9	0.00	0.00
10	0.00	0.00
11	0.00	0.00
12	0.00	0.00
13	0.00	0.00
14	0.00	0.00
15	0.00	0.00
16	0.00	0.00
17	0.00	0.00
18	0.00	0.00

Table 4.1.11-10 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A23

Axial Node (1=Top)	Cycle-2 0.0 EFPD to Cycle-2 166.5 EFPD
1	165.61
2	166.50
3	166.50

4	166.50
5	166.56
6	166.56
7	166.50
8	166.50
9	166.50
10	166.50
11	166.56
12	166.50
13	166.50
14	166.20
15	137.89
16	64.84
17	10.12
18	0.99

Table 4.1.11-11 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A23a

Axial Node (1=Top)	Cycle-2 0.0 EFPD to Cycle-2 166.5 EFPD
1	165.65
2	166.50
3	166.50
4	166.45
5	166.50
6	166.55
7	166.50
8	166.45
9	166.50
10	166.50

11	166.50
12	166.45
13	166.50
14	166.26
15	136.66
16	61.87
17	10.02
18	1.06

Table 4.1.11-12 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A25

Axial Node (1=Top)	Cycle-3 0.0 EFPD to Cycle-3 168.5 EFPD	Cycle-3 168.5 EFPD to Cycle-3 250.0 EFPD
1	168.38	81.60
2	168.50	81.50
3	168.50	81.50
4	168.44	81.50
5	168.50	81.50
6	168.50	81.50
7	168.50	81.56
8	168.50	81.56
9	168.50	81.50
10	168.50	81.50
11	168.50	81.44
12	168.50	81.50
13	168.50	81.50
14	165.24	76.88
15	111.40	3.04
16	15.24	0.00

17	5.49	0.00
18	0.26	0.00

Table 4.1.11-13 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A25a

Axial Node (1=Top)	Cycle-3 0.0 EFPD to Cycle-3 168.5 EFPD	Cycle-3 168.5 EFPD to Cycle-3 250.0 EFPD
1	156.32	71.98
2	76.64	8.99
3	10.17	0.00
4	6.84	0.00
5	0.17	0.00
6	0.00	0.00
7	0.00	0.00
8	0.00	0.00
9	0.00	0.00
10	0.00	0.00
11	0.00	0.00
12	0.00	0.00
13	0.00	0.00
14	0.00	0.00
15	0.00	0.00
16	0.00	0.00
17	0.00	0.00
18	0.00	0.00

Table 4.1.11-14 CRA & APSRA Insertion Time Data (EFPDs Inserted) for Assembly Num. A26

Axial Node (1=Top)	Cycle-1A 0.0 EFPD to Cycle-1A 268.8 EFPD (CRA Inserted)	Cycle-1B 0.0 EFPD to Cycle-1B 142.2 EFPD (APSRA Inserted)
1	13.23	0.00

2	12.27	0.00
3	11.36	0.00
4	10.46	0.00
5	9.73	0.00
6	9.19	0.00
7	8.86	0.20
8	8.67	0.44
9	8.66	0.42
10	8.80	6.32
11	9.16	71.66
12	9.73	140.55
13	10.58	140.21
14	11.95	139.62
15	2.69	109.45
16	0.00	16.83
17	0.00	0.00
18	0.00	0.00

Table 4.1.11-15 APSRA Insertion Time Data (EFPDs Inserted) for Assembly Number A28

Axial Node (1=Top)	Cycle-2 0.0 EFPD to Cycle-2 166.5 EFPD
1	0.00
2	0.00
3	0.00
4	0.00
5	0.00
6	0.00
7	1.93
8	6.55

9	15.29
10	57.78
11	122.85
12	156.14
13	142.18
14	109.13
15	47.29
16	7.78
17	0.00
18	0.00

Table 4.1.11-16 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number A29

Axial Node (1=Top)	Cycle-3 0.0 EFPD to Cycle-3 168.5 EFPD	Cycle-3 168.5 EFPD to Cycle-3 250.0 EFPD
1	168.59	81.50
2	168.50	81.55
3	168.50	81.50
4	168.50	81.50
5	168.50	81.50
6	168.55	81.50
7	168.50	81.50
8	168.50	81.50
9	168.50	81.50
10	168.50	81.50
11	168.55	81.45
12	168.50	81.50
13	168.50	81.50
14	165.37	76.92

15	114.16	3.00
16	16.44	0.00
17	6.04	0.00
18	0.27	0.00

Table 4.1.11-17 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number O1

Axial Node (1=Top)	Cycle-1 0.0 EFPD to Cycle-1 309.3 EFPD of Oconee	Cycle-1B 0.0 EFPD to Cycle-1B 142.2 EFPD
1	309.60	142.20
2	309.60	142.20
3	309.60	142.20
4	309.60	133.93
5	54.07	126.00
6	0.00	125.02
7	0.00	124.60
8	0.00	124.32
9	0.00	124.16
10	0.00	124.09
11	0.00	124.14
12	0.00	124.22
13	0.00	124.55
14	0.00	125.39
15	0.00	114.38
16	0.00	28.95
17	0.00	4.64
18	0.00	0.00

4.2 Criteria

The design of the waste package will depend on waste package configuration criticality analyses performed using an acceptable disposal criticality analysis methodology. Criteria that relate to the development and design of repository and engineered barrier components are derived from the applicable requirements and planning documents. The Engineered Barrier Design Requirements Document (EBDRD, Ref. 5.8) provides requirements for engineered barrier segment design. The Repository Design Requirements Document (RDRD, Ref. 5.9) provides requirements for repository design. The Controlled Design Assumptions Document (Ref. 5.10) provides guidance for requirements listed in the EBDRD and RDRD which have unqualified or unconfirmed data associated with the requirement.

This analysis supports the disposal criticality analysis methodology by providing input, in the form of fuel and burnable poison depletion results, to benchmark calculations which address the prediction of both spent fuel isotopic compositions and their associated reactivity. These benchmark calculations will contribute to the determination of bias values in the method of critical multiplication factor calculation that is implemented by the analytic tools to be used in the disposal criticality methodology. The requirements for utilizing the bias in the method of calculation of the critical multiplication factor for disposal configurations containing spent nuclear fuel are located in Section 3.2.2.5 of the RDRD and Section 3.2.2.6 of the EBDRD. This analysis does not satisfy these requirements, but the results from this analysis will be used as input to subsequent analyses which will satisfy these requirements.

4.3 Assumptions

4.3.1 The inherent approximation of uniformly distributed non-fuel lattice cells in the Path B unit cell models of the SAS2H calculations as described in Section 7.2 is considered acceptable within the fidelity of these calculations as documented in Section S2.2.3.1 of Volume 1, Rev. 5 in reference 5.4. The basis for this assumption is provided in the previously identified section of reference 5.4. This assumption is used throughout all depletion calculations documented in Section 7.

4.3.2 With the utilization of one cross-section update per irradiation time step, the maximum duration of any time step in any reactor cycle irradiation layout of this analysis should not exceed 80 days. The basis for this assumption is that the 80 day irradiation time step limit assures that the isotopic concentrations of the system (primarily fuel and borated moderator) will not alter the neutron spectrum radically enough to cause a time step of the depletion calculation to be performed without the availability of cross-sections which have been properly weighted with an updated neutron spectrum and spatial flux. This assumption is used throughout all depletion calculations documented in Section 7.

4.3.3 Distributing the spacer grid material uniformly in the moderator composition of the Path A and B models is acceptable. The basis for this assumption is that the limited reactivity worth of the spacer grid materials will have negligible impact on the neutron spectrum when placed homogeneously in axial regions of the assembly. This assumption is used throughout all depletion calculations documented in Section 7.

4.4 Codes and Standards

Not applicable.

5. References

5.1 Activity Evaluation: *Perform Criticality, Thermal, Structural, and Shielding Analyses*. Document Identifier Number (DI#): BB0000000-01717-2200-00025 REV 02, Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O).

5.2 Quality Assurance Requirements and Description. DOE/RW-0333P REV 07, DOE (U.S. Department of Energy).

5.3 *Summary Report of Commercial Reactor Criticality Data for Crystal River Unit 3*. DI#: B00000000-01717-5705-00060 REV 00, CRWMS M&O.

5.4 *SCALE 4.3: Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation*. User's Manual Volumes 0 through 3, Oak Ridge National Laboratory, Document Number: CCC-545.

5.5 *Software Qualification Report for the SCALE Modular Code System Version 4.3*. SCALE Version 4.3 Configuration Software Configuration Identifier (CSCI): 30011 V4.3, DI#: 30011-2002 REV 00, CRWMS M&O.

5.6 *Q-List*. YMP/90-55Q, REV 04, YMP (Yucca Mountain Site Characterization Project).

5.7 *This reference is intentionally left blank.*

5.8 *Engineered Barrier Design Requirements Document*. YMP/CM-0024, REV 0, ICN 1, DOE OCRWM.

5.9 *Repository Design Requirements Document*. YMP/CM-0023, REV 0, ICN 1, DOE OCRWM.

5.10 *Controlled Design Assumptions Document*. DI#: B00000000-01717-4600-00032 REV 04, ICN 01, CRWMS M&O.

5.11 *CRC Depletion Calculations for the Non-Rodded Assemblies in Batches 1, 2, and 3 of Crystal River Unit 3*. DI#: BBA000000-01717-0200-00032 REV 00, CRWMS M&O.

5.12 Attachments for BBA000000-01717-0200-00040 REV 00 - CRC Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X of Crystal River Unit 3. Batch Number: MOY-970820-04.

5.13 CRC Depletion Calculations for the Rodded Assemblies in Batches 1, 2, 3, and 1X of Crystal River Unit 3 (DI#: BBA000000-01717-0200-00040 REV 00) - Attachments XL and XLI - 2 Data Cartridges. Batch Number: MOY-970820-03.

6. Use of Computer Software

6.1 Scientific and Engineering Software

The SAS2H control module of the SCALE 4.3 modular code system (Ref. 5.4) was used in this analysis to perform fuel assembly depletion calculations required for CRC evaluations. The SCALE 4.3 code system is subject to the requirements of the QARD (Ref. 5.2). The SCALE 4.3 code system was obtained from the Software Configuration Management in accordance with appropriate procedures. The CSCI number for SCALE 4.3 is 30011 V4.3. The SAS2H calculations documented in this analysis were performed on Hewlett Packard (HP) 9000 series workstations. The SAS2H control module utilizes the BONAMI, NITAWL, XSDRNPM, COUPLE, and ORIGEN-S calculational modules to perform isotopic depletion calculations. A detailed description of the SAS2H control module is provided in Volume 1, Section S2 of reference 5.4. The SAS2H control module of the SCALE 4.3 code system is applicable to the engineering application within this analysis and is used within the range of verification and validation as documented in reference 5.5.

A software routine entitled "Commercial Reactor Assembly Follow Taskmaster" (CRAFT) was written to automate the production of SAS2H input decks as required to support fuel assembly depletion calculations relevant to CRC evaluations. The CRAFT code does not generate data. All calculations performed by the CRAFT code are verified by visual inspection and/or hand calculations. The CRAFT code, Version 3.0, compiled on February 25, 1997, was utilized in this analysis to orchestrate the depletion calculations for the fuel assemblies. The CRAFT 3.0 source code ("CRAFT.f.V-3.compiled_on_02_25_97") and executable file ("CRAFT3.0") exist in the directory "/users/wright/CRAFT_V3" on the Waste Package Development Department (WPDD) HP 9000 series workstation designated "Opus". The CRAFT code is subject to the requirements of the QARD as defined by Section I.2.1 Part C of Supplement I Rev. 1 of the QARD. Complete documentation of the CRAFT code, Version 3.0, including code description, user information, and documentation that the software provides correct results for a specified range of input parameters is included in Attachment I of this analysis.

A software routine entitled "CRC_DATA_TABULIZER" was written to automate the production of tables containing the isotopic results and other pertinent data for a set of 29 principal isotopes at each CRC statepoint for each assembly. The CRC_DATA_TABULIZER code does not generate data. All calculations performed by the CRC_DATA_TABULIZER code are verified by visual inspection and/or hand calculations. The CRC_DATA_TABULIZER code, Version 2.0, compiled on March 20, 1997, was utilized to tabulate the principal isotope results for each fuel assembly at each CRC statepoint. The CRC_DATA_TABULIZER, Version 2.0, source code (CRC_DATA_TABULIZER_V2.f) and executable file (CRC_DATA_TABULIZER_V2.exe) exist in the directory "/users/wright/CRC_DATA_TABULIZER" on the WPDD HP 9000 series workstation designated "Opus". The CRC_DATA_TABULIZER code is subject to the requirements of the QARD as defined by Section I.2.1 Part C of Supplement I Rev. 1 of the QARD. Complete documentation of the CRC_DATA_TABULIZER code including code description, user information, and documentation that the software provides correct results for a specified range of input parameters is presented in Attachment V of reference 5.11.

A software routine entitled "RLAYOUT" was written to automate the development of appropriate irradiation time step layouts for depletion calculations involving rod insertion histories in which rod movements must be followed. The RLAYOUT code does not generate data. All calculations performed by the RLAYOUT code are verified by visual inspection and/or hand calculations. The RLAYOUT code, compiled on February 4, 1997, was utilized to develop appropriate irradiation time step layouts for the statepoint depletion calculations having associated rod insertion histories. The RLAYOUT source code (RLAYOUT.f) and executable file (RLAYOUT.exe) exist in the directory "/users/wright/RLAYOUT" on the WPDD HP 9000 series workstation designated "Opus". The RLAYOUT code is subject to the requirements of the QARD as defined by Section I.2.1 Part C of Supplement I Rev. 1 of the QARD. Complete documentation of the RLAYOUT code including code description, user information, and documentation that the software provides correct results for a specified range of input parameters is presented in Attachment III of this analysis.

6.2 Computational Support Software

The Excel, Version 5.0, and Lotus 1-2-3, Version 4.0, spreadsheet packages are two of the computational support software packages utilized in this analysis. The user-defined formulas, inputs, and results for all calculations performed with these spreadsheet packages are documented, where applicable, throughout this analysis. The "sed" line editor (Revision: 70.12) available in the "/bin" directory on the HP 9000 series workstations is utilized in the "sedexecute" script file which is called and executed by the CRAFT code. The usage of the "sed" line editor is described in Section 6 of Attachment I.

7. Design Analysis

This design analysis documents the fuel assembly SAS2H depletion calculations for the rodded assemblies of fuel batches 1, 2, 3, and 1X which are required for the CRC evaluations of Crystal River Unit 3. Sections 7.1 through 7.5 describe how the parameters listed in Section 4.1 are utilized to perform the appropriate SAS2H depletion calculations relevant to CRC evaluations. The CRAFT description and user information provided in Attachment I is essential for understanding the SAS2H modeling techniques employed in this analysis. The information in Attachment I, the input parameters in Section 4.1, and the CRAFT input decks in Attachments IV through XXI work together to provide a complete description of how all of the SAS2H depletion calculations in this analysis were performed.

7.1 Assembly Depletion Calculation Procedure

The calculational procedure for the fuel assembly SAS2H depletion calculations performed in this analysis is based on the utilization of the CRAFT Version 3.0 code. The CRAFT code is described generally in Sections 7.4 and 7.5. The complete detailed description of the CRAFT Version 3.0 code is provided in Attachment I of this analysis. The procedure for performing a fuel assembly depletion calculation with CRAFT Version 3.0 consists of the following four steps:

1) Create a CRAFT input deck for the assembly depletion calculation.
2) Assure that the CRAFT executable file and the CRAFT input deck entitled "datain" and the "sedexecute" executable file are in the same directory. The "sedexecute" executable file is a script file which is used in conjunction with the CRAFT code to create the consolidated output files described in Section 7.5.
3) Execute CRAFT.
4) Check and analyze the CRAFT generated SAS2H input decks and the SAS2H isotopic results.

The various CRAFT generated and consolidated SAS2H output files contain unique filenames which specify the following information:

1) reactor identifier,
2) one-eighth core symmetry assembly number in current reactor cycle,
3) axial node number,
4) reactor cycle number in which the SAS2H calculation begins,
5) EFPD statepoint at which the SAS2H calculation begins,
6) reactor cycle number in which the SAS2H calculation ends,
7) EFPD statepoint at which the SAS2H calculation ends.

A complete detailed description of the filename content and format is provided in Attachment I. Specific isotopic results contained in the various consolidated output files generated by CRAFT may be retrieved using the output filename information.

7.2 Path B Unit Cell Model Development

The SAS2H control module uses ORIGEN-S to perform a point depletion calculation for the fuel assembly or section of the fuel assembly described in the SAS2H input deck. The ORIGEN-S calculational module uses cell-weighted cross-sections based on one-dimensional (1-D) transport calculations performed by XSDRNPM. One-dimensional transport calculations are performed on two unit cell models, Path A and Path B, to calculate energy dependent spatial neutron flux distributions necessary to perform cross-section cell-weighting calculations.

The Path A unit cell model is simply a unit cell of the fuel assembly lattice containing a fuel rod. In the Path A model, the fuel pellet, gap, and clad are modeled explicitly. The only modification required to develop the Path A model is the conversion of the fuel assembly's square lattice unit cell perimeter to a radial perimeter conserving moderator volume within the unit cell, exterior to the fuel rod cladding. This modification is performed automatically by the SAS2H control module. A 1-D transport calculation is performed on the Path A unit cell model for each energy group, and the unit cell spatial flux distributions for each energy group are used to calculate cell-weighted cross-sections for the fuel.

The Path B unit cell model is a larger unit cell representation than the Path A model; hence, it is sometimes referred to as the larger unit cell model. The Path B unit cell model represents all or part of the fuel assembly. The Path B unit cell model attempts to account for spectral effects due to heterogeneities within the fuel assembly such as water gaps, burnable poison rods, control rods, or axial power shaping rods. Typically, fuel assemblies contain a number of similar non-fuel lattice cells dispersed somewhat uniformly throughout the assembly lattice. The structure of the Path B unit cell model is based on a uniform distribution of these non-fuel lattice cells. In reality, most fuel assemblies do not have uniformly distributed non-fuel lattice cells, but the approximation of uniformly distributed non-fuel lattice cells is considered acceptable within the fidelity of these calculations as documented in Section S2.2.3.1 of Volume 1, Rev. 5 in reference 5.4.

The basic structure of the Path B unit cell model for the fuel assembly depletion calculations performed in this analysis includes an inner region composed of an explicit representation of the non-fuel lattice cell. This inner region has essentially the same format as the Path A model with the fuel rod replaced by the non-fuel rod. A region representing the homogenization of the remainder of the fuel assembly surrounds the inner region in the Path B unit cell model. A final region representing the moderator in the assembly-to-assembly spacing surrounds the homogenized region in the Path B unit cell model. The size of each radial region surrounding the inner region in the Path B unit cell model is determined by conserving the fuel-to-moderator volume ratio in the system. The cell-weighted cross-sections from the Path A model are used with the fuel of the homogenized region during the Path B model transport calculations. New cell-weighted cross-sections for each energy group are then developed using the unit cell spatial flux distribution results from the Path B model transport calculations. These cell-weighted cross-sections are used in point depletion calculations performed by ORIGEN-S to calculate depleted fuel and depleted burnable poison, if present, isotopics in the fuel assembly. A detailed description of the calculations used to produce time-dependent cross-sections by SAS2H is documented in Section S2.2.4 of Volume 1, Rev. 5 in reference 5.4.

The Path B unit cell models for the various fuel assembly configurations must be developed manually and input to the SAS2H control module. The primary concern in the development of the Path B model for PWR assemblies is the conservation of the fuel-to-moderator volume ratio in the system. For the fuel assemblies in batches 1, 2, 3, and 1X of Crystal River Unit 3 a combination of the following sets of Path B models must be utilized:

Set 1) This set is composed of one Path B model representing the base fuel assembly configuration with sixteen water-filled guide tubes and one water-filled instrument tube. This Path B model may only be employed in a statepoint depletion calculation which does not have any BPRA, CRA, or APSRA insertion history.

Set 2) This set is composed of three Path B models that are utilized in statepoint depletion calculations that have a BPRA insertion history. One of the Path B models in this set represents a fuel assembly axial region containing sixteen BPRs inserted into the guide tubes with one water-filled instrument tube. Another Path B model in this set represents a fuel assembly axial region containing sixteen non-absorbing BPRs inserted into the guide tubes with one water-filled instrument tube. .The last Path B model in this set represents a fuel assembly axial region with the BPRA removed. Since a constant number of Path B model radial zones must be maintained during a given SAS2H calculation (i.e., a statepoint depletion calculation), it is necessary to define a Path B model equivalent to that previously described in Set 1, but with the same number of radial zones as those previously described in this set.

Set 3) This set is composed of two Path B models that are utilized in statepoint depletion calculations that have a CRA insertion history. One of the Path B models in this set represents a fuel assembly axial region containing sixteen CRs inserted into the guide tubes with one water-filled instrument tube. The other Path B model in this set represents a fuel assembly axial region with the CRA removed. Since a constant number of Path B model radial zones must be maintained during a given SAS2H calculation (i.e., a statepoint depletion calculation), it is necessary to define a Path B model equivalent to that previously described in Set 1, but with the same number of radial zones as the first Path B model described in this set.

Set 4) This set is composed of three Path B models that are utilized in statepoint depletion calculations that have a APSRA insertion history. One of the Path B models in this set represents a fuel assembly axial region containing sixteen APSRs (absorbing region present in the guide tubes) with one water-filled instrument tube. Another Path B model in this set represents a fuel assembly axial region containing sixteen APSRs (only the follow rod region present in the guide tubes) with one water-filled instrument tube. The last Path B model in this set represents a fuel assembly axial region with the APSRA removed. Since a constant number of Path B model radial zones must be maintained during a given SAS2H calculation (i.e., a statepoint depletion calculation), it is necessary to define a Path B model equivalent to that previously described in Set 1, but with the same number of radial zones as those previously described in this set.

The Path B model development spreadsheets in Tables 7.2-1 through 7.2-4, present the input parameters required, the parameters calculated, references to equations used to calculate the parameters, and the final Path B unit cell model dimensions available for direct implementation into SAS2H input decks for the rodded assembly depletion analyses of batches 1, 2, 3, and 1X. The assembly specifications required to develop the Path B models are the same for batches 1, 2, 3, and 1X. The spreadsheet presented in Table 7.2-1, calculates the dimensions of the Path B unit cell model for Set 1, as previously described. The spreadsheet presented in Table 7.2-2, calculates the dimensions of the Path B unit cell models for Set 2, as previously described. The spreadsheet presented in Table 7.2-3, calculates the dimensions of the Path B unit cell models for Set 3, as previously described. The spreadsheet presented in Table 7.2-4, calculates the dimensions of the Path B unit cell models for Set 4, as previously described. Table 7.2-5, contains a listing of the equations referenced and utilized in each of the spreadsheets presented in Tables 7.2-1 and 7.2-4.

Table 7.2-1 Set 1 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

SAS2H Path B Unit Cell Model Dimension Calculations for the Rodded Assembly Axial Regions in Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3 that Contain 16 Water-Filled Guide Tubes and 1 Water-Filled Instrument Tube

Input Parameters

Number of unit cells in assembly:	225
Number of fuel rods in assembly:	208
Number of guide tubes in assembly:	16
Rod pitch in assembly (cm):	1.44272
Fuel pellet diameter (cm):	0.9398
Fuel cladding outer diameter (cm):	1.0922
Guide tube outer diameter (cm):	1.3462
Guide tube inner diameter (cm):	1.26492
Instrument tube outer diameter (cm):	1.38193
Instrument tube inner diameter (cm):	1.12014
Assembly pitch (cm):	21.81098

Fuel-to-Moderator Volume Ratio Calculation:

Identifier of Equation(s) Utilized: 1 (Table 7.2-5)

Fuel-to-Moderator Volume Ratio = 0.533864

Moderator Unit Volume in Central Unit Cell of Path B Model:

Identifier of Equation(s) Utilized: 2 (Table 7.2-5)

Moderator Unit Volume in Central Unit Cell of Path B Model = 1.914755

Fuel Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 3 (Table 7.2-5)

Fuel Unit Volume in Fuel Rod Unit Cell = 0.693683

Table 7.2-1 Set 1 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Moderator Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 4 (Table 7.2-5)

Moderator Unit Volume in Fuel Rod Unit Cell = 1.144539

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model:

Identifier of Equation(s) Utilized: 5 (Table 7.2-5)

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model = 12.36742

Path B Unit Cell Model Dimensions:

	Zone #	Outer Radius (cm)	Zone Description
Inner	1	0.63246	Water filled gap
	2	0.67310	Guide tube
	3	0.81397	Guide tube unit cell moderator
	4	2.97599	Homogenized region
Outer	5	2.99939	Moderator in the assembly-to-assembly gap

Notes: The Zone 4 outer radius is calculated using Equation 6.
The Zone 5 outer radius is calculated using Equation 7.

Table 7.2-2 Set 2 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

SAS2H Path B Unit Cell Model Dimension Calculations for the Rodded Path B Models for Use in Assembly Axial Regions of Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3 that have a BPRA Insertion History

Input Parameters

Number of unit cells in assembly:	225
Number of fuel rods in assembly:	208
Number of guide tubes in assembly:	16
Number of BPR's in assembly:	16
Rod pitch in assembly (cm):	1.44272
Fuel pellet diameter (cm):	0.9398
Fuel cladding outer diameter (cm):	1.0922
Guide tube outer diameter (cm):	1.3462
Guide tube inner diameter (cm):	1.26492
BPR cladding outer diameter (cm):	1.0922
BPR cladding inner diameter (cm):	0.9144
BP pellet diameter (cm):	0.8636
Instrument tube outer diameter (cm):	1.38193
Instrument tube inner diameter (cm):	1.12014
Assembly pitch (cm):	21.81098

Fuel-to-Moderator Volume Ratio Calculation:

Identifier of Equation(s) Utilized: 1 (Table 7.2-5)

Fuel-to-Moderator Volume Ratio = 0.565214

Moderator Unit Volume in Central Unit Cell of Path B Model:

Identifier of Equation(s) Utilized: 2 (Table 7.2-5)

Moderator Unit Volume in Central Unit Cell of Path B Model = 0.977852

Fuel Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 3 (Table 7.2-5)

Fuel Unit Volume in Fuel Rod Unit Cell = 0.693683

Table 7.2-2 Set 2 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Moderator Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 4 (Table 7.2-5)

Moderator Unit Volume in Fuel Rod Unit Cell = 1.144539

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model:

Identifier of Equation(s) Utilized: 5 (Table 7.2-5)

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model = 11.81651

Path B Unit Cell Model Dimensions:

	Zone #	Outer Radius (cm)	Zone Descriptions With Absorbing BPRA Inserted	Zone Descriptions With Non-Absorbing BPRA Inserted
Inner	1	0.43180	Absorbing BP Material	Non-Absorbing BP Material
	2	0.45720	Helium Gap	Helium Gap
	3	0.54610	BPR cladding	BPR cladding
	4	0.63246	Water Filled Gap	Water Filled Gap
	5	0.67310	Guide tube	Guide tube
	6	0.81397	Unit cell moderator	Unit cell moderator
	7	2.91402	Homogenized region	Homogenized region
Outer	8	2.93693	Moderator Outside Assembly	Moderator Outside Assembly

Notes: The Zone 7 outer radius is calculated using Equation 6.
The Zone 8 outer radius is calculated using Equation 7.

The Path B model that is used after the removal of the BPRA during a statepoint depletion calculation must use the same number of radial zones as the Path B model with the BPRA inserted. One difference between the Path B model with the BPRA removed and the Path B model with the BPRA inserted is that the materials in zones 1 through 3 are changed to water. Another difference is that the outer radius of zones 7 and 8 are adjusted to match the homogenized region and outer water region dimensions of the base Path B model (the Path B model with all empty guide tubes). Typically, a BPRA is not moved or removed during a reactor cycle. In this analysis there is no instance when a BPRA would need to be removed from an assembly axial node during a statepoint calculation. For this reason, the Path B model for the assembly node after removal of a BPRA during a statepoint calculation is not used in any of the assembly depletion calculations documented in this analysis.

Table 7.2-3 Set 3 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Path B Models for Use in Assembly Axial Regions of Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3 that have a CRA Insertion History

Input Parameters

Number of unit cells in assembly:	225
Number of fuel rods in assembly:	208
Number of guide tubes in assembly:	16
Number of CR's in assembly:	16
Rod pitch in assembly (cm):	1.44272
Fuel pellet diameter (cm):	0.9398
Fuel cladding outer diameter (cm):	1.0922
Guide tube outer diameter (cm):	1.3462
Guide tube inner diameter (cm):	1.26492
CR cladding outer diameter (cm):	1.1176
CR cladding inner diameter (cm):	1.01092
CR absorber material diameter (cm):	0.99568
Instrument tube outer diameter (cm):	1.38193
Instrument tube inner diameter (cm):	1.12014
Assembly pitch (cm):	21.81098

Fuel-to-Moderator Volume Ratio Calculation:

Identifier of Equation(s) Utilized: 1 (Table 7.2-5)

Fuel-to-Moderator Volume Ratio = 0.56678

Moderator Unit Volume in Central Unit Cell of Path B Model:

Identifier of Equation(s) Utilized: 2 (Table 7.2-5)

Moderator Unit Volume in Central Unit Cell of Path B Model = 0.933769

Fuel Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 3 (Table 7.2-5)

Table 7.2-3 Set 3 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Fuel Unit Volume in Fuel Rod Unit Cell = 0.693683

Moderator Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 4 (Table 7.2-5)

Moderator Unit Volume in Fuel Rod Unit Cell = 1.144539

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model:

Identifier of Equation(s) Utilized: 5 (Table 7.2-5)

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model = 11.76595

Path B Unit Cell Model Dimensions:

	Zone #	Outer Radius (cm)	With CRA Inserted in Axial Region	With CRA Removed from Axial Region
Inner	1	0.49784	CR Absorber Material	Water
	2	0.50546	Helium Gap	Water
	3	0.55880	CR cladding	Water
	4	0.63246	Water	Water
	5	0.67310	Guide tube	Guide tube
	6	0.81397	Unit cell moderator	Unit cell moderator
	7	2.90826	Homogenized region	—
Outer	8	2.93113	Moderator Outside Assembly	—
	7	2.97599	—	Homogenized region
Outer	8	2.99939	—	Moderator Outside Assembly

Notes: The Zone 7 outer radius is calculated using Equation 6.
The Zone 8 outer radius is calculated using Equation 7.
The outer radius values for zones 7 and 8 with the control rod removed are calculated as shown in Table 7.2-1.

Table 7.2-4 Set 4 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Path B Models for Use in Assembly Axial Regions of Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3 that have a Black APSRA Insertion History

Input Parameters

Number of unit cells in assembly:	225
Number of fuel rods in assembly:	208
Number of guide tubes in assembly:	16
Number of APSR's in assembly:	16
Rod pitch in assembly (cm):	1.44272
Fuel pellet diameter (cm):	0.9398
Fuel cladding outer diameter (cm):	1.0922
Guide tube outer diameter (cm):	1.3462
Guide tube inner diameter (cm):	1.26492
APSR cladding outer diameter (cm):	1.1176
APSR cladding inner diameter (cm):	1.01092
APSR absorber material diameter (cm):	0.99568
Instrument tube outer diameter (cm):	1.38193
Instrument tube inner diameter (cm):	1.12014
Assembly pitch (cm):	21.81098

The APSR follow rod has the same dimensions as the APSR cladding and is filled with water.

Fuel-to-Moderator Volume Ratio Calculation:

Identifier of Equation(s) Utilized: 1 (Table 7.2-5)

Fuel-to-Moderator Volume Ratio for the cross-section of the assembly containing the absorbing region of the APSRA = 0.56678

Fuel-to-Moderator Volume Ratio for the cross-section of the assembly containing the follow rod region of the APSRA = 0.53956

Moderator Unit Volume in Central Unit Cell of Path B Model:

Identifier of Equation(s) Utilized: 2 (Table 7.2-5)

Moderator Unit Volume in the Central Unit Cell of the Path B Model for the Inserted APSR Absorber Region = 0.933769

Moderator Unit Volume in the Central Unit Cell of the Path B Model for the Inserted APSR Follow Rod = 1.736414

Table 7.2-4 Set 4 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Fuel Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 3 (Table 7.2-5)

Fuel Unit Volume in Fuel Rod Unit Cell = 0.693683

Moderator Unit Volume in Fuel Rod Unit Cell:

Identifier of Equation(s) Utilized: 4 (Table 7.2-5)

Moderator Unit Volume in Fuel Rod Unit Cell = 1.144539

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model:

Identifier of Equation(s) Utilized: 5 (Table 7.2-5)

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model with the APSR Absorber Region Inserted = 11.76595

Number of Fuel Rod Unit Cells that must be Represented in the Homogenized Zone of the Path B Model with the APSR Follow Rod Region Inserted = 12.30592

Path B Unit Cell Model Dimensions:

	Zone #	Outer Radius (cm)	With APSRA Inserted in Axial Region	With APSRA Removed from Axial Region	With APSRA Follow Rod Axial Region Inserted
Inner	1	0.49784	APSR Absorber Material	Water	Water
	2	0.50546	Helium Gap	Water	Water
	3	0.55880	APSR cladding	Water	APSR cladding
	4	0.63246	Water	Water	Water
	5	0.67310	Guide tube	Guide tube	Guide tube
	6	0.81397	Unit cell moderator	Unit cell moderator	Unit cell moderator
	7	2.90826	Homogenized region	—	—
Outer	8	2.93113	Moderator Outside Assembly	—	—
	7	2.97599	—	Homogenized region	—
Outer	8	2.99939	—	Moderator Outside Assembly	—

Table 7.2-4 Set 4 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

	7	2.96913	—	—	Homogenized region
Outer	8	2.99248	—	—	Moderator Outside Assembly

Notes: The Zone 7 outer radius is calculated using Equation 6.
The Zone 8 outer radius is calculated using Equation 7.
The outer radius values for zones 7 and 8 with the APSR removed are calculated as shown in Table 7.2-1.

Table 7.2-5 Equations Utilized in the Path B Model Dimension Calculation Spreadsheets Presented in Tables 7.2-1 and 7.2-4

Equation 1 (Fuel-to-Moderator Volume Ratio in Actual Assembly):

$$\frac{F}{M}\ Ratio = \frac{(Number\ of\ Fuel\ Rods)(\frac{\pi}{4})(Fuel\ Pellet\ Diameter)^2}{\{(Number\ of\ Fuel\ Rods)[Rod\ Pitch^2-(Clad\ OD)^2(\frac{\pi}{4})]+}$$

$$(Number\ of\ Empty\ GT's)[Rod\ Pitch^2-(GT\ OD)^2(\frac{\pi}{4})+(GT\ ID)^2(\frac{\pi}{4})]+$$

$$(Number\ of\ Rodded\ GT's)[Rod\ Pitch^2-(GT\ OD)^2(\frac{\pi}{4})+(GT\ ID)^2(\frac{\pi}{4})-(Inserted\ Rod\ OD)^2(\frac{\pi}{4})+$$

$$(APSR\ Follow\ Rod\ ID)^2(\frac{\pi}{4})]+[Rod\ Pitch^2-(IT\ OD)^2(\frac{\pi}{4})+(IT\ ID)^2(\frac{\pi}{4})]\}$$

where GT means guide tube, IT means instrument tube, and ID means inner diameter, OD means outer diameter. This equation assumes that there is no instrument inserted in the instrument tube, and the instrument tube is filled with moderator. The APSR Follow Rod ID is only specified if the follow rod region of an APSRA is being represented in the Path B model.

Equation 2 (Central Unit Cell Moderator Volume):

$$CUCMV = Rod\ Pitch^2-(GT\ OD)^2(\frac{\pi}{4})+(GT\ ID)^2(\frac{\pi}{4})-(Inserted\ Rod\ OD)^2(\frac{\pi}{4})$$

Equation 3 (Fuel Volume in an Assembly Lattice Cell Containing a Fuel Rod):

$$FV = (Fuel\ Pellet\ OD)^2(\frac{\pi}{4})$$

Equation 4 (Moderator Volume in an Assembly Lattice Cell Containing a Fuel Rod):

$$MV = Rod\ Pitch^2 - (Fuel\ Clad\ OD)^2\left(\frac{\pi}{4}\right)$$

Base equation from which Equation 5 is derived:

$$\frac{F}{M}\ Ratio = \frac{x\ (FV)}{CUCMV + x\ (MV)}$$

where x is the number of assembly lattice cells containing fuel rods that must be represented in the Path B homogenized region.

Equation 5:

$$x = \frac{\left(\frac{F}{M}\ Ratio\right)(CUCMV)}{FV - \left(\frac{F}{M}\ Ratio\right)(MV)}$$

Base equations from which Equations 6 and 7 are derived:

$$Area\ of\ Any\ Annular\ Region\ in\ the\ Path\ B\ Model = \pi\ (Outer\ Radius\ of\ Annular\ Region^2 - Inner\ Radius\ of\ Annular\ Region^2)$$

$$\updownarrow$$

$$Outer\ Radius\ of\ Annular\ Region = \sqrt{\frac{Area\ of\ Annular\ Region}{\pi} + IR^2}$$

where IR means the inner radius of the annular region.

Equation 6:

$$Path\ B\ Model\ Homogenized\ Region\ Outer\ Radius = \sqrt{\frac{x\ (Rod\ Pitch)^2}{\pi} + IR^2}$$

Equation 7:

$$\textit{Assembly-to-Assembly Spacing Moderator Zone Outer Radius} = \left\{ \frac{(x+1)}{\textit{Number of Lattice Cells In Assembly}} * \left[\textit{Assembly Pitch}^2 - (\textit{Rod Pitch})^2(\textit{Number of Lattice Cells In Assembly})\right]\left(\frac{1}{\pi}\right) + IR^2 \right\}^{0.5}$$

7.3 Cycle Irradiation History Layouts for the Depletion of the Rodded Assemblies in Batches 1, 2, 3, and 1X of Crystal River Unit 3

The irradiation time step layouts for the statepoint depletion calculations performed with the SAS2H control module, as documented in this analysis, will vary depending on whether or not the analyzed assembly has a CRA or APSRA insertion history in the statepoint calculation of interest. This variation in irradiation time step layouts between statepoint calculations containing rod insertion histories occurs because the rod insertion histories vary between statepoint calculations for different assemblies. The rod insertion histories for an assembly must be modeled such that the appropriate axial nodes of the fuel assembly are depleted using the appropriate neutron flux and spectrum over the correct exposure duration. The presence of a CRA or APSRA will effect the isotopic inventory in a fuel assembly local axial region as a result of the hardened neutron spectrum. In general, a hardened neutron spectrum (a higher average energy for the neutron population) will be produced as a result of decreased neutron moderation and increased parasitic capture of thermal neutrons. A locally hardened neutron spectrum in a thermal reactor for a short period of time will result in a local decrease in reactivity due to the following:

1) a decrease in the thermal utilization factor (the ratio of thermal neutron absorptions in the fuel to total thermal neutron absorptions);
2) a decrease in the resonance escape probability (the fraction of fission neutrons that manage to slow down from fission to thermal energies without being absorbed).

The presence of a locally hardened neutron spectrum for longer periods of time will result in the build-up of Pu-239 through the parasitic capture of fast neutrons by U-238 with subsequent beta decay through Np-239. Due to the lower depletion of U-235 through fission and the increase production of Pu-239 through parasitic capture by U-238, the fissile content and hence reactivity of the fuel will be greater upon transition back to a thermal neutron spectrum rather than if the fuel had experienced a continuous thermal neutron spectrum. Therefore, the use of BPRAs, CRAs and APSRAs in reactor operation is not only for power regulation, but also for fuel assembly burnup extension. The isotopic inventory may be quite different between fuel with and without an absorbing rod assembly insertion history. These isotopic inventory differences must be accounted for in the CRC depletion calculations to allow for correct prediction of core k_{eff} values in subsequent CRC reactivity evaluations.

In SAS2H, the duration of an irradiation interval may be separated into a number of time steps of variable length. Typically, an irradiation interval is a CRC statepoint depletion calculation interval, or the continuous irradiation time required to go from one CRC statepoint to another. To follow the CRA or APSRA insertion histories, detailed intra-cycle variable irradiation time steps are required. This is due to the fact that the CRs and APSRs are only present in a given axial node of an assembly for a given period of exposure during a statepoint depletion calculation. A user specified number of cross-section library updates are performed during each time step of an irradiation interval. The boron letdown curve of the reactor cycle may also be followed by specifying, at each irradiation step, a fraction of the soluble boron concentration defined in the base moderator material specification. This boron concentration is applied uniformly over the irradiation time step. The boron concentration fraction at the mid-point of each irradiation time step is specified in the SAS2H depletion calculations of this analysis to appropriately follow boron letdown curves. Considering the cross-section update frequency, the boron letdown data, and the absorber rod assembly insertion histories, the following three primary requirements apply to determining an appropriate reactor cycle irradiation layout for a rodded assembly.

1) The duration of each time step should be specified such that a maximum of 80 days of irradiation is not exceeded between cross-section updates. The SAS2H calculations in this analysis utilize one cross-section update per irradiation step. Therefore, the maximum duration of any time step in any reactor cycle irradiation layout of this analysis should not exceed 80 days. The 80 day limit is an arbitrary limit based on engineering judgement. The 80 day irradiation time step limit should assure that the isotopic concentrations of the system (primarily fuel and borated moderator) will not alter the neutron spectrum radically enough to cause a time step of the depletion calculation to be performed without the availability of cross-sections which have been properly weighted with an appropriate neutron spectrum and spatial flux.

2) Any radical perturbations in the boron letdown curve should be followed by defining irradiation time step durations such that the average boron concentration over each time step is representative of the actual boron letdown. Usually, the 80 day time step limit imposed for cross-section update frequency is adequate to properly follow a reactor cycle's boron letdown curve.

3) The duration of each time step should be specified such that the insertion of a CRA or APSRA in a given assembly axial node may be modeled for the correct exposure time in terms of EFPD. A more detailed description of the meaning of this statement is warranted. In SAS2H, there is an option to vary the Path B unit cell model between irradiation steps as long as the number of radial zones in the Path B models of a given SAS2H calculation (i.e., statepoint depletion calculation) remain the same. Therefore, an assembly axial node represented in a given SAS2H statepoint depletion calculation that has a CRA or APSRA insertion history for a specified period of exposure (that is a fraction of the exposure covered by the statepoint depletion calculation) may be modeled appropriately by changing the Path B model from one representing the insertion of a CRA or APSRA to one representing the removal of a CRA or APSRA at the appropriate time step (corresponding to the CRA or APSRA removal time).

All three of the requirements previously described must be correctly addressed in the SAS2H input decks developed for each axial node of an assembly in each statepoint depletion calculation. Assuring that the cross-section update frequency and the boron letdown curves are properly modeled is usually a by-product of developing the irradiation layouts for the statepoint depletion calculations containing either CRA or APSRA insertion history. The irradiation time step layout for a given statepoint depletion calculation must be developed such that breakpoints exist between irradiation time steps that allow for the appropriate removal or insertion of a CRA or APSRA to obtain the correct integrated neutron spectrum exposure for each axial node of the assembly. It becomes obvious then that the complexity of the irradiation time step layout for a given statepoint calculation is proportional to the number of CRC axial nodes being modeled and the frequency of CRA or APSRA movement during the assembly depletion. The time steps developed to model CRA or APSRA insertion histories are also designed to encompass the cross-section update and boron letdown requirements. A program entitled "RLAYOUT" was written to automate the development of appropriate irradiation time step layouts for the statepoint depletion calculations of an assembly containing either a CRA or APSRA insertion history. The RLAYOUT program is described in Attachment III of this analysis.

The RLAYOUT program is only utilized to determine the irradiation time step layouts for the CRC statepoint depletion calculations that contain either a CRA or APSRA insertion history. A single assembly may have a combination of CRC statepoint calculations that either require or do not require the RLAYOUT developed irradiation time step layouts. For the CRC statepoint depletion calculations that do not require the consideration of CRA or APSRA insertion histories, the irradiation time step layouts are developed by considering the cross-section update frequency and the boron letdown data. Tables 7.3-1 through 7.3-7 contain the CRC statepoint depletion calculation time step layouts for each reactor cycle that is relevant to statepoint calculations documented in this analysis which do not have either a CRA or APSRA insertion history. The mid-step boron concentrations presented in Tables 7.3-1 through 7.3-7 are obtained by using linear interpolation within the data presented in Tables 4.1.9-1 through 4.1.9-7. A description of the linear interpolation procedures employed are presented in the "UNITS_CONVERSION" subroutine description section of the CRAFT code description in Attachment I of this analysis.

The irradiation time step layouts developed with the RLAYOUT program for the assemblies documented in this analysis are presented in Tables 7.3-8 through 7.3-24. Tables 7.3-8 through 7.3-24 contain information required to prepare the irradiation layout portion and the CRA or APSRA insertion history portion of the CRAFT input decks for assemblies containing either a CRA or APSRA insertion history. The boron letdown data utilized by RLAYOUT in developing the irradiation layouts that are presented in Tables 7.3-8 through 7.3-24 is not exactly the same as that utilized in developing the irradiation history layouts for the non-rodded statepoint depletion calculations as presented in Tables 7.3-1 through 7.3-7. The boron letdown data provided to the RLAYOUT program is taken from the data presented in 4.1.9-1 through 4.1.9-7. However, some of the measured boron concentrations shown in Tables 4.1.9-1 through 4.1.9-7 were eliminated due to the fact that the particular boron concentration measurements in question were not made at nominal full-power core operation conditions. The use of the entire set of boron letdown data from Tables 4.1.9-1 through 4.1.9-7 in the non-rodded statepoint depletion calculation layouts has no adverse effect on the depletion calculation results. The modified boron letdown data from Tables 4.1.9-1 through 4.1.9-7 is presented in Tables 7.3-25 through 7.3-31. The acronym "ppmb" in the following tables means part per million of natural boron by mass of moderator.

Table 7.3-1 Crystal River Unit 3 Cycle-1A
Irradiation History Layout for Non-Rodded Assemblies

Cycle-1A

BOC to EOC (268.8 EFPD of Cycle-1)

4 : Number of Irradiation Steps
67.2 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	921.02	33.60
2	872.24	100.80
3	738.29	168.00
4	608.17	235.20

Table 7.3-2 Crystal River Unit 3 Cycle-1B
Irradiation History Layout for Non-Rodded Assemblies

Cycle-1B

BOC to Stpt2 (142.2 EFPD of Cycle-1B or 411.0 EFPD of Cycle-1)

2 : Number of Irradiation Steps
71.1 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD of Cycle-1B	Mid-Step EFPD of Cycle-1
1	518.65	35.55	304.35
2	256.11	106.65	375.45

Stpt2 (142.2 EFPD of Cycle-1B or 411.0 EFPD of Cycle-1) to EOC

1 : Number of Irradiation Steps
29.1 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD of Cycle-1B	Mid-Step EFPD of Cycle-1
1	237.54	156.75	425.55

Table 7.3-3 Crystal River Unit 3 Cycle-2
Irradiation History Layout for Non-Rodded Assemblies

Cycle-2

BOC to EOC

3 : Number of Irradiation Steps
55.5 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	688.93	27.75
2	527.51	83.25
3	353.48	138.75

Table 7.3-4 Crystal River Unit 3 Cycle-3
Irradiation History Layout for Non-Rodded Assemblies

Cycle-3

BOC to Stpt2 (168.5 EFPD)

3 : Number of Irradiation Steps
56.167 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	880.38	28.08
2	694.68	84.25
3	536.65	140.42

Stpt2 (168.5 EFPD) to Stpt3 (250.0 EFPD)

2 : Number of Irradiation Steps
40.75 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	382.60	188.88
2	267.17	229.63

Stpt3 (250.0 EFPD) to EOC (323.0 EFPD)

2 : Number of Irradiation Steps
36.5 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	234.64	268.25
2	128.17	304.75

Table 7.3-5 Crystal River Unit 3 Cycle-7
Irradiation History Layout for Non-Rodded Assemblies

Cycle-7

BOC to Stpt2 (260.3 EFPD)

4 : Number of Irradiation Steps
65.075 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1424.17	32.54
2	1300.75	97.61
3	1159.96	162.69
4	971.50	227.76

Stpt2 (260.3 EFPD) to Stpt3 (291.0 EFPD)

1 : Number of Irradiation Steps
30.7 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	856.06	275.65

Stpt3 (291.0 EFPD) to Stpt4 (319.0 EFPD)

1 : Number of Irradiation Steps
28 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	805.91	305.00

Stpt4 (319.0 EFPD) to Stpt5 (462.3 EFPD)

2 : Number of Irradiation Steps
71.65 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	565.35	354.83
2	356.75	426.48

Stpt5 (462.3 EFPD) to Stpt6 (479.0 EFPD)

1 : Number of Irradiation Steps
16.7 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	231.02	470.65

Stpt6 (479.0 EFPD) to EOC (497.9 EFPD)

1 : Number of Irradiation Steps
18.9 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	183.83	488.45

Table 7.3-6 Crystal River Unit 3 Cycle-8 Irradiation History Layout for Non-Rodded Assemblies

Cycle-8

BOC to Stpt2 (97.6 EFPD)

2 : Number of Irradiation Steps
48.8 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1510.73	24.40
2	1419.25	73.20

Stpt2 (97.6 EFPD) to Stpt3 (139.8 EFPD)

1 : Number of Irradiation Steps
42.2 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD

1	1305.52	118.70

Stpt3 (139.8 EFPD) to Stpt4 (404.0 EFPD)

4 : Number of Irradiation Steps
66.05 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1142.75	172.83
2	985.95	238.88
3	793.58	304.93
4	588.91	370.98

Stpt4 (404.0 EFPD) to Stpt5 (409.6 EFPD)

1 : Number of Irradiation Steps
5.6 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	484.53	406.80

Stpt5 (409.6 EFPD) to Stpt6 (515.5 EFPD)

2 : Number of Irradiation Steps
52.95 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	416.34	436.08
2	274.55	489.03

Stpt6 (515.5 EFPD) to EOC (535.9 EFPD)

1 : Number of Irradiation Steps
20.4 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	185.39	525.70

Table 7.3-7 Crystal River Unit 3 Cycle-9
Irradiation History Layout for Non-Rodded Assemblies

Cycle-9

BOC to Stpt2 (158.8 EFPD)

3 : Number of Irradiation Steps
52.93 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1599.85	26.47
2	1491.21	79.40
3	1361.78	132.33

Stpt2 (158.8 EFPD) to Stpt3 (219.0 EFPD)

1 : Number of Irradiation Steps
60.2 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1211.60	188.90

Stpt3 (219.0 EFPD) to Stpt4 (363.1 EFPD)

2 : Number of Irradiation Steps
72.05 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1016.51	255.03
2	802.70	327.08

Stpt4 (363.1 EFPD) to EOC (557.23 EFPD)

3 : Number of Irradiation Steps
64.71 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	584.95	395.46
2	388.60	460.17
3	192.66	524.88

Table 7.3-8 Rodded Irradiation Time Step Layout for Assembly A1

IRRADIATION LAYOUT FOR ASSEMBLY: A01
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	41.67	41.67	913.3
2	68.68	110.35	902.9
3	68.68	179.03	784.8
4	43.05	222.08	663.5
5	43.05	265.13	575.6
6	3.87	269.00	505.6

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.67	4.67	541.2
2	25.50	30.17	569.2
3	43.28	73.46	434.2
4	43.28	116.74	309.6
5	9.26	126.00	279.6
6	1.00	127.00	284.2
7	1.00	128.00	285.1
8	6.91	134.91	288.7
9	7.09	142.00	284.3
10	.20	142.20	280.6

Cycle-1B, 142.2 EFPD to Cycle-1B, 171.3 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	6.57	6.57	277.1
2	5.45	12.02	266.5
3	16.98	29.00	204.7
4	.10	29.10	157.6

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A01

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation
COLUMN C: Cycle-1B, 142.2 EFPD to Cycle-1B, 171.3 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A						B										C			
NODE #	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

```
  3    ||X|X|X|X|X|X||X|X|X|X|X|X|X|X|X|X ||X|X|X|X
  4    ||X|X|X|X|X|X||X|X|X|X|X|X|X|X| |  ||X|X| |
  5    ||X|X|X|X|X|X||X|X|X|X|X|X|X| | |  ||X| | |
  6    ||X|X|X|X|X|X||X|X|X|X|X|X| | | |  || | | |
  7    ||X|X|X|X|X|X||X|X|X|X|X| | | | |  || | | |
  8    ||X|X|X|X|X|X||X|X|X|X|X| | | | |  || | | |
  9    ||X|X|X|X|X|X||X|X|X|X|X| | | | |  || | | |
 10    ||X|X|X|X|X|X||X|X|X|X|X| | | | |  || | | |
 11    ||X|X|X|X|X|X||X|X|X|X|X| | | | |  || | | |
 12    ||X|X|X|X|X|X||X|X|X|X|X| | | | |  || | | |
 13    ||X|X|X|X|X|X||X|X|X|X|X|X| | | |  || | | |
 14    ||X|X|X|X|X| ||X|X|X|X|X|X|X| | |  || | | |
 15    ||X|X|X| | | ||X|X|X|X| | | | | |  || | | |
 16    ||X| | | | | ||X|X| | | | | | | |  || | | |
 17    || | | | | | ||X| | | | | | | | |  || | | |
 18    || | | | | | || | | | | | | | | |  || | | |
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Table 7.3-9 Rodded Irradiation Time Step Layout for Assembly A5

IRRADIATION LAYOUT FOR ASSEMBLY: A05
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	5.03	5.03	902.3
2	59.89	64.92	921.8
3	59.89	124.80	884.0
4	57.49	182.29	767.1
5	57.49	239.78	638.7
6	29.02	268.80	590.7

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD).	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.51	4.51	541.0
2	42.03	46.54	549.3
3	35.53	82.07	422.8
4	35.53	117.60	288.1
5	7.92	125.52	279.8
6	16.68	142.20	289.0

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A05

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

X = Rod.assembly inserted in corresponding node during the irradiation step

```
--------------------------------
        ||     A      ||     B
 NODE # ||1|2|3|4|5|6||1|2|3|4|5|6
--------------------------------
   1    ||X|X|X|X|X| ||X|X|X|X|X|
```

```
  2   ||X|X|X| | | ||X|X|X|X| |
  3   ||X| | | | | ||X|X| | | |
  4   || | | | | | ||X| | | | |
  5   || | | | | | || | | | | |
  6   || | | | | | || | | | | |
  7   || | | | | | || | | | | |
  8   || | | | | | || | | | | |
  9   || | | | | | || | | | | |
 10   || | | | | | || | | | | |
 11   || | | | | | || | | | | |
 12   || | | | | | || | | | | |
 13   || | | | | | || | | | | |
 14   || | | | | | || | | | | |
 15   || | | | | | || | | | | |
 16   || | | | | | || | | | | |
 17   || | | | | | || | | | | |
 18   || | | | | | || | | | | |
----------------------------------
```

Table 7.3-10 Rodded Irradiation Time Step Layout for Assembly A7

IRRADIATION LAYOUT FOR ASSEMBLY: A07
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	2.50	2.50	901.6
2	6.50	9.00	904.3
3	1.00	10.00	906.5
4	1.00	11.00	907.1
5	1.00	12.00	907.7
6	.97	12.97	908.3
7	1.04	14.01	908.9
8	63.70	77.71	928.4
9	63.70	141.40	854.8
10	63.70	205.10	727.8
11	63.70	268.80	593.1

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.46	4.46	541.0
2	24.44	28.90	567.8
3	42.89	71.79	435.6
4	42.89	114.68	313.3
5	9.32	124.00	275.2
6	1.00	125.00	282.4
7	1.31	126.31	283.5
8	7.90	134.21	287.6
9	7.79	142.00	284.7
10	.20	142.20	280.6

Cycle-1B, 142.2 EFPD to Cycle-1B, 171.3 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	6.47	6.47	277.2
2	5.36	11.83	267.3
3	17.17	29.00	205.2
4	.10	29.10	157.6

Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	3.21	3.21	839.9
2	5.24	8.45	784.3
3	21.72	30.17	721.4
4	47.60	77.78	618.1
5	47.60	125.38	470.7
6	35.87	161.25	340.9
7	5.25	166.50	314.0

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A07

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation
COLUMN C: Cycle-1B, 142.2 EFPD to Cycle-1B, 171.3 EFPD Statepoint Calculation
COLUMN D: Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A											B										C				D						
NODE #	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	5	6	7
1	X	X	X	X	X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
2	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
3	X	X	X	X	X							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
4	X	X	X	X								X	X	X	X	X	X	X	X			X	X			X	X					
5	X	X	X	X								X	X	X	X	X	X	X				X				X						
6	X	X	X									X	X	X	X	X	X															
7	X	X	X									X	X	X	X	X	X															
8	X	X										X	X	X	X	X																
9	X	X										X	X	X	X	X																
10	X	X										X	X	X	X	X																
11	X	X	X									X	X	X	X	X																
12	X	X	X									X	X	X	X	X																
13	X	X	X	X								X	X	X	X	X																
14	X	X	X	X	X							X	X	X	X	X	X															
15	X											X	X	X	X																	
16												X	X																			
17												X																				
18																																

Table 7.3-11 Rodded Irradiation Time Step Layout for Assembly A14

IRRADIATION LAYOUT FOR ASSEMBLY: A14
Cycle-07, .0 EFPD to Cycle-07, 260.3 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	35.38	35.38	1456.1
2	55.44	90.82	1362.5
3	55.44	146.27	1253.7
4	57.01	203.28	1121.3
5	57.01	260.30	960.1

Cycle-07, 260.3 EFPD to Cycle-07, 291.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	10.13	10.13	852.1
2	20.57	30.70	802.3

Cycle-07, 291.0 EFPD to Cycle-07, 319.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	5.32	5.32	760.4
2	22.68	28.00	715.0

Cycle-07, 319.0 EFPD to Cycle-07, 462.3 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	27.11	27.11	634.3
2	58.09	85.20	506.1
3	58.09	143.30	337.1

Cycle-07, 462.3 EFPD to Cycle-07, 479.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	16.70	16.70	231.2

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A14

COLUMN A: Cycle-07, .0 EFPD to Cycle-07, 260.3 EFPD Statepoint Calculation
COLUMN B: Cycle-07, 260.3 EFPD to Cycle-07, 291.0 EFPD Statepoint Calculation
COLUMN C: Cycle-07, 291.0 EFPD to Cycle-07, 319.0 EFPD Statepoint Calculation
COLUMN D: Cycle-07, 319.0 EFPD to Cycle-07, 462.3 EFPD Statepoint Calculation
COLUMN E: Cycle-07, 462.3 EFPD to Cycle-07, 479.0 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

NODE #	A 1	A 2	A 3	A 4	A 5	B 1	B 2	C 1	C 2	D 1	D 2	D 3	E 1
1	X	X	X			X		X		X			
2	X												
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													

Table 7.3-12 Rodded Irradiation Time Step Layout for Assembly A18

IRRADIATION LAYOUT FOR ASSEMBLY: A18
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	.78	.78	901.1
2	1.42	2.20	901.7
3	1.80	4.00	902.7
4	27.29	31.29	911.4
5	45.42	76.71	933.3
6	45.42	122.12	875.0
7	58.01	180.13	771.9
8	58.01	238.15	643.2
9	11.91	250.06	575.6
10	7.50	257.56	593.9
11	3.80	261.36	556.3
12	7.44	268.80	518.8

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A18

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

NODE #	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	A 9	A 10	A 11	A 12
1												
2												

```
  3     || | | | | | | | | |  |  |
  4     || | | | | | | | | |  |  |
  5     || | | | | | | | | |  |  |
  6     || | | | | | | | | |  |  |
  7     || | | | | | | | | |  |  |
  8     || | | | | | | | | |  |  |
  9     ||X|X| | | | | | | |  |  |
 10     ||X|X|X| | | | | | |  |  |
 11     ||X|X|X|X| | | | | |  |  |
 12     ||X|X|X|X|X|X|X|X| |  |  |
 13     ||X|X|X|X|X|X|X|X|X|X |X |
 14     ||X|X|X|X|X|X|X|X|X|X |  |
 15     ||X|X|X|X|X|X|X|X|X|  |  |
 16     ||X|X|X|X|X|X| | | |  |  |
 17     ||X|X|X| | | | | | |  |  |
 18     ||X| | | | | | | | |  |  |
-----------------------------------
```

Table 7.3-13 Rodded Irradiation Time Step Layout for Assembly A18a

IRRADIATION LAYOUT FOR ASSEMBLY: A18a
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	.78	.78	901.1
2	1.42	2.20	901.7
3	1.80	4.00	902.7
4	27.29	31.29	911.4
5	45.42	76.71	933.3
6	45.42	122.12	875.0
7	58.01	180.13	771.9
8	58.01	238.15	643.2
9	11.91	250.06	575.6
10	7.50	257.56	593.9
11	3.80	261.36	556.3
12	7.44	268.80	518.8

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A18a

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

```
-----------------------------------
        ||          A
 NODE # ||1|2|3|4|5|6|7|8|9|10|11|12
-----------------------------------
  1     || | | | | | | | | |  |  |
  2     || | | | | | | | | |  |  |
  3     || | | | | | | | | |  |  |
  4     || | | | | | | | | |  |  |
  5     || | | | | | | | | |  |  |
  6     || | | | | | | | | |  |  |
  7     || | | | | | | | | |  |  |
  8     || | | | | | | | | |  |  |
  9     ||X|X| | | | | | | |  |  |
```

10	X	X	X								
11	X	X	X	X							
12	X	X	X	X	X	X	X	X			
13	X	X	X	X	X	X	X	X	X	X	X
14	X	X	X	X	X	X	X	X	X	X	
15	X	X	X	X	X	X	X	X	X		
16	X	X	X	X	X	X					
17	X	X	X								
18	X										

Table 7.3-14 Rodded Irradiation Time Step Layout for Assembly A18b

IRRADIATION LAYOUT FOR ASSEMBLY: A18b
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	.78	.78	901.1
2	1.42	2.20	901.7
3	1.80	4.00	902.7
4	27.29	31.29	911.4
5	45.42	76.71	933.3
6	45.42	122.12	875.0
7	58.01	180.13	771.9
8	58.01	238.15	643.2
9	11.91	250.06	575.6
10	7.50	257.56	593.9
11	3.80	261.36	556.3
12	7.44	268.80	518.8

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	6.34	6.34	542.7
2	10.50	16.84	558.4
3	54.86	71.70	442.3
4	37.64	109.34	318.8
5	30.66	140.00	282.6
6	2.20	142.20	281.6

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A18b

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A												B					
NODE #	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
1																		
2																		

```
   3     || | | | | | | | | |  |  |  || | | | | |
   4     || | | | | | | | | |  |  |  || | | | | |
   5     || | | | | | | | | |  |  |  || | | | | |
   6     || | | | | | | | | |  |  |  || | | | | |
   7     || | | | | | | | | |  |  |  || | | | | |
   8     || | | | | | | | | |  |  |  || | | | | |
   9     ||X|X| | | | | | | |  |  |  || | | | | |
  10     ||X|X|X| | | | | | |  |  |  ||X| | | | |
  11     ||X|X|X|X| | | | | |  |  |  ||X|X|X| | |
  12     ||X|X|X|X|X|X|X|X| |  |  |  ||X|X|X|X|X|
  13     ||X|X|X|X|X|X|X|X|X|X |X |  ||X|X|X|X|X|
  14     ||X|X|X|X|X|X|X|X|X|X |  |  ||X|X|X|X|X|
  15     ||X|X|X|X|X|X|X|X|X|  |  |  ||X|X|X|X| |
  16     ||X|X|X|X|X|X| | | |  |  |  ||X|X| | | |
  17     ||X|X|X| | | | | | |  |  |  || | | | | |
  18     ||X| | | | | | | | |  |  |  || | | | | |
------------------------------------------------
```

Table 7.3-15 Rodded Irradiation Time Step Layout for Assembly A20

IRRADIATION LAYOUT FOR ASSEMBLY: A20
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	37.78	37.78	912.2
2	63.23	101.01	909.0
3	63.23	164.24	808.8
4	60.11	224.35	678.3
5	.65	225.00	610.2
6	2.76	227.76	633.9
7	1.07	228.83	662.9
8	1.23	230.06	657.8
9	.58	230.64	650.0
10	1.36	232.00	641.7
11	1.45	233.45	629.5
12	.55	234.00	620.9
13	1.00	235.00	614.2
14	33.80	268.80	606.7

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A20

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

```
---------------------------------------
         ||                A
 NODE #  ||1|2|3|4|5|6|7|8|9|10|11|12|13|14
---------------------------------------
    1    ||X|X|X|X| | | | | |  |  |  |  |
    2    ||X|X|X|X|X| | | | |  |  |  |  |
    3    ||X|X|X|X|X|X| | | |  |  |  |  |
    4    ||X|X|X|X|X|X|X|X| |  |  |  |  |
    5    ||X|X|X|X|X|X|X|X|X|X |  |  |  |
    6    ||X|X|X|X|X|X|X|X|X|X |X |  |  |
    7    ||X|X|X|X|X|X|X|X|X|X |X |X |  |
```

```
  8    ||X|X|X|X|X|X|X|X|X|X |X |X |X |
  9    ||X|X|X|X|X|X|X|X|X|X |X |X |X |
 10    ||X|X|X|X|X|X|X|X|X|X |X |X |  |
 11    ||X|X|X|X|X|X|X|X|X|X |  |  |  |
 12    ||X|X|X|X|X|X|X|X|X|  |  |  |  |
 13    ||X|X|X|X|X|X|X| | |  |  |  |  |
 14    ||X|X|X|X|X| | | | |  |  |  |  |
 15    ||X|X|X| | | | | | |  |  |  |  |
 16    ||X| | | | | | | | |  |  |  |  |
 17    || | | | | | | | | |  |  |  |  |
 18    || | | | | | | | | |  |  |  |  |
------------------------------------------
```

Table 7.3-16 Rodded Irradiation Time Step Layout for Assembly A22

IRRADIATION LAYOUT FOR ASSEMBLY: A22
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	5.03	5.03	902.3
2	60.15	65.18	921.9
3	60.15	125.32	883.3
4	57.42	182.74	766.1
5	57.42	240.16	637.8
6	28.64	268.80	589.5

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.49	4.49	541.0
2	41.82	46.31	549.6
3	35.51	81.82	423.0
4	35.51	117.34	289.3
5	8.04	125.38	279.6
6	16.82	142.20	289.1

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A22

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

```
----------------------------------
         ||     A     ||     B
 NODE #  ||1|2|3|4|5|6||1|2|3|4|5|6
----------------------------------
    1    ||X|X|X|X|X| ||X|X|X|X|X|
    2    ||X|X|X| | | ||X|X|X|X| |
    3    ||X| | | | | ||X|X| | | |
    4    || | | | | | ||X| | | | |
    5    || | | | | | || | | | | |
    6    || | | | | | || | | | | |
```

7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											

Table 7.3-17 Rodded Irradiation Time Step Layout for Assembly A23

IRRADIATION LAYOUT FOR ASSEMBLY: A23
Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	.99	.99	864.5
2	9.13	10.12	783.1
3	54.72	64.84	659.1
4	36.53	101.36	528.0
5	36.53	137.89	422.5
6	28.11	166.00	327.4
7	1.00	167.00	311.9

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A23

COLUMN A: Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A						
NODE #	1	2	3	4	5	6	7
1	X	X	X	X	X	X	
2	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X
12	X	X	X	X	X	X	X
13	X	X	X	X	X	X	X
14	X	X	X	X	X	X	
15	X	X	X	X	X		
16	X	X	X				
17	X	X					
18	X						

Table 7.3-18 Rodded Irradiation Time Step Layout for Assembly A23a

IRRADIATION LAYOUT FOR ASSEMBLY: A23a
Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	1.06	1.06	863.7
2	8.96	10.02	783.0
3	51.85	61.87	664.0
4	37.40	99.26	537.6
5	37.40	136.66	432.0
6	29.34	166.00	328.5
7	1.00	167.00	311.9

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A23a

COLUMN A: Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

					A			
NODE #		1	2	3	4	5	6	7
1		X	X	X	X	X	X	
2		X	X	X	X	X	X	X
3		X	X	X	X	X	X	X
4		X	X	X	X	X	X	
5		X	X	X	X	X	X	X
6		X	X	X	X	X	X	X
7		X	X	X	X	X	X	X
8		X	X	X	X	X	X	
9		X	X	X	X	X	X	X
10		X	X	X	X	X	X	X
11		X	X	X	X	X	X	X
12		X	X	X	X	X	X	
13		X	X	X	X	X	X	X
14		X	X	X	X	X	X	
15		X	X	X	X			
16		X	X	X				
17		X	X					
18		X						

Table 7.3-19 Rodded Irradiation Time Step Layout for Assembly A25

IRRADIATION LAYOUT FOR ASSEMBLY: A25
Cycle-03, .0 EFPD to Cycle-03, 168.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	.26	.26	941.3
2	5.23	5.49	945.3
3	9.75	15.24	940.1
4	48.08	63.32	835.2
5	48.08	111.40	688.0
6	53.84	165.24	542.0
7	2.76	168.00	457.6
8	1.00	169.00	451.1

Cycle-03, 168.5 EFPD to Cycle-03, 250.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	3.04	3.04	444.1
2	36.92	39.96	378.6
3	36.92	76.88	272.3
4	4.56	81.44	231.2
5	.56	82.00	234.5

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A25

COLUMN A: Cycle-03, .0 EFPD to Cycle-03, 168.5 EFPD Statepoint Calculation
COLUMN B: Cycle-03, 168.5 EFPD to Cycle-03, 250.0 EFPD Statepoint Calculation

X - Rod assembly inserted in corresponding node during the irradiation step

	A								B				
NODE #	1	2	3	4	5	6	7	8	1	2	3	4	5
1	X	X	X	X	X	X	X		X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X		X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X	X	X	X	X	
12	X	X	X	X	X	X	X	X	X	X	X	X	X
13	X	X	X	X	X	X	X	X	X	X	X	X	X
14	X	X	X	X	X	X			X	X	X		
15	X	X	X	X	X				X				
16	X	X	X										
17	X	X											
18	X												

Table 7.3-20 Rodded Irradiation Time Step Layout for Assembly A25a

IRRADIATION LAYOUT FOR ASSEMBLY: A25a
Cycle-03, .0 EFPD to Cycle-03, 168.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	6.84	6.84	946.1
2	3.33	10.17	945.6
3	66.47	76.64	830.5
4	39.84	116.48	672.2
5	39.84	156.32	546.9
6	12.18	168.50	471.5

Cycle-03, 168.5 EFPD to Cycle-03, 250.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	8.99	8.99	435.5
2	62.99	71.98	333.5
3	9.52	81.50	231.6

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A25a

COLUMN A: Cycle-03, .0 EFPD to Cycle-03, 168.5 EFPD Statepoint Calculation
COLUMN B: Cycle-03, 168.5 EFPD to Cycle-03, 250.0 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

NODE #	A 1	A 2	A 3	A 4	A 5	A 6	B 1	B 2	B 3
1	X	X	X	X	X		X	X	
2	X	X	X				X		
3	X	X							
4	X								
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									

Table 7.3-21 Rodded Irradiation Time Step Layout for Assembly A26

IRRADIATION LAYOUT FOR ASSEMBLY: A26
Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	2.69	2.69	901.6
2	6.31	9.00	904.3
3	1.00	10.00	906.5
4	1.00	11.00	907.1
5	1.00	12.00	907.7
6	1.23	13.23	908.4
7	63.89	77.12	928.0
8	63.89	141.01	855.8
9	63.89	204.91	728.4
10	63.89	268.80	593.9

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	6.32	6.32	542.7
2	10.51	16.83	558.3
3	54.83	71.66	442.6
4	37.79	109.45	318.7
5	30.55	140.00	282.6
6	.55	140.55	282.5
7	1.65	142.20	281.3

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A26

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A										B						
NODE #	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7
1	X	X	X	X	X	X											
2	X	X	X	X	X												
3	X	X	X	X													
4	X	X	X														
5	X	X	X														
6	X	X															
7	X	X															
8	X	X															
9	X	X															
10	X	X									X						
11	X	X									X	X	X				
12	X	X	X								X	X	X	X	X	X	
13	X	X	X	X							X	X	X	X	X		

```
    14    | |X|X|X|X|X|  |  |  |  |    | |X|X|X|X|X|  |
    15    | |X|  |  |  |  |  |  |  |  |    | |X|X|X|X|  |  |
    16    | |  |  |  |  |  |  |  |  |  |    | |X|X|  |  |  |  |
    17    | |  |  |  |  |  |  |  |  |  |    | |  |  |  |  |  |  |
    18    | |  |  |  |  |  |  |  |  |  |    | |  |  |  |  |  |  |
----------------------------------------------------------
```

Table 7.3-22 Rodded Irradiation Time Step Layout for Assembly A28

IRRADIATION LAYOUT FOR ASSEMBLY: A28
Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	1.93	1.93	854.1
2	4.62	6.55	781.5
3	1.23	7.78	790.2
4	7.51	15.29	806.7
5	32.00	47.29	677.4
6	10.49	57.78	621.3
7	51.35	109.13	526.8
8	13.72	122.85	441.8
9	19.33	142.18	378.5
10	13.96	156.14	332.1
11	10.36	166.50	316.1

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A28

COLUMN A: Cycle-02, .0 EFPD to Cycle-02, 166.5 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

```
---------------------------------
          ||          A
 NODE #  ||1|2|3|4|5|6|7|8|9|10|11
---------------------------------
    1    || | | | | | | | | |  |
    2    || | | | | | | | | |  |
    3    || | | | | | | | | |  |
    4    || | | | | | | | | |  |
    5    || | | | | | | | | |  |
    6    || | | | | | | | | |  |
    7    ||X| | | | | | | | |  |
    8    ||X|X| | | | | | | |  |
    9    ||X|X|X|X| | | | | |  |
   10    ||X|X|X|X|X|X| | | |  |
   11    ||X|X|X|X|X|X|X|X| |  |
   12    ||X|X|X|X|X|X|X|X|X|X |
   13    ||X|X|X|X|X|X|X|X|X|  |
   14    ||X|X|X|X|X|X|X| | |  |
   15    ||X|X|X|X|X| | | | |  |
   16    ||X|X|X| | | | | | |  |
   17    || | | | | | | | | |  |
   18    || | | | | | | | | |  |
---------------------------------
```

Table 7.3-23 Rodded Irradiation Time Step Layout for Assembly A29

IRRADIATION LAYOUT FOR ASSEMBLY: A29
Cycle-03, .0 EFPD to Cycle-03, 168.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	.27	.27	941.3
2	5.77	6.04	945.7
3	10.40	16.44	937.4
4	48.86	65.30	833.4
5	48.86	114.16	683.9
6	51.21	165.37	538.3
7	3.63	169.00	455.6

Cycle-03, 168.5 EFPD to Cycle-03, 250.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	3.00	3.00	444.1
2	36.96	39.96	378.7
3	36.96	76.92	272.2
4	4.53	81.45	231.3
5	.55	82.00	234.5

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A29

COLUMN A: Cycle-03, .0 EFPD to Cycle-03, 168.5 EFPD Statepoint Calculation
COLUMN B: Cycle-03, 168.5 EFPD to Cycle-03, 250.0 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A							B				
NODE #	1	2	3	4	5	6	7	1	2	3	4	5
1	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X	X	X	X	X	X
8	X	X	X	X	X	X	X	X	X	X	X	X
9	X	X	X	X	X	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X	X	X	X	
12	X	X	X	X	X	X	X	X	X	X	X	X
13	X	X	X	X	X	X	X	X	X	X	X	X
14	X	X	X	X	X	X		X	X	X		
15	X	X	X	X	X			X				
16	X	X	X									
17	X	X										
18	X											

Table 7.3-24 Rodded Irradiation Time Step Layout for Assembly O1

IRRADIATION LAYOUT FOR ASSEMBLY: O1
Cycle-01, .0 EFPD to Cycle-01, 309.3 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	54.07	54.07	1005.9
2	63.98	118.05	867.4
3	63.98	182.04	654.9
4	63.98	246.02	450.1
5	63.98	310.00	245.4

Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.64	4.64	541.1
2	24.31	28.95	568.0
3	42.71	71.66	435.6
4	42.71	114.38	313.8
5	9.62	124.00	274.8
6	1.00	125.00	282.4
7	1.00	126.00	283.3
8	7.93	133.93	287.4
9	8.07	142.00	284.8
10	.20	142.20	280.6

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: O1

COLUMN A: Cycle-01, .0 EFPD to Cycle-01, 309.3 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A					B									
NODE #	1	2	3	4	5	1	2	3	4	5	6	7	8	9	10
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X	X		
5	X					X	X	X	X	X	X	X			
6						X	X	X	X	X	X				
7						X	X	X	X	X	X				
8						X	X	X	X	X					
9						X	X	X	X	X					
10						X	X	X	X	X					
11						X	X	X	X	X					
12						X	X	X	X	X					
13						X	X	X	X	X	X				
14						X	X	X	X	X	X				
15						X	X	X	X						

