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Design Analysis Cover Sheet

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12. REMARKS

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

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2. DESIGN ANALYSIS TITLE

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Table of Contents

Item **Page**

1. Purpose 4

2. Quality Assurance 4

3. Method 4

4. Design Inputs 5
   - 4.1 Design Parameters 5
     - 4.1.1 Fuel Assembly Descriptions 5
     - 4.1.2 Burnable Poison Rod Assembly (BPRA) Description 6
     - 4.1.3 System Pressure 7
     - 4.1.4 Fuel Assembly Insertion and Burnable Poison Loading Histories 7
     - 4.1.5 Fuel Assembly Insertion Position Histories 7
     - 4.1.6 Reactor Cycle History Data 8
     - 4.1.7 Boron Letdown Data 12
     - 4.1.8 Burnup, Fuel Temperature, and Moderator Specific Volume Data 19
   - 4.2 Criteria 44
   - 4.3 Assumptions 45
   - 4.4 Codes and Standards 45

5. References 45

6. Use of Computer Software 47
   - 6.1 Scientific and Engineering Software 47
   - 6.2 Computational Support Software 48

7. Design Analysis 48
   - 7.1 Assembly Depletion Calculation Procedure 48
   - 7.2 Path B Unit Cell Model Development 49
   - 7.3 Cycle Irradiation History Layouts for the Depletion of Non-Rodded Assemblies 59
   - 7.4 The Commercial Reactor Assembly Follow Taskmaster (CRAFT) Code & Usage 65
   - 7.5 Input & Output Filename Descriptions for CRAFT and SAS2H 67
   - 7.6 Non-Rodded Assembly Depletion Calculations for Fuel Batches 4 and 5 of Crystal River Unit 3 68
   - 7.7 Isotopic Results 82

8. Conclusions 83

9. Attachments 83

1. Purpose

The purpose of this design analysis is to document the SAS2H depletion calculations of certain non-rodded fuel assemblies from batches 4 and 5 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 non-rodded assembly is one which never contains a control rod assembly (CRA) or an axial power shaping rod assembly (APSRA) during its irradiation history. The objective of this analysis is to provide SAS2H generated isotopic compositions for each fuel assembly's depleted fuel and depleted burnable poison materials. These SAS2H generated isotopic compositions are acceptable for use in CRC benchmark reactivity calculations containing the various 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", this activity 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 obtained from statepoint calculations may be used in subsequent CRC reactivity calculations. The SAS2H input decks are automatically developed by the CRAFT program which is a software routine documented in Sections 7.4 and 7.5 and Attachment I of this analysis. The SAS2H input decks and depletion models are developed using actual assembly specifications and

irradiation 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 non-rodded fuel assemblies in fuel batches 4 and 5 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 non-rodded fuel assemblies corresponding to fuel batches 4 and 5 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 4 and 5 of Crystal River Unit 3

	Fuel Batch Identifier	
Parameter	**4**	**5**
Assembly Type	Mark-B4	Mark-B4
Weight Percent U-235	2.64	2.62
kg of U per Assembly	468.62	463.63
Fuel Height (cm)	360.172	360.172
Fuel Pellet OD[1] (cm)	0.939038	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	Inconel
Volume Fraction of Spacer Grid in Moderator	0.005757609	0.005757609
Guide Tube Material	Zircaloy	Zircaloy
Guide Tube OD (cm)	1.3462	1.3462
Guide Tube ID (cm)	1.26492	1.26492

	Fuel Batch Identifier	
Parameter	4	5
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 4 and 5 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 4 and 5 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 System Pressure

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

4.1.4 Fuel Assembly Insertion and Burnable Poison Loading Histories

The actual irradiation histories of the fuel assemblies in batches 4 and 5 must be used to appropriately perform the various assembly depletion calculations relevant to the CRC analyses. Table 4.1.4-1 contains the assembly insertion and BP loading histories for the non-rodded assemblies in fuel batches 4 and 5 which are required for the CRC analyses of Crystal River Unit 3.

Table 4.1.4-1 Crystal River Unit 3, Batches 4 and 5, Non-Rodded Fuel Assembly Insertion and BP Loading Histories

Assembly Number/Batch	Reactor Cycle Number						Comments
	2	3	4	5	6	7	
B15 / 4	X	X	X				The "B" and "C" designations in the assembly numbers delineate the initial insertion cycles for each assembly as Cycles 2 and 3, respectively. For BP rods, the wt% of B4C in the BP pellet material is given. The "X" indicates that the assembly is present in the cycle indicated.
B20a / 4	X	X	X				
B20b1 / 4	X	X		X			
B20b2 / 4	X	X			X		
B20b3 / 4	X	X				X	
B21a / 4	X	X	X				
B28a / 4	X		0.2		X		
C8 / 5		X	X			X	
C25 / 5		X	X	X			
C25a / 5		X	X	X			
C27 / 5		X	X				
C27a / 5		X	X				
C28 / 5		X	X	X			
C29 / 5		X	X	X			

4.1.5 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 4.1.5-1 contains the assembly position histories for the non-rodded assemblies in batches 4 and 5 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 4.1.5-1. The integer values (1-29)

shown in Figure 4.1.5-1 are used in the SAS2H depletion calculations to identify the various assembly locations.

Table 4.1.5-1 Assembly Position Histories for the Non-Rodded Assemblies from Batches 4 and 5 of Crystal River Unit 3

Assembly Number	Reactor Cycle Number					
	2	3	4	5	6	7
B15	K15	K11	K13			
B20a	L14	K9	H8			
B20b1	L14	K9		H8		
B20b2	L14	K9			H8	
B20b3	L14	K9				H8
B21a	L15	K13	M11			
B28a	N14		H11		H10	
C8		H15	H15			O13
C25		M14	N14	K9		
C25a		M14	N14	L10		
C27		N13	H9			
C27a		N13	K9			
C28		N14	K15	M13		
C29		O13	O13	H12		

	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 4.1.5-1 One-Eighth Symmetry Core Layout for Crystal River Unit 3

4.1.6 Reactor Cycle History Data

Table 4.1.6-1 contains a listing of the Crystal River Unit 3 reactor cycle history data that is relevant to the SAS2H depletion calculations for the CRC analyses. The time durations other than the days of downtime and the total cycle effective full power days presented in Table 4.1.6-1 are calculated using the appropriate dates from Table 4.1.6-1 and the Lotus 1-2-3 "DATEDIF" function.

Table 4.1.6-1 Crystal River Unit 3 Reactor Cycle History Data

Crystal River, Unit-3, Cycle-2 Summary

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

164 : Calendar Days of Downtime Between Cycle 2 and 3

Crystal River, Unit-3, Cycle-3 Summary

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

73 : Calendar Days of Downtime Between Cycle 3 and 4

Crystal River, Unit-3, Cycle-4 Summary

12/10/81 : Cycle Start Date
10/14/82 : 228.1 EFPD Shutdown Date
10/31/82 : Restart Date After the 228.1 EFPD Shutdown (10/29/82: Ref. 5.3)
11/25/82 : 253.0 EFPD Shutdown Date (11/26/82: Ref. 5.3)
12/20/82 : Restart Date After the 253.0 EFPD Shutdown
03/19/83 : Cycle End Date

Table 4.1.6-1 Crystal River Unit 3 Reactor Cycle History Data

308 : Cycle Length to 228.1 EFPD Date
25 : Cycle Length from 228.1 EFPD Restart to 253.0 EFPD Date
89 : Cycle Length from 253.0 EFPD Restart to EOC Date
464 : Total Cycle Length (Calendar Days)
15.167 : Days of Downtime During Shutdown at 228.1 EFPD
24 : Days of Downtime During Shutdown at 253.0 EFPD
336.6 : Total Cycle Effective Full Power Days

127 : Calendar Days of Downtime Between Cycle 4 and 5

Crystal River, Unit-3, Cycle-5 Summary

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

163 : Calendar Days of Downtime Between Cycle 5 and 6

Crystal River, Unit-3, Cycle-6 Summary

08/18/85 : Cycle Start Date
01/01/86 : 96.0 EFPD Shutdown Date
06/19/86 : Restart Date After the 96.0 EFPD Shutdown
08/21/87 : 400.0 EFPD Shutdown Date
08/31/87 : Restart Date After the 400.0 EFPD Shutdown (09/01/87: Ref. 5.3)
09/18/87 : Cycle End Date
136 : Cycle Length to 96.0 EFPD Date
428 : Cycle Length from 96.0 EFPD Restart to 400.0 EFPD Date
18 : Cycle Length from 400.0 EFPD Restart to EOC Date
761 : Total Cycle Length (Calendar Days)

Table 4.1.6-1 Crystal River Unit 3 Reactor Cycle History Data

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

Crystal River, Unit-3, Cycle-7 Summary

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

99 : Calendar Days of Downtime Between Cycle 7 and 8

A number of the dates presented in Table 4.1.6-1 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 between the restart and shutdown date values do not affect the calculations due to the fact that the depletions are based upon effective full-power day durations rather than calendar day durations. The various calendar day time periods between statepoints as presented in Table 4.1.6-1 are used for documentation purposes only. The cycle starting and ending dates are the only dates presented in Table 4.1.6-1 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. There are no cycles relevant to this analysis which used a starting date that does not directly correspond to the dates provided in reference 5.3. The days of downtime between cycles are not calculated from the dates presented in Table 4.1.6-1. 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 4.1.6-1 and use in this analysis. Therefore, no calculations documented in this analysis are affected by the date inconsistencies between Table 4.1.6-1 and reference 5.3.

4.1.7 Boron Letdown Data

The boron letdown data provided in the Core Operations Reports for Cycle 2 through Cycle 7 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 non-rodded fuel assemblies of batches 4 and 5. 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 4.1.7-1 through 4.1.7-6. 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. The specific irradiation step mid-point boron concentrations obtained from this data are presented in Section 7.3.

Table 4.1.7-1 Boron Letdown Data for Cycle 2 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm[1])
0.6	930
0.8	930
0.9	930
2.1	826
3.0	809
4.4	778
11.4	809
15.8	735

Table 4.1.7-1 Boron Letdown Data for Cycle 2 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm[1])
22.5	709
29.3	683
35.3	666
42.3	644
50.0	623
55.8	614
60.8	592
69.1	571
75.2	558
83.1	528
89.8	506
97.8	480
104.7	463
116.4	441
122.5	406
129.1	385
135.9	372
139.9	346
148.6	333
156.4	320
161.4	316

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

Table 4.1.7-2 Boron Letdown Data for Cycle 3 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
0.7	1090
2.0	1020
4.0	947
6.7	951
12.6	908
26.8	891
32.6	843
50.7	822
66.0	757
69.9	746
85.0	692
100.2	666
111.2	636
130.5	562
143.8	528
163.9	467
174.0	432
184.2	394
212.9	324
227.5	272
246.4	229
262.9	250
283.8	190
304.0	130
322.0	86

Table 4.1.7-3 Boron Letdown Data for Cycle 4 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
0.39	1038
0.42	1038
0.49	1038
2.7	916
3.9	916
20.8	796
27.1	809
33.7	817
40.7	770
46.3	804
52.3	761
60.1	728
68.9	759
75.1	729
81.4	726
87.7	698
94	678
100.3	662
108.7	636
116.3	622
122.6	588
128.9	575
133.4	606
136.9	601
142.2	601

Table 4.1.7-3 Boron Letdown Data for Cycle 4 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
146.6	528
153	493
159.4	484
165.8	471
171.1	439
177.6	415
184.3	394
202	337
221.9	277
228.1	255
233.1	251
238.3	225
246.1	203
252	186
269.4	246
275	221
282	199
289	201
295.7	162
302.5	143
308.3	125
321.5	91
328	72
334.5	56

Table 4.1.7-4 Boron Letdown Data for Cycle 5 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
13.7	1077
23.7	1064
32.1	1056
42.2	1048
57.2	951
82.9	908
105.1	865
131.1	799
156.5	744
180.6	677
210	601
235.9	528
262.4	458
282.4	394
302.1	355
328.3	272
354.2	216
379.9	148
412.1	93
431.9	45
455.3	3
471	1
483.3	3

Table 4.1.7-5 Boron Letdown Data 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
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

Table 4.1.7-6 Boron Letdown Data for Cycle 7 of Crystal River Unit 3

Exposure (EFPD)	Boron Concentration (ppm)
7.5	1478
41.4	1405

Table 4.1.7-6 Boron Letdown Data for Cycle 7 of Crystal River Unit 3

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

4.1.8 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 4.1.8-1 through 4.1.8-14 contain the burnup, fuel temperature, and moderator specific volume data necessary to perform all depletion calculations for each of the non-rodded fuel assemblies from batches 4 and 5 of Crystal River Unit 3. Node number 1 in Tables 4.1.8-1 through 4.1.8-14 represents the top axial node of the active fuel. 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 4.1.8-1 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B15 of Crystal River Unit 3

	Assembly Number B15								
	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	4.4 Cy2	4.4 Cy2	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	0.0			1.572	844.5	0.0227	4.782	1109.3	0.0237
2	0.0			2.700	1023.2	0.0226	7.908	1348.5	0.0236
3	0.0			3.390	1126.0	0.0226	9.707	1454.5	0.0235
4	0.0	Data not required.		3.710	1172.8	0.0225	10.487	1481.6	0.0233
5	0.0			3.840	1193.8	0.0224	10.777	1476.1	0.0232
6	0.0			3.886	1204.0	0.0224	10.844	1457.8	0.0230
7	0.0			3.894	1209.9	0.0223	10.791	1432.0	0.0229
8	0.0			3.885	1213.0	0.0222	10.641	1403.9	0.0228
9	0.0			3.866	1212.3	0.0221	10.442	1388.9	0.0227
10	0.0			3.841	1206.2	0.0221	10.329	1398.7	0.0226
11	0.0			3.820	1194.9	0.0220	10.369	1429.5	0.0224
12	0.0			3.808	1180.1	0.0219	10.535	1475.3	0.0223
13	0.0			3.806	1164.7	0.0219	10.799	1525.6	0.0222
14	0.0			3.809	1150.5	0.0218	11.079	1552.7	0.0221
15	0.0			3.793	1137.6	0.0217	11.177	1556.3	0.0219
16	0.0			3.660	1116.6	0.0217	10.834	1536.8	0.0218
17	0.0			3.168	1051.1	0.0216	9.513	1449.2	0.0217
18	0.0			1.901	859.4	0.0216	5.952	1181.4	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3	BOC Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4
1	6.522	1128.2	0.0236	8.118	1128.2	0.0236	11.978	934.5	0.0235
2	10.549	1290.7	0.0235	12.898	1290.7	0.0235	18.922	1079.1	0.0234
3	12.732	1346.1	0.0234	15.421	1346.1	0.0234	22.699	1164.8	0.0233
4	13.595	1345.7	0.0232	16.420	1345.7	0.0232	24.368	1222.9	0.0232
5	13.871	1333.2	0.0231	16.747	1333.2	0.0231	25.077	1267.1	0.0230
6	13.910	1321.6	0.0230	16.791	1321.6	0.0230	25.353	1301.2	0.0229
7	13.829	1312.0	0.0228	16.691	1312.0	0.0228	25.399	1326.7	0.0228

Table 4.1.8-1 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B15 of Crystal River Unit 3

8	13.641	1301.0	0.0227	16.475	1301.0	0.0227	25.253	1342.1	0.0226
9	13.394	1289.1	0.0226	16.234	1289.1	0.0226	24.947	1340.9	0.0225
10	13.258	1285.3	0.0225	16.150	1285.3	0.0225	24.640	1314.6	0.0224
11	13.323	1289.8	0.0224	16.286	1289.8	0.0224	24.520	1271.7	0.0223
12	13.559	1299.6	0.0223	16.584	1299.6	0.0223	24.633	1229.5	0.0221
13	13.941	1316.2	0.0221	16.982	1316.2	0.0221	24.955	1195.5	0.0220
14	14.387	1338.6	0.0220	17.347	1338.6	0.0220	25.402	1175.2	0.0219
15	14.612	1355.2	0.0219	17.414	1355.2	0.0219	25.669	1170.9	0.0218
16	14.245	1352.9	0.0218	16.859	1352.9	0.0218	25.128	1165.7	0.0217
17	12.638	1313.9	0.0217	14.978	1313.9	0.0217	22.565	1130.7	0.0217
18	8.076	1141.5	0.0216	9.686	1141.5	0.0216	14.847	984.8	0.0216

	Statepoint 10 (253.0 Cycle 4)			Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)		
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.
	253.0 Cy4	253.0 Cy4	253.0 Cy4	BOC Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5
1	12.473	1018.9	0.0234						
2	19.653	1123.9	0.0233	No additional statepoints.			No additional statepoints.		
3	23.537	1156.2	0.0232						
4	25.241	1157.1	0.0231						
5	25.958	1148.6	0.0229						
6	26.233	1140.0	0.0228						
7	26.278	1135.0	0.0227						
8	26.132	1134.7	0.0226						
9	25.823	1135.8	0.0225						
10	25.506	1130.7	0.0224						
11	25.379	1118.0	0.0223						
12	25.493	1105.0	0.0222						
13	25.823	1095.3	0.0221						
14	26.290	1093.1	0.0220						
15	26.590	1104.6	0.0219						
16	26.066	1121.2	0.0218						
17	23.450	1112.2	0.0217						
18	15.480	1019.8	0.0216						

Table 4.1.8-2 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20a of Crystal River Unit 3

