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Table of Contents

Item Page

1. Purpose 5

2. Quality Assurance 5

3. Method 5

4. Design Inputs 6
   4.1 Design Parameters 6
      4.1.1 Fuel Assembly Descriptions 6
      4.1.2 Burnable Poison Rod Assembly (BPRA) Description 7
      4.1.3 Control Rod Assembly (CRA) Description 8
      4.1.4 Axial Power Shaping Rod Assembly (APSRA) Description 8
      4.1.5 System Pressure 9
      4.1.6 Fuel Assembly Insertion, Burnable Poison Loading, and Control Bank Insertion Histories 9
      4.1.7 Fuel Assembly Insertion Position Histories 10
      4.1.8 Reactor Cycle History Data 11
      4.1.9 Boron Letdown Data 15
      4.1.10 Burnup, Fuel Temperature, and Moderator Specific Volume Data 18
      4.1.11 Insertion History Data for CRA's and APSRA's 32
   4.2 Criteria 36
   4.3 Assumptions 36
   4.4 Codes and Standards 37

5. References 37

6. Use of Computer Software 38
   6.1 Software Approved for QA Work 38
   6.2 Software Routines 38

7. Design Analysis 39
   7.1 Assembly Depletion Calculation Procedure 41
   7.2 Path B Unit Cell Model Development 41
   7.3 Cycle Irradiation History Layouts for the Depletion of the Rodded Assemblies in Batches 8 and 9 of Crystal River Unit 3 54
   7.4 The Commercial Reactor Assembly Follow Taskmaster (CRAFT) Code & Usage 70
   7.5 Input & Output Filename Descriptions for CRAFT and SAS2H 73
   7.6 Rodded Assembly Depletion Calculations for Fuel Batches 8 and 9 of Crystal River Unit 3 74
   7.7 Isotopic Results 97

8. Conclusions 98

9. Attachments 98

1. Purpose

The purpose of this design analysis is to document the SAS2H depletion calculations of certain rodded fuel assemblies from batches 8 and 9 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 reference 5.11. 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 8 and 9 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 8 and 9 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 8 and 9 of Crystal River Unit 3

	Fuel Batch Identifier	
Parameter	**8**	**9**
Assembly Type	Mark-B4	Mark-B4Z
Weight Percent U-235	3.49	3.84
kg of U per Assembly	463.63	463.63
Fuel Height (cm)	360.172	360.172
Fuel Pellet OD[1] (cm)	0.936244	0.936244
Fuel Rod Clad OD (cm)	1.0922	1.0922
Fuel Rod Clad ID[2] (cm)	0.95758	0.95758
Spacer Grid Material	Inconel	Zircaloy
Volume Fraction of Spacer Grid in Moderator	0.005757609	0.008165257
Guide Tube Material	Zircaloy	Zircaloy
Guide Tube OD (cm)	1.3462	1.3462

	Fuel Batch Identifier	
Parameter	8	9
Guide Tube ID (cm)	1.26492	1.26492
Instrument Tube Material	Zircaloy	Zircaloy
Instrument Tube OD (cm)	1.38193	1.38193
Instrument Tube ID (cm)	1.12014	1.12014
Array Size	15x15	15x15
Number of Fuel Rods	208	208
Number of Guide Tubes	16	16
Number of Instr. Tubes	1	1
Pin Pitch (cm)	1.44272	1.44272
Assembly Pitch (cm)	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 8 and 9 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 8 and 9 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 8 and 9 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 8 and 9 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

Tables 4.1.4-1 contains a description of the axial power shaping rod assemblies utilized in the various fuel assemblies from fuel batches 8 and 9 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. Assembly G17 from batch 9 is the only assembly depletion documented in this analysis that contained an APSRA. This assembly contained a grey APSRA during Cycle-8.

Table 4.1.4-1 Grey APSRA Description for Use in Batch 9 of Crystal River Unit 3

Parameter	Value
APSRA Neutron Absorbing Material	Inconel
Inconel Density (g/cc)	8.3
Absorber Pellet OD (cm)	0.95250
Axial Power Shaping Rod (APSR) Cladding Material	Stainless Steel 304 (SS304)
APSR Cladding OD (cm)	1.11760
APSR Cladding ID (cm)	0.98044
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 psia (pounds per square inch absolute).

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

The actual irradiation histories of the fuel assemblies in batches 8 and 9 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 8 and 9 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 8 and 9, Rodded Fuel Assembly Insertion, BP Loading, and Control Bank Insertion Histories

Assembly Number/Batch	Assembly Location in Cycle 6	7	8	9	Comments
F06 / 8	1.1	CR6			CR6 not inserted
F17a / 8	1.4	CR7			
F19a / 8	0.8	X	CR7		
G02 / 9		0.8	CR6	X	CR6 not inserted
G17 / 9		1.13	CR8		Grey APSRA
G27a / 9		0.0		CR7	

The "X" indicates that the assembly is present in the cycle indicated.
The "F" and "G" designations in the assembly number indicates that either Cycle-6 or Cycle-7 is the assembly initial insertion cycle, respectively.
The numeric inputs indicate that assembly contained a BPRA in that cycle. These values indicate the wt% of B_4C in the Al_2O_3-B_4C absorber.
CR6 refers to control bank 6.
CR7 refers to control bank 7.
CR8 refers to control bank 8 which in an APSRA bank.
"CR6 not inserted" means that control rod bank 6 was not inserted in the assembly during reactor operation at power. Therefore, there is no control rod insertion history data for these assemblies.

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 8 and 9 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 8 and 9 of Crystal River Unit 3

Assembly Number	Assembly Location in Cycle 6	7	8	9
F06	H13	H14		
F17a	L11	N12		
F19a	L13	N14	N12	
G02		H09	H14	H15
G17		L11	L12	
G27a		N13		N12

	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 8 and 9

<u>Crystal River, Unit-3, Cycle-6 Summary</u>

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

Table 4.1.8-1 Crystal River Unit 3 Reactor Cycle History Data Relevant to the Depletion Calculations for the Rodded Assemblies in Batches 8 and 9

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 in Calendar Days to 96.0 EFPD Date
428 : Cycle Length in Calendar Days from 96.0 EFPD Restart to 400.0 EFPD Date
18 : Cycle Length in Calendar Days 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

<u>Crystal River, Unit-3, Cycle-7 Summary</u>

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 in Calendar Days to 260.3 EFPD Date
40 : Cycle Length in Calendar Days from 260.3 EFPD Restart to 291.0 EFPD Date
41 : Cycle Length in Calendar Days from 291.0 EFPD Restart to 319.0 EFPD Date
220 : Cycle Length in Calendar Days from 319.0 EFPD Restart to 462.3 EFPD 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 8 and 9

19 : Cycle Length in Calendar Days from 462.3 EFPD Restart to 479.0 EFPD Date
23 : Cycle Length in Calendar Days 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

<u>Crystal River, Unit-3, Cycle-8 Summary</u>

06/21/90 : Cycle Start Date
10/09/90 : 97.6 EFPD Shutdown Date (10/10/90, Ref. 5.3)
10/25/90 : Restart Date After the 97.6 EFPD Shutdown
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 (10/11/91, Ref. 5.3)
11/27/91 : Restart Date After the 404.0 EFPD Shutdown (11/24/91, Ref. 5.3)
12/02/91 : 409.6 EFPD Shutdown Date (12/03/91, Ref. 5.3)
12/07/91 : Restart Date After the 409.6 EFPD Shutdown (12/08/91, Ref. 5.3)
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 in Calendar Days to 97.6 EFPD Date
48 : Cycle Length in Calendar Days from 97.6 EFPD Restart to 139.8 EFPD Date
300 : Cycle Length in Calendar Days from 139.8 EFPD Restart to 404.0 EFPD Date
5 : Cycle Length in Calendar Days from 404.0 EFPD Restart to 409.6 EFPD Date
111 : Cycle Length in Calendar Days from 409.6 EFPD Restart to 515.5 EFPD 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 8 and 9

26 : Cycle Length in Calendar Days 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 (09/19/93, Ref. 5.3)
09/20/93 : Restart Date After the 363.1 EFPD Shutdown
04/07/94 : Cycle End Date
168 : Cycle Length in Calendar Days to 158.8 EFPD Date
63 : Cycle Length in Calendar Days from 158.8 EFPD Restart to 219.0 EFPD Date
145 : Cycle Length in Calendar Days from 219.0 EFPD Restart to 363.1 EFPD Date
199 : Cycle Length in Calendar Days 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. 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 6, 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 8 and 9. 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 4.1.9-4. 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 6 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm[1])
9.2	1017
22.3	1012
49.8	995
68.5	952
84.6	908
127.3	778
140.1	727
184.5	631
202.8	567
248.8	441

Table 4.1.9-1 Boron Letdown Data for Cycle 6 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm[1])
274.9	366
288.2	337
318.2	266
331.6	229
349.7	183
367.4	139
373.3	123
393.3	156
397.7	137
405.3	123

[1] The acronym "ppm" means parts per million by mass of moderator.

Table 4.1.9-2 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

Table 4.1.9-2 Boron Letdown Data for Cycle 7 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
251.2	898
306.7	803
317.9	775
345.3	593
412.3	398
459.8	260
485.0	193

Table 4.1.9-3 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
194.8	1103
234.6	999
271.5	887
338	701
390.7	522
445.7	394
474	311
513.1	216

Table 4.1.9-4 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 4.1.10-6 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 8 and 9 of Crystal River Unit 3. The assembly heights corresponding to the axial nodes presented in Tables 4.1.10-1 through 4.1.10-6 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 F06 of Crystal River Unit 3

	Assembly Number F6								
	Statepoint 13 (BOC Cycle 6)			Statepoint 14 (96.0 Cycle 6)			Statepoint 15 (400.0 Cycle 6)		
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 Cy6			96.0 Cy6	127.3 Cy6	127.3 Cy6	400.0 Cy6	274.9 Cy6	274.9 Cy6
1	0.0			1.783	1160.2	0.0239	9.034	1177.7	0.0239
2	0.0			2.774	1383.4	0.0238	13.448	1357.1	0.0238
3	0.0			3.457	1504.8	0.0237	15.881	1431.3	0.0236
4	0.0	Data not required.		3.830	1555.5	0.0235	16.861	1448.3	0.0235
5	0.0			4.047	1575.5	0.0234	17.245	1444.7	0.0233
6	0.0			4.197	1583.7	0.0232	17.430	1436.7	0.0232
7	0.0			4.321	1588.3	0.0231	17.575	1429.6	0.0230
8	0.0			4.433	1592.7	0.0229	17.726	1424.6	0.0229
9	0.0			4.528	1596.5	0.0228	17.872	1421.3	0.0227
10	0.0			4.595	1598.6	0.0226	17.984	1419.4	0.0226
11	0.0			4.624	1598.8	0.0225	18.050	1419.1	0.0225
12	0.0			4.609	1597.0	0.0223	18.070	1420.7	0.0223
13	0.0			4.547	1592.8	0.0222	18.040	1423.7	0.0222
14	0.0			4.440	1584.6	0.0221	17.954	1428.2	0.0221
15	0.0			4.273	1568.3	0.0219	17.737	1431.9	0.0220
16	0.0			3.987	1529.3	0.0218	17.099	1424.6	0.0218
17	0.0			3.459	1432.7	0.0217	15.355	1369.6	0.0217
18	0.0			2.418	1206.0	0.0216	10.903	1191.0	0.0216
	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 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 Cy7	274.9 Cy6	274.9 Cy6	260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	9.364	1177.7	0.0239	13.595	956.2	0.0233	14.162	967.4	0.0232
2	13.934	1357.1	0.0238	20.658	1089.6	0.0232	21.510	1057.7	0.0232
3	16.435	1431.3	0.0236	24.551	1138.6	0.0231	25.528	1078.0	0.0231
4	17.430	1448.3	0.0235	26.229	1156.7	0.0230	27.244	1073.4	0.0230
5	17.812	1444.7	0.0233	26.944	1159.6	0.0229	27.963	1064.5	0.0228
6	17.991	1436.7	0.0232	27.278	1155.9	0.0228	28.290	1057.3	0.0227
7	18.128	1429.6	0.0230	27.478	1149.5	0.0226	28.482	1052.0	0.0226
8	18.270	1424.6	0.0229	27.636	1142.4	0.0225	28.633	1049.1	0.0225
9	18.405	1421.3	0.0227	27.769	1135.9	0.0224	28.761	1048.3	0.0224
10	18.504	1419.4	0.0226	27.860	1130.9	0.0223	28.851	1049.4	0.0223
11	18.555	1419.1	0.0225	27.905	1127.5	0.0222	28.898	1052.6	0.0222
12	18.558	1420.7	0.0223	27.898	1125.7	0.0221	28.897	1057.8	0.0221

13	18.513	1423.7	0.0222	27.821	1124.5	0.0220	28.829	1065.0	0.0220
14	18.417	1428.2	0.0221	27.631	1121.8	0.0219	28.647	1073.7	0.0220
15	18.192	1431.9	0.0220	27.179	1114.2	0.0218	28.199	1082.3	0.0219
16	17.544	1424.6	0.0218	26.035	1095.4	0.0217	27.035	1088.2	0.0218
17	15.768	1369.6	0.0217	23.168	1049.6	0.0216	24.080	1073.6	0.0217
18	11.206	1191.0	0.0216	15.945	919.5	0.0216	16.563	971.7	0.0216
	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 Cycle 7)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7	479.0 Cy7	402.3 Cy7	402.3 Cy7
1	14.710	967.4	0.0232	17.580	982.7	0.0233	17.936	982.7	0.0233
2	22.325	1057.7	0.0232	26.457	1064.6	0.0232	26.953	1064.6	0.0232
3	26.452	1078.0	0.0231	31.049	1077.3	0.0231	31.589	1077.3	0.0231
4	28.193	1073.4	0.0230	32.870	1072.9	0.0230	33.414	1072.9	0.0230
5	28.907	1064.5	0.0228	33.553	1064.8	0.0228	34.090	1064.8	0.0228
6	29.222	1057.3	0.0227	33.818	1056.6	0.0227	34.349	1056.6	0.0227
7	29.400	1052.0	0.0226	33.957	1050.4	0.0226	34.484	1050.4	0.0226
8	29.540	1049.1	0.0225	34.073	1046.2	0.0225	34.597	1046.2	0.0225
9	29.659	1048.3	0.0224	34.182	1043.6	0.0224	34.706	1043.6	0.0224
10	29.744	1049.4	0.0223	34.272	1042.7	0.0223	34.797	1042.7	0.0223
11	29.788	1052.6	0.0222	34.337	1043.4	0.0222	34.865	1043.4	0.0222
12	29.788	1057.8	0.0221	34.375	1046.0	0.0221	34.906	1046.0	0.0221
13	29.725	1065.0	0.0220	34.367	1050.7	0.0220	34.905	1050.7	0.0220
14	29.549	1073.7	0.0220	34.263	1057.6	0.0219	34.810	1057.6	0.0219
15	29.102	1082.3	0.0219	33.886	1065.4	0.0219	34.443	1065.4	0.0219
16	27.923	1088.2	0.0218	32.708	1068.5	0.0218	33.271	1068.5	0.0218
17	24.894	1073.6	0.0217	29.391	1058.5	0.0217	29.929	1058.5	0.0217
18	17.120	971.7	0.0216	20.310	969.9	0.0216	20.704	969.9	0.0216

Table 4.1.10-2 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly F17a of Crystal River Unit 3

	Assembly Number F17a								
	Statepoint 13 (BOC Cycle 6)			Statepoint 14 (95.0 Cycle 6)			Statepoint 15 (400.0 Cycle 6)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy6			95.0 Cy6	127.3 Cy6	127.3 Cy6	400.0 Cy6	274.9 Cy6	274.9 Cy6
1	0.0			2.007	1203.1	0.0241	9.827	1209.5	0.0241
2	0.0			2.956	1424.1	0.0239	14.305	1395.1	0.0240
3	0.0			3.581	1546.4	0.0238	16.759	1478.4	0.0238
4	0.0	Data not required.		3.916	1595.5	0.0236	17.705	1494.4	0.0236
5	0.0			4.107	1612.6	0.0235	18.042	1489.7	0.0235
6	0.0			4.240	1618.6	0.0233	18.202	1482.4	0.0233
7	0.0			4.348	1621.9	0.0232	18.326	1475.7	0.0231
8	0.0			4.444	1624.7	0.0230	18.452	1470.6	0.0230