```
16   || | | | | | ||X|X| | | | | | | |
17   || | | | | | ||X| | | | | | | | |
18   || | | | | | || | | | | | | | | |
---------------------------------------
```

Table 7.3-25 Boron Letdown Data Provided to RLAYOUT for Cycle 1A of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm*)
18.6	912
55.2	934
63.8	909
69.9	909
94.9	884
184.7	705
192.3	683
216.0	627
224.8	610
228.5	666
238.0	584
244.0	575
250.8	614
254.7	588

* The acronym "ppm" means parts per million by mass.

Table 7.3-26 Boron Letdown Data Provided to RLAYOUT for Cycle 1B of Crystal River Unit 3

EFPD with Cycles 1A & 1B Continuous [EFPD with BOC*-1B set to 0.0 EFPD]	Boron Concentration (ppm)
280.2 [11.4]	558
287.2 [18.4]	571
306.2 [37.4]	513
313.2 [44.4]	441

Table 7.3-26 Boron Letdown Data Provided to RLAYOUT for Cycle 1B of Crystal River Unit 3

EFPD with Cycles 1A & 1B Continuous [EFPD with BOC*-1B set to 0.0 EFPD]	Boron Concentration (ppm)
337.2 [68.4]	419
345.7 [76.9]	346
364.2 [95.4]	309
377.6 [108.8]	246
389.5 [120.7]	279
401.7 [132.9]	290
419.3 [150.5]	272
427.1 [158.3]	229

* The acronym "BOC" means beginning of cycle.

Table 7.3-27 Boron Letdown Data Provided to RLAYOUT for Cycle 2 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
3.0	809
4.4	778
11.4	809
15.8	735
22.5	709
29.3	683
35.3	666
42.3	644
55.8	614
60.8	592
75.2	558
83.1	528

Table 7.3-27 Boron Letdown Data Provided to RLAYOUT for Cycle 2 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
89.8	506
97.8	480
104.7	463
116.4	441
122.5	406
129.1	385
135.9	372
139.9	346
148.6	333
156.4	320
161.4	316

Table 7.3-28 Boron Letdown Data Provided to RLAYOUT for Cycle 3 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
4.0	947
6.7	951
26.8	891
32.6	843
50.7	822
66.0	757
69.9	746
85.0	692
100.2	666
111.2	636
130.5	562
143.8	528

Table 7.3-28 Boron Letdown Data Provided to RLAYOUT for Cycle 3 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
163.9	467
174.0	432
184.2	394
212.9	324
227.5	272
246.4	229
262.9	250
283.8	190
304.0	130
322.0	86

Table 7.3-29 Boron Letdown Data Provided to RLAYOUT for Cycle 7 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
7.5	1478
41.4	1405
60.3	1367
81.7	1333
102.9	1290
122.3	1245
139.8	1204
160.5	1167
180.8	1102
202.8	1040
230.9	963
251.2	898
345.3	593

Table 7.3-29 Boron Letdown Data Provided to RLAYOUT for Cycle 7 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
412.3	398
459.8	260
485.0	193

Table 7.3-30 Boron Letdown Data Provided to RLAYOUT for Cycle 8 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
11.2	1537
52.4	1455
78.0	1411
111.4	1332
154.4	1176
194.8	1103
234.6	999
271.5	887
338.0	701
390.7	522
445.7	394
474.0	311
513.1	216

Table 7.3-31 Boron Letdown Data for Cycle 9 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
22.1	1608
61.5	1535
145.7	1329
192.8	1201

Table 7.3-31 Boron Letdown Data for Cycle 9 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
211.3	1157
262.0	994
303.7	869
345.7	750
397.9	577
432.5	473
452.4	412
495.4	283
543.4	136

Some interesting behavior appears in the CRA nodal insertion history layouts presented in Tables 7.3-8 through 7.3-24. This interesting behavior refers to the axially staggered nodal CRA insertion locations in some of the irradiation steps that are defined. At first glance, the axial staggering of CRA nodal insertion locations in a given irradiation time step does not make any sense. This is true from a physical perspective based on knowledge of actual CRA design and reactor operation. However, certain approximations are utilized in performing the CRC depletion calculations as documented in this analysis which result in this strange presentation of CRA insertion histories. The following discussion describes the modeling techniques utilized in the CRC depletion calculations of this analysis which contribute to this staggered CRA nodal insertion phenomena.

In the SAS2H CRC depletion calculations, the time dependency of the CRA and APSRA insertion histories are treated on an integral exposure basis rather than on an actual physical irradiation history basis. This does not mean that the CRA and APSRA insertion history data utilized in the CRC depletion calculations of this analysis is not the actual insertion history data from the reactor. In fact, the CRA and APSRA insertion history data for each axial node in each statepoint depletion calculation is based on the true CRA and APSRA movement data obtained during the actual reactor operation. The implementation of this true measured data in the SAS2H CRC depletion calculations is based on modeling CRA and APSRA insertion durations (measured in EFPD) in each axial node of the assembly at the beginning of each CRC statepoint calculation. An average nodal power is utilized in each SAS2H CRC statepoint depletion calculation for a given axial node. This average nodal power is calculated based on the average nodal burnup at the beginning and end of the statepoint depletion calculation. Therefore, EFPD durations in a SAS2H CRC statepoint depletion calculation are calculated based on this average nodal power that is being utilized in the statepoint depletion calculation. The CRA nodal insertion durations (measured in EFPDs of exposure) will need to be modeled in SAS2H based on the assembly average nodal power. Due to the fact that the assembly average nodal power may be less than the actual assembly nodal power during a given period of core operation, the SAS2H insertion time of a CRA in a given axial node may vary, relative to the other assembly axial nodes, depending on the average power that is being utilized in the SAS2H calculation and the nodal exposure (EFPD) required with CRA inserted. This results in the staggered CRA insertion phenomena that is present in some of the data presented in Tables 7.3-8 through 7.3-24.

7.4 The Commercial Reactor Assembly Follow Taskmaster (CRAFT) Code & Usage

The Commercial Reactor Assembly Follow Taskmaster (CRAFT) code directs the performance of assembly depletion and decay calculations relevant to CRC evaluations. The CRAFT code generates input decks for the SAS2H control module of the SCALE 4.3 modular code system based on user-defined input which describes the fuel assembly's specifications and irradiation history. Appropriate isotopic concentrations relevant to both the CRC evaluations containing the fuel assembly and subsequent depletion and decay calculations of the fuel assembly are extracted and stored by CRAFT as it generates and executes SAS2H cases required to simulate the complete fuel assembly irradiation history.

The CRAFT code is developed with a high degree of flexibility that provides for the depletion and decay of fuel assemblies with widely varying features under either standard or non-standard core operating procedures. The following listing describes some of the capabilities and usage of the CRAFT code.

- The CRAFT code generates and executes appropriate SAS2H cases required to perform a prescribed depletion and decay sequence for a fuel assembly. The depletion and decay sequence is orchestrated from the BOC statepoint calculation of the initial prescribed insertion cycle through the final statepoint calculation of the last prescribed insertion cycle. The CRAFT code extracts and saves fuel and burnable poison isotopics at each statepoint, including BOC statepoints, during the fuel assembly's depletion and decay sequence. A certain number of the generated isotopics in the depleted fuel composition obtained from a SAS2H calculation are not used in the initial charge composition to the next SAS2H calculation due to a lack of cross-section data in the specified cross-section library. The CRAFT code provides a listing of the fuel isotopics from the output of a SAS2H calculation which are not used in the initial charge to the next SAS2H calculation. The isotopics left out of the initial charge are fission products whose reactivity worth is small relative to the isotopics retained in the initial charge composition. The listing of excluded initial charge isotopics allows for a determination of the impact upon the reactivity worth of the initial fuel composition in the subsequent depletion calculation.

- Any assembly design may be analyzed within the bounds of the SAS2H control module through the use of the CRAFT code. This includes both PWR and BWR fuel assemblies.

- An axial blanket fuel modeling option is available in the CRAFT code. Any UO_2 enrichment may be specified for the axial blanket fuel. The axial blanket fuel may be defined to exist in any of the CRC axial nodes which are defined for the CRAFT calculation.

- A spacer grid modeling technique is available with the CRAFT code. The modeling technique homogenizes the spacer grid material throughout the moderator of the fuel assembly by utilizing a user-defined spacer material and spacer material volume fraction in the moderator. The available spacer grid materials include the following-- ZIRC-4, INCONEL, SS316, SS316S, SS304, SS304S. Any volume fraction of spacer material in the moderator may be specified (including zero).

- The fuel cladding, BPR cladding, axial power shaping rod (APSR) cladding, or control rod (CR) cladding in the CRAFT calculation may be designated as any of the following materials-- ZIRC-4, INCONEL, SS316, SS316S, SS304, SS304S.

- The insertion of a BPR assembly during the irradiation of the fuel assembly may be modeled in the CRAFT calculation. Up to 10 unique BPR assembly designs may be specified for use during the depletion of a fuel assembly. Any type of BPR assembly design may be specified. The default BP material for use in CRAFT calculation is Al_2O_3-B_4C. Any arbitrary BP material may be specified for use in a BPR assembly design. A maximum of 10 unique BP materials may be specified. A maximum of 20 unique elements or isotopes may be specified in any given BP material. A BPR assembly may be inserted in any reactor cycle specified in the CRAFT calculation. Only one BPR assembly design may be specified per cycle. The position of the BPR assembly in the fuel assembly is specified by identifying the top and bottom axial nodes of the BP material. The BPR assembly remains fixed during a given reactor cycle. The depletion of the BP material is tracked during the CRAFT calculation. The appropriate depleted BP material is utilized in statepoint calculations following the BOC to statepoint 2 calculation for a given reactor cycle. Depleted BP material isotopic concentrations are also retained for use in subsequent mid-cycle statepoint reactivity calculations which may be performed as part of the CRC evaluation process.

- The insertion of a CR assembly during the irradiation of the fuel assembly may be modeled in the CRAFT calculation. Up to 10 unique CR assembly designs may be specified for use during the depletion of a fuel assembly. Any type of CR assembly design may be specified. Any arbitrary CR absorber material may be specified for use in a CR assembly design. A maximum of 10 unique CR absorber materials may be specified. A maximum of 10 unique elements or isotopes may be specified in any given CR absorber material. A CR assembly may be inserted in any reactor cycle specified in the CRAFT calculation. Multiple CR assembly designs may be specified per cycle. The position of the CR assembly in the fuel assembly is specified by identifying the top and bottom axial nodes of sections of the fuel assembly which contain the CR absorber material. The CR assembly position may be changed between each irradiation step of a SAS2H calculation generated by CRAFT. The CR assembly design may also be changed between any two CRC statepoint depletion calculations in a given reactor cycle.

- The insertion of an APSR assembly during the irradiation of the fuel assembly may be modeled in the CRAFT calculation. Up to 10 unique APSR assembly designs may be specified for use during the depletion of a fuel assembly. Any type of APSR assembly design may be specified. Any arbitrary APSR absorber material may be specified for use in an APSR assembly design. A maximum of 10 unique APSR absorber materials may be specified. A maximum of 10 unique elements or isotopes may be specified in any given APSR absorber material. An APSR assembly may be inserted in any reactor cycle specified in the CRAFT calculation. Multiple APSR assembly designs may be specified per cycle. The position of the APSR assembly in the fuel assembly is specified by identifying the top and bottom axial nodes of the APSR absorber material. The APSR assembly position may be changed between each irradiation step of a SAS2H calculation generated by CRAFT. The APSR assembly design may also be changed between any statepoint calculations in a given reactor cycle. For any APSRA modeled, the APSR follow rods are modeled in the axial region above the absorbing region of the APSR. The APSR follow rod material may be specified as a cladding material in the CRAFT input deck.

- A fuel assembly may be inserted in a maximum of 10 reactor cycles during a CRAFT calculation.

- A maximum of 20 statepoints (BOC is always considered a statepoint) may be specified in any given reactor cycle in a CRAFT calculation.

- A maximum of 23 irradiation steps of variable duration may be specified in any given SAS2H statepoint calculation to be generated during a CRAFT calculation.

- A maximum of 50 axial nodes may be specified in the CRC nodal format for use in a CRAFT calculation. Each axial node may have a unique height.

- The CRAFT code utilizes a user-defined input format for fuel temperature, moderator specific volume, and burnup data. The input data must be specified for each axial node in a user-defined nodal format of up to 50 nodes of arbitrary height. The total assembly active fuel height for the input data descriptions may be different than that specified in the CRC nodal format. Depending on the users needs, the fuel temperature, moderator specific volume and burnup input data may be specified in a different nodal format each time an assembly set of this input data is provided. Nominal fuel temperature input data representing full-power reactor operation must be provided in units of degrees Fahrenheit for each node in each statepoint calculation to be generated by the CRAFT calculation. Nominal moderator specific volume input data representing full-power reactor operation must be provided in units of cubic feet per pound for each node in each statepoint calculation to be generated by the CRAFT calculation. The nodal average burnup input data must be provided in units of GWd/MTU for each node at each statepoint including the BOC statepoint. All burnup input data that is specified must be cumulative from the initial insertion of the fuel assembly in the reactor.

- A continuation CRAFT calculation for an assembly may be initiated from any statepoint in any reactor cycle if all of the nodal consolidated output files ("*.cut" files) from the statepoint calculation immediately preceding the continuation calculation exist in the CRAFT execution directory.

Additional information on the CRAFT code is provided in the CRAFT user information in Attachment I of this analysis. Instructions on how to develop CRAFT input decks and execute CRAFT calculations are also provided in Attachment I. This attachment also discusses specific modeling procedures and details relevant to the SAS2H fuel assembly depletion calculations which are generated by CRAFT.

7.5 Input & Output Filename Descriptions for CRAFT and SAS2H

The CRAFT code generates five types of files identified as either "*.input", "*.output", "*.cut", "*.msgs", or "*.notes", where the "*" is the base file set identifier for the statepoint calculation of interest. The "*.cut" and "*.notes" files are the only files that must be retained for CRC evaluation and documentation purposes. All files are generated in the working directory in which the CRAFT calculation is performed.

All CRAFT generated filenames utilize the following format-- "{Base File Set Identifier}.{suffix}". Where the suffix corresponds to one of the five file types previously mentioned, and the base file set identifier is a 25 character name containing essential information necessary to delineate one CRAFT generated SAS2H calculation from another.

The base file set identifier for a statepoint calculation contains the following information:

1) reactor identifier (three character);
2) one-eighth core symmetry assembly number in current reactor cycle (two digit);
3) axial node number (node 1 is always the top node) (two digit);
4) reactor cycle number in which the SAS2H calculation starts (two character);
5) EFPD statepoint at which the SAS2H calculation starts (three digit);
6) reactor cycle number in which the SAS2H calculation ends (two character);
7) EFPD statepoint at which the SAS2H calculation ends (three digit).

The format of the base file set identifier is as follows where the numbers identified as #{number} correspond to one of the seven items previously listed-- #1 A #2 N #3 DC #4 T #5 AC #6 T #7. The letters contained in the base file set identifier are presented explicitly as shown in the previous format. The base file set identifier does not contain any spaces.

The "*.input" files contain a CRAFT generated SAS2H input deck. The "*.output" files contain a complete SAS2H calculation output file. The "*.cut" files contain the corresponding SAS2H input deck followed by an output extraction, from the final ORIGEN-S pass of the SAS2H calculation, which contains data relevant to CRC evaluations. The "*.msgs" files contain the standard run-time messages associated with the SAS2H calculation. The "*.notes" files contain a listing of the isotopes and their concentration which were left behind in generating the initial charge fuel composition for a continuation SAS2H calculation. The "*.notes" files are only created for CRAFT generated SAS2H calculations which represent continuation depletion and decay calculations. The "*.cut" and "*.notes" files contain all of the information which is required to perform CRC evaluations or repeat calculations as necessary for quality assurance purposes. The remainder of the CRAFT generated files may be discarded once the "*.cut" and "*.notes" files have been produced correctly.

7.6 Rodded Assembly Depletion Calculations for Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Depletion calculations for 18 rodded fuel assemblies from fuel batches 1, 2, 3, and 1X of Crystal River Unit 3 are documented in this analysis. The depleted fuel and depleted burnable poison isotopics for these fuel assemblies must be calculated at a number of statepoints during several reactor cycles of Crystal River Unit 3 for use in subsequent CRC reactivity calculations. The assembly depletion calculations documented in this analysis are applicable to CRC statepoints in Cycles-1A, -1B, -2, -3, -7, -8, and -9 of Crystal River Unit 3. Table 7.6-1 identifies the CRC statepoint EFPD values in each of these cycles for which isotopic compositions are required.

Table 7.6-1 CRC Statepoint EFPD Values Relevant to Rodded Assembly Depletion Calculations for Fuel Batches 1, 2, 3, and 1X of Crystal River Unit 3

Crystal River Unit 3 Reactor Cycle	CRC Statepoint EFPD Values
1A	0.0 (BOC)
1B	0.0 (BOC)
1B	142.2
2	0.0 (BOC)
3	0.0 (BOC)
3	168.5
3	250.0
7	0.0 (BOC)
7	260.3
7	291.0
7	319.0
7	462.3
7	479.0
8	0.0 (BOC)
8	97.6
8	139.8
8	404.0

Crystal River Unit 3 Reactor Cycle	CRC Statepoint EFPD Values
8	409.6
8	515.5
9	0.0 (BOC)
9	158.8
9	219.0
9	363.1

CRAFT input decks for each of the fuel assemblies identified in Tables 4.1.6-1 and 4.1.7-1 were developed and executed such that their depleted fuel and depleted burnable poison (if applicable) isotopic concentrations were retained at each of the CRC statepoints identified in Table 7.6-1 for which a particular assembly is inserted. The CRAFT input decks were developed in accordance with the instructions presented in Sections 5 and 7 of Attachment I of this analysis. SAS2H modeling features incorporated in the depletion calculations of this analysis are described in Attachment I. The CRAFT input decks for the assembly depletions documented in this analysis are provided in Attachments IV through XXI, as documented in Section 9.

The SAS2H input decks generated for the various depletion calculations have similar structures depending on the characteristics of the fuel assembly axial node that is being depleted. The following listing presents the base SAS2H input deck descriptions.

- Fuel assembly axial node containing empty guide tubes
- Fuel assembly axial node containing an absorbing BPRA inserted in the guide tubes
- Fuel assembly axial node (top node) containing a non-absorbing BPRA region inserted in the guide tubes
- Fuel assembly axial node containing a CRA insertion in the guide tubes (with or without CRA removal during the depletion calculation)
- Fuel assembly axial node containing an APSRA insertion in the guide tubes (with or without APSRA removal and/or APSRA follow rod region insertion during the depletion calculation)

All of the SAS2H input decks generated by CRAFT in this analysis will correspond to one of the afore-mentioned base SAS2H input decks depending on the assembly characteristics being modeled in the specific depletion calculation. The material compositions of the fuel, burnable absorber, and moderator are modified for each SAS2H case depending on the depleted material compositions at the beginning of the SAS2H case and the irradiation parameters for the SAS2H case as defined in the CRAFT input deck. The material specifications for the fuel and burnable absorber have different formats in the SAS2H input decks depending on whether the depletion case represents the initial depletion calculation for the assembly axial node or a continuation depletion calculation for the axial node utilizing previously calculated fuel and burnable poison (if applicable) isotopics for the initial charge compositions.

The following ten example SAS2H input decks are presented to demonstrate the modeling techniques employed by CRAFT in generating appropriate SAS2H depletion cases for the fuel assembly depletion calculations relevant to this analysis. These example input decks are actual SAS2H input decks which were generated and executed during the depletion of fuel assemblies relevant to CRC evaluations (the assemblies from which these examples are obtained may not be documented in this analysis). Each section of the SAS2H input decks are modified as necessary to perform each depletion calculation according to the pertinent information provided in the CRAFT input deck.

SAS2H Depletion Input Deck Example 1: BOL Depletion Calculation for a B&W Fuel Assembly Axial Node Containing 208 Fuel Rods, 16 Empty Guide Tubes, and 1 Empty Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit_3 Assy-03, Node-05 (Cyc-1A,    .0 to Cyc-1B,    .0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
uo2 1 den=10.121 1 1066.3 92234  .016 92235 1.930 92236  .009 92238 98.045 end
kr-83         1   0    1-21    1066.3    end
kr-85         1   0    1-21    1066.3    end
sr-90         1   0    1-21    1066.3    end
y-89          1   0    1-21    1066.3    end
mo-95         1   0    1-21    1066.3    end
zr-93         1   0    1-21    1066.3    end
zr-94         1   0    1-21    1066.3    end
zr-95         1   0    1-21    1066.3    end
nb-94         1   0    1-21    1066.3    end
tc-99         1   0    1-21    1066.3    end
rh-103        1   0    1-21    1066.3    end
rh-105        1   0    1-21    1066.3    end
ru-101        1   0    1-21    1066.3    end
ru-106        1   0    1-21    1066.3    end
pd-105        1   0    1-21    1066.3    end
pd-108        1   0    1-21    1066.3    end
ag-109        1   0    1-21    1066.3    end
sb-124        1   0    1-21    1066.3    end
xe-131        1   0    1-21    1066.3    end
xe-132        1   0    1-21    1066.3    end
xe-135        1   0    1-21    1066.3    end
xe-136        1   0    1-21    1066.3    end
cs-134        1   0    1-21    1066.3    end
cs-135        1   0    1-21    1066.3    end
cs-137        1   0    1-21    1066.3    end
ba-136        1   0    1-21    1066.3    end
la-139        1   0    1-21    1066.3    end
ce-144        1   0    1-21    1066.3    end
```

```
nd-143        1  0  1-21   1066.3   end
nd-145        1  0  1-21   1066.3   end
pm-147        1  0  1-21   1066.3   end
pm-148        1  0  1-21   1066.3   end
nd-147        1  0  1-21   1066.3   end
sm-147        1  0  1-21   1066.3   end
sm-149        1  0  1-21   1066.3   end
sm-150        1  0  1-21   1066.3   end
sm-151        1  0  1-21   1066.3   end
sm-152        1  0  1-21   1066.3   end
gd-155        1  0  1-21   1066.3   end
eu-153        1  0  1-21   1066.3   end
eu-154        1  0  1-21   1066.3   end
eu-155        1  0  1-21   1066.3   end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3    den=.7343    .99424      588.9    end
arbm-bormod     .7343 1 0 0 0 5000 100 3 .00092    588.9 end
arbm-spacer     .7343 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576   588.9 end
'
'
he     5    end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0    end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=04 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3  .63246   2  .67310   3  .81397 500 2.97599   3 2.99939
'
'     assembly depletion/decay parameters
'
'.  Cycle-1A, one-eighth core assembly number 03
power=1.0928     burn=67.20     down=.00000E+00 bfrac=1.000      end
power=1.0928     burn=67.20     down=.00000E+00 bfrac=.9470      end
power=1.0928     burn=67.20     down=.00000E+00 bfrac=.8016      end
power=1.0928     burn=67.20     down=195.29     bfrac=.6603      end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 2: Continuation Depletion Calculation for a B&W Fuel Assembly Axial Node Containing 208 Fuel Rods, 16 Empty Guide Tubes, and 1 Empty Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-05 (Cyc-1B,    .0 to Cyc-1B, 142.2 EFPD)
44group         latticecell
```

```
'
'  fuel density based on mass of uranium per assembly & total pellet stack
'  volume to account for fuel volume loss to pellet chamfers
'
'   material specification input
'
arbm-fuel   10.1      183 0 0 0 8016    11.8
     2004   .135E-05        90230   .373E-07
    90232   .411E-08        91231   .568E-08        92233   .578E-07
    92234   .112E-01        92235   .887            92236   .147
    92238   85.6            93237   .934E-02        94236   .466E-08
    94238   .126E-02        94239   .356            94240   .907E-01
    94241   .383E-01        94242   .650E-02        95241   .137E-02
    95601   .578E-05        95243   .524E-03        96242   .289E-04
    96243   .640E-06        96244   .507E-04        96245   .760E-06
    96246   .400E-07         1003   .153E-05         3006   .876E-08
    32072   .147E-06        32073   .448E-06        32074   .373E-06
    33075   .363E-05        32076   .111E-04        34076   .397E-07
    34077   .255E-04        34078   .784E-04        34080   .428E-03
    35081   .640E-03        34082   .103E-02        36082   .897E-05
    36083   .151E-02        36084   .353E-02        36085   .763E-03
    37085   .299E-02        36086   .602E-02        38086   .390E-05
    37087   .787E-02        38087   .249E-07        38088   .113E-01
    38089   .249E-03        39089   .149E-01        38090   .180E-01
    39090   .469E-05        40090   .418E-03        39091   .541E-03
    40091   .189E-01        40092   .205E-01        40093   .151E-01
    40094   .240E-01        41094   .137E-07        40095   .948E-03
    41095   .103E-02        42095   .228E-01        40096   .251E-01
    42096   .221E-03        42097   .235E-01        42098   .252E-01
    43099   .261E-01        44099   .952E-06        42100   .285E-01
    44100   .122E-02        44101   .238E-01        44102   .224E-01
    44103   .145E-03        45103   .176E-01        44104   .150E-01
    46104   .215E-02        46105   .989E-02        44106   .448E-02
    46106   .496E-02        46107   .544E-02        46108   .342E-02
    47109   .248E-02        46110   .101E-02        48110   .380E-03
    48111   .527E-03        48112   .277E-03        48113   .548E-05
    49113   .123E-06        48114   .311E-03        48601   .575E-07
    49115   .664E-04        50115   .493E-05        48116   .142E-03
    50116   .346E-04        50117   .129E-03        50118   .105E-03
    50119   .112E-03        50120   .109E-03        51121   .115E-03
    50122   .142E-03        52122   .282E-05        50123   .212E-05
    51123   .133E-03        52123   .136E-07        50124   .239E-03
    51124   .114E-06        52124   .225E-05        51125   .234E-03
    52125   .534E-04        50126   .531E-03        52126   .774E-05
    52601   .337E-04        53127   .122E-02        52128   .264E-02
    54128   .217E-04        52611   .359E-05        53129   .544E-02
    54129   .424E-07        52130   .110E-01        54130   .907E-04
    54131   .160E-01        54132   .298E-01        55133   .383E-01
    54134   .462E-01        55134   .147E-02        56134   .435E-03
    55135   .654E-02        56135   .366E-06        54136   .736E-01
    55136   .863E-09        56136   .227E-03        55137   .380E-01
    56137   .815E-03        56138   .394E-01        57139   .377E-01
    56140   .620E-07        57140   .938E-08        58140   .380E-01
    58141   .928E-04        59141   .346E-01        58142   .349E-01
    60142   .192E-03        59143   .118E-06        60143   .304E-01
    58144   .142E-01        60144   .217E-01        60145   .224E-01
    60146   .197E-01        60147   .366E-08        61147   .887E-02
    62147   .224E-02        60148   .112E-01        61148   .166E-07
    61601   .241E-05        62148   .153E-02        62149   .273E-03
    60150   .524E-02        62150   .859E-02        62151   .695E-03
```

```
        63151   .334E-05       62152   .459E-02       63152   .763E-06
        64152   .555E-06       63153   .266E-02       62154   .989E-03
        63154   .310E-03       64154   .198E-04       63155   .114E-03
        64155   .986E-05       63156   .184E-07       64156   .989E-03
        64157   .507E-05       64158   .373E-03       65159   .531E-04
        64160   .235E-04       65160   .222E-06       66160   .229E-05
        66161   .917E-05       66162   .599E-05       66163   .319E-05
        66164   .753E-06       67165   .804E-06       68166   .110E-06
        1    1.0     974.3    end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o   3   den=.7433    .99424      585.2    end
arbm-bormod       .7433 1 0 0 0 5000 100 3 .00052    585.2 end
arbm-spacer       .7433 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                   26000 7.0 28000 73.0 3 .00576    585.2 end
'
'

he     5    end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398    1    3    1.0922    2    .9576    0    end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=02.nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3  .63246   2  .67310   3  .81397 500 2.97599   3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 03
power=.92563     burn=71.10     down=.00000E+00 bfrac=1.000      end
power=.92563     burn=71.10     down=14.792     bfrac=.4938      end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 3: BOL Depletion Calculation for a B&W Fuel Assembly Top Axial Node Containing 208 Fuel Rods, 16 Guide Tubes with BPR's Inserted, and 1 Empty Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-02, Node-01 (Cyc-1A,     .0 to Cyc-1B,     .0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
uo2 1 den=10.121 1  820.6 92234  .021 92235 2.540 92236  .012 92238 97.427 end
```

```
kr-83        1   0   1-21   820.6   end
kr-85        1   0   1-21   820.6   end
sr-90        1   0   1-21   820.6   end
y-89         1   0   1-21   820.6   end
mo-95        1   0   1-21   820.6   end
zr-93        1   0   1-21   820.6   end
zr-94        1   0   1-21   820.6   end
zr-95        1   0   1-21   820.6   end
nb-94        1   0   1-21   820.6   end
tc-99        1   0   1-21   820.6   end
rh-103       1   0   1-21   820.6   end
rh-105       1   0   1-21   820.6   end
ru-101       1   0   1-21   820.6   end
ru-106       1   0   1-21   820.6   end
pd-105       1   0   1-21   820.6   end
pd-108       1   0   1-21   820.6   end
ag-109       1   0   1-21   820.6   end
sb-124       1   0   1-21   820.6   end
xe-131       1   0   1-21   820.6   end
xe-132       1   0   1-21   820.6   end
xe-135       1   0   1-21   820.6   end
xe-136       1   0   1-21   820.6   end
cs-134       1   0   1-21   820.6   end
cs-135       1   0   1-21   820.6   end
cs-137       1   0   1-21   820.6   end
ba-136       1   0   1-21   820.6   end
la-139       1   0   1-21   820.6   end
ce-144       1   0   1-21   820.6   end
nd-143       1   0   1-21   820.6   end
nd-145       1   0   1-21   820.6   end
pm-147       1   0   1-21   820.6   end
pm-148       1   0   1-21   820.6   end
nd-147       1   0   1-21   820.6   end
sm-147       1   0   1-21   820.6   end
sm-149       1   0   1-21   820.6   end
sm-150       1   0   1-21   820.6   end
sm-151       1   0   1-21   820.6   end
sm-152       1   0   1-21   820.6   end
gd-155       1   0   1-21   820.6   end
eu-153       1   0   1-21   820.6   end
eu-154       1   0   1-21   820.6   end
eu-155       1   0   1-21   820.6   end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7198   .99424      594.5    end
arbm-bormod     .7198 1 0 0 0 5000 100 3 .00092    594.5 end
arbm-spacer     .7198 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                26000 7.0 28000 73.0 3 .00576    594.5 end
'
'
'     BPR above the BP absorber region
'
al      6   den=3.700   .52924    594.5 end
o      6   den=3.700   .47076    594.5 end
'
he     5    end
end comp
```

```
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=17.780 ncycles=04 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=1 mixmod=3 facmesh=.50 end
  6  .43180    5  .45720    2  .54610    3  .63246    2  .67310
  3  .81397 500 2.91402    3 2.93693
'
'     assembly depletion/decay parameters
'
'   Cycle-1A, one-eighth core assembly number 02
power=.35463      burn=67.20      down=.00000E+00 bfrac=1.000     end
power=.35463      burn=67.20      down=.00000E+00 bfrac=.9470     end
power=.35463      burn=67.20      down=.00000E+00 bfrac=.8016     end
power=.35463      burn=67.20      down=195.29     bfrac=.6603     end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 4: Continuation Depletion Calculation for a B&W Fuel Assembly Top Axial Node Containing 208 Fuel Rods, 16 Guide Tubes with BPR's Inserted, and 1 Empty Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-04, Node-01 (Cyc-04, 228.1 to Cyc-04, 253.0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
arbm-fuel   10.2      192 0 0 0 8016    11.9
      2004   .114E-06     90230   .327E-07
     92233   .309E-07     92234   .177E-01      92235   1.84
     92236   .977E-01     92237   .305E-04      92238   85.4
     93237   .311E-02     93238   .302E-07      94238   .184E-03
     94239   .216         94240   .243E-01      94241   .636E-02
     94242   .337E-03     95241   .915E-04      95601   .946E-06
     95243   .103E-04     96242   .563E-05      96243   .334E-07
     96244   .387E-06      1003   .678E-06       3006   .406E-08
     32072   .410E-07     32073   .142E-06      32074   .119E-06
     33075   .174E-05     32076   .555E-05      34076   .747E-08
     34077   .126E-04     34078   .354E-04      34080   .208E-03
     35081   .311E-03     34082   .521E-03      36082   .185E-05
     36083   .827E-03     36084   .177E-02      36085   .398E-03
     37085   .157E-02     36086   .319E-02      37086   .747E-07
     38086   .720E-06     37087   .417E-02      38087   .674E-08
     38088   .597E-02     38089   .140E-02      39089   .670E-02
     38090   .961E-02     39090   .250E-05      40090   .242E-03
     39091   .208E-02     40091   .816E-02      40092   .106E-01
     40093   .766E-02     40094   .119E-01      41094   .363E-08
```

```
     40095   .277E-02      41095   .162E-02      42095   .781E-02
     40096   .121E-01      42096   .659E-04      42097   .112E-01
     42098   .118E-01      42099   .346E-05      43099   .125E-01
     44099   .320E-06      42100   .131E-01      44100   .239E-03
     44101   .109E-01      44102   .973E-02      44103   .115E-02
     45103   .628E-02      44104   .540E-02      46104   .440E-03
     45105   .277E-07      46105   .353E-02      44106   .149E-02
     46106   .793E-03      46107   .129E-02      46108   .770E-03
     47109   .563E-03      46110   .236E-03      48110   .339E-04
     47111   .160E-05      48111   .129E-03      48112   .770E-04
     48113   .429E-05      49113   .123E-07      48114   .102E-03
     48601   .275E-06      49115   .299E-04      50115   .180E-05
     48116   .536E-04      50116   .597E-05      50117   .429E-04
     50118   .383E-04      50119   .414E-04      50120   .410E-04
     51121   .440E-04      50122   .525E-04      52122   .394E-06
     50123   .189E-05      51123   .502E-04      50124   .877E-04
     51124   .137E-06      52124   .245E-06      50125   .467E-06
     51125   .854E-04      52125   .169E-04      50126   .170E-03
     51126   .317E-07      52126   .185E-05      52601   .303E-04
     53127   .410E-03      52128   .107E-02      54128   .331E-05
     52611   .506E-04      53129   .221E-02      54129   .296E-08
     52130   .490E-02      54130   .155E-04      53131   .862E-04
     54131   .766E-02      52132   .735E-05      54132   .128E-01
     54133   .709E-04      55133   .183E-01      54134   .217E-01
     55134   .338E-03      56134   .483E-04      55135   .800E-02
     56135   .682E-07      54136   .287E-01      55136   .350E-05
     56136   .758E-04      55137   .175E-01      56137   .398E-03
     56138   .188E-01      57139   .180E-01      56140   .460E-03
     57140   .693E-04      58140   .182E-01      58141   .178E-02
     59141   .149E-01      58142   .168E-01      60142   .391E-04
     58143   .498E-07      59143   .509E-03      60143   .156E-01
     58144   .869E-02      60144   .770E-02      60145   .112E-01
     60146   .911E-02      60147   .131E-03      61147   .486E-02
     62147   .119E-02      60148   .521E-02      61148   .207E-05
     61601   .211E-04      62148   .421E-03      61149   .359E-06
     62149   .183E-03      60150   .225E-02      62150   .343E-02
     61151   .123E-08      62151   .601E-03      63151   .170E-05
     62152   .179E-02      63152   .229E-05      64152   .124E-05
     62153   .475E-07      63153   .804E-03      62154   .338E-03
     63154   .586E-04      64154   .206E-05      63155   .490E-04
     64155   .900E-06      63156   .119E-04      64156   .222E-03
     64157   .216E-05      64158   .827E-04      65159   .124E-04
     64160   .529E-05      65160   .124E-06      66160   .148E-06
     66161   .214E-05      66162   .108E-05      66163   .460E-06
     66164   .137E-06      67165   .835E-07      68166   .115E-07
     1   1.0    872.8    end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7198    .99424      594.5    end
arbm-bormod     .7198 1 0 0 0 5000 100 3 .00022    594.5 end
arbm-spacer     .7198 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576    594.5 end
'
'
'     BPR above the BP absorber region
'
al      6   den=3.700   .52924   594.5 end
```

```
o     6   den=3.700  .47076   594.5 end
'
he    5   end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9390   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=17.780 ncycles=01 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=1 mixmod=3 facmesh=.50 end
  6  .43180   5  .45720   2  .54610   3  .63246   2  .67310
  3  .81397 500 2.91402   3 2.93693
'
'     assembly depletion/decay parameters
'
'   Cycle-04, one-eighth core assembly number 04
power=.45617     burn=24.90     down=24.000     bfrac=1.000     end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 5: BOL Depletion Calculation for a B&W Fuel Assembly Axial Node (Other than Top Node) Containing 208 Fuel Rods, 16 Guide Tubes with BPR's Inserted, and 1 Empty Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-02, Node-02 (Cyc-1A,    .0 to Cyc-1B,    .0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'    material specification input
'
uo2 1 den=10.121 1  936.2 92234  .021 92235 2.540 92236  .012 92238 97.427 end
kr-83        1   0   1-21    936.2    end
kr-85        1   0   1-21    936.2    end
sr-90        1   0   1-21    936.2    end
y-89         1   0   1-21    936.2    end
mo-95        1   0   1-21    936.2    end
zr-93        1   0   1-21    936.2    end
zr-94        1   0   1-21    936.2    end
zr-95        1   0   1-21    936.2    end
nb-94        1   0   1-21    936.2    end
tc-99        1   0   1-21    936.2    end
rh-103       1   0   1-21    936.2    end
rh-105       1   0   1-21    936.2    end
ru-101       1   0   1-21    936.2    end
ru-106       1   0   1-21    936.2    end
pd-105       1   0   1-21    936.2    end
pd-108       1   0   1-21    936.2    end
ag-109       1   0   1-21    936.2    end
sb-124       1   0   1-21    936.2    end
```

```
xe-131        1   0   1-21    936.2   end
xe-132        1   0   1-21    936.2   end
xe-135        1   0   1-21    936.2   end
xe-136        1   0   1-21    936.2   end
cs-134        1   0   1-21    936.2   end
cs-135        1   0   1-21    936.2   end
cs-137        1   0   1-21    936.2   end
ba-136        1   0   1-21    936.2   end
la-139        1   0   1-21    936.2   end
ce-144        1   0   1-21    936.2   end
nd-143        1   0   1-21    936.2   end
nd-145        1   0   1-21    936.2   end
pm-147        1   0   1-21    936.2   end
pm-148        1   0   1-21    936.2   end
nd-147        1   0   1-21    936.2   end
sm-147        1   0   1-21    936.2   end
sm-149        1   0   1-21    936.2   end
sm-150        1   0   1-21    936.2   end
sm-151        1   0   1-21    936.2   end
sm-152        1   0   1-21    936.2   end
gd-155        1   0   1-21    936.2   end
eu-153        1   0   1-21    936.2   end
eu-154        1   0   1-21    936.2   end
eu-155        1   0   1-21    936.2   end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7226    .99424      593.4    end
arbm-bormod     .7226 1 0 0 0 5000 100 3 .00092    593.4 end
arbm-spacer     .7226 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576    593.4 end
'
'
'     burnable absorber pellet specification
'
b4c    4    den=3.700   .01340    593.4 end
al     4    den=3.700   .52215    593.4 end
o      4    den=3.700   .46445    593.4 end
'
he     5    end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=04 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=1 mixmod=3 facmesh=.50 end
  4  .43180    5  .45720    2  .54610    3  .63246    2  .67310
  3  .81397 500 2.91402    3 2.93693
'
'     assembly depletion/decay parameters
'
'   Cycle-1A, one-eighth core assembly number 02
power=.63623     burn=67.20     down=.00000E+00 bfrac=1.000      end
```

```
power=.63623      burn=67.20      down=.00000E+00 bfrac=.9470      end
power=.63623      burn=67.20      down=.00000E+00 bfrac=.8016      end
power=.63623      burn=67.20      down=195.29     bfrac=.6603      end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 6: Continuation Depletion Calculation for a B&W Fuel Assembly Axial Node (Other than Top Node) Containing 208 Fuel Rods, 16 Guide Tubes with BPR's Inserted, and 1 Empty Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-04, Node-05 (Cyc-04, 228.1 to Cyc-04, 253.0 EFPD)
44group        latticecell
'
''   fuel density based on mass of uranium per assembly & total pellet stack
'    volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
arbm-fuel   10.3   - 199 0 0 0 8016   11.8
      2004   .129E-05        90230   .284E-07
     90232   .273E-08        91231   .302E-08         92233   .657E-07
     92234   .154E-01        92235   1.30             92236   .192
     92237   .128E-03        92238   85.0             93237   .116E-01
     93238   .275E-06        94236   .657E-08         94237   .299E-08
     94238   .159E-02        94239   .388             94240   .873E-01
     94241   .408E-01        94242   .593E-02         95241   .637E-03
     95601   .995E-05        95243   .512E-03         96242   .118E-03
     96243   .189E-05        96244   .533E-04         96245   .860E-06
     96246   .401E-07         1003   .174E-05          3006   .833E-08
     32072   .123E-06        32073   .506E-06         32074   .311E-06
     33075   .425E-05        32076   .132E-04         34076   .472E-07
     34077   .302E-04        34078   .904E-04         34080   .502E-03
     35081   .752E-03        34082   .123E-02         36082   .105E-04
     36083   .182E-02        36084   .421E-02         36085   .914E-03
     37085   .361E-02        36086   .728E-02         37086   .452E-06
     38086   .482E-05        37087   .951E-02         38087   .229E-07
     38088   .136E-01        38089   .290E-02         39089   .154E-01
     38090   .218E-01        39090   .566E-05         40090   .614E-03
     39091   .442E-02        40091   .191E-01         40092   .246E-01
     40093   .180E-01        40094   .285E-01         41094   .116E-07
     40095   .630E-02        41095   .371E-02         42095   .190E-01
     40096   .295E-01        42096   .421E-03         42097   .275E-01
     42098   .293E-01        42099   .829E-05         43099   .302E-01
     44099   .112E-05        42100   .330E-01         44100   .151E-02
     44101   .274E-01        44102   .256E-01         44103   .322E-02
     45103   .160E-01        44104   .162E-01         46104   .279E-02
     45105   .914E-07        46105   .111E-01         44106   .560E-02
     46106   .337E-02        46107   .539E-02         46108   .341E-02
     47109   .242E-02        46110   .100E-02         48110   .381E-03
     47111   .671E-05        48111   .523E-03         48112   .285E-03
     48113   .634E-05        49113   .405E-07         48114   .332E-03
     48601   .860E-06        49115   .715E-04         50115   .536E-05
     48116   .155E-03        50116   .367E-04         50117   .137E-03
     50118   .114E-03        50119   .121E-03         50120   .119E-03
     51121   .125E-03        50122   .154E-03         52122   .312E-05
```

```
       50123    .496E-05        51123    .143E-03        52123    .131E-07
       50124    .260E-03        51124    .974E-06        52124    .170E-05
       50125    .138E-05        51125    .259E-03        52125    .509E-04
       50126    .560E-03        51126    .134E-06        52126    .786E-05
       52601    .934E-04        53127    .125E-02        52128    .295E-02
       54128    .275E-04        52611    .138E-03        53129    .597E-02
       54129    .644E-07        52130    .126E-01        54130    .991E-04
       53131    .217E-03        54131    .180E-01        52132    .182E-04
       54132    .344E-01        54133    .171E-03        55133    .442E-01
       54134    .539E-01        55134    .205E-02        56134    .313E-03
       55135    .113E-01        56135    .110E-05        54136    .813E-01
       55136    .130E-04        56136    .290E-03        55137    .438E-01
       56137    .106E-02        56138    .462E-01        57139    .438E-01
       56140    .108E-02        57140    .163E-03        58140    .448E-01
       58141    .418E-02        59141    .364E-01        58142    .411E-01
       60142    .245E-03        58143    .113E-06        59143    .115E-02
       60143    .347E-01        58144    .200E-01        60144    .221E-01
       60145    .264E-01        60146    .231E-01        60147    .310E-03
       61147    .101E-01        62147    .264E-02        60148    .130E-01
       61148    .900E-05        61601    .698E-04        62148    .203E-02
       61149    .108E-05        62149    .300E-03        60150    .593E-02
       62150    .957E-02        61151    .337E-08        62151    .880E-03
       63151    .107E-05        62152    .496E-02        63152    .273E-05
       64152    .246E-85        62153    .225E-06        63153    .297E-02
       62154    .106E-02        63154    .384E-03        64154    .137E-04
       63155    .133E-03        64155    .156E-05        63156    .624E-04
       64156    .988E-03        64157    .512E-05        64158    .364E-03
       65159    .526E-04        64160    .233E-04        65160    .126E-05
       66160    .141E-05        66161    .887E-05        66162    .580E-05
       66163    .317E-05        66164    .755E-06        67165    .627E-06
       68166    .860E-07
       1 . 1.0   1010.8    end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7343    .99424      588.9     end
arbm-bormod      .7343 1 0 0 0 5000 100 3 .00022    588.9 end
arbm-spacer      .7343 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                  26000 7.0 28000 73.0 3 .00576    588.9 end
'
'
'     burnable absorber pellet specification
'
arbm-bp    3.699 5 0 0 0
        5010    .225E-02
        5011    .140
       6012    .435E-01
      13027   52.827  8016  46.987
      4 1.0   588.9 end
'
he     5    end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9390   1   3   1.0922   2    .9576   0    end
more data szf=0.50 end
'
```

```
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=01 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=1 mixmod=3 facmesh=.50 end
  4  .43180   5  .45720   2  .54610   3  .63246   2  .67310
  3  .81397 500 2.91402   3 2.93693
'
'     assembly depletion/decay parameters
'
'   Cycle-04, one-eighth core assembly number 04
power=1.0347     burn=24.90     down=24.000     bfrac=1.000     end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 7: BOL Depletion Calculation for a B&W Fuel Assembly Axial Node Containing 208 Fuel Rods, 16 Guide Tubes with a 16 Rod CRA Inserted for a Portion of the Depletion, and 1 Empty (Water-filled) Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit.3 Assy-07, Node-07 (Cyc-1A,    .0 to Cyc-1B,    .0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
uo2 1 den=10.121 1 1061.9 92234  .024 92235 2.830 92236  .013 92238 97.133 end
kr-83        1   0   1-21   1061.9   end
kr-85        1   0   1-21   1061.9   end
sr-90        1   0   1-21   1061.9   end
y-89         1   0   1-21   1061.9   end
mo-95        1   0   1-21   1061.9   end
zr-93        1   0   1-21   1061.9   end
zr-94        1   0   1-21   1061.9   end
zr-95        1   0   1-21   1061.9   end
nb-94        1   0   1-21   1061.9   end
tc-99        1   0   1-21   1061.9   end
rh-103       1   0   1-21   1061.9   end
rh-105       1   0   1-21   1061.9   end
ru-101       1   0   1-21   1061.9   end
ru-106       1   0   1-21   1061.9   end
pd-105       1   0   1-21   1061.9   end
pd-108       1   0   1-21   1061.9   end
ag-109       1   0   1-21   1061.9   end
sb-124       1   0   1-21   1061.9   end
xe-131       1   0   1-21   1061.9   end
xe-132       1   0   1-21   1061.9   end
xe-135       1   0   1-21   1061.9   end
xe-136       1   0   1-21   1061.9   end
cs-134       1   0   1-21   1061.9   end
cs-135       1   0   1-21   1061.9   end
cs-137       1   0   1-21   1061.9   end
ba-136       1   0   1-21   1061.9   end
la-139       1   0   1-21   1061.9   end
ce-144       1   0   1-21   1061.9   end
```

```
nd-143        1  0  1-21  1061.9  end
nd-145        1  0  1-21  1061.9  end
pm-147        1  0  1-21  1061.9  end
pm-148        1  0  1-21  1061.9  end
nd-147        1  0  1-21  1061.9  end
sm-147        1  0  1-21  1061.9  end
sm-149        1  0  1-21  1061.9  end
sm-150        1  0  1-21  1061.9  end
sm-151        1  0  1-21  1061.9  end
sm-152        1  0  1-21  1061.9  end
gd-155        1  0  1-21  1061.9  end
eu-153        1  0  1-21  1061.9  end
eu-154        1  0  1-21  1061.9  end
eu-155        1  0  1-21  1061.9  end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o   3   den=.7433   .99424     585.2    end
arbm-bormod     .7433 1 0 0 0 5000 100 3 .00090    585.2 end
arbm-spacer     .7433 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576   585.2 end
'
'
'    control rod material specification
'
arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 2.0 26304 69.5 28304 9.5
            6 1.0 640.0 end
 arbm-cr     10.17     4    0    0    0
          47000      79.80000
          49000      15.00000
          48000       5.00000
          13027        .20000
            7 1.0  585.1721   end
'
he    5   end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0    end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=11 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=0 mixmod=3 facmesh=.50 end
  7  .49784   5  .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784   5  .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784   5  .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
```

```
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1A, one-eighth core assembly number 07
power=1.0933     burn=2.500     down=.00000E+00 bfrac=1.000     end
power=1.0933     burn=6.500     down=.00000E+00 bfrac=1.003     end
power=1.0933     burn=1.000     down=.00000E+00 bfrac=1.005     end
power=1.0933     burn=1.000     down=.00000E+00 bfrac=1.006     end
power=1.0933     burn=1.000     down=.00000E+00 bfrac=1.007     end
power=1.0933     burn=.9700     down=.00000E+00 bfrac=1.007     end
power=1.0933     burn=1.040     down=.00000E+00 bfrac=1.008     end
power=1.0933     burn=63.70     down=.00000E+00 bfrac=1.030     end
power=1.0933     burn=63.70     down=.00000E+00 bfrac=.9481     end
power=1.0933     burn=63.70     down=.00000E+00 bfrac=.8072     end
power=1.0933     burn=63.70     down=195.29     bfrac=.6578     end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 8: Continuation Depletion Calculation for a B&W Fuel Assembly Axial Node Containing 208 Fuel Rods, 16 Guide Tubes with a 16 Rod CRA Inserted for a Portion of the Depletion, and 1 Empty (Water-filled) Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-07, Node-07 (Cyc-1B,    .0 to Cyc-1B, 142.2 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
arbm-fuel   10.1      183 0 0 0 8016    11.8
      2004   .900E-06         90230   .585E-07
     90232   .500E-08         91231   .825E-08        92233   .859E-07
     92234   .175E-01         92235   1.55            92236   .179
     92238   84.9             93237   .931E-02        94236   .407E-08
     94238   .103E-02         94239   .349            94240   .698E-01
     94241   .290E-01         94242   .356E-02        95241   .104E-02
     95601   .428E-05         95243   .243E-03        96242   .169E-04
     96243   .315E-06         96244   .197E-04        96245   .267E-06
     96246   .102E-07          1003   .151E-05         3006   .982E-08
     32072   .131E-06         32073   .431E-06        32074   .363E-06
     33075   .370E-05         32076   .116E-04        34076   .349E-07
     34077   .266E-04         34078   .784E-04        34080   .438E-03
     35081   .657E-03         34082   .109E-02        36082   .750E-05
     36083   .164E-02         36084   .370E-02        36085   .818E-03
```

```
        37085   .321E-02       36086   .647E-02       38086   .356E-05
        37087   .846E-02       38087   .226E-07       38088   .122E-01
        38089   .278E-03       39089   .161E-01       38090   .195E-01
        39090   .507E-05       40090   .448E-03       39091   .592E-03
        40091   .203E-01       40092   .218E-01       40093   .159E-01
        40094   .250E-01       41094   .118E-07       40095   .989E-03
        41095   .107E-02       42095   .236E-01       40096   .257E-01
        42096   .189E-03       42097   .240E-01       42098   .254E-01
        43099   .265E-01       44099   .962E-06       42100   .285E-01
        44100   .104E-02       44101   .237E-01       44102   .218E-01
        44103   .132E-03       45103   .166E-01       44104   .134E-01
        46104   .171E-02       46105   .863E-02       44106   .356E-02
        46106   .373E-02       46107   .411E-02       46108   .254E-02
        47109   .185E-02       46110   .757E-03       48110   .236E-03
        48111   .404E-03       48112   .222E-03       48113   .616E-05
        49113   .105E-06       48114   .267E-03       48601   .496E-07
        49115   .873E-04       50115   .442E-05       48116   .129E-03
        50116   .209E-05       50117   .111E-03       50118   .941E-04
        50119   .100E-03       50120   .989E-04       51121   .104E-03
        50122   .128E-03       52122   .227E-05       50123   .203E-05
        51123   .122E-03       52123   .993E-08       50124   .214E-03
        51124   .917E-07       52124   .182E-05       51125   .208E-03
        52125   .476E-04       50126   .448E-03       52126   .599E-05
        52601   .294E-04       53127   .107E-02       52128   .249E-02
        54128   .169E-04       52611   .335E-05       53129   .517E-02
        54129   .274E-07       52130   .108E-01       54130   .678E-04
        54131   .161E-01       54132   .291E-01       55133   .390E-01
        54134   .469E-01       55134   .126E-02       56134   .373E-03
        55135   .873E-02       56135   .269E-06       54136   .712E-01
        55136   .794E-09       56136   .204E-03       55137   .380E-01
        56137   .815E-03       56138   .401E-01       57139   .383E-01
        56140   .633E-07       57140   .959E-08       58140   .387E-01
        58141   .948E-04       59141   .353E-01       58142   .359E-01
        60142   .153E-03       59143   .123E-06       60143   .326E-01
        58144   .148E-01       60144   .214E-01       60145   .233E-01
        60146   .199E-01       60147   .373E-08       61147   .938E-02
        62147   .237E-02       60148   .113E-01       61148   .181E-07
        61601   .264E-05       62148   .142E-02       62149   .307E-03
        60150   .507E-02       62150   .832E-02       62151   .839E-03
        63151   .421E-05       62152   .428E-02       63152   .989E-06
        64152   .644E-06       63153   .232E-02       62154   .863E-03
        63154   .255E-03       64154   .163E-04       63155   .979E-04
        64155   .863E-05       63156   .136E-07       64156   .763E-03
        64157   .448E-05       64158   .280E-03       65159   .397E-04
        64160   .174E-04       65160   .149E-06       66160   .155E-05
        66161   .695E-05       66162   .421E-05       66163   .217E-05
        66164   .568E-06       67165   .490E-06       68166   .674E-07
        1   1.0    817.9   end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'      material composition of moderator within unit cell
'      with smeared inconel spacer grids
h2o    3   den=.7588    .99424      578.4     end
arbm-bormod     .7588 1 0 0 0 5000 100 3 .00054    578.4 end
arbm-spacer     .7588 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576   578.4 end
'
'
'     control rod material specification
```

```
'
arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 2.0 26304 69.5 28304 9.5
            6 1.0 640.0 end
 arbm-cr    10.17     4    0    0    0
          47000       79.80000
          49000       15.00000
          48000        5.00000
          13027         .20000
            7 1.0  578.3998    end
'
he    5   end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576  .0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=10 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=0 mixmod=3 facmesh=.50 end
  7  .49784    5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784    5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784    5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784    5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784    5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784    5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  3  .49784    3   .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784    3   .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784    3   .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
  3  .49784    3   .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 07
power=.59608     burn=4.460     down=.00000E+00 bfrac=1.000     end
power=.59608     burn=24.44     down=.00000E+00 bfrac=1.050     end
power=.59608     burn=42.89     down=.00000E+00 bfrac=.8052     end
power=.59608     burn=42.89     down=.00000E+00 bfrac=.5791     end
power=.59608     burn=9.320     down=.00000E+00 bfrac=.5087     end
power=.59608     burn=1.000     down=.00000E+00 bfrac=.5220     end
power=.59608     burn=1.310     down=.00000E+00 bfrac=.5240     end
power=.59608     burn=7.900     down=.00000E+00 bfrac=.5316     end
power=.59608     burn=7.790     down=.00000E+00 bfrac=.5262     end
power=.59608     burn=.2000     down=14.792     bfrac=.5187     end
'
'     end of input
'
end
```

SAS2H Depletion Input Deck Example 9: BOL Depletion Calculation for a B&W Fuel Assembly Axial Node Containing 208 Fuel Rods, 16 Guide Tubes with a 16 Rod APSRA Inserted for a Portion of the Depletion with a Subsequent APSRA Follow Rod Region Insertion with a Subsequent APSRA Removal, and 1 Empty (Water-filled) Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-18, Node-12 (Cyc-1A,    .0 to Cyc-1B,    .0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'    material specification input
'
uo2 1 den=10.121 1 1139.7 92234  .016 92235 1.930 92236  .009 92238 98.045 end
kr-83         1   0   1-21    1139.7    end
kr-85         1   0   1-21    1139.7    end
sr-90         1   0   1-21    1139.7    end
y-89          1   0   1-21    1139.7    end
mo-95         1   0   1-21    1139.7    end
zr-93         1   0   1-21    1139.7    end
zr-94         1   0   1-21    1139.7    end
zr-95         1   0   1-21    1139.7    end
nb-94         1   0   1-21    1139.7    end
tc-99         1   0   1-21    1139.7    end
rh-103        1   0   1-21    1139.7    end
rh-105        1   0   1-21    1139.7    end
ru-101        1   0   1-21    1139.7    end
ru-106        1   0   1-21    1139.7    end
pd-105        1   0   1-21    1139.7    end
pd-108        1   0   1-21    1139.7    end
ag-109        1   0   1-21    1139.7    end
sb-124        1   0   1-21    1139.7    end
xe-131        1   0   1-21    1139.7    end
xe-132        1   0   1-21    1139.7    end
xe-135        1   0   1-21    1139.7    end
xe-136        1   0   1-21    1139.7    end
cs-134        1   0   1-21    1139.7    end
cs-135        1   0   1-21    1139.7    end
cs-137        1   0   1-21    1139.7    end
ba-136        1   0   1-21    1139.7    end
la-139        1   0   1-21    1139.7    end
ce-144        1   0   1-21    1139.7    end
nd-143        1   0   1-21    1139.7    end
nd-145        1   0   1-21    1139.7    end
pm-147        1   0   1-21    1139.7    end
pm-148        1   0   1-21    1139.7    end
nd-147        1   0   1-21    1139.7    end
sm-147        1   0   1-21    1139.7    end
sm-149        1   0   1-21    1139.7    end
sm-150        1   0   1-21    1139.7    end
sm-151        1   0   1-21    1139.7    end
sm-152        1   0   1-21    1139.7    end
gd-155        1   0   1-21    1139.7    end
eu-153        1   0   1-21    1139.7    end
eu-154        1   0   1-21    1139.7    end
eu-155        1   0   1-21    1139.7    end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
```

```
          40000 98.18 2 1.0 640.0 end
'
'      material composition of moderator within unit cell
'      with smeared inconel spacer grids
h2o    3   den=.7717    .99424      572.3    end
arbm-bormod     .7717 1 0 0 0 5000 100 3 .00090   572.3 end
arbm-spacer     .7717 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576   572.3 end
'
'
'     APSR follow rod material specification
'
arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 2.0 26304 69.5 28304 9.5
             6 1.0 640.0 end
'
'     axial power shaping rod material specification
'
arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 2.0 26304 69.5 28304 9.5
             6 1.0 640.0 end
 arbm-apsr     10.17     4    0    0    0
            47000      79.80000
            49000      15.00000
            48000       5.00000
            13027     -  .20000
              7 1.0  572.3109    end
'
he     5    end
end comp
'
'      base reactor lattice specification
'
squarepitch   1.44272    .9398   1    3    1.0922   2    .9576   0    end
more data szf=0.50 end
'
'      assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=12 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=0 mixmod=3 facmesh=.50 end
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  7  .49784    5   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  3  .49784    3   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  3  .49784    3   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
  3  .49784    3   .50546    6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205     3 2.40078
```

```
  3  .49784   3  .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
'
'    assembly depletion/decay parameters
'
'  Cycle-1A, one-eighth core assembly number 18
power=.63853    burn=.7800    down=.00000E+00 bfrac=1.000    end
power=.63853    burn=1.420    down=.00000E+00 bfrac=1.001    end
power=.63853    burn=1.800    down=.00000E+00 bfrac=1.002    end
power=.63853    burn=27.29    down=.00000E+00 bfrac=1.011    end
power=.63853    burn=45.42    down=.00000E+00 bfrac=1.036    end
power=.63853    burn=45.42    down=.00000E+00 bfrac=.9710    end
power=.63853    burn=58.01    down=.00000E+00 bfrac=.8566    end
power=.63853    burn=58.01    down=.00000E+00 bfrac=.7138    end
power=.63853    burn=11.91    down=.00000E+00 bfrac=.6388    end
power=.63853    burn=7.500    down=.00000E+00 bfrac=.6591    end
power=.63853    burn=3.800    down=.00000E+00 bfrac=.6174    end
power=.63853    burn=7.440    down=195.29     bfrac=.5757    end
'
'    end of input
'
end
```

SAS2H Depletion Input Deck Example 10: Continuation Depletion Calculation for a B&W Fuel Assembly Axial Node Containing 208 Fuel Rods, 16 Guide Tubes with a 16 Rod APSRA Inserted for a Portion of the Depletion with a Subsequent APSRA Follow Rod Region Insertion with a Subsequent APSRA Removal, and 1 Empty (Water-filled) Instrument Tube

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-18, Node-11 (Cyc-1B,    .0 to Cyc-1B, 142.2 EFPD)
44group          latticecell
'
'  fuel density based on mass of uranium per assembly & total pellet stack
'  volume to account for fuel volume loss to pellet chamfers
'
'    material specification input
'
arbm-fuel   10.1      183 0 0 0 8016    11.9
     2004   .902E-06      90230   .394E-07
    90232   .360E-08      91231   .504E-08      92233   .518E-07
    92234   .117E-01      92235   1.00          92236   .129
    92238   85.7          93237   .710E-02      94236   .285E-08
    94238   .819E-03      94239   .326          94240   .737E-01
    94241   .280E-01      94242   .391E-02      95241   .101E-02
    95601   .404E-05      95243   .249E-03      96242   .175E-04
    96243   .312E-06      96244   .191E-04      96245   .233E-06
    96246   .101E-07       1003   .125E-05       3006   .778E-08
    32072   .118E-06      32073   .367E-06      32074   .304E-06
    33075   .302E-05      32076   .922E-05      34076   .257E-07
    34077   .214E-04      34078   .644E-04      34080   .353E-03
    35081   .531E-03      34082   .864E-03      36082   .614E-05
    36083   .129E-02      36084   .292E-02      36085   .641E-03
    37085   .251E-02      36086   .507E-02      38086   .254E-05
    37087   .662E-02      38087   .191E-07      38088   .950E-02
    38089   .215E-03      39089   .125E-01      38090   .152E-01
    39090   .394E-05      40090   .350E-03      39091   .463E-03
    40091   .159E-01      40092   .172E-01      40093   .126E-01
    40094   .200E-01      41094   .109E-07      40095   .795E-03
```

```
      41095    .864E-03       42095    .190E-01       40096    .208E-01
      42096    .144E-03       42097    .195E-01       42098    .208E-01
      43099    .218E-01       44099    .792E-06       42100    .234E-01
      44100    .809E-03       44101    .196E-01       44102    .182E-01
      44103    .116E-03       45103    .145E-01       44104    .119E-01
      46104    .144E-02       46105    .799E-02       44106    .346E-02
      46106    .367E-02       46107    .415E-02       46108    .260E-02
      47109    .191E-02       46110    .764E-03       48110    .236E-03
      48111    .401E-03       48112    .215E-03       48113    .500E-05
      49113    .960E-07       48114    .245E-03       48601    .446E-07
      49115    .785E-04       50115    .394E-05       48116    .114E-03
      50116    .173E-05       50117    .102E-03       50118    .840E-04
      50119    .895E-04       50120    .878E-04       51121    .926E-04
      50122    .114E-03       52122    .179E-05       50123    .172E-05
      51123    .107E-03       52123    .713E-08       50124    .191E-03
      51124    .723E-07       52124    .145E-05       51125    .187E-03
      52125    .428E-04       50126    .418E-03       52126    .583E-05
      52601    .267E-04       53127    .970E-03       52128    .214E-02
      54128    .136E-04       52611    .289E-05       53129    .442E-02
      54129    .217E-07       52130    .898E-02       54130    .610E-04
      54131    .135E-01       54132    .241E-01       55133    .320E-01
      54134    .384E-01       55134    .980E-03       56134    .290E-03
      55135    .638E-02       56135    .199E-06       54136    .596E-01
      55136    .658E-09       56136    .177E-03       55137    .313E-01
      56137    .668E-03       56138    .326E-01       57139    .311E-01
      56140    .514E-07       57140    .778E-08       58140    .314E-01
      58141    .771E-04       59141    .287E-01       58142    .290E-01
      60142    .127E-03       59143    .101E-06       60143    .257E-01
      58144    .119E-01       60144    .174E-01       60145    .188E-01
      60146    .161E-01       60147    .305E-08       61147    .771E-02
      62147    .195E-02       60148    .926E-02       61148    .138E-07
      61601    .201E-05       62148    .112E-02       62149    .232E-03
      60150    .425E-02       62150    .686E-02       62151    .631E-03
      63151    .312E-05       62152    .377E-02       63152    .751E-06
      64152    .490E-06       63153    .200E-02       62154    .778E-03
      63154    .207E-03       64154    .133E-04       63155    .908E-04
      64155    .792E-05       63156    .125E-07       64156    .713E-03
      64157    .391E-05       64158    .274E-03       65159    .401E-04
      64160    .178E-04       65160    .135E-06       66160    .142E-05
      66161    .706E-05       66162    .449E-05       66163    .225E-05
      66164    .542E-06       67165    .542E-06       68166    .703E-07
      1    1.0     863.7     end
arbm-zirc4  6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
            40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7684    .99424      573.9    end
arbm-bormod     .7684 1 0 0 0 5000 100 3 .00054    573.9 end
arbm-spacer     .7684 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576    573.9 end
'
'
'    APSR follow rod material specification
'
arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 2.0 26304 69.5 28304 9.5
             6 1.0 640.0 end
'
'    axial power shaping rod material specification
'
```

```
arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 2.0 26304 69.5 28304 9.5
            6 1.0 640.0 end
 arbm-apsr    10.17    4   0    0    0
          47000      79.80000
          49000      15.00000
          48000       5.00000
          13027        .20000
            7 1.0  573.8673   end
'
he    5   end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=20.003 ncycles=06 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=08 mxrepeats=0 mixmod=3 facmesh=.50 end
  7  .49784   5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784   5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  7  .49784   5   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  3  .49784   3   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  3  .49784   3   .50546   6  .55880   3  .63246   2  .67310
  3  .81397 500 2.38205   3 2.40078
  3  .49784   3   .50546   3  .55880   3  .63246   2  .67310
  3  .81397 500 2.97599   3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 18
power=.64570    burn=6.340     down=.00000E+00 bfrac=1.000     end
power=.64570    burn=10.50     down=.00000E+00 bfrac=1.029     end
power=.64570    burn=54.86     down=.00000E+00 bfrac=.8150     end
power=.64570    burn=37.64     down=.00000E+00 bfrac=.5874     end
power=.64570    burn=30.66     down=.00000E+00 bfrac=.5207     end
power=.64570    burn=2.200     down=14.792     bfrac=.5189     end
'
'     end of input
'
end
```

Attachment XL (moved to reference 5.13) contains the CRAFT generated consolidated SAS2H output files for the depletion calculations documented in this analysis as identified in the attachment listing of Section 9. The consolidated output files contain the following information:

- time/date stamp for when the SAS2H depletion calculation was performed,
- echo of the SAS2H input deck generated by CRAFT,

- the output extraction of information pertinent to CRC evaluations from the final ORIGEN-S calculation of the SAS2H depletion calculation.

7.7 Isotopic Results

Isotopic results for the set of 29 principal isotopes identified in Table 7.7-1 are tabulated for each axial node of each fuel assembly at each CRC statepoint other than beginning of life (BOC of first reactor cycle of in which the assembly is inserted) statepoints. The program entitled "CRC_DATA_TABULIZER.exe" as described in Section 6.1, and Attachment V of reference 5.11, was used to create the principal isotope result tables included in this analysis. Attachments XXII through XXXIX (these attachments were moved to reference 5.12) contain the principal isotope tabulations for the assemblies documented in this analysis. The consolidated output files for the SAS2H depletion calculations contain isotopic concentrations for all isotopes included in the ORIGEN-S cross-section library. The ORIGEN-S cross-section library contains a considerably larger number of isotopes than the 29 isotopes included in the principal isotope set. Isotopic concentrations may be extracted from the consolidated SAS2H output files for subsequent evaluation and/or use in CRC reactivity analyses.

Table 7.7-1 Principal Isotopes

Mo-95	Tc-99	Ru-101	Rh-103	Ag-109
Nd-143	Nd-145	Sm-147	Sm-149	Sm-150
Sm-151	Sm-152	Eu-151	Eu-153	Gd-155
U-233	U-234	U-235	U-236	U-238
Np-237	Pu-238	Pu-239	Pu-240	Pu-241
Pu-242	Am-241	Am-242m	Am-243	—

Between CRC statepoints in the depletion sequence for a fuel assembly axial region, a new SAS2H input deck must be created using the fuel isotopic results from the previous calculation as the initial charge. Since the 44-group cross-section library utilized in the SAS2H depletion calculations of this analysis has a reduced isotopic inventory relative to the ORIGEN-S cross-section library, a number of isotopes present in the ORIGEN-S output cannot be transferred to the initial fuel charge of the subsequent SAS2H depletion calculation. The isotopic inventory in the ORIGEN-S output which cannot be propagated to the following SAS2H depletion calculation does not significantly affect integral reactivity or the energy dependent neutron spectrum as documented in Section 4.9.1 of Attachment I. The non-propagated isotopic inventory is written to a file entitled "{depletion case identifier}.notes" to allow for subsequent analysis of the impact of excluding these isotopics in the initial charge to the subsequent SAS2H depletion calculation. The "*.notes" files are contained in Attachment XLI (moved to reference 5.13) as documented in Section 9.

8. Conclusions

The SAS2H depletion calculations of the rodded fuel assemblies from batches 1, 2, 3, and 1X of the Crystal River Unit 3 PWR that are required for CRC evaluations to support development of the disposal criticality methodology are fully documented in this analysis. The isotopic compositions of depleted fuel and depleted burnable poison for the various assemblies documented in this analysis are available in the consolidated SAS2H output files of Attachment XL (moved to reference 5.13) for subsequent evaluation and/or use in CRC reactivity evaluations. The inputs for the depletion calculations are obtained from a qualified source (Ref. 5.3). The SAS2H modeling techniques employed in the depletion calculations within this analysis are dictated by the CRAFT Version 3.0 code which is fully documented in Attachment I of this analysis.

9. Attachments

The attachments referenced throughout this design analysis are listed in Table 9-1. Attachment XL (moved to reference 5.13) contains the consolidated SAS2H output files for the assembly depletion calculations documented in this analysis. Attachment XLI (moved to reference 5.13) contains the "*.notes" files which are generated during the CRAFT calculations for each assembly documented in this analysis. Attachments XL and XLI are written in an ASCII format to an attachment tape (Ref. 5.13). Detailed listings of the content of Attachments XL and XLI on the attachment tape are provided in a hard-copy format in their corresponding attachment locations of this analysis. The listing of the tape content (Ref. 5.13) for Attachments XL and XLI contain the following information for each of the files that are written to the tape:

- the directory and filename as taken from the HP workstation,
- the corresponding filename on the tape attachment,
- the number of text pages in the file on tape after the addition of page headers,
- the date that the file was created on the HP workstation,
- the size of the file on the HP workstation in bytes,
- the file type (ASCII or BINARY).

The tape (Ref. 5.13) for Attachments XL and XLI contain text files only. This tape is written using the HP Colorado Trakker Model T1000e External Parallel Port Backup System for personal computers. The following assembly identifier combinations refer to the same assembly, respectively, in the attachments: A18z=A18, A18az=A18a, A18bz=A18b, A26z=A26, and A28z=A28.

Table 9-1 Attachment Listing

Attachment #	Number of Pages	Generation Date	Description
I	84	07/31/97	CRAFT Version 3.0 User Information

Attachment #	Number of Pages	Generation Date	Description
II	82	04/03/97	CRAFT Version 3.0 Fortran Source Code Listing (This is Appendix A: CRAFT Version 3.0 Fortran Source Code Listing of the CRAFT User Information Documented in Attachment I)
III	24	04/04/97	RLAYOUT Version 1.0 Program Description
IV	14	04/03/97	CRAFT Input Deck for Fuel Assembly A1
V	8	04/03/97	CRAFT Input Deck for Fuel Assembly A4
VI	6	04/03/97	CRAFT Input Deck for Fuel Assembly A5
VII	14	04/03/97	CRAFT Input Deck for Fuel Assembly A7
VIII	19	04/03/97	CRAFT Input Deck for Fuel Assembly A14
IX	13	07/30/97	CRAFT Input Deck for Fuel Assembly A18
X	10	07/30/97	CRAFT Input Deck for Fuel Assembly A18a
XI	6	07/30/97	CRAFT Input Deck for Fuel Assembly A18b
XII	13	04/03/97	CRAFT Input Deck for Fuel Assembly A20
XIII	6	04/03/97	CRAFT Input Deck for Fuel Assembly A22
XIV	14	04/03/97	CRAFT Input Deck for Fuel Assembly A23
XV	14	04/03/97	CRAFT Input Deck for Fuel Assembly A23a
XVI	13	04/03/97	CRAFT Input Deck for Fuel Assembly A25
XVII	13	04/03/97	CRAFT Input Deck for Fuel Assembly A25a
XVIII	7	07/30/97	CRAFT Input Deck for Fuel Assembly A26
XIX	13	07/30/97	CRAFT Input Deck for Fuel Assembly A28
XX	13	04/03/97	CRAFT Input Deck for Fuel Assembly A29
XXI	6	04/03/97	CRAFT Input Deck for Fuel Assembly O1
XXII	80	04/03/97	Principal Isotope Results for Assembly A1 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.

Attachment #	Number of Pages	Generation Date	Description
XXIII	40	04/03/97	Principal Isotope Results for Assembly A4 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXIV	27	04/03/97	Principal Isotope Results for Assembly A5 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXV	80	04/03/97	Principal Isotope Results for Assembly A7 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXVI	-120	04/03/97	Principal Isotope Results for Assembly A14 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXVII	80	07/30/97	Principal Isotope Results for Assembly A18 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXVIII	53	07/30/97	Principal Isotope Results for Assembly A18a This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXIX	27	07/30/97	Principal Isotope Results for Assembly A18b This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXX	80	04/03/97	Principal Isotope Results for Assembly A20 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXI	27	04/03/97	Principal Isotope Results for Assembly A22 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.

Attachment #	Number of Pages	Generation Date	Description
XXXII	80	04/03/97	Principal Isotope Results for Assembly A23 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXIII	53	04/03/97	Principal Isotope Results for Assembly A23a This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXIV	80	04/03/97	Principal Isotope Results for Assembly A25 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXV	40	04/03/97	Principal Isotope Results for Assembly A25a This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXVI	27	07/30/97	Principal Isotope Results for Assembly A26 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXVII	80	07/30/97	Principal Isotope Results for Assembly A28 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXVIII	80	04/03/97	Principal Isotope Results for Assembly A29 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.
XXXIX	27	04/03/97	Principal Isotope Results for Assembly O1 This attachment was moved to reference 5.12 after the initial check and backcheck of this analysis was completed.

Attachment #	Number of Pages	Generation Date	Description
XL	Total Page Count for Hard-Copy Listing of Tape Content = 29	07/30/97	Tape Containing CRAFT Generated Consolidated SAS2H Output Decks for Assemblies A1, A4, A5, A7, A14, A18, A18a, A18b, A20, A22, A23, A23a, A25, A25a, A26, A28, A29, O1 and
XLI	Total Page Count for Hard-Copy Listing of Tape Content = 23	07/30/97	CRAFT Generated "*.notes" files for Assemblies A1, A4, A5, A7, A14, A18, A18a, A18b, A20, A22, A23, A23a, A25, A25a, A26, A28, A29, O1 The files listed in these two attachments are contained on magnetic media identified by reference 5.13.

Attachment I

CRAFT Version 3.0 User Information

CRAFT, Version 3.0

Commercial Reactor Assembly Follow Taskmaster

Developed by Kenneth D. Wright
Framatome Cogema Fuels
High-Level Waste Division

under contract with the

Management and Operating Contractor for the
Yucca Mountain High-Level Radioactive Waste Repository Project

Table of Contents

1. Introduction

The Commercial Reactor Assembly Follow Taskmaster (CRAFT) code directs the performance of assembly depletion and decay calculations relevant to Commercial Reactor Critical (CRC) evaluations. The CRAFT code generates input decks for the SAS2H control module of the SCALE modular code system (Ref. 1) based on user defined input which describes the fuel assembly's irradiation history. Appropriate isotopic concentrations relevant to both the CRC evaluations containing the fuel assembly and the subsequent depletion and decay calculations for the fuel assembly are extracted and stored by CRAFT as it generates and executes SAS2H cases.

2. CRAFT Applications

The CRAFT code directs the performance of depletion and decay calculations required to simulate the complete irradiation history of a fuel assembly. During the CRAFT orchestration of the fuel assembly depletion and decay calculations, fuel and burnable poison isotopic concentrations are retained at user-defined statepoints. The fuel and burnable poison isotopic concentrations may be used for input to subsequent CRC statepoint reactivity calculations or in other analyses concerning spent nuclear fuel from commercial power reactors.

The CRAFT code is developed with a high degree of flexibility that provides for the depletion and decay of fuel assemblies with widely varying features under either standard or non-standard core operating procedures. The following list describes some of the capabilities of the CRAFT code.

1) The CRAFT code generates and executes appropriate SAS2H cases required to perform a prescribed depletion and decay sequence for a fuel assembly. The depletion and decay sequence is orchestrated from the beginning of cycle (BOC) statepoint calculation of the initial prescribed insertion cycle through the final statepoint calculation of the last prescribed insertion cycle. The CRAFT code extracts and saves fuel and burnable poison isotopics at each statepoint, including BOC statepoints, during the fuel assembly's depletion and decay sequence. A certain portion of generated isotopics in the depleted fuel composition obtained from a SAS2H calculation are not used in the charge composition to the next SAS2H calculation due to a lack of cross-section data in the specified cross-section library. The CRAFT code provides a listing of the fuel isotopics from the output of a SAS2H calculation which are not used in the initial charge to the next SAS2H calculation. The isotopics left out of the initial charge are fission products whose reactivity worth is small relative to the isotopics retained in the charge composition. The listing of excluded charge isotopics allows for a determination of the impact upon the reactivity of the initial fuel composition in the subsequent calculation.

2) Any assembly design may be analyzed within the bounds of the SAS2H control module through the use of the CRAFT code. This includes both PWR and BWR fuel assemblies.

3) An axial blanket fuel modeling option is available in the CRAFT code. Any UO_2 enrichment may be specified for the axial blanket fuel. The axial blanket fuel may be defined to exist in any of the CRC axial nodes which are defined for the CRAFT calculation.

4) A spacer grid modeling technique is available with the CRAFT code. The modeling technique homogenizes the spacer grid material throughout the moderator of the fuel assembly by utilizing a user defined spacer material and spacer material volume fraction in the moderator. The available spacer grid materials include the following-- ZIRC-4, INCONEL, SS316, SS316S, SS304, SS304S. Any volume fraction of spacer material in the moderator may be specified (including zero).

5) The fuel cladding, burnable poison rod (BPR) cladding, axial power shaping rod (APSR) cladding, or control rod (CR) cladding in the CRAFT calculation may be designated as any of the following materials-- ZIRC-4, SS316, SS316S, SS304, SS304S, or INCONEL.

6) The insertion of a BPR assembly during the irradiation of the fuel assembly may be modeled in the CRAFT calculation. Up to 10 unique BPR assembly designs may be specified for use during the depletion of a fuel assembly. Any type of BPR assembly design may be specified. The default BP material for use in CRAFT calculation is Al_2O_3-B_4C. Any arbitrary BP material may be specified for use in a BPR assembly design. A maximum of 10 unique BP materials may be specified. A maximum of 20 unique elements or isotopes may be specified in any given BP material. A BPR assembly may be inserted in any reactor cycle specified in the CRAFT calculation. Only one BPR assembly design may be specified per cycle. The position of the BPR assembly in the fuel assembly is specified by identifying the top and bottom axial nodes of the BP material. The BPR assembly remains fixed during a given reactor cycle. The depletion of the BP material is tracked during the CRAFT calculation. The appropriate depleted BP material is utilized in statepoint calculations following the BOC to statepoint 1 calculation for a given reactor cycle. Depleted BP material isotopic concentrations are also retained for use in subsequent mid-cycle statepoint reactivity calculations which may be performed as part of the CRC evaluation process.

7) The insertion of a CR assembly during the irradiation of the fuel assembly may be modeled in the CRAFT calculation. Up to 10 unique CR assembly designs may be specified for use during the depletion of a fuel assembly. Any type of CR assembly design may be specified. Any arbitrary CR absorber material may be specified for use in a CR assembly design. A maximum of 10 unique CR absorber materials may be specified. A maximum of 10 unique elements or isotopes may be specified in any given CR absorber material. A CR assembly may be inserted in any reactor cycle specified in the CRAFT calculation. Multiple

CR assembly designs may be specified per cycle. The position of the CR assembly in the fuel assembly is specified by identifying number of CR absorber regions and the top and bottom axial nodes of each region. The CR assembly position may be changed between each irradiation step of a SAS2H calculation generated by CRAFT. The CR assembly design may also be changed between any two statepoint calculations in a given reactor cycle.

8) The insertion of an APSR assembly during the irradiation of the fuel assembly may be modeled in the CRAFT calculation. Up to 10 unique APSR assembly designs may be specified for use during the depletion of a fuel assembly. Any type of APSR assembly design may be specified. Any arbitrary APSR absorber material may be specified for use in an APSR assembly design. A maximum of 10 unique APSR absorber materials may be specified. A maximum of 10 unique elements or isotopes may be specified in any given APSR absorber material. An APSR assembly may be inserted in any reactor cycle specified in the CRAFT calculation. Multiple APSR assembly designs may be specified per cycle. The position of the APSR assembly in the fuel assembly is specified by identifying the top and bottom axial nodes of the APSR absorber material. The APSR assembly position may be changed between each irradiation step of a SAS2H calculation generated by CRAFT. The APSR assembly design may also be changed between any statepoint calculations in a given reactor cycle. For any APSRA modeled, the APSR follow rods are modeled in the axial region above the poison region of the APSR's. The APSR follow rod material may be specified as a cladding material as previously described in item number five of this listing.

9) A fuel assembly may be inserted in a maximum of 10 reactor cycles during a CRAFT calculation.

10) A maximum of 20 statepoints (BOC is always considered a statepoint) may be specified in any given reactor cycle in a CRAFT calculation.

11) A maximum of 23 irradiation steps of variable duration may be specified in any given SAS2H statepoint calculation to be generated during a CRAFT calculation.

12) A maximum of 50 axial nodes may be specified in the CRC nodal format for use in a CRAFT calculation. Each axial node may have a unique height.

13) The CRAFT code utilizes a user-defined input format for fuel temperature, moderator specific volume, and burnup data. The input data must be specified for each axial node in a user-defined nodal format of up to 50 nodes of arbitrary height. The total assembly active fuel height for the input data descriptions may be different than that specified in the CRC nodal format. Depending on the users needs, the fuel temperature, moderator specific volume, and burnup input data may be specified in a different nodal format each time an assembly set of this input data is provided. Nominal full-power operation nodal average fuel

temperature input data must be provided in units of degrees Fahrenheit for each node in each statepoint calculation to be generated by the CRAFT calculation. Nominal full-power operation nodal average specific moderator input data must be provided in units of cubic feet per pound for each node in each statepoint calculation to be generated by the CRAFT calculation. The nodal average burnup input data must be provided in units of gigawatt-days per metric ton of uranium (GWd/MTU) for each node at each statepoint including the BOC statepoint. All burnup input data that is specified must be cumulative from the initial insertion of the fuel assembly in the reactor.

14) Up to 50 axial nodes of arbitrary height may be specified in a CRC nodal format.

15) A continuation CRAFT calculation for an assembly may be initiated from any statepoint in any reactor cycle if all of the nodal consolidated output files ("*.cut" files, see Section 8) from the statepoint calculation immediately preceding the continuation calculation exist in the CRAFT execution directory.

3. CRAFT Methodology

The objective of the CRAFT methodology was to develop a mechanism by which fuel assembly depletion and decay calculations required to support CRC evaluations could be performed most efficiently with minimal required user interface. The result was the CRAFT code which automates the process of performing numerous complex SAS2H depletion and decay calculations while extracting and archiving results pertinent to CRC analyses. The information provided in this section describes the general flow of a CRAFT calculation. Figure 3-1, presents a general calculational flow diagram for the CRAFT code. The identifiers for the CRAFT subroutines where the various processes and calculations take place are identified in this section. Detailed information on the calculations performed by the craft code may be found in Section 4, "CRAFT Subroutine Descriptions".

The CRAFT calculation begins by reading a well-defined yet flexible user input which describes the fuel assembly depletion and decay calculation to be performed. The input contains all data necessary to describe the fuel assembly and any insertion assemblies such as burnable poison rod assemblies (BPRA's), axial power shaping rod assemblies (APSRA's), or control rod assemblies (CRA's). Fuel temperature and moderator specific volume data (which may be obtained from reactor design core-follow codes) is also utilized to provide input to the depletion calculations which are to be generated by the CRAFT code. The use of nominal full-power fuel temperatures and moderator specific volumes from core-follow codes provide an additional level of detail in the calculation due to the fact that feedback and flux redistribution effects are incorporated into the development of this input parameter data. The "DATA_AQUISITION" subroutine performs the input data acquisition functions in the CRAFT code. A detailed description of the CRAFT input deck format is provided in the CRAFT input description in Sections 5 and 7.

After data acquisition, the next procedure is to standardize all fuel assembly heights corresponding to the input data specification to a prescribed CRC fuel assembly height. The fuel assembly depletion and decay calculations must be performed on an assembly which has the same total active fuel height as that prescribed for the CRC calculation. The fuel assembly nodal formats used for providing various input to the CRAFT code are allowed to have an arbitrary active fuel height which may differ from that required for the CRC calculation. The assembly height standardization procedure performed by the "STD_HEIGHT" subroutine puts all of the input data specification active fuel heights on a common basis with the CRC active fuel height.

After active fuel height standardization, the next procedure is to convert all of the axial node formats for the fuel temperature, moderator specific volume, and burnup input data to the prescribed CRC axial node format. There must be a one-to-one correspondence between the various axial node input data and the CRC axial nodes. The input data nodal format conversions are performed by the "FUELTEMP_FORMAT", "MODSPECVOL_FORMAT", and "BURNUP_FORMAT" subroutines for the fuel temperature data, moderator specific volume data, and burnup data, respectively.

After the input data nodal formats are converted, the next procedure is to calculate the power to be specified in each SAS2H statepoint calculation that will be generated by the CRAFT code. The power is calculated in units of megawatts for each axial node of the fuel assembly based upon the nodal burnup during the statepoint calculation, the initial mass of uranium in the node (fresh fuel), and the duration of the statepoint calculation irradiation period in days. The nodal power calculations are performed by the "POWER_CALCS" subroutine.

After the nodal powers are calculated, the next procedure is to convert units and calculate moderator densities and temperatures. At this point in the CRAFT calculation, there is a nominal full-power fuel temperature and moderator specific volume value for each axial node of the assembly in each statepoint calculation. The fuel temperatures, initially input in units of degrees Fahrenheit, are converted to units of degrees Kelvin. The moderator specific volume, initially input in units of cubic feet per pound, are converted to densities in units of grams per cubic centimeter. The system pressure and moderator density are used to determine the moderator temperature in units of degrees Kelvin. The units conversions and moderator density and temperature calculations are performed by the "UNITS_CONVERSION" subroutine.

After the "UNITS_CONVERSION" subroutine is finished, the next procedure is to initiate the "EXECUTION_CONTROL" subroutine. The "EXECUTION_CONTROL" subroutine directs the development and execution of SAS2H cases required to appropriately deplete and decay the fuel assembly. The subroutine also directs the extraction of results pertinent to CRC evaluations. The development of a unique SAS2H case is required for each CRC axial node in each statepoint calculation. The CRAFT code directs the development and execution of SAS2H cases beginning with the top assembly node (always identified as node number one) working sequentially through the assembly to the bottom node. The complete irradiation history of the assembly as defined in the CRAFT input deck is performed for each axial node before initiating the development and execution of SAS2H cases for the next axial node. Three subroutines are called by the "EXECUTION_CONTROL" subroutine--

1) the "STANDARD_WRITER" subroutine

2) the "CONTINUATION_WRITER" subroutine
3) the "CUTTER" subroutine.

Two of these called subroutines create SAS2H input decks, and one extracts isotopic results for use in subsequent CRC analyses. The "EXECUTION_CONTROL" subroutine then calls either "STANDARD_WRITER" or "CONTINUATION_WRITER" to create the next SAS2H input deck. "EXECUTION_CONTROL" then executes the generated SAS2H calculation. Upon completion of the SAS2H calculation, "EXECUTION_CONTROL" calls the "CUTTER" subroutine to extract and archive the fuel and burnable poison isotopic compositions calculated by SAS2H. The next SAS2H input deck is then generated as appropriate. This cycle continues until the prescribed fuel assembly depletion and decay history is completed.

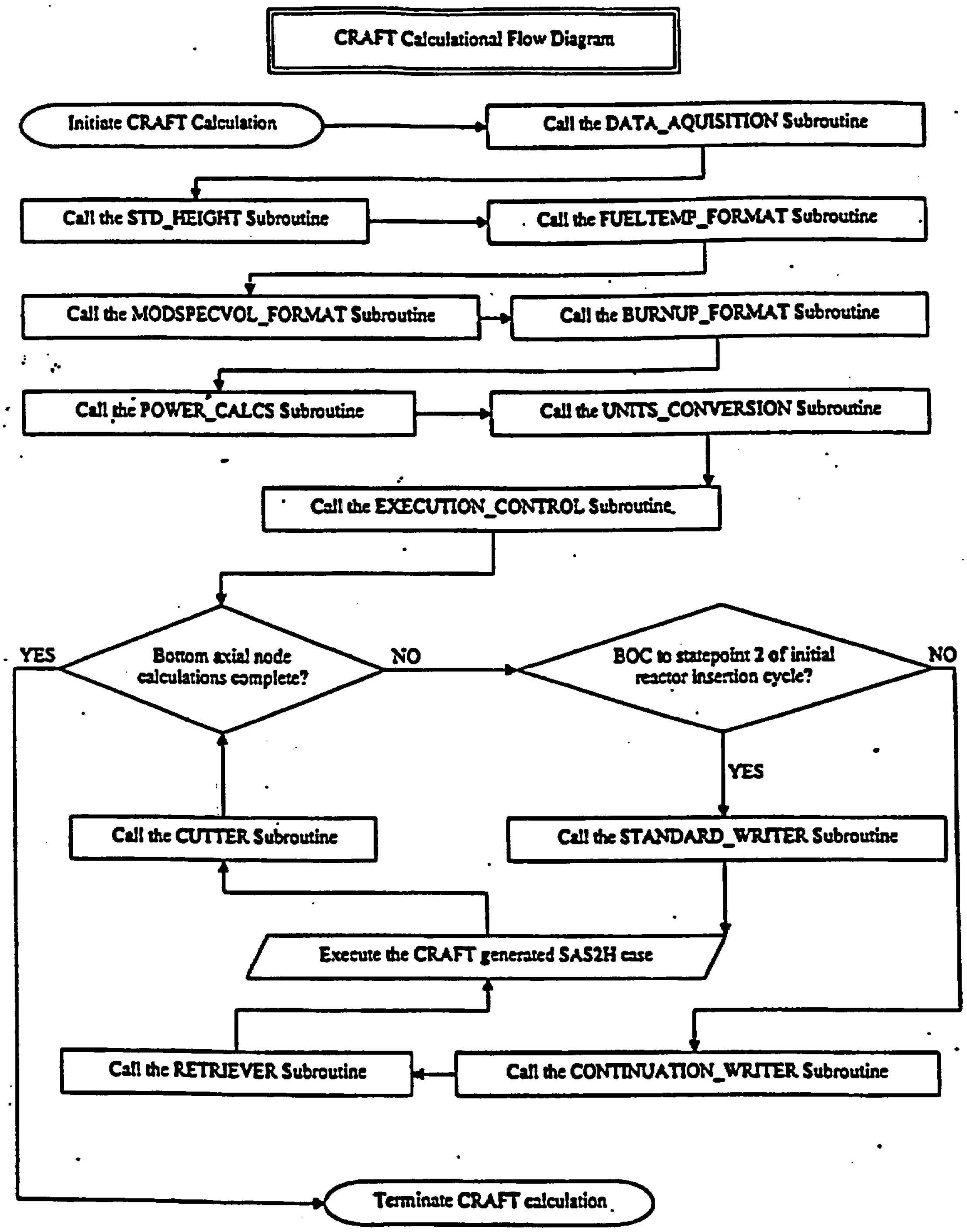
The subroutine called "STANDARD_WRITER", as previously mentioned in relation to the "EXECUTION_CONTROL" subroutine, creates an appropriate SAS2H input deck for the initial statepoint calculation in the initial insertion reactor cycle for a fuel assembly axial node. The fuel and burnable poison compositions in the SAS2H cases generated by the "STANDARD_WRITER" subroutine are always fresh. The sole source of input data for the SAS2H cases generated by the "STANDARD_WRITER" subroutine is the CRAFT input deck.

The subroutine called "CONTINUATION_WRITER", as previously mentioned in relation to the "EXECUTION_CONTROL" subroutine, writes SAS2H input decks for all statepoint calculations other than the initial statepoint calculation in the initial insertion reactor cycle. The "CONTINUATION_WRITER" subroutine calls a subroutine "RETRIEVER" to access and retrieve the fuel and burnable poison, if applicable, initial charge compositions for the statepoint calculation. The "CONTINUATION_WRITER" subroutine generates SAS2H input decks utilizing the appropriate depleted compositions such that the fuel assembly depletion and decay history continues uninterrupted.

The subroutine "CUTTER", as previously mentioned in relation to the "EXECUTION_CONTROL" subroutine, creates a CRC depletion output file for each statepoint. The file created by "CUTTER" contains the time/date stamp printed in the SAS2H output, the echoed SAS2H input deck for the statepoint calculation printed in the SAS2H output, and the pertinent section of the final ORIGEN output from the SAS2H output containing the desired depleted and decayed fuel and burnable poison isotopic concentrations. The CRC depletion output files created by "CUTTER" are identified by the same base filename identifier as the SAS2H statepoint calculation to which they apply followed by a ".cut" suffix. The CRAFT generated filenames are described in detail in Section 8.

The subroutine "RETRIEVER" reads through the appropriate "*.cut" file to obtain the fuel and burnable poison initial charge compositions for the next SAS2H calculation as previously mentioned in relation to the "CONTINUATION_WRITER" subroutine. Additionally, the "RETRIEVER" subroutine writes a file which contains a listing of all isotopes and their concentrations which were present in the ORIGEN output of the SAS2H calculation, but not utilized in the initial charge composition of the next SAS2H calculation. This file is identified by the base filename identifier corresponding to the SAS2H case which is being generated followed by a "*.notes" suffix. The CRAFT generated filenames are described in detail in Section 8.

Figure 3-1



4. CRAFT Subroutine Descriptions

The CRAFT code is organized into 14 subroutines. Each of the subroutines has a specific responsibility in performing a CRAFT calculation. The following sections provide descriptions of the structure and task of each subroutine. The subroutines comprising the CRAFT code include the following:

1) Main program block--
"PROGRAM CRAFT"
2) Reactor and problem data acquisition subroutine--
"DATA_AQUISITION"
3) Assembly height standardization subroutine--
"STD_HEIGHT"
4) Fuel temperature input nodal format conversion subroutine--
"FUELTEMP_FORMAT"
5) Moderator specific volume input nodal format conversion subroutine--
"MODSPECVOL_FORMAT"
6) Burnup input nodal format conversion subroutine--
"BURNUP_FORMAT"
7) Nodal power calculation subroutine--
"POWER_CALCS"
8) Units conversion subroutine--
"UNITS_CONVERSION"
9) SAS2H input deck creation and execution control subroutine--
"EXECUTION_CONTROL"
10) Standard beginning of assembly life SAS2H input deck writing subroutine--
"STANDARD_WRITER"
11) Continuation SAS2H input deck writing subroutine--
"CONTINUATION_WRITER"
12) CRC statepoint depletion/decay output file generator subroutine--
"CUTTER"
13) Fuel and burnable poison composition retrieval subroutine--
"RETRIEVER"
14) Two digit integer conversion utility subroutine.--
"ZEROS"

4.1 Program CRAFT

The main program block is the orchestrator of the CRAFT calculation. The purpose of the main program block is to define fixed data sets and initiate the sequential execution of appropriate subroutines to perform the CRAFT calculation. The subroutines initiated by the main program block of the CRAFT code include the following, in order of initiation-- DATA_AQUISITION, STD_HEIGHT, FUELTEMP_FORMAT, MODSPECVOL_FORMAT, BURNUP_FORMAT, POWER_CALCS, UNITS_CONVERSION, and EXECUTION_CONTROL.

4.2 DATA_AQUISITION Subroutine

A sufficient description of the DATA_AQUISITION subroutine is provided in Section 3. A detailed description of the CRAFT input deck format is provided in Sections 5 and 7.

4.3 STD_HEIGHT Subroutine

This subroutine standardizes all assembly total active fuel heights as specified in the user-defined input to the standard assembly active fuel height being utilized in the CRC evaluation. The active fuel height standardization calculation performed on the various input data requires the adjustment of input data nodal heights. The input data nodal height adjustment is performed by multiplying each input data node height by a factor equal to the ratio of the CRC assembly total active fuel height to the input data assembly total active fuel height. This calculation is summarized in the following equation--

$$\text{Standardized Input Node Height} = \left(\frac{\text{Original Input Node Height} * \text{CRC Assembly Total Active Fuel Height}}{\text{Input Data Assembly Total Active Fuel Height}} \right)$$

All nodal input data which is a constituent of a complete set of assembly input data is adjusted using the equation above such that all sets of assembly input data have the same total active fuel height corresponding to the prescribed CRC total active fuel height.

4.4 FUELTEMP_FORMAT, MODSPECVOL_FORMAT, and BURNUP_FORMAT Subroutines

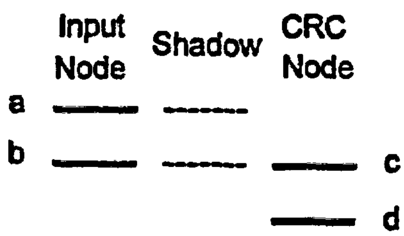
This subroutine standardizes all nodal input data such that there exists a one-to-one correspondence between input data values and CRC axial nodes. This basically means that the assembly axial node formats in which the input data is provided are adjusted such that they identically match the prescribed CRC axial node format. Appropriate averaging of the nodal input data values must be performed to adjust the input parameter nodal formats to the CRC nodal format. A nodal shadowing technique is used to calculate appropriate nodal average input values corresponding to the specified CRC nodal format using the data as provided in the arbitrary input nodal formats. The shadowing technique consists of determining which input data axial nodes shadow a particular CRC axial node. The relative shadowing contributions from the input data nodes upon the CRC axial node are used to determine the appropriate average input value for the CRC axial node. Average input data values for fuel temperature, moderator specific volume, and burnup are determined for each CRC axial node using each set of assembly input data provided in the CRAFT input deck.

The method for implementing the nodal shadowing technique consists of determining all of the possible combinations of input axial node to CRC axial node shadows that may exists. Three classes of input axial node to CRC axial node shadows are defined:

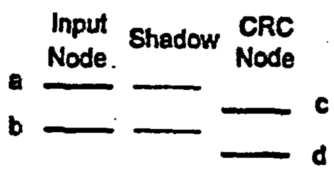
1) shadows created by input axial nodes which are the same height as the CRC axial nodes;
2) shadows created by input axial nodes which are smaller than the CRC axial nodes;
3) shadows created by input axial nodes which are larger than the CRC axial nodes.

Determining the average input parameter for a given CRC axial node requires that the input data values in the nodes which contribute to the average input data value for the CRC axial node be averaged appropriately. This averaging requires the determination of the relative weight which should be attributed to each of the contributing input data values. The shadowing technique determines the relative contribution of each input data axial node to the average input data value for the CRC axial node by weighting the input data values by their relative shadow contributions. The nodal shadowing descriptions below demonstrate how the contribution from each input data node to a CRC axial node is calculated. The CRAFT code calculates an average input data value for each CRC axial node by summing the contributions from all input data nodes which shadow the CRC axial node. This averaging process is performed for all fuel temperature input data, moderator specific volume input data, and burnup input data.

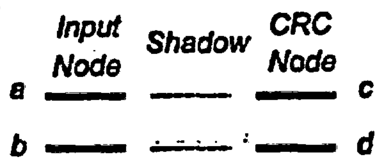
Shadows created by input axial nodes which are the same height as the CRC axial nodes--



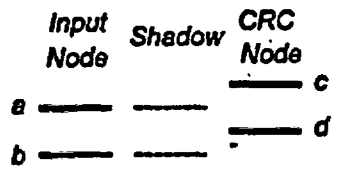
No Contribution from the Input Node to the CRC Node



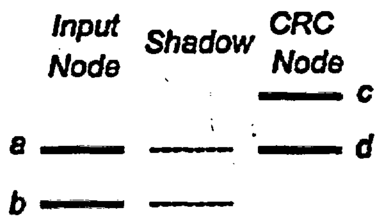
Input Node Contribution to CRC Node $= \left(\frac{b-c}{d-c}\right) * (\textit{Input Data Value})$



Input Node Contribution to CRC Node = Input Data Value

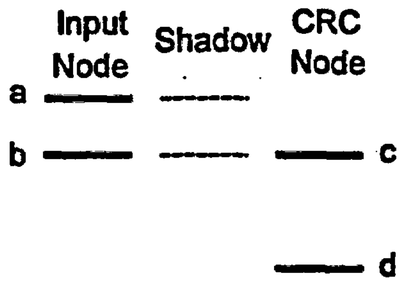


Input Node Contribution to CRC Node $= \left(\frac{d-a}{d-c}\right) *$ *(Input Data Value)*

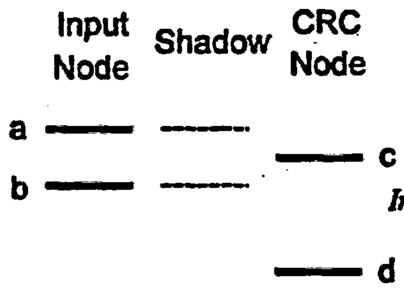


No Contribution from the Input Node to the CRC Node

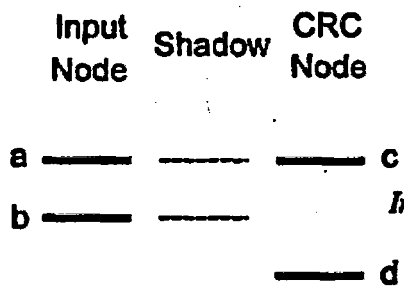
Shadows created by input axial nodes which are smaller than the CRC axial nodes--



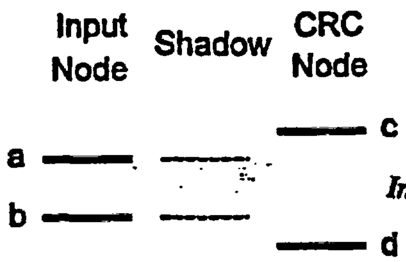
No Contribution from the Input Node to the CRC Node



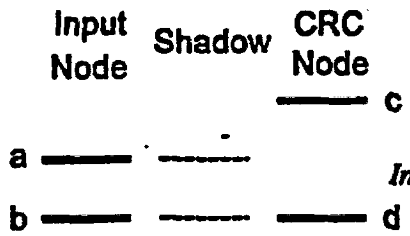
Input Node Contribution to CRC Node $= (\frac{b-c}{d-c}) * (\textit{Input Data Value})$



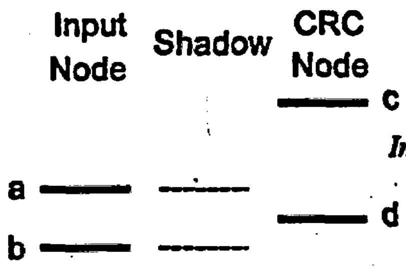
Input Node Contribution to CRC Node $= (\frac{b-a}{d-c}) * (\textit{Input Data Value})$



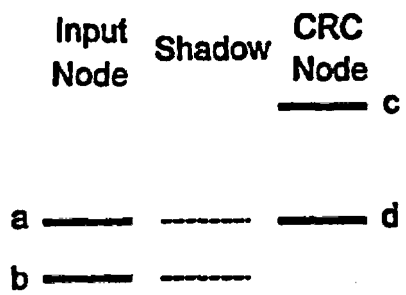
Input Node Contribution to CRC Node $= (\frac{b-a}{d-c}) * (\text{Input Data Value})$



Input Node Contribution to CRC Node $= (\frac{b-a}{d-c}) * (\text{Input Data Value})$

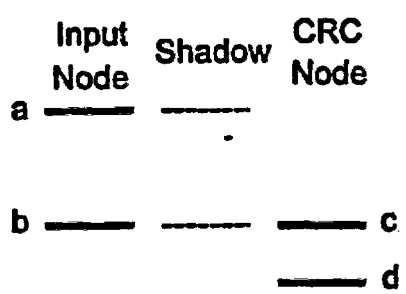


Input Node Contribution to CRC Node $= (\frac{d-a}{d-c}) * (\text{Input Data Value})$

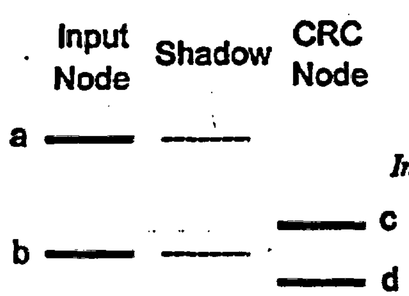


No Contribution from the Input Node to the CRC Node

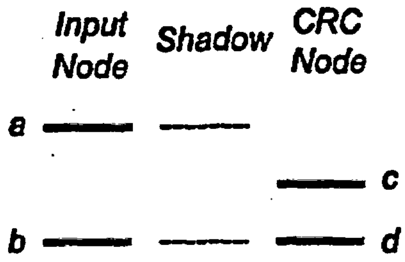
Shadows created by input axial nodes which are larger than the CRC axial nodes--



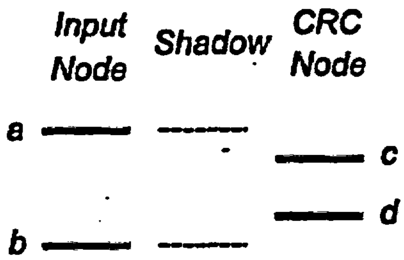
No Contribution from the Input Node to the CRC Node



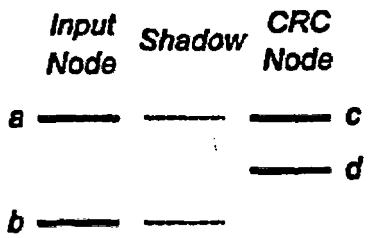
Input Node Contribution to CRC Node $= \left(\frac{b-c}{d-c}\right) * (\textit{Input Data Value})$



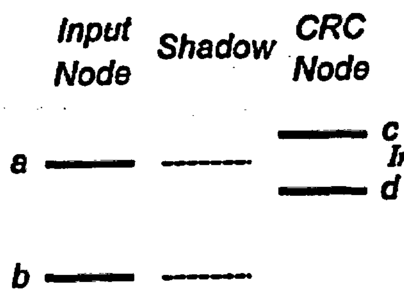
Input Node Contribution to CRC Node = Input Data Value



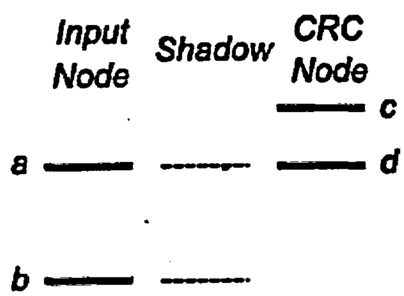
Input Node Contribution to CRC Node = Input Data Value



Input Node Contribution to CRC Node = Input Data Value



Input Node Contribution to CRC Node $= \left(\frac{d-a}{d-c}\right) *$ *(Input Data Value)*



No Contribution from the Input Node to the CRC Node

4.5 POWER_CALCS Subroutine

This subroutine calculates the average nodal power to be applied to each CRC axial node in the CRAFT generated statepoint calculations. The average nodal powers are calculated in megawatts using the average nodal burnup during the entire statepoint calculation, the initial uranium mass in the node, and the duration which the statepoint calculation covers in EFPD. The following equation shows how an average nodal power is calculated for a given statepoint calculation.

$$\textit{Average Nodal Power (MW)} = \text{(Average Nodal Burnup During Statepoint Calculation in GWd/MTU)} * \text{(Initial Uranium Mass in Node in Grams)} * \left(\frac{1}{\text{Duration of Calculation in EFPD}}\right) * \left(\frac{1}{1000}\right)$$

where,

$$\text{Initial Uranium Mass in Node} = (\text{Initial Uranium Mass in Assembly}) * \left(\frac{\text{CRC Node Height}}{\text{CRC Total Active Fuel Height}}\right)$$

An average nodal power in units of megawatts is calculated for each node of the assembly for each statepoint calculation. The average nodal power is constant for a given node during a given statepoint calculation. The average nodal powers are not adjusted between the irradiation steps of a given SAS2H calculation. The use of the average nodal burnup in the determination of the average nodal power results in a final total burnup for the node which is equivalent to the node's total average burnup.

4.6 UNITS_CONVERSION Subroutine

This subroutine converts all of the CRC formatted fuel temperature input data from units of degrees Fahrenheit to units of degrees Kelvin. The following equation is used to make this units conversion.

$$\text{Temperature } (K) = [(\text{Temperature } (F) - 32.0) * (\frac{5}{9})] + 273.15$$

This subroutine also converts the CRC formatted moderator specific volume input data from units of cubic feet per pound to density input data in units of grams per cubic centimeter. The following equation is used to make this conversion. The (1/62.42691) conversion factor appearing in the following equation is obtained from conversion data in reference 3.

$$\text{Density } (g/cm^3) = \frac{1}{(\text{Specific Volume } (ft^3/lb)) * (62.42691)}$$

This subroutine also calculates the CRC formatted moderator temperature input data in units of degrees Fahrenheit using linear interpolation in the following density versus temperature versus pressure table for subcooled water shown in Table 4.6-1. Table 4.6-1 is obtained from the SCALE-4.3 user documentation (Ref. 1, p. S2.5.12).

Table 4.6-1
Density (g/cm³) of Subcooled Water at Various Temperatures and Pressures

	Pressure, psia								
Temp. (°F)	3000	2500	2000	1500	1000	800	600	400	200
50	1.0084	1.0069	1.0055	1.0040	1.0025	1.0019	1.0013	1.0007	1.0000
100	1.0018	1.0004	0.9989	0.9975	0.9960	0.9954	0.9948	0.9942	0.9936
150	0.9893	0.9878	0.9864	0.9849	0.9834	0.9828	0.9822	0.9815	0.9809
200	0.9725	0.9709	0.9694	0.9679	0.9663	0.9656	0.9650	0.9644	0.9637
250	0.9522	0.9505	0.9489	0.9472	0.9455	0.9449	0.9442	0.9435	0.9428
300	0.9289	0.9271	0.9252	0.9234	0.9215	0.9208	0.9200	0.9192	0.9185
350	0.9026	0.9006	0.8985	0.8964	0.8943	0.8934	0.8925	0.8916	
400	0.8733	0.8709	0.8685	0.8660	0.8634	0.8624	0.8613	0.8603	
450	0.8405	0.8375	0.8345	0.8314	0.8281	0.8268	0.8255		
500	0.8029	0.7992	0.7952	0.7911	0.7869	0.7851			
510	0.7947	0.7907	0.7866	0.7822	0.7776				
520	0.7862	0.7820	0.7776	0.7729	0.7680				
530	0.7775	0.7729	0.7682	0.7632	0.7579				
540	0.7683	0.7635	0.7584	0.7530	0.7472				
550	0.7589	0.7537	0.7482	0.7423					
560	0.7490	0.7434	0.7374	0.7310					
570	0.7386	0.7326	0.7261	0.7190					
580	0.7278	0.7212	0.7141	0.7062					
590	0.7164	0.7092	0.7012	0.6923					
600	0.7043	0.6963	0.6874						
610	0.6915	0.6825	0.6724						
620	0.6777	0.6676	0.6558						
630	0.6629	0.6512	0.6370						
640	0.6467	0.6329							

	Pressure, psia								
Temp. (°F)	3000	2500	2000	1500	1000	800	600	400	200
650	0.6288	0.6119							
660	0.6086	0.5866							
670	0.5850								
680	0.5559								

Once the moderator temperature is determined in degrees Fahrenheit, the same units conversion equation previously described for use with the fuel temperature data is used to convert the moderator temperature to degrees Kelvin.

The CRAFT code utilizes a standard linear interpolation scheme to determine the moderator temperature values once the pressure and density are known. Linear interpolation is performed using the following equation:

$$\frac{\text{Target Value} - x_1}{\text{Reference Value} - y_1} = \frac{x_2 - x_1}{y_2 - y_1}$$

where,

Target Value = the value for which the interpolation is being performed to obtain;
Reference Value = the known value which has a one-to-one correspondence to the Target Value;
x_1 = *the target parameter value displayed in the table which corresponds to* y_1;
x_2 = *the target parameter value displayed in the table which corresponds to* y_2;
y_1 = *the reference parameter value displayed in the table which is the largest value less than the Reference Value;*
y_2 = *the reference parameter value displayed in the table which is the smallest value greater than the Reference Value.*

The UNITS_CONVERSION subroutine utilizes the following procedure to perform the linear interpolation.

1) Determine which two adjacent columns of densities in the table correspond to pressures which bound the user-defined system pressure.
2) Linear interpolate between each of the columns defined in step 1 for each row of the table to create a new density column which corresponds to the system pressure.
3) Determine which two adjacent rows in the new density column created in step 2

correspond to densities which bound the calculated moderator density.

4) Linear interpolate between the two bounding density rows to determine the moderator temperature which corresponds to the system pressure and moderator density.

Once the moderator temperatures are calculated in degrees Kelvin for each of the CRC nodes in each statepoint calculation, the UNITS_CONVERSION subroutine's duties are complete.

4.7 EXECUTION_CONTROL Subroutine

A description of the EXECUTION_CONTROL subroutine is provided in Section 3.

4.8 STANDARD_WRITER Subroutine

This subroutine generates all SAS2H input decks which correspond to BOC to statepoint 2 depletion cases for the initial insertion cycle of the fuel assembly in the reactor. The SAS2H input decks created by the STANDARD_WRITER subroutine contain all fresh fuel. A detailed explanation of how to develop a SAS2H input deck to perform a fuel assembly depletion and decay calculation is provided in reference 1. The purpose of this discussion is not to explain how to develop a SAS2H input deck, but to explain the general format of the CRAFT generated SAS2H input decks.

The SAS2H input decks generated by the CRAFT code incorporate a general format consisting of the following five sections:

1) Identification and Global Comment Section;
2) Material Specification Section;
3) Base Fuel Assembly Lattice Specification Section;
4) SAS2H Control Specifications and Unit Cell Models Section;
5) Irradiation History Specification Section.

4.8.1 Identification and Global Comment Section

The first line of every SAS2H input deck relevant to CRC evaluations contains the SAS2H control module identifier and the "skipshipdata" parameter which tells the SAS2H control module not to perform an optional shielding analysis for a shipping container. The second line of every SAS2H input deck relevant to CRC evaluations is a case identification card. This card identifies the reactor in which the assembly is inserted, the relative one-eighth core symmetry assembly number, the CRC axial node to which the case pertains, the reactor cycle and statepoint at which the case begins, and the reactor cycle and statepoint at which the case ends. The third line identifies the cross-section library which is utilized in the SAS2H calculation. The ENDF/B-V based 44-group cross-section library is currently the suggested library for use in all CRAFT calculations relevant to CRC analyses. The remainder of the Identification and Global Comment Section contains general comments related to the SAS2H calculation.

4.8.2 Material Specification Section

The material specification section defines the fuel composition, the burnable poison composition, the control rod absorber material composition, the axial power shaping rod absorber material composition, the moderator composition, the fill gas composition, the fuel cladding composition, and other cladding compositions for use in either BPRA's, CRA's, or APSRA's. Only the material compositions necessary for use in a given CRAFT generated SAS2H calculation are specified in the SAS2H input deck. Each material composition specification has a unique material mixture identifier. The fuel composition's material mixture number is always 1. The fuel cladding's material mixture number is always 2. The moderator's material mixture is always 3. The Al_2O_3-B_4C burnable poison's material mixture number is always 4. The helium fill gas' material mixture number is always 5. Other compositions such as control rod or axial power shaping rod absorber materials, cladding materials other than the fuel cladding material, or burnable absorber materials other than Al_2O_3-B_4C must be given unique material mixture identifier numbers greater than 5. These additional material mixture number specifications are provided by the user in the CRAFT input deck.

The material specification section defines the UO_2 fresh fuel composition for the axial node to which the CRAFT generated SAS2H calculation pertains. The UO_2 fresh fuel composition is characterized by the fuel density, fuel temperature, and weight percentages of U-234, U-235, U-236, and U-238. For fresh fuel SAS2H cases, a number of additional isotopes are specified in trace amounts in the fuel composition to assure that their buildup and decay is tracked during the depletion calculation. Table 4.8.2-1 contains a listing of the trace isotopes which are always specified as each having a concentration of 1E-21 atoms/b-cm in the fresh fuel composition.

Table 4.8.2-1
Trace Isotopes Specified in Fresh Fuel Compositions

kr-83	kr-85	sr-90	y-89	mo-95	zr-93	zr-94
zr-95	nb-94	tc-99	rh-103	rh-105	ru-101	ru-106
pd-105	pd-108	ag-109	sb-124	xe-131	xe-132	xe-135
xe-136	cs-134	cs-135	cs-137	ba-136	la-139	ce-144
nd-143	nd-145	pm-147	pm-148	nd-147	sm-147	sm-149
sm-150	sm-151	sm-152	gd-155	eu-153	eu-154	eu-155

Several of the additional material composition specifications that must be provided in the SAS2H input decks include cladding materials for either fuel rods, control rod assemblies, axial power shaping rod assemblies, or burnable poison rod assemblies. The cladding materials available for specification include ZIRC-4, INCONEL, SS316, SS316S, SS304, and SS304S. The SS316/SS316S and SS304/SS304S materials are delineated by the use of two special weighting functions. The special weighting functions affect the generation of multigroup cross-sections for iron, nickel, and chromium. One of the special weighting functions corresponds to $1/E\ \sigma_t(E)$, where $\sigma_t(E)$ is the total cross-section of the stainless steel material. In the other special weighting function, $\sigma_t(E)$ is the total cross-section for the referenced nuclide. The stainless steel material identifiers ending in "S" use the weighting function where $\sigma_t(E)$ is the total cross-section for the referenced nuclide. The compositions and SCALE nuclide identifiers for the various cladding material compositions are shown in Table 4.8.2-2.

Table 4.8.2-2
Cladding Material Compositions Available in the CRAFT Code

Element/ Isotope	SCALE Identifier	Constituent wt% in Each Cladding Material Composition					
		ZIRC-4	INCONEL	SS316	SS316S	SS304	SS304S
C	6012	—	—	0.08	0.08	—	—
O	8016	0.12	—	—	—	—	—
Si	14000	—	2.5	1.0	1.0	—	—
Ti	22000	—	2.5	—	—	—	—
Cr	24000	0.10	—	—	17.0	—	19.0
Cr*	24304	—	—	17.0	—	19.0	—
Cr*	24404	—	15.0	—	—	—	—
Mn	25055	—	—	2.0	2.0	2.0	2.0
Fe	26000	0.20	—	—	65.42	—	69.5
Fe*	26304	—	—	65.42	—	69.5	—
Fe*	26404	—	7.0	—	—	—	—
Ni	28000	—	—	—	12.0	—	9.5
Ni*	28304	—	—	12.0	—	9.5	—
Ni*	28404	—	73.0	—	—	—	—
Zr	40000	98.18	—	—	—	—	—
Mo	42000	—	—	2.5	2.5	—	—
Sn	50000	1.40	—	—	—	—	—

* These SCALE nuclide identifiers refer to the special 1/E $\sigma_t(E)$ weighted multigroup cross-sections.