	Assembly Number B20a								
	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	4.4 Cy2	4.4 Cy2	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	0.0			2.693	1037.1	0.0235	5.526	1053.4	0.0236
2	0.0			4.526	1298.0	0.0234	9.151	1263.8	0.0235
3	0.0			5.615	1437.7	0.0233	11.307	1357.2	0.0234
4	0.0	Data not required.		6.113	1502.4	0.0232	12.290	1380.2	0.0233
5	0.0			6.322	1533.1	0.0231	12.687	1374.3	0.0231
6	0.0			6.402	1550.2	0.0229	12.823	1361.1	0.0230
7	0.0			6.421	1562.2	0.0228	12.854	1349.4	0.0229
8	0.0			6.404	1570.6	0.0226	12.852	1344.8	0.0228
9	0.0			6.352	1571.8	0.0225	12.861	1351.8	0.0226
10	0.0			6.277	1559.9	0.0224	12.913	1372.2	0.0225
11	0.0			6.206	1534.2	0.0223	13.013	1400.9	0.0224
12	0.0			6.167	1502.9	0.0222	13.133	1428.3	0.0223
13	0.0			6.167	1473.8	0.0220	13.236	1447.0	0.0222
14	0.0			6.181	1450.2	0.0219	13.282	1454.3	0.0220
15	0.0			6.134	1430.3	0.0218	13.177	1452.2	0.0219
16	0.0			5.863	1396.6	0.0217	12.664	1436.2	0.0218
17	0.0			5.048	1300.5	0.0216	11.095	1368.8	0.0217
18	0.0			3.056	1033.6	0.0216	6.968	1142.1	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3	BOC Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4
1	7.148	1086.0	0.0235	8.735	1086.0	0.0235	12.246	885.2	0.0234
2	11.631	1240.7	0.0234	13.948	1240.7	0.0234	19.408	1008.1	0.0233
3	14.168	1292.0	0.0233	16.805	1292.0	0.0233	23.446	1082.9	0.0232
4	15.233	1289.0	0.0232	17.999	1289.0	0.0232	25.334	1143.2	0.0231
5	15.612	1274.8	0.0230	18.429	1274.8	0.0230	26.179	1192.5	0.0230
6	15.718	1262.6	0.0229	18.553	1262.6	0.0229	26.552	1229.3	0.0229
7	15.731	1254.9	0.0228	18.580	1254.9	0.0228	26.744	1255.6	0.0228
8	15.728	1251.3	0.0227	18.602	1251.3	0.0227	26.882	1273.0	0.0226
9	15.757	1251.7	0.0226	18.672	1251.7	0.0226	27.013	1279.5	0.0225
10	15.852	1255.7	0.0225	18.821	1255.7	0.0225	27.147	1272.8	0.0224
11	16.009	1261.4	0.0223	19.023	1261.4	0.0223	27.254	1253.1	0.0223
12	16.192	1266.5	0.0222	19.210	1266.5	0.0222	27.299	1225.0	0.0221

Table 4.1.8-2 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20a of Crystal River Unit 3

13	16.364	1271.8	0.0221	19.329	1271.8	0.0221	27.277	1195.2	0.0220
14	16.494	1280.7	0.0220	19.343	1280.7	0.0220	27.200	1169.5	0.0219
15	16.462	1291.6	0.0219	19.149	1291.6	0.0219	26.963	1150.6	0.0218
16	15.915	1292.0	0.0218	18.424	1292.0	0.0218	26.107	1133.3	0.0217
17	14.085	1262.8	0.0217	16.339	1262.8	0.0217	23.405	1100.7	0.0217
18	9.018	1106.8	0.0216	10.581	1106.8	0.0216	15.467	971.1	0.0216

	Statepoint 10 (253.0 Cycle 4)			Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)		
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.
	253.0 Cy4	253.0 Cy4	253.0 Cy4	BOC Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5
1	12.701	999.1	0.0232						
2	20.076	1095.9	0.0232	No additional statepoints.			No additional statepoints.		
3	24.216	1124.9	0.0231						
4	26.144	1121.3	0.0229						
5	26.999	1106.9	0.0228						
6	27.370	1092.7	0.0227						
7	27.558	1081.7	0.0226						
8	27.695	1074.3	0.0225						
9	27.826	1068.6	0.0224						
10	27.959	1062.9	0.0223						
11	28.066	1056.4	0.0222						
12	28.111	1050.2	0.0221						
13	28.091	1046.0	0.0220						
14	28.020	1046.0	0.0219						
15	27.793	1051.1	0.0219						
16	26.941	1058.0	0.0218						
17	24.195	1051.4	0.0217						
18	16.041	976.8	0.0216						

Table 4.1.8-3 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b1 of Crystal River Unit 3

	Assembly Number B20b1								
	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2			BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	0.0			2.693	1037.1	0.0235	5.526	1053.4	0.0236
2	0.0			4.526	1298.0	0.0234	9.151	1263.8	0.0235
3	0.0			5.615	1437.7	0.0233	11.307	1357.2	0.0234

Table 4.1.8-3 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b1 of Crystal River Unit 3

4	0.0	Data not required.		6.113	1502.4	0.0232	12.290	1380.2	0.0233
5	0.0			6.322	1533.1	0.0231	12.687	1374.3	0.0231
6	0.0			6.402	1550.2	0.0229	12.823	1361.1	0.0230
7	0.0			6.421	1562.2	0.0228	12.854	1349.4	0.0229
8	0.0			6.404	1570.6	0.0226	12.852	1344.8	0.0228
9	0.0			6.352	1571.8	0.0225	12.861	1351.8	0.0226
10	0.0			6.277	1559.9	0.0224	12.913	1372.2	0.0225
11	0.0			6.206	1534.2	0.0223	13.013	1400.9	0.0224
12	0.0			6.167	1502.9	0.0222	13.133	1428.3	0.0223
13	0.0			6.167	1473.8	0.0220	13.236	1447.0	0.0222
14	0.0			6.181	1450.2	0.0219	13.282	1454.3	0.0220
15	0.0			6.134	1430.3	0.0218	13.177	1452.2	0.0219
16	0.0			5.863	1396.6	0.0217	12.664	1436.2	0.0218
17	0.0			5.048	1300.5	0.0216	11.095	1368.8	0.0217
18	0.0			3.056	1033.6	0.0216	6.968	1142.1	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3	BOC Cy5	246.4 Cy3+	246.4 Cy3+	388.5 Cy5	262.1 Cy5	262.1 Cy5
1	7.148	1086.0	0.0235	8.735	1086.0	0.0235	14.867	936.1	0.0229
2	11.631	1240.7	0.0234	13.948	1240.7	0.0234	22.963	1013.8	0.0228
3	14.168	1292.0	0.0233	16.805	1292.0	0.0233	27.028	1021.3	0.0227
4	15.233	1289.0	0.0232	17.999	1289.0	0.0232	28.563	1008.6	0.0226
5	15.612	1274.8	0.0230	18.429	1274.8	0.0230	29.031	994.8	0.0225
6	15.718	1262.6	0.0229	18.553	1262.6	0.0229	29.100	984.6	0.0225
7	15.731	1254.9	0.0228	18.580	1254.9	0.0228	29.055	978.3	0.0224
8	15.728	1251.3	0.0227	18.602	1251.3	0.0227	29.021	975.7	0.0223
9	15.757	1251.7	0.0226	18.672	1251.7	0.0226	29.063	976.0	0.0222
10	15.852	1255.7	0.0225	18.821	1255.7	0.0225	29.210	978.0	0.0222
11	16.009	1261.4	0.0223	19.023	1261.4	0.0223	29.412	980.0	0.0221
12	16.192	1266.5	0.0222	19.210	1266.5	0.0222	29.580	981.1	0.0220
13	16.364	1271.8	0.0221	19.329	1271.8	0.0221	29.645	980.9	0.0219
14	16.494	1280.7	0.0220	19.343	1280.7	0.0220	29.555	979.4	0.0219
15	16.462	1291.6	0.0219	19.149	1291.6	0.0219	29.184	977.4	0.0218
16	15.915	1292.0	0.0218	18.424	1292.0	0.0218	28.120	973.9	0.0217
17	14.085	1262.8	0.0217	16.339	1262.8	0.0217	25.154	959.9	0.0216
18	9.018	1106.8	0.0216	10.581	1106.8	0.0216	16.690	886.8	0.0216

Table 4.1.8-4 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b2 of Crystal River Unit 3

	Assembly Number B20b2								
	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2			BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	0.0			2.693	1037.1	0.0235	5.526	1053.4	0.0236
2	0.0			4.526	1298.0	0.0234	9.151	1263.8	0.0235
3	0.0			5.615	1437.7	0.0233	11.307	1357.2	0.0234
4	0.0	Data not required.		6.113	1502.4	0.0232	12.290	1380.2	0.0233
5	0.0			6.322	1533.1	0.0231	12.687	1374.3	0.0231
6	0.0			6.402	1550.2	0.0229	12.823	1361.1	0.0230
7	0.0			6.421	1562.2	0.0228	12.854	1349.4	0.0229
8	0.0			6.404	1570.6	0.0226	12.852	1344.8	0.0228
9	0.0			6.352	1571.8	0.0225	12.861	1351.8	0.0226
10	0.0			6.277	1559.9	0.0224	12.913	1372.2	0.0225
11	0.0			6.206	1534.2	0.0223	13.013	1400.9	0.0224
12	0.0			6.167	1502.9	0.0222	13.133	1428.3	0.0223
13	0.0			6.167	1473.8	0.0220	13.236	1447.0	0.0222
14	0.0			6.181	1450.2	0.0219	13.282	1454.3	0.0220
15	0.0			6.134	1430.3	0.0218	13.177	1452.2	0.0219
16	0.0			5.863	1396.6	0.0217	12.664	1436.2	0.0218
17	0.0			5.048	1300.5	0.0216	11.095	1368.8	0.0217
18	0.0			3.056	1033.6	0.0216	6.968	1142.1	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 13 (BOC Cycle 6)			Statepoint 14 (96.0 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.
	250.0 Cy3	246.4 Cy3	246.4 Cy3	BOC Cy6	246.4 Cy3+	246.4 Cy3+	96.0 Cy6	127.3 Cy6	127.3 Cy6
1	7.148	1086.0	0.0235	8.735	1086.0	0.0235	10.300	949.6	0.0230
2	11.631	1240.7	0.0234	13.948	1240.7	0.0234	16.307	1054.6	0.0230
3	14.168	1292.0	0.0233	16.805	1292.0	0.0233	19.522	1077.1	0.0229
4	15.233	1289.0	0.0232	17.999	1289.0	0.0232	20.856	1080.3	0.0228
5	15.612	1274.8	0.0230	18.429	1274.8	0.0230	21.355	1078.4	0.0227
6	15.718	1262.6	0.0229	18.553	1262.6	0.0229	21.523	1075.6	0.0226
7	15.731	1254.9	0.0228	18.580	1254.9	0.0228	21.578	1072.5	0.0225
8	15.728	1251.3	0.0227	18.602	1251.3	0.0227	21.615	1068.7	0.0224
9	15.757	1251.7	0.0226	18.672	1251.7	0.0226	21.684	1063.5	0.0223
10	15.852	1255.7	0.0225	18.821	1255.7	0.0225	21.814	1056.6	0.0222
11	16.009	1261.4	0.0223	19.023	1261.4	0.0223	21.981	1048.8	0.0221
12	16.192	1266.5	0.0222	19.210	1266.5	0.0222	22.123	1041.0	0.0220

Table 4.1.8-4 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b2 of Crystal River Unit 3

13	16.364	1271.8	0.0221	19.329	1271.8	0.0221	22.192	1034.4	0.0220
14	16.494	1280.7	0.0220	19.343	1280.7	0.0220	22.150	1028.8	0.0219
15	16.462	1291.6	0.0219	19.149	1291.6	0.0219	21.887	1023.3	0.0218
16	15.915	1292.0	0.0218	18.424	1292.0	0.0218	21.048	1015.0	0.0217
17	14.085	1262.8	0.0217	16.339	1262.8	0.0217	18.695	992.6	0.0217
18	9.018	1106.8	0.0216	10.581	1106.8	0.0216	12.172	900.4	0.0216

	Statepoint 15 (400.0 Cycle 6)			Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	400.0 Cy6	274.9 Cy6	274.9 Cy6	BOC Cy7	274.9 Cy6	274.9 Cy6	260.3 Cy7	160.5 Cy7	160.5 Cy7
1	16.097	970.4	0.0230						
2	24.495	1046.0	0.0230	No additional statepoints.			No additional statepoints.		
3	28.537	1056.9	0.0229						
4	30.009	1048.7	0.0228						
5	30.470	1038.8	0.0227						
6	30.567	1030.6	0.0226						
7	30.555	1024.0	0.0225						
8	30.529	1018.3	0.0224						
9	30.531	1012.7	0.0223						
10	30.588	1006.8	0.0222						
11	30.683	1001.2	0.0221						
12	30.771	996.9	0.0221						
13	30.813	995.0	0.0220						
14	30.773	995.5	0.0219						
15	30.515	998.4	0.0218						
16	29.584	1001.3	0.0217						
17	26.676	992.8	0.0217						
18	17.903	923.4	0.0216						

Table 4.1.8-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b3 of Crystal River Unit 3

	Assembly Number B20b3								
	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2			BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	0.0			2.693	1037.1	0.0235	5.526	1053.4	0.0236
2	0.0			4.526	1298.0	0.0234	9.151	1263.8	0.0235
3	0.0			5.615	1437.7	0.0233	11.307	1357.2	0.0234

Table 4.1.8-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b3 of Crystal River Unit 3

4	0.0	Data not required.		6.113	1502.4	0.0232	12.290	1380.2	0.0233
5	0.0			6.322	1533.1	0.0231	12.687	1374.3	0.0231
6	0.0			6.402	1550.2	0.0229	12.823	1361.1	0.0230
7	0.0			6.421	1562.2	0.0228	12.854	1349.4	0.0229
8	0.0			6.404	1570.6	0.0226	12.852	1344.8	0.0228
9	0.0			6.352	1571.8	0.0225	12.861	1351.8	0.0226
10	0.0			6.277	1559.9	0.0224	12.913	1372.2	0.0225
11	0.0			6.206	1534.2	0.0223	13.013	1400.9	0.0224
12	0.0			6.167	1502.9	0.0222	13.133	1428.3	0.0223
13	0.0			6.167	1473.8	0.0220	13.236	1447.0	0.0222
14	0.0			6.181	1450.2	0.0219	13.282	1454.3	0.0220
15	0.0			6.134	1430.3	0.0218	13.177	1452.2	0.0219
16	0.0			5.863	1396.6	0.0217	12.664	1436.2	0.0218
17	0.0			5.048	1300.5	0.0216	11.095	1368.8	0.0217
18	0.0			3.056	1033.6	0.0216	6.968	1142.1	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3	BOC Cy7	246.4 Cy3+	246.4 Cy3+	260.3 Cy7	160.5 Cy7	160.5 Cy7
1	7.148	1086.0	0.0235	8.735	1086.0	0.0235	12.970	963.3	0.0232
2	11.631	1240.7	0.0234	13.948	1240.7	0.0234	20.372	1080.3	0.0231
3	14.168	1292.0	0.0233	16.805	1292.0	0.0233	24.317	1117.7	0.0230
4	15.233	1289.0	0.0232	17.999	1289.0	0.0232	26.003	1131.5	0.0229
5	15.612	1274.8	0.0230	18.429	1274.8	0.0230	26.670	1134.6	0.0228
6	15.718	1262.6	0.0229	18.553	1262.6	0.0229	26.913	1133.5	0.0227
7	15.731	1254.9	0.0228	18.580	1254.9	0.0228	26.999	1130.5	0.0226
8	15.728	1251.3	0.0227	18.602	1251.3	0.0227	27.042	1126.5	0.0225
9	15.757	1251.7	0.0226	18.672	1251.7	0.0226	27.103	1121.5	0.0224
10	15.852	1255.7	0.0225	18.821	1255.7	0.0225	27.213	1115.3	0.0223
11	16.009	1261.4	0.0223	19.023	1261.4	0.0223	27.351	1108.3	0.0222
12	16.192	1266.5	0.0222	19.210	1266.5	0.0222	27.458	1101.4	0.0221
13	16.364	1271.8	0.0221	19.329	1271.8	0.0221	27.480	1094.9	0.0220
14	16.494	1280.7	0.0220	19.343	1280.7	0.0220	27.368	1088.0	0.0219
15	16.462	1291.6	0.0219	19.149	1291.6	0.0219	26.978	1078.7	0.0218
16	15.915	1292.0	0.0218	18.424	1292.0	0.0218	25.893	1062.8	0.0217
17	14.085	1262.8	0.0217	16.339	1262.8	0.0217	23.035	1029.5	0.0216
18	9.018	1106.8	0.0216	10.581	1106.8	0.0216	15.152	928.2	0.0216

Table 4.1.8-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b3 of Crystal River Unit 3