9	0.0			4.526	1626.9	0.0228	18.576	1467.0	0.0228
10	0.0			4.594	1628.2	0.0227	18.691	1464.8	0.0227
11	0.0			4.648	1629.9	0.0225	18.816	1465.1	0.0225
12	0.0			4.674	1633.9	0.0224	18.971	1469.4	0.0224
13	0.0			4.653	1636.0	0.0222	19.090	1475.4	0.0223
14	0.0			4.572	1631.7	0.0221	19.095	1480.8	0.0221
15	0.0			4.427	1618.0	0.0220	18.920	1484.2	0.0220
16	0.0			4.164	1584.3	0.0218	18.295	1476.5	0.0219
17	0.0			3.675	1491.0	0.0217	16.537	1426.4	0.0217
18	0.0			2.664	1263.1	0.0216	11.960	1234.7	0.0216
	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 Cycle 7)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy7	274.9 Cy6	274.9 Cy6	260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	10.197	1209.5	0.0241	13.697	986.1	0.0234	14.229	1000.3	0.0233
2	14.835	1395.1	0.0240	21.263	1118.8	0.0233	22.152	1084.2	0.0233
3	17.358	1478.4	0.0238	25.698	1161.9	0.0232	26.725	1095.7	0.0231
4	18.323	1494.4	0.0236	27.478	1177.7	0.0231	28.544	1091.2	0.0230
5	18.661	1489.7	0.0235	28.183	1179.9	0.0229	29.253	1084.5	0.0229
6	18.814	1482.4	0.0233	28.502	1175.5	0.0228	29.565	1077.2	0.0228
7	18.930	1475.7	0.0231	28.688	1168.8	0.0227	29.742	1072.1	0.0227
8	19.047	1470.6	0.0230	28.827	1161.8	0.0226	29.874	1069.2	0.0226
9	19.159	1467.0	0.0228	28.942	1155.4	0.0225	29.984	1068.5	0.0225
10	19.258	1464.8	0.0227	29.038	1150.3	0.0224	30.079	1069.7	0.0224
11	19.364	1465.1	0.0225	29.141	1146.2	0.0223	30.183	1072.5	0.0223
12	19.499	1469.4	0.0224	29.267	1143.0	0.0221	30.315	1077.1	0.0222
13	19.599	1475.4	0.0223	29.342	1140.8	0.0220	30.399	1084.1	0.0221
14	19.590	1480.8	0.0221	29.246	1137.8	0.0219	30.313	1092.8	0.0220
15	19.407	1484.2	0.0220	28.835	1129.8	0.0218	29.905	1100.7	0.0219
16	18.771	1476.5	0.0219	27.695	1110.6	0.0217	28.745	1101.1	0.0218
17	16.978	1426.4	0.0217	24.794	1064.7	0.0217	25.755	1083.8	0.0217
18	12.283	1234.7	0.0216	17.342	934.1	0.0216	17.998	980.3	0.0216
	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 Cycle 7)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7	479.0 Cy7	402.3 Cy7	402.3 Cy7
1	14.776	1000.3	0.0233	17.619	1014.2	0.0233	18.000	1014.2	0.0233
2	23.010	1084.2	0.0233	27.334	1089.0	0.0232	27.858	1089.0	0.0232
3	27.698	1095.7	0.0231	32.511	1095.4	0.0231	33.076	1095.4	0.0231
4	29.542	1091.2	0.0230	34.431	1092.8	0.0230	34.997	1092.8	0.0230
5	30.245	1084.5	0.0229	35.096	1083.4	0.0229	35.654	1083.4	0.0229
6	30.543	1077.2	0.0228	35.338	1074.4	0.0228	35.888	1074.4	0.0228
7	30.706	1072.1	0.0227	35.459	1067.9	0.0227	36.004	1067.9	0.0227

8	30.826	1069.2	0.0226	35.555	1063.6	0.0226	36.098	1063.6	0.0226
9	30.928	1068.5	0.0225	35.647	1061.0	0.0225	36.190	1061.0	0.0225
10	31.017	1069.7	0.0224	35.741	1060.0	0.0224	36.285	1060.0	0.0224
11	31.118	1072.5	0.0223	35.861	1060.2	0.0223	36.406	1060.2	0.0223
12	31.251	1077.1	0.0222	36.027	1061.9	0.0222	36.576	1061.9	0.0222
13	31.338	1084.1	0.0221	36.170	1066.0	0.0221	36.725	1066.0	0.0221
14	31.259	1092.8	0.0220	36.164	1072.7	0.0220	36.728	1072.7	0.0220
15	30.853	1100.7	0.0219	35.828	1080.3	0.0219	36.403	1080.3	0.0219
16	29.676	1101.1	0.0218	34.653	1083.6	0.0218	35.233	1083.6	0.0218
17	26.610	1083.8	0.0217	31.296	1064.4	0.0217	31.852	1064.4	0.0217
18	18.586	980.3	0.0216	21.931	975.5	0.0216	22.340	975.5	0.0216

Table 4.1.10-3 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly F19a of Crystal River Unit 3

	Assembly Number F19a								
	Statepoint 13 (BOC Cycle 6)			Statepoint 14 (96.0 Cycle 6)			Statepoint 15 (400.0 Cycle 6)		
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 Cy6			96.0 Cy6	127.3 Cy6	127.3 Cy6	400.0 Cy6	274.9 Cy6	274.9 Cy6
1	0.0			1.776	1141.8	0.0239	8.818	1161.9	0.0238
2	0.0			2.760	1372.1	0.0238	13.244	1343.3	0.0237
3	0.0			3.407	1493.4	0.0236	15.612	1416.3	0.0236
4	0.0	Data not required.		3.760	1540.6	0.0235	16.521	1430.5	0.0234
5	0.0			3.969	1558.0	0.0233	16.857	1425.4	0.0233
6	0.0			4.120	1566.2	0.0232	17.034	1417.6	0.0231
7	0.0			4.249	1572.0	0.0230	17.194	1411.1	0.0230
8	0.0			4.371	1578.0	0.0229	17.371	1406.8	0.0229
9	0.0			4.480	1582.9	0.0228	17.546	1404.2	0.0227
10	0.0			4.563	1585.7	0.0226	17.684	1402.6	0.0226
11	0.0			4.618	1587.1	0.0225	17.795	1403.2	0.0225
12	0.0			4.631	1589.5	0.0223	17.901	1407.7	0.0223
13	0.0			4.587	1589.4	0.0222	17.951	1413.5	0.0222
14	0.0			4.485	1583.4	0.0221	17.898	1418.6	0.0221
15	0.0			4.322	1569.0	0.0219	17.703	1422.7	0.0219
16	0.0			4.038	1532.5	0.0218	17.095	1416.2	0.0218
17	0.0			3.495	1435.6	0.0217	15.346	1363.8	0.0217
18	0.0			2.389	1198.9	0.0216	10.757	1184.0	0.0216
	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 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 Cy7	274.9 Cy6	274.9 Cy6	260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	9.155	1161.9	0.0238	10.932	734.8	0.0223	11.182	757.0	0.0223
2	13.731	1343.3	0.0237	16.654	805.5	0.0222	17.042	816.4	0.0223
3	16.163	1416.3	0.0236	19.749	833.3	0.0222	20.201	830.4	0.0222

4	17.088	1430.5	0.0234	21.003	842.0	0.0221	21.474	829.4	0.0222
5	17.426	1425.4	0.0233	21.495	843.2	0.0221	21.968	825.2	0.0221
6	17.598	1417.6	0.0231	21.732	840.8	0.0221	22.201	820.8	0.0221
7	17.750	1411.1	0.0230	21.902	836.9	0.0220	22.367	817.2	0.0220
8	17.920	1406.8	0.0229	22.067	832.5	0.0220	22.527	814.6	0.0220
9	18.084	1404.2	0.0227	22.217	828.4	0.0219	22.674	813.0	0.0220
10	18.208	1402.6	0.0226	22.327	825.1	0.0219	22.781	812.5	0.0219
11	18.302	1403.2	0.0225	22.407	822.6	0.0218	22.861	813.0	0.0219
12	18.388	1407.7	0.0223	22.478	820.6	0.0218	22.933	814.5	0.0218
13	18.420	1413.5	0.0222	22.485	819.0	0.0218	22.944	817.1	0.0218
14	18.355	1418.6	0.0221	22.370	817.0	0.0217	22.831	820.9	0.0217
15	18.153	1422.7	0.0219	22.056	812.6	0.0217	22.516	824.5	0.0217
16	17.535	1416.2	0.0218	21.199	802.5	0.0216	21.647	825.3	0.0216
17	15.755	1363.8	0.0217	18.904	779.0	0.0216	19.307	814.2	0.0216
18	11.055	1184.0	0.0216	13.017	711.9	0.0216	13.282	753.0	0.0216
	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 Cycle 7)		
Node	Burnup	Fuel-	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7	479.0 Cy7	402.3 Cy7	402.3 Cy7
1	11.425	757.0	0.0223	12.747	771.5	0.0223	12.917	771.5	0.0223
2	17.415	816.4	0.0223	19.388	829.3	0.0223	19.635	829.3	0.0223
3	20.629	830.4	0.0222	22.855	840.1	0.0222	23.128	840.1	0.0222
4	21.916	829.4	0.0222	24.192	836.8	0.0222	24.468	836.8	0.0222
5	22.409	825.2	0.0221	24.671	831.1	0.0221	24.944	831.1	0.0221
6	22.636	820.8	0.0221	24.872	825.8	0.0221	25.141	825.8	0.0221
7	22.795	817.2	0.0220	25.007	821.5	0.0220	25.273	821.5	0.0220
8	22.948	814.6	0.0220	25.144	818.1	0.0220	25.408	818.1	0.0220
9	23.090	813.0	0.0220	25.276	815.7	0.0220	25.540	815.7	0.0220
10	23.194	812.5	0.0219	25.378	814.2	0.0219	25.642	814.2	0.0219
11	23.272	813.0	0.0219	25.461	813.6	0.0219	25.725	813.6	0.0219
12	23.344	814.5	0.0218	25.545	813.9	0.0218	25.810	813.9	0.0218
13	23.355	817.1	0.0218	25.577	815.4	0.0218	25.845	815.4	0.0218
14	23.244	820.9	0.0217	25.495	818.4	0.0217	25.767	818.4	0.0217
15	22.929	824.5	0.0217	25.203	822.2	0.0217	25.478	822.2	0.0217
16	22.049	825.3	0.0216	24.306	824.5	0.0216	24.582	824.5	0.0216
17	19.670	814.2	0.0216	21.759	816.8	0.0216	22.019	816.8	0.0216
18	13.523	753.0	0.0216	14.953	760.2	0.0216	15.136	760.2	0.0216
	Statepoint 22 (BOC Cycle 8)			Statepoint 23 (97.6 Cycle 8)			Statepoint 24 (139.8 Cycle 8)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy8	402.3 Cy7	402.3 Cy7	97.6 Cy8	111.4 Cy8	111.4 Cy8	139.8 Cy8	111.4 Cy8	111.4 Cy8
1	13.111	771.5	0.0223	14.496	927.4	0.0232	15.171	927.4	0.0232
2	19.917	829.3	0.0223	22.247	1019.3	0.0231	23.299	1019.3	0.0231

3	23.440	840.1	0.0222	26.259	1058.0	0.0230	27.498	1058.0	0.0230
4	24.784	836.8	0.0222	27.853	1077.6	0.0229	29.179	1077.6	0.0229
5	25.257	831.1	0.0221	28.469	1086.5	0.0228	29.836	1086.5	0.0228
6	25.450	825.8	0.0221	28.748	1089.5	0.0227	30.136	1089.5	0.0227
7	25.580	821.5	0.0220	28.931	1089.4	0.0226	30.328	1089.4	0.0226
8	25.714	818.1	0.0220	29.096	1087.3	0.0225	30.498	1087.3	0.0225
9	25.845	815.7	0.0220	29.245	1084.3	0.0224	30.648	1084.3	0.0224
10	25.947	814.2	0.0219	29.357	1081.2	0.0223	30.761	1081.2	0.0223
11	26.032	813.6	0.0219	29.444	1078.2	0.0222	30.849	1078.2	0.0222
12	26.118	813.9	0.0218	29.523	1075.1	0.0221	30.928	1075.1	0.0221
13	26.156	815.4	0.0218	29.533	1071.5	0.0220	30.936	1071.5	0.0220
14	26.080	818.4	0.0217	29.397	1065.4	0.0219	30.789	1065.4	0.0219
15	25.795	822.2	0.0217	29.001	1054.4	0.0218	30.364	1054.4	0.0218
16	24.899	824.5	0.0216	27.912	1035.4	0.0217	29.213	1035.4	0.0217
17	22.318	816.8	0.0216	24.970	1000.8	0.0216	26.134	1000.8	0.0216
18	15.348	760.2	0.0216	17.110	904.2	0.0216	17.898	904.2	0.0216
	Statepoint 25 (404.0 Cycle 8)			Statepoint 26 (409.6 Cycle 8)			Statepoint 27 (515.5 Cycle 8)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	404.0 Cy8	234.6 Cy8	234.6 Cy8	409.6 Cy8	234.6 Cy8	234.6 Cy8	515.5 Cy8	470.7 Cy8	470.7 Cy8
1	19.864	941.1	0.0232	19.959	941.1	0.0232	21.997	914.1	0.0232
2	30.254	1014.7	0.0231	30.404	1014.7	0.0231	33.377	1005.2	0.0231
3	35.409	1041.6	0.0230	35.578	1041.6	0.0230	38.856	1037.6	0.0230
4	37.413	1053.1	0.0229	37.586	1053.1	0.0229	40.905	1036.0	0.0229
5	38.160	1054.5	0.0228	38.333	1054.5	0.0228	41.627	1028.0	0.0228
6	38.468	1052.4	0.0227	38.641	1052.4	0.0227	41.901	1019.9	0.0227
7	38.647	1049.0	0.0226	38.819	1049.0	0.0226	42.053	1013.2	0.0226
8	38.800	1045.2	0.0225	38.971	1045.2	0.0225	42.188	1007.9	0.0225
9	38.940	1041.8	0.0224	39.110	1041.8	0.0224	42.317	1003.5	0.0224
10	39.053	1039.0	0.0223	39.224	1039.0	0.0223	42.427	1000.2	0.0223
11	39.158	1037.2	0.0222	39.330	1037.2	0.0222	42.536	997.9	0.0222
12	39.271	1036.3	0.0221	39.444	1036.3	0.0221	42.662	996.8	0.0221
13	39.325	1035.9	0.0220	39.499	1035.9	0.0220	42.741	997.7	0.0220
14	39.213	1034.9	0.0219	39.389	1034.9	0.0219	42.668	1001.0	0.0219
15	38.767	1030.8	0.0218	38.945	1030.8	0.0218	42.266	1006.1	0.0218
16	37.437	1019.3	0.0217	37.615	1019.3	0.0217	40.950	1009.7	0.0217
17	33.719	991.5	0.0217	33.887	991.5	0.0217	37.072	996.4	0.0217
18	23.251	910.3	0.0216	23.374	910.3	0.0216	25.744	923.3	0.0216

Table 4.1.10-4 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly G02 of Crystal River Unit 3

	Assembly Number G2								
	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 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 Cy7			260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	0.0			5.256	1173.1	0.0239	5.982	1158.3	0.0239
2	0.0			8.059	1404.0	0.0238	9.145	1325.4	0.0238
3	0.0			9.712	1523.2	0.0236	10.975	1388.9	0.0236
4	0.0	Data not required.		10.506	1569.6	0.0235	11.829	1397.2	0.0235
5	0.0			10.893	1584.3	0.0233	12.230	1391.3	0.0233
6	0.0			11.092	1585.0	0.0232	12.428	1384.6	0.0232
7	0.0			11.202	1582.0	0.0230	12.534	1380.9	0.0230
8	0.0			11.265	1578.2	0.0229	12.595	1380.7	0.0229
9	0.0			11.295	1574.5	0.0227	12.625	1383.4	0.0228
10	0.0			11.296	1570.9	0.0226	12.628	1388.8	0.0226
11	0.0			11.268	1567.5	0.0224	12.606	1396.6	0.0225
12	0.0			11.215	1564.3	0.0223	12.560	1407.1	0.0224
13	0.0			11.129	1560.8	0.0222	12.485	1418.9	0.0222
14	0.0			10.987	1555.1	0.0220	12.354	1432.2	0.0221
15	0.0			10.723	1540.2	0.0219	12.093	1445.3	0.0220
16	0.0			10.171	1502.6	0.0218	11.511	1449.3	0.0218
17	0.0			8.963	1411.3	0.0217	10.182	1414.4	0.0217
18	0.0			6.184	1185.4	0.0216	7.043	1229.7	0.0216
	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 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.
	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7	479.0 Cy7	402.3 Cy7	402.3 Cy7
1	6.683	1158.3	0.0239	10.284	1161.1	0.0239	10.719	1161.1	0.0239
2	10.186	1325.4	0.0238	15.395	1320.5	0.0238	16.007	1320.5	0.0238
3	12.172	1388.9	0.0236	18.050	1367.6	0.0236	18.728	1367.6	0.0236
4	13.069	1397.2	0.0235	19.096	1366.6	0.0235	19.784	1366.6	0.0235
5	13.472	1391.3	0.0233	19.489	1355.9	0.0233	20.171	1355.9	0.0233
6	13.660	1384.6	0.0232	19.638	1346.3	0.0232	20.314	1346.3	0.0232
7	13.755	1380.9	0.0230	19.705	1340.1	0.0230	20.378	1340.1	0.0230
8	13.806	1380.7	0.0229	19.747	1336.9	0.0229	20.420	1336.9	0.0229
9	13.830	1383.4	0.0228	19.779	1336.2	0.0227	20.453	1336.2	0.0227
10	13.829	1388.8	0.0226	19.801	1337.4	0.0226	20.478	1337.4	0.0226
11	13.806	1396.6	0.0225	19.815	1340.5	0.0225	20.496	1340.5	0.0225
12	13.763	1407.1	0.0224	19.827	1345.9	0.0223	20.513	1345.9	0.0223
13	13.693	1418.9	0.0222	19.832	1354.1	0.0222	20.527	1354.1	0.0222
14	13.569	1432.2	0.0221	19.802	1365.5	0.0221	20.508	1365.5	0.0221
15	13.310	1445.3	0.0220	19.630	1377.8	0.0220	20.349	1377.8	0.0220