Once the fuel material specification is complete, the fuel cladding material specification is defined. The fuel cladding material may be either ZIRC-4, INCONEL, SS316, SS316S, SS304, or SS404S. The compositions of these materials are hard-wired in the CRAFT code. The user is required to define an average fuel cladding temperature that will be applied to all fuel cladding material specifications.

The moderator material specification may contain homogenized spacer grid materials and/or soluble boron. The appropriate CRAFT calculated moderator density and temperature values are utilized in the moderator material composition description. The soluble boron concentration corresponding to the first irradiation step of the SAS2H case is used to define the base soluble boron content in the moderator composition. The soluble boron concentrations in each of the irradiation steps of the SAS2H calculation are defined by specifying a fraction of the initial boron concentration specified in the base moderator material composition description. The material and volume fraction of spacer grids displacing moderator in the fuel assembly are specified by the user in the CRAFT input deck. The spacer grid materials available for specification include ZIRC-4, INCONEL, SS316, SS316S, SS404, and SS404S. The spacer grids are homogenized in the moderator composition based on the volume fraction of spacer grids in the moderator that is specified in the CRAFT input deck. The sum of the volume fractions of spacer grid material and moderator material (light-water) should equal unity.

If the fuel assembly contains a BPRA during the CRAFT generated SAS2H calculation, the material specifications for the BPR cladding and burnable poison material are specified. The BPR cladding may be designated as either ZIRC-4, INCONEL, SS316, SS316S, SS304, and SS304S. The default burnable poison material is Al_2O_3-B_4C, but any arbitrary burnable poison material may be specified. The BPR cladding and burnable poison material compositions are given the same temperature as the moderator.

If the fuel assembly contains a CRA or APSRA during the CRAFT generated SAS2H calculation, the material specifications for the CR or APSR cladding and absorber material are specified. The CR or APSR cladding may be designated as either ZIRC-4, INCONEL, SS316, SS316S, SS304, and SS304S. The CR or APSR cladding and absorber material compositions are given the same temperature as the moderator.

The fuel rod fill gas material is always specified as helium. The helium material temperature is allowed to default to 293 degrees Kelvin.

4.8.3 Base Fuel Assembly Lattice Specification Section

The base fuel assembly lattice specification section describes the fuel assembly configuration and specifies special control parameters that are to be utilized in performing the XSDRNPM calculations associated with the CRAFT generated SAS2H calculation. The fuel assembly lattice specification includes a "squarepitch" designator which tells SAS2H that the fuel assembly is a square array of unit cells with a constant pitch. The fuel rod pitch, fuel pellet outer diameter, fuel rod cladding inner diameter, and fuel rod cladding outer diameter are specified. The number of fuel rods per fuel assembly and active fuel length are also specified. The active fuel length represents the fuel stack height for the CRC node that the CRAFT generated SAS2H calculation represents. The special parameters that allow more control over the XSDRNPM calculation are described in Section 7. One special control parameter is always specified in the CRAFT generated SAS2H calculations. This parameter is designated "szf", and represents the spatial mesh factor for use in defining the XSDRNPM one-dimensional transport calculations.

4.8.4 SAS2H Control Specifications and Unit Cell Models Section

The SAS2H control specifications and unit cell models are provided in this section of the SAS2H input deck. The control specifications for SAS2H include the number of irradiation steps in the calculation, the number of cross-section libraries to be specified per irradiation step, and the SAS2H output print level. The unit cell model specification includes the following:

1) the unit cell model input level;
2) the number of radial zones to be specified in all unit cells of the SAS2H calculation;
3) the moderator material mixture number in the unit cell models;
4) the XSDRNPM spatial mesh factor;
5) the signal to specify if a single unit cell model description will be provided for all irradiation steps or if multiple unit cell model descriptions will be provided to accommodate each irradiation step.

4.8.5 Irradiation History Specification Section

The irradiation history specification section includes the following data for each irradiation step:

1) the assembly (node) power in megawatts;
2) the irradiation step burn duration in calendar days;
3) the down time following the irradiation step in calendar days;
4) the fraction of the soluble boron concentration specified in the base moderator material composition that corresponds to the average soluble boron concentration in the moderator over the duration of the irradiation step.

The irradiation history specification section is always the final section in CRAFT generated SAS2H input decks.

4.8.6 Calculations Performed within the STANDARD_WRITER Subroutine

- The density of UO_2 in the fresh fuel composition is calculated by the STANDARD_WRITER subroutine based on the initial mass loading of uranium in the assembly. The initial mass loading of uranium in an axial node is calculated using the following equation.

$$Initial\ Uranium\ Mass\ in\ Node = (Initial\ Uranium\ Mass\ in\ Assembly) * \left(\frac{CRC\ Node\ Height}{CRC\ Total\ Active\ Fuel\ Height}\right)$$

The mass of oxygen in the UO_2 of the node must be calculated after the initial uranium mass in the node is determined. The following equation is used to calculate the mass of oxygen in the fuel. The weight percentages of the uranium isotopes (U-234, U-235, U-236, and U-238) are calculated using the equations presented in the next bulleted calculation.

$$Oxygen\ Mass\ in\ UO_2 = \frac{[(Mass\ of\ Uranium\ in\ UO_2)*(2)*(15.994915)*(100)]}{\left[\begin{array}{c}(wt\%\ U^{235})*(235.043915) + (wt\%\ U^{234})*(234.040904) + \\ (wt\%\ U^{236})*(236.045637) + (wt\%\ U^{238})*(238.05077)\end{array}\right]}$$

The mass of UO_2 in the axial node is then calculated by summing the mass of the uranium in the axial node and the mass of oxygen in the axial node.

The fuel volume in the axial node must be calculated prior to calculating the fuel density. The fuel volume is calculated using the following equation.

$$\begin{array}{c}Fuel\ Volume\\ in\ Axial\ Node\end{array} = \left(\frac{\pi}{4}\right) * (Fuel\ Outer\ Diameter)^2 * (Node\ Height) * (Number\ of\ Fuel\ Rods\ in\ Assembly)$$

The fuel density in the axial node is then calculated by dividing the UO_2 mass in the node by the fuel volume in the node.

- The weight percentages of the various isotopes in the uranium of the fresh UO_2 fuel composition are calculated using the following equations (Ref. 2).

$$U^{234}\ wt\% = (0.007731)*(U^{235}\ wt\%)^{1.0837}$$

$$U^{236}\ wt\% = (0.0046)*(U^{235}\ wt\%)$$

$$U^{238}\ wt\% = 100 - U^{234}\ wt\% - U^{235}\ wt\% - U^{236}\ wt\%$$

- The volume fraction of H_2O in the homogenized moderator composition must be calculated by the STANDARD_WRITER subroutine to define the moderator material composition. The following equation is used to calculate the appropriate volume fraction of H_2O.

$$\begin{matrix}\textit{Volume Fraction of } H_2O \\ \textit{n Homogenized Moderator Composition}\end{matrix} = 1.0 - \begin{matrix}\textit{Volume Fraction of Spacer Material} \\ \textit{in Homogenized Moderator Compositio}\end{matrix}$$

- The volume fraction of soluble boron in the H_2O of the homogenized moderator composition must be calculated by the STANDARD_WRITER subroutine to define the moderator material composition. The following equation is used to calculate the appropriate volume fraction of soluble boron.

$$\begin{matrix}\textit{Volume Fraction of Soluble Boron} \\ \textit{in Homogenized Moderator Composition}\end{matrix} = \frac{\begin{pmatrix}\textit{Boron} \\ \textit{Concentration} \\ \textit{ppm}\end{pmatrix} * (1.0E-6) *}{\begin{pmatrix}\textit{Volume Fraction of } H_2O \textit{ in} \\ \textit{Homogenized Moderator Composition}\end{pmatrix}}$$

- The density of the homogenized moderator composition must be calculated by the STANDARD_WRITER subroutine to define the moderator material composition. The following equation is used to calculate the appropriately averaged homogenized moderator density in grams per cubic centimeter.

$$\begin{matrix}\textit{Density of Homogenized} \\ \textit{Moderator Composition}\end{matrix} = \begin{matrix}\left[\begin{pmatrix}\textit{Actual} \\ \textit{Moderator} \\ \textit{Density}\end{pmatrix} * \begin{pmatrix}\textit{Volume Fraction} \\ \textit{of } H_2O \textit{ in the} \\ \textit{Moderator Composition}\end{pmatrix}\right] + \\ \left[\begin{pmatrix}\textit{Actual Density} \\ \textit{of} \\ \textit{Spacer Material}\end{pmatrix} * \begin{pmatrix}\textit{Volume Fraction} \\ \textit{of Spacer Material in the} \\ \textit{Moderator Composition}\end{pmatrix}\right]\end{matrix}$$

- If the fuel assembly contains a BPRA with Al_2O_3-B_4C burnable absorber material during the irradiation history covered in a SAS2H calculation, the aluminum and oxygen weight fractions must be calculated to define the fresh burnable absorber material composition. The following equation are used to calculate the aluminum and oxygen weight fractions in Al_2O_3-B_4C.

$$\begin{matrix}\textit{Aluminum Weight} \\ \textit{Fraction in } Al_2O_3-B_4C\end{matrix} = \frac{\left(\frac{100 - B_4C \textit{ wt\% in } Al_2O_3-B_4C}{100}\right) * (\textit{Density of } Al_2O_3-B_4C)^2 *}{(2) * (26.981539) * \left(\frac{1}{101.9631}\right)}$$

$$\text{Oxygen Weight Fraction in } Al_2O_3\text{-}B_4C = 1 - \left(\frac{B_4C \text{ wt\% in } Al_2O_3\text{-}B_4C}{100}\right) - \left(\text{Aluminum Weight Fraction in } Al_2O_3\text{-}B_4C\right)$$

- The soluble boron fraction must be calculated by the STANDARD_WRITER subroutine for all irradiation steps. The soluble boron fraction for a given irradiation step is calculated using the following equation.

$$\text{Soluble Boron Fraction in Irradiation Step} = \frac{\text{Soluble Boron ppm in Irradiation Step}}{\text{Soluble Boron ppm in Base Moderator Composition of the SAS2H Input Deck}}$$

4.9 CONTINUATION_WRITER Subroutine

This subroutine generates all SAS2H input decks which correspond to continuation cases in which the fuel and burnable poison isotopic initial charge compositions are obtained from the output of a previous CRAFT generated SAS2H calculation. A detailed explanation of how to develop a SAS2H input deck to perform a fuel assembly depletion and decay calculation is provided in reference 1. The purpose of this discussion is not to explain how to develop a SAS2H input deck, but to explain the general format and calculations utilized by CRAFT in generating SAS2H input decks for calculations which initially contain spent fuel and burnable poison material compositions.

The format of the CRAFT generated SAS2H input decks for the continuation of a fuel assembly depletion and decay calculation relevant to CRC analyses is the same as that previously described for the standard beginning-of-life SAS2H input decks. The material specification section of the SAS2H input deck is the only input section where the continuation case differs from the standard case.

The CRAFT code tracks the depletion and decay of the fuel and burnable absorber materials during the fuel assembly depletion and decay calculation. The CONTINUATION_WRITER subroutine is designed to locate the appropriate fuel and burnable poison isotopic concentrations, and utilize them in developing the correct fuel and burnable poison initial charge compositions to allow for continuation of the fuel assembly depletion calculation. All calculations performed by the STANDARD_WRITER subroutine other than those related to the fuel and burnable poison material composition specifications are performed identically by the CONTINUATION_WRITER subroutine.

4.9.1 Initial Charge Fuel and Burnable Poison Material Composition Specifications

The initial charge fuel material composition specification for a continuation SAS2H calculation utilizes all available isotopic concentrations from the appropriate previous SAS2H depletion and decay calculation's output for which cross-section data is available in the SCALE 44-group library (Vol. 3, p. M4.2.19, Ref. 1) (recommended CRC cross-section library). Table 4.9.1-1 contains a listing of all the isotopes for which data is available in the 44-group cross-section library.

Table 4.9.1-1
Isotopic Inventory of the 44-group Cross-Section Library

H-1	H-2	H-3	He-3	He-4	Li-6	Li-7	Be-9	B-10
B-11	C-12	N-14	N-15	O-16	O-17	F-19	Na-23	Mg
Al-27	Si	P-31	S	S-32	Cl	K	Ca	Ti
V	Cr	Mn-55	Fe	Co-59	Ni	Cu	Ga	Ge-72
Ge-73	Ge-74	Ge-76	As-75	Se-74	Se-76	Se-77	Se-78	Se-80
Se-82	Br-79	Br-81	Kr-78	Kr-80	Kr-82	Kr-83	Kr-84	Kr-85
Kr-86	Rb-85	Rb-86	Rb-87	Sr-84	Sr-86	Sr-87	Sr-88	Sr-89
Sr-90	Y-89	Y-90	Y-91	Zr	Zr-90	Zr-91	Zr-92	Zr-93
Zr-94	Zr-95	Zr-96	Nb-93	Nb-94	Nb-95	Mo	Mo-92	Mo-94
Mo-95	Mo-96	Mo-97	Mo-98	Mo-99	Mo-100	Tc-99	Ru-96	Ru-98
Ru-99	Ru-100	Ru-101	Ru-102	Ru-103	Ru-104	Ru-105	Ru-106	Rh-103
Rh-105	Pd-102	Pd-104	Pd-105	Pd-106	Pd-107	Pd-108	Pd-110	Ag-107
Ag-109	Ag-111	Cd	Cd-106	Cd-108	Cd-110	Cd-111	Cd-112	Cd-113
Cd-114	Cd-116	Cd-115m	In-113	In-115	Sn-112	Sn-114	Sn-115	Sn-116
Sn-117	Sn-118	Sn-119	Sn-120	Sn-122	Sn-123	Sn-124	Sn-125	Sn-126
Sb-121	Sb-123	Sb-124	Sb-125	Sb-126	Te-120	Te-122	Te-123	Te-124
Te-125	Te-126	Te-128	Te-130	Te-132	Te-127m	Te-129m	I-127	I-129
I-130	I-131	I-135	Xe-124	Xe-126	Xe-128	Xe-129	Xe-130	Xe-131
Xe-132	Xe-133	Xe-134	Xe-135	Xe-136	Cs-133	Cs-134	Cs-135	Cs-136
Cs-137	Ba-134	Ba-135	Ba-136	Ba-137	Ba-138	Ba-140	La-139	La-140
Ce-140	Ce-141	Ce-142	Ce-143	Ce-144	Pr-141	Pr-142	Pr-143	Nd-142
Nd-143	Nd-144	Nd-145	Nd-146	Nd-147	Nd-148	Nd-150	Pm-147	Pm-148
Pm-149	Pm-151	Pm-148m	Sm-144	Sm-147	Sm-148	Sm-149	Sm-150	Sm-151

Table 4.9.1-1
Isotopic Inventory of the 44-group Cross-Section Library

Sm-152	Sm-153	Sm-154	Eu	Eu-151	Eu-152	Eu-153	Eu-154	Eu-155
Eu-156	Eu-157	Gd-152	Gd-154	Gd-155	Gd-156	Gd-157	Gd-158	Gd-160
Tb-159	Tb-160	Dy-160	Dy-161	Dy-162	Dy-163	Dy-164	Ho-165	Er-166
Er-167	Lu-175	Lu-176	Hf	Hf-174	Hf-176	Hf-177	Hf-178	Hf-179
Hf-180	Ta-181	Ta-182	W	W-182	W-183	W-184	W-186	Re-185
Re-187	Au-197	Pb	Bi-209	Th-230	Th-232	Pa-231	Pa-233	U-232
U-233	U-234	U-235	U-236	U-237	U-238	Np-237	Np-238	Pu-236
Pu-237	Pu-238	Pu-239	Pu-240	Pu-241	Pu-242	Pu-243	Pu-244	Am-241
Am-242	Am-243	Am-242m	Cm-241	Cm-242	Cm-243	Cm-244	Cm-245	Cm-246
Cm-247	Cm-248	Bk-249	Cf-249	Cf-250	Cf-251	Cf-252	Cf-253	Es-253

The fuel composition is composed of the initial oxygen mass in the fresh UO_2 and the mass of each of the actinides and fission products of the depleted fuel composition which are available in the 44-group library. There are some isotopes listed in the ORIGEN output of the spent fuel composition which are not available in the 44-group library. These isotopes are excluded from the initial charge composition for the continuation of the fuel assembly depletion. A listing of all excluded isotopes and their abundance in grams per node is retained in the CRAFT generated "*.notes" file corresponding to the SAS2H calculation for which the initial charge composition is obtained. The total mass of all isotopes (including oxygen) in the fuel composition is calculated to assist in determining the weight percentages of each isotope in the composition and the density of the composition. The fuel composition is then defined as an arbitrary material specification in the SAS2H input deck with the appropriate nodal fuel temperature applied.

Excluding the isotopic concentrations from the ORIGEN-S output, that are not available in the 44-group library, from the fuel charge composition of a subsequent depletion calculation has a negligible effect on the neutron spectrum. The neutron spectrum must be predicted correctly during the SAS2H depletion calculations to obtain the proper cell-weighting of the cross-sections. For an absorber isotope to have a significant effect on the neutron spectrum, the absorber isotope must be present in a significant quantity and have a significant absorption cross-section. Three simple calculations were performed to demonstrate that the isotopes excluded from the continuation SAS2H depletion calculations (as identified in the "*.notes" files) do not effect the neutron spectrum significantly enough to result in a change in the final depleted composition. The first two of the three calculations represent a simple fuel depletion calculation that was split into parts and continued via CRAFT. The third of these calculations is a continuous calculation equivalent to the simple depletion represented by the first two calculations. The final depleted isotopic results at the end of the second calculation (the second part of the total depletion composed of the first two calculations) are identical to the final depleted isotopic results obtained from the third calculation. The SAS2H input decks for these three calculations are presented in Figure 4.9.1-1 through Figure 4.9.1-3.

Figure 4.9.1-1 Calculation 1 of the Isotopic Exclusion Test Depletion Calculation

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-01 (Cyc-1B,    .0 to Cyc-1B,   75.0 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
uo2 1 den=10.121 1  929.8 92234  .016 92235 1.930 92236  .009 92238 98.045 end
kr-83         1   0   1-21     929.8   end
kr-85         1   0   1-21     929.8   end
sr-90         1   0   1-21     929.8   end
y-89          1   0   1-21     929.8   end
mo-95         1   0   1-21     929.8   end
zr-93         1   0   1-21     929.8   end
zr-94         1   0   1-21     929.8   end
zr-95         1  -0   1-21     929.8   end
nb-94         1   0   1-21     929.8   end
tc-99         1   0   1-21     929.8   end
rh-103        1   0   1-21     929.8   end
rh-105        1   0   1-21     929.8   end
ru-101        1   0   1-21     929.8   end
ru-106        1   0   1-21     929.8   end
pd-105        1   0   1-21     929.8   end
pd-108        1   0   1-21     929.8   end
ag-109        1   0   1-21     929.8   end
sb-124        1   0   1-21     929.8   end
xe-131        1   0   1-21     929.8   end
xe-132        1   0   1-21     929.8   end
xe-135        1   0   1-21     929.8   end
xe-136        1   0   1-21     929.8   end
cs-134        1   0   1-21     929.8   end
cs-135        1   0   1-21     929.8   end
cs-137        1   0   1-21     929.8   end
ba-136        1   0   1-21     929.8   end
la-139        1   0   1-21     929.8   end
ce-144        1   0   1-21     929.8   end
nd-143        1   0   1-21     929.8   end
nd-145        1   0   1-21     929.8   end
pm-147        1   0   1-21     929.8   end
pm-148        1   0   1-21     929.8   end
nd-147        1   0   1-21     929.8   end
sm-147        1   0   1-21     929.8   end
sm-149        1   0   1-21     929.8   end
sm-150        1   0   1-21     929.8   end
sm-151        1   0   1-21     929.8   end
sm-152        1   0   1-21     929.8   end
gd-155        1   0   1-21     929.8   end
eu-153        1   0   1-21     929.8   end
eu-154        1   0   1-21     929.8   end
eu-155        1   0   1-21     929.8   end
```

```
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7556    .99424      579.8     end
arbm-bormod     .7556 1 0 0 0 5000 100 3 .00052    579.8 end
arbm-spacer     .7556 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576    579.8 end
'
'
he     5    end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=360.172 ncycles=02 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3  .63246    2  .67310    3  .81397 500 2.97599    3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 03
power=74.181     burn=71.10      down=.00000E+00 bfrac=1.000      end
power=74.181     burn=71.10      down=10.000     bfrac=.4938      end
'
'     end of input
'
end
```

Figure 4.9.1-2 Calculation 2 of the Isotopic Exclusion Test Depletion Calculation

```
=sas2h     parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-01 (Cyc-1B,  75.0 to Cyc-1B, 142.2 EFPD)
44group          latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'    material specification input
'
arbm-fuel    10.1       216 0 0 0 8016    11.9
      2004   .837E-06        90230   .858E-08
     90232   .166E-08        91231   .365E-08        91233   .478E-09
     92232   .242E-08        92233   .679E-07        92234   .887E-02
     92235   .434            92236   .213            92237   .101E-02
     92238   84.7            93237   .209E-01        93238   .119E-04
     94236   .238E-07        94237   .242E-07        94238   .468E-02
     94239   .419            94240   .171            94241   .912E-01
     94242   .350E-01        95241   .508E-03        95601   .689E-05
     95242   .265E-09        95243   .560E-02        96242   .180E-03
     96243   .345E-05        96244   .118E-02        96245   .276E-04
     96246   .346E-05        96247   .400E-07        96248   .242E-08
      1003   .324E-05         3006   .113E-07         3007   .607E-09
```

4009	.117E-08	32072	.327E-06	32073	.914E-06
32074	.767E-06	33075	.685E-05	32076	.202E-04
34076	.148E-06	34077	.468E-04	34078	.156E-03
35079	.246E-09	34080	.796E-03	36080	.377E-08
35081	.119E-02	34082	.189E-02	36082	.299E-04
36083	.240E-02	36084	.660E-02	36085	.142E-02
37085	.522E-02	36086	.106E-01	37086	.299E-05
38086	.112E-04	37087	.138E-01	38087	.674E-07
38088	.196E-01	38089	.923E-02	39089	.170E-01
38090	.318E-01	39090	.837E-05	40090	.200E-03
39091	.140E-01	40091	.206E-01	40092	.369E-01
40093	.276E-01	41093	.695E-09	40094	.447E-01
41094	.310E-07	40095	.209E-01	41095	.104E-01
42095	.150E-01	40096	.476E-01	42096	.468E-03
42097	.455E-01	42098	.493E-01	42099	.118E-03
43099	.489E-01	44099	.171E-05	42100	.561E-01
44100	.449E-02	44101	.468E-01	44102	.466E-01
44103	.142E-01	45103	.223E-01	44104	.346E-01
46104	.617E-02	45105	.402E-05	46105	.177E-01
44106	.183E-01	46106	.130E-01	46107	.149E-01
47107	.280E-09	46108	.971E-02	48108	.942E-08
47109	.636E-02	46110	.287E-02	48110	.198E-02
47111	.672E-04	48111	.141E-02	48112	.759E-03
48113	.746E-05	49113	.699E-07	48114	.773E-03
50114	.142E-08	48601	.392E-05	49115	.109E-03
50115	.111E-04	48116	.312E-03	50116	.121E-03
50117	.299E-03	50118	.236E-03	50119	.247E-03
50120	.242E-03	51121	.249E-03	50122	.316E-03
52122	.121E-04	50123	.153E-04	51123	.274E-03
52123	.617E-07	50124	.527E-03	51124	.556E-05
52124	.423E-05	50125	.925E-05	51125	.613E-03
52125	.263E-04	50126	.124E-02	51126	.105E-05
52126	.198E-04	52601	.327E-03	53127	.246E-02
52128	.556E-02	54128	.908E-04	52611	.615E-03
53129	.106E-01	54129	.333E-06	52130	.219E-01
54130	.369E-03	53131	.137E-02	54131	.274E-01
52132	.217E-03	54132	.626E-01	54133	.129E-02
55133	.697E-01	54134	.917E-01	55134	.609E-02
56134	.316E-03	54135	.948E-11	55135	.453E-02
56135	.127E-05	54136	.155	55136	.546E-04
56136	.424E-03	55137	.763E-01	56137	.421E-03
56138	.761E-01	57139	.719E-01	56140	.537E-02
57140	.813E-03	58140	.712E-01	58141	.168E-01
59141	.495E-01	58142	.678E-01	59142	.209E-08
60142	.601E-03	58143	.544E-05	59143	.535E-02
60143	.451E-01	58144	.483E-01	60144	.263E-01
60145	.405E-01	60146	.398E-01	60147	.159E-02
61147	.151E-01	62147	.758E-03	60148	.228E-01
61148	.590E-04	61601	.839E-04	62148	.244E-02
61149	.280E-04	62149	.765E-03	60150	.108E-01
62150	.206E-01	61151	.312E-06	62151	.973E-03
63151	.348E-06	62152	.912E-02	63152	.354E-06
64152	.407E-06	62153	.994E-05	63153	.702E-02
62154	.263E-02	63154	.107E-02	64154	.129E-04
63155	.314E-03	64155	.160E-05	63156	.615E-03
64156	.282E-02	63157	.278E-09	64157	.257E-04
64158	.153E-02	65159	.159E-03	64160	.674E-04
65160	.845E-05	66160	.386E-05	66161	.232E-04
66162	.172E-04	66163	.117E-04	66164	.240E-05
67165	.398E-05	68166	.727E-06	68167	.123E-07

```
     1   1.0    929.8   end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'    material composition of moderator within unit cell
'    with smeared inconel spacer grids
h2o   3   den=.7556   .99424     579.8   end
arbm-bormod    .7556 1 0 0 0 5000 100 3 .00024    579.8 end
arbm-spacer    .7556 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                26000 7.0 28000 73.0 3 .00576   579.8 end
'
'
he    5   end
end comp
'
'    base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'    assembly specification
'
npin/assembly=208 fuelngth=360.172 ncycles=01 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3  .63246   2  .67310   3  .81397 500 2.97599   3 2.99939
'
'    assembly depletion/decay parameters
'
'  Cycle-1B, one-eighth core assembly number 03
power=27.597     burn=29.10     down=14.792     bfrac=1.000     end
'
'    end of input
'
end
```

Figure 4.9.1-3 Calculation 3 of the Isotopic Exclusion Test Depletion Calculation

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-01 (Cyc-1B,    .0 to Cyc-1B,  75.0 EFPD)
44group         latticecell
'
'  fuel density based on mass of uranium per assembly & total pellet stack
'  volume to account for fuel volume loss to pellet chamfers
'
'    material specification input
'
uo2 1 den=10.121 1  929.8 92234  .016 92235 1.930 92236  .009 92238 98.045 end
kr-83        1   0   1-21     929.8   end
kr-85        1   0   1-21     929.8   end
sr-90        1   0   1-21     929.8   end
y-89         1   0   1-21     929.8   end
mo-95        1   0   1-21     929.8   end
zr-93        1   0   1-21     929.8   end
zr-94        1   0   1-21     929.8   end
zr-95        1   0   1-21     929.8   end
nb-94        1   0   1-21     929.8   end
tc-99        1   0   1-21     929.8   end
rh-103       1   0   1-21     929.8   end
rh-105       1   0   1-21     929.8   end
```

```
ru-101       1   0   1-21    929.8    end
ru-106       1   0   1-21    929.8    end
pd-105       1   0   1-21    929.8    end
pd-108       1   0   1-21    929.8    end
ag-109       1   0   1-21    929.8    end
sb-124       1   0   1-21    929.8    end
xe-131       1   0   1-21    929.8    end
xe-132       1   0   1-21    929.8    end
xe-135       1   0   1-21    929.8    end
xe-136       1   0   1-21    929.8    end
cs-134       1   0   1-21    929.8    end
cs-135       1   0   1-21    929.8    end
cs-137       1   0   1-21    929.8    end
ba-136       1   0   1-21    929.8    end
la-139       1   0   1-21    929.8    end
ce-144       1   0   1-21    929.8    end
nd-143       1   0   1-21    929.8    end
nd-145       1   0   1-21    929.8    end
pm-147       1   0   1-21    929.8    end
pm-148       1   0   1-21    929.8    end
nd-147       1   0   1-21    929.8    end
sm-147       1   0   1-21    929.8    end
sm-149       1   0   1-21    929.8    end
sm-150       1   0   1-21    929.8    end
sm-151       1   0   1-21    929.8    end
sm-152       1   0   1-21    929.8    end
gd-155       1   0   1-21    929.8    end
eu-153       1   0   1-21    929.8    end
eu-154       1   0   1-21    929.8    end
eu-155       1   0   1-21    929.8    end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3    den=.7556    .99424      579.8     end
arbm-bormod     .7556 1 0 0 0 5000 100 3 .00052    579.8 end
arbm-spacer     .7556 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576    579.8 end
'
'
he     5    end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0    end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=360.172 ncycles=03 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3  .63246    2  .67310    3  .81397 500 2.97599    3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 03
power=74.181      burn=71.10     down=.00000E+00 bfrac=1.000      end
power=74.181      burn=71.10     down=10.000     bfrac=.4938      end
```

```
power=27.597    burn=29.10    down=14.792    bfrac=.4615    end
'
'    end of input
'
end
```

The burnable poison initial charge composition for continuing a fuel assembly depletion calculation is developed using the depleted abundances of B-10 and B-11 in the burnable poison material. These depleted abundances of B-10 and B-11 are obtained from the appropriate previous SAS2H depletion and decay calculation's output. The depletion of other isotopes in the burnable poison composition are not tracked in the CRAFT calculation. The isotopes in the burnable poison material other than B-10 and B-11 are respecified in the burnable poison composition of the continuing depletion calculation with their initial abundances. The total mass of all isotopes in the burnable poison composition is calculated to assist in determining the weight percentages of each isotope in the composition and the density of the composition. The burnable poison composition is then defined as an arbitrary material specification in the SAS2H input deck with the nodal moderator temperature applied.

4.9.2 Calculations Performed within the CONTINUATION_WRITER Subroutine

- The density of the fuel composition in the CRAFT generated continuing depletion SAS2H input deck must be calculated by the CONTINUATION_WRITER subroutine. This calculation is performed by simply dividing the total mass of the charge fuel composition (including oxygen) in the node by the total fuel volume in the node. The charge fuel composition (excluding oxygen) is obtained from the appropriate previous SAS2H calculation's output. The oxygen contribution and fuel volume of the node are calculated in the same manner as previously described in the STANDARD_WRITER subroutine description.

- The weight percentages of each isotope in the depleted initial charge compositions for the fuel and burnable poison are calculated by using the following equation.

$$\begin{matrix} \textit{Weight Percent} \\ \textit{of Constituent in Material} \end{matrix} = \frac{\textit{Mass of Constituent}}{\textit{Total Material Mass}} * 100$$

- The default burnable poison material is Al_2O_3-B_4C. If this burnable poison material is specified for use in the BPRA of a continuing depletion calculation, the initial mass abundances of the aluminum, oxygen, and carbon in the fresh material must be calculated for use is defining the depleted burnable material composition for the continuation case. The first step in calculating the mass abundances of these elements is to use the following equation to calculate the mass of B_4C in the Al_2O_3-B_4C material in the node.

$$\begin{matrix} B_4C\ Mass \\ in\ Node \end{matrix} = \left(\frac{B_4C\ wt\%\ in\ Al_2O_3-B_4C}{100}\right) * \left(\begin{matrix} Density\ of \\ Al_2O_3-B_4C \end{matrix}\right) * \left(\begin{matrix} Burnable\ Poison \\ Volume\ in\ Node \end{matrix}\right)$$

The carbon mass in the Al_2O_3-B_4C material of the node may then be calculated using the following equation.

$$Carbon\ Mass\ in\ Al_2O_3-B_4 = (B_4C\ Mass\ in\ Node) * (0.217374)$$

The aluminum mass in the Al_2O_3-B_4C of the node is calculated using the following equation.

$$\begin{matrix} Aluminum\ Mass \\ in\ Al_2O_3-B_4C \end{matrix} = \left(\frac{100 - B_4C\ wt\%}{100}\right) * \left(\begin{matrix} Density\ of \\ Al_2O_3-B_4C \end{matrix}\right) * \left(\begin{matrix} Burnable\ Poison \\ Volume\ in\ Node \end{matrix}\right) * \left(\frac{2 * 26.981539}{101.961278}\right)$$

The oxygen mass in the Al_2O_3-B_4C of the node is calculated using the following equation.

$$\begin{matrix} Oxygen\ Mass \\ in\ Al_2O_3-B_4C \end{matrix} = \left[\left(\frac{100 - B_4C\ wt\%}{100}\right) * \left(\begin{matrix} Density\ of \\ Al_2O_3-B_4C \end{matrix}\right) * \left(\begin{matrix} Burnable\ Poison \\ Volume\ in\ Node \end{matrix}\right)\right] - \left(\begin{matrix} Aluminum\ Mass \\ in\ Al_2O_3-B_4C \end{matrix}\right)$$

The total mass of the Al_2O_3-B_4C material in the node for the continuation case is the sum of the aluminum, oxygen, and carbon masses calculated from the fresh burnable poison description, plus the depleted B-10 and B-11 masses in the burnable poison of the node obtained from the appropriate previous SAS2H depletion and decay calculation's output. The volume of the burnable poison material in the node must be calculated using the following equation for use in calculating the density of the depleted burnable poison material.

$$\begin{matrix} Volume\ of \\ Burnable\ Poison \\ in\ Node \end{matrix} = \begin{matrix} Burnable\ Poison \\ (Cross-Sectional\ Area) \\ in\ a\ BPR \end{matrix} * \left(\begin{matrix} Number\ of\ BPR's \\ in\ Assembly \end{matrix}\right) * (Node\ Height)$$

where the burnable poison cross-sectional area is defined in the CRAFT input deck.

The density of the depleted burnable poison for the continuing depletion SAS2H case is calculated by dividing the total mass of the depleted burnable poison material in the node by the burnable poison volume in the node. The weight percentages of the constituents of the Al_2O_3-B_4C material are calculated and used by CRAFT in generating the SAS2H input deck.

- The CRAFT code has the ability to model burnable poison materials other than Al_2O_3-B_4C. If a burnable poison material other than Al_2O_3-B_4C is specified, the CONTINUATION_WRITER subroutine must calculate the appropriate depleted composition for the continuing depletion SAS2H case. The first step in determining the depleted burnable poison material composition is to calculate the total mass of the depleted burnable poison in the node using the following equation.

$$\text{Depleted Burnable Poison Total Mass in Node} = \sum_{\substack{\text{All Isotopes}\\ \text{Other Than}\\ \text{B-10 and B-11}}} \left[\left(\frac{\text{Isotope wt\%}}{100}\right)*\left(\text{Original Burnable Poison Density}\right)\right] + \text{B-10 and B-11 Mass in Node from Previous Depletion Calculation}$$

The density of the depleted burnable poison composition is then calculated by dividing the total depleted burnable poison mass in the node by the total burnable poison material volume in the node.

The weight percents of the constituents of the burnable poison composition other than B-10 and B-11 are calculated using the following equation.

$$\text{Weight Percent of Constituent in Burnable Poison other than B-10 and B-11} = \frac{\left(\frac{\text{Original wt\% of Constituent}}{100}\right)*\left(\text{Original Burnable Poison Density}\right)*\left(\text{Burnable Poison Volume in Node}\right)}{\text{Total Mass of Depleted Burnable Poison in Node}}*100$$

The weight percentages of the constituents of the burnable poison material are calculated and used by CRAFT in generating the SAS2H input deck.

4.10 CUTTER Subroutine

The cutter subroutine creates a consolidated output file for each CRAFT generated SAS2H calculation. This output file contains the time/date stamp from the SAS2H calculation output file, the echo of the SAS2H input deck from the SAS2H output file, and the portion of the final ORIGEN calculation's output produced as part of the SAS2H calculation which contains the light element, actinide, and fission product material compositions relevant to CRC evaluations. The output files generated by the CUTTER subroutine contain the statepoint calculation's base filename followed by the "*.cut" suffix. Section 8 contains a detailed description of the CRAFT generated filenames.

4.11 RETRIEVER Subroutine

The RETRIEVER subroutine reads through the appropriate "*.cut" file to obtain the fuel and burnable poison initial charge compositions for the next SAS2H calculation. Additionally, the RETRIEVER subroutine writes a file which contains a listing of all isotopes and their concentrations which were present in the ORIGEN output of the SAS2H calculation, but not utilized in the initial charge composition of the next SAS2H calculation. This file is identified by the initial filename identifier corresponding to the SAS2H case which is being generated followed by a "*.notes" suffix. The RETRIEVER subroutine calculates the total mass of the depleted fuel composition in the node which will be used as the initial charge for the next SAS2H calculation. The total oxygen mass in the node, which is calculated in the CONTINUATION_WRITER subroutine, is included in the total fuel mass calculated by RETRIEVER. The weight percentages of each isotope in the fuel composition are then calculated by RETRIEVER to be transferred through an array designation to the CONTINUATION_WRITER subroutine where they will be implemented into the appropriate SAS2H input deck.

4.12 ZEROS Subroutine

The ZEROS subroutine is a utility for converting integer values less than 100 to a two character string representation with leading zeros if necessary.

5. CRAFT Input Summary

The following table summarizes the input card formats and parameters required to perform a CRAFT calculation. The CRAFT input deck filename must be "datain".

Card Number	Special Notes	Card Format	Card Description
1		1 Character	[Y] to signal that this case should pick up from a previous statepoint, any other character equals alternative
1A	★	Integer	Relative cycle number at which to begin the calculation {If Input Card (IC) 1 = "Y"}
1B	★	Integer	Relative statepoint number within the startup cycle at which to begin the calculation {If IC 1 = "Y"}
2		21 Characters	Problem identifier (i.e., Crystal River, Unit 3)
3		3 Characters	Problem prefix to be used as an identifier in all filenames
4		15 Characters	SCALE cross-section library to be utilized by SAS2H
5		Real	wt% U-235 enrichment in UO_2
6		Real	Mass of U per assembly (g)
7		Real	Number of fuel rods in assembly
8		Real	Rod pitch in assembly (cm)
9		Real	Fuel pellet diameter (cm)
10		Real	Fuel rod cladding inner diameter (cm)
11		Real	Fuel rod cladding outer diameter (cm)
12		Real	Active fuel length (cm)
13		1 Character	[Y] to indicate that the assembly contains axial blanket fuel, any other character equals alternative
13A	★	Real	wt% U-235 enrichment in UO_2 for axial blanket fuel {If IC 13 = "Y"}

Card Number	Special Notes	Card Format	Card Description
13B	★	Integer	Number of CRC axial nodes containing axial blanket fuel {If IC 13 = "Y"}
13C	★, ℜ	Integer	CRC axial node number(s) (1=top node) containing axial blanket fuel {If IC 13 = "Y"}
14		7 Characters	Spacer grid material identification (ZIRC-4, INCONEL, SS304, SS304S, SS316, SS316S)
14A		Real	Volume fraction of spacer grids in the moderator of the fuel assembly
15		10 Characters	Fuel cladding material identification (ZIRC-4 or ZIRCALLOY4, SS304, SS304S, SS316, SS316S)
15A		Real	Average fuel cladding temperature (K)
16		1 Character	[Y] to indicate if a cladding specification other than Zirc-4 is required by any CR, BPR, or APSR
16A	★	Integer	Total number of special cladding material compositions to be specified other than Zirc-4 {If IC 16 = "Y"}
16B	★, ℜ	Integer	Material mixture number to be used in SAS2H calculations for special cladding composition {If IC 16 = "Y"}
16C	★, ℜ	6 Characters	Special cladding material identification (INCONEL, SS304, SS304S, SS316, SS316S) {If IC 16 = "Y"}
17		Real	System pressure (psia)
18		1 Character	[Y] to indicate if the assembly ever contains a BPRA, any other character equals alternative
18A	★	Integer	Number of reactor cycles in which the assembly contains a BPRA {If IC 18 = "Y"}
18B	★	Integer, Integer	Number of different BPRA designs inserted in assembly throughout its irradiation history, Number of BP material used other than Al_2O_3-B_4C {If IC 18 = "Y"}

Card Number	Special Notes	Card Format	Card Description
18C	★, ℜ	Real, Real, Real, Integer, Integer, Integer	Density of burnable poison (g/cc), B_4C wt% in burnable poison, Cross-sectional area of burnable poison in BPR (cm^2), Number of BPR's in BPRA, SAS2H material mixture number for BPR cladding, SAS2H material mixture number for BP material {If IC 18 = "Y"}
18D	★, ℜ	Integer	Number of radial zones in BPRA Path B model {If IC 18 = "Y"}
18E	★, ℜ	Integer, Real	Material mixture number for zone of BPRA Path B model, Outer radii (cm) for zone of BPRA Path B model (This combination must be specified from inner zone to outer zone.) {If IC 18 = "Y"}
18F	★, ℜ	Integer, Real	Material mixture number for zone of Path B model with removed BPRA, Outer radii (cm) for zone of Path B model with removed BPRA (This combination must be specified from inner zone to outer zone.) {If IC 18 = "Y"}
18G	★, ℜ	Integer, Real	Material mixture number for zone of Path B model for BPRA region above the BP absorber region, Outer radii (cm) for zone of Path B model for BPRA region above the BP absorber region (This combination must be specified from inner zone to outer zone.) {If IC 18 = "Y"}
18H	★, ℜ	5 Characters, Integer	Material in BPR above the BP absorber material (i.e., "AL2O3"), Corresponding SAS2H material mixture number {If IC 18 = "Y"}
18I	★, ℜ	Integer	Number of isotopes in material composition above the BP absorber material in the BPR {If IC 18 = "Y"} & {Value #1 of IC 18H ≠ "AL2O3"}

Card Number	Special Notes	Card Format	Card Description
18J	★, ℜ	Integer, Real	SCALE nuclide identifier in material composition above the BP absorber material in the BPR, Corresponding wt% of nuclide in material composition {If IC 18 = "Y"} & {Value #1 of IC 18H ≠ "AL2O3"}
18K	★	Integer	SAS2H material mixture number to be used for the BP material specified in 18L and 18M {If IC 18 = "Y"} & {Value #2 of IC 18B > 0}
18L	★	Integer	Number of isotopes in the BP absorber material mixture {If IC 18 = "Y"} & {Value #2 of IC 18B > 0}
18M	★, ℜ	Integer, Real	SCALE nuclide identifier in BP absorber material mixture, wt% for nuclide in mixture {If IC 18 = "Y"} & {Value #2 of IC 18B > 0}
18N	★, ℜ	Integer, Integer, Integer, Integer	Relative cycle number containing BPRA, Relative BPRA design number, Top axial node containing BPRA, Bottom axial node containing BPRA {If IC 18 = "Y"}
19		Integer	Number of radial zones in standard Path B model
20	ℜ	Integer, Real	Material mixture number for zone of standard Path B model, Outer radii (cm) for zone of standard Path B model (This combination must be specified from inner zone to outer zone.)
21		Integer	Number of cross-section libraries to be created per irradiation step
22		Integer	SAS2H print level
23		Real	Zone mesh factor for use by XSDRNPM
24		7 Character	[SPECIAL] to indicate the input of 7 XSDRNPM calculational control parameters to follow, any other character string indicates no XSDRNPM calculational control parameter input

Card Number	Special Notes	Card Format	Card Description
24A	★	Real	XSDRNPM calculational control parameter: Spatial Mesh Factor (SZF < 1 for finer, SZF > 1 for coarser), Default = 1 {If IC 24 = "SPECIAL"}
24B	★	Integer	XSDRNPM calculational control parameter: Order of Angular Quadrature, Default = 8 {If IC 24 = "SPECIAL"}
24C	★	Integer	XSDRNPM calculational control parameter: Maximum Number of Inner Iterations, Default = 20 {If IC 24 = "SPECIAL"}
24D	★	Integer	XSDRNPM calculational control parameter: Maximum Number of Outer Iterations, Default = 25 {If IC 24 = "SPECIAL"}
24E	★	Real	XSDRNPM calculational control parameter: Overall Convergence Criteria, Default = 0.0001 {If IC 24 = "SPECIAL"}
24F	★	Real	XSDRNPM calculational control parameter: Scalar Flux Point Convergence, Default = 0.0001 {If IC 24 = "SPECIAL"}
24G	★	Integer	XSDRNPM calculational control parameter: IUS = 1 for upscatter scaling to speed convergence, IUS = 0 for no scaling, Default = 0 {If IC 24 = "SPECIAL"}
25		Integer	Number of reactor cycles in which the assembly is inserted
26	ℜ	2 Characters	Reactor cycle identifier in which assembly is inserted
27	ℜ	Integer	Number of CRC statepoints in reactor cycle in which the assembly is inserted (BOC is always considered statepoint 1 in a cycle)
28	ℜ	Real	Statepoint EFPD
29	ℜ	Real	Length to statepoint in calendar days
30	ℜ	Real	Downtime at statepoint

Card Number	Special Notes	Card Format	Card Description
31	ℜ	Real	Days of downtime at EOC
32	ℜ	Real	Total cycle length in EFPD
33	ℜ	Real	Total cycle length in calendar days
34	ℜ	Integer	Integer position of assembly in cycle
35		1 Character	Flag to signal if constant or variable irradiation step histories will be specified [Y=variable, N=constant]
36	★, ℜ	Integer	Relative cycle number to which the following boron letdown data applies {If IC 35 = "N"}
37	★, ℜ	Integer	Relative statepoint number in the relative cycle to which the following boron letdown data applies (BOC statepoint equals 1) {If IC 35 = "N"}
38	★, ℜ	Real	Irradiation step length in EFPD {If IC 35 = "N"}
39	★, ℜ	Real	Number of irradiation steps to next statepoint {If IC 35 = "N"}
40	★, ℜ	Real	Mid-point ppmb concentration for irradiation step {If IC 35 = "N"}
41	★, ℜ	Integer	Relative cycle number to which the following boron letdown data applies {If IC 35 = "Y"}
42	★, ℜ	Integer	Relative statepoint number in the relative cycle to which the following boron letdown data applies (BOC statepoint equals 1) {If IC 35 = "Y"}
43	★, ℜ	Real	Number of irradiation steps to next statepoint {If IC 35 = "Y"}
44	★, ℜ	Real, Real	Irradiation step length in EFPD, Mid-point ppmb concentration for irradiation step {If IC 35 = "Y"}
45		Integer	Number of axial nodes for CRC calculation

Card Number	Special Notes	Card Format	Card Description
46	ℜ	Real, Real	Node number, Node height (cm)
47		6 Characters	'RODDED' if any control rod assembly data is to be provided, any other character string equals alternative
47A	★	Integer	Number of previously defined irradiation steps in which the assembly contains a CRA {If IC 47 = "RODDED"}
47A.1	★, ℜ	Integer	Number of delineated axial assembly sections containing the CRA during the irradiation step of interest {If IC 47 = "RODDED"}
47B	★, ℜ	Integer, Integer, Integer, Integer, Integer, Integer, Integer	Relative cycle number containing the CRA, Relative statepoint in cycle (BOC=stpt 1), Relative irradiation step number, Top axial node number containing CRA, Bottom axial node number containing CRA, CRA absorber material mixture, CRA design description number {If IC 47 = "RODDED"}
47C	★	Integer	Number of different CRA absorber material mixtures that will be specified for use in this fuel assembly {If IC 47 = "RODDED"}
47D	★, ℜ	Integer	SAS2H material mixture identifier for CRA absorber material mixture {If IC 47 = "RODDED"}
47E	★, ℜ	Integer	Number of isotopes in CRA absorber material mixture {If IC 47 = "RODDED"}
47F	★, ℜ	Integer, Real	SCALE nuclide identifier in CRA absorber material mixture, wt% for nuclide in mixture {If IC 47 = "RODDED"}
47G	★	Integer	Number of different CRA designs that will be specified for use with this fuel assembly {If IC 47 = "RODDED"}

Card Number	Special Notes	Card Format	Card Description
47H	★, ℜ	Real, Integer	CRA absorber material density for design, SAS2H material mixture number for CR cladding in CRA design {If IC 47 = "RODDED"}
47I	★, ℜ	Integer	Number of radial zones in the Path B unit cell model for the assembly containing CRA design {If IC 47 = "RODDED"}
47J	★, ℜ	Integer, Real	Zone mixture identifier for use in CRA design Path B unit cell model, Corresponding zone outer radii (cm) {If IC 47 = "RODDED"}
47K	★, ℜ	Integer, Real	Zone mixture identifier for use in Path B unit cell model after the CRA is removed, Corresponding zone outer radii (cm) {If IC 47 = "RODDED"}
48		6 Characters	'RODDED' if any axial power shaping rod assembly data is to be provided, any other character string equals alternative
48A	★	Integer	Number of previously defined irradiation steps in which the assembly contains an APSR assembly {If IC 48 = "RODDED"}
48B	★, ℜ	Integer, Integer, Integer, Integer, Integer, Integer, Integer, Integer	Relative cycle number containing the APSR, Relative statepoint in cycle (BOC=stpt 1), Relative irradiation step number in cycle, Top axial node number containing APSR, Bottom axial node number containing APSR, APSR absorber material mixture number, APSR assembly design description number, APSR follow rod material mixture number {If IC 48 = "RODDED"}
48C	★	Integer	Number of different APSR assembly absorber material mixtures that will be specified for use with this fuel assembly {If IC 48 = "RODDED"}
48D	★, ℜ	Integer	SAS2H material mixture identifier for APSR assembly absorber material mixture {If IC 48 = "RODDED"}

Card Number	Special Notes	Card Format	Card Description
48E	★, ℜ	Integer	Number of isotopes in APSR assembly absorber material mixture {If IC 48 = "RODDED"}
48F	★, ℜ	Integer, Real	SCALE nuclide identifier in APSR absorber material mixture, wt% for nuclide in mixture {If IC 48 = "RODDED"}
48G	★	Integer	Number of different APSR assembly designs that will be specified for use with this fuel assembly {If IC 48 = "RODDED"}
48H	★, ℜ	Real, Integer	APSR absorber material density for APSR assembly design, SAS2H material mixture number for APSR cladding in APSRA design {If IC 48 = "RODDED"}
48I	★, ℜ	Integer	Number of radial zones in the Path B unit cell model for the assembly containing APSR assembly design {If IC 48 = "RODDED"}
48J	★, ℜ	Integer, Real	Zone mixture identifier for use in APSR assembly design Path B unit cell model, Corresponding zone outer radii (cm) {If IC 48 = "RODDED"}
48K	★, ℜ	Integer, Real	Zone mixture identifier for use in Path B unit cell model after the APSR assembly is removed, Corresponding zone outer radii (cm) {If IC 48 = "RODDED"}
48L	★, ℜ	Integer, Real	Zone mixture identifier for use in Path B unit cell model for the follow rod section of the APSR assembly, Corresponding zone outer radii (cm) {If IC 48 = "RODDED"}
49	ℜ	Integer	Number of axial nodes for fuel temperature input
50	ℜ	Real, Real	Axial node number for fuel temperature input, Corresponding axial node height (cm)
51	ℜ	Real	Axial node fuel temperature input data (F)
52	ℜ	Integer	Number of axial nodes for moderator specific volume input

Card Number	Special Notes	Card Format	Card Description
53	ℜ	Real, Real	Axial node number for moderator specific volume input, Corresponding axial node height (cm)
54	ℜ	Real	Axial node moderator specific volume input data (ft^3/lb)
55	ℜ	Integer	Number of axial nodes for burnup input data
56	ℜ	Real, Real	Axial node number for burnup input, Corresponding axial node height (cm)
57	ℜ	Real	Axial node burnup input data (GWd/MTU)

★: The existence of these input cards is dependent on certain previous input card values. The detailed descriptions for these input cards in Section 7 explain the various dependencies.

ℜ: These are recursive input cards that must be entered multiple times in a specific grouping format. The detailed descriptions for the recursive input cards in Section 7 explain the specific grouping formats and number of required input iterations.

▮ : The continuous shaded boxes in the special notes column indicate groupings of recursive input cards. The format and content of these recursive groupings are explained in the detailed input descriptions in Section 7.

6. CRAFT Code Limits and Execution Instructions

The following listing describes the CRAFT code limitations.

1) The maximum number of irradiation steps allowed in a given CRAFT generated SAS2H input deck is 23.
2) The maximum number of isotopes allowed in a CR or APSR absorber material specification is 10.
3) The maximum number of concentric zones allowed in a SAS2H Path B model is 15.
4) The maximum number of axial nodes allowed in any axial format is 50.
5) The maximum number of reactor cycles in which an assembly may be inserted is 10.
6) The maximum number of CRC statepoints allowed in a single reactor cycle (BOC counts as one statepoint) is 20.
7) The maximum number of BPRA design description specifications allowed is 10.
8) The maximum number of different CR absorber material mixtures allowed is 25.

9) The maximum number of CRA design description specifications allowed is 10.
10) The maximum number of APSR absorber material mixtures allowed is 25.
11) The maximum number of APSRA design description specifications allowed is 10.

The procedure for performing a fuel assembly depletion calculation with CRAFT Version 1.0 consists of the following four steps:

1) Create a CRAFT input deck for the assembly depletion calculation.
2) Assure that the CRAFT executable file, the CRAFT input deck entitled "datain", the "batch43" executable file, and the "sedexecute" executable file are in the same directory. The "batch43" executable file is a script file which is used by CRAFT to execute the SCALE code system. An ASCII listing of the "batch43" script is shown in Table 6-1. The "sedexecute" executable file is a script file which is used in conjunction with the CRAFT code to create the consolidated output files described in Section 8 of this document. An ASCII listing of the "sedexecute" script is shown in Table 6-2.
3) Assure that the "sed" line editor is loaded onto the computer system and is in the command path (i.e., executable from the command line through the issuance of the "sed" command).
4) Execute CRAFT.

Table 6-1 Listing of the "batch43" Script Required for the Execution of CRAFT

```
#!/bin/csh
if ( ! ( $?SCALE ) )   setenv SCALE /neutronics/Scale4.3
setenv CMDS $SCALE/cmds
set pid=`$CMDS/ppid`
setenv TMPDIR /users/wright/scale4.3/tmp
if ( -e $1 ) then
  set input=$1
  set output=$1:r.output
  set msgs=$1:r.msgs
else if ( -e $1.inp ) then
  set input=$1.inp
  set output=$1.out
  set msgs=$1.msg
else if ( -e $1.input ) then
  set input=$1.input
  set output=$1.output
  set msgs=$1.msgs
else
  echo ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  echo         "the input file you specified does not exist"
  echo ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  exit
endif
$CMDS/scale43 $input $output >& $msgs
rm -r $TMPDIR
```

The stucture of the "batch43" script shown in Table 6-1 is only understandable if examined in the context in which it is used in the CRAFT code.

Table 6-2 Listing of the "sedexecute" Script Required for the Execution of CRAFT

```
print
'****************************************************************************'
> $1.cut
print '*    Date and Time Validation Stamp for the Execution of the SAS2H Case
 *' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print ' ' >> $1.cut
sed -n $3,$4p $1.output >> $1.cut
print ' ' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print '*           Echo of SAS2H Input Deck Obtained from SAS2H Output
  *' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print ' ' >> $1.cut
sed -n "/1          primary module access and input record/,/      '     end
of input/p" $1.output >> $1.cut
print ' ' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print '* SAS2H Output Relevant to CRC Evaluations Obtained from Final ORIGEN
Case *' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print ' ' >> $1.cut
sed -n "$2,/0 halt/p" $1.output >> $1.cut
print ' ' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print '*          End of Extracted SAS2H Output Relevant to CRC Evaluations
  *' >> $1.cut
print
'****************************************************************************'
>> $1.cut
print ' ' >> $1.cut
```

The stucture of the "sedexecute" script shown in Table 6-1 is only understandable if examined in the context in which it is used in the "CUTTER" subroutine of the CRAFT code. The "sed" command issued in the "sedexecute" script initiates the execution of the sed line editor.

7. Detailed Descriptions of CRAFT Input Cards

Input Card Number		Detailed Description
1	:	The CRAFT code is capable of continuing an assembly depletion/decay calculation from a statepoint other than the BOC statepoint of relative cycle number one. The requirements for continuing a CRAFT calculation from an arbitrary statepoint include the following– 1) all CRAFT input for the statepoints prior to the continuation statepoint must be specified in the CRAFT input deck for the continuation calculation; 2) all "*.cut" files from the last statepoint calculation prior to the continuation statepoint, for each node, must be present in the CRAFT execution directory. If the CRAFT calculation is a continuation calculation, an uppercase letter "Y" should be placed in column 1 of this card. Otherwise, any character other than "Y" will signal that the CRAFT calculation is to begin from BOC of relative cycle number one as defined in the CRAFT input deck.
1A	:	This card should only be specified if the value of card number 1 is "Y". This card should contain an integer value representing the relative cycle number as specified in the CRAFT input deck from which the calculation should commence. The relative cycle number refers to the sequential cycle number in which the assembly is inserted. The relative cycle number is not the cycle identifier. For example, if a CRAFT calculation is to be performed for an assembly inserted in the actual reactor cycles 1 and 4, input data for the assembly would be provided to CRAFT for cycles 1 and 4, in that order. Cycle 1 would be considered relative cycle number 1, and cycle 4 would be considered relative cycle number 2.
1B	:	This card should only be specified if the value of card number 1 is "Y". This card should contain an integer value representing the relative statepoint, within the continuation relative cycle number provided on card 1A, from which the calculation should commence.

Input Card Number		Detailed Description
2	:	This card should contain a 21 character problem identifier which will be placed on all SAS2H input decks and echoed throughout the SAS2H output. The problem identifier must be placed in columns 1 through 21 of this card. An example of a problem identifier would be "Crystal River, Unit 3".
3	:	This card should contain a 3 character prefix which will be used as the initial 3 characters of each file generated in the CRAFT calculation. The prefix must be placed in columns 1 through 3 of this card. An example of a prefix meaningful for use with the problem identifier example previously provided would be "CR3".
4	:	This card should contain the identifier for the SCALE cross-section library which is to be used in all of the SAS2H calculations generated by the CRAFT calculation. Available SCALE cross-section libraries include the following-- 1) 44GROUPNDF5 or 44group; 2) 27BURNUPLIB; 3) 27GROUPNDF4; 4) 238GROUPNDF5; 5) HANSEN-ROACH. The 44group cross-section library is recommended for use in all CRAFT calculations relevant to Commercial Reactor Critical evaluations.
5	:	This card should contain the weight percent of U-235 in the UO_2 fuel of the assembly. This value should not be adjusted to compensate for axial blanket fuel. Axial blanket fuel descriptions provided later in the CRAFT input deck will override the enrichment specified on this card as appropriate.
6	:	This card should contain the total mass of uranium metal in the fuel assembly in units of grams per assembly.
7	:	This card should contain the number of fuel rods in the assembly.
8	:	This card should contain the rod pitch in the assembly in units of cm.

Input Card Number		Detailed Description
9	:	This card should contain the nominal fuel pellet diameter in the assembly in units of cm.
10	:	This card should contain the nominal fuel rod cladding inner diameter in the assembly in units of cm.
11	:	This card should contain the nominal fuel rod cladding outer diameter in the assembly in units of cm.
12	:	This card should contain the nominal active fuel length in the assembly in units of cm.
13	:	The CRAFT code is capable of modeling fuel assemblies which utilize axial blanket fuel designs. If the assembly utilizes an axial blanket fuel design, an uppercase letter "Y" should be placed in column 1 of this card. If the assembly does not utilize an axial blanket fuel design, any character other than "Y" should be specified.
13A	:	This card should only be specified if the value of card number 13 is "Y". This card should contain the weight percent of U-235 in the UO_2 fuel of the axial blanket region of the assembly.
13B	:	This card should only be specified if the value of card number 13 is "Y". This card should contain an integer number representing the number of CRC axial nodes that will contain the axial blanket fuel.
13C	:	This card should only be specified if the value of card number 13 is "Y". This card should contain a single integer value which identifies a CRC axial node containing axial blanket fuel. This input card must be repeated a number of times equal to the value specified on input card 13B.
14	:	This card should contain a 7 character name, beginning in column 1, which specifies the spacer grid material. The currently available spacer grid material specifications include--

1) ZIRC-4
2) INCONEL
2) SS304
3) SS304S
4) SS316
5) SS316S.

Input Card Number		Detailed Description
14A	:	This card should contain a value representing the volume fraction of the moderated region of the fuel assembly which is displaced by spacer grid material. The sum of the moderator volume fraction and the spacer grid volume fraction should equal one. The moderator and spacer grid volumes present in the assembly-to-assembly spacing region may also be included in calculation of the spacer grid volume fraction to be input on this card.
15	:	This card should contain the identification of the fuel cladding material. The identification must be specified in columns 1 through 10. The currently available cladding material specifications include-- 1) Zirc-4 or ZIRCALLOY4; 2) INCONEL; 3) SS304; 4) SS304S; 5) SS316; 6) SS316S.
15A	:	This card should contain an average fuel rod cladding temperature value in units of degrees Kelvin that will be used consistently throughout the CRAFT generated SAS2H calculations.
16	:	The CRAFT code is capable of modeling CRA's, APSRA's, and BPRA's with cladding material compositions other than the default Zirc-4. If any cladding material must be specified other than the default Zirc-4, an uppercase letter "Y" should be placed in column 1 of this card. If Zirc-4 is the only cladding material utilized in the CRAFT calculation, any character other than "Y" should be specified.
16A	:	This card should only be specified if the value of card number 16 is "Y". This card should contain an integer value specifying the number of additional cladding materials to be specified other than the default cladding material Zirc-4.

Input Card Number		Detailed Description

Input cards 16B and 16C represent an input grouping that must be specified recursively for each cladding material as denoted on input card 16A. This means that input cards 16B and 16C would be input for the first cladding material, and then input again for the second cladding material, etc., until all of the cladding materials other than Zirc-4 which are utilized in the CRAFT calculation, as specified on input card 16A, have been described.

16B : This card should only be specified if the value of card number 16 is "Y". This card should contain an integer value representing the material mixture number which corresponds to a cladding material specification that may be specified in the SAS2H input decks generated by the CRAFT calculation.

16C : This card should only be specified if the value of card number 16 is "Y". This card should contain either a 5 or 6 character identifier corresponding to the cladding material. The cladding material identifiers currently available in CRAFT include the following--

1) SS304
2) SS304S
3) SS316
4) SS316S.
5) INCONEL

17 : This card should contain the system pressure in units of psi.

18 : The CRAFT code is capable of modeling an assembly that contains a BPRA. Usually, fuel assemblies may contain a BPRA in one cycle but not in subsequent cycles. If the fuel assembly for which the CRAFT calculation is to be performed contains a BPRA in any of its specified reactor cycles, an uppercase letter "Y" should be placed in column 1 of this card. Any other character signifies that the assembly never contains a BPRA.

18A : This card should only be specified if the value of card number 18 is "Y". This card should contain an integer value representing the number of reactor cycles in which the fuel assembly contains a BPRA.

Input Card Number		Detailed Description
18B	:	This card should only be specified if the value of card number 18 is "Y". This card should contain two integer values delineated by spaces. The first value represents the number of different BPRA designs inserted in the fuel assembly during its irradiation history. The second value represents the number of BP absorber materials other than the default, Al_2O_3-B_4C, which are utilized during the irradiation of the assembly as specified in the CRAFT calculation.

Input cards 18C through 18J represent an input grouping that must be specified recursively for each BPRA design as denoted on input card 18B. This means that input cards 18C through 18J would be input for BPRA design 1, and then input again for BPRA design 2, etc., until all of the number of BPRA designs specified on input card 18B have been described.

18C	:	This card should only be specified if the value of card number 18 is "Y". This card should contain 6 values delineated by spaces. The first value should be the density of the Al_2O_3-B_4C burnable absorber material. The second value should be the weight percent of the B_4C in the Al_2O_3-B_4C absorber material. The third value should be the cross-sectional area of the burnable poison material in a single BPR. The fourth value should be the number of BPR's in the BPRA. The fifth value should be the BPR cladding material mixture number to be utilized in the CRAFT generated SAS2H calculations. The sixth value should be the BP absorber material mixture number to be utilized in the CRAFT generated SAS2H calculations.
18D	:	This card should only be specified if the value of card number 18 is "Y". This card should contain the integer number of radial zones that will be used to describe the SAS2H Path B model for the assembly node containing the BPRA.
18E	:	This card should only be specified if the value of card number 18 is "Y". This card contains the description of a single radial zone in the SAS2H Path B model for the assembly containing the BPRA. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 18D.

Input Card Number		Detailed Description
18F	:	This card should only be specified if the value of card number 18 is "Y". If an assembly contains a BPRA in one cycle but not in another, an alternative SAS2H Path B model must be provided that describes the assembly after removal of the BPRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the BPRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly node with the BPRA removed. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 18D.
18G	:	This card should only be specified if the value of card number 18 is "Y". Some BPR designs incorporate a non-absorbing region above the poison region in the BPR. To accomodate this type of BPR design an alternative SAS2H Path B model must be provided that describes the BPR assembly above the poison region of the BPR. This alternative Path B model must contain the same number of radial zones as the Path B model with the BPRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly node containing the BPRA region above the poison region of the BPR. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 18D.

Input Card Number		Detailed Description
18H	:	This card should only be specified if the value of card number 18 is "Y". This card contains a five character entry followed by an integer entry. This card should contain the 5 character string "AL2O3" if the material in the non-absorbing region of the BPR (above the poison region of the BPR) is composed of Al2O3. Any other character string indicates that a material other than Al2O3 is present in the BPR above the poison region. The integer entry of this card should be the SAS2H material mixture number for the material within the BPR above the BP absorbing region.
18I	:	This card should only be specified if the value of card number 18 is "Y", and the character string specified on input card 18H is not "AL2O3". This card should contain an integer value indicating the number of isotopes in the composition of the material contained within the BPR above the poison region.
18J	:	This card should only be specified if the value of card number 18 is "Y", and the character string specified on input card 18H is not "AL2O3". This card should contain an integer value and a floating-point value. The first value specified on this card should be an integer representing the SCALE nuclide identifier for a constituent of the material composition within the BPR above the poison region. The second value should be a floating-point value representing the corresponding wt% of this nuclide in the material composition. This input card should be repeated a number of times equal to that specified on input card 18I.
18K	:	This card should only be specified if the last value of card number 18B is greater than zero. This card should contain an integer value representing the SAS2H material mixture number for the BP absorber material being specified on cards 18L and 18M.
18L	:	This card should only be specified if the last value of card number 18B is greater than zero. This card should contain an integer value specifying the number of isotopes in the BP absorber material mixture specified on input card 18K.

Input Card Number		Detailed Description
18M	:	This card should only be specified if the last value of card number 18B is greater than zero. This card should contain two values delineated by spaces. The first value should be the SCALE nuclide identifier corresponding to a constituent of the BP absorber material mixture specified on input card 18K. The second value should be the weight percent of the nuclide, identified by the first value, in the BP absorber material mixture specified on input card 18K. If the BP absorber material contains boron, the SCALE nuclide identifiers for B-10 and B-11 must be specified explicitly. This input card must be repeated a number of times equal to that specified on input card 18L such that data for all nuclides in the BP absorber material mixture are provided, and the sum of the weight percents of the nuclides in the mixture equals 100.
18N	:	This card should only be specified if the value of card number 18 is "Y". This input card contains four integer values delineated by spaces. The first value is the relative cycle number containing a BPRA. The second value is the relative BPRA design number corresponding to the order in which information was provided in the groupings of input cards 18C through 18F. The third value is the upper CRC axial node number containing the BPRA (the topmost CRC node number is always considered 1). The fourth value is the lower CRC axial node number containing the BPRA. This input card must be repeated a number of times equal to the value specified on input card 18A.
19	:	This card should contain an integer value representing the number of radial zones in the SAS2H Path B model for the fuel assembly as it would be if the assembly never contained a BPRA, a CRA, or an APSR assembly during its irradiation history. This is called the standard Path B model.
20	:	This card contains the description of a single radial zone in the standard Path B model for the fuel assembly. This card should contain two values delineated by spaces.. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 19.

Input Card Number		Detailed Description
21	:	This card should contain an integer value representing the number of cross-section libraries that are to be produced for each irradiation step in the SAS2H calculations generated by CRAFT. The number of cross-section libraries per irradiation step for CRC evaluations should be set to 1.
22	:	This card should contain an integer value representing the SAS2H print level desired for the output of SAS2H calculations generated by CRAFT. The minimum print level allowed for CRC evaluations is 5. A complete listing and description of the available print levels is provided on page S2.5.18 of reference 1.
23	:	This card should contain the zone mesh factor that should be utilized by XSDRNPM in the SAS2H calculations generated by CRAFT. A description of the zone mesh factor is provided on page S2.5.5 of reference 1.
24	:	The CRAFT calculation allows the specification of special XSDRNPM control parameters that will be utilized in SAS2H calculations generated by CRAFT. If any of the special control parameters described in cards 24A through 24G are to be specified, the character string "SPECIAL" must be provided in columns 1 through 7 of this card. Any other character string specification indicates that the default XSDRNPM control parameters are to be utilized.
24A	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter SZF. The size of the largest spatial mesh interval can be adjusted by entering a value for SZF. SZF less than 1 indicates a finer mesh spacing. SZF greater than one indicates a coarser mesh spacing. SZF equal to 1 is the default.
24B	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter ISN. The ISN value specifies the order of angular quadrature for XSDRNPM. Quadrature sets are geometry-dependent quantities that are defaulted to a value of 8.

Input Card Number		Detailed Description
24C	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter IIM. The IIM value specifies the maximum number of inner iterations to be used by XSDRNPM. The default value is 20.
24D	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter ICM. The ICM value specifies the maximum number of outer iterations to be used by XSDRNPM. The default value is 25.
24E	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter EPS. The EPS value specifies the overall convergence criteria. This value is used by XSDRNPM after each outer iteration to determine if the problem has converged. The default value of EPS is 0.0001. A smaller value tightens the convergence criteria, and a larger value loosens the convergence criteria.
24F	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter PTC. The PTC value specifies the point flux convergence criteria used by XSDRNPM to determine if convergence has been achieved after an inner iteration. The default value of PTC is 0.0001. A smaller value tightens the convergence criteria, and a larger value loosens the convergence criteria.
24G	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter IUS. The IUS value is a flag to direct XSDRNPM to use an upscatter scaling technique to accelerate the solution or force convergence. The default value is 0, which indicates that upscatter scaling is not used. An IUS value of 1 directs XSDRNPM to use the upscatter scaling technique. The default value is 0.
25	:	This card should specify an integer number of reactor cycles in which the fuel assembly is inserted in the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 26 through 34 represent an input grouping that must be specified recursively for each reactor cycle in which the fuel assembly is inserted in the CRAFT calculation as denoted on input card 25. This means that input cards 26 through 34 would be input for the first reactor cycle, and then input again for the second reactor cycle, etc., until all of the number of reactor cycles specified on input card 25 have been described.

26	:	This card should contain a 2 character reactor cycle identifier that will be used to identify the cycle on appropriate SAS2H input decks generated by the CRAFT calculation. For example, if the first reactor cycle were identified as "Cycle-1A", the value of this input card should be "1A". If a reactor cycle were identified as "Cycle-1", the value of this input card should be "01", etc...
27	:	This card should contain an integer value specifying the number of CRC statepoints in the reactor cycle specified on input card number 25. The BOC is always considered statepoint 1 in a CRC evaluation. For example, if the reactor cycle specified on card 25 contained one mid-cycle CRC statepoint, the value specified on this card would be 2.

Input cards 28 through 30 represent an input grouping that must be specified recursively for each CRC statepoint in the reactor cycle as denoted on input card 27. This means that input cards 28 through 30 would be input for the first statepoint (BOC), and then input again for the second statepoint, etc., until all of the number of CRC statepoints in the reactor cycle as specified on input card 27 have been described.

28	:	This card should contain a value specifying the EFPD for the statepoint. If the first statepoint in a reactor cycle (BOC) is being described, the value of this card should be 0.
29	:	This card should contain a value specifying the length in calendar days from the BOC to the CRC statepoint. If the first statepoint in a reactor cycle (BOC) is being described, the value of this card should be 0.
30	:	This card should contain a value specifying the downtime in calendar days for the reactor shutdown at the CRC statepoint. If the first statepoint in a reactor cycle (BOC) is being described, the value of this card should be 0.
31	:	This card should contain a value specifying the downtime in calendar days at the EOC reactor shutdown.

Input Card Number		Detailed Description
32	:	This card should contain a value specifying the total EFPD for the reactor cycle from the BOC startup to the EOC shutdown.
33	:	This card should contain a value specifying the total cycle length in calendar days from the BOC startup to the EOC shutdown.
34	:	This card should contain an integer value less than 100 that specifies the position of the fuel assembly in the symmetrical representation of the reactor core. Typically, a CRC evaluation is performed using core symmetry to reduce the overall calculation time required to perform the evaluation. When core symmetry is used, the input parameters utilized in the CRAFT calculation for each node of an assembly are the average of the parameters from each symmetric core location corresponding to the assembly node. Usually, one-eighth core symmetry is utilized in performing CRC evaluations.
35	:	This card should contain a single character to signal to CRAFT whether variable or constant irradiation step description data will be provided. The variable irradiation step description input allows the specification of unique irradiation step durations for each irradiation step in a statepoint calculation. This option may be useful when modeling rodded cycles. The constant irradiation step duration applies the same irradiation step length to a specified number of irradiation steps in a given statepoint calculation. The character "Y" placed in column one of the input card specifies variable irradiation step duration input. The character "N" placed in column one of the input card specifies constant irradiation step duration input.

Input cards 36 through 40 should be specified only if the value of input card 35 is "N". Input cards 36 through 40 represent an input grouping that must be specified recursively for each reactor cycle in which the fuel assembly is inserted in the CRAFT calculation as denoted on input card 25. This means that input cards 36 through 40 would be input for the first reactor cycle, and then input again for the second reactor cycle, etc., until all of the number of reactor cycles specified on input card 25 have been described.

Input Card Number		Detailed Description
36	:	This card should only be specified if the value of card number 35 is "N". This card should contain an integer value specifying the relative cycle number to which the input data provided in the current grouping of input cards 36 through 40 apply. For example, if the CRAFT calculation involved two reactor cycles labeled Cycle-1 and Cycle-5, the relative cycle number corresponding to Cycle-5 would be specified as 2.

Input cards 37 through 40 represent an input grouping that must be specified recursively for the SAS2H calculations commencing from each statepoint in the relative reactor cycle specified on input card 36. This means that input cards 37 through 40 would be input for the first statepoint calculation (BOC to statepoint 2) in the reactor cycle, and then input again for the second statepoint calculation (perhaps statepoint 2 to statepoint 3) in the reactor cycle, etc., until all of the statepoint calculations in the reactor cycle, as specified on input card 27 corresponding to the appropriate reactor cycle, have been described. The last iteration of input cards 37 through 40 for a given reactor cycle should correspond to the last mid-cycle statepoint to EOC SAS2H calculation.

37	:	This card should only be specified if the value of card number 35 is "N". This card should contain an integer value corresponding to the relative statepoint calculation number in the reactor cycle for which input data is being provided. The BOC to mid-cycle statepoint 2 calculation is always considered relative statepoint calculation 1. The last mid-cycle statepoint to EOC calculation is always considered the last relative statepoint calculation in a given reactor cycle.
38	:	This card should only be specified if the value of card number 35 is "N". This card should contain a value specifying the irradiation step length in EFPD for the SAS2H statepoint calculation for which input data is being provided. If the value on input card 35 is "N", the CRAFT code only allows the use of a fixed irradiation step length in each generated SAS2H calculation. However, different irradiation step lengths may be specified for different CRAFT generated SAS2H calculations.
39	:	This card should only be specified if the value of card number 35 is "N". This card should contain an integer value specifying the number of irradiation steps to be utilized in the CRAFT generated SAS2H calculation corresponding to the statepoint calculation for which input data is being provided.

Input Card Number		Detailed Description
40	:	This card should only be specified if the value of card number 35 is "N". This card should contain the soluble boron concentration in units of ppmb at the mid-point of a given irradiation step in the current statepoint calculation for which input data is being provided. This input card must be repeated a number of times equal to that specified on input card 39. The order of repetition of this input card should be such that the initial ppmb concentration corresponds to the first irradiation step, and the final ppmb concentration corresponds to the last irradiation step in the statepoint calculation of interest.

Input cards 41 through 44 should be specified only if the value of input card 35 is "Y". Input cards 41 through 44 represent an input grouping that must be specified recursively for each reactor cycle in which the fuel assembly is inserted in the CRAFT calculation as denoted on input card 25. This means that input cards 41 through 44 would be input for the first reactor cycle, and then input again for the second reactor cycle, etc., until all of the number of reactor cycles specified on input card 25 have been described.

41	:	This card should only be specified if the value of card number 35 is "Y". This card should contain an integer value specifying the relative cycle number to which the input data provided in the current grouping of input cards 41 through 44 apply. For example, if the CRAFT calculation involved two reactor cycles labeled Cycle-1 and Cycle-5, the relative cycle number corresponding to Cycle-5 would be specified as 2.

Input cards 42 through 44 represent an input grouping that must be specified recursively for the SAS2H calculations commencing from each statepoint in the relative reactor cycle specified on input card 41. This means that input cards 42 through 44 would be input for the first statepoint calculation (BOC to statepoint 2) in the reactor cycle, and then input again for the second statepoint calculation (perhaps statepoint 2 to statepoint 3) in the reactor cycle, etc., until all of the statepoint calculations in the reactor cycle, as specified on input card 27 corresponding to the appropriate reactor cycle, have been described. The last iteration of input cards 42 through 44 for a given reactor cycle should correspond to the last mid-cycle statepoint to EOC SAS2H calculation.

Input Card Number		Detailed Description
42	:	This card should only be specified if the value of card number 35 is "Y". This card should contain an integer value corresponding to the relative statepoint calculation number in the reactor cycle for which input data is being provided. The BOC to mid-cycle statepoint 2 calculation is always considered relative statepoint calculation 1. The last mid-cycle statepoint to EOC calculation is always considered the last relative statepoint calculation in a given reactor cycle.
43	:	This card should only be specified if the value of card number 35 is "Y". This card should contain an integer value specifying the number of irradiation steps to be utilized in the CRAFT generated SAS2H calculation corresponding to the statepoint calculation for which input data is being provided.
44	:	This card should only be specified if the value of card number 35 is "Y". This card should contain two real values delineated by spaces. The first value on this card should specify the irradiation step length in EFPD for the SAS2H statepoint calculation for which input data is being provided. The second value on this card should specify the soluble boron concentration in units of ppmb at the mid-point of a given irradiation step in the current statepoint calculation for which input data is being provided. This input card must be repeated a number of times equal to that specified on input card 43. The order of repetition of this input card should be such that the initial ppmb concentration corresponds to the first irradiation step, and the final ppmb concentration corresponds to the last irradiation step in the statepoint calculation of interest.
45	:	This card should contain an integer value corresponding to the number of axial nodes utilized in the CRC evaluation.
46	:	This card contains two integer values delineated by spaces. The first value specifies an axial node number in the CRC axial format. The second value specifies the corresponding node height in units of cm. This card must be repeated a number of times equal to that specified on input card 45. The repetition of this card should be performed such that the CRC axial node data is provided in sequential order (i.e., node 1 through node N, where N is the final node). Node 1should always be specified as the top node of the fuel assembly.

Input Card Number		Detailed Description
47	:	The CRAFT code is capable of modeling an assembly that contains a CRA. If the fuel assembly for which the CRAFT calculation is to be performed contains a CRA in any of its specified reactor cycles, the character string "RODDED" should be placed in columns 1 through 6 of this card. Any other character string signifies that the assembly never contains a CRA.
47A	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of previously defined irradiation steps in the CRAFT calculation in which the fuel assembly contains a CRA.
47A.1	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of axial section of the fuel assembly which contain a CRA during the irradiation step for which data is being provided. This card should be repeated the number of times specified in card number 47A.

Input Card Number		Detailed Description
47B	:	This card should only be specified if the value of card number 47 is "RODDED". This card must be repeated a number of times equal to that specified on input card 47A.1. This card should contain 8 integer values delineated by spaces. The first integer value specifies the relative cycle number in the CRAFT calculation in which a CRA is inserted. The second integer value specifies the relative statepoint calculation number in which a CRA is inserted in the cycle identified by the first value of this card. The BOC to statepoint 1 is always considered statepoint calculation 1. The third value specifies the relative irradiation step number in the statepoint calculation identified by the second value of this card in which the CRA is inserted. The fourth value specifies the upper CRC axial node of the axial assembly section containing the CRA in the relative irradiation step specified by the third value of this card. The top node in the CRC axial format is always node 1. The fifth value specifies the lower CRC axial node of the axial assembly section containing the CRA in the relative irradiation step specified by the third value of this card. The CRAFT code is capable of modeling numerous CRA absorber material mixtures and CRA designs for insertion in an assembly throughout its irradiation history. The sixth value specifies the CRA absorber material mixture number for SAS2H corresponding to the CRA described on this card. The CRA absorber material specifications and mixture numbers are specified on input cards 47C through 47F. The seventh value specifies the CRA design description number corresponding to the CRA described on this card. The CRA design inputs are specified on input cards 47G through 47K. The CRA design description number corresponds to the relative position in which the relevant CRA design description input is provided in the CRAFT input deck.
47C	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of different CRA absorber material mixtures which must be specified for use in the various CRA designs which are inserted in the fuel assembly during its irradiation history relevant to the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 47D through 47F represent an input grouping that must be specified recursively for each CRA absorber material mixture used in the CRAFT calculation as denoted on input card 47C. This means that input cards 47D through 47F would be input for the first CRA absorber material mixture, and then input again for the second CRA absorber material mixture, etc., until all of the CRA absorber material mixtures specified on input card 47C have been described.

47D	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value denoting the material mixture number that should be utilized in the CRAFT generated SAS2H calculations to identify the CRA absorber material mixture for which input is being provided.
47E	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of isotopes in the CRA absorber material mixture specified on input card 47D.
47F	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain two values delineated by spaces. The first value should be the SCALE nuclide identifier corresponding to a constituent of the CRA absorber material mixture specified on input card 47D. The second value should be the weight percent of the nuclide, identified by the first value, in the CRA absorber material mixture specified on input card 47D. This input card must be repeated a number of times equal to that specified on input card 47E such that data for all nuclides in the CRA absorber material mixture are provided, and the sum of the weight percents of the nuclides in the mixture equals 100.
47G	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of different CRA design descriptions that will be specified for use in the CRAFT calculation.

Input cards 47H through 47K represent an input grouping that must be specified recursively for each CRA design used in the CRAFT calculation as denoted on input card 47G. This means that input cards 47H through 47K would be input for the first CRA design description, and then input again for the second CRA design description, etc., until all of the CRA design descriptions specified on input card 47G have been described. The order in which the CRA design descriptions are provided determines the relative CRA design number which corresponds to the description.

Input Card Number		Detailed Description
47H	:	This card should only be specified if the value of card number 47 is "RODDED". This card contains two values delineated by spaces. The first value should specify the absorber material density in units of g/cc for the CRA design for which input is being provided. The second value should be an integer specifying the SAS2H material mixture number for the CR cladding in the CRA design for which input is being provided.
47I	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of radial zones utilized in the SAS2H Path B model for the fuel assembly containing the CRA design for which input is being provided.
47J	:	This card should only be specified if the value of card number 47 is "RODDED". This card contains the description of a single radial zone in the SAS2H Path B model for the fuel assembly containing the CRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 47I.
47K	:	This card should only be specified if the value of card number 47 is "RODDED". If an assembly contains a CRA in one cycle but not in another, an alternative SAS2H Path B model must be provided that describes the assembly after removal of the CRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the CRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly after the removal of the CRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 47I.

Input Card Number		Detailed Description
48	:	The CRAFT code is capable of modeling a fuel assembly that contains a APSRA. If the fuel assembly for which the CRAFT calculation is to be performed contains an APSRA in any of its specified reactor cycles, the character string "RODDED" should be placed in columns 1 through 6 of this card. Any other character string signifies that the assembly never contains an APSRA.
48A	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of previously defined irradiation steps in the CRAFT calculation in which the fuel assembly contains an APSRA.

Input Card Number		Detailed Description
48B	:	This card should only be specified if the value of card number 48 is "RODDED". This card must be repeated a number of times equal to that specified on input card 48A. This card should contain 7 integer values delineated by spaces. The first integer value specifies the relative cycle number in the CRAFT calculation in which a APSRA is inserted. The second integer value specifies the relative statepoint calculation number in which a APSRA is inserted in the cycle identified by the first value of this card. The BOC to statepoint 1 is always considered statepoint calculation 1. The third value specifies the relative irradiation step number in the statepoint calculation identified by the second value of this card in which the APSRA is inserted. The fourth value specifies the upper CRC axial node of the axial assembly section containing the APSRA in the relative irradiation step specified by the third value of this card. The top node in the CRC axial format is always node 1. The fifth value specifies the lower CRC axial node of the axial assembly section containing the APSRA in the relative irradiation step specified by the third value of this card. The CRAFT code is capable of modeling numerous APSRA absorber material mixtures and APSRA designs for insertion in an assembly throughout its irradiation history. The sixth value specifies the APSRA absorber material mixture number for SAS2H corresponding to the APSRA described on this card. The APSRA absorber material specifications and mixture numbers are specified on input cards 48C through 48F. The seventh value specifies the APSRA design description number corresponding to the APSRA described on this card. The APSRA design inputs are specified on input cards 48G through 48K. The APSRA design description number corresponds to the relative position in which the relevant APSRA design description input is provided in the CRAFT input deck. The eighth value is the SAS2H material mixture number corresponding to the APSR follow rod material.
48C	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of different APSRA absorber material mixtures which must be specified for use in the various APSRA designs which are inserted in the fuel assembly during its irradiation history relevant to the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 48D through 48F represent an input grouping that must be specified recursively for each APSRA absorber material mixture used in the CRAFT calculation as denoted on input card 48C. This means that input cards 48D through 48F would be input for the first APSRA absorber material mixture, and then input again for the second APSRA absorber material mixture, etc., until all of the APSRA absorber material mixtures specified on input card 48C have been described.

48D	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value denoting the material mixture number that should be utilized in the CRAFT generated SAS2H calculations to identify the APSRA absorber material mixture for which input is being provided.
48E	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of isotopes in the APSRA absorber material mixture specified on input card 48D.
48F	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain two values delineated by spaces. The first value should be the SCALE nuclide identifier corresponding to a constituent of the APSRA absorber material mixture specified on input card 48D. The second value should be the weight percent of the nuclide, identified by the first value, in the APSRA absorber material mixture specified on input card 48D. This input card must be repeated a number of times equal to that specified on input card 48E such that data for all nuclides in the APSRA absorber material mixture are provided, and the sum of the weight percents of the nuclides in the mixture equals 100.
48G	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of different APSRA design descriptions that will be specified for use in the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 48H through 48L represent an input grouping that must be specified recursively for each APSRA design used in the CRAFT calculation as denoted on input card 48G. This means that input cards 48H through 48L would be input for the first APSRA design description, and then input again for the second APSRA design description, etc., until all of the APSRA design descriptions specified on input card 48G have been described. The order in which the APSRA design descriptions are provided determines the relative APSRA design number which corresponds to the description.

48H	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain two values delineated by spaces. The first value should specify the absorber material density in units of g/cc for the APSRA design for which input is being provided. The second value should be an integer specifying the SAS2H material mixture for the APSR cladding in the APSRA for which input is being provided.
48I	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of radial zones utilized in the SAS2H Path B model for the fuel assembly containing the APSRA design for which input is being provided.
48J	:	This card should only be specified if the value of card number 48 is "RODDED". This card contains the description of a single radial zone in the SAS2H Path B model for the fuel assembly containing the APSRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 48I.

Input Card Number		Detailed Description
48K	:	This card should only be specified if the value of card number 48 is "RODDED". If an assembly contains a APSRA in one cycle but not in another, an alternative SAS2H Path B model must be provided that describes the assembly after removal of the APSRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the APSRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly after the removal of the APSRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 48I.
48L	:	This card should only be specified if the value of card number 48 is "RODDED". APSRA designs typically utilize follow rods which are not of the same material composition as the APSR cladding. To facilitate modeling of the APSR follow rod region, an alternative SAS2H Path B model must be provided that describes the follow rod region of the APR's above the poison region in the APSRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the APSRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the follow rod region of the APSRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 48I.

Input Card Number		Detailed Description

Input cards 49 through 51 represent an input grouping that must be specified recursively for each statepoint calculation to be generated by the CRAFT calculation. This means that input cards 49 through 51 would be input for the first statepoint calculation (BOC to statepoint 2 of relative cycle number 1), and then input again for the second statepoint calculation, etc., until all of the statepoint calculations to be generated by CRAFT have been addressed (the final statepoint calculation would be that ending at the final statepoint in the last relative cycle).

49	:	This card should contain an integer value specifying the number of axial nodes in the axial format in which the current fuel temperature input data is being provided.
50	:	This card should contain two values delineated by spaces. The first value should be the appropriate node number in the fuel temperature axial format for the statepoint calculation for which input is being provided. The second value should be the node height corresponding to the axial node number identified by the first value. This input card specification should be repeated the number of times identified on input card 49. The nodal format input specified with this card should be ordered sequentially such that node 1 represents the top node of the fuel assembly.
51	:	This card should contain an exposure weighted average fuel temperature value in units of degrees Fahrenheit for the appropriate node in the fuel temperature input axial format corresponding to the statepoint calculation for which input data is being provided. This input card specification should be repeated the number of times identified on input card 49. The data provided in the sequential repetition of this input card should be ordered to correspond to the nodal input format described by the previous repetition of input card 50.

Input cards 52 through 54 represent an input grouping that must be specified recursively for each statepoint calculation to be generated by the CRAFT calculation. This means that input cards 52 through 54 would be input for the first statepoint calculation (BOC to statepoint 2 of relative cycle number 1), and then input again for the second statepoint calculation, etc., until all of the statepoint calculations to be generated by CRAFT have been addressed (the final statepoint calculation would be that ending at the final statepoint in the last relative cycle).

52	:	This card should contain an integer value specifying the number of axial nodes in the axial format in which the current moderator specific volume input data is being provided.

Input Card Number		Detailed Description
53	:	This card should contain two values delineated by spaces. The first value should be the appropriate node number in the moderator specific volume axial format for the statepoint calculation for which input is being provided. The second value should be the node height corresponding to the axial node number identified by the first value. This input card specification should be repeated the number of times identified on input card 52. The nodal format input specified with this card should be ordered sequentially such that node 1 represents the top node of the fuel assembly.
54	:	This card should contain an exposure weighted average moderator specific volume value in units of ft^3/lb for the appropriate node in the moderator specific volume input axial format corresponding to the statepoint calculation for which input data is being provided. This input card specification should be repeated the number of times identified on input card 52. The data provided in the sequential repetition of this input card should be ordered to correspond to the nodal input format described by the previous repetition of input card 53.

Input cards 55 through 57 represent an input grouping that must be specified recursively for each statepoint calculation to be generated by the CRAFT calculation. This means that input cards 55 through 57 would be input for the first statepoint calculation (BOC to statepoint 2 of relative cycle number 1), and then input again for the second statepoint calculation, etc., until all of the statepoint calculations to be generated by CRAFT have been addressed (the final statepoint calculation would be that ending at the final statepoint in the last relative cycle).

55	:	This card should contain an integer value specifying the number of axial nodes in the axial format in which the current burnup input data is being provided.
56	:	This card should contain two values delineated by spaces. The first value should be the appropriate node number in the burnup axial format for the statepoint calculation for which input is being provided. The second value should be the node height corresponding to the axial node number identified by the first value. This input card specification should be repeated the number of times identified on input card 55. The nodal format input specified with this card should be ordered sequentially such that node 1 represents the top node of the fuel assembly.

Input Card Number		Detailed Description
57	:	This card should contain an exposure weighted average burnup value in units of GWd/MTU corresponding to the total burnup of the node at the beginning of the statepoint calculation for which input data is being provided. This input card specification should be repeated the number of times identified on input card 55. The data provided in the sequential repetition of this input card should be ordered to correspond to the nodal input format described by the previous repetition of input card 56.

8. CRAFT Output Description

The CRAFT code generates five types of files identified as either "*.input", "*.output", "*.cut", "*.msgs", or "*.notes", where the "*" is the base file set identifier for the statepoint calculation of interest. The "*.cut" and "*.notes" files are the only files that must be retained for CRC evaluation and documentation purposes. All files are generated in the working directory in which the CRAFT calculation is performed.

All CRAFT generated filenames utilize the following format: "{Base File Set Identifier}.{suffix}". Where the suffix corresponds to one of the five file types previously mentioned, and the base file set identifier is a 25 character name containing essential information necessary to delineate one CRAFT generated SAS2H calculation from another.

The base file set identifier for a statepoint calculation contains the following information:

1) reactor identifier (three character);
2) one-eighth core symmetry assembly number in current reactor cycle (two digit);
3) axial node number (node 1 is always the top node) (two digit);
4) reactor cycle number in which the SAS2H calculation starts (two character);
5) EFPD statepoint at which the SAS2H calculation starts (truncated to three digits);
6) reactor cycle number in which the SAS2H calculation ends (two character);
7) EFPD statepoint at which the SAS2H calculation ends (truncated to three digits).

The format of the base file set identifier is as follows where the numbers identified as #{number} correspond to one of the seven items previously listed-- #1 A #2 N #3 DC #4 T #5 AC #6 T #7. The base file set identifier does not contain any spaces.

The "*.input" files contain a CRAFT generated SAS2H input deck. The "*.output" files contain a complete SAS2H calculation output file. The "*.cut" files contain the corresponding SAS2H input deck followed by an output extraction, from the final ORIGEN pass of the SAS2H calculation, which contains data relevant to CRC evaluations. The "*.msgs" files contain the standard run-time messages associated with the SAS2H calculation. The "*.notes" files contain a listing of the isotopes and their concentration which were left behind in generating the initial charge fuel composition for a continuation SAS2H calculation. The "*.notes" files are only generated for CRAFT generated SAS2H calculations which are continuing depletion and decay calculations. The "*.cut" and "*.notes" files contain all of the information which is required to perform CRC evaluations or repeat calculations as necessary for quality assurance purposes. The remainder of the CRAFT generated files may be discarded once the "*.cut" and "*.notes" files have been produced correctly.

9. Modifications Made Between CRAFT Version 1.0 and Version 2.0

Two modifications were made to the CRAFT Version 2.0 source code to create CRAFT Version 3.0. The CRAFT Version 2.0 code is documented in Attachment I of reference 4. The Version 3.0 code modifications are documented in this section. The modifications do not affect the validity of any of the previous results obtained using either the CRAFT Version 1.0 or CRAFT Version 2.0 codes.

Modification 1:

In Version 3.0, the following lines were added to the code as presented on page 10 of the source code listing in Appendix A.

```
      READ (10,*) NUMOFSECTIONS ! Number of axial sections of the fuel
     *                          assembly which have a rod assembly inserted.
         DO 315 SECT=1,NUMOFSECTIONS
...{existing source code}...
  315    CONTINUE
```

The purpose of this modification is to allow the CRAFT code to model a non-continuous number of axial assembly sections containing a CRA during an individual irradiation time step in the depletion calculations.

Modification 2:

In Version 3.0, the following modification was made to a line of the code as presented on page 57 of the source code listing in Appendix A.

Format of the modified line of source code in Version 2.0:

```
            IF (BPMIX(BPRA_DESCRIPTION_ID).EQ.0) THEN
```

Format of the modified line of source code in Version 3.0:

```
            IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c      (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
```

The purpose of this modification is to enable CRAFT to label the burnable poison material as

Al_2O_3-B_4C in the SAS2H input decks if a SAS2H material mixture number for the burnable poison is entered in the CRAFT input deck as either "0" or "4". This modification is purely for commentary purposes and does not affect the calculational flow as dictated by the CRAFT code.

10. References

1) *SCALE 4.3: Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation User Manuals, Volumes 0 through 3*, Oak Ridge National Laboratory, Document Number: CCC-545.

2) S. M. Bowman, O. W. Hermann, and M. C. Brady. *Scale-4 Analysis of Pressurized Water Reactor Critical Configurations: Volume 2-Sequoyah Unit 2 Cycle 3*, Oak Ridge National Laboratory, Document Number: ORNL/TM-12294/V2.

3) F. W. Walker, J. R. Parrington, and F. Feiner. *Nuclides and Isotopes, Fourteenth Edition*, General Electric Company, 1989.

4) K. D. Wright. *CRC Depletion Calculations for the Non-Rodded Assemblies in Batches 4 and 5 of Crystal River Unit 3*, Office of Civilian Radioactive Waste Management, U. S. Department of Energy, Document Identifier: BBA000000-01717-0200-00033 REV 00.