	Statepoint 18 (291.0 Cycle 7)			Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	291.0 Cy7	345.3 Cy7	345.3 Cy7	319.0 Cy7	345.3 Cy7	345.3 Cy7	462.3 Cy7	402.3 Cy7	402.3 Cy7
1	13.560	980.1	0.0232	14.127	980.1	0.0232	17.066	991.8	0.0232
2	21.234	1060.8	0.0232	22.057	1060.8	0.0232	26.200	1064.3	0.0231
3	25.294	1077.6	0.0231	26.217	1077.6	0.0231	30.790	1074.0	0.0230
4	27.014	1072.5	0.0230	27.960	1072.5	0.0230	32.602	1067.7	0.0229
5	27.686	1064.5	0.0228	28.628	1064.5	0.0228	33.241	1060.3	0.0228
6	27.925	1058.4	0.0227	28.857	1058.4	0.0227	33.428	1053.2	0.0227
7	28.005	1054.7	0.0226	28.927	1054.7	0.0226	33.466	1048.1	0.0226
8	28.044	1053.1	0.0225	28.956	1053.1	0.0225	33.479	1044.7	0.0225
9	28.102	1052.7	0.0224	29.006	1052.7	0.0224	33.522	1042.6	0.0224
10	28.209	1053.0	0.0223	29.108	1053.0	0.0223	33.624	1041.1	0.0223
11	28.347	1054.5	0.0222	29.240	1054.5	0.0222	33.766	1040.4	0.0222
12	28.455	1057.8	0.0221	29.346	1057.8	0.0221	33.895	1041.2	0.0221
13	28.481	1063.1	0.0220	29.374	1063.1	0.0220	33.964	1044.2	0.0220
14	28.374	1070.1	0.0220	29.269	1070.1	0.0220	33.917	1049.4	0.0219
15	27.985	1078.4	0.0219	28.881	1078.4	0.0219	33.588	1055.9	0.0219
16	26.882	1084.4	0.0218	27.763	1084.4	0.0218	32.470	1058.5	0.0218
17	23.947	1073.6	0.0217	24.762	1073.6	0.0217	29.212	1052.2	0.0217
18	15.795	990.5	0.0216	16.373	990.5	0.0216	19.625	981.2	0.0216

	Statepoint 21 (479.0 Cycle 7)			Statepoint 22 (BOC Cycle 8)			Statepoint 23 (97.6 Cycle 8)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	479.0 Cy7	402.3 Cy7	402.3 Cy7	BOC Cy8	402.3 Cy7	402.3 Cy7	97.6 Cy8	111.4 Cy8	111.4 Cy8
1	17.423	991.8	0.0232						
2	26.690	1064.3	0.0231	No additional statepoints.			No additional statepoints.		
3	31.321	1074.0	0.0230						
4	33.137	1067.7	0.0229						
5	33.770	1060.3	0.0228						
6	33.950	1053.2	0.0227						
7	33.985	1048.1	0.0226						
8	33.996	1044.7	0.0225						
9	34.039	1042.6	0.0224						
10	34.141	1041.1	0.0223						
11	34.285	1040.4	0.0222						
12	34.416	1041.2	0.0221						
13	34.489	1044.2	0.0220						

Table 4.1.8-5 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B20b3 of Crystal River Unit 3

14	34.450	1049.4	0.0219						
15	34.129	1055.9	0.0219						
16	33.017	1058.5	0.0218						
17	29.736	1052.2	0.0217						
18	20.017	981.2	0.0216						

Table 4.1.8-6 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B21a of Crystal River Unit 3

	Assembly Number B21a								
	Statepoint 4 (BOC Cycle 2)			Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2	4.4 Cy2	4.4 Cy2	BOC Cy3	89.8 Cy2	89.8 Cy2	168.5 Cy3	85.0 Cy3	85.0 Cy3
1	0.0			1.363	806.9	0.0226	4.478	1085.1	0.0236
2	0.0			2.375	967.6	0.0225	7.444	1321.1	0.0235
3	0.0			3.017	1065.0	0.0225	9.154	1426.5	0.0234
4	0.0	Data not required.		3.329	1111.2	0.0224	9.914	1458.9	0.0233
5	0.0			3.465	1132.9	0.0223	10.215	1459.9	0.0231
6	0.0			3.518	1144.0	0.0223	10.297	1446.2	0.0230
7	0.0			3.532	1150.4	0.0222	10.248	1422.2	0.0229
8	0.0			3.525	1153.8	0.0221	10.080	1393.1	0.0227
9	0.0			3.504	1153.2	0.0221	9.838	1375.0	0.0226
10	0.0			3.475	1146.8	0.0220	9.662	1380.5	0.0225
11	0.0			3.447	1135.0	0.0219	9.640	1407.8	0.0224
12	0.0			3.428	1120.0	0.0219	9.772	1453.0	0.0223
13	0.0			3.419	1104.8	0.0218	10.034	1505.0	0.0222
14	0.0			3.408	1090.8	0.0218	10.323	1536.7	0.0220
15	0.0			3.354	1075.5	0.0217	10.398	1541.5	0.0219
16	0.0			3.166	1046.6	0.0217	9.983	1515.9	0.0218
17	0.0			2.665	974.8	0.0216	8.622	1419.7	0.0217
18	0.0			1.557	804.3	0.0216	5.285	1147.7	0.0216

	Statepoint 7 (250.0 Cycle 3)			Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	250.0 Cy3	246.4 Cy3	246.4 Cy3	BOC Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4
1	6.158	1118.8	0.0236	7.632	1118.8	0.0236	11.485	934.9	0.0236
2	9.999	1278.8	0.0235	12.199	1278.8	0.0235	18.297	1082.9	0.0235
3	12.092	1336.0	0.0233	14.635	1336.0	0.0233	22.177	1184.5	0.0234
4	12.952	1340.6	0.0232	15.639	1340.6	0.0232	24.033	1263.9	0.0233

Table 4.1.8-6 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B21a of Crystal River Unit 3

5	13.260	1332.3	0.0231	16.004	1332.3	0.0231	24.883	1324.1	0.0232
6	13.329	1323.5	0.0229	16.083	1323.5	0.0229	25.241	1367.1	0.0230
7	13.261	1315.7	0.0228	15.998	1315.7	0.0228	25.323	1396.1	0.0229
8	13.060	1305.9	0.0227	15.769	1305.9	0.0227	25.157	1413.1	0.0227
9	12.767	1294.6	0.0226	15.480	1294.6	0.0226	24.726	1408.9	0.0226
10	12.561	1290.9	0.0225	15.320	1290.9	0.0225	24.182	1371.6	0.0224
11	12.557	1295.7	0.0224	15.384	1295.7	0.0224	23.842	1311.6	0.0223
12	12.754	1306.3	0.0222	15.648	1306.3	0.0222	23.847	1257.6	0.0222
13	13.134	1324.0	0.0221	16.058	1324.0	0.0221	24.176	1218.8	0.0221
14	13.587	1347.2	0.0220	16.453	1347.2	0.0220	24.748	1202.9	0.0220
15	13.786	1364.5	0.0219	16.523	1364.5	0.0219	25.202	1213.2	0.0219
16	13.344	1362.6	0.0218	15.914	1362.6	0.0218	24.753	1223.7	0.0218
17	11.682	1319.4	0.0217	13.979	1319.4	0.0217	22.172	1195.9	0.0217
18	7.334	1140.1	0.0216	8.895	1140.1	0.0216	14.499	1037.1	0.0216

Node No.	Statepoint 10 (253.0 Cycle 4)			Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)		
	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	253.0 Cy4	253.0 Cy4	253.0 Cy4	BOC Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5
1	11.978	1029.0	0.0234						
2	19.033	1144.8	0.0234	No additional statepoints.			No additional statepoints.		
3	23.038	1185.2	0.0232						
4	24.941	1188.1	0.0231						
5	25.803	1177.2	0.0230						
6	26.160	1165.9	0.0229						
7	26.241	1159.6	0.0227						
8	26.073	1159.3	0.0226						
9	25.631	1160.3	0.0225						
10	25.063	1151.6	0.0224						
11	24.707	1131.2	0.0223						
12	24.707	1111.9	0.0222						
13	25.047	1098.7	0.0221						
14	25.648	1096.1	0.0220						
15	26.150	1112.7	0.0219						
16	25.729	1137.1	0.0218						
17	23.100	1133.6	0.0217						
18	15.165	1041.0	0.0216						

Table 4.1.8-7 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B28a of Crystal River Unit 3

	Assembly Number B28a								
	Statepoint 4 (BOC Cycle 2)			Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy2			BOC Cy4	89.8 Cy2+	89.8 Cy2+	228.1 Cy4	40.7 Cy4	40.7 Cy4
1	0.0			1.406	812.3	0.0227	5.231	991.2	0.0239
2	0.0			2.485	980.2	0.0226	8.653	1211.2	0.0238
3	0.0			3.227	1091.6	0.0226	11.058	1359.2	0.0237
4	0.0	Data not required.		3.637	1154.4	0.0225	12.475	1480.6	0.0235
5	0.0			3.844	1188.2	0.0224	13.232	1565.9	0.0234
6	0.0			3.939	1206.1	0.0224	13.645	1620.0	0.0232
7	0.0			3.974	1215.9	0.0223	13.918	1655.9	0.0231
8	0.0			3.974	1221.2	0.0222	14.144	1686.3	0.0229
9	0.0			3.950	1221.0	0.0221	14.299	1706.0	0.0227
10	0.0			3.911	1213.4	0.0221	14.285	1702.2	0.0226
11	0.0			3.869	1198.5	0.0220	14.123	1674.8	0.0224
12	0.0			3.838	1179.4	0.0219	13.899	1633.8	0.0223
13	0.0			3.819	1160.4	0.0218	13.665	1588.0	0.0221
14	0.0			3.793	1142.9	0.0218	13.496	1543.9	0.0220
15	0.0			3.710	1123.1	0.0217	13.397	1516.7	0.0219
16	0.0			3.468	1087.7	0.0217	13.004	1488.6	0.0218
17	0.0			2.893	1006.1	0.0216	11.550	1408.0	0.0217
18	0.0			1.680	822.6	0.0216	7.630	1173.2	0.0216

	Statepoint 10 (253.0 Cycle 4)			Statepoint 13 (BOC Cycle 6)			Statepoint 14 (96.0 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.
	253.0 Cy4	253.0 Cy4	253.0 Cy4	BOC Cy6	253.0 Cy4+	253.0 Cy4+	96.0 Cy6	127.3 Cy6	127.3 Cy6
1	5.722	1111.4	0.0237	7.683	1111.4	0.0237	9.423	1008.8	0.0234
2	9.408	1283.6	0.0236	12.312	1283.6	0.0236	14.978	1140.3	0.0233
3	11.969	1365.4	0.0234	15.282	1365.4	0.0234	18.403	1171.5	0.0232
4	13.450	1375.0	0.0233	16.838	1375.0	0.0233	20.157	1175.8	0.0231
5	14.222	1359.8	0.0232	17.566	1359.8	0.0232	20.988	1174.0	0.0229
6	14.635	1343.5	0.0230	17.905	1343.5	0.0230	21.390	1170.5	0.0228
7	14.907	1332.8	0.0229	18.110	1332.8	0.0229	21.640	1166.5	0.0227
8	15.139	1329.5	0.0228	18.315	1329.5	0.0228	21.874	1161.4	0.0226
9	15.303	1331.2	0.0226	18.516	1331.2	0.0226	22.089	1156.0	0.0225
10	15.296	1331.2	0.0225	18.594	1331.2	0.0225	22.174	1152.0	0.0224
11	15.137	1326.7	0.0224	18.537	1326.7	0.0224	22.116	1149.8	0.0223
12	14.917	1319.8	0.0223	18.406	1319.8	0.0223	21.971	1148.8	0.0222

Table 4.1.8-7 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly B28a of Crystal River Unit 3

13	14.687	1312.9	0.0221	18.204	1312.9	0.0221	21.741	1148.2	0.0221
14	14.526	1310.4	0.0220	17.985	1310.4	0.0220	21.470	1145.8	0.0220
15	14.443	1317.7	0.0219	17.784	1317.7	0.0219	21.175	1138.0	0.0219
16	14.054	1325.3	0.0218	17.228	1325.3	0.0218	20.448	1121.3	0.0218
17	12.532	1298.9	0.0217	15.395	1298.9	0.0217	18.264	1086.4	0.0217
18	8.334	1149.2	0.0216	10.371	1149.2	0.0216	12.288	967.0	0.0216

	Statepoint 15 (400.0 Cycle 6)			Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	400.0 Cy6	274.9 Cy6	274.9 Cy6	BOC Cy7	274.9 Cy6	274.9 Cy6	260.3 Cy7	160.5 Cy7	160.5 Cy7
1	15.946	1026.8	0.0233						
2	24.356	1120.9	0.0232	No additional statepoints.			No additional statepoints.		
3	28.870	1140.3	0.0231						
4	30.865	1131.6	0.0230						
5	31.686	1119.1	0.0229						
6	32.021	1108.3	0.0228						
7	32.199	1099.3	0.0227						
8	32.365	1091.2	0.0226						
9	32.522	1084.3	0.0225						
10	32.570	1080.0	0.0224						
11	32.506	1078.7	0.0223						
12	32.384	1079.9	0.0222						
13	32.201	1083.5	0.0221						
14	31.978	1088.1	0.0220						
15	31.676	1091.2	0.0219						
16	30.759	1089.8	0.0218						
17	27.801	1071.3	0.0217						
18	19.018	979.0	0.0216						

Table 4.1.8-8 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C8 of Crystal River Unit 3

	Assembly Number C8								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			1.225	776.6	0.0224	1.977	850.9	0.0226
2	0.0			2.111	914.3	0.0224	3.348	1001.0	0.0226
3	0.0			2.665	997.0	0.0224	4.163	1070.2	0.0225

Table 4.1.8-8 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C8 of Crystal River Unit 3

4	0.0	Data not required.		2.931	1033.1	0.0223	4.528	1090.2	0.0225
5	0.0			3.044	1044.6	0.0223	4.671	1093.2	0.0224
6	0.0			3.080	1044.3	0.0222	4.712	1091.4	0.0223
7	0.0			3.075	1039.1	0.0222	4.707	1089.2	0.0223
8	0.0			3.050	1033.8	0.0221	4.682	1087.9	0.0222
9	0.0			3.023	1032.2	0.0220	4.659	1088.0	0.0222
10	0.0			3.010	1036.7	0.0220	4.656	1089.7	0.0221
11	0.0			3.023	1047.4	0.0219	4.689	1093.3	0.0220
12	0.0			3.064	1062.0	0.0219	4.765	1099.2	0.0220
13	0.0			3.131	1076.1	0.0218	4.894	1110.0	0.0219
14	0.0			3.230	1089.8	0.0218	5.116	1134.6	0.0218
15	0.0			3.359	1107.4	0.0217	5.408	1171.0	0.0218
16	0.0			3.375	1115.4	0.0217	5.433	1174.5	0.0217
17	0.0			2.956	1052.9	0.0216	4.775	1120.7	0.0216
18	0.0			1.776	856.5	0.0216	2.913	936.7	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	2.690	850.9	0.0226	4.306	735.9	0.0223	4.533	820.3	0.0225
2	4.532	1001.0	0.0226	7.205	834.4	0.0223	7.564	921.0	0.0224
3	5.686	1070.2	0.0225	8.994	894.0	0.0223	9.418	955.6	0.0224
4	6.293	1090.2	0.0225	9.922	929.3	0.0222	10.369	961.3	0.0223
5	6.561	1093.2	0.0224	10.360	952.9	0.0222	10.812	959.2	0.0223
6	6.654	1091.4	0.0223	10.547	969.7	0.0221	11.000	955.1	0.0222
7	6.676	1089.2	0.0223	10.621	980.6	0.0221	11.073	951.9	0.0222
8	6.674	1087.9	0.0222	10.640	985.4	0.0220	11.093	950.3	0.0221
9	6.677	1088.0	0.0222	10.634	983.3	0.0220	11.088	949.4	0.0221
10	6.704	1089.7	0.0221	10.625	974.4	0.0219	11.080	948.0	0.0220
11	6.761	1093.3	0.0220	10.633	960.2	0.0219	11.089	945.5	0.0220
12	6.842	1099.2	0.0220	10.670	944.3	0.0218	11.129	942.6	0.0219
13	6.941	1110.0	0.0219	10.752	929.5	0.0218	11.216	941.3	0.0219
14	7.089	1134.6	0.0218	10.936	917.5	0.0217	11.409	945.1	0.0218
15	7.266	1171.0	0.0218	11.249	909.9	0.0217	11.744	961.7	0.0218
16	7.139	1174.5	0.0217	11.299	910.3	0.0216	11.825	987.8	0.0217
17	6.242	1120.7	0.0216	10.139	898.1	0.0216	10.643	974.8	0.0216
18	3.838	936.7	0.0216	6.379	794.2	0.0216	6.722	874.1	0.0216

Table 4.1.8-8 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C8 of Crystal River Unit 3