16	12.704	1449.3	0.0218	19.008	1385.9	0.0218	19.732	1385.9	0.0218
17	11.270	1414.4	0.0217	17.167	1362.7	0.0217	17.856	1362.7	0.0217
18	7.814	1229.7	0.0216	12.115	1200.5	0.0216	12.631	1200.5	0.0216
	Statepoint 22 (BOC Cycle 8)			Statepoint 23 (97.6 Cycle 8)			Statepoint 24 (139.8 Cycle 8)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy8	402.3 Cy7	402.3 Cy7	97.6 Cy8	111.4 Cy8	111.4 Cy8	139.8 Cy8	111.4 Cy8	111.4 Cy8
1	11.212	1161.1	0.0239	12.603	903.7	0.0231	13.242	903.7	0.0231
2	16.698	1320.5	0.0238	18.899	1013.1	0.0230	19.887	1013.1	0.0230
3	19.491	1367.6	0.0236	22.144	1057.1	0.0229	23.310	1057.1	0.0229
4	20.557	1366.6	0.0235	23.445	1076.5	0.0228	24.693	1076.5	0.0228
5	20.939	1355.9	0.0233	23.959	1084.9	0.0227	25.246	1084.9	0.0227
6	21.077	1346.3	0.0232	24.176	1088.0	0.0226	25.482	1088.0	0.0226
7	21.138	1340.1	0.0230	24.285	1088.1	0.0225	25.600	1088.1	0.0225
8	21.180	1336.9	0.0229	24.355	1086.7	0.0224	25.674	1086.7	0.0224
9	21.215	1336.2	0.0227	24.405	1084.4	0.0223	25.725	1084.4	0.0223
10	21.243	1337.4	0.0226	24.438	1081.7	0.0222	25.759	1081.7	0.0222
11	21.266	1340.5	0.0225	24.456	1078.7	0.0222	25.776	1078.7	0.0222
12	21.289	1345.9	0.0223	24.462	1075.1	0.0221	25.780	1075.1	0.0221
13	21.312	1354.1	0.0222	24.448	1070.2	0.0220	25.759	1070.2	0.0220
14	21.305	1365.5	0.0221	24.374	1062.5	0.0219	25.671	1062.5	0.0219
15	21.161	1377.8	0.0220	24.117	1050.3	0.0218	25.384	1050.3	0.0218
16	20.550	1385.9	0.0218	23.314	1029.9	0.0217	24.519	1029.9	0.0217
17	18.637	1362.7	0.0217	21.033	989.7	0.0216	22.098	989.7	0.0216
18	13.218	1200.5	0.0216	14.753	877.5	0.0216	15.451	877.5	0.0216
	Statepoint 25 (404.0 Cycle 8)			Statepoint 26 (409.6 Cycle 8)			Statepoint 27 (515.5 Cycle 8)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	404.0 Cy8	234.6 Cy8	234.6 Cy8	409.6 Cy8	234.6 Cy8	234.6 Cy8	515.5 Cy8	470.7 Cy8	470.7 Cy8
1	17.720	920.5	0.0231	17.823	920.5	0.0231	19.904	954.0	0.0231
2	26.482	1011.9	0.0230	26.628	1011.9	0.0230	29.523	1014.5	0.0230
3	30.818	1040.9	0.0229	30.981	1040.9	0.0229	34.147	1032.8	0.0229
4	32.503	1047.3	0.0228	32.669	1047.3	0.0228	35.870	1030.9	0.0228
5	33.139	1046.5	0.0227	33.305	1046.5	0.0227	36.481	1023.1	0.0227
6	33.384	1043.4	0.0226	33.549	1043.4	0.0226	36.694	1015.5	0.0226
7	33.490	1039.8	0.0225	33.655	1039.8	0.0225	36.776	1009.4	0.0225
8	33.551	1036.2	0.0224	33.715	1036.2	0.0224	36.822	1004.7	0.0224
9	33.596	1033.0	0.0223	33.760	1033.0	0.0223	36.859	1001.1	0.0224
10	33.632	1030.5	0.0222	33.796	1030.5	0.0222	36.895	998.5	0.0223
11	33.665	1028.7	0.0222	33.829	1028.7	0.0222	36.933	996.8	0.0222
12	33.692	1027.4	0.0221	33.858	1027.4	0.0221	36.975	996.2	0.0221
13	33.700	1026.3	0.0220	33.867	1026.3	0.0220	37.007	997.3	0.0220
14	33.629	1024.7	0.0219	33.798	1024.7	0.0219	36.972	1000.2	0.0219

15	33.310	1021.4	0.0218	33.481	1021.4	0.0218	36.695	1004.8	0.0218
16	32.262	1013.0	0.0217	32.432	1013.0	0.0217	35.656	1007.4	0.0217
17	29.184	987.7	0.0216	29.344	987.7	0.0216	32.413	991.4	0.0217
18	20.330	892.9	0.0216	20.445	892.9	0.0216	22.688	923.7	0.0216
	Statepoint 28 (BOC Cycle 9)			Statepoint 29 (158.8 Cycle 9)			Statepoint 30 (219.0 Cycle 9)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy9	470.7 Cy8	470.7 Cy8	158.8 Cy9	110.5 Cy9	110.5 Cy9	219.0 Cy9	192.8 Cy9	192.8 Cy9
1	20.343	954.0	0.0231	21.309	684.7	0.0221	21.724	694.0	0.0221
2	30.121	1014.5	0.0230	31.599	712.4	0.0221	32.214	721.1	0.0221
3	34.792	1032.8	0.0229	36.537	730.3	0.0221	37.240	736.1	0.0221
4	36.518	1030.9	0.0228	38.392	737.4	0.0220	39.127	740.3	0.0221
5	37.123	1023.1	0.0227	39.062	740.0	0.0220	39.807	740.6	0.0220
6	37.328	1015.5	0.0226	39.299	740.4	0.0220	40.044	739.3	0.0220
7	37.404	1009.4	0.0225	39.386	739.5	0.0219	40.128	737.4	0.0219
8	37.442	1004.7	0.0224	39.425	738.0	0.0219	40.163	735.4	0.0219
9	37.472	1001.1	0.0224	39.447	736.1	0.0219	40.180	733.3	0.0219
10	37.499	998.5	0.0223	39.461	734.0	0.0218	40.190	731.4	0.0218
11	37.527	996.8	0.0222	39.472	731.8	0.0218	40.197	729.6	0.0218
12	37.558	996.2	0.0221	39.481	729.4	0.0218	40.202	727.9	0.0218
13	37.580	997.3	0.0220	39.474	726.5	0.0217	40.190	726.1	0.0217
14	37.540	1000.2	0.0219	39.390	723.0	0.0217	40.101	724.1	0.0217
15	37.261	1004.8	0.0218	39.047	718.0	0.0217	39.747	721.2	0.0217
16	36.221	1007.4	0.0217	37.900	710.1	0.0217	38.574	715.9	0.0217
17	32.951	991.4	0.0217	34.422	694.7	0.0216	35.029	703.0	0.0216
18	23.087	923.7	0.0216	24.066	664.7	0.0216	24.483	673.3	0.0216
	Statepoint 31 (363.1 Cycle 9)								
Node	Burnup	Fuel	Moderator						
No.	(GWd/MTU)	Temp.	Spec. Vol.						
	363.1 Cy9	303.7 Cy9	303.7 Cy9						
1	22.838	709.0	0.0222						
2	33.814	735.3	0.0221						
3	39.026	746.8	0.0221						
4	40.957	747.4	0.0221						
5	41.635	745.1	0.0220						
6	41.858	742.1	0.0220						
7	41.926	739.4	0.0220						
8	41.946	736.9	0.0219						
9	41.952	734.8	0.0219						
10	41.954	733.0	0.0219						
11	41.956	731.5	0.0218						
12	41.958	730.3	0.0218						
13	41.947	729.5	0.0218						

14	41.859	728.9	0.0217
15	41.501	728.2	0.0217
16	40.295	725.9	0.0217
17	36.619	716.2	0.0216
18	25.610	686.7	0.0216

Table 4.1.10-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly G17 of Crystal River Unit 3

	Assembly Number G17								
	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 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 Cy7			260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	0.0			5.304	1181.8	0.0239	6.032	1164.0	0.0239
2	0.0			8.081	1408.5	0.0238	9.165	1332.0	0.0238
3	0.0			9.806	1527.7	0.0236	11.073	1396.1	0.0237
4	0.0	Data not required.		10.638	1571.0	0.0235	11.964	1401.6	0.0235
5	0.0			10.999	1578.3	0.0233	12.331	1391.2	0.0233
6	0.0			11.168	1574.8	0.0232	12.493	1381.7	0.0232
7	0.0			11.265	1569.8	0.0230	12.584	1376.8	0.0231
8	0.0			11.331	1565.3	0.0229	12.647	1376.1	0.0229
9	0.0			11.379	1561.7	0.0227	12.695	1378.8	0.0228
10	0.0			11.409	1558.9	0.0226	12.729	1384.0	0.0226
11	0.0			11.429	1556.6	0.0224	12.755	1391.5	0.0225
12	0.0			11.453	1556.1	0.0223	12.791	1402.2	0.0224
13	0.0			11.464	1558.0	0.0222	12.820	1416.2	0.0222
14	0.0			11.376	1555.9	0.0220	12.748	1430.9	0.0221
15	0.0			11.099	1542.7	0.0219	12.475	1444.3	0.0220
16	0.0			10.480	1503.8	0.0218	11.821	1448.1	0.0218
17	0.0			9.185	1410.1	0.0217	10.399	1411.7	0.0217
18	0.0			6.388	1189.6	0.0216	7.245	1226.1	0.0216
	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 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.
	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7	479.0 Cy7	402.3 Cy7	402.3 Cy7
1	6.738	1164.0	0.0239	10.367	1167.2	0.0239	10.809	1167.2	0.0239
2	10.210	1332.0	0.0238	15.459	1329.1	0.0238	16.081	1329.1	0.0238
3	12.278	1396.1	0.0237	18.219	1376.1	0.0236	18.908	1376.1	0.0236
4	13.211	1401.6	0.0235	19.292	1372.3	0.0235	19.988	1372.3	0.0235
5	13.573	1391.2	0.0233	19.609	1357.7	0.0233	20.295	1357.7	0.0233
6	13.719	1381.7	0.0232	19.692	1345.9	0.0232	20.370	1345.9	0.0232
7	13.796	1376.8	0.0231	19.732	1338.9	0.0230	20.406	1338.9	0.0230
8	13.850	1376.1	0.0229	19.776	1335.5	0.0229	20.449	1335.5	0.0229
9	13.892	1378.8	0.0228	19.828	1334.7	0.0227	20.502	1334.7	0.0227

10	13.922	1384.0	0.0226	19.883	1335.7	0.0226	20.561	1335.7	0.0226
11	13.949	1391.5	0.0225	19.950	1338.4	0.0225	20.632	1338.4	0.0225
12	13.990	1402.2	0.0224	20.058	1343.8	0.0223	20.746	1343.8	0.0223
13	14.031	1416.2	0.0222	20.206	1353.7	0.0222	20.905	1353.7	0.0222
14	13.970	1430.9	0.0221	20.259	1365.8	0.0221	20.972	1365.8	0.0221
15	13.698	1444.3	0.0220	20.076	1378.6	0.0220	20.803	1378.6	0.0220
16	13.017	1448.1	0.0218	19.369	1387.1	0.0218	20.101	1387.1	0.0218
17	11.485	1411.7	0.0217	17.404	1363.8	0.0217	18.099	1363.8	0.0217
18	8.014	1226.1	0.0216	12.324	1200.1	0.0216	12.843	1200.1	0.0216
	Statepoint 22 (BOC Cycle 8)			Statepoint 23 (97.6 Cycle 8)			Statepoint 24 (139.8 Cycle 8)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy8	402.3 Cy7	402.3 Cy7	97.6 Cy8	111.4 Cy8	111.4 Cy8	139.8 Cy8	111.4 Cy8	111.4 Cy8
1	11.305	1167.2	0.0239	13.171	1012.6	0.0236	14.025	1012.6	0.0236
2	16.779	1329.1	0.0238	19.625	1134.2	0.0235	20.906	1134.2	0.0235
3	19.681	1376.1	0.0236	23.047	1188.7	0.0234	24.544	1188.7	0.0234
4	20.769	1372.3	0.0235	24.316	1205.8	0.0233	25.893	1205.8	0.0233
5	21.068	1357.7	0.0233	24.689	1198.6	0.0231	26.262	1198.6	0.0231
6	21.134	1345.9	0.0232	24.841	1201.5	0.0230	26.434	1201.5	0.0230
7	21.166	1338.9	0.0230	24.934	1203.1	0.0229	26.541	1203.1	0.0229
8	21.209	1335.5	0.0229	25.016	1202.5	0.0227	26.631	1202.5	0.0227
9	21.265	1334.7	0.0227	25.096	1200.7	0.0226	26.715	1200.7	0.0226
10	21.327	1335.7	0.0226	25.174	1198.2	0.0225	26.797	1198.2	0.0225
11	21.402	1338.4	0.0225	25.274	1196.2	0.0224	26.902	1196.2	0.0224
12	21.524	1343.8	0.0223	25.530	1201.5	0.0222	27.186	1201.5	0.0222
13	21.696	1353.7	0.0222	25.839	1230.7	0.0221	27.587	1230.7	0.0221
14	21.778	1365.8	0.0221	25.865	1225.9	0.0220	27.611	1225.9	0.0220
15	21.624	1378.6	0.0220	25.575	1210.9	0.0219	27.284	1210.9	0.0219
16	20.929	1387.1	0.0218	24.652	1186.1	0.0218	26.284	1186.1	0.0218
17	18.886	1363.8	0.0217	22.198	1140.2	0.0217	23.666	1140.2	0.0217
18	13.434	1200.1	0.0216	15.667	1008.4	0.0216	16.672	1008.4	0.0216
	Statepoint 25 (404.0 Cycle 8)			Statepoint 26 (409.6 Cycle 8)			Statepoint 27 (515.5 Cycle 8)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	404.0 Cy8	234.6 Cy8	234.6 Cy8	409.6 Cy8	234.6 Cy8	234.6 Cy8	515.5 Cy8	470.7 Cy8	470.7 Cy8
1	19.849	1022.1	0.0236	19.979	1022.1	0.0236	22.566	1025.2	0.0235
2	29.336	1126.9	0.0235	29.519	1126.9	0.0235	33.090	1104.9	0.0234
3	34.134	1165.1	0.0234	34.338	1165.1	0.0234	38.254	1137.9	0.0233
4	35.766	1169.3	0.0232	35.972	1169.3	0.0232	39.881	1130.2	0.0232
5	35.970	1155.3	0.0231	36.171	1155.3	0.0231	39.966	1107.8	0.0230
6	36.137	1152.2	0.0230	36.336	1152.2	0.0230	40.088	1097.6	0.0229
7	36.248	1149.5	0.0228	36.446	1149.5	0.0228	40.172	1090.6	0.0228
8	36.338	1146.5	0.0227	36.537	1146.5	0.0227	40.246	1085.2	0.0227