Attachment II

CRAFT Version 3.0 Fortran Source Code Listing

This is Appendix A: CRAFT Version 3.0 Fortran Source Code Listing of the CRAFT User Information Documented in Attachment I

```
      PROGRAM CRAFT
***********************************************************
*     Commercial Reactor Assembly Follow Taskmaster       *
***********************************************************
*     This code writes the SAS2H input decks necessary to  *
*     perform depletion and decay calculations on an assembly *
*     required in subsequent Commercial Reactor Critical   *
*     evaluations.  The code controls the SAS2H input deck *
*     creation such that a new SAS2H input deck is developed *
*     to perform depletion and decay calculations between CRC *
*     statepoints in a given sequence.  The depletion and  *
*     decay of the fuel assembly through all CRC statepoints *
*     is simulated as a continuous process by using feed fuel *
*     isotopics from the previous calculation in the sequence.*
***********************************************************
*
      INTEGER*4 BPZONE(10), BPMA(15,10), LMA(15,10), LUZONE,
     c LMB(15), NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM(20), MONUM(20), BUNUM(20), CT1, CT2,
     c APSRINS(10,20,23,50), APSRSTEPNUM,
     c APSRMIXNUM, APSRMIXID(25),
     c CRINS(10,20,23,50), CRSTEPNUM,
     c CRMIXNUM, CRMIXID(25), CRNUMISOS(25),
     c CRISOID(25,10), AXBLANK(50), AXBLANKNODNUM,
     c STPTS(10), CYCPOS(10), APSRNUMISOS(25), APSRISOID(25,10),
     c STPTSUM, BPRADESNUM, CRDESNUM, CRZONE(10), CRMA(15,10),
     c LMC(15,10), APSRDESNUM, APSRZONE(10), APSRMA(15,10),
     c LMD(15,10), BPCYCID, BPTN(10), BPBN(10), DES, BPCYCNUM,
     c BPDESID(10), CRDES(10,20,23,50), APSRDES(10,20,23,50),
     c RELATIVE_STPT_NUM, RELATIVE_APSR_MIX_ID,
     c STPTTALLY(20), CT1START, CT2START, CLADTOT, CLADDESNUM(10),
     c BPRCLAD(10), CRCLAD(10), APSRCLAD(10), BPMIXNUM, BPMIX(10),
     c BPMIXID(10), BPNUMISOS(20), BPISOID(10,20), VARSTEPNUM(10,20),
     c BPRFM(15,10), BPFMNUMISOS(25), BPFISOID(25,10), ABOVEBPNUM(10),
     c APSRFM(15,10), APSRFOLLOWMIX(10,20,23,50)
*
      REAL CLTEMP, PRESS, BPDEN(10), BPRA(15,10), CRISOWTPCT(25,10),
     c LRA(15,10), LRB(15), MESH, SZF, EPS, PTC, APSRISOWTPCT(25,10),
     c NODES(50,2), BLETDOWN(10,20,25), AXBLANKRICH, STPTDAT(10,20,3),
     c FTNDES(50,2,20), FTDAT(50,20), MONDES(50,2,20), MODAT(50,20),
     c BUNDES(50,2,20), BUDAT(50,20), RICH, FMASS, RODS, CYCLEN(10,2),
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN(10), CRDEN(10),
     c CRRA(15,10), LRC(15,10), APSRDEN(10), APSRRA(15,10), LRD(15,10),
     c BPWTPCT(10), HTOT, FDHT(20), MDHT(20), BDHT(20), FTIN(50,20),
     c MOIN(50,20), BUIN(50,20), GRAMS(50), POWER(50,20),
     c FTFINAL(50,20), MODDENFINAL(50,20), MODTEMPFINAL(50,20),
     c DENDAT(29,10), BPISOWTPCT(10,20), BPXSECT(10), UCSPACERFRAC,
     c VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50), BPRFR(15,10),
     c BPFISOWTPCT(25,10), APSRFR(15,10)
*
      CHARACTER REACT*21, PREFIX*3, AXBLANKET*1, BPRFLAG*1,
     c FUELCLAD*10, FLAG2*7, CYCLEID(10)*2, CRSTAT*6,
     c APSRSTAT*6, LIB*15, NM*31, CLADDESNAME(10)*7,
     c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
*    Data input for table of subcooled water density (g/cc) at
*    various temperatures (F) and pressures (psia).
*    (REFERENCE: Radiation Shielding Information Center Number
*    CCC-545, "SCALE 4.2, Modular Code System for Performing
*    Standardized Computer Analyses for Licensing Evaluation,
```

```
*     Volume 1, Page S2.5.14, Table S2.5.2.)
*
      DATA ((DENDAT(E,Q),Q=1,10),E=1,29) /0.0,3000.0,2500.0,
     c 2000.0,1500.0,1000.0,
     c 800.0,600.0,400.0,200.0,50.0,1.0084,1.0069,1.0055,1.0040,
     c 1.0025,1.0019,
     c 1.0013,1.0007,1.000,100,1.0018,1.0004,0.9989,0.9975,0.9960,
     c 0.9954,0.9948,0.9942,0.9936,150.0,0.9893,0.9878,0.9864,0.9849,
     c 0.9834,0.9828,0.9822,0.9815,0.9809,200,0.9725,0.9709,0.9694,
     c 0.9679,0.9663,0.9656,0.9650,0.9644,0.9637,250.0,0.9522,0.9505,
     c 0.9489,0.9472,0.9455,0.9449,0.9442,0.9435,0.9428,300,0.9289,
     c 0.9271,0.9252,0.9234,0.9215,0.9208,0.9200,0.9192,0.9185,350.0,
     c 0.9026,0.9006,0.8985,0.8964,0.8943,0.8934,0.8925,0.8916,0,
     c 400.0,0.8733,0.8709,0.8685,0.8660,0.8634,0.8624,0.8613,0.8603,0,
     c 450.0,0.8405,0.8375,0.8345,0.8314,0.8281,0.8268,0.8255,0,0,
     c 500.0,0.8029,0.7992,0.7952,0.7911,0.7869,0.7851,0,0,0,
     c 510.0,0.7947,0.7907,0.7866,0.7822,0.7776,0,0,0,0,
     c 520.0,0.7862,0.7820,0.7776,0.7729,0.7680,0,0,0,0,
     c 530.0,0.7775,0.7729,0.7682,0.7632,0.7579,0,0,0,0,
     c 540.0,0.7683,0.7635,0.7584,0.7530,0.7472,0,0,0,0,
     c 550.0,0.7589,0.7537,0.7482,0.7423,0,0,0,0,0,
     c 560.0,0.7490,0.7434,0.7374,0.7310,0,0,0,0,0,
     c 570.0,0.7386,0.7326,0.7261,0.7190,0,0,0,0,0,
     c 580.0,0.7278,0.7212,0.7141,0.7062,0,0,0,0,0,
     c 590.0,0.7164,0.7092,0.7012,0.6923,0,0,0,0,0,
     c 600.0,0.7043,0.6963,0.6874,0,0,0,0,0,0,
     c 610.0,0.6915,0.6825,0.6724,0,0,0,0,0,0,
     c 620.0,0.6777,0.6676,0.6558,0,0,0,0,0,0,
     c 630.0,0.6629,0.6512,0.6370,0,0,0,0,0,0,
     c 640.0,0.6467,0.6329,0,0,0,0,0,0,0,
     c 650.0,0.6288,0.6119,0,0,0,0,0,0,0,
     c 660.0,0.6086,0.5866,0,0,0,0,0,0,0,
     c 670.0,0.5850,0,0,0,0,0,0,0,0,
     c 680.0,0.5559,0,0,0,0,0,0,0,0/
*
      write (*,*) 'calling data_aquisition'
      CALL DATA_AQUISITION (BPZONE, BPMA,
     c LMB, NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM, MONUM, BUNUM, APSRINS,
     c APSRSTEPNUM, APSRMIXNUM, APSRMIXID, CRINS,
     c CRSTEPNUM, CRMIXNUM, CRMIXID, CRNUMISOS,
     c CRISOID, AXBLANK, AXBLANKNODNUM, STPTS,
     c CYCPOS, APSRNUMISOS, APSRISOID, STPTSUM,
     c BPRADESNUM, CRDESNUM, CRZONE, CRMA, LMC,
     c APSRDESNUM, APSRZONE, APSRMA, LMD,
     c BPCYCID, BPTN, BPBN, DES, BPCYCNUM, BPDESID,
     c CRDES, APSRDES, LMA, LUZONE,
     c CLTEMP, PRESS, BPDEN, BPRA, CRISOWTPCT,
     c LRA, LRB, MESH, SZF, EPS, PTC, APSRISOWTPCT,
     c NODES, BLETDOWN, AXBLANKRICH, STPTDAT,
     c FTNDES, FTDAT, MONDES, MODAT,
     c BUNDES, BUDAT, RICH, FMASS, RODS, CYCLEN,
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN, CRDEN,
     c CRRA, LRC, APSRDEN, APSRRA, LRD,
     c BPWTPCT, REACT, PREFIX, AXBLANKET, BPRFLAG,
     c FUELCLAD, FLAG2, CYCLEID, CRSTAT,
     c APSRSTAT, LIB, BPXSECT, BPRODS, GT1START,
     c GT2START, CLADTOT, CLADDESNUM, CLADDESNAME,
     c BPRCLAD, CRCLAD, APSRCLAD, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
```

```
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c BPRFM, BPFMNUMISOS, BPFISOID, ABOVEBPNUM, APSRFM,
     c BPRFR, BPFISOWTPCT, APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
      write (*,*) 'calling std_height'
      CALL STD_HEIGHT (AXNUM, FTNUM,
     c MONUM, BUNUM, HTOT, NODES, STPTSUM,
     c FDHT, FTNDES, MDHT, MONDES,
     c BDHT, BUNDES)
*
      write (*,*) 'calling fueltemp_format'
      CALL FUELTEMP_FORMAT (STPTSUM, AXNUM, FTNUM,
     c NODES, FTNDES, FTDAT, FTIN)
*
      write (*,*) 'calling modspecvol_format'
      CALL MODSPECVOL_FORMAT (STPTSUM, AXNUM, MONUM,
     c NODES, MONDES, MODAT, MOIN)
*
      write (*,*) 'calling burnup_format'
      CALL BURNUP_FORMAT (STPTSUM, AXNUM, BUNUM,
     c NODES, BUNDES, BUDAT, BUIN)
*
      write (*,*) 'calling power_calcs'
      CALL POWER_CALCS (NBR, AXNUM, STPTSUM, STPTTALLY,
     c STPTS, GRAMS, FMASS, NODES, HTOT, BUIN,
     c STPTDAT, POWER, CYCLEN, STEPCONTROL, VARBLETDOWN,
     c VARSTEPNUM, VARPOWER)
*
      write (*,*) 'calling units_conversion'
      CALL UNITS_CONVERSION (STPTSUM, AXNUM, FTFINAL,
     c FTIN, MODDENFINAL, MOIN, PRESS, MODTEMPFINAL,
     c DENDAT)
*
      write (*,*) 'calling execution_control'
      CALL EXECUTION_CONTROL (NBR, RELATIVE_STPT_NUM,
     c CT1, CT2, CT3, AXNUM, CYCPOS, AXBLANK,
     c BPDESID, CRINS, CRDES,
     c CRMIXNUM, CRMIXID, CRNUMISOS, CRISOID,
     c APSRINS, APSRMIXNUM, APSRMIXID,
     c RELATIVE_APSR_MIX_ID, APSRNUMISOS,
     c APSRISOID, ISN, IIM, ICM, IUS, PLEVEL,
     c BPZONE, BPMA, CRZONE, CRMA,
     c LMC, APSRZONE, APSRMA, LMD,
     c BPTN, BPBN, STPTS, APSRDES,
     c STPTDAT, AXBLANKRICH, GRAMS,
     c NODES, RODS, RICH, FTFINAL,
     c MODDENFINAL, MODTEMPFINAL,
     c BLETDOWN, BPWTPCT, BPDEN, CRDEN,
     c CRISOWTPCT, APSRDEN, APSRISOWTPCT,
     c PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
     c BPRA, CRRA, LRC, APSRRA,
     c LRD, POWER, CYCDOWN, PREFIX,
     c NM, CYCLEID, REACT, LIB, AXBLANKET,
     c FUELCLAD, BPRFLAG, CRSTAT, APSRSTAT, FLAG2,
     c LUZONE, LMB, LRB, BPXSECT, BPRODS,
     c CT1START, CT2START, STPTTALLY, CLADTOT,
     c CLADDESNUM, CLADDESNAME, BPRCLAD, CRCLAD,
     c APSRCLAD, CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
```

```
     c VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
      END

*****************************************************************
*     Reactor and Problem Data Acquisition Subroutine           *
*****************************************************************
      SUBROUTINE DATA_AQUISITION (BPZONE, BPMA,
     c LMB, NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM, MONUM, BUNUM, APSRINS,
     c APSRSTEPNUM, APSRMIXNUM, APSRMIXID, CRINS,
     c CRSTEPNUM, CRMIXNUM, CRMIXID, CRNUMISOS,
     c CRISOID, AXBLANK, AXBLANKNODNUM, STPTS,
     c CYCPOS, APSRNUMISOS, APSRISOID, STPTSUM,
     c BPRADESNUM, CRDESNUM, CRZONE, CRMA, LMC,
     c APSRDESNUM, APSRZONE, APSRMA, LMD,
     c BPCYCID, BPTN, BPBN, DES, BPCYCNUM, BPDESID,
     c CRDES, APSRDES, LMA, LUZONE,
     c CLTEMP, PRESS, BPDEN, BPRA, CRISOWTPCT,
     c LRA, LRB, MESH, SZF, EPS, PTC, APSRISOWTPCT,
     c NODES, BLETDOWN, AXBLANKRICH, STPTDAT,
     c FTNDES, FTDAT, MONDES, MODAT,
     c BUNDES, BUDAT, RICH, FMASS, RODS, CYCLEN,
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN, CRDEN,
     c CRRA, LRC, APSRDEN, APSRRA, LRD,
     c BPWTPCT, REACT, PREFIX, AXBLANKET, BPRFLAG,
     c FUELCLAD, FLAG2, CYCLEID, CRSTAT,
     c APSRSTAT, LIB, BPXSECT, BPRODS, CT1START,
     c CT2START, CLADTOT, CLADDESNUM, CLADDESNAME,
     c BPRCLAD, CRCLAD, APSRCLAD, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c BPRFM, BPFMNUMISOS, BPFISOID, ABOVEBPNUM, APSRFM,
     c BPRFR, BPFISOWTPCT, APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
      INTEGER*4 BPZONE(10), BPMA(15,10), LMA(15,10), LUZONE,
     c LMB(15), NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM(20), MONUM(20), BUNUM(20), CT1, CT2, CT3,
     c APSRINS(10,20,23,50), APSRSTEPNUM, APSRCYC, APSRSTEP,
     c TOPN, BOTN, APSRMIX, APSRMIXNUM, APSRMIXID(25),
     c CRINS(10,20,23,50), CRSTEPNUM, CRCYC, CRSTEP, CYCHOLDER,
     c CRMIX, STPTHOLDER, CRMIXNUM, CRMIXID(25), CRNUMISOS(25),
     c CRISOID(25,10), AXBLANK(50), AXBLANKNODNUM, AXBLANKTEMP,
     c STPTS(10), CYCPOS(10), APSRNUMISOS(25), APSRISOID(25,10),
     c STPTSUM, BPRADESNUM, CRDESNUM, CRZONE(10), CRMA(15,10),
     c LMC(15,10), APSRDESNUM, APSRZONE(10), APSRMA(15,10),
     c LMD(15,10), BPCYCID, BPTN(10), BPBN(10), DES, BPCYCNUM,
     c BPDESID(10), CRDES(10,20,23,50), APSRDES(10,20,23,50),
     c BPRODS(10), CT1START, CT2START, APSRSTPT, CRSTPT,
     c CLADTOT, CLADDESNUM(10), BPRCLAD(10), CRCLAD(10),
     c APSRCLAD(10), BPMIXNUM, BPMIX(10), BPMIXID(10),
     c BPNUMISOS(20), BPISOID(10,20), VARSTEPNUM(10,20),
     c BPRFM(15,10), BPFMNUMISOS(25), BPFISOID(25,10),
     c ABOVEBPNUM(10), APSRFM(15,10), FMIX, APSRFOLLOWMIX(10,20,23,50),
     c NUMOFSECTIONS, SECT
*
      REAL CLTEMP, PRESS, BPDEN(10), BPRA(15,10), CRISOWTPCT(25,10),
```

```
     c LRA(15,10), LRB(15), MESH, SZF, EPS, PTC, APSRISOWTPCT(25,10),
     c NODES(50,2), BLETDOWN(10,20,25), AXBLANKRICH, STPTDAT(10,20,3),
     c FTNDES(50,2,20), FTDAT(50,20), MONDES(50,2,20), MODAT(50,20),
     c BUNDES(50,2,20), BUDAT(50,20), RICH, FMASS, RODS, CYCLEN(10,2),
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN(10), CRDEN(10),
     c CRRA(15,10), LRC(15,10), APSRDEN(10), APSRRA(15,10), LRD(15,10),
     c BPWTPCT(10), BPXSECT(10), BPISOWTPCT(10,20), UCSPACERFRAC,
     c VARBLETDOWN(10,20,25,25), BPRFR(15,10), BPFISOWTPCT(25,10),
     c APSRFR(15,10)
*
      CHARACTER REACT*21, PREFIX*3, AXBLANKET*1, BPRFLAG*1,
     c FUELCLAD*10, FLAG2*7, CYCLEID(10)*2, CRSTAT*6,
     c APSRSTAT*6, LIB*15, PICKUPFLAG*1, CLADFLAG*1, CLADDESNAME(10)*7,
     c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
*     Hardwired ASSYFOLLOW limitations:
***************************************************************************
*******
*     Maximum number of irradiation steps in a given SAS2H input deck = 23.
*
*     Maximum number of isotopes in a CR or APSR material composition = 10.
*
*     Maximum number of concentric zones in a Path B Model = 15.
*
*     Maximum number of axial nodes in any axial format = 50.
*
*     Maximum number of reactor cycles in which an assembly may be inserted =
10.   *
*     Maximum number of CRC statepoints allowed in a given cycle = 20.
*
*     Maximum number of BPRA designs = 10.
*
*     Maximum number of CR absorber material mixtures = 25.
*
*     Maximum number of CRA designs = 10.
*
*     Maximum number of APSR absorber material mixtures = 25.
*
*     Maximum number of APSR assembly designs = 10.
*
***************************************************************************
*******
*
      OPEN (UNIT=10, FILE='datain', STATUS='OLD')
      REWIND (UNIT=10)
      READ (10,2) PICKUPFLAG ! PICKUPFLAG is a signal to begin the assembly
*                              depletion and decay calculation at a point
*                              other than the beginning of the assembly's
*                              irradiation history as specified in the input
*                              deck
    2 FORMAT(A1)
      IF (PICKUPFLAG.EQ.'Y') THEN
         READ(10,*) CT1START
         READ(10,*) CT2START
      ELSE
         CT1START=1
         CT2START=1
      ENDIF
*
      READ (10,10) REACT    ! REACT is the problem identification
```

```
*                              (up to 21 characters).
      READ (10,20) PREFIX    ! PREFIX is a 3 character prefix to be
*                              placed at the beginning of all SAS2H
*                              input decks produced.
      READ (10,40) LIB       ! LIB is a 15 character identification
*                              of the cross-section library requested
*                              for use in the SCALE code system.
   10 FORMAT (A21)
   20 FORMAT (A3)
   30 FORMAT (A2)
   40 FORMAT (A15)
*
*     Fuel Batch Data Acquisition
*
      READ (10,*) RICH   ! RICH is the fuel assy wt% U-235 in UO2
*                          enrichment.
      READ (10,*) FMASS  ! FMASS is the fuel assy loading of
*                          uranium in g/assy.
      READ (10,*) RODS   ! RODS is the number of fuel rods in the assy.
      READ (10,*) PITCH  ! PITCH is the fuel rod pitch in the assy.
      READ (10,*) FOD    ! FOD is the fuel rod outer diameter in cm.
      READ (10,*) CID    ! CID is the clad inner diameter in cm.
      READ (10,*) COD    ! COD is the clad outer diameter in cm.
      READ (10,*) LENGTH ! LENGTH is the active fuel length in cm.
      READ (10,70) AXBLANKET ! Flag for axial blanket modelling.
   70 FORMAT(A1)
      IF (AXBLANKET.EQ.'Y') THEN
         READ (10,*) AXBLANKRICH ! Axial blanket fuel U-235 enrichment.
*        Initialize AXBLANK array
         DO 80 CT1=1,50
            AXBLANK(CT1)=0
   80    CONTINUE
*        Gather data for AXBLANK array
         READ (10,*) AXBLANKNODNUM ! Number of nodes with axial
*                                    blanket fuel.
         DO 90 CT1=1,AXBLANKNODNUM
            READ (10,*) AXBLANKTEMP ! Node containing axial
*                                     blanket fuel.
            AXBLANK(AXBLANKTEMP)=1 ! Identify axial blanket fuel
*                                    node location in AXBLANK.
   90    CONTINUE
      ENDIF
*     Spacer data acquisition
      READ (10,92) SPACERMAT
   92 FORMAT(A7)
      READ (10,*) UCSPACERFRAC
*     Cladding data acquisition
      READ (10,100) FUELCLAD
  100 FORMAT (A10)
      READ (10,*) CLTEMP
      READ (10,101) CLADFLAG
  101 FORMAT (A1)
      IF (CLADFLAG.EQ.'Y') THEN
         READ(10,*) CLADTOT
         DO 108 CT1=1,CLADTOT
            READ(10,*) CLADDESNUM(CT1)
            READ(10,105) CLADDESNAME(CT1)
  105       FORMAT (A7)
  108    CONTINUE
      ENDIF
```

```
*     System Pressure
      READ (10,*) PRESS
      READ (10,110) BPRFLAG
  110 FORMAT (A1)
      IF (BPRFLAG.EQ.'Y') THEN
         READ(10,*) BPCYCNUM  ! Number of cycles with BPRA
         READ(10,*) BPRADESNUM, BPMIXNUM
         DO 145 CT2=1,BPRADESNUM
*           Get BP density, B4C wt% in Al2O3-B4C,
*           BP x-sectional area, # BP rods, and BPR clad mix num
            READ (10,*) BPDEN(CT2), BPWTPCT(CT2), BPXSECT(CT2),
     c      BPRODS(CT2), BPRCLAD(CT2), BPMIX(CT2)
*           Larger BPRA unit cell data acquisition
            READ (10,*) BPZONE(CT2)
            DO 112 CT1=1,BPZONE(CT2)
               READ (10,*) BPMA(CT1,CT2), BPRA(CT1,CT2)
  112       CONTINUE
*           Larger standard unit cell for use with BPRAs
            DO 114 CT1=1,BPZONE(CT2)
               READ (10,*) LMA(CT1,CT2), LRA(CT1,CT2)
  114       CONTINUE
            DO 116 CT1=1,BPZONE(CT2)
               READ(10,*) BPRFM(CT1,CT2), BPRFR(CT1,CT2)
  116       CONTINUE
            READ(10,118) ABOVEBP(CT2), ABOVEBPNUM(CT2)
  118       FORMAT (A5,1X,I3)
            IF (ABOVEBP(CT2).NE.'AL2O3') THEN
               READ (10,*) BPFMNUMISOS(CT2)
               DO 120 CT1=1,BPFMNUMISOS(CT2)
                  READ (10,*) BPFISOID(CT2,CT1),
     c            BPFISOWTPCT(CT2,CT1)
  120          CONTINUE
            ENDIF
  145    CONTINUE
         DO 147 CT1=1,10
            DO 146 CT2=1,20
               BPISOID(CT1,CT2)=0
               BPISOWTPCT(CT1,CT2)=0.0
  146       CONTINUE
  147    CONTINUE
         IF (BPMIXNUM.NE.0) THEN
            DO 150 CT1=1,BPMIXNUM
               READ (10,*) BPMIXID(CT1) ! SAS2H Mixture ID for CR
               READ (10,*) BPNUMISOS(CT1)
               DO 149 CT2=1,BPNUMISOS(CT1)
                  READ (10,*) BPISOID(CT1,CT2), BPISOWTPCT(CT1,CT2)
  149          CONTINUE
  150       CONTINUE
         ENDIF
         DO 156 CT1=1,10
            BPDESID(CT1)=0
  156    CONTINUE
         DO 157 CT1=1,BPCYCNUM
            READ(10,*) BPCYCID, BPDESID(BPCYCID), BPTN(BPCYCID),
     c      BPBN(BPCYCID)
  157    CONTINUE
      ENDIF
*     Larger standard unit cell
      READ (10,*) LUZONE
      DO 170 CT1=1,LUZONE
```

```
         READ (10,*) LMB(CT1), LRB(CT1)
  170 CONTINUE
*     Contol parameter data acquisition
      READ (10,*) NLIB
      READ (10,*) PLEVEL
      READ (10,*) MESH
      READ (10,180) FLAG2
  180 FORMAT (A7)
      IF (FLAG2.EQ.'SPECIAL') THEN
         READ (10,*) SZF
         READ (10,*) ISN
         READ (10,*) IIM
         READ (10,*) ICM
         READ (10,*) EPS
         READ (10,*) PTC
         READ (10,*) IUS
      ENDIF
*     Reactor history data acquisition
      READ (10,*) NBR
      DO 210 CT1=1,NBR
         READ (10,190) CYCLEID(CT1)
  190    FORMAT (A2)
         READ (10,*) STPTS(CT1)
         DO 200 CT2=1,STPTS(CT1)
            READ (10,*) STPTDAT(CT1,CT2,1)
            READ (10,*) STPTDAT(CT1,CT2,2)
            READ (10,*) STPTDAT(CT1,CT2,3)
  200    CONTINUE
         READ (10,*) CYCDOWN(CT1)
         READ (10,*) CYCLEN(CT1,1)
         READ (10,*) CYCLEN(CT1,2)
         READ (10,*) CYCPOS(CT1)
  210 CONTINUE
      STEPCONTROL='N'
      READ (10,212) STEPCONTROL
  212 FORMAT(A1)
      IF (STEPCONTROL.EQ.'N') THEN
         DO 220 CT1=1,NBR
            READ (10,*) CYCHOLDER
            DO 217 CT2=1,STPTS(CYCHOLDER)
               READ (10,*) STPTHOLDER
               READ (10,*) BLETDOWN(CYCHOLDER,STPTHOLDER,1)
               READ (10,*) BLETDOWN(CYCHOLDER,STPTHOLDER,2)
               DO 213 CT3=3,(INT(BLETDOWN(CYCHOLDER,STPTHOLDER,2))+2)
                  READ (10,*) BLETDOWN(CYCHOLDER,STPTHOLDER,CT3)
  213          CONTINUE
  217       CONTINUE
  220    CONTINUE
      ELSEIF (STEPCONTROL.EQ.'Y') THEN
         DO 240 CT1=1,NBR
            READ (10,*) CYCHOLDER
            DO 235 CT2=1,STPTS(CYCHOLDER)
               READ (10,*) STPTHOLDER
               READ (10,*) VARSTEPNUM(CYCHOLDER,STPTHOLDER)
               DO 230 CT3=1,VARSTEPNUM(CYCHOLDER,STPTHOLDER)
                  READ (10,*) VARBLETDOWN(CYCHOLDER,STPTHOLDER,CT3,1),
     c            VARBLETDOWN(CYCHOLDER,STPTHOLDER,CT3,2)
  230          CONTINUE
  235       CONTINUE
  240    CONTINUE
```

```
      ENDIF
      READ (10,*) AXNUM
      DO 260 CT1=1,AXNUM
         READ (10,250) NODES(CT1,1), NODES(CT1,2)
250      FORMAT (F3.0,1X,F10.7)
260   CONTINUE
*     Control Rod Data Aquisition
      READ (10,270) CRSTAT
270   FORMAT (A6)
      IF (CRSTAT.EQ.'RODDED') THEN
         DO 300 CT1=1,10
            DO 295 CT2=1,20
               DO 290 CT3=1,23
                  DO 280 CT4=1,50
                     CRINS(CT1,CT2,CT3,CT4)=0
280               CONTINUE
290            CONTINUE
295         CONTINUE
300      CONTINUE
         READ (10,*) CRSTEPNUM ! Number of pre-defined irradiation steps
*                                in which the assembly contains a control
*                                rod assembly.
         DO 320 CT1=1,CRSTEPNUM
            READ (10,*) NUMOFSECTIONS ! Number of axial sections of the fuel
*                                       assembly which have a rod assembly
inserted.
            DO 315 SECT=1,NUMOFSECTIONS
               READ (10,*) CRCYC, CRSTPT, CRSTEP, TOPN,
     c                     BOTN, CRMIX, DES
               DO 310 CT2=TOPN,BOTN
                  CRINS(CRCYC,CRSTPT,CRSTEP,CT2)=CRMIX
                  CRDES(CRCYC,CRSTPT,CRSTEP,CT2)=DES
310            CONTINUE
315         CONTINUE
320      CONTINUE
      READ (10,*) CRMIXNUM
      DO 340 CT1=1,CRMIXNUM
         READ (10,*) CRMIXID(CT1) ! SAS2H Mixture ID for CR
         READ (10,*) CRNUMISOS(CT1)
         DO 330 CT2=1,CRNUMISOS(CT1)
            READ(10,*) CRISOID(CT1,CT2), CRISOWTPCT(CT1,CT2)
330      CONTINUE
340   CONTINUE
      READ(10,*) CRDESNUM
      DO 349 CT2=1,CRDESNUM
         READ(10,*) CRDEN(CT2), CRCLAD(CT2)
         READ(10,*) CRZONE(CT2)
         DO 344 CT1=1,CRZONE(CT2)
            READ(10,*) CRMA(CT1,CT2), CRRA(CT1,CT2)
344      CONTINUE
         DO 347 CT1=1,CRZONE(CT2)
            READ(10,*) LMC(CT1,CT2), LRC(CT1,CT2)
347      CONTINUE
349   CONTINUE
      ENDIF
*     Axial Power Shaping Rod Data Aquisition
      READ (10,350) APSRSTAT
350   FORMAT (A6)
      IF (APSRSTAT.EQ.'RODDED') THEN
         DO 380 CT1=1,10
```

```
            DO 375 CT2=1,20
               DO 370 CT3=1,23
                  DO 360 CT4=1,50
                     APSRINS(CT1,CT2,CT3,CT4)=0
360               CONTINUE
370            CONTINUE
375         CONTINUE
380      CONTINUE
         READ (10,*) APSRSTEPNUM ! Number of pre-defined irradiation steps
*                                  in which the assembly contains an axial
*                                  power shaping rod assembly.
         DO 400 CT1=1,APSRSTEPNUM
            READ (10,*) APSRCYC, APSRSTPT, APSRSTEP, TOPN, BOTN,
   c        APSRMIX, DES, FMIX
            DO 390 CT2=TOPN,BOTN
               APSRINS(APSRCYC,APSRSTPT,APSRSTEP,CT2)=APSRMIX
               APSRDES(APSRCYC,APSRSTPT,APSRSTEP,CT2)=DES
               APSRFOLLOWMIX(APSRCYC,APSRSTPT,APSRSTEP,CT2)=FMIX
390         CONTINUE
400      CONTINUE
      READ (10,*) APSRMIXNUM
      DO 410 CT1=1,APSRMIXNUM
         READ (10,*) APSRMIXID(CT1) ! SAS2H Mixture ID for APSR's
         READ (10,*) APSRNUMISOS(CT1)
         DO 405 CT2=1,APSRNUMISOS(CT1)
            READ(10,*) APSRISOID(CT1,CT2), APSRISOWTPCT(CT1,CT2)
405      CONTINUE
410   CONTINUE
      READ(10,*) APSRDESNUM
      DO 429 CT2=1,APSRDESNUM
         READ(10,*) APSRDEN(CT2), APSRCLAD(CT2)
         READ(10,*) APSRZONE(CT2)
         DO 412 CT1=1,APSRZONE(CT2)
            READ(10,*) APSRMA(CT1,CT2), APSRRA(CT1,CT2)
412      CONTINUE
         DO 414 CT1=1,APSRZONE(CT2)
            READ(10,*) LMD(CT1,CT2), LRD(CT1,CT2)
414      CONTINUE
         DO 416 CT1=1,APSRZONE(CT2)
            READ(10,*) APSRFM(CT1,CT2), APSRFR(CT1,CT2)
416      CONTINUE
429   CONTINUE
      ENDIF
      STPTSUM=0
      DO 430 CT1=1,10
         STPTSUM=STPTSUM+STPTS(CT1)
430   CONTINUE
*     Acquisition of fuel temperature data for each node
         DO 470 CT1=1,(STPTSUM-1)
            READ (10,*) FTNUM(CT1)
            DO 450 CT2=1,FTNUM(CT1)
              READ (10,440) FTNDES(CT2,1,CT1), FTNDES(CT2,2,CT1)
440           FORMAT (F3.0,1X,F10.7)
450         CONTINUE
            DO 460 CT2=1,FTNUM(CT1)
               READ (10,*) FTDAT(CT2,CT1)
460         CONTINUE
470      CONTINUE
*     Acquisition of moderator specific volume data for each node
         DO 510 CT1=1,(STPTSUM-1)
```

```
          READ (10,*) MONUM(CT1)
          DO 490 CT2=1,MONUM(CT1)
             READ (10,480) MONDES(CT2,1,CT1), MONDES(CT2,2,CT1)
 480         FORMAT (F3.0,1X,F10.7)
 490      CONTINUE
          DO 500 CT2=1,MONUM(CT1)
             READ (10,*) MODAT(CT2,CT1)
 500      CONTINUE
 510   CONTINUE
*    Acquisition of nodal burnup data for each statepoint in each cycle
       DO 550 CT1=1,STPTSUM
          READ (10,*) BUNUM(CT1)
          DO 530 CT2=1,BUNUM(CT1)
             READ (10,520) BUNDES(CT2,1,CT1), BUNDES(CT2,2,CT1)
 520         FORMAT (F3.0,1X,F10.7)
 530      CONTINUE
          DO 540 CT2=1,BUNUM(CT1)
             READ (10,*) BUDAT(CT2,CT1)
 540      CONTINUE
 550   CONTINUE

    RETURN
    END


******************************************************************
*   Subroutine to standardize the assembly height to             *
*   the desired CRC assembly height.                             *
******************************************************************
      SUBROUTINE STD_HEIGHT (AXNUM, FTNUM,
     c MONUM, BUNUM, HTOT, NODES, STPTSUM,
     c FDHT, FTNDES, MDHT, MONDES,
     c BDHT, BUNDES)
*
      INTEGER*4 AXNUM, CT1, CT2, FTNUM(20), MONUM(20), BUNUM(20),
     c STPTSUM
*
      REAL HTOT, NODES(50,2), FDHT(20), FTNDES(50,2,20),
     c MDHT(20), MONDES(50,2,20), BDHT(20), BUNDES(50,2,20)
*
*
      HTOT=0
      DO 10 CT1=1,AXNUM
         HTOT=HTOT+NODES(CT1,2)
   10 CONTINUE
      DO 30 CT1=1,STPTSUM
         FDHT(CT1)=0
         DO 20 CT2=1,FTNUM(CT1)
            FDHT(CT1)=FDHT(CT1)+FTNDES(CT2,2,CT1)
   20    CONTINUE
   30 CONTINUE
      DO 50 CT1=1,STPTSUM
         MDHT(CT1)=0
         DO 40 CT2=1,MONUM(CT1)
            MDHT(CT1)=MDHT(CT1)+MONDES(CT2,2,CT1)
   40    CONTINUE
   50 CONTINUE
      DO 70 CT1=1,STPTSUM
         BDHT(CT1)=0
         DO 60 CT2=1,BUNUM(CT1)
```

```
            BDHT(CT1)=BDHT(CT1)+BUNDES(CT2,2,CT1)
   60    CONTINUE
   70 CONTINUE
      DO 90 CT1=1,STPTSUM
         DO 80 CT2=1,FTNUM(CT1)
            FTNDES(CT2,2,CT1)=FTNDES(CT2,2,CT1)*(HTOT/FDHT(CT1))
   80    CONTINUE
   90 CONTINUE
      DO 110 CT1=1,STPTSUM
         DO 100 CT2=1,MONUM(CT1)
            MONDES(CT2,2,CT1)=MONDES(CT2,2,CT1)*(HTOT/MDHT(CT1))
  100    CONTINUE
  110 CONTINUE
      DO 130 CT1=1,STPTSUM
         DO 120 CT2=1,BUNUM(CT1)
            BUNDES(CT2,2,CT1)=BUNDES(CT2,2,CT1)*(HTOT/BDHT(CT1))
  120    CONTINUE
  130 CONTINUE

      RETURN
      END


*****************************************************************
*   Subroutine to convert fuel temperature input nodal formats  *
*   into the requested CRC nodal format                         *
*****************************************************************
      SUBROUTINE FUELTEMP_FORMAT (STPTSUM, AXNUM, FTNUM,
     c NODES, FTNDES, FTDAT, FTIN)
*
      INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, FTNUM(20)
*
      REAL HCTOLD, HCT, SUM, NODES(50,2), FTHOLD, FTHCT,
     c FTNDES(50,2,20), FTDAT(50,20), FTIN(50,20)
*
      DO 30 CT1=1,STPTSUM
         HCTOLD=0
         HCT=0
         DO 20 CT2=1,AXNUM
            SUM=0
            HCTOLD=HCT
            HCT=HCT+NODES(CT2,2)
            FTHOLD=0
            FTHCT=0
            DO 10 CT3=1,FTNUM(CT1)
               FTHOLD=FTHCT
               FTHCT=FTHCT+FTNDES(CT3,2,CT1)
               IF ((FTHOLD.LT.HCTOLD).AND.(FTHCT.GT.HCTOLD).AND.
     c            (FTHCT.LT.HCT)) THEN
                  SUM=SUM+(((FTHCT-HCTOLD)/NODES(CT2,2))
     c               *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.EQ.HCTOLD).AND.(FTHCT.EQ.HCT)) THEN
                  SUM=SUM+FTDAT(CT3,CT1)
               ENDIF
               IF ((FTHOLD.GT.HCTOLD).AND.(FTHOLD.LT.HCT).AND.
     c            (FTHCT.GT.HCT)) THEN
                  SUM=SUM+(((HCT-FTHOLD)/NODES(CT2,2))
     c               *FTDAT(CT3,CT1))
               ENDIF
```

```
               IF ((FTHOLD.EQ.HCTOLD).AND.(FTHCT.GT.HCTOLD).AND.
     c            (FTHCT.LT.HCT)) THEN
                  SUM=SUM+(((FTHCT-FTHOLD)/NODES(CT2,2))
     c               *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.GT.HCTOLD).AND.(FTHCT.LT.HCT)) THEN
                  SUM=SUM+(((FTHCT-FTHOLD)/NODES(CT2,2))
     c               *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.GT.HCTOLD).AND.(FTHOLD.LT.HCT).AND.
     c            (FTHCT.EQ.HCT)) THEN
                  SUM=SUM+(((FTHCT-FTHOLD)/NODES(CT2,2))
     c               *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.LT.HCTOLD).AND.(FTHCT.EQ.HCT)) THEN
                  SUM=SUM+FTDAT(CT3,CT1)
               ENDIF
               IF ((FTHOLD.LT.HCTOLD).AND.(FTHCT.GT.HCT)) THEN
                  SUM=SUM+FTDAT(CT3,CT1)
               ENDIF
               IF ((FTHOLD.EQ.HCTOLD).AND.(FTHCT.GT.HCT)) THEN
                  SUM=SUM+FTDAT(CT3,CT1)
               ENDIF
 10         CONTINUE
            FTIN(CT2,CT1)=SUM
 20      CONTINUE
 30   CONTINUE

      RETURN
      END


*****************************************************************
*   Subroutine to convert moderator specific volume input nodal  *
*   formats into the requested CRC nodal format                  *
*****************************************************************
      SUBROUTINE MODSPECVOL_FORMAT (STPTSUM, AXNUM, MONUM,
     c NODES, MONDES, MODAT, MOIN)
*
      INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, MONUM(20)
*
      REAL HCTOLD, HCT, SUM, NODES(50,2), MOHOLD, MOHCT,
     c MONDES(50,2,20), MODAT(50,20), MOIN(50,20)
*
      DO 30 CT1=1,STPTSUM
         HCTOLD=0
         HCT=0
         DO 20 CT2=1,AXNUM
            SUM=0
            HCTOLD=HCT
            HCT=HCT+NODES(CT2,2)
            MOHOLD=0
            MOHCT=0
            DO 10 CT3=1,MONUM(CT1)
               MOHOLD=MOHCT
               MOHCT=MOHCT+MONDES(CT3,2,CT1)
               IF ((MOHOLD.LT.HCTOLD).AND.(MOHCT.GT.HCTOLD).AND.
     c            (MOHCT.LT.HCT)) THEN
                  SUM=SUM+(((MOHCT-HCTOLD)/NODES(CT2,2))
     c               *MODAT(CT3,CT1))
```

```
                ENDIF
                IF ((MOHOLD.EQ.HCTOLD).AND.(MOHCT.EQ.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
                IF ((MOHOLD.GT.HCTOLD).AND.(MOHOLD.LT.HCT).AND.
     c             (MOHCT.GT.HCT)) THEN
                   SUM=SUM+(((HCT-MOHOLD)/NODES(CT2,2))
     c                *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.EQ.HCTOLD).AND.(MOHCT.GT.HCTOLD).AND.
     c             (MOHCT.LT.HCT)) THEN
                   SUM=SUM+(((MOHCT-MOHOLD)/NODES(CT2,2))
     c                *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.GT.HCTOLD).AND.(MOHCT.LT.HCT)) THEN
                   SUM=SUM+(((MOHCT-MOHOLD)/NODES(CT2,2))
     c                *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.GT.HCTOLD).AND.(MOHOLD.LT.HCT).AND.
     c             (MOHCT.EQ.HCT)) THEN
                   SUM=SUM+(((MOHCT-MOHOLD)/NODES(CT2,2))
     c                *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.LT.HCTOLD).AND.(MOHCT.EQ.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
                IF ((MOHOLD.LT.HCTOLD).AND.(MOHCT.GT.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
                IF ((MOHOLD.EQ.HCTOLD).AND.(MOHCT.GT.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
   10        CONTINUE
             MOIN(CT2,CT1)=SUM
   20     CONTINUE
   30 CONTINUE

      RETURN
      END

*****************************************************************
*   Subroutine to convert burnup input nodal formats into the   *
*   requested CRC nodal format                                  *
*****************************************************************
      SUBROUTINE BURNUP_FORMAT (STPTSUM, AXNUM, BUNUM,
     c NODES, BUNDES, BUDAT, BUIN)
*
      INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, BUNUM(20)
*
      REAL HCTOLD, HCT, SUM, NODES(50,2), BUHOLD, BUHCT,
     c BUNDES(50,2,20), BUDAT(50,20), BUIN(50,20)
*
      DO 30 CT1=1,STPTSUM
         HCTOLD=0
         HCT=0
         DO 20 CT2=1,AXNUM
            SUM=0
            HCTOLD=HCT
            HCT=HCT+NODES(CT2,2)
```

```
            BUHOLD=0
            BUHCT=0
            DO 10 CT3=1,BUNUM(CT1)
               BUHOLD=BUHCT
               BUHCT=BUHCT+BUNDES(CT3,2,CT1)
               IF ((BUHOLD.LT.HCTOLD).AND.(BUHCT.GT.HCTOLD).AND.
     c            (BUHCT.LT.HCT)) THEN
                  SUM=SUM+(((BUHCT-HCTOLD)/NODES(CT2,2))
     c               *BUDAT(CT3,CT1))
               ENDIF
               IF ((BUHOLD.EQ.HCTOLD).AND.(BUHCT.EQ.HCT)) THEN
                  SUM=SUM+BUDAT(CT3,CT1)
               ENDIF
               IF ((BUHOLD.GT.HCTOLD).AND.(BUHOLD.LT.HCT).AND.
     c            (BUHCT.GT.HCT)) THEN
                  SUM=SUM+(((HCT-BUHOLD)/NODES(CT2,2))
     c               *BUDAT(CT3,CT1))
               ENDIF
               IF ((BUHOLD.EQ.HCTOLD).AND.(BUHCT.GT.HCTOLD).AND.
     c            (BUHCT.LT.HCT)) THEN
                  SUM=SUM+(((BUHCT-BUHOLD)/NODES(CT2,2))
     c               *BUDAT(CT3,CT1))
               ENDIF
               IF ((BUHOLD.GT.HCTOLD).AND.(BUHCT.LT.HCT)) THEN
                  SUM=SUM+(((BUHCT-BUHOLD)/NODES(CT2,2))
     c               *BUDAT(CT3,CT1))
               ENDIF
               IF ((BUHOLD.GT.HCTOLD).AND.(BUHOLD.LT.HCT).AND.
     c            (BUHCT.EQ.HCT)) THEN
                  SUM=SUM+(((BUHCT-BUHOLD)/NODES(CT2,2))
     c               *BUDAT(CT3,CT1))
               ENDIF
               IF ((BUHOLD.LT.HCTOLD).AND.(BUHCT.EQ.HCT)) THEN
                  SUM=SUM+BUDAT(CT3,CT1)
               ENDIF
               IF ((BUHOLD.LT.HCTOLD).AND.(BUHCT.GT.HCT)) THEN
                  SUM=SUM+BUDAT(CT3,CT1)
               ENDIF
               IF ((BUHOLD.EQ.HCTOLD).AND.(BUHCT.GT.HCT)) THEN
                  SUM=SUM+BUDAT(CT3,CT1)
               ENDIF
 10         CONTINUE
            BUIN(CT2,CT1)=SUM
 20      CONTINUE
 30   CONTINUE

      RETURN
      END

*************************************************************************
*     Subroutine to calculate nodal powers for each reactor cycle      *
*************************************************************************
      SUBROUTINE POWER_CALCS (NBR, AXNUM, STPTSUM, STPTTALLY,
     c STPTS, GRAMS, FMASS, NODES, HTOT, BUIN,
     c STPTDAT, POWER, CYCLEN, STEPCONTROL, VARBLETDOWN,
     c VARSTEPNUM, VARPOWER)
*
      INTEGER*4 CT1, NBR, AXNUM, CT2, CT3, CYCLENUMBER, STPTNUMBER,
     c STPTSUM, STPTTALLY(20), STPTS(10), VARSTEPNUM(10,20), CT4
```

```
*
      REAL GRAMS(50), FMASS, NODES(50,2), HTOT, BURN, BUIN(50,20),
     c DAYS, STPTDAT(10,20,3), POWER(50,20), CYCLEN(10,2),
     c VARPOWER(10,20,25,50), VARBLETDOWN(10,20,25,25),
     c TOTALBURNDAYS
*
      CHARACTER STEPCONTROL*1
*
      DO 10 CT1=1,10
         STPTTALLY(CT1)=0
   10 CONTINUE
      STPTTALLY(1)=STPTS(1)
      IF (NBR.GE.2) THEN
         DO 20 CT1=2,NBR
            STPTTALLY(CT1)=STPTTALLY(CT1-1)+STPTS(CT1)
   20    CONTINUE
      ENDIF
      IF (STEPCONTROL.EQ.'N') THEN
       DO 50 CT1=1,AXNUM
         GRAMS(CT1)=FMASS*(NODES(CT1,2)/HTOT)
         DO 40 CT2=1,(STPTSUM-1)
            BURN=BUIN(CT1,(CT2+1))-BUIN(CT1,CT2)
            IF (NBR.GE.2) THEN
               DO 30 CT3=2,NBR
                  IF((CT2.LE.STPTTALLY(CT3)).AND.
     c                (CT2.GT.STPTTALLY(CT3-1))) THEN
                     CYCLENUMBER=CT3
                  ELSEIF (CT2.LE.STPTTALLY(1)) THEN
                     CYCLENUMBER=1
                  ENDIF
   30          CONTINUE
            ELSEIF (NBR.EQ.1) THEN
               CYCLENUMBER=1
            ENDIF
            IF (CYCLENUMBER.EQ.1) THEN
               STPTNUMBER=CT2
            ELSEIF (CYCLENUMBER.GT.1) THEN
               STPTNUMBER=CT2-STPTTALLY(CYCLENUMBER-1)
            ENDIF
            IF (STPTNUMBER.EQ.STPTS(CYCLENUMBER)) THEN
               DAYS=CYCLEN(CYCLENUMBER,1)-
     c         STPTDAT(CYCLENUMBER,STPTNUMBER,1)
            ELSE
               DAYS=STPTDAT(CYCLENUMBER,(STPTNUMBER+1),1)-
     c         STPTDAT(CYCLENUMBER,STPTNUMBER,1)
            ENDIF
            POWER(CT1,CT2)=BURN*GRAMS(CT1)*(1.0/1000.0)*(1/DAYS)
   40    CONTINUE
   50  CONTINUE
      ELSEIF (STEPCONTROL.EQ.'Y') THEN
       DO 100 CT1=1,AXNUM
         GRAMS(CT1)=FMASS*(NODES(CT1,2)/HTOT)
         DO 90 CT2=1,(STPTSUM-1)
            IF (NBR.GE.2) THEN
               DO 70 CT3=2,NBR
                  IF((CT2.LE.STPTTALLY(CT3)).AND.
     c                (CT2.GT.STPTTALLY(CT3-1))) THEN
                     CYCLENUMBER=CT3
                  ELSEIF (CT2.LE.STPTTALLY(1)) THEN
                     CYCLENUMBER=1
```

```
                ENDIF
70           CONTINUE
          ELSEIF (NBR.EQ.1) THEN
             CYCLENUMBER=1
          ENDIF
          IF (CYCLENUMBER.EQ.1) THEN
             STPTNUMBER=CT2
          ELSEIF (CYCLENUMBER.GT.1) THEN
             STPTNUMBER=CT2-STPTTALLY(CYCLENUMBER-1)
          ENDIF
          TOTALBURNDAYS=0.0
          DO 75 CT4=1,VARSTEPNUM(CYCLENUMBER,STPTNUMBER)
             TOTALBURNDAYS=TOTALBURNDAYS+
   c         VARBLETDOWN(CYCLENUMBER,STPTNUMBER,CT4,1)
75        CONTINUE
          DO 80 CT4=1,VARSTEPNUM(CYCLENUMBER,STPTNUMBER)
             DAYS=VARBLETDOWN(CYCLENUMBER,STPTNUMBER,CT4,1)
             BURN=(BUIN(CT1,(CT2+1))-BUIN(CT1,CT2))*
   c         (DAYS/TOTALBURNDAYS)
             VARPOWER(CYCLENUMBER,STPTNUMBER,CT4,CT1)=BURN*
   c         GRAMS(CT1)*(1.0/1000.0)*(1/DAYS)
80        CONTINUE
90     CONTINUE
100  CONTINUE
     ENDIF

     RETURN
     END


************************************************************************
*     Subroutine to convert fuel temperature units and calculate       *
*     moderator specific volumes and densities with the correct units  *
************************************************************************
     SUBROUTINE UNITS_CONVERSION (STPTSUM, AXNUM, FTFINAL,
    c FTIN, MODDENFINAL, MOIN, PRESS, MODTEMPFINAL, DENDAT)
*
     INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, COL1, COL2, ROW1, ROW2
*
     REAL FTFINAL(50,20), FTIN(50,20), MODDENFINAL(50,20), MOIN(50,20),
    c PRESS, DENDAT(29,10), P1, P2, DENCOL(29), T, MODTEMPFINAL(50,20)
*
     DO 50 CT1=1,STPTSUM
        DO 40 CT2=1,AXNUM
           FTFINAL(CT2,CT1)=((FTIN(CT2,CT1)-32.0)*(5.0/9.0))
   c                       +273.15
           MODDENFINAL(CT2,CT1)=(1/(MOIN(CT2,CT1)*62.42691))
           DO 10 CT3=2,10
              IF ((PRESS.LT.DENDAT(1,CT3)).AND.
   c          (PRESS.GT.DENDAT(1,(CT3+1)))) THEN
                 P1=DENDAT(1,CT3)
                 P2=DENDAT(1,(CT3+1))
                 COL1=CT3
                 COL2=(CT3+1)
              ELSEIF (PRESS.EQ.DENDAT(1,CT3)) THEN
                 P1=PRESS
                 P2=DENDAT(1,(CT3+1))
                 COL1=CT3
                 COL2=(CT3+1)
              ENDIF
```

```
10        CONTINUE
          DO 20 CT3=2,29
             DENCOL(CT3)=((PRESS-P2)*((DENDAT(CT3,COL1)
  c          -DENDAT(CT3,COL2))/(P1-P2)))+DENDAT(CT3,COL2)
20        CONTINUE
          DO 30 CT3=2,29
             IF ((MODDENFINAL(CT2,CT1).LT.DENCOL(CT3)).AND.
  c             (MODDENFINAL(CT2,CT1).GT.DENCOL(CT3+1))) THEN
                ROW1=CT3
                ROW2=CT3+1
                T=(((MODDENFINAL(CT2,CT1)-DENCOL(ROW2))*
  c               (DENDAT(ROW1,1)-DENDAT(ROW2,1)))/(DENCOL(ROW1)
  c               -DENCOL(ROW2)))+DENDAT(ROW2,1)
             ELSEIF ((MODDENFINAL(CT2,CT1)).EQ.DENCOL(CT3)) THEN
                T=DENDAT(CT3,1)
             ENDIF
30        CONTINUE
          MODTEMPFINAL(CT2,CT1)=((T-32.0)*(5.0/9.0))+273.15
40     CONTINUE
50  CONTINUE

    RETURN
    END


*****************************************************************
*     SAS2H Input Deck Creation and Execution Control Subroutine  *
*****************************************************************
      SUBROUTINE EXECUTION_CONTROL (NBR, RELATIVE_STPT_NUM,
     c          CT1, CT2, CT3, AXNUM, CYCPOS, AXBLANK,
     c          BPDESID, CRINS, CRDES,
     c          CRMIXNUM, CRMIXID, CRNUMISOS, CRISOID,
     c          APSRINS, APSRMIXNUM, APSRMIXID,
     c          RELATIVE_APSR_MIX_ID, APSRNUMISOS,
     c          APSRISOID, ISN, ITM, ICM, IUS, PLEVEL,
     c          BPZONE, BPMA, CRZONE, CRMA,
     c          LMC, APSRZONE, APSRMA, LMD,
     c          BPTN, BPBN, STPTS, APSRDES,
     c          STPTDAT, AXBLANKRICH, GRAMS,
     c          NODES, RODS, RICH, FTFINAL,
     c          MODDENFINAL, MODTEMPFINAL,
     c          BLETDOWN, BPWTPCT, BPDEN, CRDEN,
     c          CRISOWTPCT, APSRDEN, APSRISOWTPCT,
     c          PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
     c          BPRA, CRRA, LRC, APSRRA,
     c          LRD, POWER, CYCDOWN, PREFIX,
     c          NM, CYCLEID, REACT, LIB, AXBLANKET,
     c          FUELCLAD, BPRFLAG, CRSTAT, APSRSTAT, FLAG2,
     c          LUZONE, LMB, LRB, BPXSECT, BPRODS, CT1START,
     c          CT2START, STPTTALLY, CLADTOT, CLADDESNUM,
     c          CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c          CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c          BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c          SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c          VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c          ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c          APSRFR, ABOVEBP, APSRFOLLOWMIX)

      INTEGER*4 CT1, CT2, CT3, NBR, RELATIVE_STPT_NUM,
     c          AXNUM, CYCPOS(10), AXBLANK(50),
```

```
     c         BPDESID(10), CRINS(10,20,23,50), CRDES(10,20,23,50),
     c         CRMIXNUM, CRMIXID(25), CRNUMISOS(25), CRISOID(25,10),
     c         APSRINS(10,20,23,50), APSRMIXNUM, APSRMIXID(25),
     c         RELATIVE_APSR_MIX_ID, APSRNUMISOS(25),
     c         APSRISOID(25,10), ISN, IIM, ICM, IUS, PLEVEL,
     c         BPZONE(10), BPMA(15,10), CRZONE(10), CRMA(15,10),
     c         LMC(15,10), APSRZONE(10), APSRMA(15,10), LMD(15,10),
     c         BPTN(10), BPBN(10), STPTS(10), APSRDES(10,20,23,50),
     c         BPRODS(10), SYSTEM, SASEXERESULT,
     c         CARRYCOUNTER, CT1START, CT2START, CT2GOVALUE,
     c         STPTTALLY(20), CT2ENDVALUE, CLADTOT, CLADDESNUM(10),
     c         BPRCLAD(10), CRCLAD(10), APSRCLAD(10), BPMIXNUM,
     c         BPMIX(10), BPMIXID(10), BPNUMISOS(20), BPISOID(10,20),
     c         VARSTEPNUM(10,20), BPRFM(15,10), BPFMNUMISOS(25),
     c         BPFISOID(25,10), ABOVEBPNUM(10), APSRFM(15,10),
     c         APSRFOLLOWMIX(10,20,23,50), APSRINSOLD(10,20,23,50)
*
      REAL     STPTDAT(10,20,3), AXBLANKRICH, GRAMS(50),
     c         NODES(50,2), RODS, RICH, FTFINAL(50,20),
     c         MODDENFINAL(50,20), MODTEMPFINAL(50,20),
     c         BLETDOWN(10,20,25), BPWTPCT(10), BPDEN(10), CRDEN(10),
     c         CRISOWTPCT(25,10), APSRDEN(10), APSRISOWTPCT(25,10),
     c         PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
     c         BPRA(15,10), CRRA(15,10), LRC(15,10), APSRRA(15,10),
     c         LRD(15,10), POWER(50,20), CYCDOWN(10), BPXSECT(10),
     c         FINALDOWNTIME, MASSTOTAL, FUELISOWTPCT(1000),
     c         BPRAISOVALUE(2), LEFTVAL(1000), CLTEMP,
     c         BPISOWTPCT(10,20), UCSPACERFRAC,
     c         VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50),
     c         BPRFR(15,10), BPFISOWTPCT(25,10), APSRFR(15,10)
*
      CHARACTER PREFIX*3, NM*31, CYCLEID(10)*2, REACT*21, LIB*15,
     c         AXBLANKET*1, FUELCLAD*10, BPRFLAG*1, CRSTAT*6,
     c         APSRSTAT*6, FLAG2*7, SASEXECOMMAND*33,
     c         PREVIOUSNAME*25, FUELISONAME(1000)*5,
     c         BPRAISONAME(2)*6, LEFTLIST(1000)*6,
     c         CLADDESNAME(10)*7, SPACERMAT*7, STEPCONTROL*1,
     c         ABOVEBP(10)*5
*
      LOGICAL  BPRA_INSERTED
*
      RELATIVE_STPT_NUM=0
      DO 30 CT3=1,AXNUM
       IF (CT1START.EQ.1) THEN
          RELATIVE_STPT_NUM=CT2START-1
       ELSE
          RELATIVE_STPT_NUM=STPTTALLY(CT1START-1)+CT2START-1
       ENDIF
       DO 20 CT1=CT1START,NBR
*  CT1 is the insertion cycle incrementer
         IF (CT1.EQ.CT1START) THEN
            CT2GOVALUE=CT2START
         ELSE
            CT2GOVALUE=1
         ENDIF
         IF (CT1.EQ.NBR) THEN
            CT2ENDVALUE=STPTS(CT1)-1
         ELSE
            CT2ENDVALUE=STPTS(CT1)
         ENDIF
```

```
*  CT2 is the statepoint incrementer within cycle CT1
         DO 10 CT2=CT2GOVALUE,CT2ENDVALUE
               RELATIVE_STPT_NUM=RELATIVE_STPT_NUM+1
               IF ((CT1.EQ.1).AND.(CT2.EQ.1)) THEN
               CALL STANDARD_WRITER (RELATIVE_STPT_NUM, CT1,
     c         CT2, CT3, AXNUM, CYCPOS, AXBLANK,
     c         BPDESID, CRINS, CRDES,
     c         CRMIXNUM, CRMIXID, CRNUMISOS, CRISOID,
     c         APSRINS, APSRMIXNUM, APSRMIXID,
     c         RELATIVE_APSR_MIX_ID, APSRNUMISOS,
     c         APSRISOID, ISN, IIM, ICM, IUS, PLEVEL,
     c         BPZONE, BPMA, CRZONE, CRMA,
     c         LMC, APSRZONE, APSRMA, LMD,
     c         BPTN, BPBN, STPTS, APSRDES,
     c         STPTDAT, AXBLANKRICH, GRAMS,
     c         NODES, RODS, RICH, FTFINAL,
     c         MODDENFINAL, MODTEMPFINAL,
     c         BLETDOWN, BPWTPCT, BPDEN, CRDEN,
     c         CRISOWTPCT, APSRDEN, APSRISOWTPCT,
     c         PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
     c         BPRA, CRRA, LRC, APSRRA,
     c         LRD, POWER, CYCDOWN, PREFIX,
     c         NM, CYCLEID, REACT, LIB, AXBLANKET,
     c         FUELCLAD, BPRFLAG, CRSTAT, APSRSTAT, FLAG2,
     c         LUZONE, LMB, LRB, PREVIOUSNAME, FINALDOWNTIME,
     c         BPRA_INSERTED, CLADTOT, CLADDESNUM,
     c         CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c         CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c         BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c         SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c         VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c         ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c         APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START,
     c         CT2GOVALUE, APSRINSOLD)
               SASEXECOMMAND(1:8)='batch43 '
               SASEXECOMMAND(9:33)=NM(1:25)
               SASEXERESULT=SYSTEM(SASEXECOMMAND)
               IF (SASEXERESULT.LT.0) THEN
                  WRITE (*,*) 'AN ERROR OCCURRED DURING SAS2H',
     c            'EXECUTION OF ', NM(1:25)
               ENDIF
               CALL CUTTER (NM)
            ELSE
               CALL CONTINUATION_WRITER (RELATIVE_STPT_NUM,
     c         CT1, CT2, CT3, AXNUM, CYCPOS, AXBLANK, BPDESID,
     c         CRINS, CRDES, CRMIXNUM, CRMIXID,
     c         CRNUMISOS, CRISOID, APSRINS,
     c         APSRMIXNUM, APSRMIXID, RELATIVE_APSR_MIX_ID,
     c         APSRNUMISOS, APSRISOID, ISN, IIM, ICM, IUS,
     c         PLEVEL, BPZONE, BPMA, CRZONE, CRMA,
     c         LMC, APSRZONE, APSRMA, LMD,
     c         BPTN, BPBN, STPTS, APSRDES,
     c         STPTDAT, AXBLANKRICH, GRAMS,
     c         NODES, RODS, RICH, FTFINAL, MODDENFINAL,
     c         MODTEMPFINAL, BLETDOWN, BPWTPCT,
     c         BPDEN, CRDEN, CRISOWTPCT, APSRDEN,
     c         APSRISOWTPCT, PITCH, FOD, COD, CID, SZF,
     c         EPS, PTC, MESH, BPRA, CRRA, LRC, APSRRA,
     c         LRD, POWER, CYCDOWN, PREFIX, NM,
     c         CYCLEID, REACT, LIB, AXBLANKET, FUELCLAD,
```

```
     c          BPRFLAG, CRSTAT, APSRSTAT, FLAG2, LUZONE,
     c          LMB, LRB, MASSTOTAL, FUELISONAME, FUELISOWTPCT,
     c          BPRAISONAME, BPRAISOVALUE, LEFTLIST, CARRYCOUNTER,
     c          BPXSECT, BPRODS, PREVIOUSNAME, FINALDOWNTIME,
     c          LEFTVAL, BPRA_INSERTED, CLADTOT, CLADDESNUM,
     c          CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c          CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c          BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c          SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c          VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c          ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c          APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START,
     c          CT2GOVALUE, APSRINSOLD)
                SASEXECOMMAND(1:8)='batch43 '
                SASEXECOMMAND(9:33)=NM(1:25)
                SASEXERESULT=SYSTEM(SASEXECOMMAND)
                IF (SASEXERESULT.LT.0) THEN
                   WRITE (*,*) 'AN ERROR OCCURRED DURING SAS2H',
     c             'EXECUTION OF ', NM(1:25)
                ENDIF
                CALL CUTTER (NM)
             ENDIF
   10     CONTINUE
   20   CONTINUE
   30 CONTINUE

      RETURN
      END


*******************************************************************
*     Subroutine to write standard beginning of assembly life     *
*     SAS2H input decks                                           *
*******************************************************************
      SUBROUTINE STANDARD_WRITER (RELATIVE_STPT_NUM, CT1, CT2, CT3,
     c AXNUM, CYCPOS, AXBLANK, BPDESID,
     c CRINS, CRDES, CRMIXNUM, CRMIXID,
     c CRNUMISOS, CRISOID, APSRINS,
     c APSRMIXNUM, APSRMIXID, RELATIVE_APSR_MIX_ID,
     c APSRNUMISOS, APSRISOID, ISN, IIM, ICM, IUS,
     c PLEVEL, BPZONE, BPMA, CRZONE, CRMA,
     c LMC, APSRZONE, APSRMA, LMD,
     c BPTN, BPBN, STPTS, APSRDES,
     c STPTDAT, AXBLANKRICH, GRAMS,
     c NODES, RODS, RICH, FTFINAL, MODDENFINAL,
     c MODTEMPFINAL, BLETDOWN, BPWTPCT,
     c BPDEN, CRDEN, CRISOWTPCT, APSRDEN,
     c APSRISOWTPCT, PITCH, FOD, COD, CID, SZF, EPS, PTC,
     c MESH, BPRA, CRRA, LRC, APSRRA,
     c LRD, POWER, CYCDOWN, PREFIX, NM,
     c CYCLEID, REACT, LIB, AXBLANKET, FUELCLAD,
     c BPRFLAG, CRSTAT, APSRSTAT, FLAG2, LUZONE, LMB, LRB,
     c PREVIOUSNAME, FINALDOWNTIME, BPRA_INSERTED, CLADTOT,
     c CLADDESNUM, CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START, CT2GOVALUE,
```

```
     c APSRINSOLD)
*
      INTEGER*4 RELATIVE_STPT_NUM, CT1, CT2, CT3, AXNUM,
     c NUMSTPT1, NUMSTPT2, NUMSTPT3, CYCPOS(10), AXBLANK(50),
     c BPDESID(10), BPRA_DESCRIPTION_ID, CT4, CT5, CRINS(10,20,23,50),
     c CR_MIXTURE_ID, CR_DESCRIPTION, CRDES(10,20,23,50), CRMIXNUM,
     c CRMIXID(25), RELATIVE_CR_MIX_ID, CRNUMISOS(25),
     c CRISOID(25,10), APSRINS(10,20,23,50), APSR_MIXTURE_ID,
     c APSR_DESCRIPTION, APSRMIXNUM, APSRMIXID(25),
     c RELATIVE_APSR_MIX_ID, APSRNUMISOS(25), APSRISOID(25,10),
     c ISN, IIM, ICM, IUS, PLEVEL, BPZONE(10), BPMA(15,10),
     c CRZONE(10), CRMA(15,10), LMC(15,10), APSRZONE(10),
     c APSRMA(15,10), LMD(15,10), BPTN(10), BPBN(10), STPTS(10),
     c APSRDES(10,20,23,50), LUZONE, LMB(15), NUMSTPT4, NUMSTPT5,
     c NUMSTPT6, CLADTOT, CLADDESNUM(10), BPRCLAD(10), CRCLAD(10),
     c APSRCLAD(10), APSRCLNUM, CRCLNUM, BPRCLNUM, BPMIXNUM,
     c BPMIX(10), BPMIXID(10), BPNUMISOS(20), BPISOID(10,20),
     c VARSTEPNUM(10,20), BPRFM(15,10), BPFMNUMISOS(25),
     c BPFISOID(25,10), ABOVEBPNUM(10), APSRFM(15,10),
     c APSRFOLLOWMIX(10,20,23,50), FOLNODKEEP,
     c FOLSTEPKEEP, APSRFOLNUM, APSRFOLLOWDATA(10,20,23,50),
     c CT1START, CT2GOVALUE, APSRINSOLD(10,20,23,50)
*
      REAL STPTDAT(10,20,3), ENR, AXBLANKRICH, OXYGMS, GRAMS(50),
     c UO2GMS, FVOL, PI, NODES(50,2), RODS, FDEN, WT234,
     c WT235, WT236, WT238, RICH, FTFINAL(50,20),
     c MODDENFINAL(50,20), MODTEMPFINAL(50,20), BLETDOWN(10,20,25),
     c BPWTPCT(10), BPDEN(10), ALFRAC, OFRAC, CRDEN(10),
     c CRISOWTPCT(25,10), APSRDEN(10), APSRISOWTPCT(25,10),
     c PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH, BPRA(15,10),
     c CRRA(15,10), LRC(15,10), APSRRA(15,10), LRD(15,10),
     c DOWNTIME, BORON_FRACTION, POWER(50,20), CYCDOWN(10), LRB(15),
     c FINALDOWNTIME, CLTEMP, BPISOWTPCT(10,20), UCSPACERFRAC,
     c BORATEDMODVF, BORONVF, UCMODREGIONDEN,
     c VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50),
     c BPRFR(15,10), BPFISOWTPCT(25,10), APSRFR(15,10)
*
      CHARACTER CHNODE*2, CHID*2, PREFIX*3, CHSTPT1*1, CHSTPT2*1,
     c CHSTPT3*1, NM*31, CYCLEID(10)*2, REACT*21, LIB*15,
     c AXBLANKET*1, FUELCLAD*10, BPRFLAG*1, CRSTAT*6, APSRSTAT*6,
     c FLAG2*7, IRRAD_STEPS*2, PLEVELCH*2, BPZONECH*2, CRZONECH*2,
     c APSRZONECH*2, LUZONECH*2, PREVIOUSNAME*25, ASSYPOSITION*2,
     c CHSTPT4*1, CHSTPT5*1, CHSTPT6*1, CLADDESNAME(10)*7,
     c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
      LOGICAL BPRA_INSERTED, CR_INSERTED, CRCOMPFLAG, APSR_INSERTED,
     c APSRCOMPFLAG, BPRA_FOLLOW, APSRBOTFLAG, FOLLOWIN
*
      PI=3.14159265359
* Determination of the input deck filename
         CALL ZEROS(CT3,CHNODE)
         CALL ZEROS(CYCPOS(CT1),CHID)
         NUMSTPT1=INT(STPTDAT(CT1,CT2,1)/100.0)
         CHSTPT1=CHAR(NUMSTPT1+48)
         NUMSTPT2=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100))/10.0)
         CHSTPT2=CHAR(NUMSTPT2+48)
         NUMSTPT3=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100)-
     c   (NUMSTPT2*10)))
         CHSTPT3=CHAR(NUMSTPT3+48)
         IF (CT2.LT.STPTS(CT1)) THEN
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              NUMSTPT4=INT(STPTDAT(CT1,(CT2+1),1)/100.0)
              CHSTPT4=CHAR(NUMSTPT4+48)
              NUMSTPT5=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100))/10.0)
              CHSTPT5=CHAR(NUMSTPT5+48)
              NUMSTPT6=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100)-
     c        (NUMSTPT5*10)))
              CHSTPT6=CHAR(NUMSTPT6+48)
           ELSEIF (CT2.EQ.STPTS(CT1)) THEN
              NUMSTPT4=INT(STPTDAT((CT1+1),1,1)/100.0)
              CHSTPT4=CHAR(NUMSTPT4+48)
              NUMSTPT5=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100))/10.0)
              CHSTPT5=CHAR(NUMSTPT5+48)
              NUMSTPT6=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100)-
     c        (NUMSTPT5*10)))
              CHSTPT6=CHAR(NUMSTPT6+48)
           ENDIF
           NM(1:3)=PREFIX
           NM(4:4)='A'
           NM(5:6)=CHID
           NM(7:7)='N'
           NM(8:9)=CHNODE
           NM(10:11)='DC'
           NM(12:13)=CYCLEID(CT1)
           NM(14:14)='T'
           NM(15:15)=CHSTPT1
           NM(16:16)=CHSTPT2
           NM(17:17)=CHSTPT3
           NM(18:19)='AC'
           IF (CT2.EQ.STPTS(CT1)) THEN
              NM(20:21)=CYCLEID(CT1+1)
           ELSE
              NM(20:21)=CYCLEID(CT1)
           ENDIF
           NM(22:22)='T'
           NM(23:23)=CHSTPT4
           NM(24:24)=CHSTPT5
           NM(25:25)=CHSTPT6
           NM(26:31)='.input'
           PREVIOUSNAME=NM(1:25)
*    Open and rewind the input deck file
           OPEN(UNIT=100, FILE=NM, STATUS='UNKNOWN')
           REWIND(UNIT=100)
*    Write first section of input deck
           WRITE (100,10)
     10    FORMAT ('=sas2h',T11,'parm=skipshipdata')
           IF (CT2.LT.STPTS(CT1)) THEN
              WRITE (100,20) REACT, CHID, CHNODE,
     c        NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
     c        STPTDAT(CT1,(CT2+1),1)
     20       FORMAT (A21,1X,'Assy-',A2,
     c        ', Node-',A2,1X,
     c        '(Cyc-',A2,', 'F5.1,' to Cyc-',
     c        A2,', ',F5.1,' EFPD)')
           ELSEIF (CT2.EQ.STPTS(CT1)) THEN
              WRITE (100,25) REACT, CHID, CHNODE,
     c        NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
     c        STPTDAT((CT1+1),1,1)
     25       FORMAT (A21,1X,'Assy-',A2,
     c        ', Node-',A2,1X,
     c        '(Cyc-',A2,', 'F5.1,' to Cyc-',
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     c     A2,', ',F5.1,' EFPD)')
         ENDIF
         WRITE (100,30) LIB
  30     FORMAT (A15,1X,'latticecell')
         WRITE (100,40)
  40     FORMAT ('''')
         WRITE (100,50)
  50     FORMAT ('''    fuel density based on mass of uranium per',
     c   ' assembly',T56,'& total pellet stack')
         WRITE (100,60)
  60     FORMAT ('''    volume to account for fuel volume loss to',
     c   ' pellet c',T55,'hamfers')
         WRITE (100,70)
  70     FORMAT ('''')
*  Write second section of input deck (material specifications)
         WRITE (100,80)
  80     FORMAT ('''',5X,'material specification input')
         WRITE (100,90)
  90     FORMAT ('''')
*  Calculate initital fuel parameters depending upon whether or not the

*  node represents axial blanket fuel
         IF ((AXBLANKET.EQ.'Y').AND.(AXBLANK(CT3).EQ.1)) THEN
            ENR=AXBLANKRICH
            OXYGMS=(GRAMS(CT3)*2*15.994915)/(((ENR/100)*235.043915)+
     c      (((0.007731*((ENR)**1.0837))/100)*234.040904)+
     c      (((0.0046*ENR)/100)*236.045637)+(((100-(0.007731*
     c      (ENR**1.0837))-(ENR)-(0.0046*ENR))/100)*238.05077))
            UO2GMS=GRAMS(CT3)+OXYGMS
            FVOL=(PI/4)*(FOD**2)*(NODES(CT3,2))*(RODS)
            FDEN=UO2GMS/FVOL
            WT234=0.007731*(ENR**1.0837)
            WT235=ENR
            WT236=0.0046*ENR
            WT238=100.0-WT234-ENR-WT236
         ELSE
            ENR=RICH
            OXYGMS=(GRAMS(CT3)*2*15.994915)/(((ENR/100)*235.043915)+
     c      (((0.007731*((ENR)**1.0837))/100)*234.040904)+
     c      (((0.0046*ENR)/100)*236.045637)+(((100-(0.007731*
     c      (ENR**1.0837))-(ENR)-(0.0046*ENR))/100)*238.05077))
            UO2GMS=GRAMS(CT3)+OXYGMS
            FVOL=(PI/4)*(FOD**2)*(NODES(CT3,2))*(RODS)
            FDEN=UO2GMS/FVOL
            WT234=0.007731*(ENR**1.0837)
            WT235=ENR
            WT236=0.0046*ENR
            WT238=100.0-WT234-ENR-WT236
         ENDIF
*  Write fuel composition input description
         IF (FDEN.LT.(10.0)) THEN
            WRITE (100,100) FDEN, FTFINAL(CT3,RELATIVE_STPT_NUM), WT234,
     c      WT235, WT236, WT238
 100        FORMAT ('uo2 1 den=',F5.3,1X,'1',1X,F6.1,1X,'92234',1X,F5.3,
     c      1X,'92235',1X,F5.3,1X,'92236',1X,F5.3,1X,'92238',1X,F6.3,1X,
     c      'end')
         ELSE
            WRITE (100,110) FDEN, FTFINAL(CT3,RELATIVE_STPT_NUM), WT234,
     c      WT235, WT236, WT238
 110        FORMAT ('uo2 1 den=',F6.3,1X,'1',1X,F6.1,1X,'92234',1X,F5.3,
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c         1X,'92235',1X,F5.3,1X,'92236',1X,F5.3,1X,'92238',1X,F6.3,1X,
c          'end')
          ENDIF
          WRITE (100,120)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  120     FORMAT ('kr-83          1   0    1-21   ',F6.1,'    end')
          WRITE (100,130)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  130     FORMAT ('kr-85          1   0    1-21   ',F6.1,'    end')
          WRITE (100,140)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  140     FORMAT ('sr-90          1   0    1-21   ',F6.1,'    end')
          WRITE (100,150)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  150     FORMAT ('y-89           1   0    1-21   ',F6.1,'    end')
          WRITE (100,160)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  160     FORMAT ('mo-95          1   0    1-21   ',F6.1,'    end')
          WRITE (100,170)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  170     FORMAT ('zr-93          1   0    1-21   ',F6.1,'    end')
          WRITE (100,180)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  180     FORMAT ('zr-94          1   0    1-21   ',F6.1,'    end')
          WRITE (100,190)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  190     FORMAT ('zr-95          1   0    1-21   ',F6.1,'    end')
          WRITE (100,200)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  200     FORMAT ('nb-94          1   0    1-21   ',F6.1,'    end')
          WRITE (100,210)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  210     FORMAT ('tc-99          1   0    1-21   ',F6.1,'    end')
          WRITE (100,220)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  220     FORMAT ('rh-103         1   0    1-21   ',F6.1,'    end')
          WRITE (100,230)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  230     FORMAT ('rh-105         1   0    1-21   ',F6.1,'    end')
          WRITE (100,240)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  240     FORMAT ('ru-101         1   0    1-21   ',F6.1,'    end')
          WRITE (100,250)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  250     FORMAT ('ru-106         1   0    1-21   ',F6.1,'    end')
          WRITE (100,260)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  260     FORMAT ('pd-105         1   0    1-21   ',F6.1,'    end')
          WRITE (100,270)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  270     FORMAT ('pd-108         1   0    1-21   ',F6.1,'    end')
          WRITE (100,280)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  280     FORMAT ('ag-109         1   0    1-21   ',F6.1,'    end')
          WRITE (100,290)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  290     FORMAT ('sb-124         1   0    1-21   ',F6.1,'    end')
          WRITE (100,300)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  300     FORMAT ('xe-131         1   0    1-21   ',F6.1,'    end')
          WRITE (100,310)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  310     FORMAT ('xe-132         1   0    1-21   ',F6.1,'    end')
          WRITE (100,320)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  320     FORMAT ('xe-135         1   0    1-21   ',F6.1,'    end')
          WRITE (100,330)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  330     FORMAT ('xe-136         1   0    1-21   ',F6.1,'    end')
          WRITE (100,340)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  340     FORMAT ('cs-134         1   0    1-21   ',F6.1,'    end')
          WRITE (100,350)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  350     FORMAT ('cs-135         1   0    1-21   ',F6.1,'    end')
          WRITE (100,360)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  360     FORMAT ('cs-137         1   0    1-21   ',F6.1,'    end')
          WRITE (100,370)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  370     FORMAT ('ba-136         1   0    1-21   ',F6.1,'    end')
          WRITE (100,380)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  380     FORMAT ('la-139         1   0    1-21   ',F6.1,'    end')
          WRITE (100,390)  FTFINAL(CT3,RELATIVE_STPT_NUM)
  390     FORMAT ('ce-144         1   0    1-21   ',F6.1,'    end')
          WRITE (100,400)  FTFINAL(CT3,RELATIVE_STPT_NUM)
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 400    FORMAT ('nd-143         1   0   1-21   ',F6.1,'   end')
        WRITE (100,410) FTFINAL(CT3,RELATIVE_STPT_NUM)
 410    FORMAT ('nd-145         1   0   1-21   ',F6.1,'   end')
        WRITE (100,420) FTFINAL(CT3,RELATIVE_STPT_NUM)
 420    FORMAT ('pm-147         1   0   1-21   ',F6.1,'   end')
        WRITE (100,430) FTFINAL(CT3,RELATIVE_STPT_NUM)
 430    FORMAT ('pm-148         1   0   1-21   ',F6.1,'   end')
        WRITE (100,440) FTFINAL(CT3,RELATIVE_STPT_NUM)
 440    FORMAT ('nd-147         1   0   1-21   ',F6.1,'   end')
        WRITE (100,450) FTFINAL(CT3,RELATIVE_STPT_NUM)
 450    FORMAT ('sm-147         1   0   1-21   ',F6.1,'   end')
        WRITE (100,460) FTFINAL(CT3,RELATIVE_STPT_NUM)
 460    FORMAT ('sm-149         1   0   1-21   ',F6.1,'   end')
        WRITE (100,470) FTFINAL(CT3,RELATIVE_STPT_NUM)
 470    FORMAT ('sm-150         1   0   1-21   ',F6.1,'   end')
        WRITE (100,480) FTFINAL(CT3,RELATIVE_STPT_NUM)
 480    FORMAT ('sm-151         1   0   1-21   ',F6.1,'   end')
        WRITE (100,490) FTFINAL(CT3,RELATIVE_STPT_NUM)
 490    FORMAT ('sm-152         1   0   1-21   ',F6.1,'   end')
        WRITE (100,500) FTFINAL(CT3,RELATIVE_STPT_NUM)
 500    FORMAT ('gd-155         1   0   1-21   ',F6.1,'   end')
        WRITE (100,510) FTFINAL(CT3,RELATIVE_STPT_NUM)
 510    FORMAT ('eu-153         1   0   1-21   ',F6.1,'   end')
        WRITE (100,520) FTFINAL(CT3,RELATIVE_STPT_NUM)
 520    FORMAT ('eu-154         1   0   1-21   ',F6.1,'   end')
        WRITE (100,530) FTFINAL(CT3,RELATIVE_STPT_NUM)
 530    FORMAT ('eu-155         1   0   1-21   ',F6.1,'   end')
*  Write cladding material specifications
*  Additional cladding material specifications may be added to the
*  following IF statement as required
        IF ((FUELCLAD.EQ.'ZIRC-4    ').OR.
     c  (FUELCLAD.EQ.'ZIRCALLOY4')) THEN
           WRITE (100,532)
 532       FORMAT ('arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000',
     c     ' 0.10 26000 0.20 50000 1.40')
           WRITE (100,535) CLTEMP
 535       FORMAT (T12,'40000 98.18 2 1.0 ',F5.1,' end')
        ELSEIF (FUELCLAD.EQ.'SS304     ') THEN
           WRITE (100,537)
 537       FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c     ' 2.0 26304 69.5 28304 9.5')
           WRITE (100,540) CLTEMP
 540       FORMAT (T12,'2 1.0 ',F5.1,' end')
        ELSEIF (FUELCLAD.EQ.'SS304S    ') THEN
           WRITE (100,542)
 542       FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c     ' 2.0 26000 69.5 28000 9.5')
           WRITE (100,545) CLTEMP
 545       FORMAT (T13,'2 1.0 ',F5.1,' end')
        ELSEIF (FUELCLAD.EQ.'SS316     ') THEN
           WRITE (100,547)
 547       FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c     ' 1.0 24304 17.0 25055 2.0')
           WRITE (100,550)
 550       FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
           WRITE (100,552) CLTEMP
 552       FORMAT (T12,'2 1.0 ',F5.1,' end')
        ELSEIF (FUELCLAD.EQ.'SS316S    ') THEN
           WRITE (100,555)
 555       FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
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     c       ' 1.0 24000 17.0 25055 2.0')
             WRITE (100,557)
 557         FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
             WRITE (100,559) CLTEMP
 559         FORMAT (T13,'2 1.0 ',F5.1,' end')
          ENDIF
*  Write moderator material specifications
          BORATEDMODVF=1.0-UCSPACERFRAC
          IF (STEPCONTROL.EQ.'N') THEN
             BORONVF=BLETDOWN(CT1,CT2,3)*(1E-6)*BORATEDMODVF
          ELSEIF (STEPCONTROL.EQ.'Y') THEN
             BORONVF=VARBLETDOWN(CT1,CT2,1,2)*(1E-6)*BORATEDMODVF
          ENDIF
          WRITE (100,560)
 560      FORMAT ('''')
          IF ((SPACERMAT.EQ.'ZIRC-4 ').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
             WRITE (100,561)
 561         FORMAT ('''      material composition of moderator',
     c       ' within unit cell')
             WRITE (100,562)
 562         FORMAT ('''      with smeared zirc-4 spacer grids')
             UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c       BORATEDMODVF)+(6.56*UCSPACERFRAC)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,563) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 563            FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,564) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 564            FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
             ENDIF
             WRITE (100,565) UCMODREGIONDEN, BORONVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 565         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c       1X,F6.5,1X,F7.1,1X,'end')
             WRITE (100,566) UCMODREGIONDEN
 566         FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 8016 0.12',
     c       ' 24000 0.10 26000 0.25')
             WRITE (100,567) UCSPACERFRAC,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 567         FORMAT (T17'50000 1.40 40000 98.18 3',1X,F6.5,1X,
     c       F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'INCONEL').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
             WRITE (100,568)
 568         FORMAT ('''      material composition of moderator',
     c       ' within unit cell')
             WRITE (100,569)
 569         FORMAT ('''      with smeared inconel spacer grids')
             UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c       BORATEDMODVF)+(8.3*UCSPACERFRAC)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,570) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 570            FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,571) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
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571          FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
          ENDIF
          WRITE (100,572) UCMODREGIONDEN, BORONVF,
     c    MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
572       FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c    1X,F6.5,1X,F7.1,1X,'end')
          WRITE (100,573) UCMODREGIONDEN
573       FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 14000 2.5',
     c    ' 22000 2.5 24000 15.0')
          WRITE (100,574) UCSPACERFRAC,
     c    MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
574       FORMAT (T17'26000 7.0 28000 73.0 3',1X,F6.5,1X,
     c    F7.1,1X,'end')
        ELSEIF ((SPACERMAT.EQ.'SS316  ').AND.
     c  (UCSPACERFRAC.GT.(0.0))) THEN
          WRITE (100,575)
575       FORMAT ('''     material composition of moderator',
     c    ' within unit cell')
          WRITE (100,576)
576       FORMAT ('''     with smeared ss316 spacer grids')
          UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c    BORATEDMODVF)+(7.75*UCSPACERFRAC)
          IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
             WRITE (100,577) UCMODREGIONDEN, BORATEDMODVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
577          FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
          ELSE
             WRITE (100,578) UCMODREGIONDEN, BORATEDMODVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
578          FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
          ENDIF
          WRITE (100,579) UCMODREGIONDEN, BORONVF,
     c    MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
579       FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c    1X,F6.5,1X,F7.1,1X,'end')
          WRITE (100,580) UCMODREGIONDEN
580       FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
     c    ' 14000 1.0 24304 17.0 25055 2.0')
          WRITE (100,581) UCSPACERFRAC,
     c    MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
581       FORMAT (T5'26304 65.42 28304 12.0 42000 2.5 3',1X,F6.5,1X,
     c    F7.1,1X,'end')
        ELSEIF ((SPACERMAT.EQ.'SS316S ').AND.
     c  (UCSPACERFRAC.GT.(0.0))) THEN
          WRITE (100,582)
582       FORMAT ('''     material composition of moderator',
     c    ' within unit cell')
          WRITE (100,583)
583       FORMAT ('''     with smeared ss316s spacer grids')
          UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c    BORATEDMODVF)+(7.75*UCSPACERFRAC)
          IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
             WRITE (100,584) UCMODREGIONDEN, BORATEDMODVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
584          FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
          ELSE
             WRITE (100,585) UCMODREGIONDEN, BORATEDMODVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
585          FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
          ENDIF
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            WRITE (100,586) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 586        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,587) UCMODREGIONDEN
 587        FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
     c      ' 14000 1.0 24000 17.0 25055 2.0')
            WRITE (100,588) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 588        FORMAT (T5'26000 65.42 28000 12.0 42000 2.5 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS304  ').AND.
     c   (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,589)
 589        FORMAT ('''      material composition of moderator',
     c      ' within unit cell')
            WRITE (100,590)
 590        FORMAT ('''      with smeared ss304 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.92*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,591) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 591           FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,592) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 592           FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,593) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 593        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,594) UCMODREGIONDEN
 594        FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24304 19.0',
     c      ' 25055 2.0 26304 69.5 28304 9.5')
            WRITE (100,595) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 595        FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS304S ').AND.
     c   (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,596)
 596        FORMAT ('''      material composition of moderator',
     c      ' within unit cell')
            WRITE (100,597)
 597        FORMAT ('''      with smeared ss304s spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.92*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,598) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 598           FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,599) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 599           FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,600) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 600        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
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     c       1X,F6.5,1X,F7.1,1X,'end')
             WRITE (100,601) UCMODREGIONDEN
 601         FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24000 19.0',
     c       ' 25055 2.0 26000 69.5 28000 9.5')
             WRITE (100,602) UCSPACERFRAC,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 602         FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
          ELSEIF (UCSPACERFRAC.EQ.(0.0)) THEN
             WRITE (100,603)
 603         FORMAT ('''      material composition of moderator',
     c       ' within unit cell')
             WRITE (100,604)
 604         FORMAT ('''      with no smeared spacer grids')
             UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c       BORATEDMODVF)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,605) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 605            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,606) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 606            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
             ENDIF
             WRITE (100,607) UCMODREGIONDEN, BORONVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 607         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c       1X,F6.5,1X,F7.1,1X,'end')
          ENDIF
          WRITE (100,608)
 608      FORMAT ('''')
*  Write BPRA material specifications
*  BPR follow specifications
          BPRA_FOLLOW=.FALSE.
          IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c       (CT3.LT.BPTN(CT1))) THEN
             BPRA_FOLLOW=.TRUE.
             BPRA_DESCRIPTION_ID=BPDESID(CT1)
             WRITE(100,610)
 610         FORMAT('''')
             WRITE(100,612)
 612         FORMAT('''',5X,'BPR above the BP absorber region')
             WRITE(100,614)
 614         FORMAT('''')
             IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c       (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
               DO 616 CT5=1,10
                IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
                 BPRCLNUM=CT5
                 EXIT
                ENDIF
 616           CONTINUE
               IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
                WRITE (100,618)
 618            FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c          ' 2.0 26304 69.5 28304 9.5')
                WRITE (100,620) CLADDESNUM(BPRCLNUM), CLTEMP
 620            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
                WRITE (100,622)
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622         FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c      ' 2.0 26000 69.5 28000 9.5')
            WRITE (100,624) CLADDESNUM(BPRCLNUM), CLTEMP
624         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
            WRITE (100,626)
626         FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c      ' 1.0 24304 17.0 25055 2.0')
            WRITE (100,628)
628         FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
            WRITE (100,630) CLADDESNUM(BPRCLNUM), CLTEMP
630         FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
            WRITE (100,632)
632         FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c      ' 1.0 24000 17.0 25055 2.0')
            WRITE (100,633)
633         FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
            WRITE (100,634) CLADDESNUM(BPRCLNUM), CLTEMP
634         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
            WRITE (100,635)
635         FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c      ' 22000 2.5 24000 15.0')
            WRITE (100,636)
636         FORMAT (T13,'26000 7.0 28000 73.0')
            WRITE (100,637) CLADDESNUM(BPRCLNUM), CLTEMP
637         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ENDIF
         ENDIF
         IF (ABOVEBP(BPDESID(CT1)).EQ.'AL2O3') THEN
            ALFRAC=(((BPDEN(BPDESID(CT1)))*2.0*26.981539)/
     c      (101.9631))/BPDEN(BPDESID(CT1))
            OFRAC=1.0-ALFRAC
            IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
               WRITE (100,638) ABOVEBPNUM(BPDESID(CT1)),
     c         BPDEN(BPDESID(CT1)), ALFRAC,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
638            FORMAT ('al',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c         1X,F7.1,1X,'end')
               WRITE (100,640) ABOVEBPNUM(BPDESID(CT1)),
     c         BPDEN(BPDESID(CT1)), OFRAC,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
640            FORMAT ('o',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c         1X,F7.1,1X,'end')
            ELSE
               WRITE (100,642) ABOVEBPNUM(BPDESID(CT1)),
     c         BPDEN(BPDESID(CT1)), ALFRAC,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
642            FORMAT ('al',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c         1X,F7.1,1X,'end')
               WRITE (100,644) ABOVEBPNUM(BPDESID(CT1)),
     c         BPDEN(BPDESID(CT1)), OFRAC,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
644            FORMAT ('o',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c         1X,F7.1,1X,'end')
            ENDIF
         ELSE
            WRITE (100,*) 'arbm-bp    ',
     c      BPDEN(BPRA_DESCRIPTION_ID),
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     c          '    ', BPFMNUMISOS(BPRA_DESCRIPTION_ID),
     c          '  0   0   0'
                DO 650 CT4=1,BPFMNUMISOS(BPRA_DESCRIPTION_ID)
                   WRITE (100,648)
     c             BPFISOID(BPRA_DESCRIPTION_ID,CT4),
     c             BPFISOWTPCT(BPRA_DESCRIPTION_ID,CT4)
 648               FORMAT (10X,I6,3X,F10.5)
 650            CONTINUE
                WRITE (100,*) '              ',
     c          ABOVEBPNUM(BPRA_DESCRIPTION_ID),
     c          ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM),
     c          '    end'
             ENDIF
          ENDIF
*  Actual BPRA specifications
          BPRA_INSERTED=.FALSE.
          IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c       (CT3.GE.BPTN(CT1)).AND.(CT3.LE.BPBN(CT1))) THEN
             BPRA_INSERTED=.TRUE.
             BPRA_DESCRIPTION_ID=BPDESID(CT1)
             WRITE (100,685)
 685         FORMAT ('''')
             IF (BPMIX(BPRA_DESCRIPTION_ID).EQ.0) THEN
                WRITE (100,690) BPWTPCT(BPDESID(CT1))
 690            FORMAT ('''',5X,'Al2O3-B4C burnable absorber pellet',1X,
     c          'specification (',F4.2,1X,'wt% b4c)')
             ELSE
                WRITE (100,695)
 695            FORMAT ('''',5X,'burnable absorber pellet ',
     c          'specification')
             ENDIF
             WRITE (100,700)
 700         FORMAT ('''')
*  Write B4C material specification
             IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c       (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
               DO 701 CT5=1,10
                IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
                 BPRCLNUM=CT5
                 EXIT
                ENDIF
 701           CONTINUE
               IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
                WRITE (100,702)
 702            FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c          ' 2.0 26304 69.5 28304 9.5')
                WRITE (100,703) CLADDESNUM(BPRCLNUM), CLTEMP
 703            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
                WRITE (100,704)
 704            FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c          ' 2.0 26000 69.5 28000 9.5')
                WRITE (100,705) CLADDESNUM(BPRCLNUM), CLTEMP
 705            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
                WRITE (100,706)
 706            FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c          ' 1.0 24304 17.0 25055 2.0')
                WRITE (100,707)
 707            FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
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                 WRITE (100,708) CLADDESNUM(BPRCLNUM), CLTEMP
708              FORMAT (T12,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
                 WRITE (100,709)
709              FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c           ' 1.0 24000 17.0 25055 2.0')
                 WRITE (100,710)
710              FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                 WRITE (100,711) CLADDESNUM(BPRCLNUM), CLTEMP
711              FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
                 WRITE (100,712)
712              FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c           ' 22000 2.5 24000 15.0')
                 WRITE (100,713)
713              FORMAT (T13,'26000 7.0 28000 73.0')
                 WRITE (100,714) CLADDESNUM(BPRCLNUM), CLTEMP
714              FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ENDIF
              ENDIF
*  Material specification for AL2O3-B4C
              IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c        (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
                 IF (BPWTPCT(BPDESID(CT1)).NE.(0.0)) THEN
                    IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                       WRITE (100,718) BPDEN(BPDESID(CT1)),
     c                 (BPWTPCT(BPDESID(CT1))/100.0),
     c                 MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
718                    FORMAT ('b4c    4    den=',F4.3,1X,F7.5,1X,F7.1,1X,
     c                 'end')
                    ELSE
                       WRITE (100,720) BPDEN(BPDESID(CT1)),
     c                 (BPWTPCT(BPDESID(CT1))/100.0),
     c                 MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
720                    FORMAT ('b4c    4    den=',F5.3,1X,F7.5,1X,F7.1,1X,
     c                 'end')
                    ENDIF
                 ENDIF
*  Calculate aluminum and oxygen material specifications
                 ALFRAC=((((((100.0-BPWTPCT(BPDESID(CT1)))/100.0)*
     c           BPDEN(BPDESID(CT1)))*2.0*26.981539)/(101.9631))/
     c           BPDEN(BPDESID(CT1))
                 OFRAC=1.0-(BPWTPCT(BPDESID(CT1))/100.0)-ALFRAC
                 IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                    WRITE (100,734) BPDEN(BPDESID(CT1)), ALFRAC,
     c              MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
734              FORMAT ('al     4    den=',F4.3,1X,F7.5,1X,F7.1,1X,'end')
                    WRITE (100,736) BPDEN(BPDESID(CT1)), OFRAC,
     c              MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
736              FORMAT ('o      4    den=',F4.3,1X,F7.5,1X,F7.1,1X,'end')
                 ELSE
                    WRITE (100,738) BPDEN(BPDESID(CT1)), ALFRAC,
     c              MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
738              FORMAT ('al     4    den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
                    WRITE (100,740) BPDEN(BPDESID(CT1)), OFRAC,
     c              MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
740              FORMAT ('o      4    den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
                 ENDIF
              ELSE
*  Material specification for BP other than Al2O3-B4C
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```
                DO 742 CT4=1,BPMIXNUM
                   IF (BPMIXID(CT4).EQ.BPMIX(BPRA_DESCRIPTION_ID)) THEN
                      RELATIVE_BP_MIX_ID=CT4
                   ENDIF
 742            CONTINUE
                WRITE (100,*) 'arbm-bp    ', BPDEN(BPRA_DESCRIPTION_ID),
     c          '    ', BPNUMISOS(RELATIVE_BP_MIX_ID),
     c          '   0   0   0'
                DO 750 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                   WRITE (100,745) BPISOID(RELATIVE_BP_MIX_ID,CT4),
     c             BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)
 745               FORMAT (10X,I6,3X,F10.5)
 750            CONTINUE
                WRITE (100,*) '             ', BPMIX(BPRA_DESCRIPTION_ID),
     c          ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '    end'
             ENDIF
          ENDIF
*  Write control rod material specification
          CR_INSERTED=.FALSE.
          IF (CRSTAT.EQ.'RODDED') THEN
             CRCOMPFLAG=.FALSE.
             DO 760 CT4=1,23
                IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                   CRCOMPFLAG=.TRUE.
                   CR_INSERTED=.TRUE.
                   CR_MIXTURE_ID=CRINS(CT1,CT2,CT4,CT3)
                   CR_DESCRIPTION=CRDES(CT1,CT2,CT4,CT3)
                   EXIT
                ENDIF
 760         CONTINUE
             IF (CRCOMPFLAG.EQ..TRUE.) THEN
                DO 770 CT4=1,CRMIXNUM
                   IF (CRMIXID(CT4).EQ.CR_MIXTURE_ID) THEN
                      RELATIVE_CR_MIX_ID=CT4
                   ENDIF
 770            CONTINUE
                WRITE (100,780)
 780            FORMAT ('''')
                WRITE (100,790)
 790            FORMAT ('''',T5,' control rod material specification')
                WRITE (100,800)
 800            FORMAT ('''')
             IF (CRCLAD(CR_DESCRIPTION).NE.0) THEN
               DO 801 CT5=1,10
                IF (CRCLAD(CR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
                 CRCLNUM=CT5
                 EXIT
                ENDIF
 801           CONTINUE
               IF (CLADDESNAME(CRCLNUM).EQ.'SS304  ') THEN
                WRITE (100,802)
 802            FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c          '2.0 26304 69.5 28304 9.5')
                WRITE (100,803) CLADDESNUM(CRCLNUM), CLTEMP
 803            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS304S ') THEN
                WRITE (100,804)
 804            FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c          '2.0 26000 69.5 28000 9.5')
                WRITE (100,805) CLADDESNUM(CRCLNUM), CLTEMP
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805         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316  ') THEN
            WRITE (100,806)
806         FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
   c        '1.0 24304 17.0 25055 2.0')
            WRITE (100,807)
807         FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
            WRITE (100,808) CLADDESNUM(CRCLNUM), CLTEMP
808         FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316S ') THEN
            WRITE (100,809)
809         FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
   c        '1.0 24000 17.0 25055 2.0')
            WRITE (100,810)
810         FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
            WRITE (100,811) CLADDESNUM(CRCLNUM), CLTEMP
811         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'INCONEL') THEN
            WRITE (100,812)
812         FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
   c        ' 22000 2.5 24000 15.0')
            WRITE (100,813)
813         FORMAT (T13,'26000 7.0 28000 73.0')
            WRITE (100,814) CLADDESNUM(CRCLNUM), CLTEMP
814         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ENDIF
         ENDIF
            WRITE (100,*) 'arbm-cr   ', CRDEN(CR_DESCRIPTION),
   c        '   ', CRNUMISOS(RELATIVE_CR_MIX_ID), '   0   0   0'
            DO 820 CT4=1,CRNUMISOS(RELATIVE_CR_MIX_ID)
               WRITE (100,815) CRISOID(RELATIVE_CR_MIX_ID,CT4),
   c           CRISOWTPCT(RELATIVE_CR_MIX_ID, CT4)
815            FORMAT (10X,I5,3X,F10.5)
820         CONTINUE
            WRITE (100,*) '             ', CR_MIXTURE_ID, ' 1.0 ',
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
         ENDIF
      ENDIF
*  Write APSR material specification
      IF ((CT1.EQ.CT1START).AND.(CT2.EQ.CT2GOVALUE).AND.
   c  (CT3.EQ.1)) THEN
      DO 824 CT4=1,10
         DO 823 CT5=1,20
            DO 822 CT6=1,23
               DO 821 CT7=1,50
                  APSRINSOLD(CT4,CT5,CT6,CT7)=
   c              APSRINS(CT4,CT5,CT6,CT7)
821            CONTINUE
822         CONTINUE
823      CONTINUE
824   CONTINUE
      ENDIF
      APSR_INSERTED=.FALSE.
      IF (APSRSTAT.EQ.'RODDED') THEN
         DO 830 CT4=1,23
            APSRBOTFLAG=.FALSE.
            DO 825 CT5=50,1,-1
               IF ((APSRINSOLD(CT1,CT2,CT4,CT5).NE.0).AND.
   c           (APSRBOTFLAG.EQ..FALSE.)) THEN
                  APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT5)
```

```
                    APSRBOTFLAG=.TRUE.
                    FOLNODKEEP=CT5
                    FOLSTEPKEEP=CT4
                 ENDIF
                 IF ((APSRINSOLD(CT1,CT2,CT4,CT5).EQ.0).AND.
     c           (APSRBOTFLAG.EQ..TRUE.)) THEN
                    APSRINS(CT1,CT2,CT4,CT5)=
     c              APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
                    APSRFOLLOWDATA(CT1,CT2,CT4,CT5)=3
                 ENDIF
 825          CONTINUE
 830       CONTINUE
           FOLLOWIN=.FALSE.
           DO 831 CT4=1,23
              IF (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3) THEN
                 FOLLOWIN=.TRUE.
                 EXIT
              ENDIF
 831       CONTINUE
           IF (FOLLOWIN.EQ..TRUE.) THEN
              WRITE (100,832)
 832          FORMAT ('''')
              WRITE (100,834)
 834          FORMAT ('''',T5,' APSR follow rod material',
     c        ' specification')
              WRITE (100,836)
 836          FORMAT ('''')
           IF ((APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.0)
     c     .AND.
     c     (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.2)) THEN
             DO 838 CT5=1,10
              IF (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
     c        .EQ.CLADDESNUM(CT5)) THEN
               APSRFOLNUM=CT5
               EXIT
              ENDIF
 838         CONTINUE
             IF (CLADDESNAME(APSRFOLNUM).EQ.'SS304   ') THEN
              WRITE (100,840)
 840          FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c        '2.0 26304 69.5 28304 9.5')
              WRITE (100,842) CLADDESNUM(APSRFOLNUM), CLTEMP
 842          FORMAT (T12,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS304S ') THEN
              WRITE (100,844)
 844          FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c        '2.0 26000 69.5 28000 9.5')
              WRITE (100,846) CLADDESNUM(APSRFOLNUM), CLTEMP
 846          FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316   ') THEN
              WRITE (100,848)
 848          FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c        '1.0 24304 17.0 25055 2.0')
              WRITE (100,850)
 850          FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
              WRITE (100,852) CLADDESNUM(APSRFOLNUM), CLTEMP
 852          FORMAT (T12,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316S ') THEN
              WRITE (100,854)
 854          FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
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     c         '1.0 24000 17.0 25055 2.0')
               WRITE (100,856)
 856           FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
               WRITE (100,858) CLADDESNUM(APSRFOLNUM), CLTEMP
 858           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'INCONEL') THEN
               WRITE (100,860)
 860           FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c         ' 22000 2.5 24000 15.0')
               WRITE (100,862)
 862           FORMAT (T13,'26000 7.0 28000 73.0')
               WRITE (100,864) CLADDESNUM(APSRFOLNUM), CLTEMP
 864           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ENDIF
            ENDIF
            ENDIF
            APSRCOMPFLAG=.FALSE.
            DO 865 CT4=1,23
               IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRINS(CT1,CT2,CT4,CT3).NE.
     c         APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP))) THEN
                  APSRCOMPFLAG=.TRUE.
                  APSR_INSERTED=.TRUE.
                  APSR_MIXTURE_ID=APSRINS(CT1,CT2,CT4,CT3)
                  APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT3)
                  EXIT
               ENDIF
 865        CONTINUE
            IF (APSRCOMPFLAG.EQ..TRUE.) THEN
               DO 866 CT4=1,APSRMIXNUM
                  IF (APSRMIXID(CT4).EQ.APSR_MIXTURE_ID) THEN
                     RELATIVE_APSR_MIX_ID=CT4
                  ENDIF
 866           CONTINUE
               WRITE (100,868)
 868           FORMAT ('''')
               WRITE (100,870)
 870           FORMAT ('''',T5,' axial power shaping rod material',
     c         ' specification')
               WRITE (100,880)
 880           FORMAT ('''')
            IF (APSRCLAD(APSR_DESCRIPTION).NE.0) THEN
              DO 881 CT5=1,10
               IF (APSRCLAD(APSR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
                APSRCLNUM=CT5
                EXIT
               ENDIF
 881          CONTINUE
              IF (CLADDESNAME(APSRCLNUM).EQ.'SS304  ') THEN
               WRITE (100,882)
 882           FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c         '2.0 26304 69.5 28304 9.5')
               WRITE (100,883) CLADDESNUM(APSRCLNUM), CLTEMP
 883           FORMAT (T12,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS304S ') THEN
               WRITE (100,884)
 884           FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c         '2.0 26000 69.5 28000 9.5')
               WRITE (100,885) CLADDESNUM(APSRCLNUM), CLTEMP
 885           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
```

```
                ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316  ') THEN
                 WRITE (100,886)
  886            FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c           '1.0 24304 17.0 25055 2.0')
                 WRITE (100,887)
  887            FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
                 WRITE (100,888) CLADDESNUM(APSRCLNUM), CLTEMP
  888            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316S ') THEN
                 WRITE (100,889)
  889            FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c           '1.0 24000 17.0 25055 2.0')
                 WRITE (100,890)
  890            FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                 WRITE (100,891) CLADDESNUM(APSRCLNUM), CLTEMP
  891            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'INCONEL') THEN
                 WRITE (100,892)
  892            FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c           ' 22000 2.5 24000 15.0')
                 WRITE (100,893)
  893            FORMAT (T13,'26000 7.0 28000 73.0')
                 WRITE (100,894) CLADDESNUM(APSRCLNUM), CLTEMP
  894            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ENDIF
              ENDIF
                 WRITE (100,*) 'arbm-apsr   ', APSRDEN(APSR_DESCRIPTION),
     c           '   ', APSRNUMISOS(RELATIVE_APSR_MIX_ID), '   0   0   0'
                 DO 900 CT4=1,APSRNUMISOS(RELATIVE_APSR_MIX_ID)
                    WRITE (100,895) APSRISOID(RELATIVE_APSR_MIX_ID,CT4),
     c              APSRISOWTPCT(RELATIVE_APSR_MIX_ID, CT4)
  895               FORMAT (10X,I5,3X,F10.5)
  900            CONTINUE
                 WRITE (100,*) '            ', APSR_MIXTURE_ID, ' 1.0 ',
     c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
              ENDIF
           ENDIF
*  Write fuel rod fill gas material specification
           WRITE (100,910)
  910      FORMAT ('''')
           WRITE (100,920)
  920      FORMAT ('he    5    end')
           WRITE (100,930)
  930      FORMAT ('end comp')
*  Write base reactor lattice specifications
           WRITE (100,940)
  940      FORMAT ('''')
           WRITE (100,950)
  950      FORMAT ('''    base reactor lattice specification')
           WRITE (100,960)
  960      FORMAT ('''')
           WRITE (100,970) PITCH, FOD, COD, CID
  970      FORMAT ('squarepitch',3X,F7.5,3X,F6.4,3X,'1   3',3X,F6.4,
     c     3X,'2',3X,F6.4,3X,'0   end')
* The following writing routine for 'SPECIAL' input data
* has not been formatted to compensate for FORTRAN's ingenious
* incapability to print leading zeros in numeric fields.
* Errors will occur in the FIDO input if null space exists
* between an equal sign and the appropriate value.  Therefore,
* the IIM and ICM factors must always be at least 10.
```

```
          IF (FLAG2.EQ.'SPECIAL') THEN
             IF (SZF.LT.1) THEN
                WRITE (100,980) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  980           FORMAT ('more data',1X,'szf=0',F3.2,1X,'isn=',I1,1X,
     c          'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c          1X,'ius=',I1,3X,'end')
             ELSE
                WRITE (100,990) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  990           FORMAT ('more data',1X,'szf=',F4.2,1X,'isn=',I1,1X,
     c          'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c          1X,'ius=',I1,3X,'end')
             ENDIF
          ELSEIF (FLAG2.NE.'SPECIAL') THEN
             IF (MESH.LT.1) THEN
                WRITE (100,1000) MESH
 1000           FORMAT ('more data',1X,'szf=0',F3.2,1X,'end')
             ELSE
                WRITE (100,1010) MESH
 1010           FORMAT ('more data',1X,'szf=',F4.2,1X,'end')
             ENDIF
          ENDIF
*  Write assembly specifications
          WRITE (100,1020)
 1020     FORMAT ('''')
          WRITE (100,1030)
 1030     FORMAT ('''      assembly specification')
          WRITE (100,1040)
 1040     FORMAT ('''')
          IF (STEPCONTROL.EQ.'Y') THEN
             CALL ZEROS(VARSTEPNUM(CT1,CT2),IRRAD_STEPS)
          ELSEIF (STEPCONTROL.EQ.'N') THEN
             CALL ZEROS(INT(BLETDOWN(CT1,CT2,2)),IRRAD_STEPS)
          ENDIF
*  Assembly specification if no BPRA, no CR, and no APSR is inserted
          IF ((BPRA_INSERTED.EQ..FALSE.).AND.(CR_INSERTED.EQ..FALSE.)
     c    .AND.(APSR_INSERTED.EQ..FALSE.)
     c    .AND.(BPRA_FOLLOW.EQ..FALSE.)
     c    .AND.(FOLLOWIN.EQ..FALSE.)) THEN
             IF (NODES(CT3,2).GE.(100.0)) THEN
                WRITE (100,1041) RODS, NODES(CT3,2), IRRAD_STEPS
 1041           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c       (NODES(CT3,2).GE.(10.0))) THEN
                WRITE (100,1042) RODS, NODES(CT3,2), IRRAD_STEPS
 1042           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
                WRITE (100,1043) RODS, NODES(CT3,2), IRRAD_STEPS
 1043           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ENDIF
             CALL ZEROS(PLEVEL,PLEVELCH)
             CALL ZEROS(LUZONE,LUZONECH)
             IF (MESH.LT.(1.0)) THEN
                WRITE (100,1044) PLEVELCH, LUZONECH, MESH
 1044           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=1',1X,
     c          'mixmod=3 facmesh=',F3.2,1X,'end')
             ELSE
```

```
                WRITE (100,1045) PLEVELCH, LUZONECH, MESH
 1045           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
    c           'numztotal=',A2,1X,'mxrepeats=1',1X,
    c           'mixmod=3 facmesh=',F4.2,1X,'end')
             ENDIF
             DO 1047 CT4=1,LUZONE
                IF (MOD(CT4,6).EQ.0) THEN
                   WRITE (100,*)
                ENDIF
                WRITE (100,1046) LMB(CT4), LRB(CT4)
 1046           FORMAT (I3,1X,F7.5,1X,$)
 1047        CONTINUE
             WRITE (100,*)
          ENDIF
*  Assembly specification if BPRA is inserted
          IF (BPRA_FOLLOW.EQ..TRUE.) THEN
             IF (NODES(CT3,2).GE.(100.0)) THEN
                WRITE (100,1050) RODS, NODES(CT3,2), IRRAD_STEPS
 1050           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
    c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
    c        (NODES(CT3,2).GE.(10.0))) THEN
                WRITE (100,1052) RODS, NODES(CT3,2), IRRAD_STEPS
 1052           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
    c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
                WRITE (100,1054) RODS, NODES(CT3,2), IRRAD_STEPS
 1054           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
    c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ENDIF
             CALL ZEROS(PLEVEL,PLEVELCH)
             CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
             IF (MESH.LT.(1.0)) THEN
                WRITE (100,1056) PLEVELCH, BPZONECH, MESH
 1056           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
    c           'numztotal=',A2,1X,'mxrepeats=1',1X,
    c           'mixmod=3 facmesh=',F3.2,1X,'end')
             ELSE
                WRITE (100,1058) PLEVELCH, BPZONECH, MESH