Node No.	Statepoint 16 (BOC Cycle 7)			Statepoint 17 (260.3 Cycle 7)			Statepoint 18 (291.0 Cycle 7)		
	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	253.0 Cy4+	253.0 Cy4+	260.3 Cy7	160.5 Cy7	160.5 Cy7	291.0 Cy7	345.3 Cy7	345.3 Cy7
1	5.354	820.3	0.0225	7.088	755.5	0.0223	7.337	777.6	0.0223
2	8.897	921.0	0.0224	11.791	829.8	0.0222	12.182	843.3	0.0223
3	11.109	955.6	0.0224	14.683	861.2	0.0222	15.136	858.6	0.0222
4	12.226	961.3	0.0223	16.121	868.2	0.0221	16.591	854.4	0.0222
5	12.715	959.2	0.0223	16.754	867.5	0.0221	17.224	848.0	0.0221
6	12.902	955.1	0.0222	17.003	864.7	0.0221	17.470	843.1	0.0221
7	12.966	951.9	0.0222	17.091	861.4	0.0220	17.554	840.0	0.0220
8	12.987	950.3	0.0221	17.117	858.2	0.0220	17.576	838.5	0.0220
9	13.002	949.4	0.0221	17.127	855.2	0.0219	17.583	838.1	0.0219
10	13.030	948.0	0.0220	17.147	852.6	0.0219	17.602	838.5	0.0219
11	13.080	945.5	0.0220	17.186	850.4	0.0218	17.641	839.6	0.0219
12	13.151	942.6	0.0219	17.241	848.4	0.0218	17.698	841.4	0.0218
13	13.244	941.3	0.0219	17.304	846.0	0.0217	17.763	843.8	0.0218
14	13.405	945.1	0.0218	17.398	841.6	0.0217	17.857	845.7	0.0217
15	13.669	961.7	0.0218	17.519	832.3	0.0217	17.975	845.3	0.0217
16	13.641	987.8	0.0217	17.226	816.7	0.0216	17.666	841.3	0.0216
17	12.243	974.8	0.0216	15.323	789.8	0.0216	15.718	828.0	0.0216
18	7.778	874.1	0.0216	9.726	722.4	0.0216	9.989	764.4	0.0216

Node No.	Statepoint 19 (319.0 Cycle 7)			Statepoint 20 (462.3 Cycle 7)			Statepoint 21 (479.0 Cycle 7)		
	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	7.581	777.6	0.0223	8.906	792.0	0.0223	9.079	792.0	0.0223
2	12.558	843.3	0.0223	14.547	857.4	0.0223	14.797	857.4	0.0223
3	15.567	858.6	0.0222	17.804	868.9	0.0222	18.079	868.9	0.0222
4	17.033	854.4	0.0222	19.306	862.1	0.0222	19.581	862.1	0.0222
5	17.663	848.0	0.0221	19.914	854.2	0.0221	20.186	854.2	0.0221
6	17.902	843.1	0.0221	20.126	848.3	0.0221	20.393	848.3	0.0221
7	17.979	840.0	0.0220	20.182	844.5	0.0220	20.447	844.5	0.0220
8	17.996	838.5	0.0220	20.186	842.2	0.0220	20.450	842.2	0.0220
9	17.999	838.1	0.0219	20.185	841.0	0.0220	20.448	841.0	0.0220
10	18.015	838.5	0.0219	20.201	840.3	0.0219	20.465	840.3	0.0219
11	18.053	839.6	0.0219	20.245	840.1	0.0219	20.509	840.1	0.0219
12	18.109	841.4	0.0218	20.313	840.6	0.0218	20.578	840.6	0.0218
13	18.174	843.8	0.0218	20.397	841.7	0.0218	20.664	841.7	0.0218

Table 4.1.8-8 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C8 of Crystal River Unit 3

14	18.268	845.7	0.0217	20.511	842.9	0.0217	20.781	842.9	0.0217
15	18.382	845.3	0.0217	20.631	842.7	0.0217	20.904	842.7	0.0217
16	18.060	841.3	0.0216	20.275	840.3	0.0216	20.546	840.3	0.0216
17	16.074	828.0	0.0216	18.123	830.6	0.0216	18.378	830.6	0.0216
18	10.229	764.4	0.0216	11.652	771.9	0.0216	11.834	771.9	0.0216

Table 4.1.8-9 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C25 of Crystal River Unit 3

	Assembly Number C25								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			1.946	908.8	0.0230	3.080	976.4	0.0231
2	0.0			3.378	1126.2	0.0230	5.222	1162.3	0.0230
3	0.0			4.307	1249.2	0.0229	6.523	1235.8	0.0229
4	0.0	Data not required.		4.783	1302.2	0.0228	7.134	1253.2	0.0228
5	0.0			5.002	1318.3	0.0227	7.390	1252.7	0.0227
6	0.0			5.079	1316.0	0.0226	7.473	1248.2	0.0226
7	0.0			5.072	1304.9	0.0225	7.462	1244.1	0.0225
8	0.0			5.008	1292.0	0.0224	7.392	1240.7	0.0224
9	0.0			4.923	1285.7	0.0223	7.300	1238.7	0.0223
10	0.0			4.869	1292.0	0.0223	7.249	1239.5	0.0223
11	0.0			4.881	1311.0	0.0222	7.280	1243.1	0.0222
12	0.0			4.961	1338.3	0.0221	7.397	1248.3	0.0221
13	0.0			5.080	1365.3	0.0220	7.568	1254.7	0.0220
14	0.0			5.172	1379.8	0.0219	7.712	1260.4	0.0219
15	0.0			5.134	1370.7	0.0218	7.693	1261.5	0.0218
16	0.0			4.829	1324.8	0.0217	7.314	1248.9	0.0217
17	0.0			4.048	1211.7	0.0216	6.241	1194.4	0.0216
18	0.0			2.376	953.5	0.0216	3.754	1001.0	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	4.105	976.4	0.0231	5.680	727.4	0.0224	5.895	802.3	0.0224
2	6.831	1162.3	0.0230	9.498	817.9	0.0224	9.841	890.2	0.0224
3	8.411	1235.8	0.0229	11.812	881.1	0.0223	12.226	929.5	0.0224
4	9.117	1253.2	0.0228	12.952	928.2	0.0223	13.395	938.3	0.0223

Table 4.1.8-9 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C25 of Crystal River Unit 3

5	9.397	1252.7	0.0227	13.478	962.5	0.0222	13.930	935.2	0.0222
6	9.481	1248.2	0.0226	13.694	985.6	0.0222	14.146	929.9	0.0222
7	9.465	1244.1	0.0225	13.743	999.8	0.0221	14.195	926.2	0.0221
8	9.392	1240.7	0.0224	13.692	1006.1	0.0221	14.144	924.9	0.0221
9	9.313	1238.7	0.0223	13.594	1004.0	0.0220	14.046	924.5	0.0220
10	9.291	1239.5	0.0223	13.517	993.3	0.0219	13.970	923.2	0.0220
11	9.357	1243.1	0.0222	13.514	976.6	0.0219	13.968	919.9	0.0219
12	9.500	1248.3	0.0221	13.598	958.4	0.0218	14.054	915.3	0.0219
13	9.674	1254.7	0.0220	13.736	942.5	0.0218	14.197	911.1	0.0218
14	9.787	1260.4	0.0219	13.834	930.1	0.0217	14.300	908.7	0.0218
15	9.702	1261.5	0.0218	13.710	918.8	0.0217	14.179	908.5	0.0217
16	9.216	1248.9	0.0217	13.055	900.3	0.0216	13.516	905.8	0.0217
17	7.914	1194.4	0.0216	11.260	859.9	0.0216	11.677	884.9	0.0216
18	4.828	1001.0	0.0216	6.927	758.9	0.0216	7.203	802.5	0.0216

	Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)			Statepoint 13 (BOC 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 Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5	BOC Cy6	262.1 Cy5	262.1 Cy5
1	6.675	802.3	0.0224	13.608	998.2	0.0231			
2	11.036	890.2	0.0224	21.391	1099.2	0.0231	No additional statepoints.		
3	13.587	929.5	0.0224	25.514	1111.3	0.0230			
4	14.777	938.3	0.0223	27.225	1099.8	0.0229			
5	15.282	935.2	0.0222	27.840	1084.9	0.0228			
6	15.459	929.9	0.0222	27.985	1073.3	0.0227			
7	15.475	926.2	0.0221	27.928	1066.3	0.0226			
8	15.407	924.9	0.0221	27.794	1064.2	0.0225			
9	15.314	924.5	0.0220	27.671	1066.9	0.0224			
10	15.263	923.2	0.0220	27.636	1072.8	0.0223			
11	15.298	919.9	0.0219	27.717	1079.5	0.0222			
12	15.420	915.3	0.0219	27.885	1084.5	0.0221			
13	15.583	911.1	0.0218	28.061	1086.8	0.0220			
14	15.682	908.7	0.0218	28.106	1086.2	0.0219			
15	15.534	908.5	0.0217	27.790	1084.0	0.0218			
16	14.815	905.8	0.0217	26.664	1079.3	0.0217			
17	12.839	884.9	0.0216	23.590	1059.4	0.0217			
18	7.974	802.5	0.0216	15.363	964.4	0.0216			

Table 4.1.8-10 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C25a of Crystal River Unit 3

	Assembly Number C25a								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			1.946	908.8	0.0230	3.080	976.4	0.0231
2	0.0			3.378	1126.2	0.0230	5.222	1162.3	0.0230
3	0.0			4.307	1249.2	0.0229	6.523	1235.8	0.0229
4	0.0	Data not required.		4.783	1302.2	0.0228	7.134	1253.2	0.0228
5	0.0			5.002	1318.3	0.0227	7.390	1252.7	0.0227
6	0.0			5.079	1316.0	0.0226	7.473	1248.2	0.0226
7	0.0			5.072	1304.9	0.0225	7.462	1244.1	0.0225
8	0.0			5.008	1292.0	0.0224	7.392	1240.7	0.0224
9	0.0			4.923	1285.7	0.0223	7.300	1238.7	0.0223
10	0.0			4.869	1292.0	0.0223	7.249	1239.5	0.0223
11	0.0			4.881	1311.0	0.0222	7.280	1243.1	0.0222
12	0.0			4.961	1338.3	0.0221	7.397	1248.3	0.0221
13	0.0			5.080	1365.3	0.0220	7.568	1254.7	0.0220
14	0.0			5.172	1379.8	0.0219	7.712	1260.4	0.0219
15	0.0			5.134	1370.7	0.0218	7.693	1261.5	0.0218
16	0.0			4.829	1324.8	0.0217	7.314	1248.9	0.0217
17	0.0			4.048	1211.7	0.0216	6.241	1194.4	0.0216
18	0.0			2.376	953.5	0.0216	3.754	1001.0	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	4.105	976.4	0.0231	5.680	727.4	0.0224	5.895	802.3	0.0224
2	6.831	1162.3	0.0230	9.498	817.9	0.0224	9.841	890.2	0.0224
3	8.411	1235.8	0.0229	11.812	881.1	0.0223	12.226	929.5	0.0224
4	9.117	1253.2	0.0228	12.952	928.2	0.0223	13.395	938.3	0.0223
5	9.397	1252.7	0.0227	13.478	962.5	0.0222	13.930	935.2	0.0222
6	9.481	1248.2	0.0226	13.694	985.6	0.0222	14.146	929.9	0.0222
7	9.465	1244.1	0.0225	13.743	999.8	0.0221	14.195	926.2	0.0221
8	9.392	1240.7	0.0224	13.692	1006.1	0.0221	14.144	924.9	0.0221
9	9.313	1238.7	0.0223	13.594	1004.0	0.0220	14.046	924.5	0.0220
10	9.291	1239.5	0.0223	13.517	993.3	0.0219	13.970	923.2	0.0220
11	9.357	1243.1	0.0222	13.514	976.6	0.0219	13.968	919.9	0.0219
12	9.500	1248.3	0.0221	13.598	958.4	0.0218	14.054	915.3	0.0219

Table 4.1.8-10 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C25a of Crystal River Unit 3

13	9.674	1254.7	0.0220	13.736	942.5	0.0218	14.197	911.1	0.0218
14	9.787	1260.4	0.0219	13.834	930.1	0.0217	14.300	908.7	0.0218
15	9.702	1261.5	0.0218	13.710	918.8	0.0217	14.179	908.5	0.0217
16	9.216	1248.9	0.0217	13.055	900.3	0.0216	13.516	905.8	0.0217
17	7.914	1194.4	0.0216	11.260	859.9	0.0216	11.677	884.9	0.0216
18	4.828	1001.0	0.0216	6.927	758.9	0.0216	7.203	802.5	0.0216

	Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)			Statepoint 13 (BOC 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 Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5	BOC Cy6	262.1 Cy5	262.1 Cy5
1	6.693	802.3	0.0224	14.661	1045.1	0.0235			
2	11.066	890.2	0.0224	22.943	1154.0	0.0234	No additional statepoints.		
3	13.627	929.5	0.0224	27.383	1179.9	0.0232			
4	14.823	938.3	0.0223	29.291	1174.8	0.0231			
5	15.333	935.2	0.0222	30.011	1161.5	0.0230			
6	15.512	929.9	0.0222	30.171	1148.3	0.0229			
7	15.529	926.2	0.0221	30.035	1136.7	0.0228			
8	15.461	924.9	0.0221	29.728	1128.8	0.0226			
9	15.367	924.5	0.0220	29.410	1128.4	0.0225			
10	15.315	923.2	0.0220	29.260	1135.9	0.0224			
11	15.350	919.9	0.0219	29.366	1148.4	0.0223			
12	15.472	915.3	0.0219	29.702	1163.3	0.0222			
13	15.635	911.1	0.0218	30.141	1176.0	0.0221			
14	15.736	908.7	0.0218	30.425	1180.8	0.0220			
15	15.589	908.5	0.0217	30.212	1178.2	0.0219			
16	14.867	905.8	0.0217	29.015	1169.3	0.0218			
17	12.885	884.9	0.0216	25.701	1139.9	0.0217			
18	8.004	802.5	0.0216	16.854	1031.9	0.0216			

Table 4.1.8-11 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C27 of Crystal River Unit 3

	Assembly Number C27								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			2.215	970.2	0.0234	3.541	1041.7	0.0234
2	0.0			3.938	1236.7	0.0234	6.140	1256.0	0.0233
3	0.0			5.181	1390.6	0.0233	7.858	1339.7	0.0232

Table 4.1.8-11 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C27 of Crystal River Unit 3

4	0.0	Data not required.		5.850	1455.8	0.0231	8.690	1355.3	0.0231
5	0.0			6.166	1473.7	0.0230	9.044	1351.0	0.0230
6	0.0			6.284	1469.7	0.0229	9.165	1344.1	0.0229
7	0.0			6.286	1456.1	0.0228	9.162	1338.9	0.0227
8	0.0			6.215	1441.4	0.0227	9.085	1335.3	0.0226
9	0.0			6.121	1435.4	0.0225	8.985	1333.6	0.0225
10	0.0			6.064	1444.7	0.0224	8.936	1335.3	0.0224
11	0.0			6.090	1469.7	0.0223	8.987	1339.7	0.0223
12	0.0			6.195	1504.4	0.0222	9.136	1345.5	0.0222
13	0.0			6.342	1537.4	0.0221	9.341	1351.7	0.0221
14	0.0			6.447	1552.9	0.0220	9.500	1356.9	0.0220
15	0.0			6.386	1540.5	0.0219	9.454	1357.3	0.0219
16	0.0			6.004	1485.2	0.0218	8.988	1344.4	0.0218
17	0.0			5.055	1353.7	0.0217	7.707	1288.9	0.0217
18	0.0			2.999	1055.2	0.0216	4.693	1086.9	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	4.815	1041.7	0.0234	8.304	920.5	0.0236	8.757	1039.3	0.0234
2	8.099	1256.0	0.0233	13.712	1069.8	0.0236	14.400	1179.8	0.0234
3	10.113	1339.7	0.0232	17.207	1176.4	0.0235	18.033	1230.2	0.0232
4	11.021	1355.3	0.0231	19.047	1277.0	0.0234	19.932	1228.1	0.0231
5	11.380	1351.0	0.0230	19.927	1350.8	0.0232	20.827	1212.3	0.0230
6	11.487	1344.1	0.0229	20.331	1400.6	0.0231	21.231	1197.2	0.0229
7	11.468	1338.9	0.0227	20.517	1437.1	0.0229	21.414	1186.4	0.0227
8	11.384	1335.3	0.0226	20.593	1461.5	0.0228	21.491	1180.4	0.0226
9	11.298	1333.6	0.0225	20.614	1473.5	0.0226	21.515	1177.3	0.0225
10	11.285	1335.3	0.0224	20.617	1470.4	0.0225	21.522	1174.1	0.0224
11	11.381	1339.7	0.0223	20.631	1450.8	0.0224	21.537	1168.9	0.0223
12	11.569	1345.5	0.0222	20.666	1417.2	0.0222	21.573	1162.4	0.0222
13	11.784	1351.7	0.0221	20.719	1376.6	0.0221	21.629	1156.8	0.0221
14	11.915	1356.9	0.0220	20.748	1341.7	0.0220	21.665	1155.9	0.0220
15	11.804	1357.3	0.0219	20.608	1318.1	0.0219	21.538	1162.2	0.0219
16	11.226	1344.4	0.0218	19.905	1297.4	0.0218	20.840	1169.8	0.0218
17	9.697	1288.9	0.0217	17.655	1243.8	0.0217	18.539	1161.1	0.0217
18	5.994	1086.9	0.0216	11.381	1069.6	0.0216	12.011	1050.8	0.0216

Table 4.1.8-12 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C27a of Crystal River Unit 3