9	36.429	1143.7	0.0226	36.628	1143.7	0.0226	40.330	1081.0	0.0226
10	36.529	1141.7	0.0225	36.728	1141.7	0.0225	40.430	1077.7	0.0224
11	36.681	1141.2	0.0224	36.881	1141.2	0.0224	40.598	1075.9	0.0223
12	37.161	1148.8	0.0223	37.365	1148.8	0.0223	41.169	1081.1	0.0222
13	38.145	1178.6	0.0221	38.361	1178.6	0.0221	42.348	1104.7	0.0221
14	38.270	1180.2	0.0220	38.491	1180.2	0.0220	42.539	1110.9	0.0220
15	37.907	1173.8	0.0219	38.130	1173.8	0.0219	42.229	1116.8	0.0219
16	36.664	1157.3	0.0218	36.886	1157.3	0.0218	40.998	1120.5	0.0218
17	33.232	1125.5	0.0217	33.441	1125.5	0.0217	37.357	1101.9	0.0217
18	23.427	1007.9	0.0216	23.580	1007.9	0.0216	26.483	1001.2	0.0216

Table 4.1.10-6 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly G27a of Crystal River Unit 3

	Assembly Number G27a								
	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 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 Cy7			260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	0.0			3.680	1023.6	0.0233	4.195	1039.4	0.0233
2	0.0			6.285	1253.1	0.0232	7.105	1191.1	0.0232
3	0.0			7.944	1353.1	0.0231	8.912	1238.3	0.0231
4	0.0	Data not required.		8.773	1386.5	0.0230	9.787	1242.0	0.0230
5	0.0			9.167	1393.3	0.0229	10.189	1234.3	0.0229
6	0.0			9.352	1390.2	0.0228	10.370	1226.7	0.0228
7	0.0			9.439	1384.1	0.0227	10.450	1222.1	0.0227
8	0.0			9.480	1377.9	0.0225	10.485	1220.5	0.0226
9	0.0			9.500	1372.7	0.0224	10.503	1221.6	0.0225
10	0.0			9.514	1369.1	0.0223	10.518	1224.9	0.0224
11	0.0			9.528	1367.1	0.0222	10.536	1230.3	0.0223
12	0.0			9.539	1366.8	0.0221	10.553	1237.9	0.0222
13	0.0			9.525	1367.1	0.0220	10.549	1248.0	0.0221
14	0.0			9.439	1365.0	0.0219	10.473	1259.8	0.0220
15	0.0			9.198	1354.5	0.0218	10.233	1270.9	0.0219
16	0.0			8.635	1323.2	0.0217	9.644	1272.1	0.0218
17	0.0			7.393	1242.0	0.0216	8.301	1234.8	0.0217
18	0.0			4.679	1025.2	0.0216	5.291	1082.7	0.0216
	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 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.
	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7	479.0 Cy7	402.3 Cy7	402.3 Cy7
1	4.700	1039.4	0.0233	7.360	1055.1	0.0233	7.698	1055.1	0.0233
2	7.894	1191.1	0.0232	11.912	1193.3	0.0232	12.401	1193.3	0.0232
3	9.829	1238.3	0.0231	14.408	1234.0	0.0231	14.950	1234.0	0.0231
4	10.737	1242.0	0.0230	15.435	1232.7	0.0230	15.985	1232.7	0.0230

5	11.137	1234.3	0.0229	15.819	1222.4	0.0229	16.363	1222.4	0.0229
6	11.307	1226.7	0.0228	15.948	1213.2	0.0228	16.486	1213.2	0.0228
7	11.376	1222.1	0.0227	15.985	1207.1	0.0226	16.520	1207.1	0.0226
8	11.401	1220.5	0.0226	15.996	1203.9	0.0225	16.530	1203.9	0.0225
9	11.412	1221.6	0.0225	16.007	1202.8	0.0224	16.542	1202.8	0.0224
10	11.423	1224.9	0.0224	16.031	1203.3	0.0223	16.568	1203.3	0.0223
11	11.439	1230.3	0.0223	16.075	1205.3	0.0222	16.614	1205.3	0.0222
12	11.459	1237.9	0.0222	16.137	1209.1	0.0221	16.681	1209.1	0.0221
13	11.460	1248.0	0.0221	16.198	1215.3	0.0221	16.749	1215.3	0.0221
14	11.390	1259.8	0.0220	16.201	1224.1	0.0220	16.760	1224.1	0.0220
15	11.151	1270.9	0.0219	16.022	1234.2	0.0219	16.591	1234.2	0.0219
16	10.540	1272.1	0.0218	15.382	1238.5	0.0218	15.954	1238.5	0.0218
17	9.111	1234.8	0.0217	13.599	1211.8	0.0217	14.139	1211.8	0.0217
18	5.842	1082.7	0.0216	9.018	1076.4	0.0216	9.413	1076.4	0.0216
	Statepoint 28 (BOC Cycle 9)			Statepoint 29 (158.8 Cycle 9)			Statepoint 30 (219.0 Cycle 9)		
Node	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator	Burnup	Fuel	Moderator
No.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.	(GWd/MTU)	Temp.	Spec. Vol.
	BOC Cy9	402.3 Cy7+	402.3 Cy7+	158.8 Cy9	110.5 Cy9	110.5 Cy9	219.0 Cy9	192.8 Cy9	192.8 Cy9
1	8.071	1055.1	0.0233	10.491	955.3	0.0235	11.554	967.3	0.0235
2	12.945	1193.3	0.0232	17.245	1134.6	0.0234	18.991	1127.4	0.0234
3	15.559	1234.0	0.0231	20.919	1205.8	0.0233	22.999	1182.6	0.0233
4	16.604	1232.7	0.0230	22.482	1236.8	0.0232	24.697	1202.3	0.0232
5	16.978	1222.4	0.0229	23.127	1250.8	0.0231	25.393	1207.0	0.0230
6	17.096	1213.2	0.0228	23.394	1256.3	0.0230	25.677	1206.1	0.0229
7	17.127	1207.1	0.0226	23.512	1257.9	0.0228	25.802	1203.5	0.0228
8	17.137	1203.9	0.0225	23.572	1257.4	0.0227	25.865	1200.7	0.0227
9	17.150	1202.8	0.0224	23.613	1255.6	0.0226	25.908	1197.9	0.0226
10	17.178	1203.3	0.0223	23.655	1253.3	0.0225	25.952	1195.6	0.0224
11	17.228	1205.3	0.0222	23.709	1250.6	0.0223	26.012	1193.8	0.0223
12	17.300	1209.1	0.0221	23.776	1247.8	0.0222	26.087	1192.7	0.0222
13	17.375	1215.3	0.0221	23.823	1244.0	0.0221	26.143	1192.0	0.0221
14	17.396	1224.1	0.0220	23.760	1236.5	0.0220	26.079	1190.2	0.0220
15	17.238	1234.2	0.0219	23.417	1222.5	0.0219	25.712	1184.6	0.0219
16	16.603	1238.5	0.0218	22.421	1196.5	0.0218	24.634	1169.6	0.0218
17	14.754	1211.8	0.0217	19.844	1146.0	0.0217	21.835	1130.6	0.0217
18	9.865	1076.4	0.0216	13.178	996.1	0.0216	14.519	1002.7	0.0216
	Statepoint 31 (363.1 Cycle 9)								
Node	Burnup	Fuel	Moderator						
No.	(GWd/MTU)	Temp.	Spec. Vol.						
	363.1 Cy9	303.7 Cy9	303.7 Cy9						
1	14.277	995.0	0.0235						
2	23.326	1121.3	0.0234						
3	28.034	1161.1	0.0233						

4	29.952	1165.7	0.0231
5	30.697	1160.7	0.0230
6	30.978	1154.4	0.0229
7	31.091	1148.9	0.0228
8	31.148	1144.5	0.0227
9	31.192	1141.3	0.0225
10	31.247	1139.1	0.0224
11	31.327	1137.9	0.0223
12	31.436	1138.0	0.0222
13	31.535	1139.5	0.0221
14	31.512	1141.9	0.0220
15	31.153	1143.7	0.0219
16	29.977	1140.7	0.0218
17	26.753	1117.4	0.0217
18	17.942	1010.3	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 4.1.11-4 present the CRA and APSRA insertion time data relevant to each assembly depletion calculation documented in this analysis. Assemblies F06 and G02 were located in a control bank 6 location during Cycles 7 and 8, respectively. During Cycle-7 and Cycle-8 operation, control bank 6 was 100% withdrawn from the core. Therefore, no control rod insertion data is needed or presented for assemblies F06 and G02 in this analysis. The assembly heights corresponding to the axial nodes presented in Tables 4.1.11-1 through 4.1.11-4 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 F17a

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	147.11	10.10	5.37	27.07	0.26
2	36.81	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 4.1.11-2 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number F19a

Axial Node (1=Top)	Cycle-8, 0.0 EFPD to Cycle-8, 97.6 EFPD	Cycle-8, 97.6 EFPD to Cycle-8, 139.8 EFPD	Cycle-8, 139.8 EFPD to Cycle-8, 404.0 EFPD	Cycle-8, 404.0 EFPD to Cycle-8, 409.6 EFPD	Cycle-8, 409.6 EFPD to Cycle-8, 515.5 EFPD
1	24.88	4.06	20.60	1.83	19.43
2	0.00	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 4.1.11-3 Grey APSRA Insertion Time Data (EFPDs Inserted) for Assembly Number G17

Axial Node (1=Top)	Cycle-8, 0.0 EFPD to Cycle-8, 97.6 EFPD	Cycle-8, 97.6 EFPD to Cycle-8, 139.8 EFPD	Cycle-8, 139.8 EFPD to Cycle-8, 404.0 EFPD	Cycle-8, 404.0 EFPD to Cycle-8, 409.6 EFPD	Cycle-8, 409.6 EFPD to Cycle-8, 515.5 EFPD
1	0.00	0.00	0.00	0.00	0.00
2	0.00	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	62.94	16.04	100.40	2.13	46.66
10	97.60	42.20	264.20	5.60	103.15
11	97.60	42.20	264.20	5.60	103.22
12	53.50	34.60	216.64	4.59	76.88
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 4.1.11-4 CRA Insertion Time Data (EFPDs Inserted) for Assembly Number G27a

Axial Node (1=Top)	Cycle-9, 0.0 EFPD to Cycle-9, 158.8 EFPD	Cycle-9, 158.8 EFPD to Cycle-9, 219.0 EFPD	Cycle-9, 219.0 EFPD to Cycle-9, 363.1 EFPD
1	57.22	14.04	35.99
2	2.07	0.00	0.00
3	0.00	0.00	0.00
4	0.00	0.00	0.00
5	0.00	0.00	0.00
6	0.00	0.00	0.00
7	0.00	0.00	0.00
8	0.00	0.00	0.00
9	0.00	0.00	0.00
10	0.00	0.00	0.00
11	0.00	0.00	0.00
12	0.00	0.00	0.00
13	0.00	0.00	0.00
14	0.00	0.00	0.00
15	0.00	0.00	0.00
16	0.00	0.00	0.00
17	0.00	0.00	0.00
18	0.00	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 Rodded Assemblies in Batches 1, 2, 3, and 1X of Crystal River Unit 3.* DI#: BBA000000-01717-0200-00040 REV 00, CRWMS M&O.

5.12 *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.

5.13 *Interoffice Correspondence (IOC) from Hugh Benton to Greg Carlisle, Subject: Software Routines.* July 29, 1997, IOC Number: LV.WP.DAT.07/97-164, CRWMS, M&O.

5.14 Attachments for BBA000000-01717-0200-00043 REV 00 - CRC Depletion Calculations for the Rodded Assemblies in Batches 8 and 9 of Crystal River Unit 3. Batch Number: MOY-970902-09.

5.15 CRC Depletion Calculations for the Rodded Assemblies in Batches 8 and 9 of Crystal River Unit 3 (DI#: BBA000000-01717-0200-00043 REV 00) - Attachments XIII and XIV - 2 Data Cartridges. Batch Number: MOY-970902-08.

6. Use of Computer Software

6.1 Software Approved for QA Work

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.

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 of reference 5.11.

6.2 Software Routines

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 reference 5.11. The CRAFT Version 3.0 software routine will ultimately be documented as an addendum to the existing SCALE V4.3 baseline and assume the SCALE V4.3 baseline CSCI identifier number of 30011 V4.3 (Ref. 5.13).

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 5.12. The CRC_DATA_TABULIZER Version 2.0 software routine will ultimately be documented as an addendum to the existing SCALE V4.3 baseline and assume the SCALE V4.3 baseline CSCI identifier number of 30011 V4.3 (Ref. 5.13).

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 reference 5.11. The RLAYOUT software routine will ultimately be documented as an addendum to the existing SCALE V4.3 baseline and assume the SCALE V4.3 baseline CSCI identifier number of 30011 V4.3 (Ref. 5.13).

7. Design Analysis

This design analysis documents the fuel assembly SAS2H depletion calculations for the rodded assemblies of fuel batches 8 and 9 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 of reference 5.11 is essential for understanding the SAS2H modeling techniques employed in this analysis. The information in Attachment I (Ref. 5.11), the input parameters in Section 4.1, and the CRAFT input decks in Attachments I through VI 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 reference 5.11. 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 (Ref. 5.11). 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 8 and 9 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 8 and 9. The assembly specifications required to develop the Path B models are the same for batches 8 and 9. 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 with a grey APSRA, 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 8 and 9 of Crystal River Unit 3

SAS2H Path B Unit Cell Model Dimension Calculations for the Rodded Assembly Axial Regions in Fuel Batches 8 and 9 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):	0.936244
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 = 0.529832

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 = 0.688443

Moderator Unit Volume in Fuel Rod Unit Cell:

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

Table 7.2-1 Set 1 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 of Crystal River Unit 3

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 (Table 7.2-5).
The Zone 5 outer radius is calculated using Equation 7 (Table 7.2-5).

Table 7.2-2 Set 2 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 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 8 and 9 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

Table 7.2-2 Set 2 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 of Crystal River Unit 3

Fuel pellet diameter (cm):	0.936244
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 = 0.560945

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 = 0.688443

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)

Table 7.2-2 Set 2 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 of Crystal River Unit 3

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 (Table 7.2-5).
The Zone 8 outer radius is calculated using Equation 7 (Table 7.2-5).

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 8 and 9 of Crystal River Unit 3

Path B Models for Use in Assembly Axial Regions of Fuel Batches 8 and 9 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):	0.936244
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 = 0.562499

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)

Fuel Unit Volume in Fuel Rod Unit Cell = 0.688443

Moderator Unit Volume in Fuel Rod Unit Cell:

Table 7.2-3 Set 3 Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 of Crystal River Unit 3

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 (Table 7.2-5).
The Zone 8 outer radius is calculated using Equation 7 (Table 7.2-5).
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, with a Grey APSRA, Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 of Crystal River Unit 3

Path B Models for Use in Assembly Axial Regions of Fuel Batches 8 and 9 of Crystal River Unit 3 that have a Grey 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):	0.936244
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):	0.98044
APSR absorber material diameter (cm):	0.95250
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 = 0.562499

Fuel-to-Moderator Volume Ratio for the cross-section of the assembly containing the follow rod region of the APSRA = 0.537017

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 = 1.688743

Table 7.2-4 Set 4, with a Grey APSRA, Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 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 = 0.688443

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 = 12.28740

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	0.47625	APSR Absorber Material	Water	Water
	2	0.49022	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, with a Grey APSRA, Path B Unit Cell Model's Dimension Calculation Spreadsheet for the Rodded Assembly Axial Regions from Fuel Batches 8 and 9 of Crystal River Unit 3

	7	2.96707	—	—	Homogenized region
Outer	8	2.99040	—	—	Moderator Outside Assembly

Notes: The Zone 7 outer radius is calculated using Equation 6 (Table 7.2-5).
The Zone 8 outer radius is calculated using Equation 7 (Table 7.2-5).
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 (The equations in this table are derived.)

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):

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

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:

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

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:

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

7.3 Cycle Irradiation History Layouts for the Depletion of the Rodded Assemblies in Batches 8 and 9 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 reference 5.11.

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 7.3-4 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 7.3-4 are obtained by using linear interpolation within the data presented in Tables 4.1.9-1 through 4.1.9-4. 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 reference 5.11.