 1058           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
    c           'numztotal=',A2,1X,'mxrepeats=1',1X,
    c           'mixmod=3 facmesh=',F4.2,1X,'end')
             ENDIF
             DO 1062 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
                IF (MOD(CT4,6).EQ.0) THEN
                   WRITE (100,*)
                ENDIF
                WRITE (100,1060) BPRFM(CT4,BPRA_DESCRIPTION_ID),
    c           BPRFR(CT4,BPRA_DESCRIPTION_ID)
 1060           FORMAT (I3,1X,F7.5,1X,$)
 1062        CONTINUE
             WRITE (100,*)
          ENDIF
          IF (BPRA_INSERTED.EQ..TRUE.) THEN
             IF (NODES(CT3,2).GE.(100.0)) THEN
                WRITE (100,1098) RODS, NODES(CT3,2), IRRAD_STEPS
 1098           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
    c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
    c        (NODES(CT3,2).GE.(10.0))) THEN
```

```
            WRITE (100,1100) RODS, NODES(CT3,2), IRRAD_STEPS
 1100       FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
            WRITE (100,1103) RODS, NODES(CT3,2), IRRAD_STEPS
 1103       FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ENDIF
         CALL ZEROS(PLEVEL,PLEVELCH)
         CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
         IF (MESH.LT.(1.0)) THEN
            WRITE (100,1104) PLEVELCH, BPZONECH, MESH
 1104       FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c      'numztotal=',A2,1X,'mxrepeats=1',1X,
     c      'mixmod=3 facmesh=',F3.2,1X,'end')
         ELSE
            WRITE (100,1106) PLEVELCH, BPZONECH, MESH
 1106       FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c      'numztotal=',A2,1X,'mxrepeats=1',1X,
     c      'mixmod=3 facmesh=',F4.2,1X,'end')
         ENDIF
         DO 1110 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
            IF (MOD(CT4,6).EQ.0) THEN
               WRITE (100,*)
            ENDIF
            WRITE (100,1108) BPMA(CT4,BPRA_DESCRIPTION_ID),
     c      BPRA(CT4,BPRA_DESCRIPTION_ID)
 1108       FORMAT (I3,1X,F7.5,1X,$)
 1110    CONTINUE
         WRITE (100,*)
      ENDIF
*  Assembly specification if CR is inserted
      IF (CR_INSERTED.EQ..TRUE.) THEN
         IF (NODES(CT3,2).GE.(100.0)) THEN
            WRITE (100,1120) RODS, NODES(CT3,2), IRRAD_STEPS
 1120       FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c   (NODES(CT3,2).GE.(10.0))) THEN
            WRITE (100,1130) RODS, NODES(CT3,2), IRRAD_STEPS
 1130       FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
            WRITE (100,1140) RODS, NODES(CT3,2), IRRAD_STEPS
 1140       FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ENDIF
         CALL ZEROS(PLEVEL,PLEVELCH)
         CALL ZEROS(CRZONE(CR_DESCRIPTION),CRZONECH)
         IF (MESH.LT.(1.0)) THEN
            WRITE (100,1150) PLEVELCH, CRZONECH, MESH
 1150       FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c      'numztotal=',A2,1X,'mxrepeats=0',1X,
     c      'mixmod=3 facmesh=',F3.2,1X,'end')
         ELSE
            WRITE (100,1160) PLEVELCH, CRZONECH, MESH
 1160       FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c      'numztotal=',A2,1X,'mxrepeats=0',1X,
     c      'mixmod=3 facmesh=',F4.2,1X,'end')
         ENDIF
```

```
            IF (STEPCONTROL.EQ.'N') THEN
             DO 1169 CT4=1,INT(BLETDOWN(CT1,CT2,2))
               IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                  DO 1164 CT5=1,CRZONE(CR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1162) CRMA(CT5,CR_DESCRIPTION),
     c               CRRA(CT5,CR_DESCRIPTION)
 1162                FORMAT (I3,1X,F7.5,1X,$)
 1164             CONTINUE
                  WRITE (100,*)
               ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1168 CT5=1,CRZONE(CR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1166) LMC(CT5,CR_DESCRIPTION),
     c               LRC(CT5,CR_DESCRIPTION)
 1166                FORMAT (I3,1X,F7.5,1X,$)
 1168             CONTINUE
                  WRITE (100,*)
               ENDIF
 1169        CONTINUE
            ELSEIF (STEPCONTROL.EQ.'Y') THEN
             DO 1210 CT4=1,VARSTEPNUM(CT1,CT2)
               IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                  DO 1180 CT5=1,CRZONE(CR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1170) CRMA(CT5,CR_DESCRIPTION),
     c               CRRA(CT5,CR_DESCRIPTION)
 1170                FORMAT (I3,1X,F7.5,1X,$)
 1180             CONTINUE
                  WRITE (100,*)
               ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1200 CT5=1,CRZONE(CR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1190) LMC(CT5,CR_DESCRIPTION),
     c               LRC(CT5,CR_DESCRIPTION)
 1190                FORMAT (I3,1X,F7.5,1X,$)
 1200             CONTINUE
                  WRITE (100,*)
               ENDIF
 1210        CONTINUE
            ENDIF
         ENDIF
*  Assembly specification if APSR is inserted
         IF ((APSR_INSERTED.EQ..TRUE.).OR.(FOLLOWIN.EQ..TRUE.)) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1220) RODS, NODES(CT3,2), IRRAD_STEPS
 1220          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1230) RODS, NODES(CT3,2), IRRAD_STEPS
 1230          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
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     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
                WRITE (100,1240) RODS, NODES(CT3,2), IRRAD_STEPS
  1240          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ENDIF
             CALL ZEROS(PLEVEL,PLEVELCH)
             CALL ZEROS(APSRZONE(APSR_DESCRIPTION),APSRZONECH)
             IF (MESH.LT.(1.0)) THEN
                WRITE (100,1250) PLEVELCH, APSRZONECH, MESH
  1250          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=0',1X,
     c          'mixmod=3 facmesh=',F3.2,1X,'end')
             ELSE
                WRITE (100,1252) PLEVELCH, APSRZONECH, MESH
  1252          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=0',1X,
     c          'mixmod=3 facmesh=',F4.2,1X,'end')
             ENDIF
             IF (STEPCONTROL.EQ.'N') THEN
              DO 1268 CT4=1,INT(BLETDOWN(CT1,CT2,2))
                IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c          (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
                   DO 1258 CT5=1,APSRZONE(APSR_DESCRIPTION)
                      IF (MOD(CT5,6).EQ.0) THEN
                         WRITE (100,*)
                      ENDIF
                      WRITE (100,1256) APSRMA(CT5,APSR_DESCRIPTION),
     c                APSRRA(CT5,APSR_DESCRIPTION)
  1256                FORMAT (I3,1X,F7.5,1X,$)
  1258             CONTINUE
                   WRITE (100,*)
                ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c          (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
                   DO 1262 CT5=1,APSRZONE(APSR_DESCRIPTION)
                      IF (MOD(CT5,6).EQ.0) THEN
                         WRITE (100,*)
                      ENDIF
                      WRITE (100,1260) APSRFM(CT5,APSR_DESCRIPTION),
     c                APSRFR(CT5,APSR_DESCRIPTION)
  1260                FORMAT (I3,1X,F7.5,1X,$)
  1262             CONTINUE
                   WRITE (100,*)
                ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                   DO 1266 CT5=1,APSRZONE(APSR_DESCRIPTION)
                      IF (MOD(CT5,6).EQ.0) THEN
                         WRITE (100,*)
                      ENDIF
                      WRITE (100,1264) LMD(CT5,APSR_DESCRIPTION),
     c                LRD(CT5,APSR_DESCRIPTION)
  1264                FORMAT (I3,1X,F7.5,1X,$)
  1266             CONTINUE
                   WRITE (100,*)
                ENDIF
  1268        CONTINUE
             ELSEIF (STEPCONTROL.EQ.'Y') THEN
              DO 1310 CT4=1,VARSTEPNUM(CT1,CT2)
                IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c          (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
                   DO 1280 CT5=1,APSRZONE(APSR_DESCRIPTION)
```

```
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1270) APSRMA(CT5,APSR_DESCRIPTION),
     c            APSRRA(CT5,APSR_DESCRIPTION)
 1270             FORMAT (I3,1X,F7.5,1X,$)
 1280          CONTINUE
               WRITE (100,*)
            ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c      (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
               DO 1290 CT5=1,APSRZONE(APSR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1285) APSRFM(CT5,APSR_DESCRIPTION),
     c            APSRFR(CT5,APSR_DESCRIPTION)
 1285             FORMAT (I3,1X,F7.5,1X,$)
 1290          CONTINUE
               WRITE (100,*)
            ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
               DO 1300 CT5=1,APSRZONE(APSR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1295) LMD(CT5,APSR_DESCRIPTION),
     c            LRD(CT5,APSR_DESCRIPTION)
 1295             FORMAT (I3,1X,F7.5,1X,$)
 1300          CONTINUE
               WRITE (100,*)
            ENDIF
 1310     CONTINUE
         ENDIF
      ENDIF
*  Write assembly depletion/decay parameters
      WRITE (100,1320)
 1320 FORMAT ('''')
      WRITE (100,1330)
 1330 FORMAT ('''     assembly depletion/decay parameters')
      WRITE (100,1340)
 1340 FORMAT ('''')
      CALL ZEROS(CYCPOS(CT1),ASSYPOSITION)
      WRITE (100,1350) CYCLEID(CT1), ASSYPOSITION
 1350 FORMAT ('''',T5,'Cycle-',A2,', one-eighth core',
     c ' assembly number ',A2)
      IF (STEPCONTROL.EQ.'N') THEN
       DO 1380 CT4=3,(INT(BLETDOWN(CT1,CT2,2))+2)
         IF (CT4.LT.(BLETDOWN(CT1,CT2,2)+2)) THEN
            DOWNTIME=0.0
            BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c      BLETDOWN(CT1,CT2,3))
            WRITE (100,1360) POWER(CT3,RELATIVE_STPT_NUM),
     c      BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1360       FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c      G10.5,1X,'bfrac=',G9.4,1X,'end')
         ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c   (CT2.LT.STPTS(CT1))) THEN
            DOWNTIME=STPTDAT(CT1,(CT2+1),3)
            BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c      BLETDOWN(CT1,CT2,3))
            WRITE (100,1365) POWER(CT3,RELATIVE_STPT_NUM),
```

```
     c         BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1365          FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c         G10.5,1X,'bfrac=',G9.4,1X,'end')
            ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c      (CT2.EQ.STPTS(CT1))) THEN
               DOWNTIME=CYCDOWN(CT1)
               BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c         BLETDOWN(CT1,CT2,3))
               WRITE (100,1370) POWER(CT3,RELATIVE_STPT_NUM),
     c         BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1370          FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c         G10.5,1X,'bfrac=',G9.4,1X,'end')
            ENDIF
 1380     CONTINUE
        ELSEIF (STEPCONTROL.EQ.'Y') THEN
          DO 1388 CT4=1,VARSTEPNUM(CT1,CT2)
            IF (CT4.LT.VARSTEPNUM(CT1,CT2)) THEN
               DOWNTIME=0.0
               BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c         VARBLETDOWN(CT1,CT2,1,2))
               WRITE (100,1382) VARPOWER(CT1,CT2,CT4,CT3),
     c         VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1382          FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c         G10.5,1X,'bfrac=',G9.4,1X,'end')
            ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c      (CT2.LT.STPTS(CT1))) THEN
               DOWNTIME=STPTDAT(CT1,(CT2+1),3)
               BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c         VARBLETDOWN(CT1,CT2,1,2))
               WRITE (100,1384) VARPOWER(CT1,CT2,CT4,CT3),
     c         VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1384          FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c         G10.5,1X,'bfrac=',G9.4,1X,'end')
            ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c      (CT2.EQ.STPTS(CT1))) THEN
               DOWNTIME=CYCDOWN(CT1)
               BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c         VARBLETDOWN(CT1,CT2,1,2))
               WRITE (100,1386) VARPOWER(CT1,CT2,CT4,CT3),
     c         VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1386          FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c         G10.5,1X,'bfrac=',G9.4,1X,'end')
            ENDIF
 1388     CONTINUE
        ENDIF
*  Store final downtime for use in extraction script 'sedexecute.exe'
        FINALDOWNTIME=DOWNTIME
*  Write input deck closing statement
        WRITE (100,1390)
 1390   FORMAT ('''')
        WRITE (100,1400)
 1400   FORMAT ('''      end of input')
        WRITE (100,1410)
 1410   FORMAT ('''')
        WRITE (100,1420)
 1420   FORMAT ('end')
        CLOSE(UNIT=100)

      RETURN
      END
```

```
*****************************************************************
*     Subroutine to write continuation depletion/decay SAS2H    *
*     input decks utilizing fuel and burnable poison compositions *
*     from the assembly's previous depletion/decay calculation  *
*     en-route to the final CRC depletion/decay calculation     *
*****************************************************************
      SUBROUTINE CONTINUATION_WRITER (RELATIVE_STPT_NUM, CT1, CT2,
     c CT3, AXNUM, CYCPOS, AXBLANK, BPDESID,
     c CRINS, CRDES, CRMIXNUM, CRMIXID,
     c CRNUMISOS, CRISOID, APSRINS,
     c APSRMIXNUM, APSRMIXID, RELATIVE_APSR_MIX_ID,
     c APSRNUMISOS, APSRISOID, ISN, IIM, ICM, IUS,
     c PLEVEL, BPZONE, BPMA, CRZONE, CRMA,
     c LMC, APSRZONE, APSRMA, LMD,
     c BPTN, BPBN, STPTS, APSRDES,
     c STPTDAT, AXBLANKRICH, GRAMS,
     c NODES, RODS, RICH, FTFINAL, MODDENFINAL,
     c MODTEMPFINAL, BLETDOWN, BPWTPCT,
     c BPDEN, CRDEN, CRISOWTPCT, APSRDEN,
     c APSRISOWTPCT, PITCH, FOD, COD, CID, SZF, EPS, PTC,
     c MESH, BPRA, CRRA, LRC, APSRRA,
     c LRD, POWER, CYCDOWN, PREFIX, NM,
     c CYCLEID, REACT, LIB, AXBLANKET, FUELCLAD,
     c BPRFLAG, CRSTAT, APSRSTAT, FLAG2, LUZONE, LMB, LRB,
     c MASSTOTAL, FUELISONAME, FUELISOWTPCT, BPRAISONAME,
     c BPRAISOVALUE, LEFTLIST, CARRYCOUNTER, BPXSECT, BPRODS,
     c PREVIOUSNAME, FINALDOWNTIME, LEFTVAL, BPRA_INSERTED, CLADTOT,
     c CLADDESNUM, CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START, CT2GOVALUE,
     c APSRINSOLD)
*
      INTEGER*4 RELATIVE_STPT_NUM, CT1, CT2, CT3, AXNUM,
     c NUMSTPT1, NUMSTPT2, NUMSTPT3, CYCPOS(10), AXBLANK(50),
     c BPDESID(10), BPRA_DESCRIPTION_ID, CT4, CT5, CRINS(10,20,23,50),
     c CR_MIXTURE_ID, CR_DESCRIPTION, CRDES(10,20,23,50), CRMIXNUM,
     c CRMIXID(25), RELATIVE_CR_MIX_ID, CRNUMISOS(25),
     c CRISOID(25,10), APSRINS(10,20,23,50), APSR_MIXTURE_ID,
     c APSR_DESCRIPTION, APSRMIXNUM, APSRMIXID(25),
     c RELATIVE_APSR_MIX_ID, APSRNUMISOS(25), APSRISOID(25,10),
     c ISN, IIM, ICM, IUS, PLEVEL, BPZONE(10), BPMA(15,10),
     c CRZONE(10), CRMA(15,10), LMC(15,10), APSRZONE(10),
     c APSRMA(15,10), LMD(15,10), BPTN(10), BPBN(10), STPTS(10),
     c APSRDES(10,20,23,50), LUZONE, LMB(15), CARRYCOUNTER,
     c FUELISOTOPENUMBER, BPRODS(10), PNMCT1, PNMCT2, PNUMSTPT1,
     c PNUMSTPT2, PNUMSTPT3, NUMSTPT4, NUMSTPT5, NUMSTPT6,
     c PNUMSTPT4, PNUMSTPT5, PNUMSTPT6, CLADTOT, CLADDESNUM(10),
     c BPRCLAD(10), CRCLAD(10), APSRCLAD(10), BPRCLNUM, CRCLNUM,
     c APSRCLNUM, BPMIXNUM, BPMIX(10), BPMIXID(10), BPNUMISOS(10),
     c BPISOID(10,20), VARSTEPNUM(10,20), BPRFM(15,10),
     c BPFMNUMISOS(25), BPFISOID(25,10), ABOVEBPNUM(10),
     c APSRFM(15,10), APSRFOLLOWMIX(10,20,23,50),
     c FOLNODKEEP, FOLSTEPKEEP, APSRFOLNUM, APSRINSOLD(10,20,23,50),
     c APSRFOLLOWDATA(10,20,23,50), CT1START, CT2GOVALUE
```

```
*
      REAL STPTDAT(10,20,3), ENR, AXBLANKRICH, OXYGMS, GRAMS(50),
     c FVOL, PI, NODES(50,2), RODS, FDEN,
     c RICH, FTFINAL(50,20),
     c MODDENFINAL(50,20), MODTEMPFINAL(50,20), BLETDOWN(10,20,25),
     c BPWTPCT(10), BPDEN(10), ALFRAC, OFRAC, CRDEN(10),
     c CRISOWTPCT(25,10), APSRDEN(10), APSRISOWTPCT(25,10),
     c PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH, BPRA(15,10),
     c CRRA(15,10), LRC(15,10), APSRRA(15,10), LRD(15,10),
     c DOWNTIME, BORON_FRACTION, POWER(50,20), CYCDOWN(10), LRB(15),
     c MASSTOTAL, FUELISOWTPCT(1000), BPRAISOVALUE(2), BPXSECT(10),
     c BPVOL, FINALDOWNTIME, LEFTVAL(1000), CLTEMP,
     c BPISOWTPCT(10,20), UCSPACERFRAC, BORATEDMODVF,
     c BORONVF, UCMODREGIONDEN, B4CMASS, ALMASS, OMASS, CMASS,
     c NEWBPMASSTOTAL, NEWBPDEN, ALWTPCT, OWTPCT, CWTPCT, B10WTPCT,
     c B11WTPCT, VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50),
     c BPRFR(15,10), BPFISOWTPCT(25,10), APSRFR(15,10)
*
      CHARACTER CHNODE*2, CHID*2, PREFIX*3, CHSTPT1*1, CHSTPT2*1,
     c CHSTPT3*1, NM*31, CYCLEID(10)*2, REACT*21, LIB*15,
     c AXBLANKET*1, FUELCLAD*10, BPRFLAG*1, CRSTAT*6, APSRSTAT*6,
     c FLAG2*7, IRRAD_STEPS*2, PLEVELCH*2, BPZONECH*2, CRZONECH*2,
     c APSRZONECH*2, LUZONECH*2, FUELISONAME(1000)*5, BPRAISONAME(2)*6,
     c LEFTLIST(1000)*6, PREVIOUSNAME*25, PCHSTPT1*1, PCHSTPT2*1,
     c PCHSTPT3*1, ASSYPOSITION*2, CHSTPT4*1, CHSTPT5*1, CHSTPT6*1,
     c PCHSTPT4*1, PCHSTPT5*1, PCHSTPT6*1, PCHID*2, CLADDESNAME(10)*7,
     c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
      LOGICAL BPRA_INSERTED, CR_INSERTED, CRCOMPFLAG, APSR_INSERTED,
     c APSRCOMPFLAG, BPRA_FOLLOW, APSRBOTFLAG, FOLLOWIN
*
      PI=3.14159265359
*  Determination of the input deck filename
         CALL ZEROS(CT3,CHNODE)
         CALL ZEROS(CYCPOS(CT1),CHID)
         IF ((CT2-1).EQ.0) THEN
            PNMCT1=CT1-1
            PNMCT2=STPTS(PNMCT1)
         ELSE
            PNMCT1=CT1
            PNMCT2=CT2-1
         ENDIF
         CALL ZEROS(CYCPOS(PNMCT1),PCHID)
*  Determine new filename
         NUMSTPT1=INT(STPTDAT(CT1,CT2,1)/100.0)
         CHSTPT1=CHAR(NUMSTPT1+48)
         NUMSTPT2=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100))/10.0)
         CHSTPT2=CHAR(NUMSTPT2+48)
         NUMSTPT3=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100)-
     c   (NUMSTPT2*10)))
         CHSTPT3=CHAR(NUMSTPT3+48)
         IF (CT2.LT.STPTS(CT1)) THEN
            NUMSTPT4=INT(STPTDAT(CT1,(CT2+1),1)/100.0)
            CHSTPT4=CHAR(NUMSTPT4+48)
            NUMSTPT5=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100))/10.0)
            CHSTPT5=CHAR(NUMSTPT5+48)
            NUMSTPT6=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100)-
     c      (NUMSTPT5*10)))
            CHSTPT6=CHAR(NUMSTPT6+48)
         ELSEIF (CT2.EQ.STPTS(CT1)) THEN
```

```
            NUMSTPT4=INT(STPTDAT((CT1+1),1,1)/100.0)
            CHSTPT4=CHAR(NUMSTPT4+48)
            NUMSTPT5=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100))/10.0)
            CHSTPT5=CHAR(NUMSTPT5+48)
            NUMSTPT6=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100)-
     c      (NUMSTPT5*10)))
            CHSTPT6=CHAR(NUMSTPT6+48)
         ENDIF
         NM(1:3)=PREFIX
         NM(4:4)='A'
         NM(5:6)=CHID
         NM(7:7)='N'
         NM(8:9)=CHNODE
         NM(10:11)='DC'
         NM(12:13)=CYCLEID(CT1)
         NM(14:14)='T'
         NM(15:15)=CHSTPT1
         NM(16:16)=CHSTPT2
         NM(17:17)=CHSTPT3
         NM(18:19)='AC'
         IF (CT2.EQ.STPTS(CT1)) THEN
            NM(20:21)=CYCLEID(CT1+1)
         ELSE
            NM(20:21)=CYCLEID(CT1)
         ENDIF
         NM(22:22)='T'
         NM(23:23)=CHSTPT4
         NM(24:24)=CHSTPT5
         NM(25:25)=CHSTPT6
         NM(26:31)='.input'
*  Determine previous filename
         PNUMSTPT1=INT(STPTDAT(PNMCT1,PNMCT2,1)/100.0)
         PCHSTPT1=CHAR(PNUMSTPT1+48)
         PNUMSTPT2=INT((STPTDAT(PNMCT1,PNMCT2,1)-
     c   (PNUMSTPT1*100))/10.0)
         PCHSTPT2=CHAR(PNUMSTPT2+48)
         PNUMSTPT3=INT((STPTDAT(PNMCT1,PNMCT2,1)-(PNUMSTPT1*100)-
     c   (PNUMSTPT2*10)))
         PCHSTPT3=CHAR(PNUMSTPT3+48)
         IF (PNMCT2.LT.STPTS(PNMCT1)) THEN
            PNUMSTPT4=INT(STPTDAT(PNMCT1,(PNMCT2+1),1)/100.0)
            PCHSTPT4=CHAR(PNUMSTPT4+48)
            PNUMSTPT5=INT((STPTDAT(PNMCT1,(PNMCT2+1),1)-
     c      (PNUMSTPT4*100))/10.0)
            PCHSTPT5=CHAR(PNUMSTPT5+48)
            PNUMSTPT6=INT((STPTDAT(PNMCT1,(PNMCT2+1),1)-
     c      (PNUMSTPT4*100)-(PNUMSTPT5*10)))
            PCHSTPT6=CHAR(PNUMSTPT6+48)
         ELSEIF (PNMCT2.EQ.STPTS(PNMCT1)) THEN
            PNUMSTPT4=INT(STPTDAT((PNMCT1+1),1,1)/100.0)
            PCHSTPT4=CHAR(PNUMSTPT4+48)
            PNUMSTPT5=INT((STPTDAT((PNMCT1+1),1,1)-
     c      (PNUMSTPT4*100))/10.0)
            PCHSTPT5=CHAR(PNUMSTPT5+48)
            PNUMSTPT6=INT((STPTDAT((PNMCT1+1),1,1)-(PNUMSTPT4*100)-
     c      (PNUMSTPT5*10)))
            PCHSTPT6=CHAR(PNUMSTPT6+48)
         ENDIF
         PREVIOUSNAME(1:3)=PREFIX
         PREVIOUSNAME(4:4)='A'
```

```
         PREVIOUSNAME(5:6)=PCHID
         PREVIOUSNAME(7:7)='N'
         PREVIOUSNAME(8:9)=CHNODE
         PREVIOUSNAME(10:11)='DC'
         IF (CT2.EQ.1) THEN
            PREVIOUSNAME(12:13)=CYCLEID(CT1-1)
         ELSE
            PREVIOUSNAME(12:13)=CYCLEID(CT1)
         ENDIF
         PREVIOUSNAME(14:14)='T'
         PREVIOUSNAME(15:15)=PCHSTPT1
         PREVIOUSNAME(16:16)=PCHSTPT2
         PREVIOUSNAME(17:17)=PCHSTPT3
         PREVIOUSNAME(18:19)='AC'
         PREVIOUSNAME(20:21)=CYCLEID(CT1)
         PREVIOUSNAME(22:22)='T'
         PREVIOUSNAME(23:23)=PCHSTPT4
         PREVIOUSNAME(24:24)=PCHSTPT5
         PREVIOUSNAME(25:25)=PCHSTPT6
*    Open and rewind the input deck file
         OPEN(UNIT=100, FILE=NM, STATUS='UNKNOWN')
         REWIND(UNIT=100)
*    Write first section of input deck
         WRITE (100,10)
 10      FORMAT ('=sas2h',T11,'parm=skipshipdata')
         IF (CT2.LT.STPTS(CT1)) THEN
            WRITE (100,20) REACT, CHID, CHNODE,
   c        NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
   c        STPTDAT(CT1,(CT2+1),1)
 20         FORMAT (A21,1X,'Assy-',A2,
   c        ', Node-',A2,1X,
   c        '(Cyc-',A2,', 'F5.1,' to Cyc-',
   c        A2,', ',F5.1,' EFPD)')
         ELSEIF (CT2.EQ.STPTS(CT1)) THEN
            WRITE (100,25) REACT, CHID, CHNODE,
   c        NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
   c        STPTDAT((CT1+1),1,1)
 25         FORMAT (A21,1X,'Assy-',A2,
   c        ', Node-',A2,1X,
   c        '(Cyc-',A2,', 'F5.1,' to Cyc-',
   c        A2,', ',F5.1,' EFPD)')
         ENDIF
         WRITE (100,30) LIB
 30      FORMAT (A15,1X,'latticecell')
         WRITE (100,40)
 40      FORMAT ('''')
         WRITE (100,50)
 50      FORMAT ('''   fuel density based on mass of uranium per',
   c     ' assembly',T56,'& total pellet stack')
         WRITE (100,60)
 60      FORMAT ('''   volume to account for fuel volume loss to',
   c     ' pellet c',T55,'hamfers')
         WRITE (100,70)
 70      FORMAT ('''')
*    Write second section of input deck (material specifications)
         WRITE (100,80)
 80      FORMAT ('''',5X,'material specification input')
         WRITE (100,90)
 90      FORMAT ('''')
*    Calculate initital fuel parameters depending upon whether or not the
```

```
*  node represents axial blanket fuel
         IF ((AXBLANKET.EQ.'Y').AND.(AXBLANK(CT3).EQ.1)) THEN
            ENR=AXBLANKRICH
         ELSE
            ENR=RICH
         ENDIF
         OXYGMS=(GRAMS(CT3)*2*15.994915)/(((ENR/100)*235.043915)+
     c   (((0.007731*((ENR)**1.0837))/100)*234.040904)+
     c   (((0.0046*ENR)/100)*236.045637)+(((100-(0.007731*
     c   (ENR**1.0837))-(ENR)-(0.0046*ENR))/100)*238.05077))
*  Determine if the burnable poison charge isotopics should be retrieved
         BPRA_INSERTED=.FALSE.
         IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c      (CT3.GE.BPTN(CT1)).AND.(CT3.LE.BPBN(CT1))) THEN
            BPRA_INSERTED=.TRUE.
         ENDIF
*  Call subroutine to retrieve charge for fuel and bp isotopics
         CALL RETRIEVER (OXYGMS, MASSTOTAL,
     c   FUELISONAME, FUELISOWTPCT, BPRAISONAME,
     c   BPRAISOVALUE, LEFTLIST, CARRYCOUNTER,
     c   PREVIOUSNAME, LEFTVAL, NM, BPRA_INSERTED)
*  Calculate the nodal fuel volume, fuel density, and oxygen wt%
         FVOL=(PI/4)*(FOD**2)*(NODES(CT3,2))*(RODS)
         FDEN=MASSTOTAL/FVOL
         OXYWTPCT=(OXYGMS/MASSTOTAL)*100.0
         FUELISOTOPENUMBER=CARRYCOUNTER+1
*  Write fuel composition input description
         IF (FDEN.LT.(10.0)) THEN
            WRITE (100,100) FDEN, FUELISOTOPENUMBER, OXYWTPCT
 100        FORMAT ('arbm-fuel',1X,G10.3,1X,I3,1X,'0 0 0',1X,
     c      '8016',1X,G10.3)
         ELSE
            WRITE (100,110) FDEN, FUELISOTOPENUMBER, OXYWTPCT
 110        FORMAT ('arbm-fuel',1X,G10.3,1X,I3,1X,'0 0 0',1X,
     c      '8016',1X,G10.3)
         ENDIF
         DO 130 CT4=1,CARRYCOUNTER
            IF (MOD(CT4,3).EQ.0) THEN
               WRITE (100,*)
            ENDIF
            WRITE (100,120) FUELISONAME(CT4), FUELISOWTPCT(CT4)
 120        FORMAT (5X,A5,1X,G10.3,1X,$)
 130     CONTINUE
         WRITE (100,*)
         WRITE (100,140) FTFINAL(CT3,RELATIVE_STPT_NUM)
 140     FORMAT (5X,'1',3X,'1.0',3X,F6.1,'   end')
*  Write cladding material specifications
*  Additional cladding material specifications may be added to the
*  following IF statement as required
         IF ((FUELCLAD.EQ.'ZIRC-4     ').OR.
     c   (FUELCLAD.EQ.'ZIRCALLOY4')) THEN
            WRITE (100,532)
 532        FORMAT ('arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000',
     c      ' 0.10 26000 0.20 50000 1.40')
            WRITE (100,535) CLTEMP
 535        FORMAT (T12,'40000 98.18 2 1.0 ',F5.1,' end')
         ELSEIF (FUELCLAD.EQ.'SS304      ') THEN
            WRITE (100,537)
 537        FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
```

```
     c        ' 2.0 26304 69.5 28304 9.5')
              WRITE (100,540) CLTEMP
   540        FORMAT (T12,'2 1.0 ',F5.1,' end')
           ELSEIF (FUELCLAD.EQ.'SS304S    ') THEN
              WRITE (100,542)
   542        FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c        ' 2.0 26000 69.5 28000 9.5')
              WRITE (100,545) CLTEMP
   545        FORMAT (T13,'2 1.0 ',F5.1,' end')
           ELSEIF (FUELCLAD.EQ.'SS316     ') THEN
              WRITE (100,547)
   547        FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c        ' 1.0 24304 17.0 25055 2.0')
              WRITE (100,550)
   550        FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
              WRITE (100,552) CLTEMP
   552        FORMAT (T12,'2 1.0 ',F5.1,' end')
           ELSEIF (FUELCLAD.EQ.'SS316S    ') THEN
              WRITE (100,555)
   555        FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c        ' 1.0 24000 17.0 25055 2.0')
              WRITE (100,557)
   557        FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
              WRITE (100,559) CLTEMP
   559        FORMAT (T13,'2 1.0 ',F5.1,' end')
           ENDIF
*  Write moderator material specifications
           BORATEDMODVF=1.0-UCSPACERFRAC
           IF (STEPCONTROL.EQ.'N') THEN
              BORONVF=BLETDOWN(CT1,CT2,3)*(1E-6)*BORATEDMODVF
           ELSEIF (STEPCONTROL.EQ.'Y') THEN
              BORONVF=VARBLETDOWN(CT1,CT2,1,2)*(1E-6)*BORATEDMODVF
           ENDIF
           WRITE (100,560)
   560     FORMAT ('''')
           IF ((SPACERMAT.EQ.'ZIRC-4 ').AND.
     c     (UCSPACERFRAC.GT.(0.0))) THEN
              WRITE (100,561)
   561        FORMAT ('''     material composition of moderator',
     c        ' within unit cell')
              WRITE (100,562)
   562        FORMAT ('''     with smeared zirc-4 spacer grids')
              UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c        BORATEDMODVF)+(6.56*UCSPACERFRAC)
              IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                 WRITE (100,563) UCMODREGIONDEN, BORATEDMODVF,
     c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   563           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
              ELSE
                 WRITE (100,564) UCMODREGIONDEN, BORATEDMODVF,
     c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   564           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
              ENDIF
              WRITE (100,565) UCMODREGIONDEN, BORONVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   565        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c        1X,F6.5,1X,F7.1,1X,'end')
              WRITE (100,566) UCMODREGIONDEN
   566        FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 8016 0.12',
     c        ' 24000 0.10 26000 0.25')
```

```
            WRITE (100,567) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 567        FORMAT (T17'50000 1.40 40000 98.18 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'INCONEL').AND.
     c   (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,568)
 568        FORMAT ('''      material composition of moderator',
     c      ' within unit cell')
            WRITE (100,569)
 569        FORMAT ('''      with smeared inconel spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(8.3*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,570) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 570           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,571) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 571           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,572) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 572        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,573) UCMODREGIONDEN
 573        FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 14000 2.5',
     c      ' 22000 2.5 24000 15.0')
            WRITE (100,574) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 574        FORMAT (T17'26000 7.0 28000 73.0 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS316  ').AND.
     c   (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,575)
 575        FORMAT ('''      material composition of moderator',
     c      ' within unit cell')
            WRITE (100,576)
 576        FORMAT ('''      with smeared ss316 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.75*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,577) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 577           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,578) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 578           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,579) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 579        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,580) UCMODREGIONDEN
 580        FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
     c      ' 14000 1.0 24304 17.0 25055 2.0')
            WRITE (100,581) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
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 581        FORMAT (T5'26304 65.42 28304 12.0 42000 2.5 3',1X,F6.5,1X,
   c        F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS316S ').AND.
   c      (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,582)
 582        FORMAT ('''     material composition of moderator',
   c        ' within unit cell')
            WRITE (100,583)
 583        FORMAT ('''     with smeared ss316s spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
   c        BORATEDMODVF)+(7.75*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
              WRITE (100,584) UCMODREGIONDEN, BORATEDMODVF,
   c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 584          FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
              WRITE (100,585) UCMODREGIONDEN, BORATEDMODVF,
   c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 585          FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,586) UCMODREGIONDEN, BORONVF,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 586        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
   c        1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,587) UCMODREGIONDEN
 587        FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
   c        ' 14000 1.0 24000 17.0 25055 2.0')
            WRITE (100,588) UCSPACERFRAC,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 588        FORMAT (T5'26000 65.42 28000 12.0 42000 2.5 3',1X,F6.5,1X,
   c        F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS304  ').AND.
   c      (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,589)
 589        FORMAT ('''     material composition of moderator',
   c        ' within unit cell')
            WRITE (100,590)
 590        FORMAT ('''     with smeared ss304 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
   c        BORATEDMODVF)+(7.92*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
              WRITE (100,591) UCMODREGIONDEN, BORATEDMODVF,
   c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 591          FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
              WRITE (100,592) UCMODREGIONDEN, BORATEDMODVF,
   c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 592          FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,593) UCMODREGIONDEN, BORONVF,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 593        FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
   c        1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,594) UCMODREGIONDEN
 594        FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24304 19.0',
   c        ' 25055 2.0 26304 69.5 28304 9.5')
            WRITE (100,595) UCSPACERFRAC,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 595        FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS304S ').AND.
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     c    (UCSPACERFRAC.GT.(0.0))) THEN
             WRITE (100,596)
 596         FORMAT ('''      material composition of moderator',
     c       ' within unit cell')
             WRITE (100,597)
 597         FORMAT ('''      with smeared ss304s spacer grids')
             UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c       BORATEDMODVF)+(7.92*UCSPACERFRAC)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,598) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 598            FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,599) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 599            FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
             ENDIF
             WRITE (100,600) UCMODREGIONDEN, BORONVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 600         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c       1X,F6.5,1X,F7.1,1X,'end')
             WRITE (100,601) UCMODREGIONDEN
 601         FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24000 19.0',
     c       ' 25055 2.0 26000 69.5 28000 9.5')
             WRITE (100,602) UCSPACERFRAC,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 602         FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
          ELSEIF (UCSPACERFRAC.EQ.(0.0)) THEN
             WRITE (100,603)
 603         FORMAT ('''      material composition of moderator',
     c       ' within unit cell')
             WRITE (100,604)
 604         FORMAT ('''      with no smeared spacer grids')
             UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c       BORATEDMODVF)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,605) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 605            FORMAT ('h2o    3    den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,606) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 606            FORMAT ('h2o    3    den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
             ENDIF
             WRITE (100,607) UCMODREGIONDEN, BORONVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 607         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c       1X,F6.5,1X,F7.1,1X,'end')
          ENDIF
          WRITE (100,608)
 608      FORMAT ('''')
*  Write BPRA material specifications
*  BPR follow specifications
          BPRA_FOLLOW=.FALSE.
          IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c       (CT3.LT.BPTN(CT1))) THEN
             BPRA_FOLLOW=.TRUE.
             BPRA_DESCRIPTION_ID=BPDESID(CT1)
             WRITE(100,610)
 610         FORMAT('''')
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              WRITE(100,612)
  612         FORMAT('''',5X,'BPR above the BP absorber region')
              WRITE(100,614)
  614         FORMAT('''')
              IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c        (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
                DO 616 CT5=1,10
                  IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
                    BPRCLNUM=CT5
                    EXIT
                  ENDIF
  616           CONTINUE
                IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
                  WRITE (100,618)
  618             FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19,0 25055',
     c            ' 2.0 26304 69.5 28304 9.5')
                  WRITE (100,620) CLADDESNUM(BPRCLNUM), CLTEMP
  620             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
                  WRITE (100,622)
  622             FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c            ' 2.0 26000 69.5 28000 9.5')
                  WRITE (100,624) CLADDESNUM(BPRCLNUM), CLTEMP
  624             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
                  WRITE (100,626)
  626             FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c            ' 1.0 24304 17.0 25055 2.0')
                  WRITE (100,628)
  628             FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
                  WRITE (100,630) CLADDESNUM(BPRCLNUM), CLTEMP
  630             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
                  WRITE (100,632)
  632             FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c            ' 1.0 24000 17.0 25055 2.0')
                  WRITE (100,633)
  633             FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                  WRITE (100,634) CLADDESNUM(BPRCLNUM), CLTEMP
  634             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
                  WRITE (100,635)
  635             FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c            ' 22000 2.5 24000 15.0')
                  WRITE (100,636)
  636             FORMAT (T13,'26000 7.0 28000 73.0')
                  WRITE (100,637) CLADDESNUM(BPRCLNUM), CLTEMP
  637             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                ENDIF
              ENDIF
              IF (ABOVEBP(BPDESID(CT1)).EQ.'AL2O3') THEN
                ALFRAC=(((BPDEN(BPDESID(CT1)))*2.0*26.981539)/
     c          (101.9631))/BPDEN(BPDESID(CT1))
                OFRAC=1.0-ALFRAC
                IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                  WRITE (100,638) ABOVEBPNUM(BPDESID(CT1)),
     c            BPDEN(BPDESID(CT1)), ALFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  638             FORMAT ('al',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c            1X,F7.1,1X,'end')
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                 WRITE (100,640) ABOVEBPNUM(BPDESID(CT1)),
     c           BPDEN(BPDESID(CT1)), OFRAC,
     c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 640             FORMAT ('o',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c           1X,F7.1,1X,'end')
              ELSE
                 WRITE (100,642) ABOVEBPNUM(BPDESID(CT1)),
     c           BPDEN(BPDESID(CT1)), ALFRAC,
     c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 642             FORMAT ('al',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c           1X,F7.1,1X,'end')
                 WRITE (100,644) ABOVEBPNUM(BPDESID(CT1)),
     c           BPDEN(BPDESID(CT1)), OFRAC,
     c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 644             FORMAT ('o',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c           1X,F7.1,1X,'end')
              ENDIF
           ELSE
              WRITE (100,*) 'arbm-bp    ',
     c        BPDEN(BPRA_DESCRIPTION_ID),
     c        '    ', BPFMNUMISOS(BPRA_DESCRIPTION_ID),
     c        '   0   0   0'
              DO 650 CT4=1,BPFMNUMISOS(BPRA_DESCRIPTION_ID)
                 WRITE (100,648)
     c           BPFISOID(BPRA_DESCRIPTION_ID,CT4),
     c           BPFISOWTPCT(BPRA_DESCRIPTION_ID,CT4)
 648             FORMAT (10X,I6,3X,F10.5)
 650          CONTINUE
              WRITE (100,*) '           ',
     c        ABOVEBPNUM(BPRA_DESCRIPTION_ID),
     c        ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM),
     c        '    end'
           ENDIF
        ENDIF
*  Actual BPRA specifications
        BPRA_INSERTED=.FALSE.
        IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c     (CT3.GE.BPTN(CT1)).AND.(CT3.LE.BPBN(CT1))) THEN
           BPRA_INSERTED=.TRUE.
           BPRA_DESCRIPTION_ID=BPDESID(CT1)
           WRITE (100,685)
 685       FORMAT ('''')
           IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c     (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
              WRITE (100,690) BPWTPCT(BPDESID(CT1))
 690          FORMAT ('''',5X,'Al2O3-B4C burnable absorber pellet',1X,
     c        'specification (',F4.2,1X,'wt% b4c)')
           ELSE
              WRITE (100,695)
 695          FORMAT ('''',5X,'burnable absorber pellet ',
     c        'specification')
           ENDIF
           WRITE (100,700)
 700       FORMAT ('''')
*  Write B4C material specification
           IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c     (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
             DO 701 CT5=1,10
              IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
               BPRCLNUM=CT5
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                EXIT
               ENDIF
 701          CONTINUE
              IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
               WRITE (100,702)
 702           FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c         ' 2.0 26304 69.5 28304 9.5')
               WRITE (100,703) CLADDESNUM(BPRCLNUM), CLTEMP
 703           FORMAT (T12,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
               WRITE (100,704)
 704           FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c         ' 2.0 26000 69.5 28000 9.5')
               WRITE (100,705) CLADDESNUM(BPRCLNUM), CLTEMP
 705           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
               WRITE (100,706)
 706           FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c         ' 1.0 24304 17.0 25055 2.0')
               WRITE (100,707)
 707           FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
               WRITE (100,708) CLADDESNUM(BPRCLNUM), CLTEMP
 708           FORMAT (T12,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
               WRITE (100,709)
 709           FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c         ' 1.0 24000 17.0 25055 2.0')
               WRITE (100,710)
 710           FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
               WRITE (100,711) CLADDESNUM(BPRCLNUM), CLTEMP
 711           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
               WRITE (100,712)
 712           FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c         ' 22000 2.5 24000 15.0')
               WRITE (100,713)
 713           FORMAT (T13,'26000 7.0 28000 73.0')
               WRITE (100,714) CLADDESNUM(BPRCLNUM), CLTEMP
 714           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ENDIF
            ENDIF
*  Material specification if it is a BOC to statepoint 1 calculation
            IF (CT2.EQ.1) THEN
*  Material specification for AL2O3-B4C
             IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c       (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
               IF (BPWTPCT(BPDESID(CT1)).NE.(0.0)) THEN
                  IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                     WRITE (100,715) BPDEN(BPDESID(CT1)),
     c               (BPWTPCT(BPDESID(CT1))/100.0),
     c               MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 715                 FORMAT ('b4c    4   den=',F4.3,1X,F7.5,1X,F7.1,1X,
     c               'end')
                  ELSE
                     WRITE (100,716) BPDEN(BPDESID(CT1)),
     c               (BPWTPCT(BPDESID(CT1))/100.0),
     c               MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 716                 FORMAT ('b4c    4   den=',F5.3,1X,F7.5,1X,F7.1,1X,
     c               'end')
                  ENDIF
```

```
                  ENDIF
*  Calculate aluminum and oxygen material specifications
                  ALFRAC=(((((100.0-BPWTPCT(BPDESID(CT1)))/100)*
     c            BPDEN(BPDESID(CT1)))*2*26.981539)/(101.9631))/
     c            BPDEN(BPDESID(CT1))
                  OFRAC=1-(BPWTPCT(BPDESID(CT1))/100.0)-ALFRAC
                  WRITE (100,718) BPDEN(BPDESID(CT1)), ALFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 718              FORMAT ('al     4    den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
                  WRITE (100,720) BPDEN(BPDESID(CT1)), OFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 720              FORMAT ('o      4    den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
                ELSE
*  Material specification for BP other than Al2O3-B4C
                  DO 722 CT4=1,BPMIXNUM
                     IF (BPMIXID(CT4).EQ.BPMIX(BPRA_DESCRIPTION_ID)) THEN
                        RELATIVE_BP_MIX_ID=CT4
                     ENDIF
 722              CONTINUE
                  WRITE (100,*) 'arbm-bp    ', BPDEN(BPRA_DESCRIPTION_ID),
     c            '    ', BPNUMISOS(RELATIVE_BP_MIX_ID),
     c            '  0   0   0'
                  DO 726 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                     WRITE (100,724) BPISOID(RELATIVE_BP_MIX_ID,CT4),
     c               BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)
 724                 FORMAT (10X,I6,3X,F10.5)
 726              CONTINUE
                  WRITE (100,*) '              ', BPMIX(BPRA_DESCRIPTION_ID),
     c            ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '    end'
                ENDIF
*  Material specification if it is not a BOC to statepoint 1 calculation
               ELSEIF(CT2.NE.1) THEN
                BPVOL=BPXSECT(BPRA_DESCRIPTION_ID)*
     c          BPRODS(BPRA_DESCRIPTION_ID)*NODES(CT3,2)
*  Material specification for AL2O3-B4C
                IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c          (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
                  B4CMASS=(BPWTPCT(BPDESID(CT1))/100.0)*
     c            BPDEN(BPDESID(CT1))*BPVOL
                  ALMASS=((((100-BPWTPCT(BPDESID(CT1)))/100.0)*
     c            BPDEN(BPDESID(CT1)))*BPVOL)*((2*26.981539)/101.961278)
                  OMASS=((((100-BPWTPCT(BPDESID(CT1)))/100.0)*
     c            BPDEN(BPDESID(CT1)))*BPVOL)-ALMASS
                  CMASS=B4CMASS*0.217374
                  NEWBPMASSTOTAL=ALMASS+OMASS+CMASS+BPRAISOVALUE(1)+
     c            BPRAISOVALUE(2)
                  NEWBPDEN=NEWBPMASSTOTAL/BPVOL
                  ALWTPCT=(ALMASS/NEWBPMASSTOTAL)*100.0
                  OWTPCT=(OMASS/NEWBPMASSTOTAL)*100.0
                  CWTPCT=(CMASS/NEWBPMASSTOTAL)*100.0
                  B10WTPCT=(BPRAISOVALUE(1)/NEWBPMASSTOTAL)*100.0
                  B11WTPCT=(BPRAISOVALUE(2)/NEWBPMASSTOTAL)*100.0
                  IF (BPWTPCT(BPDESID(CT1)).NE.(0.0)) THEN
                     WRITE (100,728) NEWBPDEN
 728                 FORMAT ('arbm-bp',1X,F7.3,1X,'5 0 0 0')
                     IF (BPRAISOVALUE(1).NE.0) THEN
                        WRITE (100,730) BPRAISONAME(1),
     c                  B10WTPCT
 730                    FORMAT(5X,A6,1X,G10.3)
                     ENDIF
```

```
                  IF (BPRAISOVALUE(2).NE.0) THEN
                     WRITE (100,732) BPRAISONAME(2),
     c               B11WTPCT
 732                 FORMAT(5X,A6,1X,G10.3)
                  ENDIF
                  WRITE (100,734) CWTPCT
 734              FORMAT (5X,' 6012',1X,G10.3)
               ELSE
                  WRITE (100,736) NEWBPDEN
 736              FORMAT ('arbm-bp',1X,F7.3,1X,'2 0 0 0')
               ENDIF
*  Calculate aluminum and oxygen material specifications
               WRITE (100,738) ALWTPCT, OWTPCT
 738           FORMAT (5X,'13027',1X,F7.3,1X,' 8016',1X,F7.3)
               WRITE (100,740) MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 740           FORMAT (5X,'4',1X,'1.0',1X,F6.1,1X,'end')
            ELSE
*  Material specification for BP other than Al2O3-B4C
               DO 742 CT4=1,BPMIXNUM
                  IF (BPMIXID(CT4).EQ.BPMIX(BPRA_DESCRIPTION_ID)) THEN
                     RELATIVE_BP_MIX_ID=CT4
                  ENDIF
 742           CONTINUE
               NEWBPMASSTOTAL=0.0
               DO 743 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                IF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5010) THEN
                   NEWBPMASSTOTAL=NEWBPMASSTOTAL+BPRAISOVALUE(1)
                ELSEIF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5011)
     c          THEN
                   NEWBPMASSTOTAL=NEWBPMASSTOTAL+BPRAISOVALUE(2)
                ELSE
                   NEWBPMASSTOTAL=NEWBPMASSTOTAL+
     c             ((BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)/100.0)*
     c             BPDEN(BPRA_DESCRIPTION_ID)*BPVOL)
                ENDIF
 743           CONTINUE
               NEWBPDEN=NEWBPMASSTOTAL/BPVOL
               WRITE (100,*) 'arbm-bp    ', NEWBPDEN,
     c         '   ', BPNUMISOS(RELATIVE_BP_MIX_ID),
     c         '  0    0    0'
               DO 750 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                IF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5010) THEN
                   IF (BPRAISOVALUE(1).NE.0) THEN
                      WRITE (100,744) BPRAISONAME(1),
     c                ((BPRAISOVALUE(1)/NEWBPMASSTOTAL)*100.0)
 744                  FORMAT(5X,A6,1X,G10.3)
                   ENDIF
                ELSEIF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5011)
     c          THEN
                   IF (BPRAISOVALUE(2).NE.0) THEN
                      WRITE (100,746) BPRAISONAME(2),
     c                ((BPRAISOVALUE(2)/NEWBPMASSTOTAL)*100.0)
 746                  FORMAT(5X,A6,1X,G10.3)
                   ENDIF
                ELSE
                   WRITE (100,748) BPISOID(RELATIVE_BP_MIX_ID,CT4),
     c             (((BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)/100.0)*
     c             BPDEN(BPRA_DESCRIPTION_ID)*BPVOL)/
     c             NEWBPMASSTOTAL)*100.0
 748               FORMAT (10X,I6,3X,F10.5)
```

```
               ENDIF
  750         CONTINUE
              WRITE (100,*) '             ', BPMIX(BPRA_DESCRIPTION_ID),
     c        ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
            ENDIF
          ENDIF
        ENDIF
*  Write control rod material specification
        CR_INSERTED=.FALSE.
        IF (CRSTAT.EQ.'RODDED') THEN
          CRCOMPFLAG=.FALSE.
          DO 760 CT4=1,23
            IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
              CRCOMPFLAG=.TRUE.
              CR_INSERTED=.TRUE.
              CR_MIXTURE_ID=CRINS(CT1,CT2,CT4,CT3)
              CR_DESCRIPTION=CRDES(CT1,CT2,CT4,CT3)
              EXIT
            ENDIF
  760     CONTINUE
          IF (CRCOMPFLAG.EQ..TRUE.) THEN
            DO 770 CT4=1,CRMIXNUM
              IF (CRMIXID(CT4).EQ.CR_MIXTURE_ID) THEN
                RELATIVE_CR_MIX_ID=CT4
              ENDIF
  770       CONTINUE
            WRITE (100,780)
  780       FORMAT ('''')
            WRITE (100,790)
  790       FORMAT ('''',T5,' control rod material specification')
            WRITE (100,800)
  800       FORMAT ('''')
          IF (CRCLAD(CR_DESCRIPTION).NE.0) THEN
           DO 801 CT5=1,10
            IF (CRCLAD(CR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
             CRCLNUM=CT5
             EXIT
            ENDIF
  801      CONTINUE
           IF (CLADDESNAME(CRCLNUM).EQ.'SS304  ') THEN
            WRITE (100,802)
  802       FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c      '2.0 26304 69.5 28304 9.5')
            WRITE (100,803) CLADDESNUM(CRCLNUM), CLTEMP
  803       FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS304S ') THEN
            WRITE (100,804)
  804       FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c      '2.0 26000 69.5 28000 9.5')
            WRITE (100,805) CLADDESNUM(CRCLNUM), CLTEMP
  805       FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316  ') THEN
            WRITE (100,806)
  806       FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c      '1.0 24304 17.0 25055 2.0')
            WRITE (100,807)
  807       FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
            WRITE (100,808) CLADDESNUM(CRCLNUM), CLTEMP
  808       FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316S ') THEN
```

```
                WRITE (100,809)
809             FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c          '1.0 24000 17.0 25055 2.0')
                WRITE (100,810)
810             FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                WRITE (100,811) CLADDESNUM(CRCLNUM), CLTEMP
811             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(CRCLNUM).EQ.'INCONEL') THEN
                WRITE (100,812)
812             FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c          ' 22000 2.5 24000 15.0')
                WRITE (100,813)
813             FORMAT (T13,'26000 7.0 28000 73.0')
                WRITE (100,814) CLADDESNUM(CRCLNUM), CLTEMP
814             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ENDIF
              ENDIF
                WRITE (100,*) 'arbm-cr    ', CRDEN(CR_DESCRIPTION),
     c          '.  ', CRNUMISOS(RELATIVE_CR_MIX_ID), '    0   0   0'
                DO 820 CT4=1,CRNUMISOS(RELATIVE_CR_MIX_ID)
                   WRITE (100,815) CRISOID(RELATIVE_CR_MIX_ID,CT4),
     c             CRISOWTPCT(RELATIVE_CR_MIX_ID, CT4)
815                FORMAT (10X,I5,3X,F10.5)
820             CONTINUE
                WRITE (100,*) '           ', CR_MIXTURE_ID, ' 1.0 ',
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '    end'
              ENDIF
           ENDIF
*  Write APSR material specification
           IF ((CT1.EQ.CT1START).AND.(CT2.EQ.CT2GOVALUE).AND.
     c     (CT3.EQ.1)) THEN
           DO 824 CT4=1,10
              DO 823 CT5=1,20
                 DO 822 CT6=1,23
                    DO 821 CT7=1,50
                       APSRINSOLD(CT4,CT5,CT6,CT7)=
     c                 APSRINS(CT4,CT5,CT6,CT7)
821                 CONTINUE
822              CONTINUE
823           CONTINUE
824        CONTINUE
           ENDIF
           APSR_INSERTED=.FALSE.
           IF (APSRSTAT.EQ.'RODDED') THEN
              DO 830 CT4=1,23
                 APSRBOTFLAG=.FALSE.
                 DO 825 CT5=50,1,-1
                    IF ((APSRINSOLD(CT1,CT2,CT4,CT5).NE.0).AND.
     c              (APSRBOTFLAG.EQ..FALSE.)) THEN
                       APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT5)
                       APSRBOTFLAG=.TRUE.
                       FOLNODKEEP=CT5
                       FOLSTEPKEEP=CT4
                    ENDIF
                    IF ((APSRINSOLD(CT1,CT2,CT4,CT5).EQ.0).AND.
     c              (APSRBOTFLAG.EQ..TRUE.)) THEN
                       APSRINS(CT1,CT2,CT4,CT5)=
     c                 APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
                       APSRFOLLOWDATA(CT1,CT2,CT4,CT5)=3
                    ENDIF
```

```
825        CONTINUE
830     CONTINUE
        FOLLOWIN=.FALSE.
        DO 831 CT4=1,23
           IF (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3) THEN
              FOLLOWIN=.TRUE.
              EXIT
           ENDIF
831     CONTINUE
        IF (FOLLOWIN.EQ..TRUE.) THEN
           WRITE (100,832)
832        FORMAT ('''')
           WRITE (100,834)
834        FORMAT ('''',T5,' APSR follow rod material',
     c     ' specification')
           WRITE (100,836)
836        FORMAT ('''')
        IF ((APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.0)
     c  .AND.
     c  (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.2)) THEN
          DO 838 CT5=1,10
           IF (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
     c     .EQ.CLADDESNUM(CT5)) THEN
            APSRFOLNUM=CT5
            EXIT
           ENDIF
838       CONTINUE
          IF (CLADDESNAME(APSRFOLNUM).EQ.'SS304  ') THEN
           WRITE (100,840)
840        FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c     '2.0 26304 69.5 28304 9.5')
           WRITE (100,842) CLADDESNUM(APSRFOLNUM), CLTEMP
842        FORMAT (T12,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS304S ') THEN
           WRITE (100,844)
844        FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c     '2.0 26000 69.5 28000 9.5')
           WRITE (100,846) CLADDESNUM(APSRFOLNUM), CLTEMP
846        FORMAT (T13,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316  ') THEN
           WRITE (100,848)
848        FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c     '1.0 24304 17.0 25055 2.0')
           WRITE (100,850)
850        FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
           WRITE (100,852) CLADDESNUM(APSRFOLNUM), CLTEMP
852        FORMAT (T12,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316S ') THEN
           WRITE (100,854)
854        FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c     '1.0 24000 17.0 25055 2.0')
           WRITE (100,856)
856        FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
           WRITE (100,858) CLADDESNUM(APSRFOLNUM), CLTEMP
858        FORMAT (T13,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'INCONEL') THEN
           WRITE (100,860)
860        FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c     ' 22000 2.5 24000 15.0')
           WRITE (100,862)
```

```
862         FORMAT (T13,'26000 7.0 28000 73.0')
            WRITE (100,864) CLADDESNUM(APSRFOLNUM), CLTEMP
864         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
          ENDIF
        ENDIF
        ENDIF
        APSRCOMPFLAG=.FALSE.
        DO 865 CT4=1,23
            IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
   c        (APSRINS(CT1,CT2,CT4,CT3).NE.
   c        APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP))) THEN
               APSRCOMPFLAG=.TRUE.
               APSR_INSERTED=.TRUE.
               APSR_MIXTURE_ID=APSRINS(CT1,CT2,CT4,CT3)
               APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT3)
               EXIT
            ENDIF
865     CONTINUE
        IF (APSRCOMPFLAG.EQ..TRUE.) THEN
            DO 866 CT4=1,APSRMIXNUM
               IF (APSRMIXID(CT4).EQ.APSR_MIXTURE_ID) THEN
                  RELATIVE_APSR_MIX_ID=CT4
               ENDIF
866         CONTINUE
            WRITE (100,868)
868         FORMAT ('''')
            WRITE (100,870)
870         FORMAT ('''',T5,' axial power shaping rod material',
   c        ' specification')
            WRITE (100,880)
880         FORMAT ('''')
        IF (APSRCLAD(APSR_DESCRIPTION).NE.0) THEN
          DO 881 CT5=1,10
            IF (APSRCLAD(APSR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
             APSRCLNUM=CT5
             EXIT
            ENDIF
881       CONTINUE
          IF (CLADDESNAME(APSRCLNUM).EQ.'SS304  ') THEN
           WRITE (100,882)
882        FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
   c       '2.0 26304 69.5 28304 9.5')
           WRITE (100,883) CLADDESNUM(APSRCLNUM), CLTEMP
883        FORMAT (T12,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS304S ') THEN
           WRITE (100,884)
884        FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
   c       '2.0 26000 69.5 28000 9.5')
           WRITE (100,885) CLADDESNUM(APSRCLNUM), CLTEMP
885        FORMAT (T13,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316  ') THEN
           WRITE (100,886)
886        FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
   c       '1.0 24304 17.0 25055 2.0')
           WRITE (100,887)
887        FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
           WRITE (100,888) CLADDESNUM(APSRCLNUM), CLTEMP
888        FORMAT (T12,I2,' 1.0 ',F5.1,' end')
          ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316S ') THEN
           WRITE (100,889)
```

```
  889         FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c        '1.0 24000 17.0 25055 2.0')
              WRITE (100,890)
  890         FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
              WRITE (100,891) CLADDESNUM(APSRCLNUM), CLTEMP
  891         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'INCONEL') THEN
              WRITE (100,892)
  892         FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c        ' 22000 2.5 24000 15.0')
              WRITE (100,893)
  893         FORMAT (T13,'26000 7.0 28000 73.0')
              WRITE (100,894) CLADDESNUM(APSRCLNUM), CLTEMP
  894         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ENDIF
            ENDIF
              WRITE (100,*) 'arbm-apsr   ', APSRDEN(APSR_DESCRIPTION),
     c        '   ', APSRNUMISOS(RELATIVE_APSR_MIX_ID), '    0   0   0'
              DO 900 CT4=1,APSRNUMISOS(RELATIVE_APSR_MIX_ID)
                 WRITE (100,895) APSRISOID(RELATIVE_APSR_MIX_ID,CT4),
     c           APSRISOWTPCT(RELATIVE_APSR_MIX_ID, CT4)
  895            FORMAT (10X,I5,3X,F10.5)
  900         CONTINUE
              WRITE (100,*) '           ', APSR_MIXTURE_ID, ' 1.0 ',
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
            ENDIF
         ENDIF
*  Write fuel rod fill gas material specification
         WRITE (100,910)
  910    FORMAT ('''')
         WRITE (100,920)
  920    FORMAT ('he    5   end')
         WRITE (100,930)
  930    FORMAT ('end comp')
*  Write base reactor lattice specifications
         WRITE (100,940)
  940    FORMAT ('''')
         WRITE (100,950)
  950    FORMAT ('''     base reactor lattice specification')
         WRITE (100,960)
  960    FORMAT ('''')
         WRITE (100,970) PITCH, FOD, COD, CID
  970    FORMAT ('squarepitch',3X,F7.5,3X,F6.4,3X,'1   3',3X,F6.4,
     c   3X,'2',3X,F6.4,3X,'0   end')
* The following writing routine for 'SPECIAL' input data
* has not been formatted to compensate for FORTRAN's ingenious
* incapability to print leading zeros in numeric fields.
* Errors will occur in the FIDO input if null space exists
* between an equal sign and the appropriate value.  Therefore,
* the IIM and ICM factors must always be at least 10.
         IF (FLAG2.EQ.'SPECIAL') THEN
            IF (SZF.LT.1) THEN
               WRITE (100,980) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  980          FORMAT ('more data',1X,'szf=0',F3.2,1X,'isn=',I1,1X,
     c         'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c         1X,'ius=',I1,3X,'end')
            ELSE
               WRITE (100,990) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  990          FORMAT ('more data',1X,'szf=',F4.2,1X,'isn=',I1,1X,
     c         'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
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```
     c          1X,'ius=',I1,3X,'end')
             ENDIF
          ELSEIF (FLAG2.NE.'SPECIAL') THEN
             IF (MESH.LT.1) THEN
                WRITE (100,1000) MESH
 1000           FORMAT ('more data',1X,'szf=0',F3.2,1X,'end')
             ELSE
                WRITE (100,1010) MESH
 1010           FORMAT ('more data',1X,'szf=',F4.2,1X,'end')
             ENDIF
          ENDIF
*  Write assembly specifications
          WRITE (100,1020)
 1020     FORMAT ('''')
          WRITE (100,1030)
 1030     FORMAT ('''     assembly specification')
          WRITE (100,1040)
 1040     FORMAT ('''')
          IF (STEPCONTROL.EQ.'Y') THEN
             CALL ZEROS(VARSTEPNUM(CT1,CT2),IRRAD_STEPS)
          ELSEIF (STEPCONTROL.EQ.'N') THEN
             CALL ZEROS(INT(BLETDOWN(CT1,CT2,2)),IRRAD_STEPS)
          ENDIF
*  Assembly specification if no BPRA, no CR, and no APSR is inserted
          IF ((BPRA_INSERTED.EQ..FALSE.).AND.(CR_INSERTED.EQ..FALSE.)
     c    .AND.(APSR_INSERTED.EQ..FALSE.)
     c    .AND.(BPRA_FOLLOW.EQ..FALSE.)
     c    .AND.(FOLLOWIN.EQ..FALSE.)) THEN
             IF (NODES(CT3,2).GE.(100.0)) THEN
                WRITE (100,1041) RODS, NODES(CT3,2), IRRAD_STEPS
 1041           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c       (NODES(CT3,2).GE.(10.0))) THEN
                WRITE (100,1042) RODS, NODES(CT3,2), IRRAD_STEPS
 1042           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
                WRITE (100,1043) RODS, NODES(CT3,2), IRRAD_STEPS
 1043           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ENDIF
             CALL ZEROS(PLEVEL,PLEVELCH)
             CALL ZEROS(LUZONE,LUZONECH)
             IF (MESH.LT.(1.0)) THEN
                WRITE (100,1044) PLEVELCH, LUZONECH, MESH
 1044           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=1',1X,
     c          'mixmod=3 facmesh=',F3.2,1X,'end')
             ELSE
                WRITE (100,1045) PLEVELCH, LUZONECH, MESH
 1045           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=1',1X,
     c          'mixmod=3 facmesh=',F4.2,1X,'end')
             ENDIF
             DO 1047 CT4=1,LUZONE
                IF (MOD(CT4,6).EQ.0) THEN
                   WRITE (100,*)
                ENDIF
                WRITE (100,1046) LMB(CT4), LRB(CT4)
```

```
1046          FORMAT (I3,1X,F7.5,1X,$)
1047       CONTINUE
           WRITE (100,*)
        . ENDIF
*  Assembly specification if BPRA is inserted
        IF (BPRA_FOLLOW.EQ..TRUE.) THEN
           IF (NODES(CT3,2).GE.(100.0)) THEN
              WRITE (100,1050) RODS, NODES(CT3,2), IRRAD_STEPS
1050          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
           ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c     (NODES(CT3,2).GE.(10.0))) THEN
              WRITE (100,1052) RODS, NODES(CT3,2), IRRAD_STEPS
1052          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
           ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
              WRITE (100,1054) RODS, NODES(CT3,2), IRRAD_STEPS
1054          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
           ENDIF
           CALL ZEROS(PLEVEL,PLEVELCH)
           CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
           IF (MESH.LT.(1.0)) THEN
              WRITE (100,1056) PLEVELCH, BPZONECH, MESH
1056          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c        'numztotal=',A2,1X,'mxrepeats=1',1X,
     c        'mixmod=3 facmesh=',F3.2,1X,'end')
           ELSE
              WRITE (100,1058) PLEVELCH, BPZONECH, MESH
1058          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c        'numztotal=',A2,1X,'mxrepeats=1',1X,
     c        'mixmod=3 facmesh=',F4.2,1X,'end')
           ENDIF
           DO 1062 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
              IF (MOD(CT4,6).EQ.0) THEN
                 WRITE (100,*)
              ENDIF
              WRITE (100,1060) BPRFM(CT4,BPRA_DESCRIPTION_ID),
     c        BPRFR(CT4,BPRA_DESCRIPTION_ID)
1060          FORMAT (I3,1X,F7.5,1X,$)
1062       CONTINUE
           WRITE (100,*)
        ENDIF
        IF (BPRA_INSERTED.EQ..TRUE.) THEN
           IF (NODES(CT3,2).GE.(100.0)) THEN
              WRITE (100,1098) RODS, NODES(CT3,2), IRRAD_STEPS
1098          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
           ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c     (NODES(CT3,2).GE.(10.0))) THEN
              WRITE (100,1100) RODS, NODES(CT3,2), IRRAD_STEPS
1100          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
           ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
              WRITE (100,1102) RODS, NODES(CT3,2), IRRAD_STEPS
1102          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
           ENDIF
           CALL ZEROS(PLEVEL,PLEVELCH)
           CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
```

```
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1104) PLEVELCH, BPZONECH, MESH
 1104          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1106) PLEVELCH, BPZONECH, MESH
 1106          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            DO 1110 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
               IF (MOD(CT4,6).EQ.0) THEN
                  WRITE (100,*)
               ENDIF
               WRITE (100,1108) BPMA(CT4,BPRA_DESCRIPTION_ID),
     c         BPRA(CT4,BPRA_DESCRIPTION_ID)
 1108          FORMAT (I3,1X,F7.5,1X,$)
 1110       CONTINUE
            WRITE (100,*)
         ENDIF
*  Assembly specification if CR is inserted
         IF (CR_INSERTED.EQ..TRUE.) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1120) RODS, NODES(CT3,2), IRRAD_STEPS
 1120          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1130) RODS, NODES(CT3,2), IRRAD_STEPS
 1130          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1140) RODS, NODES(CT3,2), IRRAD_STEPS
 1140          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(CRZONE(CR_DESCRIPTION),CRZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1150) PLEVELCH, CRZONECH, MESH
 1150          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=0',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1160) PLEVELCH, CRZONECH, MESH
 1160          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=0',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            IF (STEPCONTROL.EQ.'N') THEN
             DO 1168 CT4=1,INT(BLETDOWN(CT1,CT2,2))
               IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                  DO 1162 CT5=1,CRZONE(CR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1161) CRMA(CT5,CR_DESCRIPTION),
     c               CRRA(CT5,CR_DESCRIPTION)
 1161                FORMAT (I3,1X,F7.5,1X,$)
```

```
1162            CONTINUE
                WRITE (100,*)
             ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                DO 1166 CT5=1,CRZONE(CR_DESCRIPTION)
                   IF (MOD(CT5,6).EQ.0) THEN
                      WRITE (100,*)
                   ENDIF
                   WRITE (100,1164) LMC(CT5,CR_DESCRIPTION),
     c             LRC(CT5,CR_DESCRIPTION)
1164               FORMAT (I3,1X,F7.5,1X,$)
1166            CONTINUE
                WRITE (100,*)
             ENDIF
1168       CONTINUE
          ELSEIF (STEPCONTROL.EQ.'Y') THEN
           DO 1210 CT4=1,VARSTEPNUM(CT1,CT2)
             IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                DO 1180 CT5=1,CRZONE(CR_DESCRIPTION)
                   IF (MOD(CT5,6).EQ.0) THEN
                      WRITE (100,*)
                   ENDIF
                   WRITE (100,1170) CRMA(CT5,CR_DESCRIPTION),
     c             CRRA(CT5,CR_DESCRIPTION)
1170               FORMAT (I3,1X,F7.5,1X,$)
1180            CONTINUE
                WRITE (100,*)
             ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                DO 1200 CT5=1,CRZONE(CR_DESCRIPTION)
                   IF (MOD(CT5,6).EQ.0) THEN
                      WRITE (100,*)
                   ENDIF
                   WRITE (100,1190) LMC(CT5,CR_DESCRIPTION),
     c             LRC(CT5,CR_DESCRIPTION)
1190               FORMAT (I3,1X,F7.5,1X,$)
1200            CONTINUE
                WRITE (100,*)
             ENDIF
1210       CONTINUE
          ENDIF
       ENDIF
*  Assembly specification if APSR is inserted
       IF ((APSR_INSERTED.EQ..TRUE.).OR.(FOLLOWIN.EQ..TRUE.)) THEN
          IF (NODES(CT3,2).GE.(100.0)) THEN
             WRITE (100,1220) RODS, NODES(CT3,2), IRRAD_STEPS
1220         FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c       'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
          ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c    (NODES(CT3,2).GE.(10.0))) THEN
             WRITE (100,1230) RODS, NODES(CT3,2), IRRAD_STEPS
1230         FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c       'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
          ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
             WRITE (100,1240) RODS, NODES(CT3,2), IRRAD_STEPS
1240         FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c       'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
          ENDIF
          CALL ZEROS(PLEVEL,PLEVELCH)
          CALL ZEROS(APSRZONE(APSR_DESCRIPTION),APSRZONECH)
          IF (MESH.LT.(1.0)) THEN
             WRITE (100,1250) PLEVELCH, APSRZONECH, MESH
```

```
1250        FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c      'numztotal=',A2,1X,'mxrepeats=0',1X,
     c      'mixmod=3 facmesh=',F3.2,1X,'end')
         ELSE
            WRITE (100,1252) PLEVELCH, APSRZONECH, MESH
1252        FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c      'numztotal=',A2,1X,'mxrepeats=0',1X,
     c      'mixmod=3 facmesh=',F4.2,1X,'end')
         ENDIF
         IF (STEPCONTROL.EQ.'N') THEN
          DO 1268 CT4=1,INT(BLETDOWN(CT1,CT2,2))
            IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c      (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
               DO 1258 CT5=1,APSRZONE(APSR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1256) APSRMA(CT5,APSR_DESCRIPTION),
     c            APSRRA(CT5,APSR_DESCRIPTION)
1256              FORMAT (I3,1X,F7.5,1X,$)
1258           CONTINUE
               WRITE (100,*)
            ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c      (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
               DO 1262 CT5=1,APSRZONE(APSR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1260) APSRFM(CT5,APSR_DESCRIPTION),
     c            APSRFR(CT5,APSR_DESCRIPTION)
1260              FORMAT (I3,1X,F7.5,1X,$)
1262           CONTINUE
               WRITE (100,*)
            ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
               DO 1266 CT5=1,APSRZONE(APSR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1264) LMD(CT5,APSR_DESCRIPTION),
     c            LRD(CT5,APSR_DESCRIPTION)
1264              FORMAT (I3,1X,F7.5,1X,$)
1266           CONTINUE
               WRITE (100,*)
            ENDIF
1268      CONTINUE
         ELSEIF (STEPCONTROL.EQ.'Y') THEN
          DO 1310 CT4=1,VARSTEPNUM(CT1,CT2)
            IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c      (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
               DO 1280 CT5=1,APSRZONE(APSR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1270) APSRMA(CT5,APSR_DESCRIPTION),
     c            APSRRA(CT5,APSR_DESCRIPTION)
1270              FORMAT (I3,1X,F7.5,1X,$)
1280           CONTINUE
               WRITE (100,*)
            ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c      (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
```

```
                  DO 1290 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1285) APSRFM(CT5,APSR_DESCRIPTION),
     c               APSRFR(CT5,APSR_DESCRIPTION)
 1285                FORMAT (I3,1X,F7.5,1X,$)
 1290             CONTINUE
                  WRITE (100,*)
               ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1300 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1295) LMD(CT5,APSR_DESCRIPTION),
     c               LRD(CT5,APSR_DESCRIPTION)
 1295                FORMAT (I3,1X,F7.5,1X,$)
 1300             CONTINUE
                  WRITE (100,*)
               ENDIF
 1310       CONTINUE
           ENDIF
        ENDIF
*  Write assembly depletion/decay parameters
        WRITE (100,1320)
 1320   FORMAT ('''')
        WRITE (100,1330)
 1330   FORMAT ('''      assembly depletion/decay parameters')
        WRITE (100,1340)
 1340   FORMAT ('''')
        CALL ZEROS(CYCPOS(CT1),ASSYPOSITION)
        WRITE (100,1350) CYCLEID(CT1), ASSYPOSITION
 1350   FORMAT ('''',T5,'Cycle-',A2,', one-eighth core',
     c  ' assembly number ',A2)
        IF (STEPCONTROL.EQ.'N') THEN
         DO 1380 CT4=3,(INT(BLETDOWN(CT1,CT2,2))+2)
           IF (CT4.LT.(BLETDOWN(CT1,CT2,2)+2)) THEN
              DOWNTIME=0.0
              BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c        BLETDOWN(CT1,CT2,3))
              WRITE (100,1360) POWER(CT3,RELATIVE_STPT_NUM),
     c        BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1360         FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c        G10.5,1X,'bfrac=',G9.4,1X,'end')
           ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c     (CT2.LT.STPTS(CT1))) THEN
              DOWNTIME=STPTDAT(CT1,(CT2+1),3)
              BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c        BLETDOWN(CT1,CT2,3))
              WRITE (100,1365) POWER(CT3,RELATIVE_STPT_NUM),
     c        BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1365         FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c        G10.5,1X,'bfrac=',G9.4,1X,'end')
           ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c     (CT2.EQ.STPTS(CT1))) THEN
              DOWNTIME=CYCDOWN(CT1)
              BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c        BLETDOWN(CT1,CT2,3))
              WRITE (100,1370) POWER(CT3,RELATIVE_STPT_NUM),
     c        BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
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 1370         FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c        G10.5,1X,'bfrac=',G9.4,1X,'end')
           ENDIF
 1380    CONTINUE
        ELSEIF (STEPCONTROL.EQ.'Y') THEN
         DO 1388 CT4=1,VARSTEPNUM(CT1,CT2)
           IF (CT4.LT.VARSTEPNUM(CT1,CT2)) THEN
              DOWNTIME=0.0
              BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c        VARBLETDOWN(CT1,CT2,1,2))
              WRITE (100,1382) VARPOWER(CT1,CT2,CT4,CT3),
     c        VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1382         FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c        G10.5,1X,'bfrac=',G9.4,1X,'end')
           ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c     (CT2.LT.STPTS(CT1))) THEN
              DOWNTIME=STPTDAT(CT1,(CT2+1),3)
              BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c        VARBLETDOWN(CT1,CT2,1,2))
              WRITE (100,1384) VARPOWER(CT1,CT2,CT4,CT3),
     c        VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1384         FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c        G10.5,1X,'bfrac=',G9.4,1X,'end')
           ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c     (CT2.EQ.STPTS(CT1))) THEN
              DOWNTIME=CYCDOWN(CT1)
              BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c        VARBLETDOWN(CT1,CT2,1,2))
              WRITE (100,1386) VARPOWER(CT1,CT2,CT4,CT3),
     c        VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1386         FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c        G10.5,1X,'bfrac=',G9.4,1X,'end')
           ENDIF
 1388    CONTINUE
        ENDIF
*  Store final downtime for use in extraction script 'sedexecute.exe'
        FINALDOWNTIME=DOWNTIME
*  Write input deck closing statement
        WRITE (100,1390)
 1390   FORMAT ('''')
        WRITE (100,1400)
 1400   FORMAT ('''     end of input')
        WRITE (100,1410)
 1410   FORMAT ('''')
        WRITE (100,1420)
 1420   FORMAT ('end')
        CLOSE(UNIT=100)

      RETURN
      END

*****************************************************
*     This subroutine cuts the final ORIGEN output in  *
*     the SAS2H output file down to the essential      *
*     data needed for the CRC calculations.            *
*****************************************************
      SUBROUTINE CUTTER (NM)
*
      INTEGER*4 LINECOUNTER, CUTLINE, NUM1, NUM2,
     c NUM3, NUM4, NUM5, NUM6, NUM7, SEDEXERESULT,
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```
     c VERIFCOUNTER, VERIFCUTLINE, VERIFENDCUTLINE,
     c OUTPUTREMOVALRESULT
*
      CHARACTER NM*31, OUTPUTFILE*32, BPLABEL*14,
     c LINVAL*7, SEDEXECOMMAND*60, FORMATLABEL*29,
     c VERIFLABEL*14, VERIFLINVAL*7, VERIFENDLINVAL*7,
     c OUTPUTREMOVAL*35
*
      LOGICAL BPFIND, NUMZEROFLAG, VERIFFIND
*
      OUTPUTFILE(1:25)=NM(1:25)
      OUTPUTFILE(26:32)='.output'
      OPEN (UNIT=700, FILE=OUTPUTFILE, STATUS='OLD')
      REWIND(700)
      LINECOUNTER=0
      BPFIND=.FALSE.
      DO 14 WHILE (BPFIND.EQ..FALSE.)
         LINECOUNTER=LINECOUNTER+1
         READ(700,12) BPLABEL
 12      FORMAT (T98,A14)
         IF (BPLABEL.EQ.'light elements') THEN
            READ(700,*)
            READ(700,13) FORMATLABEL
 13         FORMAT (T46,A29)
            IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
               BPFIND=.TRUE.
            ELSE
               BACKSPACE(700)
               BACKSPACE(700)
            ENDIF
         ENDIF
 14   CONTINUE
      NUMZEROFLAG=.FALSE.
      CUTLINE=LINECOUNTER-2
               NUM1=INT(CUTLINE/1000000.0)
               IF ((NUM1.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(1:1)=' '
               ELSE
                  LINVAL(1:1)=CHAR(NUM1+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM2=INT((CUTLINE-(NUM1*1000000))/100000.0)
               IF ((NUM2.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(2:2)=' '
               ELSE
                  LINVAL(2:2)=CHAR(NUM2+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM3=INT((CUTLINE-(NUM2*100000)-
     c         (NUM1*1000000))/10000.0)
               IF ((NUM3.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(3:3)=' '
               ELSE
                  LINVAL(3:3)=CHAR(NUM3+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM4=INT((CUTLINE-(NUM3*10000)-
     c         (NUM2*100000)-(NUM1*1000000))/1000.0)
               IF ((NUM4.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(4:4)=' '
```

```
               ELSE
                  LINVAL(4:4)=CHAR(NUM4+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM5=INT((CUTLINE-(NUM4*1000)-(NUM3*10000)-
c              (NUM2*100000)-(NUM1*1000000))/100.0)
               IF ((NUM5.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(5:5)=' '
               ELSE
                  LINVAL(5:5)=CHAR(NUM5+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM6=INT((CUTLINE-(NUM5*100)-(NUM4*1000)-
c              (NUM3*10000)-(NUM2*100000)-
c              (NUM1*1000000))/10.0)
               IF ((NUM6.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(6:6)=' '
               ELSE
                  LINVAL(6:6)=CHAR(NUM6+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM7=INT(CUTLINE-(NUM6*10)-(NUM5*100)-
c              (NUM4*1000)-(NUM3*10000)-(NUM2*100000)-
c              (NUM1*1000000))
               LINVAL(7:7)=CHAR(NUM7+48)
      REWIND(700)
      VERIFCOUNTER=0
      VERIFFIND=.FALSE.
      DO 30 WHILE (VERIFFIND.EQ..FALSE.)
         VERIFCOUNTER=VERIFCOUNTER+1
         READ(700,20) VERIFLABEL
20       FORMAT (T45,A14)
         IF (VERIFLABEL.EQ.'program:  sas2') THEN
            VERIFFIND=.TRUE.
         ENDIF
30    CONTINUE
      NUMZEROFLAG=.FALSE.
      VERIFCUTLINE=VERIFCOUNTER-12
      VERIFENDCUTLINE=VERIFCOUNTER+18
               NUM1=INT(VERIFCUTLINE/1000000.0)
               IF ((NUM1.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(1:1)=' '
               ELSE
                  VERIFLINVAL(1:1)=CHAR(NUM1+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM2=INT((VERIFCUTLINE-(NUM1*1000000))/100000.0)
               IF ((NUM2.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(2:2)=' '
               ELSE
                  VERIFLINVAL(2:2)=CHAR(NUM2+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM3=INT((VERIFCUTLINE-(NUM2*100000)-
c              (NUM1*1000000))/10000.0)
               IF ((NUM3.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(3:3)=' '
               ELSE
                  VERIFLINVAL(3:3)=CHAR(NUM3+48)
                  NUMZEROFLAG=.TRUE.
```

```
           ENDIF
           NUM4=INT((VERIFCUTLINE-(NUM3*10000)-
     c     (NUM2*100000)-(NUM1*1000000))/1000.0)
           IF ((NUM4.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFLINVAL(4:4)=' '
           ELSE
              VERIFLINVAL(4:4)=CHAR(NUM4+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
           NUM5=INT((VERIFCUTLINE-(NUM4*1000)-(NUM3*10000)-
     c     (NUM2*100000)-(NUM1*1000000))/100.0)
           IF ((NUM5.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFLINVAL(5:5)=' '
           ELSE
              VERIFLINVAL(5:5)=CHAR(NUM5+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
           NUM6=INT((VERIFCUTLINE-(NUM5*100)-(NUM4*1000)-
     c     (NUM3*10000)-(NUM2*100000)-
     c     (NUM1*1000000))/10.0)
           IF ((NUM6.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFLINVAL(6:6)=' '
           ELSE
              VERIFLINVAL(6:6)=CHAR(NUM6+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
           NUM7=INT(VERIFCUTLINE-(NUM6*10)-(NUM5*100)-
     c     (NUM4*1000)-(NUM3*10000)-(NUM2*100000)-
     c     (NUM1*1000000))
           VERIFLINVAL(7:7)=CHAR(NUM7+48)
           NUM1=INT(VERIFENDCUTLINE/1000000.0)
           IF ((NUM1.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFENDLINVAL(1:1)=' '
           ELSE
              VERIFENDLINVAL(1:1)=CHAR(NUM1+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
           NUM2=INT((VERIFENDCUTLINE-(NUM1*1000000))/100000.0)
           IF ((NUM2.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFENDLINVAL(2:2)=' '
           ELSE
              VERIFENDLINVAL(2:2)=CHAR(NUM2+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
           NUM3=INT((VERIFENDCUTLINE-(NUM2*100000)-
     c     (NUM1*1000000))/10000.0)
           IF ((NUM3.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFENDLINVAL(3:3)=' '
           ELSE
              VERIFENDLINVAL(3:3)=CHAR(NUM3+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
           NUM4=INT((VERIFENDCUTLINE-(NUM3*10000)-
     c     (NUM2*100000)-(NUM1*1000000))/1000.0)
           IF ((NUM4.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
              VERIFENDLINVAL(4:4)=' '
           ELSE
              VERIFENDLINVAL(4:4)=CHAR(NUM4+48)
              NUMZEROFLAG=.TRUE.
           ENDIF
```

```
               NUM5=INT((VERIFENDCUTLINE-(NUM4*1000)-(NUM3*10000)-
     c         (NUM2*100000)-(NUM1*1000000))/100.0)
               IF ((NUM5.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFENDLINVAL(5:5)=' '
               ELSE
                  VERIFENDLINVAL(5:5)=CHAR(NUM5+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM6=INT((VERIFENDCUTLINE-(NUM5*100)-(NUM4*1000)-
     c         (NUM3*10000)-(NUM2*100000)-
     c         (NUM1*1000000))/10.0)
               IF ((NUM6.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFENDLINVAL(6:6)=' '
               ELSE
                  .VERIFENDLINVAL(6:6)=CHAR(NUM6+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM7=INT(VERIFENDCUTLINE-(NUM6*10)-(NUM5*100)-
     c         (NUM4*1000)-(NUM3*10000)-(NUM2*100000)-
     c         (NUM1*1000000))
               VERIFENDLINVAL(7:7)=CHAR(NUM7+48)
      SEDEXECOMMAND(1:11)='sedexecute '
      SEDEXECOMMAND(12:36)=NM(1:25)
      SEDEXECOMMAND(37:37)=' '
      SEDEXECOMMAND(38:44)=LINVAL
      SEDEXECOMMAND(45:45)=' '
      SEDEXECOMMAND(46:52)=VERIFLINVAL
      SEDEXECOMMAND(53:53)=' '
      SEDEXECOMMAND(54:60)=VERIFENDLINVAL
      SEDEXERESULT=SYSTEM(SEDEXECOMMAND)
      IF (SEDEXERESULT.LT.0) THEN
         WRITE (*,*) 'AN ERROR OCCURRED DURING OUTPUT',
     c   'EXTRACTION FROM ', NM(1:25), '.output'
      ENDIF
      OUTPUTREMOVAL(1:3)='rm '
      OUTPUTREMOVAL(4:28)=NM(1:25)
      OUTPUTREMOVAL(29:35)='.output'
      OUTPUTREMOVALRESULT=SYSTEM(OUTPUTREMOVAL)
      IF (OUTPUTREMOVALRESULT.LT.0) THEN
         WRITE (*,*) 'AN ERROR OCCURRED DURING ',
     c   'DELETION OF ', NM(1:25), '.output'
      ENDIF

      RETURN
      END


*****************************************************
*     This subroutine retrieves the fuel and burnable *
*     poison composition information from the previous *
*     depletion and decay calculation for the assembly.*
*****************************************************
      SUBROUTINE RETRIEVER (OXYGMS, MASSTOTAL,
     c FUELISONAME, FUELISOWTPCT, BPRAISONAME,
     c BPRAISOVALUE, LEFTLIST, CARRYCOUNTER,
     c PREVIOUSNAME, LEFTVAL, NM, BPRA_INSERTED)
*
      INTEGER*4 COLUMNSTART, COLUMNEND, ISONUMBER, CT1,
     c LEFTCOUNTER, CARRYCOUNTER, CT2, ISOFLAG(1000), Z
*
```

```
      REAL ISOVALUE(1000), BPRAISOVALUE(2), MASSTOTAL,
     c FUELISOVALUE(1000), FUELISOWTPCT(1000), OXYGMS,
     c LEFTVAL(1000)
*
      CHARACTER ROWFLAG*7, COL1*8, COL2*8, COL3*8, COL4*8,
     c COL5*8, COL6*8, COL7*8, COL8*8, ACTINIDELABEL*9,
     c FORMATLABEL*29, ISOLABEL*6, ISONAME(1000)*6,
     c FISSPRODLABEL*16, BPRAISONAME(2)*6, ORIGNAME(297)*6,
     c LIBRARYID(297)*5, FUELISONAME(1000)*5, LEFTLIST(1000)*6,
     c PREVIOUSNAME*25, RETRIEVALFILE*29, BPLABEL*14, NM*31,
     c NOTESFILE*31
*
      LOGICAL ROWFLAGLOG, ACTINIDEFIND, FISSPRODFIND, BPFIND,
     c BPRA_INSERTED
*
      DATA (LIBRARYID(Z),Z=1,297) /' 1001',
     c ' 1002',' 1003',' 2003',' 2004',' 3006',
     c ' 3007',' 4009',' 5010',' 5011',' 6012',' 7014',
     c ' 7015',' 8016',' 8017',' 9019','11023','12000',
     c '13027','14000','15031','16000','16032','17000',
     c '19000','20000','22000','23000','24000','25055',
     c '26000','27059','28000','29000','31000','32072',
     c '32073','32074','32076','33075','34074','34076',
     c '34077','34078','34080','34082','35079','35081',
     c '36078','36080','36082','36083','36084','36085',
     c '36086','37085','37086','37087','38084','38086',
     c '38087','38088','38089','38090','39089','39090',
     c '39091','40000','40090','40091','40092','40093',
     c '40094','40095','40096','41093','41094','41095',
     c '42000','42092','42094','42095','42096','42097',
     c '42098','42099','42100','43099','44096','44098',
     c '44099','44100','44101','44102','44103','44104',
     c '44105','44106','45103','45105','46102','46104',
     c '46105','46106','46107','46108','46110','47107',
     c '47109','47111','48000','48106','48108','48110',
     c '48111','48112','48113','48114','48116','48601',
     c '49113','49115','50112','50114','50115','50116',
     c '50117','50118','50119','50120','50122','50123',
     c '50124','50125','50126','51121','51123','51124',
     c '51125','51126','52120','52122','52123','52124',
     c '52125','52126','52128','52130','52132','52601',
     c '52611','53127','53129','53130','53131','53135',
     c '54124','54126','54128','54129','54130','54131',
     c '54132','54133','54134','54135','54136','55133',
     c '55134','55135','55136','55137','56134','56135',
     c '56136','56137','56138','56140','57139','57140',
     c '58140','58141','58142','58143','58144','59141',
     c '59142','59143','60142','60143','60144','60145',
     c '60146','60147','60148','60150','61147','61148',
     c '61149','61151','61601','62144','62147','62148',
     c '62149','62150','62151','62152','62153','62154',
     c '63000','63151','63152','63153','63154','63155',
     c '63156','63157','64152','64154','64155','64156',
     c '64157','64158','64160','65159','65160','66160',
     c '66161','66162','66163','66164','67165','68166',
     c '68167','71175','71176','72000','72174','72176',
     c '72177','72178','72179','72180','73181','73182',
     c '74000','74182','74183','74184','74186','75185',
     c '75187','79197','82000','83209','90230','90232',
     c '91231','91233','92232','92233','92234','92235',
```

```
     c '92236','92237','92238','93237','93238','94236',
     c '94237','94238','94239','94240','94241','94242',
     c '94243','94244','95241','95242','95243','95601',
     c '96241','96242','96243','96244','96245','96246',
     c '96247','96248','97249','98249','98250','98251',
     c '98252','98253','99253'/
      DATA (ORIGNAME(Z),Z=1,297) /' h  1 ',
     c ' h  2 ',' h  3 ','he  3 ','he  4 ','li  6 ',
     c 'li  7 ','be  9 ',' b 10 ',' b 11 ',' c 12 ',
     c ' n 14 ',' n 15 ',' o 16 ',' o 17 ',' f 19 ',
     c 'na 23 ',' mg   ','al 27 ',' si   ',' p 31 ',
     c ' s    ',' s 32 ',' cl   ','  k   ',' ca   ',
     c ' ti   ','  v   ',' cr   ','mn 55 ',' fe   ',
     c 'co 59 ',' ni   ',' cu   ',' ga   ','ge 72 ',
     c 'ge 73 ','ge 74 ','ge 76 ','as 75 ','se 74 ',
     c 'se 76 ','se 77 ','se 78 ','se 80 ','se 82 ',
     c 'br 79 ','br 81 ','kr 78 ','kr 80 ','kr 82 ',
     c 'kr 83 ','kr 84 ','kr 85 ','kr 86 ','rb 85 ',
     c 'rb 86 ','rb 87 ','sr 84 ','sr 86 ','sr 87 ',
     c 'sr 88 ','sr 89 ','sr 90 ',' y 89 ',' y 90 ',
     c ' y 91 ',' zr   ','zr 90 ','zr 91 ','zr 92 ',
     c 'zr 93 ','zr 94 ','zr 95 ','zr 96 ','nb 93 ',
     c 'nb 94 ','nb 95 ',' mo   ','mo 92 ','mo 94 ',
     c 'mo 95 ','mo 96 ','mo 97 ','mo 98 ','mo 99 ',
     c 'mo100 ','tc 99 ','ru 96 ','ru 98 ','ru 99 ',
     c 'ru100 ','ru101 ','ru102 ','ru103 ','ru104 ',
     c 'ru105 ','ru106 ','rh103 ','rh105 ','pd102 ',
     c 'pd104 ','pd105 ','pd106 ','pd107 ','pd108 ',
     c 'pd110 ','ag107 ','ag109 ','ag111 ',' cd   ',
     c 'cd106 ','cd108 ','cd110 ','cd111 ','cd112 ',
     c 'cd113 ','cd114 ','cd116 ','cd115m','in113 ',
     c 'in115 ','sn112 ','sn114 ','sn115 ','sn116 ',
     c 'sn117 ','sn118 ','sn119 ','sn120 ','sn122 ',
     c 'sn123 ','sn124 ','sn125 ','sn126 ','sb121 ',
     c 'sb123 ','sb124 ','sb125 ','sb126 ','te120 ',
     c 'te122 ','te123 ','te124 ','te125 ','te126 ',
     c 'te128 ','te130 ','te132 ','te127m','te129m',
     c ' i127 ',' i129 ',' i130 ',' i131 ',' i135 ',
     c 'xe124 ','xe126 ','xe128 ','xe129 ','xe130 ',
     c 'xe131 ','xe132 ','xe133 ','xe134 ','xe135 ',
     c 'xe136 ','cs133 ','cs134 ','cs135 ','cs136 ',
     c 'cs137 ','ba134 ','ba135 ','ba136 ','ba137 ',
     c 'ba138 ','ba140 ','la139 ','la140 ','ce140 ',
     c 'ce141 ','ce142 ','ce143 ','ce144 ','pr141 ',
     c 'pr142 ','pr143 ','nd142 ','nd143 ','nd144 ',
     c 'nd145 ','nd146 ','nd147 ','nd148 ','nd150 ',
     c 'pm147 ','pm148 ','pm149 ','pm151 ','pm148m',
     c 'sm144 ','sm147 ','sm148 ','sm149 ','sm150 ',
     c 'sm151 ','sm152 ','sm153 ','sm154 ',' eu   ',
     c 'eu151 ','eu152 ','eu153 ','eu154 ','eu155 ',
     c 'eu156 ','eu157 ','gd152 ','gd154 ','gd155 ',
     c 'gd156 ','gd157 ','gd158 ','gd160 ','tb159 ',
     c 'tb160 ','dy160 ','dy161 ','dy162 ','dy163 ',
     c 'dy164 ','ho165 ','er166 ','er167 ','lu175 ',
     c 'lu176 ',' hf   ','hf174 ','hf176 ','hf177 ',
     c 'hf178 ','hf179 ','hf180 ','ta181 ','ta182 ',
     c '  w   ',' w182 ',' w183 ',' w184 ',' w186 ',
     c 're185 ','re187 ','au197 ',' pb   ','bi209 ',
     c 'th230 ','th232 ','pa231 ','pa233 ',' u232 ',
     c ' u233 ',' u234 ',' u235 ',' u236 ',' u237 ',
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     c ' u238 ','np237 ','np238 ','pu236 ','pu237 ',
     c 'pu238 ','pu239 ','pu240 ','pu241 ','pu242 ',
     c 'pu243 ','pu244 ','am241 ','am242 ','am243 ',
     c 'am242m','cm241 ','cm242 ','cm243 ','cm244 ',
     c 'cm245 ','cm246 ','cm247 ','cm248 ','bk249 ',
     c 'cf249 ','cf250 ','cf251 ','cf252 ','cf253 ',
     c 'es253 '/

      RETRIEVALFILE(1:25)=PREVIOUSNAME
      RETRIEVALFILE(26:29)='.cut'
      NOTESFILE(1:25)=NM(1:25)
      NOTESFILE(26:31)='.notes'
      OPEN(UNIT=300, FILE=RETRIEVALFILE, STATUS='OLD')
      OPEN(UNIT=500, FILE=NOTESFILE, STATUS='UNKNOWN')
      REWIND(300)
      REWIND(500)
      DO 5 CT1=1,1000
         ISOVALUE(CT1)=0.0
         FUELISOVALUE(CT1)=0.0
         FUELISOWTPCT(CT1)=0.0
         LEFTVAL=0.0
         ISONAME='       '
         FUELISONAME='      '
         LEFTLIST='       '
         ISOFLAG=0
    5 CONTINUE
      ROWFLAGLOG=.FALSE.
      DO 11 WHILE (ROWFLAGLOG.EQ..FALSE.)
         READ (300,10) ROWFLAG, COL1, COL2, COL3,
     c   COL4, COL5, COL6, COL7, COL8
   10    FORMAT (T15,A7,T24,A8,T34,A8,T44,A8,T54,A8,
     c   T64,A8,T74,A8,T84,A8,T94,A8)
         IF (ROWFLAG.EQ.'initial') THEN
            ROWFLAGLOG=.TRUE.
         ENDIF
   11 CONTINUE
      IF (COL1.NE.'        ') THEN
         COLUMNSTART=23
         COLUMNEND=32
      ENDIF
      IF (COL2.NE.'        ') THEN
         COLUMNSTART=33
         COLUMNEND=42
      ENDIF
      IF (COL3.NE.'        ') THEN
         COLUMNSTART=43
         COLUMNEND=52
      ENDIF
      IF (COL4.NE.'        ') THEN
         COLUMNSTART=53
         COLUMNEND=62
      ENDIF
      IF (COL5.NE.'        ') THEN
         COLUMNSTART=63
         COLUMNEND=72
      ENDIF
      IF (COL6.NE.'        ') THEN
         COLUMNSTART=73
         COLUMNEND=82
      ENDIF
```

```
      IF (COL7.NE.'          ') THEN
         COLUMNSTART=83
         COLUMNEND=92
      ENDIF
      IF (COL8.NE.'          ') THEN
         COLUMNSTART=93
         COLUMNEND=102
      ENDIF
*   Get B-10 and B-11 composition data for BPRA
      IF (BPRA_INSERTED.EQ..TRUE.) THEN
         BPRAISOVALUE(1)=0.0
         BPRAISOVALUE(2)=0.0
         BPRAISONAME(1)='      '
         BPRAISONAME(2)='      '
         REWIND(300)
         BPFIND=.FALSE.
         DO 14 WHILE (BPFIND.EQ..FALSE.)
            READ(300,12) BPLABEL
   12       FORMAT (T98,A14)
            IF (BPLABEL.EQ.'light elements') THEN
               READ(300,*)
               READ(300,13) FORMATLABEL
   13          FORMAT (T46,A29)
               IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
                  BPFIND=.TRUE.
               ENDIF
            ENDIF
   14    CONTINUE
         DO 24 CT1=1,25
            READ (300,22) BPRAISONAME(1)
   22       FORMAT(T6,A6)
            IF (BPRAISONAME(1).EQ.' b 10 ') THEN
               BACKSPACE(300)
               EXIT
            ENDIF
   24    CONTINUE
         READ (300,26) BPRAISONAME(1), BPRAISOVALUE(1)
   26       FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
         READ (300,29) BPRAISONAME(2), BPRAISOVALUE(2)
   29       FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
         IF (BPRAISONAME(1).EQ.' b 10 ') THEN
            BPRAISONAME(1)='  5010'
         ENDIF
         IF (BPRAISONAME(2).EQ.' b 11 ') THEN
            BPRAISONAME(2)='  5011'
         ENDIF
      ENDIF
*   Get fuel composition data
      REWIND(300)
      ACTINIDEFIND=.FALSE.
      DO 50 WHILE (ACTINIDEFIND.EQ..FALSE.)
         READ(300,30) ACTINIDELABEL
   30    FORMAT (T103,A9)
         IF (ACTINIDELABEL.EQ.'actinides') THEN
            READ(300,*)
            READ(300,40) FORMATLABEL
   40       FORMAT (T46,A29)
            IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
               ACTINIDEFIND=.TRUE.
            ENDIF
```

```
         ENDIF
   50 CONTINUE
      READ(300,*)
      READ(300,*)
      ISOLABEL='      '
      ISONUMBER=0
      DO 70 WHILE (ISOLABEL.NE.'tal   ')
         ISONUMBER=ISONUMBER+1
         READ(300,60) ISONAME(ISONUMBER), ISOVALUE(ISONUMBER)
   60    FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
         ISOLABEL=ISONAME(ISONUMBER)
         IF (ISOLABEL.EQ.'tal   ') THEN
            ISONAME(ISONUMBER)='      '
            ISOVALUE(ISONUMBER)=0
         ENDIF
   70 CONTINUE
      ISONUMBER=ISONUMBER-1
      REWIND(300)
      FISSPRODFIND=.FALSE.
      DO 110 WHILE (FISSPRODFIND.EQ..FALSE.)
         READ(300,90) FISSPRODLABEL
   90    FORMAT (T96,A16)
         IF (FISSPRODLABEL.EQ.'fission products') THEN
            READ(300,*)
            READ(300,100) FORMATLABEL
  100       FORMAT (T46,A29)
            IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
               FISSPRODFIND=.TRUE.
            ENDIF
         ENDIF
  110 CONTINUE
      READ(300,*)
      READ(300,*)
      ISOLABEL='      '
      DO 130 WHILE (ISOLABEL.NE.'tal   ')
         ISONUMBER=ISONUMBER+1
         READ(300,120) ISONAME(ISONUMBER), ISOVALUE(ISONUMBER)
  120    FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
         ISOLABEL=ISONAME(ISONUMBER)
         IF (ISOLABEL.EQ.'      ') THEN
            ISONUMBER=ISONUMBER-1
            READ(300,*)
            READ(300,*)
            READ(300,*)
            READ(300,*)
            READ(300,*)
         ENDIF
         IF (ISOLABEL.EQ.'tal   ') THEN
            ISONAME(ISONUMBER)='      '
            ISOVALUE(ISONUMBER)=0
         ENDIF
  130 CONTINUE
      ISONUMBER=ISONUMBER-1
      WRITE (500,*) 'FUEL COMPOSITION'
      DO 140 CT1=1,ISONUMBER
         WRITE (500,*) ISONAME(CT1), '     ', ISOVALUE(CT1)
  140 CONTINUE
      WRITE (500,*)
      IF (BPRA_INSERTED.EQ..TRUE.) THEN
         WRITE (500,*) 'B-10 AND B-11 IN BPRA'
```

```
         DO 150 CT1=1,2
            WRITE (500,*) BPRAISONAME(CT1), '     ',
     c      BPRAISOVALUE(CT1)
 150     CONTINUE
      ENDIF
      MASSTOTAL=OXYGMS
      LEFTCOUNTER=0
      CARRYCOUNTER=0
      DO 190 CT1=1,ISONUMBER
         DO 180 CT2=1,297
            IF (ISONAME(CT1).EQ.ORIGNAME(CT2)) THEN
               CARRYCOUNTER=CARRYCOUNTER+1
               ISOFLAG(CT1)=1
               FUELISONAME(CARRYCOUNTER)=LIBRARYID(CT2)
               FUELISOVALUE(CARRYCOUNTER)=ISOVALUE(CT1)
            ENDIF
            IF ((CT2.EQ.297).AND.(ISOFLAG(CT1).NE.1)) THEN
               LEFTCOUNTER=LEFTCOUNTER+1
               LEFTLIST(LEFTCOUNTER)=ISONAME(CT1)
               LEFTVAL(LEFTCOUNTER)=ISOVALUE(CT1)
            ENDIF
 180     CONTINUE
 190  CONTINUE
      DO 195 CT1=1,CARRYCOUNTER
         MASSTOTAL=MASSTOTAL+FUELISOVALUE(CT1)
 195  CONTINUE
      DO 200 CT1=1,CARRYCOUNTER
         FUELISOWTPCT(CT1)=(FUELISOVALUE(CT1)/MASSTOTAL)*100.0
 200  CONTINUE
      WRITE (500,*) 'SAS2H FUEL COMPOSITION INPUT FROM ORIGIN OUTPUT'
      DO 230 CT1=1,CARRYCOUNTER
         WRITE (500,*) FUELISONAME(CT1), '     ', FUELISOVALUE(CT1)
 230  CONTINUE
      WRITE (500,*) 'ISOTOPES IN ORIGIN OUTPUT LEFT OUT OF SAS2H INPUT'
      DO 240 CT1=1,LEFTCOUNTER
         WRITE (500,*) LEFTLIST(CT1), '     ', LEFTVAL(CT1)
 240  CONTINUE

      RETURN
      END

*****************************************************************************
*       Two digit integer conversion subroutine which adds leading zeros    *
*****************************************************************************
      SUBROUTINE ZEROS(IN,CHOUT)

      INTEGER*4 IN
      CHARACTER CHOUT*2, CH1, CH2

      CH1=CHAR((IN/10)+48)
      CH2=CHAR((IN-(INT(IN/10)*10))+48)
      CHOUT(1:1)=CH1
      CHOUT(2:2)=CH2

      RETURN
      END
```