	Assembly Number C27a								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			2.215	970.2	0.0234	3.541	1041.7	0.0234
2	0.0			3.938	1236.7	0.0234	6.140	1256.0	0.0233
3	0.0			5.181	1390.6	0.0233	7.858	1339.7	0.0232
4	0.0	Data not required.		5.850	1455.8	0.0231	8.690	1355.3	0.0231
5	0.0			6.166	1473.7	0.0230	9.044	1351.0	0.0230
6	0.0			6.284	1469.7	0.0229	9.165	1344.1	0.0229
7	0.0			6.286	1456.1	0.0228	9.162	1338.9	0.0227
8	0.0			6.215	1441.4	0.0227	9.085	1335.3	0.0226
9	0.0			6.121	1435.4	0.0225	8.985	1333.6	0.0225
10	0.0			6.064	1444.7	0.0224	8.936	1335.3	0.0224
11	0.0			6.090	1469.7	0.0223	8.987	1339.7	0.0223
12	0.0			6.195	1504.4	0.0222	9.136	1345.5	0.0222
13	0.0			6.342	1537.4	0.0221	9.341	1351.7	0.0221
14	0.0			6.447	1552.9	0.0220	9.500	1356.9	0.0220
15	0.0			6.386	1540.5	0.0219	9.454	1357.3	0.0219
16	0.0			6.004	1485.2	0.0218	8.988	1344.4	0.0218
17	0.0			5.055	1353.7	0.0217	7.707	1288.9	0.0217
18	0.0			2.999	1055.2	0.0216	4.693	1086.9	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	4.793	1041.7	0.0234	8.343	927.0	0.0237	8.805	1046.0	0.0235
2	8.056	1256.0	0.0233	13.784	1081.5	0.0236	14.489	1188.6	0.0234
3	10.051	1339.7	0.0232	17.266	1190.4	0.0235	18.107	1236.6	0.0233
4	10.947	1355.3	0.0231	19.091	1288.4	0.0234	19.989	1235.6	0.0232
5	11.299	1351.0	0.0230	19.975	1362.6	0.0233	20.889	1221.3	0.0230
6	11.401	1344.1	0.0229	20.387	1413.9	0.0231	21.301	1206.3	0.0229
7	11.380	1338.9	0.0227	20.580	1451.4	0.0230	21.492	1195.9	0.0228
8	11.295	1335.3	0.0226	20.666	1475.6	0.0228	21.580	1190.6	0.0227
9	11.207	1333.6	0.0225	20.695	1488.6	0.0227	21.613	1188.2	0.0225
10	11.192	1335.3	0.0224	20.702	1485.6	0.0225	21.624	1185.4	0.0224
11	11.287	1339.7	0.0223	20.713	1465.2	0.0224	21.638	1180.4	0.0223
12	11.473	1345.5	0.0222	20.745	1431.9	0.0222	21.672	1173.8	0.0222

Table 4.1.8-12 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C27a of Crystal River Unit 3

13	11.687	1351.7	0.0221	20.798	1390.3	0.0221	21.727	1168.2	0.0221
14	11.816	1356.9	0.0220	20.840	1354.7	0.0220	21.778	1168.1	0.0220
15	11.704	1357.3	0.0219	20.757	1332.7	0.0219	21.714	1178.2	0.0219
16	11.128	1344.4	0.0218	20.149	1317.4	0.0218	21.122	1191.8	0.0218
17	9.612	1288.9	0.0217	17.941	1270.2	0.0217	18.864	1182.9	0.0217
18	5.943	1086.9	0.0216	11.589	1091.1	0.0216	12.247	1068.9	0.0216

Table 4.1.8-13 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C28 of Crystal River Unit 3

	Assembly Number C28								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			1.265	791.1	0.0225	2.034	851.1	0.0226
2	0.0			2.254	948.3	0.0225	3.543	1004.5	0.0226
3	0.0			2.936	1047.1	0.0225	4.513	1073.8	0.0225
4	0.0	Data not required.		3.306	1092.7	0.0224	4.994	1092.8	0.0224
5	0.0			3.482	1107.8	0.0223	5.202	1094.2	0.0224
6	0.0			3.548	1107.5	0.0223	5.272	1091.1	0.0223
7	0.0			3.550	1100.6	0.0222	5.272	1087.9	0.0222
8	0.0			3.515	1092.7	0.0221	5.234	1085.5	0.0222
9	0.0			3.470	1089.5	0.0221	5.187	1084.5	0.0221
10	0.0			3.442	1094.5	0.0220	5.164	1085.3	0.0220
11	0.0			3.451	1107.6	0.0220	5.187	1087.9	0.0220
12	0.0			3.497	1125.5	0.0219	5.255	1091.5	0.0219
13	0.0			3.559	1142.0	0.0218	5.345	1095.2	0.0219
14	0.0			3.593	1149.1	0.0218	5.403	1097.8	0.0218
15	0.0			3.535	1138.5	0.0217	5.344	1096.1	0.0217
16	0.0			3.292	1099.5	0.0217	5.034	1081.7	0.0217
17	0.0			2.723	1009.1	0.0216	4.239	1029.9	0.0216
18	0.0			1.567	819.8	0.0216	2.497	867.2	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	2.747	851.1	0.0226	4.528	755.3	0.0224	4.776	840.9	0.0226
2	4.685	1004.5	0.0226	7.652	865.7	0.0224	8.043	947.4	0.0225
3	5.862	1073.8	0.0225	9.545	934.1	0.0224	10.007	985.5	0.0225

Table 4.1.8-13 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C28 of Crystal River Unit 3

4	6.408	1092.8	0.0224	10.460	975.3	0.0223	10.948	992.4	0.0224
5	6.628	1094.2	0.0224	10.877	1002.3	0.0223	11.371	989.6	0.0223
6	6.695	1091.1	0.0223	11.053	1021.0	0.0222	11.548	985.0	0.0223
7	6.689	1087.9	0.0222	11.107	1033.3	0.0221	11.601	981.8	0.0222
8	6.650	1085.5	0.0222	11.092	1039.1	0.0221	11.587	980.4	0.0222
9	6.612	1084.5	0.0221	11.043	1037.2	0.0220	11.539	980.0	0.0221
10	6.608	1085.3	0.0220	10.998	1027.6	0.0220	11.495	979.0	0.0220
11	6.652	1087.9	0.0220	10.987	1012.4	0.0219	11.487	976.6	0.0220
12	6.736	1091.5	0.0219	11.025	995.3	0.0218	11.528	973.6	0.0219
13	6.826	1095.2	0.0219	11.099	980.3	0.0218	11.608	972.1	0.0219
14	6.864	1097.8	0.0218	11.170	969.2	0.0217	11.689	975.5	0.0218
15	6.763	1096.1	0.0217	11.150	962.3	0.0217	11.685	987.5	0.0218
16	6.376	1081.7	0.0217	10.775	954.7	0.0216	11.322	1000.2	0.0217
17	5.408	1029.9	0.0216	9.395	922.4	0.0216	9.906	983.9	0.0216
18	3.230	867.2	0.0216	5.778	800.2	0.0216	6.119	876.5	0.0216

	Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)			Statepoint 13 (BOC 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 Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5	BOC Cy6	262.1 Cy5	262.1 Cy5
1	5.656	840.9	0.0226	12.247	989.1	0.0232			
2	9.445	947.4	0.0225	19.518	1106.1	0.0231	No additional statepoints.		
3	11.711	985.5	0.0225	23.552	1131.9	0.0230			
4	12.779	992.4	0.0224	25.341	1128.9	0.0229			
5	13.235	989.6	0.0223	26.035	1118.2	0.0228			
6	13.405	985.0	0.0223	26.208	1106.3	0.0227			
7	13.447	981.8	0.0222	26.088	1093.6	0.0226			
8	13.430	980.4	0.0222	25.777	1081.9	0.0225			
9	13.400	980.0	0.0221	25.441	1078.2	0.0224			
10	13.390	979.0	0.0220	25.291	1084.3	0.0223			
11	13.424	976.6	0.0220	25.401	1097.2	0.0222			
12	13.499	973.6	0.0219	25.748	1115.5	0.0221			
13	13.589	972.1	0.0219	26.226	1134.5	0.0220			
14	13.646	975.5	0.0218	26.571	1142.1	0.0219			
15	13.584	987.5	0.0218	26.478	1138.3	0.0218			
16	13.118	1000.2	0.0217	25.522	1125.7	0.0217			
17	11.492	983.9	0.0216	22.587	1095.1	0.0217			
18	7.162	876.5	0.0216	14.645	980.1	0.0216			

Table 4.1.8-14 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C29 of Crystal River Unit 3

	Assembly Number C29								
	Statepoint 5 (BOC Cycle 3)			Statepoint 6 (168.5 Cycle 3)			Statepoint 7 (250.0 Cycle 3)		
Node No.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.	Burnup (GWd/MTU)	Fuel Temp.	Moderator Spec. Vol.
	BOC Cy3			168.5 Cy3	85.0 Cy3	85.0 Cy3	250.0 Cy3	246.4 Cy3	246.4 Cy3
1	0.0			1.370	816.1	0.0227	2.221	881.2	0.0228
2	0.0			2.487	997.2	0.0227	3.932	1053.5	0.0227
3	0.0			3.306	1113.7	0.0226	5.090	1130.0	0.0226
4	0.0	Data not required.		3.766	1166.7	0.0225	5.678	1148.9	0.0226
5	0.0			3.988	1182.7	0.0225	5.934	1149.0	0.0225
6	0.0			4.073	1182.2	0.0224	6.023	1145.0	0.0224
7	0.0			4.080	1174.8	0.0223	6.029	1141.4	0.0223
8	0.0			4.045	1166.9	0.0222	5.991	1139.1	0.0223
9	0.0			3.998	1164.0	0.0222	5.944	1138.4	0.0222
10	0.0			3.970	1169.9	0.0221	5.923	1139.5	0.0221
11	0.0			3.983	1184.5	0.0220	5.952	1142.2	0.0220
12	0.0			4.036	1204.2	0.0220	6.029	1145.7	0.0220
13	0.0			4.104	1222.0	0.0219	6.127	1149.0	0.0219
14	0.0			4.139	1229.2	0.0218	6.186	1151.2	0.0218
15	0.0			4.068	1217.1	0.0217	6.113	1149.3	0.0218
16	0.0			3.788	1174.2	0.0217	5.758	1134.9	0.0217
17	0.0			3.137	1074.3	0.0216	4.857	1082.7	0.0216
18	0.0			1.810	860.3	0.0216	2.872	907.5	0.0216

	Statepoint 8 (BOC Cycle 4)			Statepoint 9 (228.1 Cycle 4)			Statepoint 10 (253.0 Cycle 4)		
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 Cy4	246.4 Cy3	246.4 Cy3	228.1 Cy4	40.7 Cy4	40.7 Cy4	253.0 Cy4	253.0 Cy4	253.0 Cy4
1	3.038	881.2	0.0228	4.719	741.7	0.0225	4.949	831.9	0.0226
2	5.232	1053.5	0.0227	8.143	848.3	0.0225	8.518	944.1	0.0225
3	6.612	1130.0	0.0226	10.446	932.3	0.0225	10.912	993.1	0.0225
4	7.262	1148.9	0.0226	11.690	1000.6	0.0224	12.200	1007.3	0.0224
5	7.525	1149.0	0.0225	12.286	1050.3	0.0224	12.809	1003.8	0.0224
6	7.606	1145.0	0.0224	12.540	1081.3	0.0223	13.065	997.4	0.0223
7	7.603	1141.4	0.0223	12.625	1099.4	0.0222	13.150	993.0	0.0222
8	7.565	1139.1	0.0223	12.622	1107.9	0.0222	13.147	991.4	0.0222
9	7.528	1138.4	0.0222	12.574	1106.4	0.0221	13.101	991.1	0.0221
10	7.529	1139.5	0.0221	12.522	1094.9	0.0220	13.051	990.1	0.0220
11	7.582	1142.2	0.0220	12.503	1076.2	0.0219	13.033	987.1	0.0220
12	7.677	1145.7	0.0220	12.531	1055.4	0.0219	13.066	982.6	0.0219

Table 4.1.8-14 Burnup, Fuel Temperature, and Moderator Specific Volume Data for Assembly C29 of Crystal River Unit 3

13	7.775	1149.0	0.0219	12.588	1036.5	0.0218	13.127	978.4	0.0219
14	7.813	1151.2	0.0218	12.602	1021.6	0.0218	13.148	976.2	0.0218
15	7.696	1149.3	0.0218	12.432	1007.4	0.0217	12.981	976.0	0.0217
16	7.261	1134.9	0.0217	11.793	983.9	0.0217	12.332	972.3	0.0217
17	6.173	1082.7	0.0216	10.124	933.4	0.0216	10.612	946.4	0.0216
18	3.702	907.5	0.0216	6.183	803.1	0.0216	6.506	849.8	0.0216

	Statepoint 11 (BOC Cycle 5)			Statepoint 12 (388.5 Cycle 5)			Statepoint 13 (BOC 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 Cy5	253.0 Cy4	253.0 Cy4	388.5 Cy5	262.1 Cy5	262.1 Cy5	BOC Cy6	262.1 Cy5	262.1 Cy5
1	5.877	831.9	0.0226	14.058	1064.7	0.0235			
2	9.948	944.1	0.0225	22.121	1183.0	0.0235	No additional statepoints.		
3	12.545	993.1	0.0225	26.634	1208.3	0.0233			
4	13.853	1007.3	0.0224	28.677	1203.7	0.0232			
5	14.424	1003.8	0.0224	29.476	1190.6	0.0231			
6	14.633	997.4	0.0223	29.680	1177.3	0.0229			
7	14.680	993.0	0.0222	29.581	1165.5	0.0228			
8	14.658	991.4	0.0222	29.322	1157.2	0.0227			
9	14.617	991.1	0.0221	29.058	1156.4	0.0226			
10	14.597	990.1	0.0220	28.948	1164.0	0.0225			
11	14.623	987.1	0.0220	29.065	1177.4	0.0224			
12	14.698	982.6	0.0219	29.384	1193.8	0.0222			
13	14.785	978.4	0.0219	29.781	1208.5	0.0221			
14	14.805	976.2	0.0218	30.012	1215.0	0.0220			
15	14.611	976.0	0.0217	29.758	1213.2	0.0219			
16	13.898	972.3	0.0217	28.543	1203.0	0.0218			
17	12.015	946.4	0.0216	25.282	1169.7	0.0217			
18	7.438	849.8	0.0216	16.623	1054.1	0.0216			

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. Upper-level systems requirements are provided in the Mined Geologic Repository System Requirements Document (MGDSRD, Ref. 5.7). The requirements flow down to the Engineered Barrier Design Requirements Document (EBDRD, Ref. 5.8) as specific requirements for engineered barrier segment design and the Repository Design Requirements Document (RDRD, Ref. 5.9) as specific 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.

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 Evalutation.* 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 *Mined Geologic Repository System Requirements Document.* DOE/RW-0404P, DI#: B00000000-00811-1708-00002 REV 02, DCN 02, U. S. DOE Office of Civilian Radioactive Waste Management (OCRWM).

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

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

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

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

5.12* CRC Depletion Calculations for the Non-Rodded Assemblies in Batches 4 and 5 of Crystal River Unit 3 (DI#: BBA000000-01717-0200-00033 REV 00) - Attachments XXXI and XXXII - 2 Data Cartridges + Special Instruction Sheet. Batch Number: MOY-970724-07

5.13* Attachments for BBA000000-01717-0200-00033 REV 00 - CRC Depletion Calculations for the Non-Rodded Assemblies in Batches 4 and 5 of Crystal River Unit 3. Batch Number: MOY-970724-08 .

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

• These references are submitted with this analyis records package.

6. Use of Computer Software

6.1 Scientific and Engineering Software

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

A software routine entitled "Commercial Reactor Assembly Follow Taskmaster" (CRAFT) was written to automate the production of SAS2H input decks as required to support fuel assembly depletion calculations relevant to CRC evaluations. The CRAFT code does not generate data. All calculations performed by the CRAFT code are verified by visual inspection and/or hand calculations. The CRAFT code, Version 1.0, compiled on December 16, 1996, was utilized in this analysis to orchestrate the depletion calculations for the fuel assemblies with following identifiers-- B15, B20a, B20b1, B20b2, B21a. The CRAFT code, Version 2.0, compiled on January 13, 1997, was utilized in this analysis to orchestrate the depletion calculations for the fuel assemblies with following identifiers-- B20b3, B28a, C8, C25, C25a, C27, C27a, C28, and C29. The CRAFT 1.0 source code ("CRAFT.f.V-1.compiled_on_12_16_96") and executable file ("CRAFT1.0") exist in the directory "/users/wright/CRAFT_V1" on the Waste Package Development Department (WPDD) HP 9000 series workstation designated "Opus". The CRAFT 2.0 source code ("CRAFT.f.V-2.compiled_on_01_13_97") and executable file ("CRAFT2.0") exist in the directory "/users/wright/CRAFT_V2" 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 1.0, 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. Complete documentation of the CRAFT code, Version 2.0, including descriptions of the code modification made between Version 1.0 and Version 2.0, and the user information is included in Attachment I of this analysis. The CRAFT 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. 5.14).

A software routine entitled "CRC_DATA_TABULIZER" was written to automate the production of tables containing the isotopic results and other pertinent data for a set of 29 principal isotopes at each CRC statepoint for each assembly. The CRC_DATA_TABULIZER code does not generate data. All calculations performed by the CRC_DATA_TABULIZER code are verified by visual inspection and/or hand calculations. The CRC_DATA_TABULIZER code, Version 2.0, compiled on March 20, 1997, was utilized to tabulate the principal isotope results for each fuel assembly at each CRC statepoint. The CRC_DATA_TABULIZER, Version 2.0, source code (CRC_DATA_TABULIZER_V2.f) and executable file (CRC_DATA_TABULIZER_V2.exe) exist in the directory "/users/wright/CRC_DATA_TABULIZER" on the WPDD HP 9000 series workstation designated "Opus". The CRC_DATA_TABULIZER code is subject to the requirements of the QARD as defined by Section I.2.1 Part C of Supplement I Rev. 1 of the QARD. Complete documentation of the CRC_DATA_TABULIZER code including code description, user information, and documentation that the software provides correct results for a specified range of input parameters is presented in Attachment V of reference 5.11. 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. 5.14).