The irradiation time step layouts developed with the RLAYOUT program for the assemblies documented in this analysis are presented in Tables 7.3-5 through 7.3-8. Tables 7.3-5 through 7.3-8 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 7.3-5 through 7.3-8 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 7.3-4. The boron letdown data provided to the RLAYOUT program is taken from the data presented in 4.1.9-1 through 4.1.9-4. However, some of the measured boron concentrations shown in Tables 4.1.9-1 through 4.1.9-4 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 4.1.9-4 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 4.1.9-4 is presented in Tables 7.3-9 through 7.3-12. 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-6 Irradiation History Layout for Non-Rodded Assemblies

Cycle-6

BOC to Stpt2 (96.0 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1010.95	24.00
2	942.44	72.00

Stpt2 (96.0 EFPD) to Stpt3 (400.0 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	751.31	134.00
2	547.28	210.00
3	341.80	286.00
4	152.42	362.00

Stpt3 (400.0 EFPD) to EOC (412.07 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	121.71	406.04

Table 7.3-2 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 7.3-3 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 7.3-4 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 7.3-5 Rodded Irradiation Time Step Layout for Assembly F17a

IRRADIATION LAYOUT FOR ASSEMBLY: F17a
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	36.81	36.81	1454.5
2	55.15	91.96	1360.5
3	55.15	147.11	1251.4
4	56.59	203.71	1119.3
5	56.59	260.30	959.5

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	10.10	10.10	852.1
2	20.60	30.70	802.4

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	5.37	5.37	760.3
2	22.63	28.00	714.9

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	27.07	27.07	634.4
2	58.11	85.18	506.2
3	58.11	143.30	337.2

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: F17a

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 7.3-6 Rodded Irradiation Time Step Layout for Assembly F19a

IRRADIATION LAYOUT FOR ASSEMBLY: F19a
Cycle-08, .0 EFPD to Cycle-08, 97.6 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	24.88	24.88	1534.5
2	36.36	61.24	1473.6
3	36.36	97.60	1407.6

Cycle-08, 97.6 EFPD to Cycle-08, 139.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	4.06	4.06	1359.8
2	38.14	42.20	1298.2

Cycle-08, 139.8 EFPD to Cycle-08, 404.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	20.60	20.60	1191.6
2	60.90	81.50	1110.1
3	60.90	142.40	946.9
4	60.90	203.30	771.9
5	60.90	264.20	580.3

Cycle-08, 404.0 EFPD to Cycle-08, 409.6 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	1.83	1.83	488.9
2	3.77	5.60	482.4

Cycle-08, 409.6 EFPD to Cycle-08, 515.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	19.43	19.43	455.4
2	43.23	62.66	379.5
3	43.23	105.90	262.7

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: F19a

COLUMN A: Cycle-08, .0 EFPD to Cycle-08, 97.6 EFPD Statepoint Calculation
COLUMN B: Cycle-08, 97.6 EFPD to Cycle-08, 139.8 EFPD Statepoint Calculation
COLUMN C: Cycle-08, 139.8 EFPD to Cycle-08, 404.0 EFPD Statepoint Calculation
COLUMN D: Cycle-08, 404.0 EFPD to Cycle-08, 409.6 EFPD Statepoint Calculation
COLUMN E: Cycle-08, 409.6 EFPD to Cycle-08, 515.5 EFPD Statepoint Calculation

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

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

Table 7.3-7 Rodded Irradiation Time Step Layout for Assembly G17

IRRADIATION LAYOUT FOR ASSEMBLY: G17
Cycle-08, .0 EFPD to Cycle-08, 97.6 EFPD Statepoint Calculation

Step Exposure at Mid-Step Boron

Irradiation Step Number	Duration (EFPD)	End of Step (EFPD)	Concentration (ppm)
1	53.50	53.50	1506.1
2	9.44	62.94	1445.0
3	35.06	98.00	1405.2

Cycle-08, 97.6 EFPD to Cycle-08, 139.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	16.04	16.04	1344.7
2	18.56	34.60	1288.8
3	7.40	42.00	1241.7
4	.20	42.20	1227.9

Cycle-08, 139.8 EFPD to Cycle-08, 404.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	50.20	50.20	1156.3
2	50.20	100.40	1048.9
3	58.12	158.52	892.6
4	58.12	216.64	729.6
5	47.36	264.00	556.6
6	.20	264.20	490.3

Cycle-08, 404.0 EFPD to Cycle-08, 409.6 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	2.13	2.13	487.6
2	2.46	4.59	482.3
3	1.41	6.00	477.8

Cycle-08, 409.6 EFPD to Cycle-08, 515.5 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	46.66	46.66	421.9
2	30.22	76.88	316.4
3	26.12	103.00	247.0
4	2.90	105.90	211.7

NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: G17

COLUMN A: Cycle-08, .0 EFPD to Cycle-08, 97.6 EFPD Statepoint Calculation
COLUMN B: Cycle-08, 97.6 EFPD to Cycle-08, 139.8 EFPD Statepoint Calculation
COLUMN C: Cycle-08, 139.8 EFPD to Cycle-08, 404.0 EFPD Statepoint Calculation
COLUMN D: Cycle-08, 404.0 EFPD to Cycle-08, 409.6 EFPD Statepoint Calculation
COLUMN E: Cycle-08, 409.6 EFPD to Cycle-08, 515.5 EFPD Statepoint Calculation

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

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

Table 7.3-8 Rodded Irradiation Time Step Layout for Assembly G27a

IRRADIATION LAYOUT FOR ASSEMBLY: G27a
Cycle-09, .0 EFPD to Cycle-09, 158.8 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	2.07	2.07	1647.0
2	55.15	57.22	1594.0
3	50.79	108.01	1483.3
4	50.79	158.80	1359.1

Cycle-09, 158.8 EFPD to Cycle-09, 219.0 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	14.04	14.04	1274.3
2	46.16	60.20	1193.6

Cycle-09, 219.0 EFPD to Cycle-09, 363.1 EFPD Statepoint Calculation

Irradiation Step Number	Step Duration (EFPD)	Exposure at End of Step (EFPD)	Mid-Step Boron Concentration (ppm)
1	35.99	35.99	1074.4
2	54.06	90.04	934.0
3	54.06	144.10	777.3

```
NODAL ROD ASSEMBLY INSERTION LAYOUT FOR FUEL ASSEMBLY: G27a

COLUMN A: Cycle-09,     .0 EFPD to Cycle-09, 158.8 EFPD Statepoint Calculation
COLUMN B: Cycle-09, 158.8 EFPD to Cycle-09, 219.0 EFPD Statepoint Calculation
COLUMN C: Cycle-09, 219.0 EFPD to Cycle-09, 363.1 EFPD Statepoint Calculation

X = Rod assembly inserted in corresponding node during the irradiation step
-----------------------------
        ||   A    || B ||  C
 NODE # ||1|2|3|4||1|2||1|2|3
-----------------------------
    1   ||X|X| | ||X| ||X| |
    2   ||X| | | || | || | |
    3   || | | | || | || | |
    4   || | | | || | || | |
    5   || | | | || | || | |
    6   || | | | || | || | |
    7   || | | | || | || | |
    8   || | | | || | || | |
    9   || | | | || | || | |
   10   || | | | || | || | |
   11   || | | | || | || | |
   12   || | | | || | || | |
   13   || | | | ||-| || | |
   14   || | | | || | || | |
   15   || | | | || | || | |
   16   || | | | || | || | |
   17   || | | | || | || | |
   18   || | | | || | || | |
-----------------------------
```

Table 7.3-9 Boron Letdown Data Provided to RLAYOUT for Cycle 6 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
9.2	1017
22.3	1012
49.8	995
68.5	952
84.6	908
127.3	778
140.1	727
184.5	631
202.8	567
248.8	441
274.9	366

Table 7.3-9 Boron Letdown Data Provided to RLAYOUT for Cycle 6 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
288.2	337
318.2	266
331.6	229
349.7	183
367.4	139
373.3	123

Table 7.3-10 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
412.3	398
459.8	260
485.0	193

Table 7.3-11 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 7.3-12 Boron Letdown Data Provided to RLAYOUT 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
262.0	994
303.7	869
345.7	750
397.9	577
432.5	473

Table 7.3-12 Boron Letdown Data Provided to RLAYOUT for Cycle 9 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
452.4	412
495.4	283
543.4	136

Some interesting behavior appears in the CRA nodal insertion history layouts presented in Tables 7.3-5 through 7.3-8. 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 a real-time 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 7.3-5 through 7.3-8.

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 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 reference 5.11. Instructions on how to develop CRAFT input decks and execute CRAFT calculations are also provided in Attachment I (Ref. 5.11). 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 8 and 9 of Crystal River Unit 3

Depletion calculations for 6 rodded fuel assemblies from fuel batches 8 and 9 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 6, 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 4 and 5 of Crystal River Unit 3

Crystal River Unit 3 Reactor Cycle	CRC Statepoint EFPD Values
6	0.0 (BOC)
6	96.0
6	400.0
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
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 reference 5.11. SAS2H modeling features incorporated in the depletion calculations of this analysis are described in Attachment I (Ref. 5.11). The CRAFT input decks for the assembly depletions documented in this analysis are provided in Attachments I through VI, 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 aforementioned 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-05	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
'
'     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 XIII (moved to reference 5.15) 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 5.12, was used to create the principal isotope result tables included in this analysis. Attachments VII through XII (moved to reference 5.14) 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 of reference 5.11. 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 XIV (moved to reference 5.15) as documented in Section 9.

8. Conclusions

The SAS2H depletion calculations of the rodded fuel assemblies from batches 8 and 9 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 XIII (moved to reference 5.15) 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 reference 5.11.

9. Attachments

The attachments referenced throughout this design analysis are listed in Table 9-1. Attachment XIII (moved to reference 5.15) contains the consolidated SAS2H output files for the assembly depletion calculations documented in this analysis. Attachment XIV (moved to reference 5.15) contains the "*.notes" files which are generated during the CRAFT calculations for each assembly documented in this analysis. Attachments XIII and XIV (moved to reference 5.15) are written in an ASCII format to an

attachment tape. Detailed listings of the content of Attachments XIII and XIV (moved to reference 5.15) on the attachment tape are provided in a hard-copy format in their corresponding attachment locations. The listing of the tape content for Attachments XIII and XIV 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 for Attachments XIII and XIV (moved to reference 5.15) contain text files only. This tape is written using the HP Colorado Trakker Model T1000e External Parallel Port Backup System for personal computers.

Table 9-1 Attachment Listing

Attachment #	Number of Pages	Generation Date	Description
I	16	08/06/97	CRAFT Input Deck for Fuel Assembly F06
II	17	08/06/97	CRAFT Input Deck for Fuel Assembly F17a
III	27	08/06/97	CRAFT Input Deck for Fuel Assembly F19a
IV	28	08/06/97	CRAFT Input Deck for Fuel Assembly G02
V	22	08/06/97	CRAFT Input Deck for Fuel Assembly G17
VI	18	08/06/97	CRAFT Input Deck for Fuel Assembly G27a
VII	107	08/06/97	Principal Isotope Results for Assembly F06 This attachment was moved to reference 5.14.
VIII	107	08/06/97	Principal Isotope Results for Assembly F17a This attachment was moved to reference 5.14.
IX	186	08/06/97	Principal Isotope Results for Assembly F19a This attachment was moved to reference 5.14.
X	200	08/06/97	Principal Isotope Results for Assembly G02 This attachment was moved to reference 5.14.
XI	147	08/06/97	Principal Isotope Results for Assembly G17 This attachment was moved to reference 5.14.

Attachment #	Number of Pages	Generation Date	Description
XII	120	08/06/97	Principal Isotope Results for Assembly G27a This attachment was moved to reference 5.14.
XIII	Total Page Count for Hard-Copy Listing of Tape Content = 18	08/06/97	Tape Containing CRAFT Generated Consolidated SAS2H Output Decks for Assemblies F06, F17a, F19a, G02, G17, G27a and CRAFT Generated "*.notes" files for Assemblies F06, F17a, F19a, G02, G17, G27a This attachment was moved to reference 5.15.
XIV	Total Page Count for Hard-Copy Listing of Tape Content = 16	08/06/97	

```
N                        : This is not a pick-up case
Crystal River, Unit 3    : Reactor Identifier
CR3                      : Prefix Identifier for reactor
44group                  : Scale cross-section library
3.49                     : 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)
0.936244                 : 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 1.1 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 18N)
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
06                       : Insertion reactor cycle identifier
3                        : # of stpts in cycle
0                        : Stpt EFPD
0                        : Length to stpt in calendar days
0                        : Downtime at stpt
96.0                     : Stpt EFPD
136.0                    : Length to stpt in calendar days
168.917                  : Downtime at stpt
400.0                    : Stpt EFPD
```

```
732.917          : Length to stpt in calendar days
10.417           : Downtime at stpt
113.0            : Days of downtime at EOC
412.07           : Total cycle EFPD
761.0            : Total cycle length in calendar days
06               : 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              : Total cycle length in calendar days
07               : 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
48.0             : Irradiation step length in EFPD
2                : # of irradiation steps to next stpt
1010.95          : ppmb
942.44           : ppmb
2                : Relative stpt # in insertion cycle
76.0             : Irradiation step length in EFPD
4                : # of irradiation steps to next stpt
751.31           : ppmb
547.28           : ppmb
341.80           : ppmb
152.42           : ppmb
3                : Relative stpt # in insertion cycle
12.07            : Irradiation step length in EFPD
1                : # of irradiation steps to next stpt
121.71           : ppmb
2                : Relative insertion cycle #
1                : Relative stpt # in insertion cycle
65.075           : Irradiation step length in EFPD
4                : # of irradiation steps to next stpt
1424.17          : ppmb
1300.75          : ppmb
1159.96          : ppmb
971.50           : ppmb
2                : Relative stpt # in insertion cycle
30.7             : Irradiation step length in EFPD
1                : # of irradiation steps to next stpt
856.06           : ppmb
3                : Relative stpt # in insertion cycle
28.0             : Irradiation step length in EFPD
1                : # of irradiation steps to next stpt
805.91           : ppmb
4                : Relative stpt # in insertion cycle
71.65            : Irradiation step length in EFPD
2                : # of irradiation steps to next stpt
565.35           : ppmb
356.75           : ppmb
5                : Relative stpt # in insertion cycle
```

```
16.7                    : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
231.02                  : ppmb
6                       : Relative stpt # in insertion cycle
18.9                    : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
183.83                  : 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-6 to Stpt2-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1160.2
1383.4
1504.8
1555.5
1575.5
1583.7
1588.3
1592.7
1596.5
1598.6
1598.8
1597.0
1592.8
1584.6
1568.3
1529.3
1432.7
1206.0
18                      : # of fuel temp axial nodes (Stpt2-6 to Stpt3-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
```

```
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1177.7
1357.1
1431.3
1448.3
1444.7
1436.7
1429.6
1424.6
1421.3
1419.4
1419.1
1420.7
1423.7
1428.2
1431.9
1424.6
1369.6
1191.0
18                    : # of fuel temp axial nodes (Stpt3-6 to EOC-6)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1177.7
1357.1
1431.3
1448.3
1444.7
1436.7
1429.6
1424.6
1421.3
1419.4
1419.1
1420.7
1423.7
1428.2
1431.9
1424.6
1369.6
1191.0
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
 956.2
1089.6
1138.6
1156.7
1159.6
1155.9
1149.5
1142.4
1135.9
1130.9
1127.5
1125.7
1124.5
1121.8
1114.2
1095.4
1049.6
 919.5
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
 967.4
1057.7
1078.0
1073.4
1064.5
1057.3
1052.0
1049.1
1048.3
1049.4
1052.6
1057.8
1065.0
1073.7
1082.3
```

```
1088.2
1073.6
 971.7
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
 967.4
1057.7
1078.0
1073.4
1064.5
1057.3
1052.0
1049.1
1048.3
1049.4
1052.6
1057.8
1065.0
1073.7
1082.3
1088.2
1073.6
 971.7
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
 982.7
1064.6
1077.3
1072.9
1064.8
1056.6
1050.4
1046.2
1043.6
1042.7
1043.4
```

```
1046.0
1050.7
1057.6
1065.4
1068.5
1058.5
 969.9
18                          : # of fuel temp 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
 982.7
1064.6
1077.3
1072.9
1064.8
1056.6
1050.4
1046.2
1043.6
1042.7
1043.4
1046.0
1050.7
1057.6
1065.4
1068.5
1058.5
 969.9
18                          : # of mod spec vol axial nodes (BOC-6 to Stpt2-6)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
0.0221
0.0219
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt2-6 to Stpt3-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
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
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt3-6 to EOC-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
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
0.0236
```

```
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
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
0.0233
0.0232
0.0231
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
0.0216
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
0.0232
0.0231
0.0230
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
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
0.0232
0.0231
0.0230
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
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
0.0233
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
0.0219
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
0.0233
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
0.0219
0.0218
0.0217
0.0216
18                      : # of burnup axial nodes (BOC-6)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10    20.0025
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 (Stpt2-6)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1.783
2.774
3.457
3.830
4.047
4.197
4.321
4.433
4.528
4.595
4.624
4.609
4.547
4.440
4.273
3.987
3.459
2.418
18                    : # of burnup axial nodes (Stpt3-6)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
```

```
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 9.034
13.448
15.881
16.861
17.245
17.430
17.575
17.726
17.872
17.984
18.050
18.070
18.040
17.954
17.737
17.099
15.355
10.903
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
 9.364
13.934
16.435
17.430
17.812
17.991
18.128
18.270
18.405
18.504
18.555
18.558
18.513
18.417
18.192
17.544
15.768
11.206
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
13.595
20.658
24.551
26.229
26.944
27.278
27.478
27.636
27.769
27.860
27.905
27.898
27.821
27.631
27.179
26.035
23.168
15.945
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
14.162
21.510
25.528
27.244
27.963
28.290
28.482
28.633
28.761
28.851
28.898
28.897
28.829
28.647
28.199
27.035
```

```
24.080
16.563
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
14.710
22.325
26.452
28.193
28.907
29.222
29.400
29.540
29.659
29.744
29.788
29.788
29.725
29.549
29.102
27.923
24.894
17.120
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
17.580
26.457
31.049
32.870
33.553
33.818
33.957
34.073
34.182
34.272
34.337
34.375
```

```
34.367
34.263
33.886
32.708
29.391
20.310
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
17.936
26.953
31.589
33.414
34.090
34.349
34.484
34.597
34.706
34.797
34.865
34.906
34.905
34.810
34.443
33.271
29.929
20.704
```