Attachment III

RLAYOUT Version 1.0 Program Description

RLAYOUT Version 1.0

Rodded Assembly Irradiation History Layout Developer

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under contract with the

Management and Operating Contractor for the
Yucca Mountain High-Level Radioactive Waste Repository Project

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1. Purpose

The RLAYOUT program was written to support Commercial Reactor Critical (CRC) evaluations. The CRC evaluations are performed as part of the disposal criticality methodology development for the proposed Yucca Mountain High-Level Radioactive Waste Repository.

2. Objective

The objective of the RLAYOUT program is to develop the irradiation time step layouts for CRC depletion calculations performed by SAS2H such that the assembly axial node irradiation histories are simulated according to relevant data. The data that is relevant to determining an appropriate irradiation time step layout for a CRC SAS2H depletion calculation includes the following:

1) the control rod assembly (CRA) or axial power shaping rod assembly (APSRA) insertion time in a given axial node of an assembly during each CRC statepoint depletion calculation;
2) the boron letdown data measured at nominal full-power conditions;
3) the minimum desired cross-section update frequency to be implemented in the CRC SAS2H depletion calculations.

The RLAYOUT program is intended to be used without supporting documentation through the implementation of run-time user defined input prompts.

3. Methodology

The methodology employed by the RLAYOUT program is to prompt the user for a minimum set of required information, and develop appropriate irradiation layouts for the CRC statepoint calculations in which the assembly of interest contains either a CRA or an APSRA. The developed irradiation layouts will provide the following information:

1) the number of SAS2H irradiation time steps required for each statepoint depletion calculation;
2) the duration of each SAS2H irradiation time step required for each statepoint depletion calculation;
3) the soluble boron concentration at the mid-point of each SAS2H irradiation time step required for each statepoint depletion calculation;
4) the identification of which axial assembly nodes in which SAS2H irradiation time steps should have either a CRA or an APSRA inserted.

The RLAYOUT program prompts the user for a minimum set of input information required to develop the irradiation history layouts. This minimum set of input information includes the following:

1) the assembly archive identifier (i.e., the label designated to the assembly such that it may be uniquely identified in the CRC depletion calculation archives);

2) the number of axial nodes to be utilized in the CRAFT calculations;
3) the number of rodded CRC statepoint calculations required for the assembly depletion;
4) the number of reactor cycles in which the assembly is inserted and has a rodded statepoint calculation (this number is used to identify the number of files corresponding to the boron letdown data for the relevant reactor cycles);
5) the filenames corresponding to the boron letdown data for each reactor cycle relevant to the assembly CRC depletion calculations;
6) the cycle identifier (2 characters), and each rodded statepoint depletion calculation's starting and ending EFPD values (floating point);
7) the filename containing the CRA and/or APSRA nodal insertion history data.

In SAS2H, the duration of an irradiation interval may be separated into a number of time steps of variable length. Typically, an irradiation interval is a CRC statepoint depletion calculation interval, or the continuous irradiation time required to go from one CRC statepoint to another. To follow the CRA or APSRA insertion histories, detailed intra-cycle variable irradiation time steps are required. This is due to the fact that the CRs and APSRs are only present in a given axial node of an assembly for a given period of exposure during a statepoint depletion calculation. A user specified number of cross-section library updates are performed during each time step of an irradiation interval. The boron letdown curve of the reactor cycle may also be followed by specifying, at each irradiation step, a fraction of the soluble boron concentration defined in the base moderator material specification. This boron concentration is applied uniformly over the irradiation time step. The boron concentration fraction at the mid-point of each irradiation time step is specified in the SAS2H depletion calculations of this analysis to appropriately follow boron letdown curves. Considering the cross-section update frequency, the boron letdown data, and the absorber rod assembly insertion histories, the following three primary requirements apply to determining an appropriate reactor cycle irradiation layout for a rodded assembly.

1) The duration of each time step should be specified such that a maximum of 80 days of irradiation is not exceeded between cross-section updates. The SAS2H calculations in this analysis utilize one cross-section update per irradiation step. Therefore, the maximum duration of any time step in any reactor cycle irradiation layout of this analysis should not exceed 80 days. The 80 day limit is an arbitrary limit based on engineering judgement. The 80 day irradiation time step limit should assure that the isotopic concentrations of the system (primarily fuel and borated moderator) will not alter the neutron spectrum radically enough to cause a time step of the depletion calculation to be performed without the availability of cross-sections which have been properly weighted with an appropriate neutron spectrum and spatial flux.

2) Any radical perturbations in the boron letdown curve should be followed by defining irradiation time step durations such that the average boron concentration over each time step is representative of the actual boron letdown. Usually, the 80 day time step limit imposed for cross-section update frequency is adequate to properly follow a reactor cycle's boron letdown curve.

3) The duration of each time step should be specified such that the insertion of a CRA or APSRA in a given assembly axial node may be modeled for the correct exposure time in

terms of EFPD. A more detailed description of the meaning this statement is warranted. In SAS2H, there is an option to vary the Path B unit cell model between irradiation steps as long as the number of radial zones in the Path B models of a given SAS2H calculation (i.e., statepoint depletion calculation) remain the same. Therefore, an assembly axial node represented in a given SAS2H statepoint depletion calculation that has a CRA or APSRA insertion history for a specified period of exposure (that is a fraction of the exposure covered by the statepoint depletion calculation) may be modeled appropriately by changing the Path B model from one representing the insertion of a CRA or APSRA to one representing the removal of a CRA or APSRA at the appropriate time step (corresponding to the CRA or APSRA removal time).

All three of the requirements previously described must be correctly addressed in the SAS2H input decks developed for each axial node of an assembly in each statepoint depletion calculation. Assuring that the cross-section update frequency and the boron letdown curves are properly modeled is usually a by-product of developing the irradiation layouts for the statepoint depletion calculations containing either CRA or APSRA insertion history. The irradiation time step layout for a given statepoint depletion calculation must be developed such that breakpoints exist between irradiation time steps, that allow for the appropriate removal or insertion of a CRA or APSRA, to obtain the correct integrated neutron spectrum exposure for each axial node of the assembly. It becomes obvious then that the complexity of the irradiation time step layout for a given statepoint calculation is proportional to the number of CRC axial nodes being modeled and the frequency of CRA or APSRA movement during the assembly depletion. The time steps developed to model CRA or APSRA insertion histories are also designed to encompass the cross-section update and boron letdown requirements. RLAYOUT automates this development of appropriate irradiation time step layouts for the statepoint depletion calculations of an assembly containing either a CRA or APSRA insertion history.

4. Required File Structures for the Input to RLAYOUT

The RLAYOUT program utilizes two types of input data files. The first type of input data file contains the boron letdown data for a given reactor cycle that is needed by RLAYOUT to develop the SAS2H irradiation layouts. The second type of input data file contains the nodal CRA and/or APSRA insertion times for each CRC statepoint depletion calculation. Each of these files must follow a specific layout to be read properly by the RLAYOUT program.

The files containing boron letdown data should only contain data for a single reactor cycle. The format of these boron letdown data files should consist of the following:

1) the lines of input data should begin at the top of the file;
2) there should be no blank lines present in the input data;
3) each line should contain two values delineated by spaces;
4) the first value on a line of input should be the EFPD value corresponding to the boron data that is subsequently provided on the same input line;
5) the second value on a line of input should be the measured soluble boron concentration (ppm) in the moderator at the corresponding EFPD value;
6) a minimum of one blank line should appear at the bottom of the file.

The files containing rod insertion time data should provide the rod insertion time data for each statepoint depletion calculation to be performed for the assembly in which a CRA and/or APSRA is inserted. The rod insertion time data for each statepoint depletion calculation should be provided in the order in which the statepoint depletion calculations are performed. Each set of rod insertion time data for each statepoint depletion calculation must contain a line of input corresponding to the specified number of axial nodes as input by the user when executing the RLAYOUT program. The rod insertion time input data file for an assembly should correspond to a specific format as follows:

1) the node number corresponding to a line of input containing a rod insertion time should begin in column one of the input file;
2) the node number "1" (always the top node) should be used to delineate a set of nodal rod insertion times for a given CRC statepoint depletion calculation;
3) the rod insertion time on a given line of input should be specified in terms of EFPD of rod insertion during the statepoint calculation (this value should be based on an average power that is calculated from the same nodal burnup data that will be utilized in the corresponding CRAFT calculation);
4) the rod insertion time on a given line of input should be located in columns 60 through 74;
5) each set of nodal rod insertion time input data provided for each CRC statepoint depletion calculation must contain data for the full number of axial nodes as specified by the user in the input to RLAYOUT;
6) the nodal input data for a given CRC statepoint depletion calculation must always be specified in sequential order according to node number;
7) any comments or other data may appear in the input files as long as it does not interfere with the format described in numbers one through six above.

5. Calculations Performed by the RLAYOUT Program

The RLAYOUT program performs only one calculation. This is a simple linear interpolation calculation within the user provided boron letdown data to determined the soluble boron concentration at the mid-point of each irradiation time step that is defined by RLAYOUT. The RLAYOUT code utilizes the following standard linear interpolation scheme:

$$\frac{\textit{Target Value} - x_1}{\textit{Reference Value} - y_1} = \frac{x_2 - x_1}{y_2 - y_1}$$

where,

Target Value = the value for which the interpolation is being performed to obtain;
Reference Value = the known value which has a one-to-one correspondence to the Target Value;
x_1 *= the target parameter value displayed in the table which corresponds to* y_1*;*
x_2 *= the target parameter value displayed in the table which corresponds to* y_2*;*
y_1 *= the reference parameter value displayed in the table which is the largest value less than the Reference Value;*
y_2 *= the reference parameter value displayed in the table which is the smallest value greater than the Reference Value.*

6. Example of an Irradiation History Layout for a Rodded Assembly Developed by RLAYOUT

```
IRRADIATION LAYOUT FOR ASSEMBLY: A01
Cycle-1A,    .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
```

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	41.67	41.67	913.3
2	68.68	110.35	902.9
3	68.68	179.03	784.8
4	43.05	222.08	663.5
5	43.05	265.13	575.6
6	3.87	269.00	505.6

```
Cycle-1B,    .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation
```

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.67	4.67	541.2
2	25.50	30.17	569.2
3	43.28	73.46	434.2
4	43.28	116.74	309.6
5	9.26	126.00	279.6
6	1.00	127.00	284.2
7	1.00	128.00	285.1
8	6.91	134.91	288.7
9	7.09	142.00	284.3
10	.20	142.20	280.6

```
Cycle-1B, 142.2 EFPD to Cycle-1B, 171.3 EFPD Statepoint Calculation
```

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	6.57	6.57	277.1
2	5.45	12.02	266.5
3	16.98	29.00	204.7
4	.10	29.10	157.6

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: A01

COLUMN A: Cycle-1A, .0 EFPD to Cycle-1A, 268.8 EFPD Statepoint Calculation
COLUMN B: Cycle-1B, .0 EFPD to Cycle-1B, 142.2 EFPD Statepoint Calculation
COLUMN C: Cycle-1B, 142.2 EFPD to Cycle-1B, 171.3 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step

	A						B										C			
NODE #	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4
1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X		
5	X	X	X	X	X	X	X	X	X	X	X	X	X				X			
6	X	X	X	X	X	X	X	X	X	X	X	X								
7	X	X	X	X	X	X	X	X	X	X	X									
8	X	X	X	X	X	X	X	X	X	X	X									
9	X	X	X	X	X	X	X	X	X	X	X									
10	X	X	X	X	X	X	X	X	X	X	X									
11	X	X	X	X	X	X	X	X	X	X	X									
12	X	X	X	X	X	X	X	X	X	X	X									
13	X	X	X	X	X	X	X	X	X	X	X	X								
14	X	X	X	X	X		X	X	X	X	X	X	X							
15	X	X	X				X	X	X	X										
16	X						X	X												
17							X													
18																				

7. RLAYOUT Version 1.0 Fortran Source Code Listing

```
      PROGRAM RLAYOUT
*
      INTEGER*4 NUMOFSTPTCALCS, NUMOFNODES, NUMBEROFSTEPS(20),
     c NUMOFCYCLES, LINECOUNT
*
      REAL STPTID(2,20), RODINTIME(20,50), STEPLAYOUTS(20,50),
     c BORONLAYOUTS(20,50)
*
      CHARACTER ARCHIVEID*5, CYCLEID(2,20)*2,
     c BORONDATAFILES(20)*20, RESULTSFILE*11
*
***** Call subroutine to read user defined assembly information.
      CALL GETASSEMBLYINFO (NUMOFSTPTCALCS, STPTID,
     c ARCHIVEID, CYCLEID, NUMOFNODES, BORONDATAFILES,
     c NUMOFCYCLES)
*
```

```
***** Call subroutine to read the rod assembly insertion times
***** for each node of each statepoint calculation.
      CALL GETRODDEDTIMES (NUMOFSTPTCALCS, NUMOFNODES,
     c RODINTIME)
*
***** Call subroutine to define the irradiation history layout
***** for each nstatepoint calculation.
      CALL LAYOUT (RODINTIME, NUMOFSTPTCALCS, NUMOFNODES,
     c NUMBEROFSTEPS, STEPLAYOUTS, NUMOFCYCLES, STPTID)
*
***** Call subroutine to determine the mid-step soluble boron
***** concentrations for each irradiation step of each statepoint
***** calculation as defined in the STEPLAYOUTS array.
      CALL BORONDATA (NUMBEROFSTEPS, STEPLAYOUTS,
     c BORONDATAFILES, NUMOFSTPTCALCS, BORONLAYOUTS,
     c NUMOFCYCLES, CYCLEID)
*
***** Call subroutine to write rodded assembly irradiation
***** history layouts.
      CALL WRITELAYOUTS (NUMOFSTPTCALCS, CYCLEID, STPTID,
     c ARCHIVEID, STEPLAYOUTS, BORONLAYOUTS, NUMBEROFSTEPS,
     c LINECOUNT, RESULTSFILE)
*
***** Call subroutine to tabulate the nodal rod assembly
***** insertion history.
      CALL INSERTIONHISTORY (NUMOFNODES, NUMBEROFSTEPS,
     c NUMOFSTPTCALCS, LINECOUNT, RESULTSFILE, ARCHIVEID,
     c STPTID, CYCLEID, RODINTIME, STEPLAYOUTS)
*
***** Terminate execution.
      END

****************************************************************
***** GETASSEMBLYINFO Subroutine:                          *****
***** This subroutine prompts the user for assembly info.  *****
***** necessary to define the irradiation history layout.  *****
****************************************************************
      SUBROUTINE GETASSEMBLYINFO (NUMOFSTPTCALCS, STPTID,
     c ARCHIVEID, CYCLEID, NUMOFNODES, BORONDATAFILES,
     c NUMOFCYCLES)
*
      INTEGER*4 NUMOFSTPTCALCS, CALCNUM, NUMOFNODES, RELCYC,
     c NUMOFCYCLES
*
      REAL STPTID(2,20)
*
      CHARACTER ARCHIVEID*5, CYCLEID(2,20)*2,
     c BORONDATAFILES(20)*20
*
***** Get assembly archive identifier.
      WRITE (*,*) 'Enter the assembly archive identifier:'
      READ (*,10) ARCHIVEID
   10 FORMAT(A5)
***** Get the number of nodes in the CRAFT calculation.
      WRITE (*,*) 'Enter the number of axial nodes in the CRAFT',
     c ' calculation:'
      READ (*,*) NUMOFNODES
*
***** Get number of statepoint calculations required for assembly.
      WRITE (*,*) 'Enter the number of rodded statepoint calculations'
```

```
      WRITE (*,*) 'required for the assembly depletion:'
      READ (*,*) NUMOFSTPTCALCS
*
***** Get the number of reactor cycles for which boron letdown data
***** is required.
      WRITE (*,*) 'Enter the number of rodded reactor cycles for ',
     c 'which boron letdown data is required:'
      READ (*,*) NUMOFCYCLES
*
***** Get the names for each file containing boron letdown data.
      WRITE (*,*) 'Enter the name of each file containing boron ',
     c 'letdown data for each rodded reactor cycle'
      WRITE (*,*) 'on successive lines in ascending order ',
     c 'beginning with relative reactor cycle number 1:'
      WRITE (*,*) '[maximum filename length = 20 characters]'
      DO 27 RELCYC=1,NUMOFCYCLES
         READ (*,26) BORONDATAFILES(RELCYC)
   26    FORMAT(T1,A20)
   27 CONTINUE
*
***** Get the reactor cycle identifiers and statepoint EFPD values
***** for each statepoint calculation required for the assembly.
      DO 40 CALCNUM=1,NUMOFSTPTCALCS
         WRITE (*,*) 'Enter the reactor cycle identifier followed ',
     c   'by the statepoint'
         WRITE (*,*) 'EFPD value for the starting point and ',
     c   'finishing point of relative statepoint calculation'
         WRITE (*,*) 'number ', CALCNUM, ', on successive lines:'
         WRITE (*,*) 'Input line format: [Cycle ID = 2 characters, ',
     c   'Stpt EFPD = floating pt. (xxx.xx)]'
         READ (*,30) CYCLEID(1,CALCNUM), STPTID(1,CALCNUM)
         READ (*,30) CYCLEID(2,CALCNUM), STPTID(2,CALCNUM)
   30    FORMAT(A2,1X,F6.2)
   40 CONTINUE

      RETURN
      END

****************************************************************
***** GETRODDEDTIMES Subroutine:                          *****
***** This subroutine reads the rod assembly insertion    *****
***** times for each node of each statepoint calculation  *****
***** provided in a text file of a specified format.      *****
****************************************************************
      SUBROUTINE GETRODDEDTIMES (NUMOFSTPTCALCS, NUMOFNODES,
     c RODINTIME)
*
      INTEGER*4 NUMOFSTPTCALCS, SEARCHER, STPTCALCTALLY, NODE,
     c NUMOFNODES
*
      REAL RODINTIME(20,50)
*
      CHARACTER RODHISTORYFILE*15
*
      LOGICAL LASTCALCFLAG
*
***** Get the filename containing the rod history data.
      WRITE (*,*) 'Enter the filename containing the rod assembly ',
     c 'insertion times for each rodded statepoint calculation:'
      WRITE (*,*) '(This filename with extension should not exceed ',
```

```
     c '15 characters in length.)'
      READ (*,10) RODHISTORYFILE
   10 FORMAT (A15)
      OPEN(UNIT=100, FILE=RODHISTORYFILE, STATUS='OLD')
      REWIND(UNIT=100)
*
***** Read the rod insertion times for each node in each statepoint
***** calculation from the RODHISTORYFILE text file.
      STPTCALCTALLY=0
      LASTCALCFLAG=.FALSE.
      DO 50 WHILE (LASTCALCFLAG.EQ..FALSE.)
         READ(100,20) SEARCHER
   20    FORMAT(T1,I4)
         IF (SEARCHER.EQ.1) THEN
            STPTCALCTALLY=STPTCALCTALLY+1
            IF (STPTCALCTALLY.EQ.NUMOFSTPTCALCS) THEN
               LASTCALCFLAG=.TRUE.
            ENDIF
            BACKSPACE(UNIT=100)
            DO 40 NODE=1,NUMOFNODES
               READ(100,30) RODINTIME(STPTCALCTALLY,NODE)
   30          FORMAT(T60,G15.2)
   40       CONTINUE
            SEARCHER=0
         ENDIF
   50 CONTINUE

      RETURN
      END

*****************************************************************
***** LAYOUT Subroutine:                                    *****
***** This subroutine develops the irradiation history      *****
***** layout for the SAS2H depletions of each statepoint    *****
***** calculation.  The irradiation steps within each       *****
***** statepoint calculation are defined such that          *****
***** irradiation breakpoints exists to facilitate rod      *****
***** assembly movement simulation at power.  Rod assembly *****
***** insertion times in each node are rounded to the       *****
***** nearest whole number of EFPD.                         *****
*****************************************************************
      SUBROUTINE LAYOUT (RODINTIME, NUMOFSTPTCALCS, NUMOFNODES,
     c NUMBEROFSTEPS, STEPLAYOUTS, NUMOFCYCLES, STPTID)
*
      INTEGER*4 NUMOFSTPTCALCS, NUMOFNODES, INTRODINTIME(20,50),
     c STPTCALC, NODE, UNIQUES(20), DEFTIMES(20,50), COUNT,
     c PRESENTTALLY, LAST, J, PTR, FIRST, K, NUMBEROFSTEPS(20),
     c NUMOFCYCLES, SPLIT, IVAL1, IVAL2, IVAL3
*
      REAL RODINTIME(20,50), EXPLICITVALUE, BREAKPOINTS(20,50),
     c HOLD, DENOM, STEPLAYOUTS(20,50), LENGTHCHECK, INTERVAL,
     c TEMP, STPTID(2,20), VALUE
*
      LOGICAL UNIQUEFLAG, LENGTHPROB
*
***** Integerize rod assembly insertion times in each node
***** of each statepoint calculation.
      DO 20 STPTCALC=1,NUMOFSTPTCALCS
         DO 10 NODE=1,NUMOFNODES
            TEMP=RODINTIME(STPTCALC,NODE)
```

```
            IF ((TEMP-INT(TEMP)).LT.(0.5)) THEN
               VALUE=RODINTIME(STPTCALC,NODE)
            ELSEIF ((TEMP-INT(TEMP)).GE.(0.5)) THEN
               VALUE=RODINTIME(STPTCALC,NODE)+1
            ENDIF
            INTRODINTIME(STPTCALC,NODE)=INT(VALUE)
   10    CONTINUE
   20 CONTINUE
*
***** Determine the number of unique rod assembly insertion times
***** for each statepoint calculation, and record these unique rod
***** assembly insertion times in an array entitled DEFTIMES.
      DO 50 STPTCALC=1,NUMOFSTPTCALCS
         UNIQUES(STPTCALC)=0
         DO 40 NODE=1,NUMOFNODES
            IF (NODE.EQ.1) THEN
               UNIQUES(STPTCALC)=UNIQUES(STPTCALC)+1
               DEFTIMES(STPTCALC,UNIQUES(STPTCALC))=
     c         INTRODINTIME(STPTCALC,NODE)
            ELSEIF (NODE.GT.1) THEN
               UNIQUEFLAG=.TRUE.
               DO 30 COUNT=1,UNIQUES(STPTCALC)
                  IF (INTRODINTIME(STPTCALC,NODE).EQ.
     c            DEFTIMES(STPTCALC,COUNT)) THEN
                     UNIQUEFLAG=.FALSE.
                     EXIT
                  ENDIF
   30          CONTINUE
               IF (UNIQUEFLAG.EQ..TRUE.) THEN
                  UNIQUES(STPTCALC)=UNIQUES(STPTCALC)+1
                  DEFTIMES(STPTCALC,UNIQUES(STPTCALC))=
     c            INTRODINTIME(STPTCALC,NODE)
               ENDIF
            ELSEIF (NODE.EQ.NUMOFNODES) THEN
               UNIQUEFLAG=.TRUE.
               DO 35 COUNT=1,UNIQUES(STPTCALC)
                  IF (STPTID(2,STPTCALC).EQ.
     c            DEFTIMES(STPTCALC,COUNT)) THEN
                     UNIQUEFLAG=.FALSE.
                     EXIT
                  ENDIF
   35          CONTINUE
               IF (UNIQUEFLAG.EQ..TRUE.) THEN
                  UNIQUES(STPTCALC)=UNIQUES(STPTCALC)+1
                  DEFTIMES(STPTCALC,UNIQUES(STPTCALC))=
     c            STPTID(2,STPTCALC)-STPTID(1,STPTCALC)
               ENDIF
            ENDIF
   40    CONTINUE
   50 CONTINUE
*
***** Determine which rod assembly insertion times occur only once in
***** a statepoint calculation, and define these insertion times
***** using the explicit floating point value as originally read from
***** the rod insertion history data text file (UNIT=100).  The
***** BREAKPOINTS array contains the irradiation step breakpoint values
***** necessary to define the irradition history layout.
      DO 80 STPTCALC=1,NUMOFSTPTCALCS
         DO 70 COUNT=1,UNIQUES(STPTCALC)
            PRESENTTALLY=0
```

```
            DO 60 NODE=1,NUMOFNODES
               IF (DEFTIMES(STPTCALC,COUNT).EQ.
     c         INTRODINTIME(STPTCALC,NODE)) THEN
                  PRESENTTALLY=PRESENTTALLY+1
                  EXPLICITVALUE=RODINTIME(STPTCALC,NODE)
               ENDIF
   60       CONTINUE
            IF (PRESENTTALLY.EQ.1) THEN
               BREAKPOINTS(STPTCALC,COUNT)=EXPLICITVALUE
            ELSE
               BREAKPOINTS(STPTCALC,COUNT)=DEFTIMES(STPTCALC,COUNT)
            ENDIF
   70    CONTINUE
   80 CONTINUE
*
***** Sort the array BREAKPOINTS in ascending order.
      DO 110 STPTCALC=1,NUMOFSTPTCALCS
         LAST=UNIQUES(STPTCALC)
         DO 100 J=1,(UNIQUES(STPTCALC)-1)
            PTR=J
            FIRST=J+1
            DO 90 K=FIRST,LAST
               IF (BREAKPOINTS(STPTCALC,K).LT.
     c         BREAKPOINTS(STPTCALC,PTR)) THEN
                  PTR=K
               ENDIF
   90       CONTINUE
            HOLD=BREAKPOINTS(STPTCALC,J)
            BREAKPOINTS(STPTCALC,J)=BREAKPOINTS(STPTCALC,PTR)
            BREAKPOINTS(STPTCALC,PTR)=HOLD
  100    CONTINUE
  110 CONTINUE
*
***** The irradiation history layout is defined using the values from the
***** BREAKPOINTS array such that no irradiation step exceeds a 70 EFPD
***** limit.  The final irradiation step layouts for each statepoint calculation
***** are defined in the array entitled STEPLAYOUTS.
      DO 150 STPTCALC=1,NUMOFSTPTCALCS
         NUMBEROFSTEPS(STPTCALC)=0
         ZEROFLAG=.FALSE.
         DO 140 COUNT=1,UNIQUES(STPTCALC)
            IVAL1=COUNT-1
         IF (BREAKPOINTS(STPTCALC,COUNT).NE.(0.0)) THEN
            IF ((COUNT.EQ.1).AND.
     c      (BREAKPOINTS(STPTCALC,COUNT).GT.(70.0))) THEN
               LENGTHPROB=.TRUE.
               DENOM=2.0
            ELSEIF ((COUNT.GT.1).AND.((BREAKPOINTS(STPTCALC,COUNT)-
     c      BREAKPOINTS(STPTCALC,IVAL1)).GT.(70.0))) THEN
               LENGTHPROB=.TRUE.
               DENOM=2.0
            ELSE
               LENGTHPROB=.FALSE.
               NUMBEROFSTEPS(STPTCALC)=NUMBEROFSTEPS(STPTCALC)+1
               IVAL2=NUMBEROFSTEPS(STPTCALC)
               IF (COUNT.EQ.1) THEN
                  STEPLAYOUTS(STPTCALC,IVAL2)=
     c            BREAKPOINTS(STPTCALC,COUNT)
               ELSE
                  STEPLAYOUTS(STPTCALC,IVAL2)=
```

```
     c              BREAKPOINTS(STPTCALC,COUNT)-
     c              BREAKPOINTS(STPTCALC,IVAL1)
                 ENDIF
              ENDIF
              DO 130 WHILE (LENGTHPROB.EQ..TRUE.)
                 IF (COUNT.EQ.1) THEN
                    LENGTHCHECK=BREAKPOINTS(STPTCALC,COUNT)/DENOM
                 ELSE
                    LENGTHCHECK=(BREAKPOINTS(STPTCALC,COUNT)-
     c              BREAKPOINTS(STPTCALC,IVAL1))/DENOM
                 ENDIF
                 IF (LENGTHCHECK.GT.(70.0)) THEN
                    DENOM=DENOM+1.0
                 ELSE
                    LENGTHPROB=.FALSE.
                    INTERVAL=LENGTHCHECK
                    DO 120 SPLIT=1,DENOM
                       NUMBEROFSTEPS(STPTCALC)=NUMBEROFSTEPS(STPTCALC)+1
                       IVAL3=NUMBEROFSTEPS(STPTCALC)
                       STEPLAYOUTS(STPTCALC,IVAL3)=INTERVAL
 120                CONTINUE
                 ENDIF
 130          CONTINUE
           ENDIF
 140       CONTINUE
           IF ((STPTID(2,STPTCALC)-STPTID(1,STPTCALC)).GT.
     c     BREAKPOINTS(STPTCALC,UNIQUES(STPTCALC))) THEN
              INTERVAL=(STPTID(2,STPTCALC)-STPTID(1,STPTCALC))-
     c        BREAKPOINTS(STPTCALC,UNIQUES(STPTCALC))
              IF (INTERVAL.GT.(70.0)) THEN
                 LENGTHPROB=.TRUE.
                 DENOM=2.0
              ELSE
                 LENGTHPROB=.FALSE.
                 NUMBEROFSTEPS(STPTCALC)=NUMBEROFSTEPS(STPTCALC)+1
                 IVAL3=NUMBEROFSTEPS(STPTCALC)
                 STEPLAYOUTS(STPTCALC,IVAL3)=INTERVAL
              ENDIF
              DO 144 WHILE (LENGTHPROB.EQ..TRUE.)
                 LENGTHCHECK=((STPTID(2,STPTCALC)-STPTID(1,STPTCALC))-
     c           BREAKPOINTS(STPTCALC,UNIQUES(STPTCALC)))/DENOM
                 IF (LENGTHCHECK.GT.(70.0)) THEN
                    DENOM=DENOM+1.0
                 ELSE
                    LENGTHPROB=.FALSE.
                    INTERVAL=LENGTHCHECK
                    DO 142 SPLIT=1,DENOM
                       NUMBEROFSTEPS(STPTCALC)=NUMBEROFSTEPS(STPTCALC)+1
                       IVAL3=NUMBEROFSTEPS(STPTCALC)
                       STEPLAYOUTS(STPTCALC,IVAL3)=INTERVAL
 142                CONTINUE
                 ENDIF
 144          CONTINUE
           ENDIF
 150    CONTINUE

        RETURN
        END

****************************************************************
```

```
***** BORONDATA Subroutine:                                  *****
***** This subroutine determines the soluble boron           *****
***** concentrations at the mid-point of each irradiation    *****
***** step from boron letdown data files having a specific   *****
***** format.                                                *****
*****************************************************************
      SUBROUTINE BORONDATA (NUMBEROFSTEPS, STEPLAYOUTS,
     c BORONDATAFILES, NUMOFSTPTCALCS, BORONLAYOUTS,
     c NUMOFCYCLES, CYCLEID)
*
      INTEGER*4 NUMBEROFSTEPS(20), UNITNUMBER, STPTCALC,
     c LINECOUNT, LINE, UNITVALUE, STEP, HIGHLINENUM,
     c LOWLINENUM, NUMOFSTPTCALCS, NUMOFCYCLES, CY,
     c RELCYCNUM(20)
*
      REAL STEPLAYOUTS(20,50), BORONDATABUFFER(2,1000), INTERVAL,
     c MIDSTEPEFPD, BORONLAYOUTS(20,50), SUM
*
      CHARACTER BORONDATAFILES(20)*20, CYCLEID(2,50)*2
*
***** Open the boron letdown data files for each cycle relative to
***** the irradiation history of the assembly.
      DO 10 RELCYC=1,NUMOFCYCLES
         UNITNUMBER=(100*RELCYC)+100
         OPEN(UNIT=UNITNUMBER, FILE=BORONDATAFILES(RELCYC),
     c   STATUS='OLD')
         REWIND(UNIT=UNITNUMBER)
   10 CONTINUE
      CY=0
      DO 60 STPTCALC=1,NUMOFSTPTCALCS
***** Get current statepoint calculation boron letdown data.
         LINECOUNT=0
         DO 30 LINE=1,1000
            IF (STPTCALC.EQ.1) THEN
               CY=1
            ELSEIF (CYCLEID(1,STPTCALC).EQ.
     c      CYCLEID(1,(STPTCALC-1)).AND.(LINE.EQ.1)) THEN
               CY=CY
            ELSEIF (CYCLEID(1,STPTCALC).NE.
     c      CYCLEID(1,(STPTCALC-1)).AND.(LINE.EQ.1)) THEN
               CY=CY+1
            ENDIF
            RELCYCNUM(STPTCALC)=CY
            UNITVALUE=(100*CY)+100
            READ(UNITVALUE,*,END=35) BORONDATABUFFER(1,LINE),
     c      BORONDATABUFFER(2,LINE)
*  20       FORMAT(T1,G10.2,1X,G10.2)
            LINECOUNT=LINECOUNT+1
   30    CONTINUE
   35    CONTINUE
         REWIND(UNIT=UNITVALUE)
***** Determine the next mid-step EFPD value.
         IF (STPTCALC.EQ.1) THEN
            SUM=0.0
         ELSEIF (RELCYCNUM(STPTCALC).NE.RELCYCNUM(STPTCALC-1)) THEN
            SUM=0.0
         ENDIF
         DO 50 STEP=1,NUMBEROFSTEPS(STPTCALC)
            INTERVAL=STEPLAYOUTS(STPTCALC,STEP)
            SUM=SUM+INTERVAL
```

```
          MIDSTEPEFPD=SUM-(INTERVAL/2.0)
          DO 40 L=2,LINECOUNT
             IF ((BORONDATABUFFER(1,L).GT.MIDSTEPEFPD).AND.
     c       (BORONDATABUFFER(1,(L-1)).LT.MIDSTEPEFPD)) THEN
                HIGHLINENUM=L
                LOWLINENUM=L-1
                BORONLAYOUTS(STPTCALC,STEP)=
     c          (((BORONDATABUFFER(2,HIGHLINENUM)-
     c          BORONDATABUFFER(2,LOWLINENUM))/
     c          (BORONDATABUFFER(1,HIGHLINENUM)-
     c          BORONDATABUFFER(1,LOWLINENUM)))*
     c          (MIDSTEPEFPD-BORONDATABUFFER(1,LOWLINENUM)))+
     c          BORONDATABUFFER(2,LOWLINENUM)
             ELSEIF (BORONDATABUFFER(1,L).EQ.MIDSTEPEFPD) THEN
                BORONLAYOUTS(STPTCALC,STEP)=BORONDATABUFFER(2,L)
             ELSEIF (MIDSTEPEFPD.GT.
     c       BORONDATABUFFER(1,LINECOUNT)) THEN
                HIGHLINENUM=LINECOUNT
                LOWLINENUM=LINECOUNT-1
                BORONLAYOUTS(STPTCALC,STEP)=
     c          (((BORONDATABUFFER(2,HIGHLINENUM)-
     c          BORONDATABUFFER(2,LOWLINENUM))/
     c          (BORONDATABUFFER(1,HIGHLINENUM)-
     c          BORONDATABUFFER(1,LOWLINENUM)))*
     c          (MIDSTEPEFPD-BORONDATABUFFER(1,LOWLINENUM)))+
     c          BORONDATABUFFER(2,LOWLINENUM)
             ELSEIF (MIDSTEPEFPD.LT.
     c       BORONDATABUFFER(1,1)) THEN
                HIGHLINENUM=2
                LOWLINENUM=1
                BORONLAYOUTS(STPTCALC,STEP)=
     c          (((BORONDATABUFFER(2,HIGHLINENUM)-
     c          BORONDATABUFFER(2,LOWLINENUM))/
     c          (BORONDATABUFFER(1,HIGHLINENUM)-
     c          BORONDATABUFFER(1,LOWLINENUM)))*
     c          (MIDSTEPEFPD-BORONDATABUFFER(1,LOWLINENUM)))+
     c          BORONDATABUFFER(2,LOWLINENUM)
             ENDIF
   40     CONTINUE
   50   CONTINUE
   60 CONTINUE

      RETURN
      END

****************************************************************
***** WRITELAYOUTS Subroutine:                              *****
***** This subroutine tabularizes the irradiation layout    *****
***** for the assembly.                                     *****
****************************************************************
      SUBROUTINE WRITELAYOUTS (NUMOFSTPTCALCS, CYCLEID, STPTID,
     c ARCHIVEID, STEPLAYOUTS, BORONLAYOUTS, NUMBEROFSTEPS,
     c LINECOUNT, RESULTSFILE)
*
      INTEGER*4 NUMBEROFSTEPS(20), NUMOFSTPTCALCS, BLANKS,
     c COUNT, STPTCALC, STEP, LINECOUNT
*
      REAL STEPLAYOUTS(20,50), BORONLAYOUTS(20,50), STPTID(2,20),
     c TOTAL
*
```

```
      CHARACTER CYCLEID(2,20)*2, ARCHIVEID*5, RESULTSFILE*11
*
***** Open the file which will contain the irradiation history
***** tabularization.
      LINECOUNT=0
      BLANKS=0
      DO 10 COUNT=1,5
         IF (ARCHIVEID(COUNT:COUNT).EQ.' ') THEN
            BLANKS=BLANKS+1
         ENDIF
   10 CONTINUE
      RESULTSFILE(1:(11-BLANKS-6))=
     c ARCHIVEID(1:(5-BLANKS))
      RESULTSFILE((11-BLANKS-5):(11-BLANKS-1))='.hist'
      RESULTSFILE((11-BLANKS):11)=' '
      OPEN(UNIT=50,FILE=RESULTSFILE,STATUS='UNKNOWN')
      REWIND(UNIT=50)
*
***** Write irradiation history layout information for
***** each statepoint calculation.
      WRITE(50,20) ARCHIVEID
   20 FORMAT (T1,'IRRADIATION LAYOUT FOR ASSEMBLY: ',A5)
      LINECOUNT=LINECOUNT+1
      DO 100 STPTCALC=1,NUMOFSTPTCALCS
         TOTAL=0.0
         WRITE (50,30) CYCLEID(1,STPTCALC), STPTID(1,STPTCALC),
     c   CYCLEID(2,STPTCALC), STPTID(2,STPTCALC)
   30    FORMAT (T1,'Cycle-',A2,', ',F5.1,' EFPD to Cycle-',A2,
     c   ', ',F5.1,' EFPD Statepoint Calculation')
         LINECOUNT=LINECOUNT+1
         WRITE (50,*)
         LINECOUNT=LINECOUNT+1
         WRITE (50,40)
   40    FORMAT (T19,'Step',7X,'Exposure at',5X,'Mid-Step Boron')
         LINECOUNT=LINECOUNT+1
         WRITE (50,50)
   50    FORMAT (T1,'Irradiation',5X,'Duration',5X,
     c   'End of Step',5X,'Concentration')
         LINECOUNT=LINECOUNT+1
         WRITE (50,60)
   60    FORMAT (T1,'Step Number',6X,'(EFPD)',9X,'(EFPD)',7X,
     c   '(ppm)')
         LINECOUNT=LINECOUNT+1
         WRITE (50,70)
   70    FORMAT (T1,'-----------------------------------------',
     c   T44,'---------------')
         LINECOUNT=LINECOUNT+1
         DO 90 STEP=1,NUMBEROFSTEPS(STPTCALC)
            TOTAL=TOTAL+STEPLAYOUTS(STPTCALC,STEP)
            WRITE (50,80) STEP, STEPLAYOUTS(STPTCALC,STEP),
     c      TOTAL, BORONLAYOUTS(STPTCALC,STEP)
   80       FORMAT (T1,4X,I2,11X,F6.2,9X,F6.2,11X,F6.1)
            LINECOUNT=LINECOUNT+1
   90    CONTINUE
         WRITE(50,*)
         LINECOUNT=LINECOUNT+1
  100 CONTINUE
      CLOSE(UNIT=50)

      RETURN
```

```
      END

****************************************************************
***** INSERTIONHISTORY Subroutine:                          *****
***** This subroutine tabularizes the nodal insertion       *****
***** history for the rodded assembly.                      *****
****************************************************************
      SUBROUTINE INSERTIONHISTORY (NUMOFNODES, NUMBEROFSTEPS,
     c NUMOFSTPTCALCS, LINECOUNT, RESULTSFILE, ARCHIVEID,
     c STPTID, CYCLEID, RODINTIME, STEPLAYOUTS)
*
      INTEGER*4 NUMOFNODES, NUMBEROFSTEPS(20), NUMOFSTPTCALCS,
     c LINECOUNT, TOPDATAROW, BOTTOMDATAROW, COL, COLFRONT(21),
     c TABLEWIDTH, REP, POS, STPTCALC, FRONTSPACES, REARSPACES,
     c COLUMNWIDTH(20), FS, RS, STEP, VALUE, N
*
      REAL STPTID(2,20), RODINTIME(20,50), STEPLAYOUTS(20,50),
     c TEMP, SUM
*
      CHARACTER RESULTSFILE*11, ARCHIVEID*5, CYCLEID(2,20)*2
*
      LOGICAL MULTIPLE, SPECIALFLAG
*
***** Open the file which will contain the nodal insertion history
***** tabularization for the rodded assembly.
      OPEN(UNIT=50,FILE=RESULTSFILE,STATUS='OLD')
      REWIND(UNIT=50)
      DO 2 POS=1,LINECOUNT
         READ(50,*)
    2 CONTINUE
*
***** Determine the column and row delimiters for use in producing
***** the table of nodal rod insertion history.
      TOPDATAROW=15+NUMOFSTPTCALCS+LINECOUNT
      BOTTOMDATAROW=TOPDATAROW+(2*(NUMOFNODES-1))
      TABLEWIDTH=0
      DO 5 COUNT=1,NUMOFSTPTCALCS
         COLUMNWIDTH(COUNT)=NUMBEROFSTEPS(COUNT)
         TABLEWIDTH=TABLEWIDTH+NUMBEROFSTEPS(COUNT)
         IF (NUMBEROFSTEPS(COUNT).GT.9) THEN
            TABLEWIDTH=TABLEWIDTH+NUMBEROFSTEPS(COUNT)-9
            COLUMNWIDTH(COUNT)=COLUMNWIDTH(COUNT)+
     c      NUMBEROFSTEPS(COUNT)-9
         ENDIF
         TABLEWIDTH=TABLEWIDTH+NUMBEROFSTEPS(COUNT)-1
         COLUMNWIDTH(COUNT)=COLUMNWIDTH(COUNT)+
     c   NUMBEROFSTEPS(COUNT)-1
    5 CONTINUE
      TABLEWIDTH=TABLEWIDTH+(2*(NUMOFSTPTCALCS-1))+10
      DO 10 COL=1,(NUMOFSTPTCALCS+1)
         IF (COL.EQ.1) THEN
            COLFRONT(COL)=1
         ELSEIF (COL.EQ.2) THEN
            COLFRONT(COL)=11
         ELSE
            COLFRONT(COL)=COLFRONT(COL-1)+
     c      COLUMNWIDTH(COL-1)+3
         ENDIF
   10 CONTINUE
      WRITE(50,*)
```

```
      WRITE(50,*)
      WRITE(50,*)
      WRITE(50,*)
      WRITE(50,20) ARCHIVEID
   20 FORMAT(T1,'NODAL ROD ASSEMBLY INSERTION LAYOUT',
     c ' FOR FUEL ASSEMBLY: ',A5)
      WRITE(50,*)
      DO 40 STPTCALC=1,NUMOFSTPTCALCS
         WRITE(50,30) CHAR(64+STPTCALC), CYCLEID(1,STPTCALC),
     c   STPTID(1,STPTCALC), CYCLEID(2,STPTCALC), STPTID(2,STPTCALC)
   30    FORMAT(T1,'COLUMN ',A1,': Cycle-',A2,', ',F5.1,
     c   ' EFPD to Cycle-',A2,', ',F5.1,
     c   ' EFPD Statepoint Calculation')
   40 CONTINUE
      WRITE(50,*)
      WRITE(50,50)
   50 FORMAT(T1,'X = Rod assembly inserted in corresponding node',
     c' during the irradiation step')
      DO 90 REP=1,1
         DO 80 POS=1,TABLEWIDTH
            IF (POS.EQ.1) THEN
               WRITE(50,60)
   60          FORMAT(T1,'-',$)
            ELSE
               WRITE(50,70)
   70          FORMAT('-',$)
            ENDIF
            IF (POS.EQ.TABLEWIDTH) THEN
               WRITE(50,*)
            ENDIF
   80    CONTINUE
   90 CONTINUE
      WRITE(50,100)
  100 FORMAT(T1,'           ||',$)
      DO 170 STPTCALC=1,NUMOFSTPTCALCS
         FRONTSPACES=INT(COLUMNWIDTH(STPTCALC)/2.0)
         REARSPACES=COLUMNWIDTH(STPTCALC)-1-FRONTSPACES
         DO 120 FS=1,FRONTSPACES
            WRITE(50,110)
  110       FORMAT(' ',$)
  120    CONTINUE
         WRITE(50,130) CHAR(64+STPTCALC)
  130    FORMAT(A1,$)
         DO 150 RS=1,REARSPACES
            WRITE(50,140)
  140       FORMAT(' ',$)
  150    CONTINUE
         IF (STPTCALC.EQ.NUMOFSTPTCALCS) THEN
            WRITE(50,*)
         ELSE
            WRITE(50,160)
  160       FORMAT('||',$)
         ENDIF
  170 CONTINUE
      WRITE(50,180)
  180 FORMAT(T1,' NODE # ||',$)
      DO 230 STPTCALC=1,NUMOFSTPTCALCS
         DO 210 STEP=1,NUMBEROFSTEPS(STPTCALC)
            IF (STEP.LT.10) THEN
               WRITE(50,190) STEP
```

```
190         FORMAT(I1,$)
         ELSE
            WRITE(50,200) STEP
200         FORMAT(I2,$)
         ENDIF
         IF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
            WRITE(50,205)
205         FORMAT('|',$)
         ENDIF
210   CONTINUE
      IF (STPTCALC.EQ.NUMOFSTPTCALCS) THEN
         WRITE(50,*)
      ELSE
         WRITE(50,220)
220      FORMAT('||',$)
      ENDIF
230 CONTINUE
    DO 270 REP=1,1
      DO 260 POS=1,TABLEWIDTH
         IF (POS.EQ.1) THEN
            WRITE(50,240)
240         FORMAT(T1,'-',$)
         ELSE
            WRITE(50,250)
250         FORMAT('-',$)
         ENDIF
         IF (POS.EQ.TABLEWIDTH) THEN
            WRITE(50,*)
         ENDIF
260   CONTINUE
270 CONTINUE
    DO 530 NODE=1,NUMOFNODES
      WRITE(50,280) NODE
280   FORMAT(T1,3X,I2,3X,'||',$)
      DO 520 STPTCALC=1,NUMOFSTPTCALCS
         DO 510 STEP=1,NUMBEROFSTEPS(STPTCALC)
            IF (STEP.EQ.1) THEN
               SUM=STEPLAYOUTS(STPTCALC,STEP)
            ELSE
               SUM=SUM+STEPLAYOUTS(STPTCALC,STEP)
            ENDIF
            IF ((RODINTIME(STPTCALC,NODE)-
   c        INT(RODINTIME(STPTCALC,NODE))).LT.(0.5)) THEN
               TEMP=INT(RODINTIME(STPTCALC,NODE))
            ELSEIF ((RODINTIME(STPTCALC,NODE)-
   c        INT(RODINTIME(STPTCALC,NODE))).GE.(0.5)) THEN
               TEMP=INT(RODINTIME(STPTCALC,NODE)+1.0)
            ENDIF
            VALUE=0
            MULTIPLE=.FALSE.
            DO 282 N=1,NUMOFNODES
               IF ((RODINTIME(STPTCALC,N)-
   c           INT(RODINTIME(STPTCALC,N))).LT.(0.5)) THEN
                  VALUE=INT(RODINTIME(STPTCALC,N))
               ELSEIF ((RODINTIME(STPTCALC,N)-
   c           INT(RODINTIME(STPTCALC,N))).GE.(0.5)) THEN
                  VALUE=INT(RODINTIME(STPTCALC,N)+1.0)
               ENDIF
               IF ((N.NE.NODE).AND.(TEMP.EQ.VALUE)) THEN
                  MULTIPLE=.TRUE.
```

```
                  ENDIF
 282          CONTINUE
              IF (MULTIPLE.EQ..FALSE.) THEN
                 TEMP=RODINTIME(STPTCALC,NODE)
              ENDIF
              IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
     c        (STEPLAYOUTS(STPTCALC,STEP).LT.(0.5))) THEN
                 TEMP=RODINTIME(STPTCALC,NODE)
                 SPECIALFLAG=.TRUE.
              ELSE
                 SPECIALFLAG=.FALSE.
              ENDIF
              IF (SPECIALFLAG.EQ..FALSE.) THEN
              IF ((SUM.LE.TEMP).OR.((SUM-TEMP).LT.(0.5))) THEN
                IF (STEP.GT.9) THEN
                 IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
     c           (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                    WRITE(50,285)
 285                FORMAT('X ',$)
                 ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                    WRITE(50,290)
 290                FORMAT('X |',$)
                 ELSE
                    WRITE(50,300)
 300                FORMAT('X ||',$)
                 ENDIF
                ELSEIF (STEP.LE.9) THEN
                 IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
     c           (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                    WRITE(50,305)
 305                FORMAT('X',$)
                 ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                    WRITE(50,310)
 310                FORMAT('X|',$)
                 ELSE
                    WRITE(50,320)
 320                FORMAT('X||',$)
                 ENDIF
                ENDIF
              ELSE
                IF (STEP.GT.9) THEN
                 IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
     c           (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                    WRITE(50,330)
 330                FORMAT('  ',$)
                 ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                    WRITE(50,340)
 340                FORMAT('  |',$)
                 ELSE
                    WRITE(50,350)
 350                FORMAT('  ||',$)
                 ENDIF
                ELSEIF (STEP.LE.9) THEN
                 IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
     c           (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                    WRITE(50,360)
 360                FORMAT(' ',$)
                 ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                    WRITE(50,370)
 370                FORMAT(' |',$)
```

```
                  ELSE
                     WRITE(50,380)
 380                 FORMAT(' ||',$)
                  ENDIF
                 ENDIF
               ENDIF
               ELSEIF (SPECIALFLAG.EQ..TRUE.) THEN
               IF ((SUM.LE.TEMP).OR.((SUM-TEMP).LE.(0.0001))) THEN
                 IF (STEP.GT.9) THEN
                  IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
   c              (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                     WRITE(50,390)
 390                 FORMAT('X ',$)
                  ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                     WRITE(50,400)
 400                 FORMAT('X |',$)
                  ELSE
                     WRITE(50,410)
 410                 FORMAT('X ||',$)
                  ENDIF
                 ELSEIF (STEP.LE.9) THEN
                  IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
   c              (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                     WRITE(50,420)
 420                 FORMAT('X',$)
                  ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                     WRITE(50,430)
 430                 FORMAT('X|',$)
                  ELSE
                     WRITE(50,440)
 440                 FORMAT('X||',$)
                  ENDIF
                 ENDIF
               ELSE
                 IF (STEP.GT.9) THEN
                  IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
   c              (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                     WRITE(50,450)
 450                 FORMAT('  ',$)
                  ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                     WRITE(50,460)
 460                 FORMAT('  |',$)
                  ELSE
                     WRITE(50,470)
 470                 FORMAT('  ||',$)
                  ENDIF
                 ELSEIF (STEP.LE.9) THEN
                  IF ((STEP.EQ.NUMBEROFSTEPS(STPTCALC)).AND.
   c              (STPTCALC.EQ.NUMOFSTPTCALCS)) THEN
                     WRITE(50,480)
 480                 FORMAT(' ',$)
                  ELSEIF (STEP.NE.NUMBEROFSTEPS(STPTCALC)) THEN
                     WRITE(50,490)
 490                 FORMAT(' |',$)
                  ELSE
                     WRITE(50,500)
 500                 FORMAT(' ||',$)
                  ENDIF
                 ENDIF
               ENDIF
```

```
          ENDIF
510      CONTINUE
520    CONTINUE
       WRITE(50,*)
530 CONTINUE
    DO 570 REP=1,1
       DO 560 POS=1,TABLEWIDTH
          IF (POS.EQ.1) THEN
             WRITE(50,540)
540          FORMAT(T1,'-',$)
          ELSE
             WRITE(50,550)
550          FORMAT('-',$)
          ENDIF
          IF (POS.EQ.TABLEWIDTH) THEN
             WRITE(50,*)
          ENDIF
560    CONTINUE
570 CONTINUE

    RETURN
    END
```

```
N                         : This is not a pick-up case
Crystal River, Unit 3     : Reactor Identifier
CR3                       : Prefix Identifier for reactor
44group                   : Scale cross-section library
2.54                      : U-235 wt% enrichment in U of UO2
463630                    : Grams of U per assembly
208                       : Number of fuel rods in assembly
1.44272                   : Pin-pitch in assembly (cm)
0.9398                    : Fuel pellet diameter (cm)
0.95758                   : Fuel rod cladding ID (cm)
1.0922                    : Fuel rod cladding OD (cm)
360.172                   : Fuel stack height (cm)
N                         : No axial blanket fuel
INCONEL                   : Spacer grid material
0.005757609               : Vol. frac. of mod. displaced by grids
ZIRC-4                    : Fuel rod cladding material
640.0                     : Avg. fuel rod cladding temp. (K)
Y                         : No cladding materials other than ZIRC-4
1                         : Number of cladding materials needed other than ZIRC-4
6                         : SAS2H material mixture number for clad material below
SS304                     : Cladding material for CR's
2200.0                    : System pressure (psi)
N                         : Activate BPRA tracking
5                         : # of radial zones in the standard Path B model
3 0.63246                 : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                         : # of cross-section libraries per irradiation step
5                         : SAS2H output print level
0.5                       : Zone mesh factor for XSDRNPM
NO SPECIAL                : No special XSDRNPM control parameter specs.
4                         : # of insertion reactor cycles
1A                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
195.292                   : Days of downtime at EOC
268.8                     : Total cycle EFPD
413                       : Total cycle length in calendar days
01                        : Integer position of assembly in cycle
1B                        : Insertion reactor cycle identifier
2                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
142.2                     : Stpt EFPD
166.0                     : Length to stpt in calendar days
14.792                    : Downtime at stpt
97.0                      : Days of downtime at EOC
171.3                     : Total cycle EFPD
217.0                     : Total cycle length in calendar days
01                        : Integer position of assembly in cycle
02                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
164.0                     : Days of downtime at EOC
166.5                     : Total cycle EFPD
212.0                     : Total cycle length in calendar days
01                        : Integer position of assembly in cycle
03                        : Insertion reactor cycle identifier
3                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
168.5                     : Stpt EFPD
```

```
193.0                    : Length to stpt in calendar days
16.792                   : Downtime at stpt
250.0                    : Stpt EFPD
325.792                  : Length to stpt in calendar days
12.333                   : Downtime at stpt
73.0                     : Days of downtime at EOC
323.0                    : Total cycle EFPD
416.0                    : Total cycle length in calendar days
01                       : Integer position of assembly in cycle
Y                        : Flag for variable or constant irradiation step specs
1                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
6                        : Number of steps in statepoint calculation
41.67    913.3           : Step length (EFPD), Mid-step ppmb
68.68    902.9           : Step length (EFPD), Mid-step ppmb
68.68    784.8           : Step length (EFPD), Mid-step ppmb
43.05    663.5           : Step length (EFPD), Mid-step ppmb
43.05    575.6           : Step length (EFPD), Mid-step ppmb
 3.87    505.6           : Step length (EFPD), Mid-step ppmb
2                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
10                       : Number of steps in statepoint calculation
 4.67    541.2           : Step length (EFPD), Mid-step ppmb
25.50    569.2           : Step length (EFPD), Mid-step ppmb
43.28    434.2           : Step length (EFPD), Mid-step ppmb
43.28    309.6           : Step length (EFPD), Mid-step ppmb
 9.26    279.6           : Step length (EFPD), Mid-step ppmb
 1.00    284.2           : Step length (EFPD), Mid-step ppmb
 1.00    285.1           : Step length (EFPD), Mid-step ppmb
 6.91    288.7           : Step length (EFPD), Mid-step ppmb
 7.09    284.3           : Step length (EFPD), Mid-step ppmb
  .20    280.6           : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
4                        : Number of steps in statepoint calculation
 6.57    277.1           : Step length (EFPD), Mid-step ppmb
 5.45    266.5           : Step length (EFPD), Mid-step ppmb
16.98    204.7           : Step length (EFPD), Mid-step ppmb
  .10    157.6           : Step length (EFPD), Mid-step ppmb
3                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
3                        : Number of steps in statepoint calculation
55.5     688.93          : Step length (EFPD), Mid-step ppmb
55.5     527.51          : Step length (EFPD), Mid-step ppmb
55.5     353.48          : Step length (EFPD), Mid-step ppmb
4                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
3                        : Number of steps in statepoint calculation
56.167   880.38          : Step length (EFPD), Mid-step ppmb
56.167   694.68          : Step length (EFPD), Mid-step ppmb
56.167   536.65          : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
2                        : Number of steps in statepoint calculation
40.75    382.60          : Step length (EFPD), Mid-step ppmb
40.75    267.17          : Step length (EFPD), Mid-step ppmb
3                        : Relative statepoint in insertion cycle
2                        : Number of steps in statepoint calculation
36.5     234.64          : Step length (EFPD), Mid-step ppmb
36.5     128.17          : Step length (EFPD), Mid-step ppmb
18                       : # of axial nodes in CRC format
1     17.7800            : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
```

```
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
RODDED
20                    : Number of irradiation steps with CRA inserted
1                     : Number of axial section with CRA inserted in step 1
1 1 1 1 16 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 2
1 1 2 1 15 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 3
1 1 3 1 15 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 4
1 1 4 1 14 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 5
1 1 5 1 14 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 6
1 1 6 1 13 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 7
2 1 1 1 17 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 8
2 1 2 1 16 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 9
2 1 3 1 15 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 10
2 1 4 1 15 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 11
2 1 5 1 14 7 1        : Input card 47B
2                     : Number of axial section with CRA inserted in step 12
2 1 6 1 6 7 1         : Input card 47B
2 1 6 13 14 7 1       : Input card 47B
2                     : Number of axial section with CRA inserted in step 13
2 1 7 1 5 7 1         : Input card 47B
2 1 7 14 14 7 1       : Input card 47B
1                     : Number of axial section with CRA inserted in step 14
2 1 8 1 4 7 1         : Input card 47B
1                     : Number of axial section with CRA inserted in step 15
2 1 9 1 3 7 1         : Input card 47B
1                     : Number of axial section with CRA inserted in step 16
2 1 10 1 3 7 1        : Input card 47B
1                     : Number of axial section with CRA inserted in step 17
2 2 1 1 5 7 1         : Input card 47B
1                     : Number of axial section with CRA inserted in step 18
2 2 2 1 4 7 1         : Input card 47B
1                     : Number of axial section with CRA inserted in step 19
2 2 3 1 3 7 1         : Input card 47B
1                     : Number of axial section with CRA inserted in step 20
2 2 4 1 3 7 1         : Input card 47B
1                     : Number of different CRA absorber material mixtures
7                     : SAS2H material mixture number for CRA absorber
4                     : Number of isotopes or elements in the CRA absorber
47000   79.8          : SCALE isotope ID, isotope wt%
49000   15.0          : SCALE isotope ID, isotope wt%
48000   5.0           : SCALE isotope ID, isotope wt%
13027   0.2           : SCALE isotope ID, isotope wt%
1                     : Number of CRA designs
10.17   6             : CR absorber density, CR clad SAS2H mat. mix. number
8                     : Number of radial zones in Path B model with CRA inserted
7   0.49784           : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784           : Path B model CRA removed (Input Card 47K)
```

```
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                          : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 881.9
1055.5
1169.8
1222.7
1247.6
1257.8
1262.6
1267.6
1275.2
1285.4
1295.9
1303.4
1305.7
1302.6
1318.7
1561.3
1475.9
1191.0
18                          : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 974.7
1135.9
1186.3
1178.1
1153.1
1128.4
```

```
1108.3
1094.5
1086.6
1083.8
1085.1
1089.7
1096.8
1104.0
1114.5
1257.0
1271.5
1100.7
18                        : # of fuel temp axial nodes (Stpt2-18 to EOC-18)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 912.6
1033.5
1084.4
1168.3
1428.3
1490.9
1501.4
1504.9
1507.4
1510.2
1512.9
1513.2
1505.7
1478.7
1390.7
1233.5
1128.2
 974.7
18                        : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 974.1
1120.5
```

```
1189.6
1209.5
1211.3
1205.6
1201.9
1199.5
1196.7
1191.9
1183.6
1171.5
1155.5
1132.8
1084.0
1005.7
 957.9
 866.9
18                              : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 968.2
1107.5
1151.9
1149.8
1138.4
1124.8
1116.0
1112.9
1116.6
1126.7
1140.4
1153.2
1161.0
1158.9
1128.4
1061.8
1009.0
 915.6
18                              : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
```

```
17    20.0025
18    22.3520
1006.3
1108.0
1126.5
1111.8
1093.3
1079.3
1071.7
1068.2
1067.3
1068.0
1069.3
1070.6
1072.0
1071.6
1054.6
1012.1
 985.7
 923.6
18                          : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0231
0.0231
0.0230
0.0229
0.0228
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
```

```
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                    : # of mod spec vol axial nodes (Stpt2-18 to EOC-1B)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0237
0.0236
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
0.0227
0.0225
0.0224
0.0223
0.0221
0.0220
0.0219
0.0217
0.0217
0.0216
18                    : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0231
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
```

```
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                          : # of burnup axial nodes (BOC-1A)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-1B)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 2.816
 4.715
 6.179
 7.134
 7.720
 8.056
 8.232
 8.306
 8.314
 8.275
 8.206
 8.129
 8.077
 8.211
 9.357
11.135
10.619
 6.746
18                      : # of burnup axial nodes (Stpt2-18)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 4.819
 7.860
 9.908
11.075
11.694
11.953
12.045
12.060
12.042
12.010
11.979
11.963
11.987
12.208
13.574
```

```
16.249
15.740
10.259
18                          : # of burnup axial nodes (BOC-2)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 5.191
 8.429
10.599
11.995
12.770
13.190
13.318
13.341
13.329
13.308
13.294
13.297
13.332
13.535
14.814
17.321
16.644
10.859
18                          : # of burnup axial nodes (BOC-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 7.992
12.840
15.827
17.481
18.282
18.646
18.721
18.702
18.662
18.630
18.616
```

18.619
18.633
18.754
19.753
21.717
20.470
13.470
18 : # of burnup axial nodes ($tpt2-3)
1 17.7800 : Node #, node height (cm)
2 20.0025
3 20.0025
4 20.0025
5 20.0025
6 20.0025
7 20.0025
8 20.0025
9 20.0025
10 20.0025
11 20.0025
12 20.0025
13 20.0025
14 20.0025
15 20.0025
16 20.0025
17 20.0025
18 22.3520
10.720
17.114
20.924
22.904
23.812
24.195
24.276
24.275
24.283
24.335
24.424
24.518
24.577
24.659
25.403
26.806
24.902
16.497
18 : # of burnup axial nodes ($tpt3-3)
1 17.7800 : Node #, node height (cm)
2 20.0025
3 20.0025
4 20.0025
5 20.0025
6 20.0025
7 20.0025
8 20.0025
9 20.0025
10 20.0025
11 20.0025
12 20.0025
13 20.0025
14 20.0025
15 20.0025
16 20.0025
17 20.0025
18 22.3520
12.280
19.411
23.509
25.524
26.395
26.737
26.797

26.793
26.815
26.893
27.016
27.148
27.247
27.358
28.056
29.285
27.150
18.111

```
N                            : This is not a pick-up case
Crystal River, Unit 3        : Reactor identifier
CR3                          : Prefix identifier for reactor
44group                      : Scale cross-section library
2.54                         : U-235 wt% enrichment in U of UO2
463630                       : Grams of U per assembly
208                          : Number of fuel rods in assembly
1.44272                      : Pin-pitch in assembly (cm)
0.9398                       : Fuel pellet diameter (cm)
0.95758                      : Fuel rod cladding ID (cm)
1.0922                       : Fuel rod cladding OD (cm)
360.172                      : Fuel stack height (cm)
N                            : No axial blanket fuel
INCONEL                      : Spacer grid material
0.005757609                  : Vol. frac. of mod. displaced by grids
ZIRC-4                       : Fuel rod cladding material
640.0                        : Avg. fuel rod cladding temp. (K)
N                            : No cladding materials other than ZIRC-4
2200.0                       : System pressure (psi)
Y                            : Activate BPRA tracking
1                            : Number of reactor cycles with BPRA
1 0                          : # of BPRA designs, # of non-Al2O3B4C BP's
3.7 1.18 0.5857538 16 2 4      : Input Card 18C
8                            : # of radial zones in BPRA Path B model
4 0.43180                    : BPRA Path B model (Input Card 18E)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
3 0.43180                    : Path B model with BPRA removed (Input Card 18F)
3 0.45720
3 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
6 0.43180                    : BPRA Path B model above absorber (Input Card 18G)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
AL2O3 6                      : Mat. above absorber in BPR, SAS2H mat. mix. #
1 1 2 17                     : BPRA insertion history (Input Card 18H)
5                            : # of radial zones in the standard Path B model
3 0.63246                    : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                            : # of cross-section libraries per irradiation step
5                            : SAS2H output print level
0.5                          : Zone mesh factor for XSDRNPM
NO SPECIAL                   : No special XSDRNPM control parameter specs.
3                            : # of insertion reactor cycles
1A                           : Insertion reactor cycle identifier
1                            : # of stpts in cycle
0                            : Stpt EFPD
0                            : Length to stpt in calendar days
0                            : Downtime at stpt
195.292                      : Days of downtime at EOC
268.8                        : Total cycle EFPD
413.0                        : Total cycle length in calendar days
04                           : Integer position of assembly in cycle
```

```
18                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
142.2                   : Stpt EFPD
166.0                   : Length to stpt in calendar days
14.792                  : Downtime at stpt
97.0                    : Days of downtime at EOC
171.3                   : Total cycle EFPD
217.0                   : Total cycle length in calendar days
04                      : Integer position of assembly in cycle
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212.0                   : Total cycle length in calendar days
26                      : Integer position of assembly in cycle
N                       : Flag for variable or constant irradiation step specs
1                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
67.2                    : Irradiation step length in EFPD
4                       : # of irradiation steps to next stpt
921.02                  : ppmb
872.24                  : ppmb
738.29                  : ppmb
608.17                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
71.1                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
518.65                  : ppmb
256.11                  : ppmb
2                       : Relative stpt # in insertion cycle
29.1                    : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
237.54                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
18                      : # of axial nodes in CRC format
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
NO CRA INSERTION HISTORY
NO APSRA INSERTION HISTORY
18                      : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1    17.7800            : Node #, node height (cm)
```

```
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1003.2
1223.7
1384.5
1474.8
1512.2
1524.8
1528.5
1534.6
1547.3
1566.7
1587.9
1600.7
1595.7
1573.7
1538.3
1470.6
1347.9
1119.1
18                          : # of fuel temp axial nodes (BOC-18 to Stpt2-18)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1137.0
1341.4
1424.4
1411.0
1368.0
1327.9
1298.2
1279.0
1268.6
1264.8
1266.9
1275.4
1289.5
1308.3
1330.3
1344.4
```

```
1308.8
1109.5
18                        : # of fuel temp axial nodes (Stpt2-18 to EOC-1B)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1111.1
1267.6
1288.1
1255.8
1226.7
1209.2
1199.5
1193.5
1188.7
1185.4
1186.3
1191.8
1197.4
1199.5
1196.3
1183.5
1141.3
 983.4
18                        : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0239
0.0238
0.0237
0.0235
0.0234
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0223
```

```
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
18                                  : # of mod spec vol axial nodes (EOC-18 to Stpt2-18)
1      17.7800                      : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0237
0.0235
0.0234
0.0233
0.0231
0.0230
0.0228
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                                  : # of mod spec vol axial nodes (Stpt2-18 to EOC-18)
1      17.7800                      : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
```

```
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                              : # of burnup axial nodes (BOC-1A)
1     17.7800                   : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                              : # of burnup axial nodes (BOC-1B)
1     17.7800                   : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 4.168
 6.942
 9.426
11.077
```

```
12.048
12.595
12.881
12.996
12.980
12.838
12.582
12.272
11.997
11.757
11.417
10.676
 9.098
 6.066
18                          : # of burnup axial nodes (Stpt2-18)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 7.050
11.500
14.855
16.798
17.756
18.176
18.334
18.359
18.295
18.145
17.927
17.714
17.589
17.532
17.355
16.616
14.510
 9.593
18                          : # of burnup axial nodes (BOC-2)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
```

7.708
12.474
15.921
17.847
18.769
19.161
19.298
19.306
19.230
19.077
18.874
18.692
18.604
18.575
18.406
17.637
15.425
10.199

```
N                         : This is not a pick-up case
Crystal River, Unit 3     : Reactor identifier
CR3                       : Prefix identifier for reactor
44group                   : Scale cross-section library
1.93                      : U-235 wt% enrichment in U of UO2
463630                    : Grams of U per assembly
208                       : Number of fuel rods in assembly
1.44272                   : Pin-pitch in assembly (cm)
0.9398                    : Fuel pellet diameter (cm)
0.95758                   : Fuel rod cladding ID (cm)
1.0922                    : Fuel rod cladding OD (cm)
360.172                   : Fuel stack height (cm)
N                         : No axial blanket fuel
INCONEL                   : Spacer grid material
0.005757609               : Vol. frac. of mod. displaced by grids
ZIRC-4                    : Fuel rod cladding material
640.0                     : Avg. fuel rod cladding temp. (K)
Y                         : Cladding materials other than ZIRC-4
1                         : Number of cladding materials needed other than ZIRC-4
6                         : SAS2H material mixture number for clad material below
SS304                     : Cladding material for CR's
2200.0                    : System pressure (psi)
N                         : Activate BPRA tracking
5                         : # of radial zones in the standard Path B model
3 0.63246                 : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                         : # of cross-section libraries per irradiation step
5                         : SAS2H output print level
0.5                       : Zone mesh factor for XSDRNPM
NO SPECIAL                : No special XSDRNPM control parameter specs.
2                         : # of insertion reactor cycles
1A                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
195.292                   : Days of downtime at EOC
268.8                     : Total cycle EFPD
413                       : Total cycle length in calendar days
05                        : Integer position of assembly in cycle
1B                        : Insertion reactor cycle identifier
2                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
142.2                     : Stpt EFPD
166.0                     : Length to stpt in calendar days
14.792                    : Downtime at stpt
97.0                      : Days of downtime at EOC
171.3                     : Total cycle EFPD
217.0                     : Total cycle length in calendar days
05                        : Integer position of assembly in cycle
Y                         : Flag for variable or constant irradiation step specs
1                         : Relative insertion cycle
1                         : Relative statepoint in insertion cycle
6                         : Number of steps in statepoint calculation
 5.03      902.3          : Step length (EFPD), Mid-step ppmb
59.89      921.8          : Step length (EFPD), Mid-step ppmb
59.89      884.0          : Step length (EFPD), Mid-step ppmb
57.49      767.1          : Step length (EFPD), Mid-step ppmb
57.49      638.7          : Step length (EFPD), Mid-step ppmb
29.02      590.7          : Step length (EFPD), Mid-step ppmb
2                         : Relative insertion cycle
1                         : Relative statepoint in insertion cycle
6                         : Number of steps in statepoint calculation
 4.51      541.0          : Step length (EFPD), Mid-step ppmb
42.03      549.3          : Step length (EFPD), Mid-step ppmb
```

```
35.53       422.8       : Step length (EFPD), Mid-step ppmb
35.53       288.1       : Step length (EFPD), Mid-step ppmb
 7.92       279.8       : Step length (EFPD), Mid-step ppmb
16.68       289.0       : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
29.10       237.54      : Step length (EFPD), Mid-step ppmb
18                      : # of axial nodes in CRC format
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
RODDED
10                      : Number of irradiation steps with CRA inserted
1                       : Number of axial section with CRA inserted in step 1
1 1 1 1 3 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 2
1 1 2 1 2 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 3
1 1 3 1 2 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 4
1 1 4 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 5
1 1 5 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 6
2 1 1 1 4 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 7
2 1 2 1 3 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 8
2 1 3 1 2 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 9
2 1 4 1 2 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 10
2 1 5 1 1 7 1           : Input card 47B
1                       : Number of different CRA absorber material mixtures
7                       : SAS2H material mixture number for CRA absorber
4                       : Number of isotopes or elements in the CRA absorber
47000   79.8            : SCALE isotope ID, Isotope wt%
49000   15.0            : SCALE isotope ID, Isotope wt%
48000   5.0             : SCALE isotope ID, Isotope wt%
13027   0.2             : SCALE isotope ID,.Isotope wt%
1                       : Number of CRA designs
10.17   6               : CR absorber density, CR clad SAS2H mat. mix. number
8                       : Number of radial zones in Path B model with CRA inserted
7   0.49784             : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784             : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
```

```
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                            : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1      17.7800                : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 825.3
 993.2
1279.6
1403.0
1443.2
1456.5
1462.9
1472.1
1488.3
1511.8
1534.7
1545.9
1535.9
1503.9
1458.5
1393.7
1283.3
1040.6
18                            : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1      17.7800                : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 925.7
1131.7
1344.4
1340.7
1300.8
1265.2
1238.8
1221.7
1212.1
```

```
1207.7
1208.0
1214.4
1226.6
1243.8
1265.3
1279.9
1245.7
1073.7
18                              : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0236
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0217
0.0217
0.0216
18                              : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0233
0.0233
0.0232
0.0230
0.0229
```

```
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                      : # of burnup axial nodes (BOC-1A)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                      : # of burnup axial nodes (BOC-1B)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 2.445
```

```
 5.137
 8.442
10.198
11.117
11.623
11.884
11.985
11.956
11.795
11.501
11.149
10.864
10.663
10.418
 9.841
 8.445
 5.210
18                        : # of burnup axial nodes (Stpt2-18)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 4.124
 7.935
12.475
15.090
16.172
16.599
16.758
16.782
16.708
16.527
16.247
15.966
15.807
15.768
15.684
15.130
13.267
 8.365
```