6.2 Computational Support Software

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

7. Design Analysis

This design analysis documents the fuel assembly SAS2H depletion calculations for the non-rodded assemblies of fuel batches 4 and 5 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 this analysis is essential for understanding the SAS2H modeling techniques employed in this analysis. The information in Attachment I, the input parameters in Section 4.1, and the CRAFT input decks in Attachment III through XVI 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 either the CRAFT Version 1.0 code or the CRAFT Version 2.0 code. CRAFT Versions 1.0 and 2.0 are identical with the exception of one line of code. The CRAFT Version 2.0 modification is documented in Attachment I of this analysis. The CRAFT code is described

generally in Sections 7.4 and 7.5. The complete detailed description of the CRAFT Version 2.0 code is provided in Attachment I of this analysis. The complete source code listing of CRAFT Version 2.0 is presented in Attachment II of this analysis. The procedure for performing a fuel assembly depletion calculation with either CRAFT Version 1.0 or 2.0 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 on page 76 of Attachment I. Specific isotopic results contained in the various consolidated output files generated by CRAFT may be retrieved using the output filename information.

7.2 Path B Unit Cell Model Development

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

The Path A unit cell model is simply a unit cell of the fuel assembly lattice containing a fuel rod. In the Path A model, the fuel pellet, gap, and clad are modeled explicitly. The only modification required to develop the Path A model is the conversion of the fuel assembly 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 4 and 5 of Crystal River Unit 3 either one, two, or three Path B unit cell models are required. The first Path B unit cell model represents a cross-section of the fuel assembly containing water-filled guide tubes and one water-filled instrument tube. The second Path B unit cell model represents a cross-section of the fuel assembly containing the absorbing region of a 16 rod BPRA and one water-filled instrument tube. The third Path B unit cell model represents a cross-section of the fuel assembly containing the non-absorbing region of a 16 rod BPRA and one water-filled instrument tube. The non-absorbing region of a BPRA is the region above the neutron absorber Al_2O_3-B_4C. The BPR's in this non-absorbing region contain Al_2O_3. Not all assemblies require all of these Path B unit cell models. If no BPRA is inserted in the fuel assembly at a given time, the first Path B unit cell model is employed. If a BPRA is inserted in the fuel assembly at a given time and the axial region of the fuel assembly represented in the SAS2H calculation contains the absorbing region of the BPRA, the second

Path B model is employed. If a BPRA is inserted in the fuel assembly at a given time and the axial region of the fuel assembly represented in the SAS2H calculation contains the non-absorbing region of the BPRA, the third Path B model is employed.

The fuel pellet diameter is different between fuel assemblies in batches 4 and 5. The fuel pellet diameter dimension is the only different input parameter between batches 4 and 5, that is required for development of the various Path B unit cell models. The set of input parameters required to develop the various Path B models depends on whether or not a BPRA is present in the assembly region that is being modeled. The fuel pellet diameter difference ultimately does not effect the Path B model structure as demonstrated in the equations presented in Table 7.2-3. Note that in Equation 5, of Table 7.2-3, the fuel pellet unit volumes present in both the numerator and denominator cancel one another. Even though the final Path B model structure is the same regardless of fuel pellet diameter specified, for demonstrative purposes, three different Path B unit cell model development spreadsheets (Excel 5.0) are presented to describe fuel batches 4 and 5. One batch 4 fuel assembly (B28a) depletion requires a Path B model to support BPRA insertion. None of the batch 5 fuel assembly depletions documented in this analysis require a Path B model to support BPRA insertion. The Path B development spreadsheets in Tables 7.2-1 through 7.2-3, 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 in a SAS2H input deck. The spreadsheet presented in Table 7.2-1, calculates the dimensions of the Path B unit cell model with no BPRA inserted for use in batch 4 depletion calculations. The spreadsheet presented in Table 7.2-2, calculates the dimensions of the Path B unit cell model with a BPRA inserted for use in batch 4 depletion calculations. Additional Path B unit cell model material structures are presented in Table 7.2-2, to described the Path B models for non-absorbing BPRA insertions and for BPRA removal within a SAS2H calculation. The spreadsheet presented in Table 7.2-3, calculates the dimensions of the Path B unit cell model with no BPRA inserted for use in batch 5 depletion calculations. Table 7.2-4, contains a listing of the equations referenced and utilized in each of the spreadsheets presented in Tables 7.2-1 through 7.2-3.

Table 7.2-1 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 4 of Crystal River Unit 3 that do not have a BPRA Inserted

SAS2H Path B Unit Cell Model Dimension Calculations for the Non-Rodded Fuel Assemblies in Fuel Batch 4 of Crystal River Unit 3 that do not have aBPRA 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
Rod pitch in assembly (cm):	1.44272
Fuel pellet diameter (cm):	0.939038
Fuel cladding outer diameter (cm):	1.0922

Table 7.2-1 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 4 of Crystal River Unit 3 that do not have a BPRA Inserted

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 7.2-4)

Fuel-to-Moderator Volume Ratio = 0.532999

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

Identifier of Equation(s) Utilized: 2 (Table 7.2-4)

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 7.2-4)

Fuel Unit Volume in Fuel Rod Unit Cell = 0.692558

Moderator Unit Volume in Fuel Rod Unit Cell:

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

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 7.2-4)

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

Table 7.2-1 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 4 of Crystal River Unit 3 that do not have a BPRA Inserted

Path B Unit Cell Model Dimensions:

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

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

Table 7.2-2 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 4 of Crystal River Unit 3 that have a BPRA Inserted

SAS2H Path B Unit Cell Model Dimension Calculations for Non-Rodded Fuel Assemblies Containing 16 Rod Non-Annular BPRA's in Fuel Batch 4 of Crystal River Unit 3

Input Parameters

Number of unit cells in assembly:	225
Number of fuel rods in assembly:	208
Number of guide tubes in assembly:	16
Number of BPR's in assembly:	16
Rod pitch in assembly (cm):	1.44272
Fuel pellet diameter (cm):	0.939038
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

Table 7.2-2 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 4 of Crystal River Unit 3 that have a BPRA Inserted

Fuel-to-Moderator Volume Ratio Calculation:

Identifier of Equation(s) Utilized: 1 (Table 7.2-4)

Fuel-to-Moderator Volume Ratio = 0.564298

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

Identifier of Equation(s) Utilized: 2 (Table 7.2-4)

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 7.2-4)

Fuel Unit Volume in Fuel Rod Unit Cell = 0.692558

Moderator Unit Volume in Fuel Rod Unit Cell:

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

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 7.2-4)

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 Descriptions	
Zone #	Outer Radius (cm)	With Absorbing BPRA Inserted	With Non-Absorbing BPRA Inserted

Table 7.2-2 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 4 of Crystal River Unit 3 that have a BPRA Inserted

Inner	1	0.43180	Absorbing BP Material	Non-Absorbing BP Material
	2	0.45720	Helium Gap	Helium Gap
	3	0.54610	BPR cladding	BPR cladding
	4	0.63246	Water Filled Gap	Water Filled Gap
	5	0.67310	Guide tube	Guide tube
	6	0.81397	Unit cell moderator	Unit cell moderator
	7	2.91402	Homogenized region	Homogenized region
Outer	8	2.93693	Moderator Outside Assembly	Moderator Outside Assembly

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

The Path B model that is used after the removal of the BPRA during a statepoint depletion calculation must use the same number of radial zones as the Path B model with the BPRA inserted. One difference between the Path B model with the BPRA removed and the Path B model with the BPRA inserted is that the materials in zones 1 through 3 are changed to water. Another difference is that the outer radius of zones 7 and 8 are adjusted to match the homogenized region and outer water region dimensions of the base Path B model (the Path B model with all empty guide tubes). Typically, a BPRA is not moved or removed during a reactor cycle. In this analysis there is no instance when a BPRA would need to be removed from an assembly axial node during a statepoint calculation. For this reason, the Path B model for the assembly node after removal of a BPRA during a statepoint calculation is not used in any of the assembly depletion calculations documented in this analysis. This dimensions of zones 7 and 8 for the Path B model representing the removal of the BPRA during a statepoint calculation are specified incorrectly in the CRAFT input decks for the assembly depletion calculations which are documented in this analysis. The fact that the Path B model representing the removal of a BPRA during a statepoint calculation is never used in any of the calculations of this analysis allows all of the results generated in this analysis to remain unaffected.

Table 7.2-3 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 5 of Crystal River Unit 3 that do not have a BPRA Inserted

SAS2H Path B Unit Cell Model Dimension Calculations for the Non-Rodded Fuel Assemblies in Fuel Batch 5 of Crystal River Unit 3 that do not have aBPRA Insertion History

Input Parameters

Table 7.2-3 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 5 of Crystal River Unit 3 that do not have a BPRA Inserted

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 7.2-4)

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 7.2-4)

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 7.2-4)

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 7.2-4)

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 7.2-4)

Table 7.2-3 Path B Unit Cell Model Dimension Calculation Spreadsheet for the Non-Rodded Assembly Regions from Fuel Batch 5 of Crystal River Unit 3 that do not have a BPRA Inserted

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

Path B Unit Cell Model Dimensions:

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

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

Table 7.2-3 Equations Utilized in the Path B Model Dimension Calculation Spreadsheets Presented in Tables 7.2-1 and 7.2-3

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

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

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

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

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

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.

Equation 2 (Central Unit Cell Moderator Volume):

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

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

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

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

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

Base equation from which Equation 5 is derived:

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

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

Equation 5:

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

Base equations from which Equations 6 and 7 are derived:

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

$$\updownarrow$$

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

where IR means the inner radius of the annular region.

Equation 6:

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

Equation 7:

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

7.3 Cycle Irradiation History Layouts for the Depletion of Non-Rodded Assemblies

The depletion layout for a given reactor cycle in the SAS2H calculations of this analysis does not change from one assembly depletion calculation to another. This is due to the fact that non-rodded assemblies may only contain BPRA's which are not moved during a reactor cycle's operation. Therefore, detailed intra-cycle variable time steps are not required to accurately follow the characteristics of a given fuel assembly axial node during each reactor cycle of irradiation. 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 calculation interval, or the continuous irradiation time required to go from one CRC statepoint to another. 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. Two primary requirements apply to determining an appropriate reactor cycle irradiation layout:

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.

Tables 7.3-1 through 7.3-6 contain the cycle irradiation history layouts required to perform the SAS2H depletion calculations included in this analysis. The mid-step boron concentrations are obtained by using linear interpolation within the data presented in Tables 4.1.7-1 through 4.1.7-6. 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. The acronym "ppmb" in the following tables means parts per million of boron by mass of moderator.

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

Cycle-2

BOC to EOC

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

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

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

Cycle-3

BOC to Stpt2 (168.5 EFPD)

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

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

Stpt2 (168.5 EFPD) to Stpt3 (250.0 EFPD)

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

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

Stpt3 (250.0 EFPD) to EOC (323.0 EFPD)

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

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

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

Cycle-4

BOC to Stpt2 (228.1 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	787.34	38.12
2	625.59	114.35
3	373.77	190.58

Stpt2 (228.1 EFPD) to Stpt3 (253.0 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	218.65	240.55

Stpt3 (253.0 EFPD) to EOC (336.6 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	225.91	273.90
2	105.94	315.70

Table 7.3-4 Crystal River Unit 3 Cycle-5 Irradiation History Layout for Non-Rodded Assemblies

Cycle-5

BOC to Stpt2 (388.5 EFPD)

5 : Number of Irradiation Steps
77.7 : Length of Each Irradiation Step (EFPD)

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	1050.61	38.85
2	835.81	116.55
3	641.59	194.25
4	427.28	271.95
5	225.73	349.65

Stpt2 (388.5 EFPD) to EOC (484.4 EFPD)

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

Step Number	Mid-Step ppmb	Mid-Step EFPD
1	92.03	412.48
2	2.35	460.43

Table 7.3-5 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 7.3-6 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

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

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

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

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

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

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

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

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

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

- 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 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 statepoint 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. Instructions on how to develop CRAFT input decks and execute CRAFT calculations are also provided in Attachment I. This attachment also discusses specific modeling procedures and details relevant to the SAS2H fuel assembly depletion calculations which are generated by CRAFT.

7.5 Input & Output Filename Descriptions for CRAFT and SAS2H

The CRAFT code generates five types of files identified as either "*.input", "*.output", "*.cut", "*.msgs", or "*.notes", where the "*" is the base file set identifier for the statepoint calculation of

interest. The "*.cut" and "*.notes" files are the only files that must be retained for CRC evaluation and documentation purposes. All files are generated in the working directory in which the CRAFT calculation is performed.

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

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

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

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

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

7.6 Non-Rodded Assembly Depletion Calculations for Fuel Batches 4 and 5 of Crystal River Unit 3

Depletion calculations for 14 non-rodded fuel assemblies from fuel batches 4 and 5 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 Cycle-2, -3, -4, -5, -6, and -7 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 Non-Rodded Assembly Depletion Calculations from Fuel Batches 4 and 5 of Crystal River Unit 3

Crystal River Unit 3 Reactor Cycle	CRC Statepoint EFPD Values
2	0.0 (BOC)
3	0.0 (BOC)
3	168.5
3	250.0
4	0.0 (BOC)
4	228.1
4	253.0
5	0.0 (BOC)
5	388.5
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

CRAFT input decks for each of the fuel assemblies identified in Tables 4.1.4-1 and 4.1.5-1 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, and Sections 5 and 7 of Attachment I of this analysis for CRAFT Versions 1.0 and 2.0, respectively. SAS2H modeling features incorporated in the depletion calculations of this analysis are described in Attachment I of reference

5.11, and Attachment I of this analysis. The CRAFT input decks for the assembly depletions documented in this analysis are provided in Attachments III through XVI, as documented in Section 9.

After the CRAFT calculations were completed for the non-rodded assemblies documented in this analysis, it was realized that the 12.333 days of downtime, during the 250.0 EFPD shutdown of Cycle-3, had been specified as 13.333 days in the CRAFT input decks for all of the assemblies analyzed in this analysis. The CRAFT calculations which used the 13.333 day downtime were not redone. The one additional day of specified downtime does not significantly affect the isotopic composition of either the fuel or the burnable poison.

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 BPR region in each guide tube
- Fuel assembly axial node (top node) containing a non-absorbing BPR region in each guide tube