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
3.49                       : 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)
0.936244                   : 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
8                          : SAS2H material mixture number for clad material below
SS304                      : Cladding material for CR's
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 1.4 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.
2                          : # of insertion reactor cycles
06                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
96.0                       : Stpt EFPD
```

```
136.0                   : Length to stpt in calendar days
168.917                 : Downtime at stpt
400.0                   : Stpt EFPD
732.917                 : Length to stpt in calendar days
10.417                  : Downtime at stpt
113.0                   : Days of downtime at EOC
412.07                  : Total cycle EFPD
761.0                   : Total cycle length in calendar days
17                      : 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                     : 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
2                       : Number of steps in statepoint calculation
48.0     1010.95        : Step length (EFPD), Mid-step ppmb
48.0     942.44         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
4                       : Number of steps in statepoint calculation
76.0     751.31         : Step length (EFPD), Mid-step ppmb
76.0     547.28         : Step length (EFPD), Mid-step ppmb
76.0     341.80         : Step length (EFPD), Mid-step ppmb
76.0     152.42         : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
12.07    121.71         : Step length (EFPD), Mid-step ppmb
2                       : Relative insertion cycle
1                       : Relative statepoint in insertion cycle
5                       : Number of steps in statepoint calculation
36.81    1454.5         : Step length (EFPD), Mid-step ppmb
55.15    1360.5         : Step length (EFPD), Mid-step ppmb
55.15    1251.4         : Step length (EFPD), Mid-step ppmb
56.59    1119.3         : Step length (EFPD), Mid-step ppmb
56.59     959.5         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
10.10     852.1         : Step length (EFPD), Mid-step ppmb
20.60     802.4         : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
 5.37     760.3         : Step length (EFPD), Mid-step ppmb
22.63     714.9         : Step length (EFPD), Mid-step ppmb
4                       : Relative statepoint in insertion cycle
3                       : Number of steps in statepoint calculation
27.07     634.4         : Step length (EFPD), Mid-step ppmb
58.11     506.2         : Step length (EFPD), Mid-step ppmb
58.11     337.2         : 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
18.9      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
2 1 1 1 2 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 2
2 1 2 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 3
2 1 3 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 4
2 2 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 5
2 3 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 6
2 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 2.90826
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
NO APSRA INSERTION HISTORY
18                      : # of fuel temp axial nodes (BOC-6 to Stpt2-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
```

```
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1203.1
1424.1
1546.4
1595.5
1612.6
1618.6
1621.9
1624.7
1626.9
1628.2
1629.9
1633.9
1636.0
1631.7
1618.0
1584.3
1491.0
1263.1
18                    : # of fuel temp axial nodes (Stpt2-6 to Stpt3-6)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1209.5
1395.1
1478.4
1494.4
1489.7
1482.4
1475.7
1470.6
1467.0
1464.8
1465.1
1469.4
1475.4
1480.8
1484.2
1476.5
1426.4
1234.7
18                    : # of fuel temp axial nodes (Stpt3-6 to EOC-6)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1209.5
1395.1
1478.4
1494.4
1489.7
1482.4
1475.7
1470.6
1467.0
1464.8
1465.1
1469.4
1475.4
1480.8
1484.2
1476.5
1426.4
1234.7
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
 986.1
1118.8
1161.9
1177.7
1179.9
1175.5
1168.8
1161.8
1155.4
1150.3
1146.2
1143.0
1140.8
1137.8
1129.8
```

```
1110.6
1064.7
 934.1
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
1000.3
1084.2
1095.7
1091.2
1084.5
1077.2
1072.1
1069.2
1068.5
1069.7
1072.5
1077.1
1084.1
1092.8
1100.7
1101.1
1083.8
 980.3
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
1000.3
1084.2
1095.7
1091.2
1084.5
1077.2
1072.1
1069.2
1068.5
1069.7
1072.5
```

```
1077.1
1084.1
1092.8
1100.7
1101.1
1083.8
 980.3
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
1089.0
1095.4
1092.8
1083.4
1074.4
1067.9
1063.6
1061.0
1060.0
1060.2
1061.9
1066.0
1072.7
1080.3
1083.6
1064.4
 975.5
18                      : # of fuel temp 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
1014.2
1089.0
1095.4
1092.8
1083.4
1074.4
1067.9
```

```
1063.6
1061.0
1060.0
1060.2
1061.9
1066.0
1072.7
1080.3
1083.6
1064.4
 975.5
18                          : # of mod spec vol axial nodes (BOC-6 to Stpt2-6)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0241
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0228
0.0227
0.0225
0.0224
0.0222
0.0221
0.0220
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-6 to Stpt3-6)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0241
0.0240
0.0238
```

```
0.0236
0.0235
0.0233
0.0231
0.0230
0.0228
0.0227
0.0225
0.0224
0.0223
0.0221
0.0220
0.0219
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt3-6 to EOC-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0241
0.0240
0.0238
0.0236
0.0235
0.0233
0.0231
0.0230
0.0228
0.0227
0.0225
0.0224
0.0223
0.0221
0.0220
0.0219
0.0217
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
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
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 (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
0.0233
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 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
0.0233
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 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
0.0233
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
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
0.0233
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
18                    : # of burnup axial nodes (BOC-6)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
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 (Stpt2-6)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
```

```
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
2.007
2.956
3.581
3.916
4.107
4.240
4.348
4.444
4.526
4.594
4.648
4.674
4.653
4.572
4.427
4.164
3.675
2.664
18                    : # of burnup axial nodes (Stpt3-6)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 9.827
14.305
16.759
17.705
18.042
18.202
18.326
18.452
18.576
18.691
18.816
18.971
19.090
19.095
18.920
18.295
16.537
11.960
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
10.197
14.835
17.358
18.323
18.661
18.814
18.930
19.047
19.159
19.258
19.364
19.499
19.599
19.590
19.407
18.771
16.978
12.283
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
13.697
21.263
25.698
27.478
28.183
28.502
28.688
28.827
28.942
29.038
29.141
29.267
29.342
29.246
28.835
27.695
```

```
24.794
17.342
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
14.229
22.152
26.725
28.544
29.253
29.565
29.742
29.874
29.984
30.079
30.183
30.315
30.399
30.313
29.905
28.745
25.755
17.998
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
14.776
23.010
27.698
29.542
30.245
30.543
30.706
30.826
30.928
31.017
31.118
31.251
```