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.83                    : U-235 wt% enrichment in U of UO2
463630                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.9398                  : Fuel pellet diameter (cm)
0.95758                 : Fuel rod cladding ID (cm)
1.0922                  : Fuel rod cladding OD (cm)
360.172                 : Fuel stack height (cm)
N                       : No axial blanket fuel
INCONEL                 : Spacer grid material
0.005757609             : Vol. frac. of mod. displaced by grids
ZIRC-4                  : Fuel rod cladding material
640.0                   : Avg. fuel rod cladding temp. (K)
Y                       : No cladding materials other than ZIRC-4
1                       : Number of cladding materials needed other than ZIRC-4
6                       : SAS2H material mixture number for clad material below
SS304                   : Cladding material for CR's
2200.0                  : System pressure (psi)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
4                       : # of insertion reactor cycles
1A                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
195.292                 : Days of downtime at EOC
268.8                   : Total cycle EFPD
413                     : Total cycle length in calendar days
07                      : Integer position of assembly in cycle
1B                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
142.2                   : Stpt EFPD
166.0                   : Length to stpt in calendar days
14.792                  : Downtime at stpt
97.0                    : Days of downtime at EOC
171.3                   : Total cycle EFPD
217.0                   : Total cycle length in calendar days
07                      : Integer position of assembly in cycle
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212.0                   : Total cycle length in calendar days
03                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
```

193.0		: Length to stpt in calendar days
16.792		: Downtime at stpt
250.0		: Stpt EFPD
325.792		: Length to stpt in calendar days
12.333		: Downtime at stpt
73.0		: Days of downtime at EOC
323.0		: Total cycle EFPD
416.0		: Total cycle length in calendar days
04		: Integer position of assembly in cycle
Y		: Flag for variable or constant irradiation step specs
1		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
11		: Number of steps in statepoint calculation
2.50	901.6	: Step length (EFPD), Mid-step ppmb
6.50	904.3	: Step length (EFPD), Mid-step ppmb
1.00	906.5	: Step length (EFPD), Mid-step ppmb
1.00	907.1	: Step length (EFPD), Mid-step ppmb
1.00	907.7	: Step length (EFPD), Mid-step ppmb
.97	908.3	: Step length (EFPD), Mid-step ppmb
1.04	908.9	: Step length (EFPD), Mid-step ppmb
63.70	928.4	: Step length (EFPD), Mid-step ppmb
63.70	854.8	: Step length (EFPD), Mid-step ppmb
63.70	727.8	: Step length (EFPD), Mid-step ppmb
63.70	593.1	: Step length (EFPD), Mid-step ppmb
2		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
10		: Number of steps in statepoint calculation
4.46	541.0	: Step length (EFPD), Mid-step ppmb
24.44	567.8	: Step length (EFPD), Mid-step ppmb
42.89	435.6	: Step length (EFPD), Mid-step ppmb
42.89	313.3	: Step length (EFPD), Mid-step ppmb
9.32	275.2	: Step length (EFPD), Mid-step ppmb
1.00	282.4	: Step length (EFPD), Mid-step ppmb
1.31	283.5	: Step length (EFPD), Mid-step ppmb
7.90	287.6	: Step length (EFPD), Mid-step ppmb
7.79	284.7	: Step length (EFPD), Mid-step ppmb
.20	280.6	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
4		: Number of steps in statepoint calculation
6.47	277.2	: Step length (EFPD), Mid-step ppmb
5.36	267.3	: Step length (EFPD), Mid-step ppmb
17.17	205.2	: Step length (EFPD), Mid-step ppmb
.10	157.6	: Step length (EFPD), Mid-step ppmb
3		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
7		: Number of steps in statepoint calculation
3.21	839.9	: Step length (EFPD), Mid-step ppmb
5.24	784.3	: Step length (EFPD), Mid-step ppmb
21.72	721.4	: Step length (EFPD), Mid-step ppmb
47.60	618.1	: Step length (EFPD), Mid-step ppmb
47.60	470.7	: Step length (EFPD), Mid-step ppmb
35.87	340.9	: Step length (EFPD), Mid-step ppmb
5.25	314.0	: Step length (EFPD), Mid-step ppmb
4		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
3		: Number of steps in statepoint calculation
56.167	880.38	: Step length (EFPD), Mid-step ppmb
56.167	694.68	: Step length (EFPD), Mid-step ppmb
56.167	536.65	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
40.75	382.60	: Step length (EFPD), Mid-step ppmb
40.75	267.17	: Step length (EFPD), Mid-step ppmb
3		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
36.5	234.64	: Step length (EFPD), Mid-step ppmb
36.5	128.17	: Step length (EFPD), Mid-step ppmb
18		: # of axial nodes in CRC format
1	17.7800	: Node #, node height (cm)
2	20.0025	

```
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
RODDED
27                       : Number of irradiation steps with CRA inserted
1                        : Number of axial section with CRA inserted in step 1
1 1 1 1 15 7 1           : Input card 47B
1                        : Number of axial section with CRA inserted in step 2
1 1 2 1 14 7 1           : Input card 47B
2                        : Number of axial section with CRA inserted in step 3
1 1 3 1 7 7 1            : Input card 47B
1 1 3 11 14 7 1          : Input card 47B
2                        : Number of axial section with CRA inserted in step 4
1 1 4 1 5 7 1            : Input card 47B
1 1 4 13 14 7 1          : Input card 47B
2                        : Number of axial section with CRA inserted in step 5
1 1 5 1 3 7 1            : Input card 47B
1 1 5 14 14 7 1          : Input card 47B
1                        : Number of axial section with CRA inserted in step 6
1 1 6 1 2 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 7
1 1 7 1 1 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 8
2 1 1 1 17 7 1           : Input card 47B
1                        : Number of axial section with CRA inserted in step 9
2 1 2 1 16 7 1           : Input card 47B
1                        : Number of axial section with CRA inserted in step 10
2 1 3 1 15 7 1           : Input card 47B
1                        : Number of axial section with CRA inserted in step 11
2 1 4 1 15 7 1           : Input card 47B
1                        : Number of axial section with CRA inserted in step 12
2 1 5 1 14 7 1           : Input card 47B
2                        : Number of axial section with CRA inserted in step 13
2 1 6 1 7 7 1            : Input card 47B
2 1 6 14 14 7 1          : Input card 47B
1                        : Number of axial section with CRA inserted in step 14
2 1 7 1 5 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 15
2 1 8 1 4 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 16
2 1 9 1 3 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 17
2 1 10 1 3 7 1           : Input card 47B
1                        : Number of axial section with CRA inserted in step 18
2 2 1 1 5 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 19
2 2 2 1 4 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 20
2 2 3 1 3 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 21
2 2 4 1 3 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 22
3 1 1 1 5 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 23
3 1 2 1 4 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 24
3 1 3 1 3 7 1            : Input card 47B
```

```
1                  : Number of axial section with CRA inserted in step 25
3 1 4 1 2 7 1      : Input card 47B
1                  : Number of axial section with CRA inserted in step 26
3 1 5 1 2 7 1      : Input card 47B
1                  : Number of axial section with CRA inserted in step 27
3 1 6 1 1 7 1      : Input card 47B
1                  : Number of different CRA absorber material mixtures
7                  : SAS2H material mixture number for CRA absorber
4                  : Number of isotopes or elements in the CRA absorber
47000   79.8       : SCALE isotope ID, Isotope wt%
49000   15.0       : SCALE isotope ID, Isotope wt%
48000   5.0        : SCALE isotope ID, Isotope wt%
13027   0.2        : SCALE isotope ID, Isotope wt%
1                  : Number of CRA designs
10.17   6          : CR absorber density, CR clad SAS2H mat. mix. number
8                  : Number of radial zones in Path B model with CRA inserted
7   0.49784        : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784        : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                 : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1    17.7800       : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
975.5
1202.1
1328.9
1397.0
1429.2
1443.3
1451.7
1461.8
1476.9
1495.3
1513.4
1525.1
1525.5
1515.8
1498.4
1458.3
1357.3
1103.7
```

```
18              : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1    17.7800    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 897.9
1024.9
1066.6
1066.3
1048.5
1028.6
1012.6
1002.0
 996.2
 994.3
 995.7
1000.0
1006.5
1016.2
1047.3
1232.9
1279.6
1109.5
18              : # of fuel temp axial nodes (Stpt2-1B to EOC-1B)
1    17.7800    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 874.2
 973.4
1022.8
1101.7
1337.1
1403.6
1423.0
1432.8
1439.7
1446.6
1454.5
1460.8
1458.6
1439.1
```

```
1385.4
1288.2
1195.1
1021.7
18                    : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 871.5
 977.1
1121.4
1241.2
1250.0
1239.1
1232.8
1229.6
1226.0
1218.8
1206.9
1190.9
1172.9
1154.5
1132.7
1101.9
1073.3
 963.8
18                    : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1020.4
1176.9
1200.7
1188.3
1167.2
1145.2
1126.3
1111.6
1106.1
1113.7
```

```
1133.0
1158.1
1180.9
1191.9
1181.1
1143.5
1094.2
 980.9
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1041.4
1147.0
1150.4
1121.7
1098.0
1081.9
1071.6
1063.9
1058.6
1057.7
1061.0
1066.9
1074.6
1082.8
1082.9
1066.6
1044.3
 973.0
18                          : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0236
0.0236
0.0235
0.0233
0.0232
0.0231
```

```
0.0229
0.0228
0.0227
0.0225
0.0224
0.0223
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (BOC-18 to Stpt2-18)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0228
0.0227
0.0227
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-18 to EOC-18)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0236
0.0236
```

```
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0224
0.0223
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0233
0.0232
0.0232
0.0230
0.0229
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
```

```
17    20.0025
18    22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                  : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800       : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                  : # of burnup axial nodes (BOC-1A)
1     17.7800       : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
```

```
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                            : # of burnup axial nodes (BOC-1B)
1       17.7800               : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 3.645
 6.341
 8.389
 9.750
10.606
11.121
11.414
11.561
11.597
11.542
11.417
11.273
11.175
11.168
11.291
10.892
 9.417
 5.813
18                            : # of burnup axial nodes (Stpt2-1B)
1       17.7800               : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 5.260
 8.891
11.451
13.043
13.979
14.462
14.706
14.817
14.839
14.791
14.695
14.602
14.569
14.652
15.074
15.739
14.395
 9.214
18                        : # of burnup axial nodes (BOC-2)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 5.593
 9.400
12.075
13.887
14.978
15.622
15.911
16.036
16.067
16.034
15.964
15.902
15.891
15.970
16.335
16.879
15.372
 9.856
18                        : # of burnup axial nodes (BOC-3)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
```

```
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 7.656
12.915
17.273
19.795
21.042
21.673
21.905
21.966
21.942
21.868
21.778
21.716
21.714
21.789
22.075
22.359
20.344
13.277
18                          : # of burnup axial nodes (Stpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
10.803
17.876
23.097
25.889
27.189
27.785
27.950
27.922
27.817
27.726
27.706
27.779
27.934
28.121
28.346
28.278
25.590
16.831
18                          : # of burnup axial nodes (Stpt3-3)
```

1	17.7800	: Node #, node height (cm)
2	20.0025	
3	20.0025	
4	20.0025	
5	20.0025	
6	20.0025	
7	20.0025	
8	20.0025	
9	20.0025	
10	20.0025	
11	20.0025	
12	20.0025	
13	20.0025	
14	20.0025	
15	20.0025	
16	20.0025	
17	20.0025	
18	22.3520	

12.512
20.413
25.906
28.701
29.947
30.492
30.624
30.571
30.449
30.361
30.371
30.497
30.727
30.994
31.250
31.101
28.192
18.697

```
N                           : This is a pick-up case from Stpt-1, Cyc-2, Assy A14a
Crystal River, Unit 3       : Reactor Identifier
CR3                         : Prefix Identifier for reactor
44group                     : Scale cross-section library
2.54                        : U-235 wt% enrichment in U of UO2
463630                      : Grams of U per assembly
208                         : Number of fuel rods in assembly
1.44272                     : Pin-pitch in assembly (cm)
0.9398                      : Fuel pellet diameter (cm)
0.95758                     : Fuel rod cladding ID (cm)
1.0922                      : Fuel rod cladding OD (cm)
360.172                     : Fuel stack height (cm)
N                           : No axial blanket fuel
INCONEL                     : Spacer grid material
0.005757609                 : Vol. frac. of mod. displaced by grids
ZIRC-4                      : Fuel rod cladding material
640.0                       : Avg. fuel rod cladding temp. (K)
Y                           : No cladding materials other than ZIRC-4
1                           : Number of cladding materials other than ZIRC-4
8                           : SAS2H mat mix number for CR clad
SS304                       : CR clad
2200.0                      : System pressure (psi)
Y                           : Activate BPRA tracking
1                           : Number of reactor cycles with BPRA
1 0                         : # of BPRA designs, # of non-Al2O3B4C BP's
3.7 1.34 0.5857538 16 2 4     : Input Card 18C
8                           : # of radial zones in BPRA Path B model
4 0.43180                   : BPRA Path B model (Input Card 18E)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
3 0.43180                   : Path B model with BPRA removed (Input Card 18F)
3 0.45720
3 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.97599
3 2.99939
6 0.43180                   : BPRA Path B model above absorber (Input Card 18G)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
AL2O3 6                     : Mat. above absorber in BPR, SAS2H mat. mix. #
1 1 2 17                    : BPRA insertion history (Input Card 18H)
5                           : # of radial zones in the standard Path B model
3 0.63246                   : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                           : # of cross-section libraries per irradiation step
5                           : SAS2H output print level
0.5                         : Zone mesh factor for XSDRNPM
NO SPECIAL                  : No special XSDRNPM control parameter specs.
4                           : # of insertion reactor cycles
1A                          : Insertion reactor cycle identifier
1                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
195.292                     : Days of downtime at EOC
```

268.8		: Total cycle EFPD
413.0		: Total cycle length in calendar days
14		: Integer position of assembly in cycle
18		: Insertion reactor cycle identifier
2		: # of stpts in cycle
0		: Stpt EFPD
0		: Length to stpt in calendar days
0		: Downtime at stpt
142.2		: Stpt EFPD
166.0		: Length to stpt in calendar days
14.792		: Downtime at stpt
97.0		: Days of downtime at EOC
171.3		: Total cycle EFPD
217.0		: Total cycle length in calendar days
14		: Integer position of assembly in cycle
02		: Insertion reactor cycle identifier
1		: # of stpts in cycle
0		: Stpt EFPD
0		: Length to stpt in calendar days
0		: Downtime at stpt
2874.0		: Days of downtime at EOC
166.5		: Total cycle EFPD
212.0		: Total cycle length in calendar days
14		: Integer position of assembly in cycle
07		: Insertion reactor cycle identifier
6		: # of stpts in cycle
0		: Stpt EFPD
0		: Length to stpt in calendar days
0		: Downtime at stpt
260.3		: Stpt EFPD
275.0		: Length to stpt in calendar days
18.875		: Downtime at stpt
291.0		: Stpt EFPD
319.175		: Length to stpt in calendar days
39.5		: Downtime at stpt
319.0		: Stpt EFPD
414.375		: Length to stpt in calendar days
109.5		: Downtime at stpt
462.3		: Stpt EFPD
743.875		: Length to stpt in calendar days
2.229		: Downtime at stpt
479.0		: Stpt EFPD
765.104		: Length to stpt in calendar days
7.208		: Downtime at stpt
99.0		: Days of downtime at EOC
497.9		: Total cycle EFPD
796.0		: Total cycle length in calendar days
05		: Integer position of assembly in cycle
Y		: Flag for variable or constant irradiation step specs
1		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
4		: Number of steps in statepoint calculation
67.2	921.02	: Step length (EFPD), Mid-step ppmb
67.2	872.24	: Step length (EFPD), Mid-step ppmb
67.2	738.29	: Step length (EFPD), Mid-step ppmb
67.2	608.17	: Step length (EFPD), Mid-step ppmb
2		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
71.1	518.65	: Step length (EFPD), Mid-step ppmb
71.1	256.11	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
1		: Number of steps in statepoint calculation
29.10	237.54	: Step length (EFPD), Mid-step ppmb
3		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
3		: Number of steps in statepoint calculation
55.5	688.93	: Step length (EFPD), Mid-step ppmb
55.5	527.51	: Step length (EFPD), Mid-step ppmb
55.5	353.48	: Step length (EFPD), Mid-step ppmb

```
4                              : Relative insertion cycle
1                              : Relative statepoint in insertion cycle
5                              : Number of steps in statepoint calculation
35.38        1456.1            : Step length (EFPD), Mid-step ppmb
55.44        1362.5            : Step length (EFPD), Mid-step ppmb
55.44        1253.7            : Step length (EFPD), Mid-step ppmb
57.01        1121.3            : Step length (EFPD), Mid-step ppmb
57.01         960.1            : Step length (EFPD), Mid-step ppmb
2                              : Relative statepoint in insertion cycle
2                              : Number of steps in statepoint calculation
10.13         852.1            : Step length (EFPD), Mid-step ppmb
20.57         802.3            : Step length (EFPD), Mid-step ppmb
3                              : Relative statepoint in insertion cycle
2                              : Number of steps in statepoint calculation
 5.32         760.4            : Step length (EFPD), Mid-step ppmb
22.68         715.0            : Step length (EFPD), Mid-step ppmb
4                              : Relative statepoint in insertion cycle
3                              : Number of steps in statepoint calculation
27.11         634.3            : Step length (EFPD), Mid-step ppmb
58.09         506.1            : Step length (EFPD), Mid-step ppmb
58.09         337.1            : Step length (EFPD), Mid-step ppmb
5                              : Relative statepoint in insertion cycle
1                              : Number of steps in statepoint calculation
16.70         231.2            : Step length (EFPD), Mid-step ppmb
6                              : Relative statepoint in insertion cycle
1                              : Number of steps in statepoint calculation
18.90         183.83           : Step length (EFPD), Mid-step ppmb
18                             : # of axial nodes in CRC format
1    17.7800                   : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
RODDED
6                              : Number of irradiation steps with CRA inserted
1                              : Number of axial section with CRA inserted in step 1
4 1 1 1 2 7 1                  : Input card 47B
1                              : Number of axial section with CRA inserted in step 2
4 1 2 1 1 7 1                  : Input card 47B
1                              : Number of axial section with CRA inserted in step 3
4 1 3 1 1 7 1                  : Input card 47B
1                              : Number of axial section with CRA inserted in step 4
4 2 1 1 1 7 1                  : Input card 47B
1                              : Number of axial section with CRA inserted in step 5
4 3 1 1 1 7 1                  : Input card 47B
1                              : Number of axial section with CRA inserted in step 6
4 4 1 1 1 7 1                  : Input card 47B
1                              : Number of different CRA absorber material mixtures
7                              : SAS2H material mixture number for CRA absorber
4                              : Number of isotopes or elements in the CRA absorber
47000   79.8                   : SCALE isotope ID, Isotope wt%
49000   15.0                   : SCALE isotope ID, Isotope wt%
48000   5.0                    : SCALE isotope ID, Isotope wt%
13027   0.2                    : SCALE isotope ID, Isotope wt%
1                              : Number of CRA designs
10.17   8                      : CR absorber density, CR clad SAS2H mat. mix. number
8                              : Number of radial zones in Path B model with CRA inserted
```

```
7   0.49784          : Path B model CRA inserted (Input Card 47J)
5   0.50546
8   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784          : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                   : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800        : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 898.5
1070.7
1193.8
1260.2
1294.1
1310.7
1320.6
1330.3
1342.9
1358.2
1372.4
1378.6
1372.7
1358.8
1348.7
1334.6
1251.7
1049.6
18                   : # of fuel temp axial nodes (BOC-1B to Btpt2-1B)
1     17.7800        : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
```

```
16      20.0025
17      20.0025
18      22.3520
1066.3
1268.6
1338.5
1340.7
1318.5
1292.8
1272.1
1258.7
1252.1
1250.9
1254.2
1261.6
1271.6
1282.7
1299.2
1319.4
1284.6
1088.6
18                          : # of fuel temp axial nodes (Stpt2-18 to EOC-1B)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1002.2
1160.9
1226.2
1270.2
1323.1
1357.9
1374.9
1384.7
1391.5
1397.8
1405.1
1410.8
1407.9
1386.9
1340.3
1273.1
1186.3
1002.4
18                          : # of fuel temp axial nodes (BOC-2 to EOC-2)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
```

```
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 927.3
1061.1
1115.0
1126.9
1127.2
1126.4
1126.8
1127.4
1125.5
1118.0
1104.3
1087.2
1069.7
1053.7
1041.6
1035.0
1013.6
 889.8
18                      : # of fuel temp axial nodes (BOC-7 to Stpt2-7)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 981.7
1100.8
1123.5
1126.8
1121.4
1114.2
1108.0
1103.6
1100.7
1098.8
1097.4
1095.5
1091.8
1083.9
1068.7
1044.7
1008.4
 907.6
18                      : # of fuel temp axial nodes (Stpt2-7 to Stpt3-7)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
```

```
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1001.0
1074.7
1077.8
1063.7
1051.3
1041.6
1036.2
1034.4
1035.2
1037.9
1042.1
1047.5
1053.7
1059.5
1062.7
1059.9
1045.6
 963.2
18                    : # of fuel temp axial nodes (Stpt3-7 to Stpt4-7)
1       17.7800       : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1001.0
1074.7
1077.8
1063.7
1051.3
1041.6
1036.2
1034.4
1035.2
1037.9
1042.1
1047.5
1053.7
1059.5
1062.7
1059.9
1045.6
 963.2
18                    : # of fuel temp axial nodes (Stpt4-7 to Stpt5-7)
1       17.7800       : Node #, node height (cm)
2       20.0025
3       20.0025
```

```
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1014.2
1079.0
1075.1
1062.0
1049.6
1039.4
1033.0
1029.6
1028.4
1028.8
1030.4
1033.0
1036.7
1040.9
1044.2
1042.5
1028.2
 957.4
18                    : # of fuel temp axial nodes ($tpt5-7 to $tpt6-7)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1014.2
1079.0
1075.1
1062.0
1049.6
1039.4
1033.0
1029.6
1028.4
1028.8
1030.4
1033.0
1036.7
1040.9
1044.2
1042.5
1028.2
 957.4
```

```
18                      : # of mod spec vol axial nodes (EOC-1A to EOC-1A)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0232
0.0231
0.0230
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                      : # of mod spec vol axial nodes (EOC-1B to Stpt2-1B)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
```

```
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0236
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0222
```

```
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                        : # of mod spec vol axial nodes (BOC-7 to Stpt2-7)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-7 to Stpt3-7)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
```

```
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt3-7 to Stpt4-7)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt4-7 to Stpt5-7)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0231
```

```
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                              : # of mod spec vol axial nodes (Stpt5-7 to Stpt6-7)
1     17.7800                   : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                              : # of burnup axial nodes (BOC-1A)
1     17.7800                   : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
```

```
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-1B)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
3.042
4.939
6.561
7.668
8.361
8.770
8.995
9.097
9.105
9.030
8.888
8.731
8.635
8.663
8.790
8.660
7.628
5.173
18                          : # of burnup axial nodes (Stpt2-1B)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
```

```
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 5.483
 8.892
11.299
12.673
13.401
13.759
13.920
13.980
13.977
13.922
13.831
13.759
13.768
13.903
14.142
14.055
12.572
 8.373
18                          : # of burnup axial nodes (BOC-2)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 5.980
 9.666
12.216
13.671
14.457
14.858
15.044
15.113
15.116
15.072
15.005
14.962
14.994
15.127
15.321
15.142
13.506
 8.974
18                          : # of burnup axial nodes (BOC-7)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
```

```
9     20.0025
10    20.0025
11.   20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 8.374
13.458
16.706
18.408
19.258
19.659
19.822
19.857
19.812
19.713
19.598
19.528
19.554
19.696
19.899
19.649
17.597
11.653
18                         : # of burnup axial nodes (Stpt2-7)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
11.725
19.446
24.253
26.522
27.588
28.078
28.285
28.349
28.328
28.244
28.131
28.041
28.005
28.008
27.941
27.219
24.303
16.167
18                         : # of burnup axial nodes (Stpt3-7)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
```

```
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
12.243
20.297
25.222
27.518
28.581
29.061
29.260
29.319
29.297
29.214
29.105
29.019
28.989
28.996
28.925
28.177
25.179
16.777
18                         : # of burnup axial nodes (Stpt4-7)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
12.775
21.119
26.141
28.452
29.505
29.969
30.154
30.204
30.175
30.090
29.979
29.895
29.867
29.876
29.799
29.030
25.962
17.325
18                         : # of burnup axial nodes (Stpt5-7)
```

```
1     17.7800          : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
15.529
25.257
30.701
33.047
34.037
34.436
34.579
34.611
34.584
34.512
34.426
34.378
34.397
34.457
34.416
33.614
30.269
20.436
18                     : # of burnup axial nodes (Stpt6-7)
1     17.7800          : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
15.897
25.756
31.236
33.579
34.559
34.949
35.087
35.118
35.091
35.021
34.938
34.893
34.917
34.984
34.950
```

34.150
30.781
20.815

```
N                         : This is not a pick-up case
Crystal River, Unit 3     : Reactor Identifier
CR3                       : Prefix identifier for reactor
44group                   : Scale cross-section library
1.93                      : U-235 wt% enrichment in U of UO2
463630                    : Grams of U per assembly
208                       : Number of fuel rods in assembly
1.44272                   : Pin-pitch in assembly (cm)
0.9398                    : Fuel pellet diameter (cm)
0.95758                   : Fuel rod cladding ID (cm)
1.0922                    : Fuel rod cladding OD (cm)
360.172                   : Fuel stack height (cm)
N                         : No axial blanket fuel
INCONEL                   : Spacer grid material
0.005757609               : Vol. frac. of mod. displaced by grids
ZIRC-4                    : Fuel rod cladding material
640.0                     : Avg. fuel rod cladding temp. (K)
Y                         : Cladding materials other than ZIRC-4
1                         : Number of cladding materials needed other than ZIRC-4
6                         : SAS2H material mixture number for clad material below
SS304                     : Cladding material for APSR's
2200.0                    : System pressure (psi)
N                         : Activate BPRA tracking
5                         : # of radial zones in the standard Path B model
3 0.63246                 : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                         : # of cross-section libraries per irradiation step
5                         : SAS2H output print level
0.5                       : Zone mesh factor for XSDRNPM
NO SPECIAL                : No special XSDRNPM control parameter specs.
2                         : # of insertion reactor cycles
1A                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
4490.292                  : Days of downtime at EOC
268.8                     : Total cycle EFPD
413.0                     : Total cycle length in calendar days
18                        : Integer position of assembly in cycle
08                        : Insertion reactor cycle identifier
6                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
97.6                      : Stpt EFPD
110.0                     : Length to stpt in calendar days
15.5                      : Downtime at stpt
139.8                     : Stpt EFPD
173.5                     : Length to stpt in calendar days
6.2                       : Downtime at stpt
404.0                     : Stpt EFPD
479.7                     : Length to stpt in calendar days
44.4                      : Downtime at stpt
409.6                     : Stpt EFPD
529.1                     : Length to stpt in calendar days
4.9                       : Downtime at stpt
515.5                     : Stpt EFPD
645.0                     : Length to stpt in calendar days
7.6                       : Downtime at stpt
75                        : Days of downtime at EOC
535.9                     : Total cycle EFPD
679                       : Total cycle length in calendar days
01                        : Integer position of assembly in cycle
Y                         : Flag for variable or constant irradiation step specs
1                         : Relative insertion cycle
1                         : Relative statepoint in insertion cycle
```

```
12                               : Number of steps in statepoint calculation
  .78      901.1                 : Step length (EFPD), Mid-step ppmb
 1.42      901.7                 : Step length (EFPD), Mid-step ppmb
 1.80      902.7                 : Step length (EFPD), Mid-step ppmb
27.29      911.4                 : Step length (EFPD), Mid-step ppmb
45.42      933.3                 : Step length (EFPD), Mid-step ppmb
45.42      875.0                 : Step length (EFPD), Mid-step ppmb
58.01      771.9                 : Step length (EFPD), Mid-step ppmb
58.01      643.2                 : Step length (EFPD), Mid-step ppmb
11.91      575.6                 : Step length (EFPD), Mid-step ppmb
 7.50      593.9                 : Step length (EFPD), Mid-step ppmb
 3.80      556.3                 : Step length (EFPD), Mid-step ppmb
 7.44      518.8                 : Step length (EFPD), Mid-step ppmb
2                                : Relative insertion cycle
1                                : Relative statepoint in insertion cycle
2                                : Number of steps in statepoint calculation
48.8      1510.73                : Step length (EFPD), Mid-step ppmb
48.8      1419.25                : Step length (EFPD), Mid-step ppmb
2                                : Relative statepoint in insertion cycle
1                                : Number of steps in statepoint calculation
42.2      1305.52                : Step length (EFPD), Mid-step ppmb
3                                : Relative statepoint in insertion cycle
4                                : Number of steps in statepoint calculation
66.05     1142.75                : Step length (EFPD), Mid-step ppmb
66.05      985.95                : Step length (EFPD), Mid-step ppmb
66.05      793.58                : Step length (EFPD), Mid-step ppmb
66.05      588.91                : Step length (EFPD), Mid-step ppmb
4                                : Relative statepoint in insertion cycle
1                                : Number of steps in statepoint calculation
5.6        484.53                : Step length (EFPD), Mid-step ppmb
5                                : Relative statepoint in insertion cycle
2                                : Number of steps in statepoint calculation
52.95      416.34                : Step length (EFPD), Mid-step ppmb
52.95      274.55                : Step length (EFPD), Mid-step ppmb
6                                : Relative statepoint in insertion cycle
1                                : Number of steps in statepoint calculation
20.4       185.39                : Step length (EFPD), Mid-step ppmb
18                               : # of axial nodes in CRC format
1     17.7800                    : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
NO CRA INSERTION HISTORY
RODDED                           : APSRA insertion
11                               : Number of irradiation steps with CRA inserted
1 1 1 9 18 7 1 6                 : Input card 488
1 1 2 9 17 7 1 6                 : Input card 488
1 1 3 10 17 7 1 6                : Input card 488
1 1 4 11 16 7 1 6                : Input card 488
1 1 5 12 16 7 1 6                : Input card 488
1 1 6 12 16 7 1 6                : Input card 488
1 1 7 12 15 7 1 6                : Input card 488
1 1 8 12 15 7 1 6                : Input card 488
1 1 9 13 15 7 1 6                : Input card 488
1 1 10 13 14 7 1 6               : Input card 488
1 1 11 13 13 7 1 6               : Input card 488
```

```
1                   : Number of different APSR absorber material mixtures
7                   : SAS2H material mixture number for APSR absorber
4                   : Number of isotopes or elements in the APSR absorber
47000   79.8        : SCALE isotope ID, isotope wt%
49000   15.0        : SCALE isotope ID, isotope wt%
48000   5.0         : SCALE isotope ID, isotope wt%
13027   0.2         : SCALE isotope ID, isotope wt%
1                   : Number of APSRA designs
10.17   6           : APSR absorber density, APSR clad SAS2H mat. mix. number
8                   : Number of radial zones in Path B model with APSRA inserted
7   0.49784         : Path B model APSRA inserted (Input Card 48J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.90826
3   2.93113
3   0.49784         : Path B model APSRA removed (Input Card 48K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
3   0.49784         : Path B model APSR follow rod (Input Card 48L)
3   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.96913
3   2.99248
18                  : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800       : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 929.4
1153.1
1287.8
1364.2
1399.1
1413.1
1421.0
1431.8
1451.4
1482.1
1531.2
1591.7
1390.6
1185.1
1122.0
1052.3
 969.8
```

```
 927.0
18                    : # of fuel temp axial nodes (BOC-8 to Stpt2-8)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 975.0
1124.6
1168.5
1173.9
1168.5
1162.1
1156.8
1153.4
1153.4
1158.8
1184.1
1246.7
1259.9
1252.9
1230.6
1165.4
1073.4
 926.3
18                    : # of fuel temp axial nodes (Stpt2-8 to Stpt3-8)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 975.0
1124.6
1168.5
1173.9
1168.5
1162.1
1156.8
1153.4
1153.4
1158.8
1184.1
1246.7
1259.9
```

```
1252.9
1230.6
1165.4
1073.4
 926.3
18                          : # of fuel temp axial nodes ($tpt3-8 to $tpt4-8)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 977.2
1101.7
1134.2
1128.2
1116.0
1105.3
1097.4
1092.3
1090.9
1094.6
1115.0
1166.1
1178.9
1178.4
1169.2
1129.3
1063.3
 931.6
18                          : # of fuel temp axial nodes ($tpt4-8 to $tpt5-8)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 977.2
1101.7
1134.2
1128.2
1116.0
1105.3
1097.4
1092.3
1090.9
```

```
1094.6
1115.0
1166.1
1178.9
1178.4
1169.2
1129.3
1063.3
 931.6
18                          : # of fuel temp axial nodes (Stpt5-8 to Stpt6-8)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 983.9
1074.1
1076.1
1058.8
1041.2
1027.9
1018.7
1012.7
1009.9
1010.8
1022.9
1055.0
1064.7
1068.9
1071.7
1058.6
1030.9
 944.7
18                          : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0232
0.0232
0.0231
0.0230
0.0229
```

```
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-8 to Stpt2-8)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-8 to Stpt3-8)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0231
```

```
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (Stpt3-8 to Stpt4-8)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (Stpt4-8 to Stpt5-8)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
```

```
16    20.0025
17    20.0025
18    22.3520
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (Stpt5-8 to Stpt6-8)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                      : # of burnup axial nodes (BOC-1A)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
```

```
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-8)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 3.416
 6.039
 8.119
 9.507
10.341
10.809
11.047
11.116
10.998
10.622
 9.391
 6.666
 5.922
 5.786
 5.910
 6.969
 7.477
 4.839
18                          : # of burnup axial nodes (Stpt2-8)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
```

```
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 4.858
 8.345
10.833
12.370
13.263
13.759
14.013
14.095
13.994
13.650
12.517
10.008
 9.284
 9.078
 9.058
 9.803
 9.821
 6.305
18                        : # of burnup axial nodes (Stpt3-8)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 5.507
 9.362
12.012
13.600
14.507
15.006
15.259
15.341
15.243
14.908
13.810
11.380
10.668
10.445
10.384
11.023
10.854
 6.967
18                        : # of burnup axial nodes (Stpt4-8)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
```

```
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 9.904
15.935
19.409
21.159
22.042
22.481
22.681
22.729
22.627
22.331
21.408
19.386
18.788
18.573
18.427
18.657
17.588
11.499
18                          : # of burnup axial nodes (Stpt5-8)
1        17.7800            : Node #, node height (cm)
2        20.0025
3        20.0025
4        20.0025
5        20.0025
6        20.0025
7        20.0025
8        20.0025
9        20.0025
10       20.0025
11       20.0025
12       20.0025
13       20.0025
14       20.0025
15       20.0025
16       20.0025
17       20.0025
18       22.3520
10.003
16.078
19.566
21.317
22.198
22.634
22.833
22.880
22.778
22.483
21.563
19.548
18.953
18.739
18.595
18.820
17.737
11.603
```

```
18                    : # of burnup axial nodes (Stpt6-8)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
11.964
18.845
22.566
24.308
25.131
25.516
25.678
25.702
25.591
25.302
24.433
22.549
22.002
21.820
21.698
21.858
20.539
13.607
```

```
N                           : This is not a pick-up case
Crystal River, Unit 3       : Reactor Identifier
CR3                         : Prefix Identifier for reactor
44group                     : Scale cross-section library
1.93                        : U-235 wt% enrichment in U of UO2
463630                      : Grams of U per assembly
208                         : Number of fuel rods in assembly
1.44272                     : Pin-pitch in assembly (cm)
0.9398                      : Fuel pellet diameter (cm)
0.95758                     : Fuel rod cladding ID (cm)
1.0922                      : Fuel rod cladding OD (cm)
360.172                     : Fuel stack height (cm)
N                           : No axial blanket fuel
INCONEL                     : Spacer grid material
0.005757609                 : Vol. frac. of mod. displaced by grids
ZIRC-4                      : Fuel rod cladding material
640.0                       : Avg. fuel rod cladding temp. (K)
Y                           : Cladding materials other than ZIRC-4
1                           : Number of cladding materials needed other than ZIRC-4
6                           : SAS2H material mixture number for clad material below
SS304                       : Cladding material for APSR's
2200.0                      : System pressure (psi)
N                           : Activate BPRA tracking
5                           : # of radial zones in the standard Path B model
3 0.63246                   : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                           : # of cross-section libraries per irradiation step
5                           : SAS2H output print level
0.5                         : Zone mesh factor for XSDRNPM
NO SPECIAL                  : No special XSDRNPM control parameter specs.
2                           : # of insertion reactor cycles
1A                          : Insertion reactor cycle identifier
1                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
5244.292                    : Days of downtime at EOC
268.8                       : Total cycle EFPD
413.0                       : Total cycle length in calendar days
18                          : Integer position of assembly in cycle
09                          : Insertion reactor cycle identifier
4                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
158.8                       : Stpt EFPD
168.0                       : Length to stpt in calendar days
2.146                       : Downtime at stpt
219.0                       : Stpt EFPD
233.146                     : Length to stpt in calendar days
53.125                      : Downtime at stpt
363.1                       : Stpt EFPD
431.271                     : Length to stpt in calendar days
1.625                       : Downtime at stpt
55.0                        : Days of downtime at EOC
557.23                      : Total cycle EFPD
632.0                       : Total cycle length in calendar days
01                          : Integer position of assembly in cycle
Y                           : Flag for variable or constant irradiation step specs
1                           : Relative insertion cycle
1                           : Relative statepoint in insertion cycle
12                          : Number of steps in statepoint calculation
  .78     901.1             : Step length (EFPD), Mid-step ppmb
 1.42     901.7             : Step length (EFPD), Mid-step ppmb
 1.80     902.7             : Step length (EFPD), Mid-step ppmb
27.29     911.4             : Step length (EFPD), Mid-step ppmb
45.42     933.3             : Step length (EFPD), Mid-step ppmb
```

```
45.42    875.0         : Step length (EFPD), Mid-step ppmb
58.01    771.9         : Step length (EFPD), Mid-step ppmb
58.01    643.2         : Step length (EFPD), Mid-step ppmb
11.91    575.6         : Step length (EFPD), Mid-step ppmb
 7.50    593.9         : Step length (EFPD), Mid-step ppmb
 3.80    556.3         : Step length (EFPD), Mid-step ppmb
 7.44    518.8         : Step length (EFPD), Mid-step ppmb
2                      : Relative insertion cycle
1                      : Relative statepoint in insertion cycle
3                      : Number of steps in statepoint calculation
52.93    1599.85       : Step length (EFPD), Mid-step ppmb
52.93    1491.21       : Step length (EFPD), Mid-step ppmb
52.93    1361.78       : Step length (EFPD), Mid-step ppmb
2                      : Relative statepoint in insertion cycle
1                      : Number of steps in statepoint calculation
60.2     1211.60       : Step length (EFPD), Mid-step ppmb
3                      : Relative statepoint in insertion cycle
2                      : Number of steps in statepoint calculation
72.05    1016.51       : Step length (EFPD), Mid-step ppmb
72.05     802.70       : Step length (EFPD), Mid-step ppmb
4                      : Relative statepoint in insertion cycle
3                      : Number of steps in statepoint calculation
64.71     584.95       : Step length (EFPD), Mid-step ppmb
64.71     388.60       : Step length (EFPD), Mid-step ppmb
64.71     192.66       : Step length (EFPD), Mid-step ppmb
18                     : # of axial nodes in CRC format
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
NO CRA INSERTION HISTORY
RODDED                 : APSRA insertion
11                     : Number of irradiation steps with APSRA inserted
1 1 1 9 18 7 1 6       : Input card 48B
1 1 2 9 17 7 1 6       : Input card 48B
1 1 3 10 17 7 1 6      : Input card 48B
1 1 4 11 16 7 1 6      : Input card 48B
1 1 5 12 16 7 1 6      : Input card 48B
1 1 6 12 16 7 1 6      : Input card 48B
1 1 7 12 15 7 1 6      : Input card 48B
1 1 8 12 15 7 1 6      : Input card 48B
1 1 9 13 15 7 1 6      : Input card 48B
1 1 10 13 14 7 1 6     : Input card 48B
1 1 11 13 13 7 1 6     : Input card 48B
1                      : Number of different APSR absorber material mixtures
7                      : SAS2H material mixture number for APSR absorber
4                      : Number of isotopes or elements in the APSR absorber
47000   79.8           : SCALE isotope ID, Isotope wt%
49000   15.0           : SCALE isotope ID, Isotope wt%
48000   5.0            : SCALE isotope ID, Isotope wt%
13027   0.2            : SCALE isotope ID, Isotope wt%
1                      : Number of APSRA designs
10.17   6              : APSR absorber density, APSR clad SAS2H mat. mix. number
8                      : Number of radial zones in Path B model with APSRA inserted
7   0.49784            : Path B model APSRA inserted (Input Card 48J)
5   0.50546
```

```
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.90826
3   2.93113
3   0.49784                 : Path B model APSRA removed (Input Card 48K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
3   0.49784                 : Path B model APSR follow rod (Input Card 48L)
3   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.96913
3   2.99248
18                          : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 929.4
1153.1
1287.8
1364.2
1399.1
1413.1
1421.0
1431.8
1451.4
1482.1
1531.2
1591.7
1390.6
1185.1
1122.0
1052.3
 969.8
 927.0
18                          : # of fuel temp axial nodes (BOC-9 to Stpt2-9)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 983.5
1142.6
1195.4
1206.0
1203.0
1197.2
1191.6
1187.6
1187.1
1192.5
1219.6
1286.7
1300.8
1295.2
1273.0
1205.9
1107.5
 949.6
18                        : # of fuel temp axial nodes (Stpt2-9 to Stpt3-9)
1      17.7800            : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 988.8
1127.7
1173.1
1173.5
1164.3
1154.7
1147.0
1141.7
1140.2
1144.4
1167.4
1225.0
1239.4
1238.3
1225.9
1177.6
1099.4
 953.8
18                        : # of fuel temp axial nodes (Stpt3-9 to Stpt4-9)
1      17.7800            : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
```

```
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 995.4
1119.6
1145.0
1134.0
1118.7
1106.7
1098.1
1092.4
1090.2
1092.6
1111.4
1160.3
1174.5
1177.8
1174.5
1143.5
1088.5
 957.9
18                    : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1       17.7800       : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0232
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                    : # of mod spec vol axial nodes (BOC-9 to Stpt2-9)
1       17.7800       : Node #, node height (cm)
2       20.0025
```

```
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0231
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-9 to Stpt3-9)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0231
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
```

```
0.0216
18                    : # of mod spec vol axial nodes (Stpt3-9 to Stpt4-9)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                    : # of burnup axial nodes (BOC-1A)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
```

```
0.0
0.0
0.0
0.0
0.0
18                                  : # of burnup axial nodes (BOC-9)
1      17.7800                      : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 3.416
 6.039
 8.119
 9.507
10.341
10.809
11.047
11.116
10.998
10.622
 9.391
 6.666
 5.922
 5.786
 5.910
 6.969
 7.477
 4.839
18                                  : # of burnup axial nodes (Stpt2-9)
1      17.7800                      : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 5.836
 9.936
12.740
14.408
15.354
15.868
16.124
16.202
16.102
```

```
15.770
14.700
12.336
11.651
11.434
11.352
11.911
11.595
 7.424
18                          : # of burnup axial nodes (Stpt3-9)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 6.823
11.468
14.512
16.251
17.210
17.721
17.969
18.040
17.939
17.617
16.594
14.339
13.681
13.458
13.339
13.768
13.197
 8.469
18                          : # of burnup axial nodes (Stpt4-9)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 9.342
15.254
18.790
20.633
21.580
```

22.052
22.265
22.313
22.207
21.908
20.985
18.963
18.383
18.182
18.034
18.247
17.168
11.149

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor identifier
CR3                        : Prefix identifier for reactor
44group                    : Scale cross-section library
1.93                       : U-235 wt% enrichment in U of UO2
463630                     : Grams of U per assembly
208                        : Number of fuel rods in assembly
1.44272                    : Pin-pitch in assembly (cm)
0.9398                     : Fuel pellet diameter (cm)
0.95758                    : Fuel rod cladding ID (cm)
1.0922                     : Fuel rod cladding OD (cm)
360.172                    : Fuel stack height (cm)
N                          : No axial blanket fuel
INCONEL                    : Spacer grid material
0.005757609                : Vol. frac. of mod. displaced by grids
ZIRC-4                     : Fuel rod cladding material
640.0                      : Avg. fuel rod cladding temp. (K)
Y                          : Cladding materials other than ZIRC-4
1                          : Number of cladding materials needed other than ZIRC-4
6                          : SAS2H material mixture number for clad material below
SS304                      : Cladding material for APSR's
2200.0                     : System pressure (psi)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
2                          : # of insertion reactor cycles
1A                         : Insertion reactor cycle identifier
1                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
195.292                    : Days of downtime at EOC
268.8                      : Total cycle EFPD
413                        : Total cycle length in calendar days
18                         : Integer position of assembly in cycle
1B                         : Insertion reactor cycle identifier
2                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
142.2                      : Stpt EFPD
166.0                      : Length to stpt in calendar days
14.792                     : Downtime at stpt
97.0                       : Days of downtime at EOC
171.3                      : Total cycle EFPD
217.0                      : Total cycle length in calendar days
18                         : Integer position of assembly in cycle
Y                          : Flag for variable or constant irradiation step specs
1                          : Relative insertion cycle
1                          : Relative statepoint in insertion cycle
12                         : Number of steps in statepoint calculation
  .78       901.1          : Step length (EFPD), Mid-step ppmb
 1.42       901.7          : Step length (EFPD), Mid-step ppmb
 1.80       902.7          : Step length (EFPD), Mid-step ppmb
27.29       911.4          : Step length (EFPD), Mid-step ppmb
45.42       933.3          : Step length (EFPD), Mid-step ppmb
45.42       875.0          : Step length (EFPD), Mid-step ppmb
58.01       771.9          : Step length (EFPD), Mid-step ppmb
58.01       643.2          : Step length (EFPD), Mid-step ppmb
11.91       575.6          : Step length (EFPD), Mid-step ppmb
 7.50       593.9          : Step length (EFPD), Mid-step ppmb
 3.80       556.3          : Step length (EFPD), Mid-step ppmb
```

```
 7.44     518.8          : Step length (EFPD), Mid-step ppmb
2                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
6                        : Number of steps in statepoint calculation
 6.34     542.7          : Step length (EFPD), Mid-step ppmb
10.50     558.4          : Step length (EFPD), Mid-step ppmb
54.86     442.3          : Step length (EFPD), Mid-step ppmb
37.64     318.8          : Step length (EFPD), Mid-step ppmb
30.66     282.6          : Step length (EFPD), Mid-step ppmb
 2.20     281.6          : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
1                        : Number of steps in statepoint calculation
29.10      237.54        : Step length (EFPD), Mid-step ppmb
18                       : # of axial nodes in CRC format
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
NO CRA INSERTION HISTORY
RODDED                   : APSRA insertion
16                       : Number of irradiation steps with APSRA inserted
1 1 1 9 18 7 1 6         : Input card 488
1 1 2 9 17 7 1 6         : Input card 488
1 1 3 10 17 7 1 6        : Input card 488
1 1 4 11 16 7 1 6        : Input card 488
1 1 5 12 16 7 1 6        : Input card 488
1 1 6 12 16 7 1 6        : Input card 488
1 1 7 12 15 7 1 6        : Input card 488
1 1 8 12 15 7 1 6        : Input card 488
1 1 9 13 15 7 1 6        : Input card 488
1 1 10 13 14 7 1 6       : Input card 488
1 1 11 13 13 7 1 6       : Input card 488
2 1 1 10 16 7 1 6        : Input card 488
2 1 2 11 16 7 1 6        : Input card 488
2 1 3 11 15 7 1 6        : Input card 488
2 1 4 12 15 7 1 6        : Input card 488
2 1 5 12 14 7 1 6        : Input card 488
1                        : Number of different APSR absorber material mixtures
7                        : SAS2H material mixture number for APSR absorber
4                        : Number of isotopes or elements in the CRA absorber
47000   79.8             : SCALE isotope ID, Isotope wt%
49000   15.0             : SCALE isotope ID, Isotope wt%
48000    5.0             : SCALE isotope ID, Isotope wt%
13027    0.2             : SCALE isotope ID, Isotope wt%
1                        : Number of APSRA designs
10.17   6                : APSR absorber density, APSR clad SAS2H mat. mix. number
8                        : Number of radial zones in Path B model with APSRA inserted
7    0.49784             : Path B model APSRA inserted (Input Card 48J)
5    0.50546
6    0.55880
3    0.63246
2    0.67310
3    0.81397
500 2.90826
3    2.93113
3    0.49784             : Path B model APSRA removed (Input Card 48K)
```

```
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
3   0.49784                  : Path B model APSR follow rod (Input Card 48L)
3   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.96913
3   2.99248
18                           : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800                : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 929.4
1153.1
1287.8
1364.2
1399.1
1413.1
1421.0
1431.8
1451.4
1482.1
1531.2
1591.7
1390.6
1185.1
1122.0
1052.3
 969.8
 927.0
18                           : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800                : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
```

```
18    22.3520
1064.3
1253.8
1321.8
1317.4
1285.0
1251.8
1226.7
1210.8
1202.2
1185.3
1094.9
1048.4
1056.4
1070.0
1102.8
1269.7
1252.8
1075.8
18                          : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
```

```
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0231
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                          : # of burnup axial nodes (BOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
```

```
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 3.416
 6.039
 8.119
 9.507
10.341
10.809
11.047
11.116
10.998
10.622
 9.391
 6.666
 5.922
 5.786
 5.910
 6.969
 7.477
 4.839
18                          : # of burnup axial nodes ($tpt2-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 5.861
 9.956
12.792
14.424
15.255
15.627
15.760
15.750
15.564
14.951
12.957
 9.795
 9.090
 9.113
 9.779
11.959
12.257
 7.957
```

```
N                           : This is not a pick-up case
Crystal River, Unit 3       : Reactor Identifier
CR3                         : Prefix Identifier for reactor
44group                     : Scale cross-section library
2.83                        : U-235 wt% enrichment in U of UO2
463630                      : Grams of U per assembly
208                         : Number of fuel rods in assembly
1.44272                     : Pin-pitch in assembly (cm)
0.9398                      : Fuel pellet diameter (cm)
0.95758                     : Fuel rod cladding ID (cm)
1.0922                      : Fuel rod cladding OD (cm)
360.172                     : Fuel stack height (cm)
N                           : No axial blanket fuel
INCONEL                     : Spacer grid material
0.005757609                 : Vol. frac. of mod. displaced by grids
ZIRC-4                      : Fuel rod cladding material
640.0                       : Avg. fuel rod cladding temp. (K)
Y                           : No cladding materials other than ZIRC-4
1                           : Number of cladding materials needed other than ZIRC-4
6                           : SAS2H material mixture number for clad material below
SS304                       : Cladding material for CR's
2200.0                      : System pressure (psi)
N                           : Activate BPRA tracking
5                           : # of radial zones in the standard Path B model
3 0.63246                   : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                           : # of cross-section libraries per irradiation step
5                           : SAS2H output print level
0.5                         : Zone mesh factor for XSDRNPM
NO SPECIAL                  : No special XSDRNPM control parameter specs.
4                           : # of insertion reactor cycles
1A                          : Insertion reactor cycle identifier
1                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
195.292                     : Days of downtime at EOC
268.8                       : Total cycle EFPD
413                         : Total cycle length in calendar days
20                          : Integer position of assembly in cycle
1B                          : Insertion reactor cycle identifier
2                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
142.2                       : Stpt EFPD
166.0                       : Length to stpt in calendar days
14.792                      : Downtime at stpt
97.0                        : Days of downtime at EOC
171.3                       : Total cycle EFPD
217.0                       : Total cycle length in calendar days
20                          : Integer position of assembly in cycle
02                          : Insertion reactor cycle identifier
1                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
164.0                       : Days of downtime at EOC
166.5                       : Total cycle EFPD
212.0                       : Total cycle length in calendar days
23                          : Integer position of assembly in cycle
03                          : Insertion reactor cycle identifier
3                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
168.5                       : Stpt EFPD
```

```
193.0                         : Length to stpt in calendar days
16.792                        : Downtime at stpt
250.0                         : Stpt EFPD
325.792                       : Length to stpt in calendar days
12.333                        : Downtime at stpt
73.0                          : Days of downtime at EOC
323.0                         : Total cycle EFPD
416.0                         : Total cycle length in calendar days
12                            : Integer position of assembly in cycle
Y                             : Flag for variable or constant irradiation step specs
1                             : Relative insertion cycle
1                             : Relative statepoint in insertion cycle
14                            : Number of steps in statepoint calculation
37.78    912.2                : Step length (EFPD), Mid-step ppmb
63.23    909.0                : Step length (EFPD), Mid-step ppmb
63.23    808.8                : Step length (EFPD), Mid-step ppmb
60.11    678.3                : Step length (EFPD), Mid-step ppmb
  .65    610.2                : Step length (EFPD), Mid-step ppmb
 2.76    633.9                : Step length (EFPD), Mid-step ppmb
 1.07    662.9                : Step length (EFPD), Mid-step ppmb
 1.23    657.8                : Step length (EFPD), Mid-step ppmb
  .58    650.0                : Step length (EFPD), Mid-step ppmb
 1.36    641.7                : Step length (EFPD), Mid-step ppmb
 1.45    629.5                : Step length (EFPD), Mid-step ppmb
  .55    620.9                : Step length (EFPD), Mid-step ppmb
 1.00    614.2                : Step length (EFPD), Mid-step ppmb
33.80    606.7                : Step length (EFPD), Mid-step ppmb
2                             : Relative insertion cycle
1                             : Relative statepoint in insertion cycle
2                             : Number of steps in statepoint calculation
71.1      518.65              : Step length (EFPD), Mid-step ppmb
71.1      256.11              : Step length (EFPD), Mid-step ppmb
2                             : Relative statepoint in insertion cycle
1                             : Number of steps in statepoint calculation
29.1      237.54              : Step length (EFPD), Mid-step ppmb
3                             : Relative insertion cycle
1                             : Relative statepoint in insertion cycle
3                             : Number of steps in statepoint calculation
55.5      688.93              : Step length (EFPD), Mid-step ppmb
55.5      527.51              : Step length (EFPD), Mid-step ppmb
55.5      353.48              : Step length (EFPD), Mid-step ppmb
4                             : Relative insertion cycle
1                             : Relative statepoint in insertion cycle
3                             : Number of steps in statepoint calculation
56.167    880.38              : Step length (EFPD), Mid-step ppmb
56.167    694.68              : Step length (EFPD), Mid-step ppmb
56.167    536.65              : Step length (EFPD), Mid-step ppmb
2                             : Relative statepoint in insertion cycle
2                             : Number of steps in statepoint calculation
40.75     382.60              : Step length (EFPD), Mid-step ppmb
40.75     267.17              : Step length (EFPD), Mid-step ppmb
3                             : Relative statepoint in insertion cycle
2                             : Number of steps in statepoint calculation
36.5      234.64              : Step length (EFPD), Mid-step ppmb
36.5      128.17              : Step length (EFPD), Mid-step ppmb
18                            : # of axial nodes in CRC format
1    17.7800                  : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
```

```
15    20.0025
16    20.0025
17    20.0025
18    22.3520
RODDED
13                        : Number of irradiation steps with CRA inserted
1                         : Number of axial section with CRA inserted in step 1
1 1 1 1 16 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 2
1 1 2 1 15 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 3
1 1 3 1 15 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 4
1 1 4 1 14 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 5
1 1 5 2 14 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 6
1 1 6 3 13 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 7
1 1 7 4 13 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 8
1 1 8 4 12 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 9
1 1 9 5 12 7 1            : Input card 47B
1                         : Number of axial section with CRA inserted in step 10
1 1 10 5 11 7 1           : Input card 47B
1                         : Number of axial section with CRA inserted in step 11
1 1 11 6 10 7 1           : Input card 47B
1                         : Number of axial section with CRA inserted in step 12
1 1 12 7 10 7 1           : Input card 47B
1                         : Number of axial section with CRA inserted in step 13
1 1 13 8 9 7 1            : Input card 47B
1                         : Number of different CRA absorber material mixtures
7                         : SAS2H material mixture number for CRA absorber
4                         : Number of isotopes or elements in the CRA absorber
47000   79.8              : SCALE isotope ID, isotope wt%
49000   15.0              : SCALE isotope ID, isotope wt%
48000   5.0               : SCALE isotope ID, isotope wt%
13027   0.2               : SCALE isotope ID, isotope wt%
1                         : Number of CRA designs
10.17   6                 : CR absorber density, CR clad SAS2H mat. mix. number
8                         : Number of radial zones in Path B model with CRA inserted
7   0.49784               : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784               : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                        : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
```

```
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 766.4
 890.3
 980.9
1034.5
1063.3
1077.4
1085.8
1093.3
1102.2
1112.6
1121.4
1122.4
1112.5
1098.0
1109.7
1298.5
1237.3
1003.7
18                        : # of fuel temp axial nodes (BOC-18 to Stpt2-18)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1116.6
1349.1
1443.2
1455.2
1437.0
1412.9
1393.2
1380.6
1374.8
1374.1
1377.9
1386.3
1397.1
1403.6
1385.3
1329.1
1253.5
1068.4
18                        : # of fuel temp axial nodes (Stpt2-18 to EOC-18)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
```

```
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1038.6
1220.9
1294.5
1327.4
1351.3
1370.9
1385.1
1394.4
1400.1
1404.1
1409.1
1414.7
1412.9
1393.5
1337.7
1244.4
1150.2
 985.1
18                      : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1050.3
1217.7
1311.6
1360.1
1380.6
1389.8
1397.4
1404.3
1404.1
1379.8
1318.8
1260.1
1220.0
1193.8
1179.2
1168.9
1141.1
1005.6
18                      : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
```

```
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1022.2
1167.1
1207.6
1211.1
1201.2
1184.3
1159.4
1126.3
1103.4
1107.0
1130.3
1169.9
1221.0
1248.4
1234.1
1185.8
1126.2
 999.8
18                      : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1044.7
1137.9
1153.8
1140.6
1125.2
1113.4
1103.9
1090.3
1071.2
1065.2
1070.7
1081.5
1099.8
1121.4
1120.3
1098.5
1075.1
```

```
995.2
18                              : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0226
0.0226
0.0225
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
0.0216
18                              : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0236
0.0235
0.0234
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0221
```

```
0.0220
0.0219
0.0218
0.0217
0.0216
18                              : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0235
0.0235
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
0.0217
0.0216
18                              : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0236
0.0235
0.0234
0.0232
0.0231
0.0229
0.0228
0.0227
0.0225
```

```
0.0224
0.0223
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0233
0.0233
0.0231
0.0230
0.0229
```

```
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of burnup axial nodes (BOC-1A)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                        : # of burnup axial nodes (BOC-1B)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1.929
```

```
3.349
4.454
5.176
5.618
5.871
6.003
6.054
6.041
5.965
5.831
5.685
5.608
5.721
6.476
7.826
7.524
4.698
18                              : # of burnup axial nodes (Stpt2-18)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 4.564
 7.656
 9.656
10.692
11.186
11.397
11.473
11.490
11.473
11.419
11.340
11.287
11.324
11.522
12.214
13.223
12.242
 7.730
18                              : # of burnup axial nodes (BOC-2)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
```

```
16    20.0025
17    20.0025
18    22.3520
 5.094
 8.487
10.635
11.730
12.251
12.480
12.568
12.589
12.573
12.528
12.470
12.449
12.515
12.718
13.362
14.259
13.123
 8.299
18                          : # of burnup axial nodes (BOC-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 8.349
13.645
16.910
18.514
19.233
19.520
19.589
19.522
19.319
18.973
18.605
18.406
18.467
18.792
19.541
20.283
18.570
11.970
18                          : # of burnup axial nodes (Stpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
```

```
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
11.641
18.735
22.886
24.819
25.637
25.916
25.895
25.615
25.089
24.534
24.168
24.130
24.503
25.199
26.016
26.402
23.960
15.579
18                          : # of burnup axial nodes (Stpt3-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
13.385
21.262
25.705
27.687
28.483
28.733
28.682
28.343
27.715
27.095
26.738
26.761
27.260
28.139
29.033
29.332
26.649
17.494
```

```
N                           : This is not a pick-up case
Crystal River, Unit 3       : Reactor identifier
CR3                         : Prefix identifier for reactor
44group                     : Scale cross-section library
1.93                        : U-235 wt% enrichment in U of UO2
463630                      : Grams of U per assembly
208                         : Number of fuel rods in assembly
1.44272                     : Pin-pitch in assembly (cm)
0.9398                      : Fuel pellet diameter (cm)
0.95758                     : Fuel rod cladding ID (cm)
1.0922                      : Fuel rod cladding OD (cm)
360.172                     : Fuel stack height (cm)
N                           : No axial blanket fuel
INCONEL                     : Spacer grid material
0.005757609                 : Vol. frac. of mod. displaced by grids
ZIRC-4                      : Fuel rod cladding material
640.0                       : Avg. fuel rod cladding temp. (K)
Y                           : Cladding materials other than ZIRC-4
1                           : Number of cladding materials needed other than ZIRC-4
6                           : SAS2H material mixture number for clad material below
SS304                       : Cladding material for CR's
2200.0                      : System pressure (psi)
N                           : Activate BPRA tracking
5                           : # of radial zones in the standard Path B model
3 0.63246                   : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                           : # of cross-section libraries per irradiation step
5                           : SAS2H output print level
0.5                         : Zone mesh factor for XSDRNPM
NO SPECIAL                  : No special XSDRNPM control parameter specs.
2                           : # of insertion reactor cycles
1A                          : Insertion reactor cycle identifier
1                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
195.292                     : Days of downtime at EOC
268.8                       : Total cycle EFPD
413                         : Total cycle length in calendar days
22                          : Integer position of assembly in cycle
1B                          : Insertion reactor cycle identifier
2                           : # of stpts in cycle
0                           : Stpt EFPD
0                           : Length to stpt in calendar days
0                           : Downtime at stpt
142.2                       : Stpt EFPD
166.0                       : Length to stpt in calendar days
14.792                      : Downtime at stpt
97.0                        : Days of downtime at EOC
171.3                       : Total cycle EFPD
217.0                       : Total cycle length in calendar days
22                          : Integer position of assembly in cycle
Y                           : Flag for variable or constant irradiation step specs
1                           : Relative insertion cycle
1                           : Relative statepoint in insertion cycle
6                           : Number of steps in statepoint calculation
 5.03       902.3           : Step length (EFPD), Mid-step ppmb
60.15       921.9           : Step length (EFPD), Mid-step ppmb
60.15       883.3           : Step length (EFPD), Mid-step ppmb
57.42       766.1           : Step length (EFPD), Mid-step ppmb
57.42       637.8           : Step length (EFPD), Mid-step ppmb
28.64       589.5           : Step length (EFPD), Mid-step ppmb
2                           : Relative insertion cycle
1                           : Relative statepoint in insertion cycle
6                           : Number of steps in statepoint calculation
 4.49      541.0            : Step length (EFPD), Mid-step ppmb
41.82      549.6            : Step length (EFPD), Mid-step ppmb
```

```
35.51     423.0          : Step length (EFPD), Mid-step ppmb
35.51     289.3          : Step length (EFPD), Mid-step ppmb
 8.04     279.6          : Step length (EFPD), Mid-step ppmb
16.82     289.1          : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
1                        : Number of steps in statepoint calculation
29.10     237.54         : Step length (EFPD), Mid-step ppmb
18                       : # of axial nodes in CRC format
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
RODDED
10                       : Number of irradiation steps with CRA inserted
1                        : Number of axial section with CRA inserted in step 1
1 1 1 1 3 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 2
1 1 2 1 2 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 3
1 1 3 1 2 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 4
1 1 4 1 1 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 5
1 1 5 1 1 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 6
2 1 1 1 4 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 7
2 1 2 1 3 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 8
2 1 3 1 2 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 9
2 1 4 1 2 7 1            : Input card 47B
1                        : Number of axial section with CRA inserted in step 10
2 1 5 1 1 7 1            : Input card 47B
1                        : Number of different CRA absorber material mixtures
7                        : SAS2H material mixture number for CRA absorber
4                        : Number of isotopes or elements in the CRA absorber
47000   79.8             : SCALE isotope ID, Isotope wt%
49000   15.0             : SCALE isotope ID, Isotope wt%
48000    5.0             : SCALE isotope ID, Isotope wt%
13027    0.2             : SCALE isotope ID, Isotope wt%
1                        : Number of CRA designs
10.17    6               : CR absorber density, CR clad SAS2H mat. mix. number
8                        : Number of radial zones in Path B model with CRA inserted
7   0.49784              : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784              : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
```

```
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                         : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 817.6
 984.0
1269.2
1391.9
1432.1
1445.9
1453.4
1464.5
1484.2
1514.1
1546.4
1559.1
1523.6
1454.6
1384.7
1306.8
1200.9
 981.4
18                         : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 901.0
1099.8
1302.3
1300.9
1261.8
1226.2
1200.1
1183.4
1173.3
```

```
1164.2
1154.9
1154.6
1166.3
1187.8
1223.7
1262.0
1240.6
1072.3
18                     : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                     : # of mod spec vol axial nodes (BOC-1B to $tpt2-1B)
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
```

```
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                       : # of burnup axial nodes (BOC-1A)
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                       : # of burnup axial nodes (BOC-1B)
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 2.356
```

```
 4.987
 8.232
 9.957
10.858
11.352
11.601
11.681
11.603
11.320
10.761
10.054
 9.553
 9.311
 9.181
 8.884
 7.816
 4.869
18                          : # of burnup axial nodes (Stpt2-1B)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 3.912
 7.595
12.009
14.545
15.588
15.992
16.133
16.129
15.985
15.619
14.973
14.263
13.875
13.841
14.005
13.923
12.514
 7.959
```

```
N                              : This is not a pick-up case
Crystal River, Unit 3          : Reactor Identifier
CR3                            : Prefix identifier for reactor
44group                        : Scale cross-section library
2.54                           : U-235 wt% enrichment in U of UO2
463630                         : Grams of U per assembly
208                            : Number of fuel rods in assembly
1.44272                        : Pin-pitch in assembly (cm)
0.9398                         : Fuel pellet diameter (cm)
0.95758                        : Fuel rod cladding ID (cm)
1.0922                         : Fuel rod cladding OD (cm)
360.172                        : Fuel stack height (cm)
N                              : No axial blanket fuel
INCONEL                        : Spacer grid material
0.005757609                    : Vol. frac. of mod. displaced by grids
ZIRC-4                         : Fuel rod cladding material
640.0                          : Avg. fuel rod cladding temp. (K)
Y                              : No cladding materials other than ZIRC-4
1                              : Number of clad materials other than ZIRC-4
8                              : SAS2H material mixture number for following material
SS304                          : Cladding material specification
2200.0                         : System pressure (psi)
Y                              : Activate BPRA tracking
1                              : Number of reactor cycles with BPRA
1 0                            : # of BPRA designs, # of non-Al2O3B4C BP's
3.7 1.01 0.5857538 16 2 4        : Input Card 18C
8                              : # of radial zones in BPRA Path B model
4 0.43180                      : BPRA Path B model (Input Card 18E)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
3 0.43180                      : Path B model with BPRA removed (Input Card 18F)
3 0.45720
3 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.97599
3 2.99939
6 0.43180                      : BPRA Path B model above absorber (Input Card 18G)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
AL2O3 6                        : Mat. above absorber in BPR, SAS2H mat. mix. #
1 1 2 17                       : BPRA insertion history (Input Card 18H)
5                              : # of radial zones in the standard Path B model
3 0.63246                      : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                              : # of cross-section libraries per irradiation step
5                              : SAS2H output print level
0.5                            : Zone mesh factor for XSDRNPM
NO SPECIAL                     : No special XSDRNPM control parameter specs.
4                              : # of insertion reactor cycles
1A                             : Insertion reactor cycle identifier
1                              : # of stpts in cycle
0                              : Stpt EFPD
0                              : Length to stpt in calendar days
0                              : Downtime at stpt
195.292                        : Days of downtime at EOC
```

```
268.8                    : Total cycle EFPD
413.0                    : Total cycle length in calendar days
23                       : Integer position of assembly in cycle
18                       : Insertion reactor cycle identifier
2                        : # of stpts in cycle
0                        : Stpt EFPD
0                        : Length to stpt in calendar days
0                        : Downtime at stpt
142.2                    : Stpt EFPD
166.0                    : Length to stpt in calendar days
14.792                   : Downtime at stpt
97.0                     : Days of downtime at EOC
171.3                    : Total cycle EFPD
217.0                    : Total cycle length in calendar days
23                       : Integer position of assembly in cycle
02                       : Insertion reactor cycle identifier
1                        : # of stpts in cycle
0                        : Stpt EFPD
0                        : Length to stpt in calendar days
0                        : Downtime at stpt
164.0                    : Days of downtime at EOC
166.5                    : Total cycle EFPD
212.0                    : Total cycle length in calendar days
07                       : Integer position of assembly in cycle
03                       : Insertion reactor cycle identifier
3                        : # of stpts in cycle
0                        : Stpt EFPD
0                        : Length to stpt in calendar days
0                        : Downtime at stpt
168.5                    : Stpt EFPD
193.0                    : Length to stpt in calendar days
16.792                   : Downtime at stpt
250.0                    : Stpt EFPD
325.792                  : Length to stpt in calendar days
12.333                   : Downtime at stpt
73.0                     : Days of downtime at EOC
323.0                    : Total cycle EFPD
416.0                    : Total cycle length in calendar days
06                       : Integer position of assembly in cycle
Y                        : Flag for variable or constant irradiation step specs
1                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
4                        : Number of steps in statepoint calculation
67.2        921.02       : Step length (EFPD), Mid-step ppmb
67.2        872.24       : Step length (EFPD), Mid-step ppmb
67.2        738.29       : Step length (EFPD), Mid-step ppmb
67.2        608.17       : Step length (EFPD), Mid-step ppmb
2                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
2                        : Number of steps in statepoint calculation
71.1        518.65       : Step length (EFPD), Mid-step ppmb
71.1        256.11       : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
1                        : Number of steps in statepoint calculation
29.10       237.54       : Step length (EFPD), Mid-step ppmb
3                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
7                        : Number of steps in statepoint calculation
  .99       864.5        : Step length (EFPD), Mid-step ppmb
 9.13       783.1        : Step length (EFPD), Mid-step ppmb
54.72       659.1        : Step length (EFPD), Mid-step ppmb
36.53       528.0        : Step length (EFPD), Mid-step ppmb
36.53       422.5        : Step length (EFPD), Mid-step ppmb
28.11       327.4        : Step length (EFPD), Mid-step ppmb
 1.00       311.9        : Step length (EFPD), Mid-step ppmb
4                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
3                        : Number of steps in statepoint calculation
56.167      880.38       : Step length (EFPD), Mid-step ppmb
56.167      694.68       : Step length (EFPD), Mid-step ppmb
```

```
56.167      536.65      : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
40.75       382.60      : Step length (EFPD), Mid-step ppmb
40.75       267.17      : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
36.50       234.64      : Step length (EFPD), Mid-step ppmb
36.50       128.17      : Step length (EFPD), Mid-step ppmb
18                      : # of axial nodes in CRC format
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
RODDED
7                       : Number of irradiation steps with CRA inserted
1                       : Number of axial section with CRA inserted in step 1
3 1 1 1 18 7 1          : Input card 47B
1                       : Number of axial section with CRA inserted in step 2
3 1 2 1 17 7 1          : Input card 47B
1                       : Number of axial section with CRA inserted in step 3
3 1 3 1 16 7 1          : Input card 47B
1                       : Number of axial section with CRA inserted in step 4
3 1 4 1 15 7 1          : Input card 47B
1                       : Number of axial section with CRA inserted in step 5
3 1 5 1 15 7 1          : Input card 47B
1                       : Number of axial section with CRA inserted in step 6
3 1 6 1 14 7 1          : Input card 47B
1                       : Number of axial section with CRA inserted in step 7
3 1 7 2 13 7 1          : Input card 47B
1                       : Number of different CRA absorber material mixtures
7                       : SAS2H material mixture number for CRA absorber
4                       : Number of isotopes or elements in the CRA absorber
47000   79.8            : SCALE isotope ID, Isotope wt%
49000   15.0            : SCALE isotope ID, Isotope wt%
48000   5.0             : SCALE isotope ID, Isotope wt%
13027   0.2             : SCALE isotope ID, Isotope wt%
1                       : Number of CRA designs
10.17   8 .             : CR absorber density, CR clad SAS2H mat. mix. number
8                       : Number of radial zones in Path B model with CRA inserted
7   0.49784             : Path B model CRA inserted (Input Card 47J)
5   0.50546
8   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784             : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
```

```
NO APSRA INSERTION HISTORY
18                          : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 938.7
1149.6
1304.2
1395.0
1436.6
1454.3
1464.9
1478.0
1498.6
1526.7
1557.5
1567.9
1520.3
1441.6
1372.0
1295.7
1192.2
1005.8
18                          : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1052.6
1250.7
1331.4
1329.1
1292.3
1255.8
1229.3
1213.1
1204.0
1195.3
1183.6
1182.9
1195.7
```

```
1217.9
1260.9
1322.0
1307.0
1110.7
18                          : # of fuel temp axial nodes (Stpt2-18 to EOC-18)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1048.6
1200.9
1242.4
1249.2
1266.8
1274.6
1274.3
1271.8
1264.4
1249.6
1242.7
1261.5
1281.9
1296.4
1303.3
1274.3
1198.0
1015.0
18                          : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
788.9
864.6
892.7
894.4
891.3
889.0
888.1
887.9
887.4
```

```
886.2
884.8
882.2
875.2
865.7
861.2
908.1
973.2
872.0
18                        : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 939.6
1065.8
1094.9
1090.8
1080.2
1066.7
1051.9
1038.6
1033.2
1041.7
1065.6
1098.9
1127.2
1140.4
1134.9
1109.1
1054.6
 930.3
18                        : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 974.7
1066.7
1074.2
1058.6
1043.2
```

```
1032.4
1024.9
1019.4
1016.6
1020.0
1031.2
1046.7
1060.4
1074.7
1086.1
1072.9
1041.8
 953.9
18                              : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                              : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0233
```

```
0.0232
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20,0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
```

```
16    20.0025
17    20.0025
18    22.3520
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                    : # of mod spec vol axial nodes (EOC-3 to Stpt2-3)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                    : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
```

```
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                       : # of burnup axial nodes (BOC-1A)
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                       : # of burnup axial nodes (BOC-1B)
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
```

```
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 3.449
 5.866
 8.075
 9.565
10.449
10.949
11.206
11.291
11.214
10.922
10.308
 9.490
 8.973
 8.769
 8.724
 8.565
 7.653
 5.186
18                          : # of burnup axial nodes (Stpt2-1B)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 5.805
 9.673
12.706
14.516
15.410
15.800
15.948
15.955
15.819
15.443
14.716
13.885
13.484
13.499
13.812
14.009
12.790
 8.552
18                          : # of burnup axial nodes (BOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
```

```
4   20.0025
5   20.0025
6   20.0025
7   20.0025
8   20.0025
9   20.0025
10  20.0025
11  20.0025
12  20.0025
13  20.0025
14  20.0025
15  20.0025
16  20.0025
17  20.0025
18  22.3520
 6.376
10.542
13.698
15.549
16.458
16.855
16.997
16.982
16.807
16.392
15.663
14.867
14.529
14.621
14.972
15.122
13.767
 9.189
18                          : # of burnup axial nodes (BOC-3)
1   17.7800                 : Node #, node height (cm)
2   20.0025
3   20.0025
4   20.0025
5   20.0025
6   20.0025
7   20.0025
8   20.0025
9   20.0025
10  20.0025
11  20.0025
12  20.0025
13  20.0025
14  20.0025
15  20.0025
16  20.0025
17  20.0025
18  22.3520
 7.865
12.836
16.381
18.343
19.264
19.645
19.764
19.724
19.524
19.089
18.356
17.572
17.243
17.361
17.917
18.555
17.404
11.711
```

```
18                          : # of burnup axial nodes (Stpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
10.524
16.971
21.207
23.400
24.380
24.747
24.805
24.668
24.366
23.889
23.219
22.586
22.437
22.707
23.302
23.728
21.941
14.702
18                          : # of burnup axial nodes (Stpt3-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
11.962
19.074
23.549
25.776
26.735
27.077
27.114
26.957
26.639
26.167
25.535
24.973
24.914
25.305
```

26.011
26.384
24.346
16.375

```
Y                          : This is a pick-up case from Stpt-2, Cyc-18, Assy A23
2                          : Relative pick-up cycle
2                          : Relative pick-up statepoint
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.54                       : U-235 wt% enrichment in U of UO2
463630                     : Grams of U per assembly
208                        : Number of fuel rods in assembly
1.44272                    : Pin-pitch in assembly (cm)
0.9398                     : Fuel pellet diameter (cm)
0.95758                    : Fuel rod cladding ID (cm)
1.0922                     : Fuel rod cladding OD (cm)
360.172                    : Fuel stack height (cm)
N                          : No axial blanket fuel
INCONEL                    : Spacer grid material
0.005757609                : Vol. frac. of mod. displaced by grids
ZIRC-4                     : Fuel rod cladding material
640.0                      : Avg. fuel rod cladding temp. (K)
Y                          : No cladding materials other than ZIRC-4
1                          : Number of clad materials other than ZIRC-4
8                          : SAS2H material mixture number for following material
SS304                      : Cladding material specification
2200.0                     : System pressure (psi)
Y                          : Activate BPRA tracking
1                          : Number of reactor cycles with BPRA
1 0                        : # of BPRA designs, # of non-Al203B4C BP's
3.7 1.01 0.5857538 16 2 4    : Input Card 18C
8                          : # of radial zones in BPRA Path B model
4 0.43180                  : BPRA Path B model (Input Card 18E)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
3 0.43180                  : Path B model with BPRA removed (Input Card 18F)
3 0.45720
3 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.97599
3 2.99939
6 0.43180                  : BPRA Path B model above absorber (Input Card 18G)
5 0.45720
2 0.54610
3 0.63246
2 0.67310
3 0.81397
500 2.91402
3 2.93693
AL203 6                    : Mat. above absorber in BPR, SAS2H mat. mix. #
1 1 2 17                   : BPRA insertion history (Input Card 18H)
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
4                          : # of insertion reactor cycles
1A                         : Insertion reactor cycle identifier
1                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
```

```
0               : Downtime at stpt
195.292         : Days of downtime at EOC
268.8           : Total cycle EFPD
413.0           : Total cycle length in calendar days
23              : Integer position of assembly in cycle
1B              : Insertion reactor cycle identifier
2               : # of stpts in cycle
0               : Stpt EFPD
0               : Length to stpt in calendar days
0               : Downtime at stpt
142.2           : Stpt EFPD
166.0           : Length to stpt in calendar days
14.792          : Downtime at stpt
97.0            : Days of downtime at EOC
171.3           : Total cycle EFPD
217.0           : Total cycle length in calendar days
23              : Integer position of assembly in cycle
02              : Insertion reactor cycle identifier
1               : # of stpts in cycle
0               : Stpt EFPD
0               : Length to stpt in calendar days
0               : Downtime at stpt
164.0           : Days of downtime at EOC
166.5           : Total cycle EFPD
212.0           : Total cycle length in calendar days
16              : Integer position of assembly in cycle
03              : Insertion reactor cycle identifier
3               : # of stpts in cycle
0               : Stpt EFPD
0               : Length to stpt in calendar days
0               : Downtime at stpt
168.5           : Stpt EFPD
193.0           : Length to stpt in calendar days
16.792          : Downtime at stpt
250.0           : Stpt EFPD
325.792         : Length to stpt in calendar days
12.333          : Downtime at stpt
73.0            : Days of downtime at EOC
323.0           : Total cycle EFPD
416.0           : Total cycle length in calendar days
22              : Integer position of assembly in cycle
Y               : Flag for variable or constant irradiation step specs
1               : Relative insertion cycle
1               : Relative statepoint in insertion cycle
4               : Number of steps in statepoint calculation
67.2    921.02  : Step length (EFPD), Mid-step ppmb
67.2    872.24  : Step length (EFPD), Mid-step ppmb
67.2    738.29  : Step length (EFPD), Mid-step ppmb
67.2    608.17  : Step length (EFPD), Mid-step ppmb
2               : Relative insertion cycle
1               : Relative statepoint in insertion cycle
2               : Number of steps in statepoint calculation
71.1    518.65  : Step length (EFPD), Mid-step ppmb
71.1    256.11  : Step length (EFPD), Mid-step ppmb
2               : Relative statepoint in insertion cycle
1               : Number of steps in statepoint calculation
29.10   237.54  : Step length (EFPD), Mid-step ppmb
3               : Relative insertion cycle
1               : Relative statepoint in insertion cycle
7               : Number of steps in statepoint calculation
 1.06   863.7   : Step length (EFPD), Mid-step ppmb
 8.96   783.0   : Step length (EFPD), Mid-step ppmb
51.85   664.0   : Step length (EFPD), Mid-step ppmb
37.40   537.6   : Step length (EFPD), Mid-step ppmb
37.40   432.0   : Step length (EFPD), Mid-step ppmb
29.34   328.5   : Step length (EFPD), Mid-step ppmb
 1.00   311.9   : Step length (EFPD), Mid-step ppmb
4               : Relative insertion cycle
1               : Relative statepoint in insertion cycle
3               : Number of steps in statepoint calculation
```

```
56.167      880.38     : Step length (EFPD), Mid-step ppmb
56.167      694.68     : Step length (EFPD), Mid-step ppmb
56.167      536.65     : Step length (EFPD), Mid-step ppmb
2                      : Relative statepoint in insertion cycle
2                      : Number of steps in statepoint calculation
40.75       382.60     : Step length (EFPD), Mid-step ppmb
40.75       267.17     : Step length (EFPD), Mid-step ppmb
3                      : Relative statepoint in insertion cycle
2                      : Number of steps in statepoint calculation
36.50       234.64     : Step length (EFPD), Mid-step ppmb
36.50       128.17     : Step length (EFPD), Mid-step ppmb
18                     : # of axial nodes in CRC format
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
RODDED
7                      : Number of irradiation steps with CRA inserted
1                      : Number of axial section with CRA inserted in step 1
3 1 1 1 18 7 1         : Input card 47B
1                      : Number of axial section with CRA inserted in step 2
3 1 2 1 17 7 1         : Input card 47B
1                      : Number of axial section with CRA inserted in step 3
3 1 3 1 16 7 1         : Input card 47B
1                      : Number of axial section with CRA inserted in step 4
3 1 4 1 15 7 1         : Input card 47B
1                      : Number of axial section with CRA inserted in step 5
3 1 5 1 15 7 1         : Input card 47B
1                      : Number of axial section with CRA inserted in step 6
3 1 6 1 14 7 1         : Input card 47B
4                      : Number of axial section with CRA inserted in step 7
3 1 7 2 3 7 1          : Input card 47B
3 1 7 5 7 7 1          : Input card 47B
3 1 7 9 11 7 1         : Input card 47B
3 1 7 13 13 7 1        : Input card 47B
1                      : Number of different CRA absorber material mixtures
7                      : SAS2H material mixture number for CRA absorber
4                      : Number of isotopes or elements in the CRA absorber
47000   79.8           : SCALE isotope ID, isotope wt%
49000   15.0           : SCALE isotope ID, isotope wt%
48000   5.0            : SCALE isotope ID, isotope wt%
13027   0.2            : SCALE isotope ID, isotope wt%
1                      : Number of CRA designs
10.17   8              : CR absorber density, CR clad SAS2H mat. mix. number
8                      : Number of radial zones in Path B model with CRA inserted
7   0.49784            : Path B model CRA inserted (Input Card 47J)
5   0.50546
8   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784            : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
```

```
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                          : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 938.7
1149.6
1304.2
1395.0
1436.6
1454.3
1464.9
1478.0
1498.6
1526.7
1557.5
1567.9
1520.3
1441.6
1372.0
1295.7
1192.2
1005.8
18                          : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1052.6
1250.7
1331.4
1329.1
1292.3
1255.8
1229.3
1213.1
```

```
1204.0
1195.3
1183.6
1182.9
1195.7
1217.9
1260.9
1322.0
1307.0
1110.7
18                          : # of fuel temp axial nodes (Stpt2-1B to EOC-1B)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
1048.6
1200.9
1242.4
1249.2
1266.8
1274.6
1274.3
1271.8
1264.4
1249.6
1242.7
1261.5
1281.9
1296.4
1303.3
1274.3
1198.0
1015.0
18                          : # of fuel temp axial nodes (BOC-2 to EOC-2)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 850.2
 942.5
 977.7
 982.5
```

```
 980.3
 977.5
 976.0
 975.6
 974.3
 969.5
 961.4
 952.1
 940.4
 929.4
 928.8
 994.1
1087.9
 976.3
18                      : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 964.8
1104.5
1139.5
1139.8
1127.7
1109.7
1083.8
1051.6
1029.5
1032.5
1060.1
1108.6
1163.0
1194.5
1188.6
1148.7
1083.3
 956.3
18                      : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
```

```
 996.5
1092.0
1103.4
1086.1
1068.4
1055.5
1044.8
1030.4
1013.5
1008.6
1018.5
1037.7
1061.7
1086.2
1092.6
1073.5
1041.6
 957.0
18                             : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1     17.7800                  : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                             : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1     17.7800                  : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
```

```
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
```

```
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
18                    : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                    : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
```

```
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                   : # of burnup axial nodes (BOC-1A)
1    17.7800         : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                   : # of burnup axial nodes (BOC-1B)
1    17.7800         : Node #, node height (cm)
2    20.0025
```

```
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 3.449
 5.866
 8.075
 9.565
10.449
10.949
11.206
11.291
11.214
10.922
10.308
 9.490
 8.973
 8.769
 8.724
 8.565
 7.653
 5.186
18                     : # of burnup axial nodes (Stpt2-1B)
1      17.7800         : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 5.805
 9.673
12.706
14.516
15.410
15.800
15.948
15.955
15.819
15.443
14.716
13.885
13.484
13.499
13.812
14.009
12.790
```

```
 8.552
18                         : # of burnup axial nodes (BOC-2)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 6.365
10.522
13.671
15.519
16.427
16.824
16.966
16.953
16.782
16.376
15.664
14.889
14.563
14.661
15.010
15.145
13.769
 9.184
18                         : # of burnup axial nodes (BOC-3)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 8.331
13.523
17.174
19.167
20.086
20.451
20.549
20.485
20.252
19.783
19.033
18.259
17.958
```

```
18.129
18.816
19.682
18.652
12.650
18                          : # of burnup axial nodes ($tpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
11.155
17.963
22.439
24.749
25.766
26.121
26.117
25.827
25.283
24.606
23.864
23.291
23.337
23.895
24.731
25.340
23.595
15.922
18                          : # of burnup axial nodes ($tpt3-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
12.699
20.238
24.987
27.335
28.325
28.647
28.606
28.252
27.612
```

26.872
26.143
25.648
25.835
26.583
27.535
28.085
26.085
17.667

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.83                    : U-235 wt% enrichment in U of UO2
463630                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.9398                  : Fuel pellet diameter (cm)
0.95758                 : Fuel rod cladding ID (cm)
1.0922                  : Fuel rod cladding OD (cm)
360.172                 : Fuel stack height (cm)
N                       : No axial blanket fuel
INCONEL                 : Spacer grid material
0.005757609             : Vol. frac. of mod. displaced by grids
ZIRC-4                  : Fuel rod cladding material
640.0                   : Avg. fuel rod cladding temp. (K)
Y                       : No cladding materials other than ZIRC-4
1                       : Number of clad materials other than ZIRC-4
6                       : SAS2H material mixture number for following material
SS304                   : Cladding material specification
2200.0                  : System pressure (psi)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
4                       : # of insertion reactor cycles
1A                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
195.292                 : Days of downtime at EOC
268.8                   : Total cycle EFPD
413.0                   : Total cycle length in calendar days
25                      : Integer position of assembly in cycle
1B                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
142.2                   : Stpt EFPD
166.0                   : Length to stpt in calendar days
14.792                  : Downtime at stpt
97.0                    : Days of downtime at EOC
171.3                   : Total cycle EFPD
217.0                   : Total cycle length in calendar days
25                      : Integer position of assembly in cycle
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212.0                   : Total cycle length in calendar days
13                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.3                   : Stpt EFPD
```

```
193.0                    : Length to stpt in calendar days
16.792                   : Downtime at stpt
250.0                    : Stpt EFPD
325.792                  : Length to stpt in calendar days
12.333                   : Downtime at stpt
73.0                     : Days of downtime at EOC
323.0                    : Total cycle EFPD
416.0                    : Total cycle length in calendar days
07                       : Integer position of assembly in cycle
Y                        : Flag for variable or constant irradiation step specs
1                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
4                        : Number of steps in statepoint calculation
67.2        921.02       : Step length (EFPD), Mid-step ppmb
67.2        872.24       : Step length (EFPD), Mid-step ppmb
67.2        738.29       : Step length (EFPD), Mid-step ppmb
67.2        608.17       : Step length (EFPD), Mid-step ppmb
2                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
2                        : Number of steps in statepoint calculation
71.1        518.65       : Step length (EFPD), Mid-step ppmb
71.1        256.11       : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
1                        : Number of steps in statepoint calculation
29.10       237.54       : Step length (EFPD), Mid-step ppmb
3                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
3                        : Number of steps in statepoint calculation
55.5        688.93       : Step length (EFPD), Mid-step ppmb
55.5        527.51       : Step length (EFPD), Mid-step ppmb
55.5        353.48       : Step length (EFPD), Mid-step.ppmb
4                        : Relative insertion cycle
1                        : Relative statepoint in insertion cycle
8                        : Number of steps in statepoint calculation
  .26       941.3        : Step length (EFPD), Mid-step ppmb
 5.23       945.3        : Step length (EFPD), Mid-step ppmb
 9.75       940.1        : Step length (EFPD), Mid-step ppmb
48.08       835.2        : Step length (EFPD), Mid-step ppmb
48.08       688.0        : Step length (EFPD), Mid-step ppmb
53.84       542.0        : Step length (EFPD), Mid-step ppmb
 2.76       457.6        : Step length (EFPD), Mid-step ppmb
 1.00       451.1        : Step length (EFPD), Mid-step ppmb
2                        : Relative statepoint in insertion cycle
5                        : Number of steps in statepoint calculation
 3.04       444.1        : Step length (EFPD), Mid-step ppmb
36.92       378.6        : Step length (EFPD), Mid-step ppmb
36.92       272.3        : Step length (EFPD), Mid-step ppmb
 4.56       231.2        : Step length (EFPD), Mid-step ppmb
  .56       234.5        : Step length (EFPD), Mid-step ppmb
3                        : Relative statepoint in insertion cycle
2                        : Number of steps in statepoint calculation
36.50       234.64       : Step length (EFPD), Mid-step ppmb
36.50       128.17       : Step length (EFPD), Mid-step ppmb
18                       : # of axial nodes in CRC format
1    17.7800             : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
```

```
17     20.0025
18     22.3520
RODDED
13                          : Number of irradiation steps with CRA inserted
1                           : Number of axial section with CRA inserted in step 1
4 1 1 1 18 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 2
4 1 2 1 17 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 3
4 1 3 1 16 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 4
4 1 4 1 15 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 5
4 1 5 1 15 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 6
4 1 6 1 14 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 7
4 1 7 1 13 7 1              : Input card 47B
2                           : Number of axial section with CRA inserted in step 8
4 1 8 2 3 7 1               : Input card 47B
4 1 8 5 13 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 9
4 2 1 1 15 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 10
4 2 2 1 14 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 11
4 2 3 1 14 7 1              : Input card 47B
1                           : Number of axial section with CRA inserted in step 12
4 2 4 1 13 7 1              : Input card 47B
2                           : Number of axial section with CRA inserted in step 13
4 2 5 1 10 7 1              : Input card 47B
4 2 5 12 13 7 1             : Input card 47B
1                           : Number of different CRA absorber material mixtures
7                           : SAS2H material mixture number for CRA absorber
4                           : Number of isotopes or elements in the CRA absorber
47000   79.8                : SCALE isotope ID, isotope wt%
49000   15.0                : SCALE isotope ID, isotope wt%
48000   5.0                 : SCALE isotope ID, isotope wt%
13027   0.2                 : SCALE isotope ID, isotope wt%
1                           : Number of CRA designs
10.17   6                   : CR absorber density, CR clad SAS2H mat. mix. number
8                           : Number of radial zones in Path B model with CRA inserted
7   0.49784                 : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0,55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784                 : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                          : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 798.7
 950.4
1053.3
1106.3
1134.1
1148.4
1157.4
1166.3
1177.7
1191.4
1203.4
1206.4
1195.7
1176.9
1166.0
1160.2
1090.4
 888.4
18                      : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 983.8
1172.9
1242.8
1248.0
1231.1
1210.0
1192.8
1181.8
1176.7
1176.3
1180.2
1188.0
1197.9
1206.2
1207.2
1192.4
1140.9
 971.1
18                      : # of fuel temp axial nodes (Stpt2-1B to EOC-1B)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
```

```
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 928.5
1079.4
1137.8
1160.7
1174.0
1184.1
1191.3
1196.0
1199.1
1202.1
1207.3
1213.6
1215.0
1204.0
1175.3
1128.6
1059.8
 910.1
18                      : # of fuel temp axial nodes (BOC-2 to EOC-2)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1077.0
1241.9
1306.2
1319.7
1320.1
1320.1
1322.6
1326.0
1324.7
1309.0
1275.9
1240.4
1211.8
1191.5
1184.6
1187.8
1163.2
1020.3
18                      : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1       17.7800         : Node #, node height (cm)
2       20.0025
```

```
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 762.6
 828.4
 856.1
 861.8
 859.6
 854.3
 847.9
 842.4
 840.5
 844.3
 853.5
 865.4
 876.1
 884.4
 913.8
1031.6
1017.0
 898.4
18                    : # of fuel temp axial nodes ($tpt2-3 to $tpt3-3)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 805.0
 869.5
 885.3
 882.6
 876.8
 871.7
 868.0
 865.5
 864.8
 866.4
 870.3
 875.6
 882.5
 906.4
1040.8
1060.1
1038.8
```

```
950.7
18              : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1   17.7800     : Node #, node height (cm)
2   20.0025
3   20.0025
4   20.0025
5   20.0025
6   20.0025
7   20.0025
8   20.0025
9   20.0025
10  20.0025
11  20.0025
12  20.0025
13  20.0025
14  20.0025
15  20.0025
16  20.0025
17  20.0025
18  22.3520
0.0227
0.0227
0.0226
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18              : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1   17.7800     : Node #, node height (cm)
2   20.0025
3   20.0025
4   20.0025
5   20.0025
6   20.0025
7   20.0025
8   20.0025
9   20.0025
10  20.0025
11  20.0025
12  20.0025
13  20.0025
14  20.0025
15  20.0025
16  20.0025
17  20.0025
18  22.3520
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
```

```
0.0219
0.0218
0.0217
0.0216
0.0216
18                                  : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0230
0.0229
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                                  : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0225
```

```
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0225
0.0225
0.0225
0.0224
0.0224
```

```
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
18                     : # of burnup axial nodes (BOC-1A)
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                     : # of burnup axial nodes (BOC-1B)
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
2.109
```

```
3.769
5.015
5.823
6.323
6.613
6.765
6.822
6.801
6.704
6.540
6.358
6.239
6.245
6.383
6.393
5.646
3.409
18                     : # of burnup axial nodes (Stpt2-1B)
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 4.098
 7.024
 8.938
 9.967
10.484
10.722
10.818
10.840
10.809
10.726
10.605
10.497
10.470
10.555
10.701
10.561
 9.314
 5.732
18                     : # of burnup axial nodes (BOC-2)
1    17.7800           : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
```

```
16    20.0025
17    20.0025
18    22.3520
 4.503
 7.663
 9.691
10.762
11.295
11.542
11.642
11.664
11.633
11.557
11.454
11.373
11.371
11.463
11.586
11.382
10.017
 6.179
18                         : # of burnup axial nodes (BOC-3)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 7.848
12.816
15.675
16.993
17.562
17.780
17.830
17.779
17.636
17.409
17.162
17.007
17.013
17.177
17.383
17.138
15.289
 9.716
18                         : # of burnup axial nodes (Stpt2-3)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
```

```
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 9.228
14.942
18.205
19.683
20.304
20.526
20.553
20.463
20.281
20.036
19.807
19.702
19.779
20.070
20.741
21.239
19.155
12.322
18                      : # of burnup axial nodes (Stpt3-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
10.021
16.110
19.542
21.063
21.685
21.898
21.916
21.819
21.635
21.396
21.186
21.112
21.244
21.712
23.126
23.701
21.407
13.883
```

```
Y                         : This is a pick-up case from BOC-2, Assy A25
3                         : Relative pick-up cycle
1                         : Relative pick-up statepoint
Crystal River, Unit 3     : Reactor Identifier
CR3                       : Prefix identifier for reactor
44group                   : Scale cross-section library
2.83                      : U-235 wt% enrichment in U of UO2
463630                    : Grams of U per assembly
208                       : Number of fuel rods in assembly
1.44272                   : Pin-pitch in assembly (cm)
0.9398                    : Fuel pellet diameter (cm)
0.95758                   : Fuel rod cladding ID (cm)
1.0922                    : Fuel rod cladding OD (cm)
360.172                   : Fuel stack height (cm)
N                         : No axial blanket fuel
INCONEL                   : Spacer grid material
0.005757609               : Vol. frac. of mod. displaced by grids
ZIRC-4                    : Fuel rod cladding material
640.0                     : Avg. fuel rod cladding temp. (K)
Y                         : No cladding materials other than ZIRC-4
1                         : Number of clad materials other than ZIRC-4
6                         : SAS2H material mixture number for following material
SS304                     : Cladding material specification
2200.0                    : System pressure (psi)
N                         : Activate BPRA tracking
5                         : # of radial zones in the standard Path B model
3 0.63246                 : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                         : # of cross-section libraries per irradiation step
5                         : SAS2H output print level
0.5                       : Zone mesh factor for XSDRNPM
NO SPECIAL                : No special XSDRNPM control parameter specs.
4                         : # of insertion reactor cycles
1A                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
195.292                   : Days of downtime at EOC
268.8                     : Total cycle EFPD
413.0                     : Total cycle length in calendar days
25                        : Integer position of assembly in cycle
1B                        : Insertion reactor cycle identifier
2                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
142.2                     : Stpt EFPD
166.0                     : Length to stpt in calendar days
14.792                    : Downtime at stpt
97.0                      : Days of downtime at EOC
171.3                     : Total cycle EFPD
217.0                     : Total cycle length in calendar days
25                        : Integer position of assembly in cycle
02                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
164.0                     : Days of downtime at EOC
166.5                     : Total cycle EFPD
212.0                     : Total cycle length in calendar days
13                        : Integer position of assembly in cycle
03                        : Insertion reactor cycle identifier
3                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
```

0		: Downtime at stpt
168.5		: Stpt EFPD
193.0		: Length to stpt in calendar days
16.792		: Downtime at stpt
250.0		: Stpt EFPD
325.792		: Length to stpt in calendar days
12.333		: Downtime at stpt
73.0		: Days of downtime at EOC
323.0		: Total cycle EFPD
416.0		: Total cycle length in calendar days
26		: Integer position of assembly in cycle
Y		: Flag for variable or constant irradiation step specs
1		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
4		: Number of steps in statepoint calculation
67.2	921.02	: Step length (EFPD), Mid-step ppmb
67.2	872.24	: Step length (EFPD), Mid-step ppmb
67.2	738.29	: Step length (EFPD), Mid-step ppmb
67.2	608.17	: Step length (EFPD), Mid-step ppmb
2		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
71.1	518.65	: Step length (EFPD), Mid-step ppmb
71.1	256.11	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
1		: Number of steps in statepoint calculation
29.10	237.54	: Step length (EFPD), Mid-step ppmb
3		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
3		: Number of steps in statepoint calculation
55.5	688.93	: Step length (EFPD), Mid-step ppmb
55.5	527.51	: Step length (EFPD), Mid-step ppmb
55.5	353.48	: Step length (EFPD), Mid-step ppmb
4		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
6		: Number of steps in statepoint calculation
6.84	946.1	: Step length (EFPD), Mid-step ppmb
3.33	945.6	: Step length (EFPD), Mid-step ppmb
66.47	830.5	: Step length (EFPD), Mid-step ppmb
39.84	672.2	: Step length (EFPD), Mid-step ppmb
39.84	546.9	: Step length (EFPD), Mid-step ppmb
12.18	471.5	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
3		: Number of steps in statepoint calculation
8.99	435.5	: Step length (EFPD), Mid-step ppmb
62.99	333.5	: Step length (EFPD), Mid-step ppmb
9.52	231.6	: Step length (EFPD), Mid-step ppmb
3		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
36.50	234.64	: Step length (EFPD), Mid-step ppmb
36.50	128.17	: Step length (EFPD), Mid-step ppmb
18		: # of axial nodes in CRC format
1	17.7800	: Node #, node height (cm)
2	20.0025	
3	20.0025	
4	20.0025	
5	20.0025	
6	20.0025	
7	20.0025	
8	20.0025	
9	20.0025	
10	20.0025	
11	20.0025	
12	20.0025	
13	20.0025	
14	20.0025	
15	20.0025	
16	20.0025	
17	20.0025	
18	22.3520	