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 six 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. Each section of these example 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
```

Attachment XXXI contains a listing of the CRAFT generated consolidated SAS2H output files for the depletion calculations documented in this analysis. The files referred to by Attachment XXXI are contained on magnetic media identified by reference 5.12. The consolidated output files contain the following information:

- time/date stamp for when the SAS2H depletion calculation was performed,

- echo of the SAS2H input deck generated by CRAFT,
- the output extraction of information pertinent to CRC evaluations from the final ORIGEN-S calculation of the SAS2H depletion calculation.

7.7 Isotopic Results

Isotopic results for the set of 29 principal isotopes identified in Table 7.7-1 are tabulated for each axial node of each fuel assembly at each CRC statepoint other than beginning of life (BOC of first reactor cycle of in which the assembly is inserted) statepoints. The program entitled "CRC_DATA_TABULIZER.exe" as described in Section 6.1, and Attachment V of reference 5.11, was used to create the principal isotope result tables included in this analysis. Attachments XVII through XXX contain the principal isotope tabulations for the assemblies documented in this analysis. Attachments XVII through XXX were moved to an independent reference (Ref. 5.13) after the intial check and backcheck of this analysis was completed. The consolidated output files for the SAS2H depletion calculations contain isotopic concentrations for all isotopes included in the ORIGEN-S cross-section library. The ORIGEN-S cross-section library contains a considerably larger number of isotopes than the 29 isotopes included in the principal isotope set. Isotopic concentrations may be extracted from the consolidated SAS2H output files for subsequent evaluation and/or use in CRC reactivity analyses.

Table 7.7-1 Principal Isotopes

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

Between CRC statepoints in the depletion sequence for a fuel assembly axial region, a new SAS2H input deck must be created using the fuel isotopic results from the previous calculation as the initial charge. Since the 44-group cross-section library utilized in the SAS2H depletion calculations of this analysis has a reduced isotopic inventory relative to the ORIGEN-S cross-section library, a number of isotopes present in the ORIGEN-S output cannot be transferred to the initial fuel charge of the subsequent SAS2H depletion calculation. The isotopic inventory in the ORIGEN-S output which cannot be propagated to the following SAS2H depletion calculation does not significantly affect integral reactivity or the energy dependent neutron spectrum as documented in Section 4.9.1 of Attachment I. The non-propagated isotopic inventory is written to a file entitled "{depletion case identifier}.notes" to allow for subsequent analysis of the impact of excluding these isotopics in the initial charge to the subsequent SAS2H depletion calculation. The "*.notes" files are listed in Attachment XXXII. The files referred to in Attachment XXXII are contained on magnetic media identified by reference 5.12.

8. Conclusions

The SAS2H depletion calculations of the non-rodded fuel assemblies from batches 4 and 5 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, listed in Attachment XXXI and contained in reference 5.12, 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 code which is fully documented in Attachment I of reference 5.11, and Attachment I of this analysis.

9. Attachments

The attachments referenced throughout this design analysis are listed in Table 9-1. Attachment II contains the documentation of Appendix A of the CRAFT Version 2.0 User Information which is described in Attachment I. Attachment XXXI is the listing of the consolidated SAS2H output files for the assembly depletion calculations documented in this analysis. The files referred to in Attachment XXXI are contained on magnetic media identified by reference 5.12. Attachment XXXII is the listing of the "*.notes" files which are generated during the CRAFT calculations for each assembly documented in this analysis. The files referred to in Attachment XXXII are contained on magnetic media identified by reference 5.12. The file listings contained in Attachments XXXI and XXXII include the following information for each of the files that are written to the tape (Ref. 5.12):

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

The tape (Ref. 5.12) containing the files listed in Attachments XXXI and XXXII contain text files only. This tape is written using the Colorado Trakker Model 350 External Parallel Port Backup System for personal computers.

Table 9-1 Attachment Listing

Attachment #	Number of Pages	Generation Date	Description
I	83	03/15/97	CRAFT Version 2.0 User Information

Attachment #	Number of Pages	Generation Date	Description
II	82	03/15/97	CRAFT Version 2.0 Fortran Source Code Listing (This is Appendix A: CRAFT Version 2.0 Fortran Source Code Listing of the CRAFT User Information Documented in Attachment I)
III	15	03/15/97	CRAFT Input Deck for Fuel Assembly B15
IV	15	03/15/97	CRAFT Input Deck for Fuel Assembly B20a
V	13	03/15/97	CRAFT Input Deck for Fuel Assembly B20b1
VI	15	03/15/97	CRAFT Input Deck for Fuel Assembly B20b2
VII	21	03/15/97	CRAFT Input Deck for Fuel Assembly B20b3
VIII	15	03/15/97	CRAFT Input Deck for Fuel Assembly B21a
IX	16	03/15/97	CRAFT Input Deck for Fuel Assembly B28a
X	25	03/15/97	CRAFT Input Deck for Fuel Assembly C8
XI	17	03/15/97	CRAFT Input Deck for Fuel Assembly C25
XII	17	03/15/97	CRAFT Input Deck for Fuel Assembly C25a
XIII	13	03/15/97	CRAFT Input Deck for Fuel Assembly C27
XIV	13	03/15/97	CRAFT Input Deck for Fuel Assembly C27a
XV	17	03/15/97	CRAFT Input Deck for Fuel Assembly C28
XVI	17	03/15/97	CRAFT Input Deck for Fuel Assembly C29
XVII	94	03/20/97	Principal Isotope Results for Assembly B15 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XVIII	94	03/20/97	Principal Isotope Results for Assembly B20a This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XIX	79	03/20/97	Principal Isotope Results for Assembly B20b1 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.

Attachment #	Number of Pages	Generation Date	Description
XX	94	03/20/97	Principal Isotope Results for Assembly B20b2 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXI	141	03/20/97	Principal Isotope Results for Assembly B20b3 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXII	94	03/20/97	Principal Isotope Results for Assembly B21a This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXIII	94	03/20/97	Principal Isotope Results for Assembly B28a This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXIV	172	03/20/97	Principal Isotope Results for Assembly C8 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXV	110	03/20/97	Principal Isotope Results for Assembly C25 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXVI	110	03/20/97	Principal Isotope Results for Assembly C25a This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXVII	79	03/20/97	Principal Isotope Results for Assembly C27 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXVIII	79	03/20/97	Principal Isotope Results for Assembly C27a This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.

Attachment #	Number of Pages	Generation Date	Description
XXIX	110	03/20/97	Principal Isotope Results for Assembly C28 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXX	110	03/20/97	Principal Isotope Results for Assembly C29 This attachment was moved to reference 5.13 after the initial check and backcheck of this analysis was completed.
XXXI	25	03/14/97	Tape Containing CRAFT Generated Consolidated SAS2H Output Decks for Assemblies B15, B20a, B20b1, B20b2, B20b3, B21a, B28a, C8, C25, C25a, C27, C27a, C28, C29 The files listed in this attachment are contained on magnetic media identfied by reference 5.12.
XXXII	22	03/14/97	Tape Containing CRAFT Generated "*.notes" files for Assemblies B15, B20a, B20b1, B20b2, B20b3, B21a, B28a, C8, C25, C25a, C27, C27a, C28, C29 The files listed in this attachment are contained on magnetic media identfied by reference 5.12.

Attachment I

CRAFT Version 2.0 User Information

CRAFT, Version 2.0
Commercial Reactor Assembly Follow Taskmaster

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

under contract with the

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

Table of Contents

Item			Page
1.	Introduction		5
2.	CRAFT Applications		5
3.	CRAFT Methodology		8
4.	CRAFT Subroutine Descriptions		12
	4.1	Program CRAFT	12
	4.2	DATA_AQUISITION Subroutine	13
	4.3	STD_HEIGHT Subroutine	13
	4.4	FUELTEMP_FORMAT, MODSPECVOL_FORMAT, and BURNUP_FORMAT Subroutines	13
	4.5	POWER_CALCS Subroutine	20
	4.6	UNITS_CONVERSION Subroutine	21
	4.7	EXECUTION_CONTROL Subroutine	24
	4.8	STANDARD_WRITER Subroutine	24
		4.8.1 Identification and Global Comment Section	24
		4.8.2 Material Specification Section	25
		4.8.3 Base Fuel Assembly Lattice Specification Section	27
		4.8.4 SAS2H Control Specifications and Unit Cell Models Section	28
		4.8.5 Irradiation History Specification Section	28
		4.8.6 Calculations Performed within the STANDARD_WRITER Subroutine	28
	4.9	CONTINUATION_WRITER Subroutine	31
		4.9.1 Initial Charge Fuel and Burnable Poison Material Composition Specifications	31
		4.9.2 Calculations Performed within the CONTINUATION_WRITER Subroutine	39
	4.10	CUTTER Subroutine	41
	4.11	RETRIEVER Subroutine	41
	4.12	ZEROS Subroutine	42
5.	CRAFT Input Summary		43
6.	CRAFT Code Limits and Execution Instructions		52
7.	Detailed Descriptions of CRAFT Input Cards		55
8.	CRAFT Output Description		82
9.	Modifications Made Between CRAFT Version 1.0 and Version 2.0		83

10. References 83
Appendix A: CRAFT Version 2.0
Fortran Source Code Listing

1. Introduction

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

2. CRAFT Applications

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

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

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

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

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

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

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

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

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

CR assembly designs may be specified per cycle. The position of the CR assembly in the fuel assembly is specified by identifying the top and bottom axial nodes of 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 statepoint calculations in a given reactor cycle.

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

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

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

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

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

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

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

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

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

3. CRAFT Methodology

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

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

After data acquisition, the next procedure is to standardize all fuel assembly heights corresponding to the input data specification to a prescribed CRC fuel assembly height. The fuel

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

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

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

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

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

1) the "STANDARD_WRITER" subroutine

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

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

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

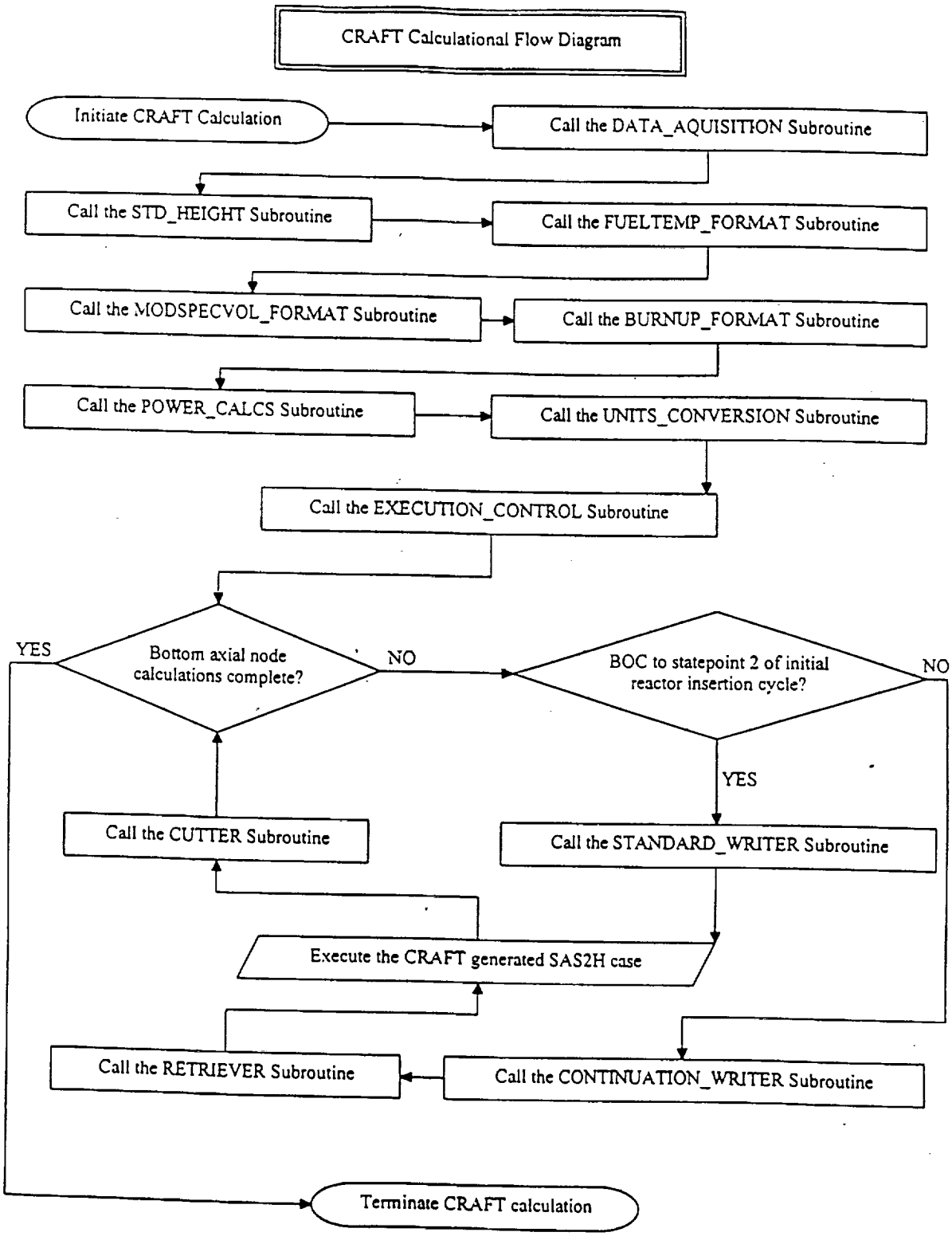
The subroutine called "CONTINUATION_WRITER", as previously mentioned in relation to the "EXECUTION_CONTROL" subroutine, writes SAS2H input decks for all statepoint calculations other than the initial statepoint calculation in the initial insertion reactor cycle. The "CONTINUATION_WRITER" subroutine calls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

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

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

by a "*.notes" suffix. The CRAFT generated filenames are described in detail in Section 8.

Figure 3-1



4. CRAFT Subroutine Descriptions

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

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

4.1 Program CRAFT

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

4.2 DATA_AQUISITION Subroutine

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

4.3 STD_HEIGHT Subroutine

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

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

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

4.4 FUELTEMP_FORMAT, MODSPECVOL_FORMAT, and BURNUP_FORMAT Subroutines

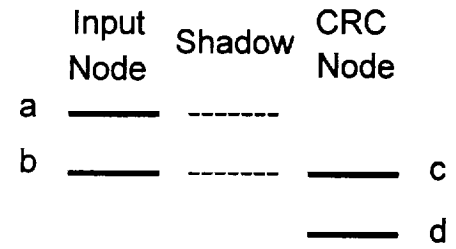
This subroutine standardizes all nodal input data such that there exists a one-to-one correspondence between input data values and CRC axial nodes. This basically means that the assembly axial node formats in which the input data is provided are adjusted such that they identically match the prescribed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

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

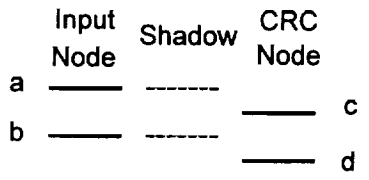
1) shadows created by input axial nodes which are the same height as the CRC axial nodes;
2) shadows created by input axial nodes which are smaller than the CRC axial nodes;
3) shadows created by input axial nodes which are larger than the CRC axial nodes.

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

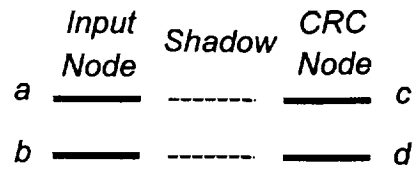
Shadows created by input axial nodes which are the same height as the CRC axial nodes--



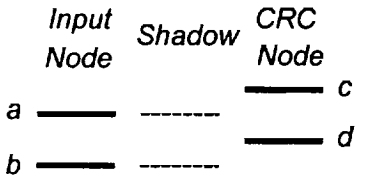
No Contribution from the Input Node to the CRC Node



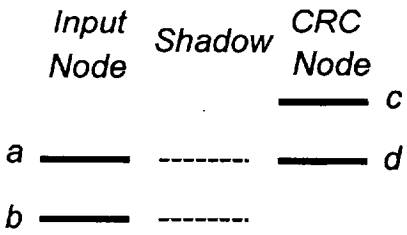
$$\textit{Input Node Contribution to CRC Node} = \left(\frac{b-c}{d-c}\right) * (\textit{Input Data Value})$$



Input Node Contribution to CRC Node = Input Data Value

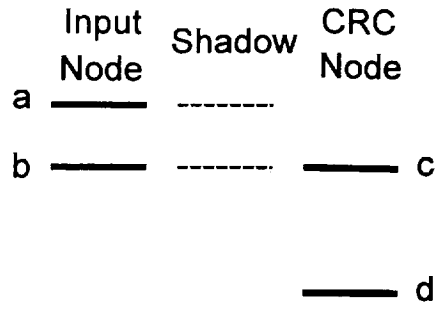


Input Node Contribution to CRC Node $= (\frac{d-a}{d-c}) * (\textit{Input Data Value})$

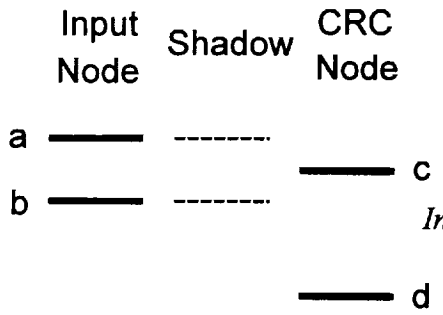


No Contribution from the Input Node to the CRC Node

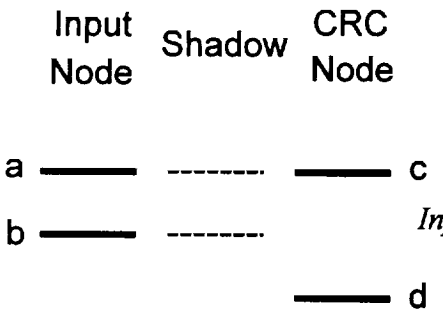
Shadows created by input axial nodes which are smaller than the CRC axial nodes--



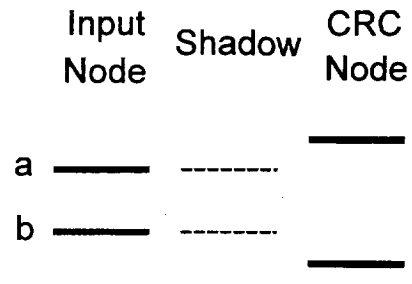
No Contribution from the Input Node to the CRC Node



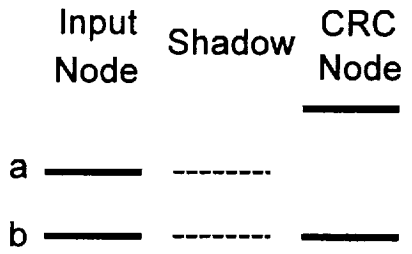
$$\textit{Input Node Contribution to CRC Node} = \left(\frac{b-c}{d-c}\right) * (\textit{Input Data Value})$$



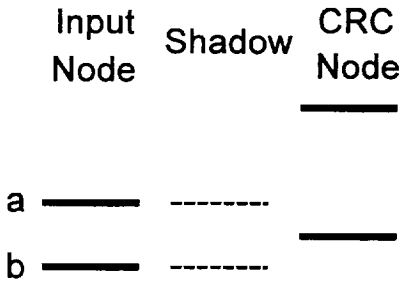
$$\textit{Input Node Contribution to CRC Node} = \left(\frac{b-a}{d-c}\right) * (\textit{Input Data Value})$$



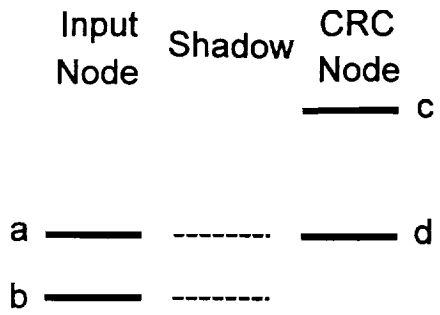