```
31.338
31.259
30.853
29.676
26.610
18.586
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
17.619
27.334
32.511
34.431
35.096
35.338
35.459
35.555
35.647
35.741
35.861
36.027
36.170
36.164
35.828
34.653
31.296
21.931
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
18.000
27.858
33.076
34.997
35.654
35.888
36.004
36.098
```

36.190
36.285
36.406
36.576
36.725
36.728
36.403
35.233
31.852
22.340

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
3.49                    : 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)
0.936244                : 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
8                       : SAS2H material mixture number for clad material below
SS304                   : Cladding material for CR's
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 0.8 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.
3                       : # of insertion reactor cycles
06                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
96.0                    : Stpt EFPD
```

```
136.0                   : Length to stpt in calendar days
168.917                 : Downtime at stpt
400.0                   : Stpt EFPD
732.917                 : Length to stpt in calendar days
10.417                  : Downtime at stpt
113.0                   : Days of downtime at EOC
412.07                  : Total cycle EFPD
761.0                   : Total cycle length in calendar days
19                      : 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                     : Total cycle length in calendar days
28                      : 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
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
2                       : Number of steps in statepoint calculation
48.0      1010.95       : Step length (EFPD), Mid-step ppmb
48.0      942.44        : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
4                       : Number of steps in statepoint calculation
76.0      751.31        : Step length (EFPD), Mid-step ppmb
76.0      547.28        : Step length (EFPD), Mid-step ppmb
76.0      341.80        : Step length (EFPD), Mid-step ppmb
76.0      152.42        : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
```

```
1                       : Number of steps in statepoint calculation
12.07    121.71         : Step length (EFPD), Mid-step ppmb
2                       : Relative insertion cycle
1                       : Relative statepoint in insertion cycle
4                       : Number of steps in statepoint calculation
65.075   1424.17        : Step length (EFPD), Mid-step ppmb
65.075   1300.75        : Step length (EFPD), Mid-step ppmb
65.075   1159.96        : Step length (EFPD), Mid-step ppmb
65.075   971.50         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
30.7     856.06         : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
28.0     805.91         : Step length (EFPD), Mid-step ppmb
4                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
71.65    565.35         : Step length (EFPD), Mid-step ppmb
71.65    356.75         : Step length (EFPD), Mid-step ppmb
5                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
16.7     231.02         : Step length (EFPD), Mid-step ppmb
6                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
18.9     183.83         : Step length (EFPD), Mid-step ppmb
3                       : Relative insertion cycle
1                       : Relative statepoint in insertion cycle
3                       : Number of steps in statepoint calculation
24.88    1534.5         : Step length (EFPD), Mid-step ppmb
36.36    1473.6         : Step length (EFPD), Mid-step ppmb
36.36    1407.6         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
 4.06    1359.8         : Step length (EFPD), Mid-step ppmb
38.14    1298.2         : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
5                       : Number of steps in statepoint calculation
20.60    1191.6         : Step length (EFPD), Mid-step ppmb
60.90    1110.1         : Step length (EFPD), Mid-step ppmb
60.90     946.9         : Step length (EFPD), Mid-step ppmb
60.90     771.9         : Step length (EFPD), Mid-step ppmb
60.90     580.3         : Step length (EFPD), Mid-step ppmb
4                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
1.83      488.9         : Step length (EFPD), Mid-step ppmb
3.77      482.4         : Step length (EFPD), Mid-step ppmb
5                       : Relative statepoint in insertion cycle
3                       : Number of steps in statepoint calculation
19.43     455.4         : Step length (EFPD), Mid-step ppmb
43.23     379.5         : Step length (EFPD), Mid-step ppmb
43.23     262.7         : 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
ROODED
5                       : Number of irradiation steps with CRA inserted
1                       : Number of axial section with CRA inserted in step 1
3 1 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 2
3 2 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 3
3 3 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 4
3 4 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 5
3 5 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 2.90826
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
NO APSRA INSERTION HISTORY
18                      : # of fuel temp axial nodes (BOC-6 to Stpt2-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1141.8
1372.1
1493.4
1540.6
1558.0
1566.2
1572.0
1578.0
1582.9
```

```
1585.7
1587.1
1589.5
1589.4
1583.4
1569.0
1532.5
1435.6
1198.9
18                      : # of fuel temp axial nodes (Stpt2-6 to Stpt3-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1161.9
1343.3
1416.3
1430.5
1425.4
1417.6
1411.1
1406.8
1404.2
1402.6
1403.2
1407.7
1413.5
1418.6
1422.7
1416.2
1363.8
1184.0
18                      : # of fuel temp axial nodes (Stpt3-6 to EOC-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1161.9
1343.3
1416.3
1430.5
1425.4
```

```
1417.6
1411.1
1406.8
1404.2
1402.6
1403.2
1407.7
1413.5
1418.6
1422.7
1416.2
1363.8
1184.0
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
734.8
805.5
833.3
842.0
843.2
840.8
836.9
832.5
828.4
825.1
822.6
820.6
819.0
817.0
812.6
802.5
779.0
711.9
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
757.0
```

```
816.4
830.4
829.4
825.2
820.8
817.2
814.6
813.0
812.5
813.0
814.5
817.1
820.9
824.5
825.3
814.2
753.0
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
757.0
816.4
830.4
829.4
825.2
820.8
817.2
814.6
813.0
812.5
813.0
814.5
817.1
820.9
824.5
825.3
814.2
753.0
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
771.5
829.3
840.1
836.8
831.1
825.8
821.5
818.1
815.7
814.2
813.6
813.9
815.4
818.4
822.2
824.5
816.8
760.2
18                    : # of fuel temp 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
771.5
829.3
840.1
836.8
831.1
825.8
821.5
818.1
815.7
814.2
813.6
813.9
815.4
818.4
822.2
824.5
816.8
760.2
18                    : # of fuel temp axial nodes (Stpt6-7 to EOC-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
771.5
829.3
840.1
836.8
831.1
825.8
821.5
818.1
815.7
814.2
813.6
813.9
815.4
818.4
822.2
824.5
816.8
760.2
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
 927.4
1019.3
1058.0
1077.6
1086.5
1089.5
1089.4
1087.3
1084.3
1081.2
1078.2
1075.1
1071.5
1065.4
1054.4
1035.4
1000.8
 904.2
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
 927.4
1019.3
1058.0
1077.6
1086.5
1089.5
1089.4
1087.3
1084.3
1081.2
1078.2
1075.1
1071.5
1065.4
1054.4
1035.4
1000.8
 904.2
18                    : # of fuel temp 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
 941.1
1014.7
1041.6
1053.1
1054.5
1052.4
1049.0
1045.2
1041.8
1039.0
1037.2
1036.3
1035.9
1034.9
1030.8
1019.3
 991.5
 910.3
18                    : # of fuel temp 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
 941.1
1014.7
1041.6
1053.1
1054.5
1052.4
1049.0
1045.2
1041.8
1039.0
1037.2
1036.3
1035.9
1034.9
1030.8
1019.3
 991.5
 910.3
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
 914.1
1005.2
1037.6
1036.0
1028.0
1019.9
1013.2
1007.9
1003.5
1000.2
 997.9
 996.8
 997.7
1001.0
1006.1
1009.7
 996.4
 923.3
```

```
18                      : # of mod spec vol axial nodes (BOC-6 to Stpt2-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
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
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0228
0.0226
0.0225
0.0223
0.0222
0.0221
0.0219
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt2-6 to Stpt3-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0238
0.0237
0.0236
0.0234
0.0233
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
```

```
0.0219
0.0218
0.0217
0.0216
18                      : # of mod spec vol axial nodes (Stpt3-6 to EOC-6)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0238
0.0237
0.0236
0.0234
0.0233
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0219
0.0218
0.0217
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
0.0223
0.0222
0.0222
0.0221
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
```

```
0.0218
0.0218
0.0218
0.0217
0.0217
0.0216
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
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
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 (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
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
```

```
0.0220
0.0220
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 (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
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
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 (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
0.0223
0.0223
```

```
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
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 (Stpt6-7 to EOC-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
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
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 (EOC-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
0.0232
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 (Stpt2-8 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
0.0232
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 (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
0.0232
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 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
0.0232
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 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
0.0232
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-6)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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 (Stpt2-6)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
```

```
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1.776
2.760
3.407
3.760
3.969
4.120
4.249
4.371
4.480
4.563
4.618
4.631
4.587
4.485
4.322
4.038
3.495
2.389
18                    : # of burnup axial nodes (Stpt3-6)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 8.818
13.244
15.612
16.521
16.857
17.034
17.194
17.371
17.546
17.684
17.795
17.901
17.951
17.898
17.703
17.095
15.346
10.757
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
 9.155
13.731
16.163
17.088
17.426
17.598
17.750
17.920
18.084
18.208
18.302
18.388
18.420
18.355
18.153
17.535
15.755
11.055
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
10.932
16.654
19.749
21.003
21.495
21.732
21.902
22.067
22.217
22.327
22.407
22.478
22.485
22.370
22.056
```

```
21.199
18.904
13.017
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
11.182
17.042
20.201
21.474
21.968
22.201
22.367
22.527
22.674
22.781
22.861
22.933
22.944
22.831
22.516
21.647
19.307
13.282
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
11.425
17.415
20.629
21.916
22.409
22.636
22.795
22.948
23.090
23.194
23.272
```

```
23.344
23.355
23.244
22.929
22.049
19.670
13.523
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
12.747
19.388
22.855
24.192
24.671
24.872
25.007
25.144
25.276
25.378
25.461
25.545
25.577
25.495
25.203
24.306
21.759
14.953
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
12.917
19.635
23.128
24.468
24.944
25.141
25.273
```

```
25.408
25.540
25.642
25.725
25.810
25.845
25.767
25.478
24.582
22.019
15.136
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
13.111
19.917
23.440
24.784
25.257
25.450
25.580
25.714
25.845
25.947
26.032
26.118
26.156
26.080
25.795
24.899
22.318
15.348
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
14.496
22.247
26.259
```

```
27.853
28.469
28.748
28.931
29.096
29.245
29.357
29.444
29.523
29.533
29.397
29.001
27.912
24.970
17.110
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
15.171
23.299
27.498
29.179
29.836
30.136
30.328
30.498
30.648
30.761
30.849
30.928
30.936
30.789
30.364
29.213
26.134
17.898
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
19.864
30.254
35.409
37.413
38.160
38.468
38.647
38.800
38.940
39.053
39.158
39.271
39.325
39.213
38.767
37.437
33.719
23.251
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
19.959
30.404
35.578
37.586
38.333
38.641
38.819
38.971
39.110
39.224
39.330
39.444
39.499
39.389
38.945
37.615
33.887
23.374
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
21.997
33.377
38.856
40.905
41.627
41.901
42.053
42.188
42.317
42.427
42.536
42.662
42.741
42.668
42.266
40.950
37.072
25.744

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
3.84                    : 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)
0.936244                : 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
ZIRC-4                  : Spacer grid material
0.008165257             : 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 0.8 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
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              : Total cycle length in calendar days
02               : 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
75.0             : Days of downtime at EOC
535.9            : Total cycle EFPD
679              : Total cycle length in calendar days
07               : 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
08               : 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
65.075           : Irradiation step length in EFPD
4                : # of irradiation steps to next stpt
1424.17          : ppmb
1300.75          : ppmb
1159.96          : ppmb
971.50           : ppmb
2                : Relative stpt # in insertion cycle
30.7             : Irradiation step length in EFPD
1                : # of irradiation steps to next stpt
856.06           : ppmb
```

```
3                    : Relative stpt # in insertion cycle
28.0                 : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
805.91               : ppmb
4                    : Relative stpt # in insertion cycle
71.65                : Irradiation step length in EFPD
2                    : # of irradiation steps to next stpt
565.35               : ppmb
356.75               : ppmb
5                    : Relative stpt # in insertion cycle
16.7                 : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
231.02               : ppmb
6                    : Relative stpt # in insertion cycle
18.9                 : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
183.83               : ppmb
2                    : Relative insertion cycle #
1                    : Relative stpt # in insertion cycle
48.8                 : Irradiation step length in EFPD
2                    : # of irradiation steps to next stpt
1510.73              : ppmb
1419.25              : ppmb
2                    : Relative stpt # in insertion cycle
42.2                 : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
1305.52              : ppmb
3                    : Relative stpt # in insertion cycle
66.05                : Irradiation step length in EFPD
4                    : # of irradiation steps to next stpt
1142.75              : ppmb
985.95               : ppmb
793.58               : ppmb
588.91               : ppmb
4                    : Relative stpt # in insertion cycle
5.6                  : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
484.53               : ppmb
5                    : Relative stpt # in insertion cycle
52.95                : Irradiation step length in EFPD
2                    : # of irradiation steps to next stpt
416.34               : ppmb
274.55               : ppmb
6                    : Relative stpt # in insertion cycle
20.4                 : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
185.39               : ppmb
3                    : Relative insertion cycle #
1                    : Relative stpt # in insertion cycle
52.93                : Irradiation step length in EFPD
3                    : # of irradiation steps to next stpt
1599.85              : ppmb
1491.21              : ppmb
1361.78              : ppmb
2                    : Relative stpt # in insertion cycle
60.2                 : Irradiation step length in EFPD
1                    : # of irradiation steps to next stpt
1211.60              : ppmb
3                    : Relative stpt # in insertion cycle
72.05                : Irradiation step length in EFPD
2                    : # of irradiation steps to next stpt
1016.51              : ppmb
802.70               : ppmb
4                    : Relative stpt # in insertion cycle
64.71                : Irradiation step length in EFPD
3                    : # of irradiation steps to next stpt
584.95               : ppmb
388.60               : ppmb
192.66               : 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-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
1173.1
1404.0
1523.2
1569.6
1584.3
1585.0
1582.0
1578.2
1574.5
1570.9
1567.5
1564.3
1560.8
1555.1
1540.2
1502.6
1411.3
1185.4
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
1158.3
1325.4
1388.9
1397.2
1391.3
1384.6
1380.9
1380.7
1383.4
1388.8
1396.6
1407.1
1418.9
1432.2
1445.3
1449.3
1414.4
1229.7
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
1158.3
1325.4
1388.9
1397.2
1391.3
1384.6
1380.9
1380.7
1383.4
1388.8
1396.6
1407.1
1418.9
1432.2
1445.3
1449.3
1414.4
1229.7
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
1161.1
1320.5
1367.6
1366.6
1355.9
1346.3
1340.1
1336.9
1336.2
1337.4
1340.5
1345.9
1354.1
1365.5
1377.8
1385.9
1362.7
1200.5
18                          : # of fuel temp 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
1161.1
1320.5
1367.6
1366.6
1355.9
1346.3
1340.1
1336.9
1336.2
1337.4
1340.5
1345.9
1354.1
1365.5
1377.8
1385.9
1362.7
1200.5
18                          : # of fuel temp axial nodes (Stpt6-7 to EOC-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
1161.1
1320.5
1367.6
1366.6
1355.9
1346.3
1340.1
1336.9
1336.2
1337.4
1340.5
1345.9
1354.1
1365.5
1377.8
1385.9
1362.7
1200.5
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
 903.7
1013.1
1057.1
1076.5
1084.9
1088.0
1088.1
1086.7
1084.4
1081.7
1078.7
1075.1
1070.2
1062.5
1050.3
1029.9
 989.7
 877.5
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
 903.7
1013.1
1057.1
1076.5
1084.9
1088.0
1088.1
1086.7
1084.4
1081.7
1078.7
1075.1
1070.2
1062.5
1050.3
1029.9
 989.7
 877.5
18                      : # of fuel temp 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
 920.5
1011.9
1040.9
1047.3
1046.5
1043.4
1039.8
1036.2
1033.0
1030.5
1028.7
1027.4
1026.3
1024.7
1021.4
```

```
1013.0
 987.7
 892.9
18                          : # of fuel temp 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
 920.5
1011.9
1040.9
1047.3
1046.5
1043.4
1039.8
1036.2
1033.0
1030.5
1028.7
1027.4
1026.3
1024.7
1021.4
1013.0
 987.7
 892.9
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
 954.0
1014.5
1032.8
1030.9
1023.1
1015.5
1009.4
1004.7
1001.1
 998.5
 996.8
```

```
 996.2
 997.3
1000.2
1004.8
1007.4
 991.4
 923.7
18                      : # of fuel temp axial nodes (Stpt6-8 to EOC-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
 954.0
1014.5
1032.8
1030.9
1023.1
1015.5
1009.4
1004.7
1001.1
 998.5
 996.8
 996.2
 997.3
1000.2
1004.8
1007.4
 991.4
 923.7
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
684.7
712.4
730.3
737.4
740.0
740.4
739.5
```

```
738.0
736.1
734.0
731.8
729.4
726.5
723.0
718.0
710.1
694.7
664.7
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
694.0
721.1
736.1
740.3
740.6
739.3
737.4
735.4
733.3
731.4
729.6
727.9
726.1
724.1
721.2
715.9
703.0
673.3
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
709.0
735.3
746.8
```

```
747.4
745.1
742.1
739.4
736.9
734.8
733.0
731.5
730.3
729.5
728.9
728.2
725.9
716.2
686.7
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
0.0216
18                    : # of mod spec vol axial nodes (Stpt6-7 to EOC-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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
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
0.0222
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
0.0222
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
0.0231
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
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
0.0231
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
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
0.0231
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 (Stpt6-8 to EOC-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
0.0224
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-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
0.0221
0.0221
0.0221
0.0220
0.0220
0.0220
0.0219
0.0219
0.0219
0.0218
0.0218
0.0218
```

```
0.0217
0.0217
0.0217
0.0217
0.0216
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
0.0221
0.0221
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0219
0.0218
0.0218
0.0218
0.0217
0.0217
0.0217
0.0217
0.0216
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
0.0222
0.0221
0.0221
0.0221
0.0220
0.0220
0.0220
0.0219
```

```
0.0219
0.0219
0.0218
0.0218
0.0218
0.0217
0.0217
0.0217
0.0216
0.0216
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
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 (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
 5.256
 8.059
 9.712
10.506
```

```
10.893
11.092
11.202
11.265
11.295
11.296
11.268
11.215
11.129
10.987
10.723
10.171
 8.963
 6.184
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
 5.982
 9.145
10.975
11.829
12.230
12.428
12.534
12.595
12.625
12.628
12.606
12.560
12.485
12.354
12.093
11.511
10.182
 7.043
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
```

```
 6.683
10.186
12.172
13.069
13.472
13.660
13.755
13.806
13.830
13.829
13.806
13.763
13.693
13.569
13.310
12.704
11.270
 7.814
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
10.284
15.395
18.050
19.096
19.489
19.638
19.705
19.747
19.779
19.801
19.815
19.827
19.832
19.802
19.630
19.008
17.167
12.115
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
10.719
16.007
18.728
19.784
20.171
20.314
20.378
20.420
20.453
20.478
20.496
20.513
20.527
20.508
20.349
19.732
17.856
12.631
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
11.212
16.698
19.491
20.557
20.939
21.077
21.138
21.180
21.215
21.243
21.266
21.289
21.312
21.305
21.161
20.550
18.637
13.218
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
12.603
18.899
22.144
23.445
23.959
24.176
24.285
24.355
24.405
24.438
24.456
24.462
24.448
24.374
24.117
23.314
21.033
14.753
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
13.242
19.887
23.310
24.693
25.246
25.482
25.600
25.674
25.725
25.759
25.776
25.780
25.759
25.671
25.384
24.519
22.098
15.451
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
17.720
26.482
30.818
32.503
33.139
33.384
33.490
33.551
33.596
33.632
33.665
33.692
33.700
33.629
33.310
32.262
29.184
20.330
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
17.823
26.628
30.981
32.669
33.305
33.549
33.655
33.715
33.760
33.796
33.829
33.858
33.867
33.798
33.481
32.432
29.344
20.445
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
19.904
29.523
34.147
35.870
36.481
36.694
36.776
36.822
36.859
36.895
36.933
36.975
37.007
36.972
36.695
35.656
32.413
22.688
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
20.343
30.121
34.792
36.518
37.123
37.328
37.404
37.442
37.472
37.499
37.527
37.558
37.580
37.540
37.261
36.221
32.951
```

```
23.087
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
21.309
31.599
36.537
38.392
39.062
39.299
39.386
39.425
39.447
39.461
39.472
39.481
39.474
39.390
39.047
37.900
34.422
24.066
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
21.724
32.214
37.240
39.127
39.807
40.044
40.128
40.163
40.180
40.190
40.197
40.202
40.190
```

```
40.101
39.747
38.574
35.029
24.483
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
22.838
33.814
39.026
40.957
41.635
41.858
41.926
41.946
41.952
41.954
41.956
41.958
41.947
41.859
41.501
40.295
36.619
25.610
```

```
N                        : This is not a pick-up case
Crystal River, Unit 3    : Reactor Identifier
CR3                      : Prefix identifier for reactor
44group                  : Scale cross-section library
3.84                     : 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)
0.936244                 : 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
ZIRC-4                   : Spacer grid material
0.008165257              : 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
8                        : SAS2H material mixture number for clad material below
SS304                    : Cladding material for CR's
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 1.13 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.
2                        : # of insertion reactor cycles
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                     : Total cycle length in calendar days
17                      : 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
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
4                       : Number of steps in statepoint calculation
65.075   1424.17        : Step length (EFPD), Mid-step ppmb
65.075   1300.75        : Step length (EFPD), Mid-step ppmb
65.075   1159.96        : Step length (EFPD), Mid-step ppmb
65.075   971.50         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
30.7     856.06         : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
28.0     805.91         : Step length (EFPD), Mid-step ppmb
4                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
71.65    565.35         : Step length (EFPD), Mid-step ppmb
71.65    356.75         : Step length (EFPD), Mid-step ppmb
5                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
16.7     231.02         : Step length (EFPD), Mid-step ppmb
6                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
18.9     183.83         : Step length (EFPD), Mid-step ppmb
2                       : Relative insertion cycle
1                       : Relative statepoint in insertion cycle
3                       : Number of steps in statepoint calculation
53.50    1506.1         : Step length (EFPD), Mid-step ppmb
```

```
 9.44   1445.0          : Step length (EFPD), Mid-step ppmb
35.06   1405.2          : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
4                       : Number of steps in statepoint calculation
16.04   1344.7          : Step length (EFPD), Mid-step ppmb
18.56   1288.8          : Step length (EFPD), Mid-step ppmb
 7.40   1241.7          : Step length (EFPD), Mid-step ppmb
  .20   1227.9          : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
6                       : Number of steps in statepoint calculation
50.20    1156.3         : Step length (EFPD), Mid-step ppmb
50.20    1048.9         : Step length (EFPD), Mid-step ppmb
58.12     892.6         : Step length (EFPD), Mid-step ppmb
58.12     729.6         : Step length (EFPD), Mid-step ppmb
47.36     556.6         : Step length (EFPD), Mid-step ppmb
  .20     490.3         : Step length (EFPD), Mid-step ppmb
4                       : Relative statepoint in insertion cycle
3                       : Number of steps in statepoint calculation
2.13     487.6          : Step length (EFPD), Mid-step ppmb
2.46     482.3          : Step length (EFPD), Mid-step ppmb
1.41     477.8          : Step length (EFPD), Mid-step ppmb
5                       : Relative statepoint in insertion cycle
4                       : Number of steps in statepoint calculation
46.66    421.9          : Step length (EFPD), Mid-step ppmb
30.22    316.4          : Step length (EFPD), Mid-step ppmb
26.12    247.0          : Step length (EFPD), Mid-step ppmb
 2.90    211.7          : 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
19                      : Number of irradiation steps with APSRA inserted
2 1 1 9  12 7 1 8       : Input card 48B
2 1 2 9  11 7 1 8       : Input card 48B
2 1 3 10 11 7 1 8       : Input card 48B
2 2 1 9  12 7 1 8       : Input card 48B
2 2 2 10 12 7 1 8       : Input card 48B
2 2 3 10 11 7 1 8       : Input card 48B
2 2 4 10 11 7 1 8       : Input card 48B
2 3 1 9  12 7 1 8       : Input card 48B
2 3 2 9  12 7 1 8       : Input card 48B
2 3 3 10 12 7 1 8       : Input card 48B
2 3 1 10 12 7 1 8       : Input card 48B
2 3 2 10 11 7 1 8       : Input card 48B
2 3 3 10 11 7 1 8       : Input card 48B
2 4 1 9  12 7 1 8       : Input card 48B
2 4 2 10 12 7 1 8       : Input card 48B
2 4 3 10 11 7 1 8       : Input card 48B
2 5 1 9  12 7 1 8       : Input card 48B
2 5 2 10 12 7 1 8       : Input card 48B
```

```
2 5 3 10 11 7 1 8        : Input card 48B
1                        : Number of different APSRA absorber material mixtures
7                        : SAS2H material mixture number for APSRA absorber
5                        : Number of isotopes or elements in the APSRA absorber
14000 2.5                : SCALE isotope ID, Isotope wt%
22000 2.5                : SCALE isotope ID, Isotope wt%
24000 15.0               : SCALE isotope ID, Isotope wt%
26000 7.0                : SCALE isotope ID, Isotope wt%
28000 73.0               : SCALE isotope ID, Isotope wt%
1                        : Number of APSRA designs
8.3   8                  : APSR absorber density, APSR clad SAS2H mat. mix. number
8                        : Number of radial zones in Path B model with APSRA inserted
7   0.47625              : Path B model APSRA inserted (Input Card 48J)
5   0.49022
8   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.90826
3   2.93113
3   0.47625              : Path B model APSRA removed (Input Card 48K)
3   0.49022
3   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.97599
3   2.99939
3   0.47625              : Path B model APSR follow rod (Input Card 48L)
3   0.49022
8   0.55880
3   0.63246
2   0.67310
3   0.81397
500 2.96707
3   2.99040
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
1181.8
1408.5
1527.7
1571.0
1578.3
1574.8
1569.8
1565.3
1561.7
1558.9
1556.6
1556.1
1558.0
1555.9
1542.7
```

```
1503.8
1410.1
1189.6
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
1164.0
1332.0
1396.1
1401.6
1391.2
1381.7
1376.8
1376.1
1378.8
1384.0
1391.5
1402.2
1416.2
1430.9
1444.3
1448.1
1411.7
1226.1
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
1164.0
1332.0
1396.1
1401.6
1391.2
1381.7
1376.8
1376.1
1378.8
1384.0
1391.5
```

```
1402.2
1416.2
1430.9
1444.3
1448.1
1411.7
1226.1
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
1167.2
1329.1
1376.1
1372.3
1357.7
1345.9
1338.9
1335.5
1334.7
1335.7
1338.4
1343.8
1353.7
1365.8
1378.6
1387.1
1363.8
1200.1
18                          : # of fuel temp 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
1167.2
1329.1
1376.1
1372.3
1357.7
1345.9
1338.9
```

```
1335.5
1334.7
1335.7
1338.4
1343.8
1353.7
1365.8
1378.6
1387.1
1363.8
1200.1
18                      : # of fuel temp axial nodes (Stpt6-7 to EOC-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
1167.2
1329.1
1376.1
1372.3
1357.7
1345.9
1338.9
1335.5
1334.7
1335.7
1338.4
1343.8
1353.7
1365.8
1378.6
1387.1
1363.8
1200.1
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
1012.6
1134.2
1188.7
```

```
1205.8
1198.6
1201.5
1203.1
1202.5
1200.7
1198.2
1196.2
1201.5
1230.7
1225.9
1210.9
1186.1
1140.2
1008.4
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
1012.6
1134.2
1188.7
1205.8
1198.6
1201.5
1203.1
1202.5
1200.7
1198.2
1196.2
1201.5
1230.7
1225.9
1210.9
1186.1
1140.2
1008.4
18                      : # of fuel temp 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
1022.1
1126.9
1165.1
1169.3
1155.3
1152.2
1149.5
1146.5
1143.7
1141.7
1141.2
1148.8
1178.6
1180.2
1173.8
1157.3
1125.5
1007.9
18                    : # of fuel temp 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
1022.1
1126.9
1165.1
1169.3
1155.3
1152.2
1149.5
1146.5
1143.7
1141.7
1141.2
1148.8
1178.6
1180.2
1173.8
1157.3
1125.5
1007.9
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
```