```
RODDED
7                               : Number of irradiation steps with CRA inserted
1                               : Number of axial section with CRA inserted in step 1
4 1 1 1 4 7 1                   : Input card 47B
1                               : Number of axial section with CRA inserted in step 2
4 1 2 1 3 7 1                   : Input card 47B
1                               : Number of axial section with CRA inserted in step 3
4 1 3 1 2 7 1                   : Input card 47B
1                               : Number of axial section with CRA inserted in step 4
4 1 4 1 1 7 1                   : Input card 47B
1                               : Number of axial section with CRA inserted in step 5
4 1 5 1 1 7 1                   : Input card 47B
1                               : Number of axial section with CRA inserted in step 6
4 2 1 1 2 7 1                   : Input card 47B
1                               : Number of axial section with CRA inserted in step 7
4 2 2 1 1 7 1                   : Input card 47B
1                               : Number of different CRA absorber material mixtures
7                               : SAS2H material mixture number for CRA absorber
4                               : Number of isotopes or elements in the CRA absorber
47000   79.8                    : SCALE isotope ID, Isotope wt%
49000   15.0                    : SCALE isotope ID, Isotope wt%
48000   5.0                     : SCALE isotope ID, Isotope wt%
13027   0.2                     : SCALE isotope ID, Isotope wt%
1                               : Number of CRA designs
10.17   6_                      : CR absorber density, CR clad SAS2H mat. mix. number
8                               : Number of radial zones in Path B model with CRA inserted
7   0.49784                     : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784                     : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                              : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800                   : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 798.7
 950.4
1053.3
1106.3
1134.1
1148.4
1157.4
1166.3
```

```
1177.7
1191.4
1203.4
1206.4
1195.7
1176.9
1166.0
1160.2
1090.4
 888.4
18                                  : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 983.8
1172.9
1242.8
1248.0
1231.1
1210.0
1192.8
1181.8
1176.7
1176.3
1180.2
1188.0
1197.9
1206.2
1207.2
1192.4
1140.9
 971.1
18                                  : # of fuel temp axial nodes (Stpt2-1B to EOC-1B)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 928.5
1079.4
1137.8
1160.7
```

```
1174.0
1184.1
1191.3
1196.0
1199.1
1202.1
1207.3
1213.6
1215.0
1204.0
1175.3
1128.6
1059.8
 910.1
18                         : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1077.0
1241.9
1306.2
1319.7
1320.1
1320.1
1322.6
1326.0
1324.7
1309.0
1275.9
1240.4
1211.8
1191.5
1184.6
1187.8
1163.2
1020.3
18                         : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
```

```
 855.6
1077.9
1183.4
1206.9
1202.7
1190.9
1174.0
1156.6
1147.8
1155.1
1178.1
1210.9
1242.2
1256.6
1245.6
1211.0
1148.8
 993.2
18                         : # of fuel temp axial nodes ($tpt2-3 to $tpt3-3)
1      17.7800             : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 894.2
1110.1
1151.9
1146.4
1133.1
1123.1
1115.7
1109.0
1104.0
1104.4
1110.2
1118.6
1127.3
1133.2
1132.0
1123.4
1099.7
1003.9
18                         : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1      17.7800             : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
```

```
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0227
0.0227
0.0226
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                        : # of mod spec vol axial nodes (EOC-18 to Stpt2-18)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-18 to EOC-18)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
```

```
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0230
0.0229
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                      : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
```

```
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800             : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0233
0.0233
0.0232
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of burnup axial nodes (BOC-1A)
1     17.7800             : Node #, node height (cm)
2     20.0025
```

```
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                        : # of burnup axial nodes (BOC-18)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.109
3.769
5.015
5.823
6.323
6.613
6.765
6.822
6.801
6.704
6.540
6.358
6.239
6.245
6.383
6.393
5.646
```

```
3.409
18                      : # of burnup axial nodes (Stpt2-18)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 4.098
 7.024
 8.938
 9.967
10.484
10.722
10.818
10.840
10.809
10.726
10.605
10.497
10.470
10.555
10.701
10.561
 9.314
 5.732
18                      : # of burnup axial nodes (BOC-2)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 4.503
 7.663
 9.691
10.762
11.295
11.542
11.642
11.664
11.633
11.557
11.454
11.373
11.371
```

```
11.463
11.586
11.382
10.017
 6.179
18                              : # of burnup axial nodes (BOC-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 7.856
12.829
15.690
17.010
17.580
17.798
17.847
17.794
17.648
17.414
17.158
16.992
16.991
17.152
17.361
17.123
15.283
 9.715
18                              : # of burnup axial nodes (Stpt2-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
 9.710
16.384
20.857
22.822
23.707
24.005
24.015
23.842
23.542
```

```
23.213
22.980
22.947
23.144
23.472
23.667
23.121
20.510
13.098
18                              : # of burnup axial nodes ($tpt3-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
10.832
18.586
23.555
25.624
26.507
26.787
26.779
26.583
26.256
25.918
25.708
25.727
25.998
26.400
26.626
26.020
23.164
14.939
```

```
N                         : This is not a pick-up case
Crystal River, Unit 3     : Reactor identifier
CR3                       : Prefix identifier for reactor
44group                   : Scale cross-section library
1.93                      : U-235 wt% enrichment in U of UO2
463630                    : Grams of U per assembly
208                       : Number of fuel rods in assembly
1.44272                   : Pin-pitch in assembly (cm)
0.9398                    : Fuel pellet diameter (cm)
0.95758                   : Fuel rod cladding ID (cm)
1.0922                    : Fuel rod cladding OD (cm)
360.172                   : Fuel stack height (cm)
N                         : No axial blanket fuel
INCONEL                   : Spacer grid material
0.005757609               : Vol. frac. of mod. displaced by grids
ZIRC-4                    : Fuel rod cladding material
640.0                     : Avg. fuel rod cladding temp. (K)
Y                         : Cladding materials other than ZIRC-4
1                         : Number of cladding materials needed other than ZIRC-4
6                         : SAS2H material mixture number for clad material below
SS304                     : Cladding material for CR's
2200.0                    : System pressure (psi)
N                         : Activate BPRA tracking
5                         : # of radial zones in the standard Path B model
3 0.63246                 : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                         : # of cross-section libraries per irradiation step
5                         : SAS2H output print level
0.5                       : Zone mesh factor for XSDRNPM
NO SPECIAL                : No special XSDRNPM control parameter specs.
2                         : # of insertion reactor cycles
1A                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
195.292                   : Days of downtime at EOC
268.8                     : Total cycle EFPD
413                       : Total cycle length in calendar days
26                        : Integer position of assembly in cycle
1B                        : Insertion reactor cycle identifier
2                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
142.2                     : Stpt EFPD
166.0                     : Length to stpt in calendar days
14.792                    : Downtime at stpt
97.0                      : Days of downtime at EOC
171.3                     : Total cycle EFPD
217.0                     : Total cycle length in calendar days
18                        : Integer position of assembly in cycle
Y                         : Flag for variable or constant irradiation step specs
1                         : Relative insertion cycle
1                         : Relative statepoint in insertion cycle
10                        : Number of steps in statepoint calculation
 2.69       901.6         : Step length (EFPD), Mid-step ppmb
 6.31       904.3         : Step length (EFPD), Mid-step ppmb
 1.00       906.5         : Step length (EFPD), Mid-step ppmb
 1.00       907.1         : Step length (EFPD), Mid-step ppmb
 1.00       907.7         : Step length (EFPD), Mid-step ppmb
 1.23       908.4         : Step length (EFPD), Mid-step ppmb
63.89       928.0         : Step length (EFPD), Mid-step ppmb
63.89       855.8         : Step length (EFPD), Mid-step ppmb
63.89       728.4         : Step length (EFPD), Mid-step ppmb
63.89       593.9         : Step length (EFPD), Mid-step ppmb
2                         : Relative insertion cycle
```

```
1                          : Relative statepoint in insertion cycle
7                          : Number of steps in statepoint calculation
 6.32       542.7          : Step length (EFPD), Mid-step ppmb
10.51       558.3          : Step length (EFPD), Mid-step ppmb
54.83       442.6          : Step length (EFPD), Mid-step ppmb
37.79       318.7          : Step length (EFPD), Mid-step ppmb
30.55       282.6          : Step length (EFPD), Mid-step ppmb
  .55       282.5          : Step length (EFPD), Mid-step ppmb
 1.65       281.3          : Step length (EFPD), Mid-step ppmb
2                          : Relative statepoint in insertion cycle
1                          : Number of steps in statepoint calculation
29.10       237.54         : Step length (EFPD), Mid-step ppmb
18                         : # of axial nodes in CRC format
1    17.7800               : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
RODDED                     : CRA insertion
6                          : Number of irradiation steps with CRA inserted
1                          : Number of axial section with CRA inserted in step 1
1 1 1 1 15 7 1             : Input card 47B
1                          : Number of axial section with CRA inserted in step 2
1 1 2 1 14 7 1             : Input card 47B
2                          : Number of axial section with CRA inserted in step 3
1 1 3 1 5 7 1              : Input card 47B
1 1 3 12 14 7 1            : Input card 47B
2                          : Number of axial section with CRA inserted in step 4
1 1 4 1 3 7 1              : Input card 47B
1 1 4 13 14 7 1            : Input card 47B
2                          : Number of axial section with CRA inserted in step 5
1 1 5 1 2 7 1              : Input card 47B
1 1 5 14 14 7 1            : Input card 47B
1                          : Number of axial section with CRA inserted in step 6
1 1 6 1 1 7 1              : Input card 47B
1                          : Number of different CRA absorber material mixtures
7                          : SAS2H material mixture number for CRA absorber
4                          : Number of isotopes or elements in the CRA absorber
47000   79.8               : SCALE isotope ID, Isotope wt%
49000   15.0               : SCALE isotope ID, Isotope wt%
48000   5.0                : SCALE isotope ID, Isotope wt%
13027   0.2                : SCALE isotope ID, Isotope wt%
1                          : Number of CRA designs
10.17   6                  : CR absorber density, CR clad SAS2H mat. mix. number
8                          : Number of radial zones in Path B model with CRA inserted
7   0.49784                : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.90826
3   2.93113
3   0.49784                : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
```

```
2   0.67310
3   0.81397
500 2.97599
3   2.99939
RODDED                        : APSRA insertion
6                             : Number of irradiation steps with APSRA inserted
2 1 1 10 16 9 1 6             : Input card 48B
2 1 2 11 16 9 1 6             : Input card 48B
2 1 3 11 15 9 1 6             : Input card 48B
2 1 4 12 15 9 1 6             : Input card 48B
2 1 5 12 14 9 1 6             : Input card 48B
2 1 6 12 12 9 1 6             : Input card 48B
1                             : Number of different APSR absorber material mixtures
9                             : SAS2H material mixture number for APSR absorber
4                             : Number of isotopes or elements in the CRA absorber
47000   79.8                  : SCALE isotope ID, Isotope wt%
49000   15.0                  : SCALE isotope ID, Isotope wt%
48000   5.0                   : SCALE isotope ID, Isotope wt%
13027   0.2                   : SCALE isotope ID, Isotope wt%
1                             : Number of APSRA designs
10.17   6                     : APSR absorber density, APSR clad SAS2H mat. mix. number
8                             : Number of radial zones in Path B model with APSRA inserted
9   0.49784                   : Path B model APSRA inserted (Input Card 48J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.90826
3   2.93113
3   0.49784                   : Path B model APSRA removed (Input Card 48K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
3   0.49784                   : Path B model APSR follow rod (Input Card 48L)
3   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.96913
3   2.99248
18                            : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800                 : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 894.7
1100.1
1233.0
1305.8
1341.5
```

```
1357.9
1368.1
1380.0
1397.3
1420.2
1442.6
1449.8
1429.5
1388.0
1336.0
1269.4
1168.3
 944.6
18                          : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
1080.1
1285.2
1358.8
1357.7
1325.9
1292.0
1266.0
1248.9
1237.5
1213.7
1097.8
 999.0
 993.9
1006.5
1041.6
1238.9
1270.0
1093.8
18                          : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0232
```

```
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                       : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1     17.7800            : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0231
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
18                       : # of burnup axial nodes (BOC-1A)
1     17.7800            : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
```

```
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                    : # of burnup axial nodes (BOC-18)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
2.845
5.061
6.838
8.044
8.786
9.214
9.439
9.518
9.470
9.282
8.954
8.566
8.260
8.097
8.098
7.767
6.697
4.116
18                    : # of burnup axial nodes (Stpt2-18)
1    17.7800          : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
```

12	20.0025
13	20.0025
14	20.0025
15	20.0025
16	20.0025
17	20.0025
18	22.3520

5.336
9.077
11.651
13.123
13.869
14.202
14.320
14.314
14.182
13.718
12.512
11.504
11.196
11.180
11.693
12.576
11.509
7.278

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.83                    : U-235 wt% enrichment in U of UO2
463630                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.9398                  : Fuel pellet diameter (cm)
0.95758                 : Fuel rod cladding ID (cm)
1.0922                  : Fuel rod cladding OD (cm)
360.172                 : Fuel stack height (cm)
N                       : No axial blanket fuel
INCONEL                 : Spacer grid material
0.005757609             : Vol. frac. of mod. displaced by grids
ZIRC-4                  : Fuel rod cladding material
640.0                   : Avg. fuel rod cladding temp. (K)
Y                       : No cladding materials other than ZIRC-4
1                       : Number of clad materials other than ZIRC-4
6                       : SAS2H material mixture number for following material
SS304                   : Cladding material specification
2200.0                  : System pressure (psi)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
4                       : # of insertion reactor cycles
1A                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
195.292                 : Days of downtime at EOC
268.8                   : Total cycle EFPD
413.0                   : Total cycle length in calendar days
28                      : Integer position of assembly in cycle
1B                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
142.2                   : Stpt EFPD
166.0                   : Length to stpt in calendar days
14.792                  : Downtime at stpt
97.0                    : Days of downtime at EOC
171.3                   : Total cycle EFPD
217.0                   : Total cycle length in calendar days
28                      : Integer position of assembly in cycle
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212.0                   : Total cycle length in calendar days
18                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
```

193.0		: Length to stpt in calendar days
16.792		: Downtime at stpt
250.0		: Stpt EFPD
325.792		: Length to stpt in calendar days
12.333		: Downtime at stpt
73.0		: Days of downtime at EOC
323.0		: Total cycle EFPD
416.0		: Total cycle length in calendar days
10		: Integer position of assembly in cycle
Y		: Flag for variable or constant irradiation step specs
1		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
4		: Number of steps in statepoint calculation
67.2	921.02	: Step length (EFPD), Mid-step ppmb
67.2	872.24	: Step length (EFPD), Mid-step ppmb
67.2	738.29	: Step length (EFPD), Mid-step ppmb
67.2	608.17	: Step length (EFPD), Mid-step ppmb
2		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
71.1	518.65	: Step length (EFPD), Mid-step ppmb
71.1	256.11	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
1		: Number of steps in statepoint calculation
29.10	237.54	: Step length (EFPD), Mid-step ppmb
3		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
11		: Number of steps in statepoint calculation
1.93	854.1	: Step length (EFPD), Mid-step ppmb
4.62	781.5	: Step length (EFPD), Mid-step ppmb
1.23	790.2	: Step length (EFPD), Mid-step ppmb
7.51	806.7	: Step length (EFPD), Mid-step ppmb
32.00	677.4	: Step length (EFPD), Mid-step ppmb
10.49	621.3	: Step length (EFPD), Mid-step ppmb
51.35	526.8	: Step length (EFPD), Mid-step ppmb
13.72	441.8	: Step length (EFPD), Mid-step ppmb
19.33	378.5	: Step length (EFPD), Mid-step ppmb
13.96	332.1	: Step length (EFPD), Mid-step ppmb
10.36	316.1	: Step length (EFPD), Mid-step ppmb
4		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
3		: Number of steps in statepoint calculation
56.167	880.38	: Step length (EFPD), Mid-step ppmb
56.167	694.68	: Step length (EFPD), Mid-step ppmb
56.167	536.65	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
40.75	382.60	: Step length (EFPD), Mid-step ppmb
40.75	267.17	: Step length (EFPD), Mid-step ppmb
3		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
36.50	234.64	: Step length (EFPD), Mid-step ppmb
36.50	128.17	: Step length (EFPD), Mid-step ppmb
18		: # of axial nodes in CRC format
1	17.7800	: Node #, node height (cm)
2	20.0025	
3	20.0025	
4	20.0025	
5	20.0025	
6	20.0025	
7	20.0025	
8	20.0025	
9	20.0025	
10	20.0025	
11	20.0025	
12	20.0025	
13	20.0025	
14	20.0025	
15	20.0025	
16	20.0025	

```
17    20.0025
18    22.3520
NO CRA INSERTION HISTORY
RODDED                       : APSRA insertion
10                           : Number of irradiation steps with APSRA inserted
3 1 1 7 16 7 1 6             : Input card 48B
3 1 2 8 16 7 1 6             : Input card 48B
3 1 3 9 16 7 1 6             : Input card 48B
3 1 4 9 15 7 1 6             : Input card 48B
3 1 5 10 15 7 1 6            : Input card 48B
3 1 6 10 14 7 1 6            : Input card 48B
3 1 7 11 14 7 1 6            : Input card 48B
3 1 8 11 13 7 1 6            : Input card 48B
3 1 9 12 13 7 1 6            : Input card 48B
3 1 10 12 12 7 1 6           : Input card 48B
1                            : Number of different APSR absorber material mixtures
7                            : SAS2H material mixture number for APSR absorber
4                            : Number of isotopes or elements in the CRA absorber
47000   79.8                 : SCALE isotope ID, isotope wt%
49000   15.0                 : SCALE isotope ID, isotope wt%
48000   5.0                  : SCALE isotope ID, isotope wt%
13027   0.2                  : SCALE isotope ID, isotope wt%
1                            : Number of APSRA designs
10.17   6                    : APSR absorber density, APSR clad SAS2H mat. mix. number
8                            : Number of radial zones in Path B model with APSRA inserted
7   0.49784                  : Path B model APSRA inserted (Input Card 48J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.90826
3   2.93113
3   0.49784                  : Path B model APSRA removed (Input Card 48K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
3   0.49784                  : Path B model APSR follow rod (Input Card 48L)
3   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.96913
3   2.99248
18                           : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1     17.7800                : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 736.2
 851.2
```

```
 931.2
 978.1
1002.3
1015.2
1023.4
1030.9
1039.7
1049.5
1057.3
1058.6
1050.4
1034.4
1013.1
 979.7
 912.5
 770.4
18                              : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1      17.7800                  : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 833.2
 976.4
1035.4
1043.6
1031.3
1014.9
1001.4
 992.7
 988.6
 988.4
 991.5
 997.7
1006.3
1016.4
1026.4
1026.7
 988.9
 845.1
18                              : # of fuel temp axial nodes (Stpt2-1B to EOC-1B)
1      17.7800                  : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
```

```
17    20.0025
18    22.3520
 803.4
 921.9
 976.2
 999.7
1015.7
1026.8
1032.9
1036.3
1038.7
1041.6
1045.8
1050.5
1051.9
1045.4
1027.7
 996.2
 941.4
 810.7
18                         : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1138.8
1342.7
1432.2
1462.7
1472.3
1477.4
1485.2
1495.6
1502.7
1472.4
1229.1
1101.8
1062.8
1042.4
1072.3
1291.0
1297.0
1114.9
18                         : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
```

```
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 982.8
1136.1
1199.8
1209.1
1199.9
1186.1
1174.0
1168.1
1175.9
1208.6
1256.3
1295.9
1316.0
1316.2
1299.1
1282.4
1236.5
1066.8
18                        : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800            : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1010.3
1130.6
1156.0
1146.9
1132.6
1121.3
1114.5
1111.8
1115.2
1131.3
1152.6
1166.6
1173.1
1180.6
1187.8
1178.8
1153.8
1049.9
18                        : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1      17.7800            : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0224
0.0223
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
0.0216
18                        : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0225
0.0224
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1       17.7800           : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
```

```
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0225
0.0225
0.0224
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                    : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0235
0.0234
0.0233
0.0231
0.0230
0.0228
0.0227
0.0225
0.0224
0.0223
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                    : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
```

```
1     17.7800          : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                     : # of mod spec vol axial nodes ($tpt2-3 to $tpt3-3)
1     17.7800          : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0234
0.0233
0.0232
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
```

```
0.0218
0.0217
0.0216
18                              : # of burnup axial nodes (BOC-1A)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                              : # of burnup axial nodes (BOC-1B)
1    17.7800                    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
1.510
2.701
3.602
4.196
4.565
4.781
4.893
4.934
4.917
4.849
4.740
```

```
4.620
4.526
4.474
4.414
4.192
3.561
2.121
18                          : # of burnup axial nodes (Stpt2-18)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
2.757
4.779
6.129
6.873
7.250
7.425
7.494
7.506
7.480
7.421
7.341
7.271
7.242
7.260
7.248
6.980
6.030
3.657
18                          : # of burnup axial nodes (BOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20,0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
3.017
5.200
6.634
7.414
7.809
7.992
8.065
```

```
8.078
8.053
8.000
7.933
7.881
7.870
7.892
7.867
7.558
6.524
3.963
18                              : # of burnup axial nodes (BOC-3)
1      17.7800                  : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 6.700
10.966
13.433
14.577
15.070
15.248
15.230
15.044
14.610
13.631
12.560
12.045
12.149
12.672
13.627
14.062
12.694
 8.065
18                              : # of burnup axial nodes (Stpt2-3)
1      17.7800                  : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 9.416
15.299
18.714
```

```
20.263
20.898
21.104
21.072
20.869
20.464
19.642
18.816
18.517
18.757
19.343
20.264
20.525
18.523
11.954
18                                   : # of burnup axial nodes ($tpt3-3)
1        17.7800                     : Node #, node height (cm)
2        20.0025
3        20.0025
4        20.0025
5        20.0025
6        20.0025
7        20.0025
8        20.0025
9        20.0025
10       20.0025
11       20.0025
12       20.0025
13       20.0025
14       20.0025
15       20.0025
16       20.0025
17       20.0025
18       22.3520
10.947
17.603
21.346
22.952
23.563
23.738
23.686
23.477
23.089
22.330
21.595
21.379
21.699
22.398
23.432
23.658
21.413
13.987
```

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.83                       : U-235 wt% enrichment in U of UO2
463630                     : Grams of U per assembly
208                        : Number of fuel rods in assembly
1.44272                    : Pin-pitch in assembly (cm)
0.9398                     : Fuel pellet diameter (cm)
0.95758                    : Fuel rod cladding ID (cm)
1.0922                     : Fuel rod cladding OD (cm)
360.172                    : Fuel stack height (cm)
N                          : No axial blanket fuel
INCONEL                    : Spacer grid material
0.005757609                : Vol. frac. of mod. displaced by grids
ZIRC-4                     : Fuel rod cladding material
640.0                      : Avg. fuel rod cladding temp. (K)
Y                          : No cladding materials other than ZIRC-4
1                          : Number of clad materials other than ZIRC-4
6                          : SAS2H material mixture number for following material
SS304                      : Cladding material specification
2200.0                     : System pressure (psi)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
4                          : # of insertion reactor cycles
1A                         : Insertion reactor cycle identifier
1                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
195.292                    : Days of downtime at EOC
268.8                      : Total cycle EFPD
413.0                      : Total cycle length in calendar days
29                         : Integer position of assembly in cycle
1B                         : Insertion reactor cycle identifier
2                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
142.2                      : Stpt EFPD
166.0                      : Length to stpt in calendar days
14.792                     : Downtime at stpt
97.0                       : Days of downtime at EOC
171.3                      : Total cycle EFPD
217.0                      : Total cycle length in calendar days
29                         : Integer position of assembly in cycle
02                         : Insertion reactor cycle identifier
1                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
164.0                      : Days of downtime at EOC
166.5                      : Total cycle EFPD
212.0                      : Total cycle length in calendar days
22                         : Integer position of assembly in cycle
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
```

193.0		: Length to stpt in calendar days
16.792		: Downtime at stpt
250.0		: Stpt EFPD
325.792		: Length to stpt in calendar days
12.333		: Downtime at stpt
73.0		: Days of downtime at EOC
323.0		: Total cycle EFPD
416.0		: Total cycle length in calendar days
16		: Integer position of assembly in cycle
Y		: Flag for variable or constant irradiation step specs
1		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
4		: Number of steps in statepoint calculation
67.2	921.02	: Step length (EFPD), Mid-step ppmb
67.2	872.24	: Step length (EFPD), Mid-step ppmb
67.2	738.29	: Step length (EFPD), Mid-step ppmb
67.2	608.17	: Step length (EFPD), Mid-step ppmb
2		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
71.1	518.65	: Step length (EFPD), Mid-step ppmb
71.1	256.11	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
1		: Number of steps in statepoint calculation
29.10	237.54	: Step length (EFPD), Mid-step ppmb
3		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
3		: Number of steps in statepoint calculation
55.5	688.93	: Step length (EFPD), Mid-step ppmb
55.5	527.51	: Step length (EFPD), Mid-step ppmb
55.5	353.48	: Step length (EFPD), Mid-step ppmb
4		: Relative insertion cycle
1		: Relative statepoint in insertion cycle
7		: Number of steps in statepoint calculation
.27	941.3	: Step length (EFPD), Mid-step ppmb
5.77	945.7	: Step length (EFPD), Mid-step ppmb
10.40	937.4	: Step length (EFPD), Mid-step ppmb
48.86	833.4	: Step length (EFPD), Mid-step ppmb
48.86	683.9	: Step length (EFPD), Mid-step ppmb
51.21	538.3	: Step length (EFPD), Mid-step ppmb
3.63	455.6	: Step length (EFPD), Mid-step ppmb
2		: Relative statepoint in insertion cycle
5		: Number of steps in statepoint calculation
3.00	444.1	: Step length (EFPD), Mid-step ppmb
36.96	378.7	: Step length (EFPD), Mid-step ppmb
36.96	272.2	: Step length (EFPD), Mid-step ppmb
4.53	231.3	: Step length (EFPD), Mid-step ppmb
.55	234.5	: Step length (EFPD), Mid-step ppmb
3		: Relative statepoint in insertion cycle
2		: Number of steps in statepoint calculation
36.50	234.64	: Step length (EFPD), Mid-step ppmb
36.50	128.17	: Step length (EFPD), Mid-step ppmb
18		: # of axial nodes in CRC format
1	17.7800	: Node #, node height (cm)
2	20.0025	
3	20.0025	
4	20.0025	
5	20.0025	
6	20.0025	
7	20.0025	
8	20.0025	
9	20.0025	
10	20.0025	
11	20.0025	
12	20.0025	
13	20.0025	
14	20.0025	
15	20.0025	
16	20.0025	
17	20.0025	

```
18    22.3520
RODDED                        : CRA insertion
12                            : Number of irradiation steps with CRA inserted
1                             : Number of axial section with CRA inserted in step 1
4 1 1 1 18 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 2
4 1 2 1 17 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 3
4 1 3 1 16 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 4
4 1 4 1 15 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 5
4 1 5 1 15 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 6
4 1 6 1 14 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 7
4 1 7 1 13 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 8
4 2 1 1 15 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 9
4 2 2 1 14 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 10
4 2 3 1 14 7 1                : Input card 47B
1                             : Number of axial section with CRA inserted in step 11
4 2 4 1 13 7 1                : Input card 47B
2                             : Number of axial section with CRA inserted in step 12
4 2 5 1 10 7 1                : Input card 47B
4 2 5 12 13 7 1               : Input card 47B
1                             : Number of different CRA absorber material mixtures
7                             : SAS2H material mixture number for CRA absorber
4                             : Number of isotopes or elements in the CRA absorber
47000   79.8                  : SCALE isotope ID, isotope wt%
49000   15.0                  : SCALE isotope ID, isotope wt%
48000   5.0                   : SCALE isotope ID, isotope wt%
13027   0.2                   : SCALE isotope ID, isotope wt%
1                             : Number of CRA designs
10.17   6                     : CR absorber density, CR clad SAS2H mat. mix. number
8                             : Number of radial zones in Path B model with CRA inserted
7   0.49784                   : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784                   : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                            : # of fuel temp axial nodes (BOC-1A to EOC-1A)
1      17.7800                : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
```

```
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 765.0
 894.2
 984.8
1036.6
1064.9
1080.0
1089.6
1098.5
1108.9
1120.1
1128.8
1130.5
1121.6
1101.7
1071.3
1025.1
 947.7
 793.9
18                     : # of fuel temp axial nodes (BOC-1B to Stpt2-1B)
1     17.7800          : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 834.9
 977.7
1035.9
1041.2
1025.0
1005.4
 990.2
 980.7
 976.3
 975.9
 979.1
 985.7
 995.7
1010.4
1032.5
1052.2
1026.3
 876.4
18                     : # of fuel temp axial nodes (Stpt2-1B to EOC-1B)
1     17.7800          : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
```

```
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 809.5
 929.2
 987.1
1020.3
1051.2
1069.8
1077.4
1080.9
1083.5
1086.9
1092.1
1098.0
1100.6
1094.9
1076.5
1042.7
 982.2
 840.4
18                 : # of fuel temp axial nodes (BOC-2 to EOC-2)
1     17.7800      : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1114.3
1309.4
1401.2
1438.2
1452.7
1459.7
1466.4
1473.4
1473.3
1449.3
1389.0
1328.2
1285.8
1262.9
1267.8
1294.0
1277.2
1104.7
18                 : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1     17.7800      : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
```

```
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 850.5
 943.4
 982.9
 987.5
 980.3
 969.2
 956.5
 945.3
 941.9
 951.4
 971.3
 995.1
1015.8
1029.2
1068.7
1233.3
1214.6
1051.5
18                    : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 878.7
 959.9
 978.2
 970.4
 959.3
 950.4
 943.7
 938.0
 934.5
 936.6
 943.6
 952.5
 962.9
 991.6
1148.8
1166.1
1141.4
1039.3
18                    : # of mod spec vol axial nodes (BOC-1A to EOC-1A)
1     17.7800         : Node #, node height (cm)
2     20.0025
```

```
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0225
0.0225
0.0224
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-18 to Stpt2-18)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0225
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
```

```
0.0216
18              : # of mod spec vol axial nodes (Stpt2-1B to EOC-1B)
1    17.7800    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0226
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18              : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1    17.7800    : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0237
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0224
0.0223
0.0222
0.0221
```

```
0.0220
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0228
0.0227
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                        : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1    17.7800              : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0228
0.0228
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
```

```
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0216
18                      : # of burnup axial nodes (BOC-1A)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                      : # of burnup axial nodes (BOC-1B)
1    17.7800            : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
1.731
3.056
4.068
4.750
5.179
```

```
5.430
5.563
5.611
5.593
5.514
5.389
5.249
5.130
5.042
4.920
4.607
3.890
2.347
18                          : # of burnup axial nodes (Stpt2-1B)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
2.984
5.144
6.608
7.439
7.864
8.060
8.140
8.155
8.123
8.051
7.954
7.863
7.817
7.825
7.822
7.567
6.588
4.052
18                          : # of burnup axial nodes (BOC-2)
1    17.7800                : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
3.249
```

```
5.575
7.134
8.016
8.471
8.685
8.773
8.790
8.760
8.695
8.612
8.543
8.516
8.532
8.515
8.216
7.143
4.398
18                          : # of burnup axial nodes (BOC-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 6.778
11.124
13.736
15.025
15.609
15.841
15.887
15.804
15.584
15.235
14.872
14.651
14.649
14.836
15.050
14.823
13.246
 8.474
18                          : # of burnup axial nodes (Stpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
```

```
16     20.0025
17     20.0025
18     22.3520
 8.657
14.019
17.187
18.694
19.345
19.575
19.583
19.434
19.153
18.801
18.508
18.403
18.538
18.925
19.776
20.613
18.771
12.244
18                         : # of burnup axial nodes (Stpt3-3)
1      17.7800             : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 9.702
15.545
18.921
20.464
21.099
21.305
21.292
21.122
20.823
20.475
20.212
20.157
20.371
20.990
22.760
23.682
21.602
14.238
```

```
N                         : This is not a pick-up case
Crystal River, Unit 3     : Reactor Identifier
CR3                       : Prefix identifier for reactor
44group                   : Scale cross-section library
2.00                      : U-235 wt% enrichment in U of UO2
468620                    : Grams of U per assembly
208                       : Number of fuel rods in assembly
1.44272                   : Pin-pitch in assembly (cm)
0.9398                    : Fuel pellet diameter (cm)
0.95758                   : Fuel rod cladding ID (cm)
1.0922                    : Fuel rod cladding OD (cm)
360.172                   : Fuel stack height (cm)
N                         : No axial blanket fuel
INCONEL                   : Spacer grid material
0.005757609               : Vol. frac. of mod. displaced by grids
ZIRC-4                    : Fuel rod cladding material
640.0                     : Avg. fuel rod cladding temp. (K)
Y                         : Cladding materials other than ZIRC-4
1                         : Number of cladding materials needed other than ZIRC-4
6                         : SAS2H material mixture number for clad material below
SS304                     : Cladding material for CR's
2200.0                    : System pressure (psi)
N                         : Activate BPRA tracking
5                         : # of radial zones in the standard Path B model
3 0.63246                 : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                         : # of cross-section libraries per irradiation step
5                         : SAS2H output print level
0.5                       : Zone mesh factor for XSDRNPM
NO SPECIAL                : No special XSDRNPM control parameter specs.
2                         : # of insertion reactor cycles
01                        : Insertion reactor cycle identifier
1                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
1428.0                    : Days of downtime at EOC
309.3                     : Total cycle EFPD
547.0                     : Total cycle length in calendar days
01                        : Integer position of assembly in cycle
1B                        : Insertion reactor cycle identifier
2                         : # of stpts in cycle
0                         : Stpt EFPD
0                         : Length to stpt in calendar days
0                         : Downtime at stpt
142.2                     : Stpt EFPD
166.0                     : Length to stpt in calendar days
14.792                    : Downtime at stpt
97.0                      : Days of downtime at EOC
171.3                     : Total cycle EFPD
217.0                     : Total cycle length in calendar days
26                        : Integer position of assembly in cycle
Y                         : Flag for variable or constant irradiation step specs
1                         : Relative insertion cycle
1                         : Relative statepoint in insertion cycle
5                         : Number of steps in statepoint calculation
54.07     1005.9          : Step length (EFPD), Mid-step ppmb
63.98     867.4           : Step length (EFPD), Mid-step ppmb
63.98     654.9           : Step length (EFPD), Mid-step ppmb
63.98     450.1           : Step length (EFPD), Mid-step ppmb
63.98     245.4           : Step length (EFPD), Mid-step ppmb
2                         : Relative insertion cycle
1                         : Relative statepoint in insertion cycle
10                        : Number of steps in statepoint calculation
 4.64     541.1           : Step length (EFPD), Mid-step ppmb
24.31     568.0           : Step length (EFPD), Mid-step ppmb
42.71     435.6           : Step length (EFPD), Mid-step ppmb
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42.71      313.8           : Step length (EFPD), Mid-step ppmb
 9.62      274.8           : Step length (EFPD), Mid-step ppmb
 1.00      282.4           : Step length (EFPD), Mid-step ppmb
 1.00      283.3           : Step length (EFPD), Mid-step ppmb
 7.93      287.4           : Step length (EFPD), Mid-step ppmb
 8.07      284.8           : Step length (EFPD), Mid-step ppmb
  .20      280.6           : Step length (EFPD), Mid-step ppmb
2                          : Relative statepoint in insertion cycle
1                          : Number of steps in statepoint calculation
29.10         237.54       : Step length (EFPD), Mid-step ppmb
18                         : # of axial nodes in CRC format
1     17.7800              : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
RODDED                     : CRA insertion
15                         : Number of irradiation steps with CRA inserted
1                          : Number of axial section with CRA inserted in step 1
1 1 1 1 5 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 2
1 1 2 1 4 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 3
1 1 3 1 4 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 4
1 1 4 1 4 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 5
1 1 5 1 4 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 6
2 1 1 1 17 7 1             : Input card 47B
1                          : Number of axial section with CRA inserted in step 7
2 1 2 1 16 7 1             : Input card 47B
1                          : Number of axial section with CRA inserted in step 8
2 1 3 1 15 7 1             : Input card 47B
1                          : Number of axial section with CRA inserted in step 9
2 1 4 1 15 7 1             : Input card 47B
1                          : Number of axial section with CRA inserted in step 10
2 1 5 1 14 7 1             : Input card 47B
2                          : Number of axial section with CRA inserted in step 11
2 1 6 1 7 7 1              : Input card 47B
2 1 6 13 14 7 1            : Input card 47B
1                          : Number of axial section with CRA inserted in step 12
2 1 7 1 5 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 13
2 1 8 1 4 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 14
2 1 9 1 3 7 1              : Input card 47B
1                          : Number of axial section with CRA inserted in step 15
2 1 10 1 3 7 1             : Input card 47B
1                          : Number of different CRA absorber material mixtures
7                          : SAS2H material mixture number for CRA absorber
4                          : Number of isotopes or elements in the CRA absorber
47000    79.8              : SCALE isotope ID, Isotope wt%
49000    15.0              : SCALE isotope ID, Isotope wt%
48000    5.0               : SCALE isotope ID, Isotope wt%
13027    0.2               : SCALE isotope ID, Isotope wt%
1                          : Number of CRA designs
```

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10.17   6               : CR absorber density, CR clad SAS2H mat. mix. number
8                       : Number of radial zones in Path B model with CRA inserted
7   0.49784             : Path B model CRA inserted (Input Card 47J)
5   0.50546
6   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.38205
3   2.40078
3   0.49784             : Path B model CRA removed (Input Card 47K)
3   0.50546
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
NO APSRA INSERTION HISTORY
18                      : # of fuel temp axial nodes (BOC-1 [OCONEE] to EOC-1)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
 825.0
 982.4
1099.5
1195.7
1418.1
1512.9
1519.9
1509.5
1498.8
1492.4
1491.5
1495.8
1503.7
1512.2
1513.7
1488.1
1388.5
1109.9
18                      : # of fuel temp axial nodes (BOC-18 to Stpt2-18)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
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14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 841.6
 981.2
1043.8
1037.1
 961.7
 918.2
 898.9
 888.8
 882.9
 878.2
 873.7
 871.9
 875.2
 885.8
 920.9
1081.4
1130.2
1000.2
18                          : # of mod spec vol axial nodes (BOC-1 [OCONEE] to EOC-1)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0236
0.0235
0.0234
0.0233
0.0232
0.0230
0.0228
0.0227
0.0226
0.0224
0.0223
0.0221
0.0220
0.0219
0.0218
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-1B to Stpt2-1B)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
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10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
18                    : # of burnup axial nodes (BOC-1 [OCONEE])
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                    : # of burnup axial nodes (BOC-1B)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
```

```
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 2.270
 3.977
 5.373
 6.781
10.599
12.825
13.478
13.638
13.636
13.609
13.621
13.679
13.741
13.709
13.411
12.554
10.596
 6.368
18                  : # of burnup axial nodes (Stpt2-18)
1    17.7800        : Node #, node height (cm)
2    20.0025
3    20.0025
4    20.0025
5    20.0025
6    20.0025
7    20.0025
8    20.0025
9    20.0025
10   20.0025
11   20.0025
12   20.0025
13   20.0025
14   20.0025
15   20.0025
16   20.0025
17   20.0025
18   22.3520
 3.557
 6.090
 7.986
 9.617
13.312
15.391
15.966
16.080
16.048
15.996
15.991
16.060
16.174
16.247
16.258
16.316
14.517
 9.061
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A18/CR3A01N17DC08T139AC08T404.cut	aXLf.551	33	Apr 3 1997	153581	ASCII
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A18a/CR3A01N02DC09T158AC09T219.cut	aXLf.581	29	Apr 3 1997	139223	ASCII
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A18a/CR3A01N04DC09T000AC09T158.cut	aXLf.586	37	Apr 3 1997	171966	ASCII
A18a/CR3A01N04DC09T158AC09T219.cut	aXLf.587	30	Apr 3 1997	140306	ASCII
A18a/CR3A01N04DC09T219AC09T363.cut	aXLf.588	37	Apr 3 1997	173720	ASCII
A18a/CR3A01N05DC09T000AC09T158.cut	aXLf.589	37	Apr 3 1997	172464	ASCII
A18a/CR3A01N05DC09T158AC09T219.cut	aXLf.590	30	Apr 3 1997	140555	ASCII
A18a/CR3A01N05DC09T219AC09T363.cut	aXLf.591	37	Apr 3 1997	173720	ASCII
A18a/CR3A01N06DC09T000AC09T158.cut	aXLf.592	37	Apr 3 1997	172547	ASCII
A18a/CR3A01N06DC09T158AC09T219.cut	aXLf.593	30	Apr 3 1997	140721	ASCII

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A18a/CR3A01N08DC09T000AC09T158.cut	aXLf.598	37	Apr 3 1997	172547	ASCII
A18a/CR3A01N08DC09T158AC09T219.cut	aXLf.599	30	Apr 3 1997	140721	ASCII
A18a/CR3A01N08DC09T219AC09T363.cut	aXLf.600	37	Apr 3 1997	173720	ASCII
A18a/CR3A01N09DC09T000AC09T158.cut	aXLf.601	37	Apr 3 1997	172547	ASCII
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A18a/CR3A01N10DC09T158AC09T219.cut	aXLf.605	30	Apr 3 1997	140638	ASCII
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A18a/CR3A01N17DC09T219AC09T363.cut	aXLf.627	36	Apr 3 1997	172720	ASCII
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A18a/CR3A18N08DC1AT000AC09T000.cut	aXLf.638	36	Apr 3 1997	154272	ASCII
A18a/CR3A18N09DC1AT000AC09T000.cut	aXLf.639	37	Apr 3 1997	157366	ASCII
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A18a/CR3A18N14DC1AT000AC09T000.cut	aXLf.644	36	Apr 3 1997	156228	ASCII
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A18a/CR3A18N16DC1AT000AC09T000.cut	aXLf.646	36	Apr 3 1997	156477	ASCII
A18a/CR3A18N17DC1AT000AC09T000.cut	aXLf.647	36	Apr 3 1997	155066	ASCII
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A18b/CR3A18N02DC1AT000AC18T000.cut	aXLf.651	38	Apr 3 1997	166615	ASCII
A18b/CR3A18N02DC1BT000AC18T142.cut	aXLf.652	36	Apr 3 1997	164878	ASCII
A18b/CR3A18N03DC1AT000AC18T000.cut	aXLf.653	39	Apr 3 1997	167528	ASCII
A18b/CR3A18N03DC1BT000AC18T142.cut	aXLf.654	36	Apr 3 1997	166625	ASCII
A18b/CR3A18N04DC1AT000AC18T000.cut	aXLf.655	39	Apr 3 1997	168026	ASCII
A18b/CR3A18N04DC1BT000AC18T142.cut	aXLf.656	37	Apr 3 1997	167252	ASCII
A18b/CR3A18N05DC1AT000AC18T000.cut	aXLf.657	39	Apr 3 1997	168441	ASCII

A18b/CR3A18N05DC1BT000AC1BT142.cut	aXLf.658	37	Apr 3 1997	167584	ASCII
A18b/CR3A18N06DC1AT000AC1BT000.cut	aXLf.659	39	Apr 3 1997	168590	ASCII
A18b/CR3A18N06DC1BT000AC1BT142.cut	aXLf.660	37	Apr 3 1997	167584	ASCII
A18b/CR3A18N07DC1AT000AC1BT000.cut	aXLf.661	39	Apr 3 1997	168839	ASCII
A18b/CR3A18N07DC1BT000AC1BT142.cut	aXLf.662	37	Apr 3 1997	167584	ASCII
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A18b/CR3A18N09DC1BT000AC1BT142.cut	aXLf.666	37	Apr 3 1997	167418	ASCII
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A18b/CR3A18N10DC1BT000AC1BT142.cut	aXLf.668	37	Apr 3 1997	170678	ASCII
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A18b/CR3A18N11DC1BT000AC1BT142.cut	aXLf.670	37	Apr 3 1997	170300	ASCII
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A18b/CR3A18N16DC1AT000AC1BT000.cut	aXLf.679	39	Apr 3 1997	171124	ASCII
A18b/CR3A18N16DC1BT000AC1BT142.cut	aXLf.680	37	Apr 3 1997	169865	ASCII
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A18b/CR3A18N17DC1BT000AC1BT142.cut	aXLf.682	36	Apr 3 1997	164199	ASCII
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A20/CR3A12N07DC03T168AC03T250.cut	aXLf.698	33	Apr 3 1997	156012	ASCII
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A20/CR3A12N08DC03T168AC03T250.cut	aXLf.700	33	Apr 3 1997	156012	ASCII
A20/CR3A12N09DC03T000AC03T168.cut	aXLf.701	34	Apr 3 1997	157751	ASCII
A20/CR3A12N09DC03T168AC03T250.cut	aXLf.702	33	Apr 3 1997	155680	ASCII
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A25a/CR3A26N12DC03T000AC03T168.cut	aXLf1.193	36	Apr 3 1997	166514	ASCII
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A25a/CR3A26N17DC03T000AC03T168.cut	aXLf1.203	36	Apr 3 1997	165660	ASCII
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A25a/CR3A26N18DC03T000AC03T168.cut	aXLf1.205	36	Apr 3 1997	163415	ASCII
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THE FOLLOWING FILES FOR ASSEMBLY A26 WERE SUPERCEEDED BY FILES UNDER ASSEMBLY DESIGNATION A26z DURING CHECKING.

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A26/CR3A18N06DC1BT000AC1BT142.cut	aXLf1.212	38	Apr 3 1997	170384	ASCII
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A26/CR3A18N12DC1BT000AC1BT142.cut	aXLf1.218	38	Apr 3 1997	173980	ASCII
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A26/CR3A18N15DC1BT000AC1BT142.cut	aXLf1.221	38	Apr 3 1997	173731	ASCII
A26/CR3A18N16DC1BT000AC1BT142.cut	aXLf1.222	38	Apr 3 1997	173209	ASCII
A26/CR3A18N17DC1BT000AC1BT142.cut	aXLf1.223	37	Apr 3 1997	167033	ASCII
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A26/CR3A26N04DC1AT000AC1BT000.cut	aXLf1.228	37	Apr 3 1997	163582	ASCII
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A28/CR3A10N09DC03T000AC03T168.cut	aXLf1.259	33	Apr 3 1997	155984	ASCII
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A07/CR3A07N04DC1BT000AC1BT142.notes	aXLIf.205	7	Apr 3 1997	9235	ASCII
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THE FOLLOWING FILES FOR ASSEMBLY A18 WERE SUPERCEEDED BY FILES UNDER ASSEMBLY DESIGNATION A18z DURING CHECKING.

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A18/CR3A01N11DC08T139AC08T404.notes	aXLIf.431	9	Apr	3	1997	11038	ASCII
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A18/CR3A01N11DC08T409AC08T515.notes	aXLIf.433	9	Apr	3	1997	10706	ASCII
A18/CR3A01N12DC08T000AC08T097.notes	aXLIf.434	6	Apr	3	1997	7632	ASCII
A18/CR3A01N12DC08T097AC08T139.notes	aXLIf.435	8	Apr	3	1997	10284	ASCII
A18/CR3A01N12DC08T139AC08T404.notes	aXLIf.436	9	Apr	3	1997	11020	ASCII
A18/CR3A01N12DC08T404AC08T409.notes	aXLIf.437	8	Apr	3	1997	10246	ASCII
A18/CR3A01N12DC08T409AC08T515.notes	aXLIf.438	9	Apr	3	1997	10647	ASCII
A18/CR3A01N13DC08T000AC08T097.notes	aXLIf.439	6	Apr	3	1997	7606	ASCII
A18/CR3A01N13DC08T097AC08T139.notes	aXLIf.440	8	Apr	3	1997	10252	ASCII
A18/CR3A01N13DC08T139AC08T404.notes	aXLIf.441	9	Apr	3	1997	10979	ASCII
A18/CR3A01N13DC08T404AC08T409.notes	aXLIf.442	8	Apr	3	1997	10282	ASCII
A18/CR3A01N13DC08T409AC08T515.notes	aXLIf.443	9	Apr	3	1997	10615	ASCII
A18/CR3A01N14DC08T000AC08T097.notes	aXLIf.444	6	Apr	3	1997	7626	ASCII
A18/CR3A01N14DC08T097AC08T139.notes	aXLIf.445	8	Apr	3	1997	10154	ASCII
A18/CR3A01N14DC08T139AC08T404.notes	aXLIf.446	9	Apr	3	1997	10960	ASCII
A18/CR3A01N14DC08T404AC08T409.notes	aXLIf.447	8	Apr	3	1997	10232	ASCII
A18/CR3A01N14DC08T409AC08T515.notes	aXLIf.448	9	Apr	3	1997	10714	ASCII
A18/CR3A01N15DC08T000AC08T097.notes	aXLIf.449	6	Apr	3	1997	7628	ASCII
A18/CR3A01N15DC08T097AC08T139.notes	aXLIf.450	8	Apr	3	1997	10130	ASCII
A18/CR3A01N15DC08T139AC08T404.notes	aXLIf.451	9	Apr	3	1997	10904	ASCII
A18/CR3A01N15DC08T404AC08T409.notes	aXLIf.452	8	Apr	3	1997	10284	ASCII
A18/CR3A01N15DC08T409AC08T515.notes	aXLIf.453	9	Apr	3	1997	10668	ASCII
A18/CR3A01N16DC08T000AC08T097.notes	aXLIf.454	6	Apr	3	1997	7658	ASCII
A18/CR3A01N16DC08T097AC08T139.notes	aXLIf.455	8	Apr	3	1997	10164	ASCII
A18/CR3A01N16DC08T139AC08T404.notes	aXLIf.456	9	Apr	3	1997	10937	ASCII
A18/CR3A01N16DC08T404AC08T409.notes	aXLIf.457	8	Apr	3	1997	10218	ASCII
A18/CR3A01N16DC08T409AC08T515.notes	aXLIf.458	9	Apr	3	1997	10756	ASCII
A18/CR3A01N17DC08T000AC08T097.notes	aXLIf.459	6	Apr	3	1997	7623	ASCII

A18/CR3A01N17DC08T097AC08T139.notes	aXLIf.460	8	Apr 3 1997	10107	ASCII
A18/CR3A01N17DC08T139AC08T404.notes	aXLIf.461	9	Apr 3 1997	10753	ASCII
A18/CR3A01N17DC08T404AC08T409.notes	aXLIf.462	8	Apr 3 1997	10133	ASCII
A18/CR3A01N17DC08T409AC08T515.notes	aXLIf.463	8	Apr 3 1997	10490	ASCII
A18/CR3A01N18DC08T000AC08T097.notes	aXLIf.464	6	Apr 3 1997	7476	ASCII
A18/CR3A01N18DC08T097AC08T139.notes	aXLIf.465	8	Apr 3 1997	9857	ASCII
A18/CR3A01N18DC08T139AC08T404.notes	aXLIf.466	8	Apr 3 1997	10322	ASCII
A18/CR3A01N18DC08T404AC08T409.notes	aXLIf.467	8	Apr 3 1997	9806	ASCII
A18/CR3A01N18DC08T409AC08T515.notes	aXLIf.468	8	Apr 3 1997	10315	ASCII

THE FOLLOWING FILES FOR ASSEMBLY A18a WERE SUPERCEEDED BY FILES UNDER ASSEMBLY DESIGNATION A18az DURING CHECKING.

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A18a/CR3A01N01DC09T000AC09T158.notes	aXLIf.469	6	Apr 3 1997	7436	ASCII
A18a/CR3A01N01DC09T158AC09T219.notes	aXLIf.470	9	Apr 3 1997	11403	ASCII
A18a/CR3A01N01DC09T219AC09T363.notes	aXLIf.471	7	Apr 3 1997	9078	ASCII
A18a/CR3A01N02DC09T000AC09T158.notes	aXLIf.472	6	Apr 3 1997	7528	ASCII
A18a/CR3A01N02DC09T158AC09T219.notes	aXLIf.473	9	Apr 3 1997	11852	ASCII
A18a/CR3A01N02DC09T219AC09T363.notes	aXLIf.474	8	Apr 3 1997	9403	ASCII
A18a/CR3A01N03DC09T000AC09T158.notes	aXLIf.475	6	Apr 3 1997	7808	ASCII
A18a/CR3A01N03DC09T158AC09T219.notes	aXLIf.476	10	Apr 3 1997	12176	ASCII
A18a/CR3A01N03DC09T219AC09T363.notes	aXLIf.477	8	Apr 3 1997	9638	ASCII
A18a/CR3A01N04DC09T000AC09T158.notes	aXLIf.478	6	Apr 3 1997	7780	ASCII
A18a/CR3A01N04DC09T158AC09T219.notes	aXLIf.479	10	Apr 3 1997	12202	ASCII
A18a/CR3A01N04DC09T219AC09T363.notes	aXLIf.480	8	Apr 3 1997	9801	ASCII
A18a/CR3A01N05DC09T000AC09T158.notes	aXLIf.481	6	Apr 3 1997	7808	ASCII
A18a/CR3A01N05DC09T158AC09T219.notes	aXLIf.482	10	Apr 3 1997	12349	ASCII
A18a/CR3A01N05DC09T219AC09T363.notes	aXLIf.483	8	Apr 3 1997	9850	ASCII
A18a/CR3A01N06DC09T000AC09T158.notes	aXLIf.484	6	Apr 3 1997	7782	ASCII
A18a/CR3A01N06DC09T158AC09T219.notes	aXLIf.485	10	Apr 3 1997	12311	ASCII
A18a/CR3A01N06DC09T219AC09T363.notes	aXLIf.486	8	Apr 3 1997	9812	ASCII
A18a/CR3A01N07DC09T000AC09T158.notes	aXLIf.487	6	Apr 3 1997	7784	ASCII
A18a/CR3A01N07DC09T158AC09T219.notes	aXLIf.488	10	Apr 3 1997	12317	ASCII
A18a/CR3A01N07DC09T219AC09T363.notes	aXLIf.489	8	Apr 3 1997	9854	ASCII
A18a/CR3A01N08DC09T000AC09T158.notes	aXLIf.490	6	Apr 3 1997	7772	ASCII
A18a/CR3A01N08DC09T158AC09T219.notes	aXLIf.491	10	Apr 3 1997	12333	ASCII
A18a/CR3A01N08DC09T219AC09T363.notes	aXLIf.492	8	Apr 3 1997	9802	ASCII
A18a/CR3A01N09DC09T000AC09T158.notes	aXLIf.493	6	Apr 3 1997	7780	ASCII
A18a/CR3A01N09DC09T158AC09T219.notes	aXLIf.494	10	Apr 3 1997	12347	ASCII
A18a/CR3A01N09DC09T219AC09T363.notes	aXLIf.495	8	Apr 3 1997	9832	ASCII
A18a/CR3A01N10DC09T000AC09T158.notes	aXLIf.496	6	Apr 3 1997	7830	ASCII
A18a/CR3A01N10DC09T158AC09T219.notes	aXLIf.497	10	Apr 3 1997	12313	ASCII
A18a/CR3A01N10DC09T219AC09T363.notes	aXLIf.498	8	Apr 3 1997	9794	ASCII
A18a/CR3A01N11DC09T000AC09T158.notes	aXLIf.499	6	Apr 3 1997	7774	ASCII
A18a/CR3A01N11DC09T158AC09T219.notes	aXLIf.500	10	Apr 3 1997	12203	ASCII
A18a/CR3A01N11DC09T219AC09T363.notes	aXLIf.501	8	Apr 3 1997	9717	ASCII
A18a/CR3A01N12DC09T000AC09T158.notes	aXLIf.502	6	Apr 3 1997	7636	ASCII
A18a/CR3A01N12DC09T158AC09T219.notes	aXLIf.503	10	Apr 3 1997	12192	ASCII
A18a/CR3A01N12DC09T219AC09T363.notes	aXLIf.504	8	Apr 3 1997	9729	ASCII
A18a/CR3A01N13DC09T000AC09T158.notes	aXLIf.505	6	Apr 3 1997	7602	ASCII
A18a/CR3A01N13DC09T158AC09T219.notes	aXLIf.506	10	Apr 3 1997	12066	ASCII
A18a/CR3A01N13DC09T219AC09T363.notes	aXLIf.507	8	Apr 3 1997	9660	ASCII
A18a/CR3A01N14DC09T000AC09T158.notes	aXLIf.508	6	Apr 3 1997	7644	ASCII
A18a/CR3A01N14DC09T158AC09T219.notes	aXLIf.509	10	Apr 3 1997	12044	ASCII
A18a/CR3A01N14DC09T219AC09T363.notes	aXLIf.510	8	Apr 3 1997	9626	ASCII
A18a/CR3A01N15DC09T000AC09T158.notes	aXLIf.511	6	Apr 3 1997	7618	ASCII
A18a/CR3A01N15DC09T158AC09T219.notes	aXLIf.512	10	Apr 3 1997	12152	ASCII
A18a/CR3A01N15DC09T219AC09T363.notes	aXLIf.513	8	Apr 3 1997	9612	ASCII
A18a/CR3A01N16DC09T000AC09T158.notes	aXLIf.514	6	Apr 3 1997	7707	ASCII
A18a/CR3A01N16DC09T158AC09T219.notes	aXLIf.515	10	Apr 3 1997	12124	ASCII
A18a/CR3A01N16DC09T219AC09T363.notes	aXLIf.516	8	Apr 3 1997	9616	ASCII
A18a/CR3A01N17DC09T000AC09T158.notes	aXLIf.517	6	Apr 3 1997	7684	ASCII
A18a/CR3A01N17DC09T158AC09T219.notes	aXLIf.518	9	Apr 3 1997	12096	ASCII
A18a/CR3A01N17DC09T219AC09T363.notes	aXLIf.519	8	Apr 3 1997	9535	ASCII
A18a/CR3A01N18DC09T000AC09T158.notes	aXLIf.520	6	Apr 3 1997	7490	ASCII
A18a/CR3A01N18DC09T158AC09T219.notes	aXLIf.521	9	Apr 3 1997	11627	ASCII
A18a/CR3A01N18DC09T219AC09T363.notes	aXLIf.522	7	Apr 3 1997	9183	ASCII

THE FOLLOWING FILES FOR ASSEMBLY A18b WERE SUPERCEEDED BY FILES UNDER ASSEMBLY DESIGNATION A18bz DURING CHECKING.

Computer File Name	Tape Backup File Name	Number of Print Pages	File Date (Output)	File Size (Bytes)	File Type (Format)
A18b/CR3A18N01DC18T000AC18T142.notes	aXLIf.523	7	Apr 3 1997	8460	ASCII
A18b/CR3A18N02DC18T000AC18T142.notes	aXLIf.524	7	Apr 3 1997	8671	ASCII
A18b/CR3A18N03DC18T000AC18T142.notes	aXLIf.525	7	Apr 3 1997	8930	ASCII
A18b/CR3A18N04DC18T000AC18T142.notes	aXLIf.526	7	Apr 3 1997	9029	ASCII
A18b/CR3A18N05DC18T000AC18T142.notes	aXLIf.527	7	Apr 3 1997	8995	ASCII
A18b/CR3A18N06DC18T000AC18T142.notes	aXLIf.528	7	Apr 3 1997	9001	ASCII
A18b/CR3A18N07DC18T000AC18T142.notes	aXLIf.529	7	Apr 3 1997	8979	ASCII
A18b/CR3A18N08DC18T000AC18T142.notes	aXLIf.530	7	Apr 3 1997	8965	ASCII
A18b/CR3A18N09DC18T000AC18T142.notes	aXLIf.531	7	Apr 3 1997	8989	ASCII
A18b/CR3A18N10DC18T000AC18T142.notes	aXLIf.532	7	Apr 3 1997	8999	ASCII
A18b/CR3A18N11DC18T000AC18T142.notes	aXLIf.533	7	Apr 3 1997	9025	ASCII
A18b/CR3A18N12DC18T000AC18T142.notes	aXLIf.534	7	Apr 3 1997	8751	ASCII
A18b/CR3A18N13DC18T000AC18T142.notes	aXLIf.535	7	Apr 3 1997	8659	ASCII
A18b/CR3A18N14DC18T000AC18T142.notes	aXLIf.536	7	Apr 3 1997	8659	ASCII
A18b/CR3A18N15DC18T000AC18T142.notes	aXLIf.537	7	Apr 3 1997	8663	ASCII
A18b/CR3A18N16DC18T000AC18T142.notes	aXLIf.538	7	Apr 3 1997	8773	ASCII
A18b/CR3A18N17DC18T000AC18T142.notes	aXLIf.539	7	Apr 3 1997	8833	ASCII
A18b/CR3A18N18DC18T000AC18T142.notes	aXLIf.540	7	Apr 3 1997	8650	ASCII

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A20/CR3A12N01DC03T000AC03T168.notes	aXLIf.541	7	Apr 3 1997	8783	ASCII
A20/CR3A12N01DC03T168AC03T250.notes	aXLIf.542	8	Apr 3 1997	9918	ASCII
A20/CR3A12N02DC03T000AC03T168.notes	aXLIf.543	7	Apr 3 1997	8904	ASCII
A20/CR3A12N02DC03T168AC03T250.notes	aXLIf.544	8	Apr 3 1997	10159	ASCII
A20/CR3A12N03DC03T000AC03T168.notes	aXLIf.545	8	Apr 3 1997	9025	ASCII
A20/CR3A12N03DC03T168AC03T250.notes	aXLIf.546	8	Apr 3 1997	10350	ASCII
A20/CR3A12N04DC03T000AC03T168.notes	aXLIf.547	8	Apr 3 1997	9104	ASCII
A20/CR3A12N04DC03T168AC03T250.notes	aXLIf.548	9	Apr 3 1997	10377	ASCII
A20/CR3A12N05DC03T000AC03T168.notes	aXLIf.549	8	Apr 3 1997	9206	ASCII
A20/CR3A12N05DC03T168AC03T250.notes	aXLIf.550	9	Apr 3 1997	10383	ASCII
A20/CR3A12N06DC03T000AC03T168.notes	aXLIf.551	8	Apr 3 1997	9206	ASCII
A20/CR3A12N06DC03T168AC03T250.notes	aXLIf.552	9	Apr 3 1997	10363	ASCII
A20/CR3A12N07DC03T000AC03T168.notes	aXLIf.553	8	Apr 3 1997	9210	ASCII
A20/CR3A12N07DC03T168AC03T250.notes	aXLIf.554	9	Apr 3 1997	10365	ASCII
A20/CR3A12N08DC03T000AC03T168.notes	aXLIf.555	8	Apr 3 1997	9212	ASCII
A20/CR3A12N08DC03T168AC03T250.notes	aXLIf.556	9	Apr 3 1997	10377	ASCII
A20/CR3A12N09DC03T000AC03T168.notes	aXLIf.557	8	Apr 3 1997	9106	ASCII
A20/CR3A12N09DC03T168AC03T250.notes	aXLIf.558	9	Apr 3 1997	10383	ASCII
A20/CR3A12N10DC03T000AC03T168.notes	aXLIf.559	8	Apr 3 1997	9116	ASCII
A20/CR3A12N10DC03T168AC03T250.notes	aXLIf.560	9	Apr 3 1997	10387	ASCII
A20/CR3A12N11DC03T000AC03T168.notes	aXLIf.561	8	Apr 3 1997	9118	ASCII
A20/CR3A12N11DC03T168AC03T250.notes	aXLIf.562	9	Apr 3 1997	10397	ASCII
A20/CR3A12N12DC03T000AC03T168.notes	aXLIf.563	8	Apr 3 1997	9069	ASCII
A20/CR3A12N12DC03T168AC03T250.notes	aXLIf.564	9	Apr 3 1997	10397	ASCII
A20/CR3A12N13DC03T000AC03T168.notes	aXLIf.565	8	Apr 3 1997	9067	ASCII
A20/CR3A12N13DC03T168AC03T250.notes	aXLIf.566	9	Apr 3 1997	10375	ASCII
A20/CR3A12N14DC03T000AC03T168.notes	aXLIf.567	8	Apr 3 1997	9128	ASCII
A20/CR3A12N14DC03T168AC03T250.notes	aXLIf.568	9	Apr 3 1997	10377	ASCII
A20/CR3A12N15DC03T000AC03T168.notes	aXLIf.569	8	Apr 3 1997	9098	ASCII
A20/CR3A12N15DC03T168AC03T250.notes	aXLIf.570	9	Apr 3 1997	10347	ASCII
A20/CR3A12N16DC03T000AC03T168.notes	aXLIf.571	8	Apr 3 1997	9152	ASCII
A20/CR3A12N16DC03T168AC03T250.notes	aXLIf.572	9	Apr 3 1997	10331	ASCII
A20/CR3A12N17DC03T000AC03T168.notes	aXLIf.573	7	Apr 3 1997	8976	ASCII
A20/CR3A12N17DC03T168AC03T250.notes	aXLIf.574	8	Apr 3 1997	10342	ASCII
A20/CR3A12N18DC03T000AC03T168.notes	aXLIf.575	7	Apr 3 1997	8998	ASCII
A20/CR3A12N18DC03T168AC03T250.notes	aXLIf.576	8	Apr 3 1997	9982	ASCII
A20/CR3A20N01DC18T000AC18T142.notes	aXLIf.577	7	Apr 3 1997	8222	ASCII
A20/CR3A20N01DC18T142AC02T000.notes	aXLIf.578	8	Apr 3 1997	9704	ASCII
A20/CR3A20N02DC18T000AC18T142.notes	aXLIf.579	7	Apr 3 1997	8397	ASCII
A20/CR3A20N02DC18T142AC02T000.notes	aXLIf.580	8	Apr 3 1997	9920	ASCII
A20/CR3A20N03DC18T000AC18T142.notes	aXLIf.581	7	Apr 3 1997	8416	ASCII
A20/CR3A20N03DC18T142AC02T000.notes	aXLIf.582	8	Apr 3 1997	9968	ASCII

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A20/CR3A20N05DC1BT142AC02T000.notes	aXLIf.586	8	Apr 3 1997	10092	ASCII
A20/CR3A20N06DC1BT000AC1BT142.notes	aXLIf.587	7	Apr 3 1997	8733	ASCII
A20/CR3A20N06DC1BT142AC02T000.notes	aXLIf.588	8	Apr 3 1997	10098	ASCII
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A20/CR3A20N07DC1BT142AC02T000.notes	aXLIf.590	8	Apr 3 1997	10094	ASCII
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A20/CR3A20N08DC1BT142AC02T000.notes	aXLIf.592	8	Apr 3 1997	10094	ASCII
A20/CR3A20N09DC1BT000AC1BT142.notes	aXLIf.593	7	Apr 3 1997	8740	ASCII
A20/CR3A20N09DC1BT142AC02T000.notes	aXLIf.594	8	Apr 3 1997	10090	ASCII
A20/CR3A20N10DC1BT000AC1BT142.notes	aXLIf.595	7	Apr 3 1997	8717	ASCII
A20/CR3A20N10DC1BT142AC02T000.notes	aXLIf.596	8	Apr 3 1997	10094	ASCII
A20/CR3A20N11DC1BT000AC1BT142.notes	aXLIf.597	7	Apr 3 1997	8741	ASCII
A20/CR3A20N11DC1BT142AC02T000.notes	aXLIf.598	8	Apr 3 1997	10100	ASCII
A20/CR3A20N12DC1BT000AC1BT142.notes	aXLIf.599	7	Apr 3 1997	8739	ASCII
A20/CR3A20N12DC1BT142AC02T000.notes	aXLIf.600	8	Apr 3 1997	10102	ASCII
A20/CR3A20N13DC1BT000AC1BT142.notes	aXLIf.601	7	Apr 3 1997	8735	ASCII
A20/CR3A20N13DC1BT142AC02T000.notes	aXLIf.602	8	Apr 3 1997	10144	ASCII
A20/CR3A20N14DC1BT000AC1BT142.notes	aXLIf.603	7	Apr 3 1997	8725	ASCII
A20/CR3A20N14DC1BT142AC02T000.notes	aXLIf.604	8	Apr 3 1997	10144	ASCII
A20/CR3A20N15DC1BT000AC1BT142.notes	aXLIf.605	7	Apr 3 1997	8653	ASCII
A20/CR3A20N15DC1BT142AC02T000.notes	aXLIf.606	8	Apr 3 1997	10237	ASCII
A20/CR3A20N16DC1BT000AC1BT142.notes	aXLIf.607	7	Apr 3 1997	8821	ASCII
A20/CR3A20N16DC1BT142AC02T000.notes	aXLIf.608	8	Apr 3 1997	10131	ASCII
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A20/CR3A20N18DC1BT000AC1BT142.notes	aXLIf.611	7	Apr 3 1997	8591	ASCII
A20/CR3A20N18DC1BT142AC02T000.notes	aXLIf.612	8	Apr 3 1997	9807	ASCII
A20/CR3A23N01DC02T000AC03T000.notes	aXLIf.613	7	Apr 3 1997	8380	ASCII
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A20/CR3A23N03DC02T000AC03T000.notes	aXLIf.615	7	Apr 3 1997	8742	ASCII
A20/CR3A23N04DC02T000AC03T000.notes	aXLIf.616	7	Apr 3 1997	8769	ASCII
A20/CR3A23N05DC02T000AC03T000.notes	aXLIf.617	7	Apr 3 1997	8735	ASCII
A20/CR3A23N06DC02T000AC03T000.notes	aXLIf.618	7	Apr 3 1997	8747	ASCII
A20/CR3A23N07DC02T000AC03T000.notes	aXLIf.619	7	Apr 3 1997	8783	ASCII
A20/CR3A23N08DC02T000AC03T000.notes	aXLIf.620	7	Apr 3 1997	8789	ASCII
A20/CR3A23N09DC02T000AC03T000.notes	aXLIf.621	7	Apr 3 1997	8789	ASCII
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A20/CR3A23N11DC02T000AC03T000.notes	aXLIf.623	7	Apr 3 1997	8842	ASCII
A20/CR3A23N12DC02T000AC03T000.notes	aXLIf.624	7	Apr 3 1997	8850	ASCII
A20/CR3A23N13DC02T000AC03T000.notes	aXLIf.625	7	Apr 3 1997	8836	ASCII
A20/CR3A23N14DC02T000AC03T000.notes	aXLIf.626	7	Apr 3 1997	8844	ASCII
A20/CR3A23N15DC02T000AC03T000.notes	aXLIf.627	7	Apr 3 1997	8895	ASCII
A20/CR3A23N16DC02T000AC03T000.notes	aXLIf.628	7	Apr 3 1997	8830	ASCII
A20/CR3A23N17DC02T000AC03T000.notes	aXLIf.629	7	Apr 3 1997	8797	ASCII
A20/CR3A23N18DC02T000AC03T000.notes	aXLIf.630	7	Apr 3 1997	8626	ASCII

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A22/CR3A22N02DC1BT000AC1BT142.notes	aXLIf.632	7	Apr 3 1997	8748	ASCII
A22/CR3A22N03DC1BT000AC1BT142.notes	aXLIf.633	7	Apr 3 1997	9076	ASCII
A22/CR3A22N04DC1BT000AC1BT142.notes	aXLIf.634	7	Apr 3 1997	9113	ASCII
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A22/CR3A22N10DC1BT000AC1BT142.notes	aXLIf.640	7	Apr 3 1997	9183	ASCII
A22/CR3A22N11DC1BT000AC1BT142.notes	aXLIf.641	7	Apr 3 1997	9145	ASCII
A22/CR3A22N12DC1BT000AC1BT142.notes	aXLIf.642	7	Apr 3 1997	9189	ASCII
A22/CR3A22N13DC1BT000AC1BT142.notes	aXLIf.643	7	Apr 3 1997	9155	ASCII
A22/CR3A22N14DC1BT000AC1BT142.notes	aXLIf.644	7	Apr 3 1997	9101	ASCII
A22/CR3A22N15DC1BT000AC1BT142.notes	aXLIf.645	7	Apr 3 1997	9097	ASCII
A22/CR3A22N16DC1BT000AC1BT142.notes	aXLIf.646	7	Apr 3 1997	9149	ASCII
A22/CR3A22N17DC1BT000AC1BT142.notes	aXLIf.647	7	Apr 3 1997	9005	ASCII

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A23/CR3A06N02DC03T168AC03T250.notes	aXLIf.652	8	Apr 3 1997	9980	ASCII
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A23/CR3A06N04DC03T168AC03T250.notes	aXLIf.656	9	Apr 3 1997	10395	ASCII
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A23/CR3A06N07DC03T168AC03T250.notes	aXLIf.662	9	Apr 3 1997	10363	ASCII
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A23/CR3A06N09DC03T000AC03T168.notes	aXLIf.665	8	Apr 3 1997	9023	ASCII
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A23/CR3A23N02DC1BT000AC1BT142.notes	aXLIf.705	7	Apr 3 1997	8705	ASCII
A23/CR3A23N02DC1BT142AC02T000.notes	aXLIf.706	8	Apr 3 1997	9907	ASCII
A23/CR3A23N03DC1BT000AC1BT142.notes	aXLIf.707	7	Apr 3 1997	8839	ASCII
A23/CR3A23N03DC1BT142AC02T000.notes	aXLIf.708	8	Apr 3 1997	10101	ASCII
A23/CR3A23N04DC1BT000AC1BT142.notes	aXLIf.709	7	Apr 3 1997	9031	ASCII
A23/CR3A23N04DC1BT142AC02T000.notes	aXLIf.710	8	Apr 3 1997	10097	ASCII
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A23/CR3A23N10DC18T142AC02T000.notes	aXLIf.722	8	Apr 3 1997	10069	ASCII
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A23/CR3A23N14DC18T000AC18T142.notes	aXLIf.729	7	Apr 3 1997	8932	ASCII
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A23/CR3A23N15DC18T000AC18T142.notes	aXLIf.731	7	Apr 3 1997	8867	ASCII
A23/CR3A23N15DC18T142AC02T000.notes	aXLIf.732	8	Apr 3 1997	10093	ASCII
A23/CR3A23N16DC18T000AC18T142.notes	aXLIf.733	7	Apr 3 1997	8877	ASCII
A23/CR3A23N16DC18T142AC02T000.notes	aXLIf.734	8	Apr 3 1997	10137	ASCII
A23/CR3A23N17DC18T000AC18T142.notes	aXLIf.735	7	Apr 3 1997	8823	ASCII
A23/CR3A23N17DC18T142AC02T000.notes	aXLIf.736	8	Apr 3 1997	10129	ASCII
A23/CR3A23N18DC18T000AC18T142.notes	aXLIf.737	7	Apr 3 1997	8630	ASCII
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A23a/CR3A16N03DC02T000AC03T000.notes	aXLIf.741	7	Apr 3 1997	8838	ASCII
A23a/CR3A16N04DC02T000AC03T000.notes	aXLIf.742	7	Apr 3 1997	8831	ASCII
A23a/CR3A16N05DC02T000AC03T000.notes	aXLIf.743	7	Apr 3 1997	8831	ASCII
A23a/CR3A16N06DC02T000AC03T000.notes	aXLIf.744	7	Apr 3 1997	8823	ASCII
A23a/CR3A16N07DC02T000AC03T000.notes	aXLIf.745	7	Apr 3 1997	8833	ASCII
A23a/CR3A16N08DC02T000AC03T000.notes	aXLIf.746	7	Apr 3 1997	8835	ASCII
A23a/CR3A16N09DC02T000AC03T000.notes	aXLIf.747	7	Apr 3 1997	8837	ASCII
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A23a/CR3A16N11DC02T000AC03T000.notes	aXLIf.749	7	Apr 3 1997	8843	ASCII
A23a/CR3A16N12DC02T000AC03T000.notes	aXLIf.750	7	Apr 3 1997	8855	ASCII
A23a/CR3A16N13DC02T000AC03T000.notes	aXLIf.751	7	Apr 3 1997	8867	ASCII
A23a/CR3A16N14DC02T000AC03T000.notes	aXLIf.752	7	Apr 3 1997	8867	ASCII
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A23a/CR3A16N16DC02T000AC03T000.notes	aXLIf.754	7	Apr 3 1997	8857	ASCII
A23a/CR3A16N17DC02T000AC03T000.notes	aXLIf.755	7	Apr 3 1997	8844	ASCII
A23a/CR3A16N18DC02T000AC03T000.notes	aXLIf.756	7	Apr 3 1997	8701	ASCII
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A23a/CR3A22N02DC03T168AC03T250.notes	aXLIf.760	8	Apr 3 1997	10077	ASCII
A23a/CR3A22N03DC03T000AC03T168.notes	aXLIf.761	7	Apr 3 1997	8982	ASCII
A23a/CR3A22N03DC03T168AC03T250.notes	aXLIf.762	8	Apr 3 1997	10346	ASCII
A23a/CR3A22N04DC03T000AC03T168.notes	aXLIf.763	8	Apr 3 1997	9166	ASCII
A23a/CR3A22N04DC03T168AC03T250.notes	aXLIf.764	9	Apr 3 1997	10365	ASCII
A23a/CR3A22N05DC03T000AC03T168.notes	aXLIf.765	8	Apr 3 1997	9206	ASCII
A23a/CR3A22N05DC03T168AC03T250.notes	aXLIf.766	9	Apr 3 1997	10347	ASCII
A23a/CR3A22N06DC03T000AC03T168.notes	aXLIf.767	8	Apr 3 1997	9218	ASCII
A23a/CR3A22N06DC03T168AC03T250.notes	aXLIf.768	9	Apr 3 1997	10337	ASCII
A23a/CR3A22N07DC03T000AC03T168.notes	aXLIf.769	8	Apr 3 1997	9210	ASCII
A23a/CR3A22N07DC03T168AC03T250.notes	aXLIf.770	9	Apr 3 1997	10337	ASCII
A23a/CR3A22N08DC03T000AC03T168.notes	aXLIf.771	8	Apr 3 1997	9204	ASCII
A23a/CR3A22N08DC03T168AC03T250.notes	aXLIf.772	9	Apr 3 1997	10349	ASCII
A23a/CR3A22N09DC03T000AC03T168.notes	aXLIf.773	8	Apr 3 1997	9210	ASCII
A23a/CR3A22N09DC03T168AC03T250.notes	aXLIf.774	9	Apr 3 1997	10351	ASCII
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A23a/CR3A22N10DC03T168AC03T250.notes	aXLIf.776	9	Apr 3 1997	10363	ASCII
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A23a/CR3A22N12DC03T168AC03T250.notes	aXLIf.780	9	Apr 3 1997	10397	ASCII
A23a/CR3A22N13DC03T000AC03T168.notes	aXLIf.781	7	Apr 3 1997	8998	ASCII
A23a/CR3A22N13DC03T168AC03T250.notes	aXLIf.782	9	Apr 3 1997	10393	ASCII
A23a/CR3A22N14DC03T000AC03T168.notes	aXLIf.783	8	Apr 3 1997	9037	ASCII
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A23a/CR3A22N17DC03T168AC03T250.notes	aXLIf.790	9	Apr 3 1997	10373	ASCII
A23a/CR3A22N18DC03T000AC03T168.notes	aXLIf.791	7	Apr 3 1997	8912	ASCII
A23a/CR3A22N18DC03T168AC03T250.notes	aXLIf.792	8	Apr 3 1997	9988	ASCII
A23a/CR3A23N01DC18T142AC02T000.notes	aXLIf.793	8	Apr 3 1997	9677	ASCII
A23a/CR3A23N02DC18T142AC02T000.notes	aXLIf.794	8	Apr 3 1997	9907	ASCII
A23a/CR3A23N03DC18T142AC02T000.notes	aXLIf.795	8	Apr 3 1997	10101	ASCII
A23a/CR3A23N04DC18T142AC02T000.notes	aXLIf.796	8	Apr 3 1997	10097	ASCII
A23a/CR3A23N05DC18T142AC02T000.notes	aXLIf.797	8	Apr 3 1997	10071	ASCII
A23a/CR3A23N06DC18T142AC02T000.notes	aXLIf.798	8	Apr 3 1997	10063	ASCII
A23a/CR3A23N07DC18T142AC02T000.notes	aXLIf.799	8	Apr 3 1997	10047	ASCII
A23a/CR3A23N08DC18T142AC02T000.notes	aXLIf.800	8	Apr 3 1997	10049	ASCII
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A23a/CR3A23N10DC18T142AC02T000.notes	aXLIf.802	8	Apr 3 1997	10069	ASCII
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A23a/CR3A23N14DC18T142AC02T000.notes	aXLIf.806	8	Apr 3 1997	10095	ASCII
A23a/CR3A23N15DC18T142AC02T000.notes	aXLIf.807	8	Apr 3 1997	10093	ASCII
A23a/CR3A23N16DC18T142AC02T000.notes	aXLIf.808	8	Apr 3 1997	10137	ASCII
A23a/CR3A23N17DC18T142AC02T000.notes	aXLIf.809	8	Apr 3 1997	10129	ASCII
A23a/CR3A23N18DC18T142AC02T000.notes	aXLIf.810	8	Apr 3 1997	9854	ASCII

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A25/CR3A07N01DC03T168AC03T250.notes	aXLIf.812	8	Apr 3 1997	9716	ASCII
A25/CR3A07N02DC03T000AC03T168.notes	aXLIf.813	7	Apr 3 1997	9160	ASCII
A25/CR3A07N02DC03T168AC03T250.notes	aXLIf.814	8	Apr 3 1997	10099	ASCII
A25/CR3A07N03DC03T000AC03T168.notes	aXLIf.815	7	Apr 3 1997	9200	ASCII
A25/CR3A07N03DC03T168AC03T250.notes	aXLIf.816	8	Apr 3 1997	10126	ASCII
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A25/CR3A07N06DC03T000AC03T168.notes	aXLIf.821	8	Apr 3 1997	9251	ASCII
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A25/CR3A07N07DC03T000AC03T168.notes	aXLIf.823	8	Apr 3 1997	9255	ASCII
A25/CR3A07N07DC03T168AC03T250.notes	aXLIf.824	8	Apr 3 1997	10234	ASCII
A25/CR3A07N08DC03T000AC03T168.notes	aXLIf.825	7	Apr 3 1997	9142	ASCII
A25/CR3A07N08DC03T168AC03T250.notes	aXLIf.826	8	Apr 3 1997	10220	ASCII
A25/CR3A07N09DC03T000AC03T168.notes	aXLIf.827	7	Apr 3 1997	9182	ASCII
A25/CR3A07N09DC03T168AC03T250.notes	aXLIf.828	8	Apr 3 1997	10260	ASCII
A25/CR3A07N10DC03T000AC03T168.notes	aXLIf.829	7	Apr 3 1997	9166	ASCII
A25/CR3A07N10DC03T168AC03T250.notes	aXLIf.830	8	Apr 3 1997	10224	ASCII
A25/CR3A07N11DC03T000AC03T168.notes	aXLIf.831	7	Apr 3 1997	9180	ASCII
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A25/CR3A07N17DC03T168AC03T250.notes	aXLIf.844	8	Apr 3 1997	10224	ASCII
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A25/CR3A07N18DC03T168AC03T250.notes	aXLIf.846	8	Apr 3 1997	10119	ASCII
A25/CR3A13N01DC02T000AC03T000.notes	aXLIf.847	7	Apr 3 1997	8477	ASCII
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A25/CR3A13N07DC02T000AC03T000.notes	aXLIf.853	7	Apr 3 1997	8859	ASCII
A25/CR3A13N08DC02T000AC03T000.notes	aXLIf.854	7	Apr 3 1997	8843	ASCII
A25/CR3A13N09DC02T000AC03T000.notes	aXLIf.855	7	Apr 3 1997	8873	ASCII
A25/CR3A13N10DC02T000AC03T000.notes	aXLIf.856	7	Apr 3 1997	8905	ASCII
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A25/CR3A25N04DC18T000AC18T142.notes	aXLIf.871	7	Apr 3 1997	8803	ASCII
A25/CR3A25N04DC18T142AC02T000.notes	aXLIf.872	8	Apr 3 1997	10046	ASCII
A25/CR3A25N05DC18T000AC18T142.notes	aXLIf.873	7	Apr 3 1997	8837	ASCII
A25/CR3A25N05DC18T142AC02T000.notes	aXLIf.874	8	Apr 3 1997	10124	ASCII
A25/CR3A25N06DC18T000AC18T142.notes	aXLIf.875	7	Apr 3 1997	8819	ASCII
A25/CR3A25N06DC18T142AC02T000.notes	aXLIf.876	8	Apr 3 1997	10166	ASCII
A25/CR3A25N07DC18T000AC18T142.notes	aXLIf.877	7	Apr 3 1997	8895	ASCII
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A25/CR3A25N10DC18T142AC02T000.notes	aXLIf.884	8	Apr 3 1997	10210	ASCII
A25/CR3A25N11DC18T000AC18T142.notes	aXLIf.885	7	Apr 3 1997	8821	ASCII
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A25/CR3A25N12DC18T000AC18T142.notes	aXLIf.887	7	Apr 3 1997	8847	ASCII
A25/CR3A25N12DC18T142AC02T000.notes	aXLIf.888	8	Apr 3 1997	10124	ASCII
A25/CR3A25N13DC18T000AC18T142.notes	aXLIf.889	7	Apr 3 1997	8835	ASCII
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A25/CR3A25N14DC18T000AC18T142.notes	aXLIf.891	7	Apr 3 1997	8821	ASCII
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A25/CR3A25N15DC18T142AC02T000.notes	aXLIf.894	8	Apr 3 1997	10108	ASCII
A25/CR3A25N16DC18T000AC18T142.notes	aXLIf.895	7	Apr 3 1997	8873	ASCII
A25/CR3A25N16DC18T142AC02T000.notes	aXLIf.896	8	Apr 3 1997	10174	ASCII
A25/CR3A25N17DC18T000AC18T142.notes	aXLIf.897	7	Apr 3 1997	8756	ASCII
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A25a/CR3A13N02DC02T000AC03T000.notes	aXLIf.902	7	Apr 3 1997	8767	ASCII
A25a/CR3A13N03DC02T000AC03T000.notes	aXLIf.903	7	Apr 3 1997	8875	ASCII
A25a/CR3A13N04DC02T000AC03T000.notes	aXLIf.904	7	Apr 3 1997	8845	ASCII
A25a/CR3A13N05DC02T000AC03T000.notes	aXLIf.905	7	Apr 3 1997	8835	ASCII
A25a/CR3A13N06DC02T000AC03T000.notes	aXLIf.906	7	Apr 3 1997	8853	ASCII
A25a/CR3A13N07DC02T000AC03T000.notes	aXLIf.907	7	Apr 3 1997	8859	ASCII

A25a/CR3A13N08DC02T000AC03T000.notes	aXLIf.908	7	Apr 3 1997	8843	ASCII
A25a/CR3A13N09DC02T000AC03T000.notes	aXLIf.909	7	Apr 3 1997	8873	ASCII
A25a/CR3A13N10DC02T000AC03T000.notes	aXLIf.910	7	Apr 3 1997	8905	ASCII
A25a/CR3A13N11DC02T000AC03T000.notes	aXLIf.911	7	Apr 3 1997	8827	ASCII
A25a/CR3A13N12DC02T000AC03T000.notes	aXLIf.912	7	Apr 3 1997	8954	ASCII
A25a/CR3A13N13DC02T000AC03T000.notes	aXLIf.913	7	Apr 3 1997	8898	ASCII
A25a/CR3A13N14DC02T000AC03T000.notes	aXLIf.914	7	Apr 3 1997	8928	ASCII
A25a/CR3A13N15DC02T000AC03T000.notes	aXLIf.915	7	Apr 3 1997	8962	ASCII
A25a/CR3A13N16DC02T000AC03T000.notes	aXLIf.916	7	Apr 3 1997	8889	ASCII
A25a/CR3A13N17DC02T000AC03T000.notes	aXLIf.917	7	Apr 3 1997	8867	ASCII
A25a/CR3A13N18DC02T000AC03T000.notes	aXLIf.918	7	Apr 3 1997	8614	ASCII
A25a/CR3A26N01DC03T000AC03T168.notes	aXLIf.919	7	Apr 3 1997	8838	ASCII
A25a/CR3A26N01DC03T168AC03T250.notes	aXLIf.920	8	Apr 3 1997	9731	ASCII
A25a/CR3A26N02DC03T000AC03T168.notes	aXLIf.921	7	Apr 3 1997	9144	ASCII
A25a/CR3A26N02DC03T168AC03T250.notes	aXLIf.922	8	Apr 3 1997	10158	ASCII
A25a/CR3A26N03DC03T000AC03T168.notes	aXLIf.923	7	Apr 3 1997	9158	ASCII
A25a/CR3A26N03DC03T168AC03T250.notes	aXLIf.924	8	Apr 3 1997	10467	ASCII
A25a/CR3A26N04DC03T000AC03T168.notes	aXLIf.925	7	Apr 3 1997	9202	ASCII
A25a/CR3A26N04DC03T168AC03T250.notes	aXLIf.926	8	Apr 3 1997	10572	ASCII
A25a/CR3A26N05DC03T000AC03T168.notes	aXLIf.927	8	Apr 3 1997	9203	ASCII
A25a/CR3A26N05DC03T168AC03T250.notes	aXLIf.928	9	Apr 3 1997	10663	ASCII
A25a/CR3A26N06DC03T000AC03T168.notes	aXLIf.929	8	Apr 3 1997	9215	ASCII
A25a/CR3A26N06DC03T168AC03T250.notes	aXLIf.930	9	Apr 3 1997	10607	ASCII
A25a/CR3A26N07DC03T000AC03T168.notes	aXLIf.931	8	Apr 3 1997	9235	ASCII
A25a/CR3A26N07DC03T168AC03T250.notes	aXLIf.932	9	Apr 3 1997	10613	ASCII
A25a/CR3A26N08DC03T000AC03T168.notes	aXLIf.933	7	Apr 3 1997	9134	ASCII
A25a/CR3A26N08DC03T168AC03T250.notes	aXLIf.934	9	Apr 3 1997	10675	ASCII
A25a/CR3A26N09DC03T000AC03T168.notes	aXLIf.935	7	Apr 3 1997	9196	ASCII
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A25a/CR3A26N11DC03T000AC03T168.notes	aXLIf.939	7	Apr 3 1997	9172	ASCII
A25a/CR3A26N11DC03T168AC03T250.notes	aXLIf.940	8	Apr 3 1997	10576	ASCII
A25a/CR3A26N12DC03T000AC03T168.notes	aXLIf.941	7	Apr 3 1997	9274	ASCII
A25a/CR3A26N12DC03T168AC03T250.notes	aXLIf.942	8	Apr 3 1997	10590	ASCII
A25a/CR3A26N13DC03T000AC03T168.notes	aXLIf.943	7	Apr 3 1997	9288	ASCII
A25a/CR3A26N13DC03T168AC03T250.notes	aXLIf.944	8	Apr 3 1997	10602	ASCII
A25a/CR3A26N14DC03T000AC03T168.notes	aXLIf.945	7	Apr 3 1997	9142	ASCII
A25a/CR3A26N14DC03T168AC03T250.notes	aXLIf.946	9	Apr 3 1997	10653	ASCII
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A25a/CR3A26N16DC03T000AC03T168.notes	aXLIf.949	7	Apr 3 1997	9174	ASCII
A25a/CR3A26N16DC03T168AC03T250.notes	aXLIf.950	8	Apr 3 1997	10622	ASCII
A25a/CR3A26N17DC03T000AC03T168.notes	aXLIf.951	7	Apr 3 1997	9204	ASCII
A25a/CR3A26N17DC03T168AC03T250.notes	aXLIf.952	8	Apr 3 1997	10541	ASCII
A25a/CR3A26N18DC03T000AC03T168.notes	aXLIf.953	7	Apr 3 1997	8955	ASCII
A25a/CR3A26N18DC03T168AC03T250.notes	aXLIf.954	8	Apr 3 1997	10177	ASCII

THE FOLLOWING FILES FOR ASSEMBLY A26 WERE SUPERCEEDED BY FILES UNDER ASSEMBLY DESIGNATION A26z DURING CHECKING.

Computer File Name	Tape Backup File Name	Number of Print Pages	File Date (Output)	File Size (Bytes)	File Type (Format)
A26/CR3A18N01DC18T000AC18T142.notes	aXLIf.955	7	Apr 3 1997	8333	ASCII
A26/CR3A18N02DC18T000AC18T142.notes	aXLIf.956	7	Apr 3 1997	8650	ASCII
A26/CR3A18N03DC18T000AC18T142.notes	aXLIf.957	7	Apr 3 1997	8742	ASCII
A26/CR3A18N04DC18T000AC18T142.notes	aXLIf.958	7	Apr 3 1997	8922	ASCII
A26/CR3A18N05DC18T000AC18T142.notes	aXLIf.959	7	Apr 3 1997	9007	ASCII
A26/CR3A18N06DC18T000AC18T142.notes	aXLIf.960	7	Apr 3 1997	9029	ASCII
A26/CR3A18N07DC18T000AC18T142.notes	aXLIf.961	7	Apr 3 1997	9013	ASCII
A26/CR3A18N08DC18T000AC18T142.notes	aXLIf.962	7	Apr 3 1997	9029	ASCII
A26/CR3A18N09DC18T000AC18T142.notes	aXLIf.963	7	Apr 3 1997	9015	ASCII
A26/CR3A18N10DC18T000AC18T142.notes	aXLIf.964	7	Apr 3 1997	9023	ASCII
A26/CR3A18N11DC18T000AC18T142.notes	aXLIf.965	7	Apr 3 1997	8999	ASCII
A26/CR3A18N12DC18T000AC18T142.notes	aXLIf.966	7	Apr 3 1997	8916	ASCII
A26/CR3A18N13DC18T000AC18T142.notes	aXLIf.967	7	Apr 3 1997	8922	ASCII
A26/CR3A18N14DC18T000AC18T142.notes	aXLIf.968	7	Apr 3 1997	8936	ASCII
A26/CR3A18N15DC18T000AC18T142.notes	aXLIf.969	7	Apr 3 1997	8932	ASCII
A26/CR3A18N16DC18T000AC18T142.notes	aXLIf.970	7	Apr 3 1997	8885	ASCII
A26/CR3A18N17DC18T000AC18T142.notes	aXLIf.971	7	Apr 3 1997	8686	ASCII

A26/CR3A18N18DC1BT000AC1BT142.notes	aXLIf.972	7	Apr 3 1997	8520	ASCII

THE FOLLOWING FILES FOR ASSEMBLY A28 WERE SUPERCEEDED BY FILES UNDER ASSEMBLY DESIGNATION A28z DURING CHECKING.

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A28/CR3A10N02DC03T000AC03T168.notes	aXLIf.975	7	Apr 3 1997	9166	ASCII
A28/CR3A10N02DC03T168AC03T250.notes	aXLIf.976	8	Apr 3 1997	10282	ASCII
A28/CR3A10N03DC03T000AC03T168.notes	aXLIf.977	7	Apr 3 1997	9157	ASCII
A28/CR3A10N03DC03T168AC03T250.notes	aXLIf.978	8	Apr 3 1997	10343	ASCII
A28/CR3A10N04DC03T000AC03T168.notes	aXLIf.979	8	Apr 3 1997	9307	ASCII
A28/CR3A10N04DC03T168AC03T250.notes	aXLIf.980	8	Apr 3 1997	10411	ASCII
A28/CR3A10N05DC03T000AC03T168.notes	aXLIf.981	8	Apr 3 1997	9242	ASCII
A28/CR3A10N05DC03T168AC03T250.notes	aXLIf.982	8	Apr 3 1997	10587	ASCII
A28/CR3A10N06DC03T000AC03T168.notes	aXLIf.983	8	Apr 3 1997	9252	ASCII
A28/CR3A10N06DC03T168AC03T250.notes	aXLIf.984	8	Apr 3 1997	10589	ASCII
A28/CR3A10N07DC03T000AC03T168.notes	aXLIf.985	8	Apr 3 1997	9244	ASCII
A28/CR3A10N07DC03T168AC03T250.notes	aXLIf.986	8	Apr 3 1997	10519	ASCII
A28/CR3A10N08DC03T000AC03T168.notes	aXLIf.987	8	Apr 3 1997	9264	ASCII
A28/CR3A10N08DC03T168AC03T250.notes	aXLIf.988	8	Apr 3 1997	10447	ASCII
A28/CR3A10N09DC03T000AC03T168.notes	aXLIf.989	7	Apr 3 1997	9118	ASCII
A28/CR3A10N09DC03T168AC03T250.notes	aXLIf.990	8	Apr 3 1997	10487	ASCII
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A28/CR3A10N12DC03T000AC03T168.notes	aXLIf.995	7	Apr 3 1997	9144	ASCII
A28/CR3A10N12DC03T168AC03T250.notes	aXLIf.996	8	Apr 3 1997	10541	ASCII
A28/CR3A10N13DC03T000AC03T168.notes	aXLIf.997	7	Apr 3 1997	9188	ASCII
A28/CR3A10N13DC03T168AC03T250.notes	aXLIf.998	8	Apr 3 1997	10445	ASCII
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A28/CR3A18N01DC02T000AC03T000.notes	aXLIf1.009	7	Apr 3 1997	8240	ASCII
A28/CR3A18N02DC02T000AC03T000.notes	aXLIf1.010	7	Apr 3 1997	8550	ASCII
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A28/CR3A18N09DC02T000AC03T000.notes	aXLIf1.017	7	Apr 3 1997	8659	ASCII
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A28/CR3A18N17DC02T000AC03T000.notes	aXLIf1.025	7	Apr 3 1997	8621	ASCII
A28/CR3A18N18DC02T000AC03T000.notes	aXLIf1.026	7	Apr 3 1997	8295	ASCII
A28/CR3A28N01DC1BT000AC1BT142.notes	aXLIf1.027	6	Apr 3 1997	8040	ASCII
A28/CR3A28N01DC1BT142AC02T000.notes	aXLIf1.028	7	Apr 3 1997	9404	ASCII
A28/CR3A28N02DC1BT000AC1BT142.notes	aXLIf1.029	7	Apr 3 1997	8441	ASCII
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A28z/CR3A28N18DC1BT142AC02T000.notes	aXLIf1.440	8	Jul 22 1997	9683	ASCII