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14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1025.2
1104.9
1137.9
1130.2
1107.8
1097.6
1090.6
1085.2
1081.0
1077.7
1075.9
1081.1
1104.7
1110.9
1116.8
1120.5
1101.9
1001.2
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
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
0.0239
0.0238
0.0237
0.0235
0.0233
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
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
0.0239
0.0238
0.0237
0.0235
0.0233
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
0.0216
18                    : # of mod spec vol axial nodes (Stpt6-7 to EOC-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
0.0239
0.0238
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0225
0.0223
0.0222
0.0221
0.0220
0.0218
0.0217
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
0.0236
0.0235
0.0234
0.0233
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
0.0216
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
0.0236
0.0235
0.0234
0.0233
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
0.0216
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
0.0236
0.0235
0.0234
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
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 (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
0.0236
0.0235
0.0234
0.0232
0.0231
0.0230
0.0228
0.0227
0.0226
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 (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
0.0235
0.0234
0.0233
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
0.0216
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
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 (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
 5.304
 8.081
 9.806
10.638
```

```
10.999
11.168
11.265
11.331
11.379
11.409
11.429
11.453
11.464
11.376
11.099
10.480
 9.185
 6.388
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
 6.032
 9.165
11.073
11.964
12.331
12.493
12.584
12.647
12.695
12.729
12.755
12.791
12.820
12.748
12.475
11.821
10.399
 7.245
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
```

```
 6.738
10.210
12.278
13.211
13.573
13.719
13.796
13.850
13.892
13.922
13.949
13.990
14.031
13.970
13.698
13.017
11.485
 8.014
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
10.367
15.459
18.219
19.292
19.609
19.692
19.732
19.776
19.828
19.883
19.950
20.058
20.206
20.259
20.076
19.369
17.404
12.324
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
10.809
16.081
18.908
19.988
20.295
20.370
20.406
20.449
20.502
20.561
20.632
20.746
20.905
20.972
20.803
20.101
18.099
12.843
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
11.305
16.779
19.681
20.769
21.068
21.134
21.166
21.209
21.265
21.327
21.402
21.524
21.696
21.778
21.624
20.929
18.886
13.434
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
13.171
19.625
23.047
24.316
24.689
24.841
24.934
25.016
25.096
25.174
25.274
25.530
25.839
25.865
25.575
24.652
22.198
15.667
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
14.025
20.906
24.544
25.893
26.262
26.434
26.541
26.631
26.715
26.797
26.902
27.186
27.587
27.611
27.284
26.284
23.666
16.672
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
19.849
29.336
34.134
35.766
35.970
36.137
36.248
36.338
36.429
36.529
36.681
37.161
38.145
38.270
37.907
36.664
33.232
23.427
18                    : # of burnup axial nodes ($tpt5-8)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
19.979
29.519
34.338
35.972
36.171
36.336
36.446
36.537
36.628
36.728
36.881
37.365
38.361
38.491
38.130
36.886
33.441
23.580
18                    : # of burnup axial nodes ($tpt6-8)
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

22.566
33.090
38.254
39.881
39.966
40.088
40.172
40.246
40.330
40.430
40.598
41.169
42.348
42.539
42.229
40.998
37.357
26.483

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
3.84                    : 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)
0.936244                : 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
ZIRC-4                  : Spacer grid material
0.008165257             : 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
8                       : SAS2H material mixture number for clad material below
SS304                   : Cladding material for CR's
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 0.0 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.
2                       : # of insertion reactor cycles
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
853.0                   : Days of downtime at EOC
497.9                   : Total cycle EFPD
796                     : Total cycle length in calendar days
27                      : 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
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
65.075   1424.17        : Step length (EFPD), Mid-step ppmb
65.075   1300.75        : Step length (EFPD), Mid-step ppmb
65.075   1159.96        : Step length (EFPD), Mid-step ppmb
65.075   971.50         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
30.7     856.06         : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
28.0     805.91         : Step length (EFPD), Mid-step ppmb
4                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
71.65    565.35         : Step length (EFPD), Mid-step ppmb
71.65    356.75         : Step length (EFPD), Mid-step ppmb
5                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
16.7     231.02         : Step length (EFPD), Mid-step ppmb
6                       : Relative statepoint in insertion cycle
1                       : Number of steps in statepoint calculation
18.9     183.83         : Step length (EFPD), Mid-step ppmb
2                       : Relative insertion cycle
1                       : Relative statepoint in insertion cycle
4                       : Number of steps in statepoint calculation
 2.07    1647.0         : Step length (EFPD), Mid-step ppmb
55.15    1594.0         : Step length (EFPD), Mid-step ppmb
50.79    1483.3         : Step length (EFPD), Mid-step ppmb
50.79    1359.1         : Step length (EFPD), Mid-step ppmb
2                       : Relative statepoint in insertion cycle
2                       : Number of steps in statepoint calculation
14.04    1274.3         : Step length (EFPD), Mid-step ppmb
```

```
46.16   1193.6          : Step length (EFPD), Mid-step ppmb
3                       : Relative statepoint in insertion cycle
3                       : Number of steps in statepoint calculation
35.99   1074.4          : Step length (EFPD), Mid-step ppmb
54.06    934.0          : Step length (EFPD), Mid-step ppmb
54.06    777.3          : 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
RODDED
4                       : Number of irradiation steps with CRA inserted
1                       : Number of axial section with CRA inserted in step 1
3 1 1 1 2 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 2
3 1 2 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 3
3 2 1 1 1 7 1           : Input card 47B
1                       : Number of axial section with CRA inserted in step 4
3 3 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 2.90826
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
NO APSRA INSERTION HISTORY
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
1023.6
1253.1
1353.1
1386.5
1393.3
1390.2
1384.1
1377.9
1372.7
1369.1
1367.1
1366.8
1367.1
1365.0
1354.5
1323.2
1242.0
1025.2
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
1039.4
1191.1
1238.3
1242.0
1234.3
1226.7
1222.1
1220.5
1221.6
1224.9
1230.3
1237.9
1248.0
1259.8
1270.9
1272.1
1234.8
```

```
1082.7
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
1039.4
1191.1
1238.3
1242.0
1234.3
1226.7
1222.1
1220.5
1221.6
1224.9
1230.3
1237.9
1248.0
1259.8
1270.9
1272.1
1234.8
1082.7
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
1055.1
1193.3
1234.0
1232.7
1222.4
1213.2
1207.1
1203.9
1202.8
1203.3
1205.3
1209.1
1215.3
```

```
1224.1
1234.2
1238.5
1211.8
1076.4
18                      : # of fuel temp 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
1055.1
1193.3
1234.0
1232.7
1222.4
1213.2
1207.1
1203.9
1202.8
1203.3
1205.3
1209.1
1215.3
1224.1
1234.2
1238.5
1211.8
1076.4
18                      : # of fuel temp axial nodes (Stpt6-7 to EOC-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
1055.1
1193.3
1234.0
1232.7
1222.4
1213.2
1207.1
1203.9
1202.8
```

```
1203.3
1205.3
1209.1
1215.3
1224.1
1234.2
1238.5
1211.8
1076.4
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
 955.3
1134.6
1205.8
1236.8
1250.8
1256.3
1257.9
1257.4
1255.6
1253.3
1250.6
1247.8
1244.0
1236.5
1222.5
1196.5
1146.0
 996.1
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
 967.3
1127.4
1182.6
1202.3
1207.0
```

```
1206.1
1203.5
1200.7
1197.9
1195.6
1193.8
1192.7
1192.0
1190.2
1184.6
1169.6
1130.6
1002.7
18                      : # of fuel temp 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
 995.0
1121.3
1161.1
1165.7
1160.7
1154.4
1148.9
1144.5
1141.3
1139.1
1137.9
1138.0
1139.5
1141.9
1143.7
1140.7
1117.4
1010.3
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
0.0233
```

```
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
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
0.0233
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
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
0.0233
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
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
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
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
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                    : # of mod spec vol axial nodes (Stpt6-7 to EOC-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
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
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
0.0235
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
0.0216
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
0.0235
0.0234
0.0233
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
0.0216
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
0.0235
0.0234
0.0233
0.0231
0.0230
0.0229
0.0228
0.0227
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-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
0.0
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 (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
3.680
6.285
7.944
8.773
9.167
9.352
9.439
9.480
9.500
9.514
9.528
9.539
9.525
9.439
9.198
8.635
7.393
4.679
18                          : # of burnup axial nodes (Stpt3-7)
1      17.7800              : Node #, node height (cm)
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3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
 4.195
 7.105
 8.912
 9.787
10.189
10.370
10.450
10.485
10.503
10.518
10.536
10.553
10.549
10.473
```

```
10.233
 9.644
 8.301
 5.291
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
 4.700
 7.894
 9.829
10.737
11.137
11.307
11.376
11.401
11.412
11.423
11.439
11.459
11.460
11.390
11.151
10.540
 9.111
 5.842
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
 7.360
11.912
14.408
15.435
15.819
15.948
15.985
15.996
16.007
16.031
```

```
16.075
16.137
16.198
16.201
16.022
15.382
13.599
 9.018
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
 7.698
12.401
14.950
15.985
16.363
16.486
16.520
16.530
16.542
16.568
16.614
16.681
16.749
16.760
16.591
15.954
14.139
 9.413
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
 8.071
12.945
15.559
16.604
16.978
17.096
```

```
17.127
17.137
17.150
17.178
17.228
17.300
17.375
17.396
17.238
16.603
14.754
 9.865
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
10.491
17.245
20.919
22.482
23.127
23.394
23.512
23.572
23.613
23.655
23.709
23.776
23.823
23.760
23.417
22.421
19.844
13.178
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
11.554
18.991
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```
22.999
24.697
25.393
25.677
25.802
25.865
25.908
25.952
26.012
26.087
26.143
26.079
25.712
24.634
21.835
14.519
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
14.277
23.326
28.034
29.952
30.697
30.978
31.091
31.148
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31.247
31.327
31.436
31.535
31.512
31.153
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17.942
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G27a/CR3A27N11DC07T319AC07T462.notes	aXIVf1.025	7	Aug	6 1997	9052	ASCII
G27a/CR3A27N11DC07T462AC07T479.notes	aXIVf1.026	10	Aug	6 1997	12076	ASCII
G27a/CR3A27N11DC07T479AC09T000.notes	aXIVf1.027	8	Aug	6 1997	10484	ASCII
G27a/CR3A27N12DC07T260AC07T291.notes	aXIVf1.028	8	Aug	6 1997	10245	ASCII
G27a/CR3A27N12DC07T291AC07T319.notes	aXIVf1.029	8	Aug	6 1997	9460	ASCII
G27a/CR3A27N12DC07T319AC07T462.notes	aXIVf1.030	7	Aug	6 1997	9060	ASCII
G27a/CR3A27N12DC07T462AC07T479.notes	aXIVf1.031	10	Aug	6 1997	12124	ASCII
G27a/CR3A27N12DC07T479AC09T000.notes	aXIVf1.032	8	Aug	6 1997	10488	ASCII
G27a/CR3A27N13DC07T260AC07T291.notes	aXIVf1.033	8	Aug	6 1997	10243	ASCII
G27a/CR3A27N13DC07T291AC07T319.notes	aXIVf1.034	8	Aug	6 1997	9496	ASCII
G27a/CR3A27N13DC07T319AC07T462.notes	aXIVf1.035	7	Aug	6 1997	8988	ASCII
G27a/CR3A27N13DC07T462AC07T479.notes	aXIVf1.036	10	Aug	6 1997	12090	ASCII
G27a/CR3A27N13DC07T479AC09T000.notes	aXIVf1.037	8	Aug	6 1997	10484	ASCII
G27a/CR3A27N14DC07T260AC07T291.notes	aXIVf1.038	8	Aug	6 1997	10219	ASCII
G27a/CR3A27N14DC07T291AC07T319.notes	aXIVf1.039	8	Aug	6 1997	9496	ASCII
G27a/CR3A27N14DC07T319AC07T462.notes	aXIVf1.040	7	Aug	6 1997	8956	ASCII
G27a/CR3A27N14DC07T462AC07T479.notes	aXIVf1.041	10	Aug	6 1997	12098	ASCII
G27a/CR3A27N14DC07T479AC09T000.notes	aXIVf1.042	8	Aug	6 1997	10454	ASCII
G27a/CR3A27N15DC07T260AC07T291.notes	aXIVf1.043	8	Aug	6 1997	10211	ASCII
G27a/CR3A27N15DC07T291AC07T319.notes	aXIVf1.044	8	Aug	6 1997	9442	ASCII
G27a/CR3A27N15DC07T319AC07T462.notes	aXIVf1.045	7	Aug	6 1997	9000	ASCII
G27a/CR3A27N15DC07T462AC07T479.notes	aXIVf1.046	10	Aug	6 1997	12074	ASCII
G27a/CR3A27N15DC07T479AC09T000.notes	aXIVf1.047	8	Aug	6 1997	10422	ASCII
G27a/CR3A27N16DC07T260AC07T291.notes	aXIVf1.048	8	Aug	6 1997	10108	ASCII
G27a/CR3A27N16DC07T291AC07T319.notes	aXIVf1.049	8	Aug	6 1997	9433	ASCII
G27a/CR3A27N16DC07T319AC07T462.notes	aXIVf1.050	7	Aug	6 1997	8998	ASCII
G27a/CR3A27N16DC07T462AC07T479.notes	aXIVf1.051	9	Aug	6 1997	12077	ASCII
G27a/CR3A27N16DC07T479AC09T000.notes	aXIVf1.052	8	Aug	6 1997	10424	ASCII
G27a/CR3A27N17DC07T260AC07T291.notes	aXIVf1.053	8	Aug	6 1997	10001	ASCII
G27a/CR3A27N17DC07T291AC07T319.notes	aXIVf1.054	8	Aug	6 1997	9389	ASCII
G27a/CR3A27N17DC07T319AC07T462.notes	aXIVf1.055	7	Aug	6 1997	8867	ASCII
G27a/CR3A27N17DC07T462AC07T479.notes	aXIVf1.056	9	Aug	6 1997	11888	ASCII
G27a/CR3A27N17DC07T479AC09T000.notes	aXIVf1.057	8	Aug	6 1997	10332	ASCII
G27a/CR3A27N18DC07T260AC07T291.notes	aXIVf1.058	8	Aug	6 1997	9829	ASCII
G27a/CR3A27N18DC07T291AC07T319.notes	aXIVf1.059	7	Aug	6 1997	9013	ASCII
G27a/CR3A27N18DC07T319AC07T462.notes	aXIVf1.060	7	Aug	6 1997	8414	ASCII
G27a/CR3A27N18DC07T462AC07T479.notes	aXIVf1.061	9	Aug	6 1997	11611	ASCII
G27a/CR3A27N18DC07T479AC09T000.notes	aXIVf1.062	8	Aug	6 1997	10174	ASCII