$$\textit{Input Node Contribution to CRC Node} = \left(\frac{b-a}{d-c}\right) * (\textit{Input Data Value})$$



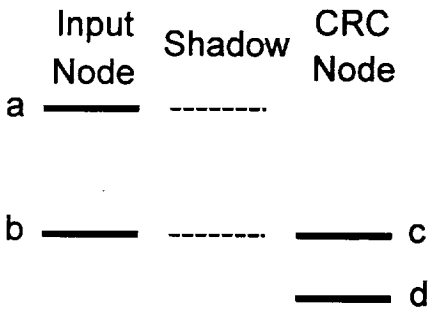
$$\textit{Input Node Contribution to CRC Node} = \left(\frac{b-a}{d-c}\right) * (\textit{Input Data Value})$$

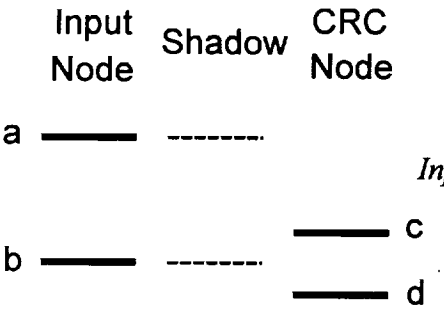


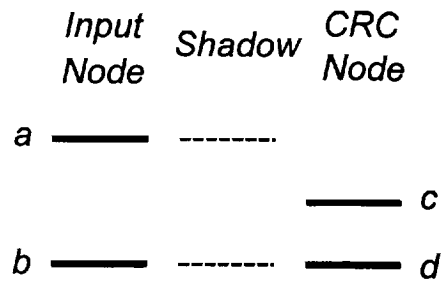
$$\textit{Input Node Contribution to CRC Node} = \left(\frac{d-a}{d-c}\right) * (\textit{Input Data Value})$$



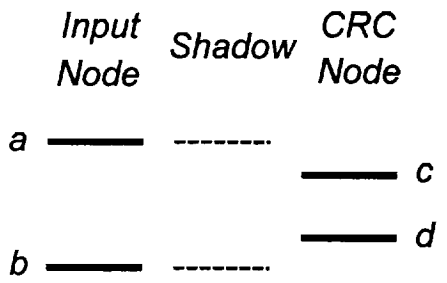
Shadows created by input axial nodes which are larger than the CRC axial nodes--



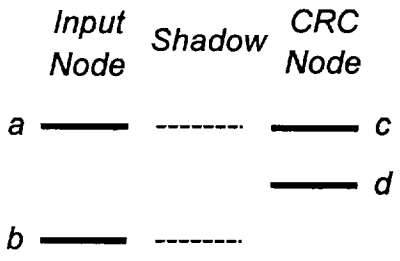




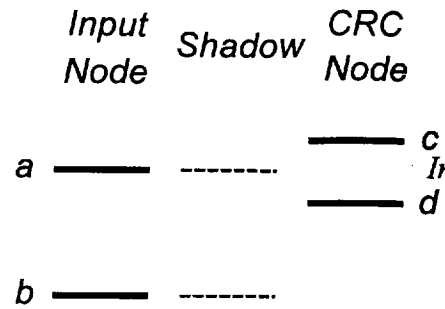
Input Node Contribution to CRC Node = Input Data Value



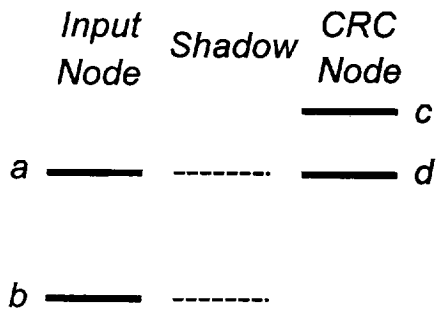
Input Node Contribution to CRC Node = Input Data Value



Input Node Contribution to CRC Node = Input Data Value



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



No Contribution from the Input Node to the CRC Node

4.5 POWER_CALCS Subroutine

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

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

where,

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

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

4.6 UNITS_CONVERSION Subroutine

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

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

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

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

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

Table 4.6-1
Density (g/cm^3) of Subcooled Water at Various Temperatures and Pressures

	Pressure, psia								
Temp. (°F)	3000	2500	2000	1500	1000	800	600	400	200
50	1.0084	1.0069	1.0055	1.0040	1.0025	1.0019	0.0013	1.0007	1.0000
100	1.0018	1.0004	0.9989	0.9975	0.9960	0.9954	0.9948	0.9942	0.9936
150	0.9893	0.9878	0.9864	0.9849	0.9834	0.9828	0.9822	0.9815	0.9809
200	0.9725	0.9709	0.9694	0.9679	0.9663	0.9656	0.9650	0.9644	0.9637
250	0.9522	0.9505	0.9489	0.9472	0.9455	0.9449	0.9442	0.9435	0.9428
300	0.9289	0.9271	0.9252	0.9234	0.9215	0.9208	0.9200	0.9192	0.9185
350	0.9026	0.9006	0.8985	0.8964	0.8943	0.8934	0.8925	0.8916	
400	0.8733	0.8709	0.8685	0.8660	0.8634	0.8624	0.8613	0.8603	
450	0.8405	0.8375	0.8345	0.8314	0.8281	0.8268	0.8255		
500	0.8029	0.7992	0.7952	0.7911	0.7869	0.7851			
510	0.7947	0.7907	0.7866	0.7822	0.7776				
520	0.7862	0.7820	0.7776	0.7729	0.7680				
530	0.7775	0.7729	0.7682	0.7632	0.7579				
540	0.7683	0.7635	0.7584	0.7530	0.7472				
550	0.7589	0.7537	0.7482	0.7423					
560	0.7490	0.7434	0.7374	0.7310					
570	0.7386	0.7326	0.7261	0.7190					
580	0.7278	0.7212	0.7141	0.7062					
590	0.7164	0.7092	0.7012	0.6923					
600	0.7043	0.6963	0.6874						
610	0.6915	0.6825	0.6724						
620	0.6777	0.6676	0.6558						
630	0.6629	0.6512	0.6370						
640	0.6467	0.6329							

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

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

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

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

where,

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

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

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

correspond to densities which bound the calculated moderator density.

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

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

4.7 EXECUTION_CONTROL Subroutine

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

4.8 STANDARD_WRITER Subroutine

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

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

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

4.8.1 Identification and Global Comment Section

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

4.8.2 Material Specification Section

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

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

Table 4.8.2-1
Trace Isotopes Specified in Fresh Fuel Compositions

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

Several of the additional material composition specifications that must be provided in the SAS2H input decks include cladding materials for either fuel rods, control rod assemblies, axial power shaping rod assemblies, or burnable poison rod assemblies. The cladding materials available for specification include ZIRC-4, INCONEL, SS316, SS316S, SS304, and SS304S. The SS316/SS316S and SS304/SS304S materials are delineated by the use of two special weighting functions. The special weighting functions affect the generation of multigroup cross-sections for iron, nickel, and chromium. One of the special weighting functions corresponds to $1/E\ \sigma_t(E)$,

where $\sigma_t(E)$ is the total cross-section of the stainless steel material. In the other special weighting function, $\sigma_t(E)$ is the total cross-section for the referenced nuclide. The stainless steel material identifiers ending in "S" use the weighting function where $\sigma_t(E)$ is the total cross-section for the referenced nuclide. The compositions and SCALE nuclide identifiers for the various cladding material compositions are shown in Table 4.8.2-2.

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

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

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

Once the fuel material specification is complete, the fuel cladding material specification is defined. The fuel cladding material may be either ZIRC-4, INCONEL, SS316, SS316S, SS304,

or SS404S. The compositions of these materials are hard-wired in the CRAFT code. The user is required to define an average fuel cladding temperature that will be applied to all fuel cladding material specifications.

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

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

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

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

4.8.3 Base Fuel Assembly Lattice Specification Section

The base fuel assembly lattice specification section describes the fuel assembly configuration and specifies special control parameters that are to be utilized in performing the XSDRNPM calculations associated with the CRAFT generated SAS2H calculation. The fuel assembly lattice specification includes a "squarepitch" designator which tells SAS2H that the fuel assembly is a square array of unit cells with a constant pitch. The fuel rod pitch, fuel pellet outer diameter, fuel rod cladding inner diameter, and fuel rod cladding outer diameter are specified. The number of fuel rods per fuel assembly and active fuel length are also specified. The active fuel length represents the fuel stack height for the CRC node that the CRAFT generated SAS2H calculation represents. The special parameters that allow more control over the XSDRNPM calculation are

described in Section 7. One special control parameter is always specified in the CRAFT generated SAS2H calculations. This parameter is designated "szf", and represents the spatial mesh factor for use in defining the XSDRNPM one-dimensional transport calculations.

4.8.4 SAS2H Control Specifications and Unit Cell Models Section

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

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

4.8.5 Irradiation History Specification Section

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

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

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

4.8.6 Calculations Performed within the STANDARD_WRITER Subroutine

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

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

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

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

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

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

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

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

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

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

$$U^{236}\ wt\% = (0.0046)*(U^{235}\ wt\%)$$

$$U^{238}\ wt\% = 100 - U^{234}\ wt\% - U^{235}\ wt\% - U^{236}\ wt\%$$

- The volume fraction of H_2O in the homogenized moderator composition must be calculated by the STANDARD_WRITER subroutine to define the moderator material composition. The following equation is used to calculate the appropriate volume fraction of H_2O.

$$\textit{Volume Fraction of } H_2O \textit{ in Homogenized Moderator Comp.} = 1.0 - \textit{Volume Fraction of Spacer Material in Homogenized Moderator Comp.}$$

- The volume fraction of soluble boron in the H_2O of the homogenized moderator composition must be calculated by the STANDARD_WRITER subroutine to define the moderator material composition. The following equation is used to calculate the appropriate volume fraction of soluble boron.

$$\textit{Volume Fraction of Soluble Boron in Homogenized Moderator Composition} = \frac{\textit{Boron (Concentration)} * (1.0E\text{-}6) * \textit{ppm}}{(\textit{Volume Fraction of } H_2O \textit{ in Homogenized Moderator Composition})}$$

- The density of the homogenized moderator composition must be calculated by the STANDARD_WRITER subroutine to define the moderator material composition. The following equation is used to calculate the appropriately averaged homogenized moderator density in grams per cubic centimeter.

$$\textit{Density of Homogenized Moderator Composition} = \frac{[(\textit{Actual Moderator Density}) * (\textit{Volume Fraction of } H_2O \textit{ in the Moderator Composition})] + [(\textit{Actual Density of Spacer Material}) * (\textit{Volume Fraction of Spacer Material in the Moderator Composition})]}{}$$

- If the fuel assembly contains a BPRA with Al_2O_3-B_4C burnable absorber material during the irradiation history covered in a SAS2H calculation, the aluminum and oxygen weight fractions must be calculated to define the fresh burnable absorber material composition. The following equation are used to calculate the aluminum and oxygen weight fractions in Al_2O_3-B_4C.

$$\textit{Aluminum Weight Fraction in } Al_2O_3\text{-}B_4C = \frac{(\frac{100 - B_4C \textit{ wt\% in } Al_2O_3\text{-}B_4C}{100}) * (\textit{Density of } Al_2O_3\text{-}B_4C)^2 * (2) * (26.981539) * (\frac{1}{101.9631})}{}$$

$$\begin{matrix}\text{Oxygen Weight} \\ \text{Fraction in } Al_2O_3\text{-}B_4C\end{matrix} = 1 - \left(\frac{B_4C \text{ wt\% in } Al_2O_3\text{-}B_4C}{100}\right) - \begin{matrix}\text{Aluminum Weight} \\ \left(\text{Fraction in } Al_2O_3\text{-}B_4C\right)\end{matrix}$$

- The soluble boron fraction must be calculated by the STANDARD_WRITER subroutine for all irradiation steps. The soluble boron fraction for a given irradiation step is calculated using the following equation.

$$\begin{matrix}\text{Soluble Boron Fraction} \\ \text{in Irradiation Step}\end{matrix} = \frac{\text{Soluble Boron ppm in Irradiation Step}}{\begin{matrix}\text{Soluble Boron ppm in Base Moderator} \\ \text{Composition of the SAS2H Input Deck}\end{matrix}}$$

4.9 CONTINUATION_WRITER Subroutine

This subroutine generates all SAS2H input decks which correspond to continuation cases in which the fuel and burnable poison isotopic initial charge compositions are obtained from the output of a previous CRAFT generated SAS2H calculation. A detailed explanation of how to develop a SAS2H input deck to perform a fuel assembly depletion and decay calculation is provided in reference 1. The purpose of this discussion is not to explain how to develop a SAS2H input deck, but to explain the general format and calculations utilized by CRAFT in generating SAS2H input decks for calculations which initially contain spent fuel and burnable poison material compositions.

The format of the CRAFT generated SAS2H input decks for the continuation of a fuel assembly depletion and decay calculation relevant to CRC analyses is the same as that previously described for the standard beginning-of-life SAS2H input decks. The material specification section of the SAS2H input deck is the only input section where the continuation case differs from the standard case.

The CRAFT code tracks the depletion and decay of the fuel and burnable absorber materials during the fuel assembly depletion and decay calculation. The CONTINUATION_WRITER subroutine is designed to locate the appropriate fuel and burnable poison isotopic concentrations, and utilize them in developing the correct fuel and burnable poison initial charge compositions to allow for continuation of the fuel assembly depletion calculation. All calculations performed by the STANDARD_WRITER subroutine other than those related to the fuel and burnable poison material composition specifications are performed identically by the CONTINUATION_WRITER subroutine.

4.9.1 Initial Charge Fuel and Burnable Poison Material Composition Specifications

The initial charge fuel material composition specification for a continuation SAS2H calculation utilizes all available isotopic concentrations from the appropriate previous SAS2H depletion and

decay calculations output for which cross-section data is available in the SCALE 44-group library (Vol. 3, p. M4.2.19, Ref. 1) (recommended CRC cross-section library). Table 4.9.1-1 contains a listing of all the isotopes for which data is available in the 44-group cross-section library.

Table 4.9.1-1
Isotopic Inventory of the 44-group Cross-Section Library

H-1	H-2	H-3	He-3	He-4	Li-6	Li-7	Be-9	B-10
B-11	C-12	N-14	N-15	O-16	O-17	F-19	Na-23	Mg
Al-27	Si	P-31	S	S-32	Cl	K	Ca	Ti
V	Cr	Mn-55	Fe	Co-59	Ni	Cu	Ga	Ge-72
Ge-73	Ge-74	Ge-76	As-75	Se-74	Se-76	Se-77	Se-78	Se-80
Se-82	Br-79	Br-81	Kr-78	Kr-80	Kr-82	Kr-83	Kr-84	Kr-85
Kr-86	Rb-85	Rb-86	Rb-87	Sr-84	Sr-86	Sr-87	Sr-88	Sr-89
Sr-90	Y-89	Y-90	Y-91	Zr	Zr-90	Zr-91	Zr-92	Zr-93
Zr-94	Zr-95	Zr-96	Nb-93	Nb-94	Nb-95	Mo	Mo-92	Mo-94
Mo-95	Mo-96	Mo-97	Mo-98	Mo-99	Mo-100	Tc-99	Ru-96	Ru-98
Ru-99	Ru-100	Ru-101	Ru-102	Ru-103	Ru-104	Ru-105	Ru-106	Rh-103
Rh-105	Pd-102	Pd-104	Pd-105	Pd-106	Pd-107	Pd-108	Pd-110	Ag-107
Ag-109	Ag-111	Cd	Cd-106	Cd-108	Cd-110	Cd-111	Cd-112	Cd-113
Cd-114	Cd-116	Cd-115m	In-113	In-115	Sn-112	Sn-114	Sn-115	Sn-116
Sn-117	Sn-118	Sn-119	Sn-120	Sn-122	Sn-123	Sn-124	Sn-125	Sn-126
Sb-121	Sb-123	Sb-124	Sb-125	Sb-126	Te-120	Te-122	Te-123	Te-124
Te-125	Te-126	Te-128	Te-130	Te-132	Te-127m	Te-129m	I-127	I-129
I-130	I-131	I-135	Xe-124	Xe-126	Xe-128	Xe-129	Xe-130	Xe-131
Xe-132	Xe-133	Xe-134	Xe-135	Xe-136	Cs-133	Cs-134	Cs-135	Cs-136
Cs-137	Ba-134	Ba-135	Ba-136	Ba-137	Ba-138	Ba-140	La-139	La-140
Ce-140	Ce-141	Ce-142	Ce-143	Ce-144	Pr-141	Pr-142	Pr-143	Nd-142
Nd-143	Nd-144	Nd-145	Nd-146	Nd-147	Nd-148	Nd-150	Pm-147	Pm-148
Pm-149	Pm-151	Pm-148m	Sm-144	Sm-147	Sm-148	Sm-149	Sm-150	Sm-151

Table 4.9.1-1
Isotopic Inventory of the 44-group Cross-Section Library

Sm-152	Sm-153	Sm-154	Eu	Eu-151	Eu-152	Eu-153	Eu-154	Eu-155
Eu-156	Eu-157	Gd-152	Gd-154	Gd-155	Gd-156	Gd-157	Gd-158	Gd-160
Tb-159	Tb-160	Dy-160	Dy-161	Dy-162	Dy-163	Dy-164	Ho-165	Er-166
Er-167	Lu-175	Lu-176	Hf	Hf-174	Hf-176	Hf-177	Hf-178	Hf-179
Hf-180	Ta-181	Ta-182	W	W-182	W-183	W-184	W-186	Re-185
Re-187	Au-197	Pb	Bi-209	Th-230	Th-232	Pa-231	Pa-233	U-232
U-233	U-234	U-235	U-236	U-237	U-238	Np-237	Np-238	Pu-236
Pu-237	Pu-238	Pu-239	Pu-240	Pu-241	Pu-242	Pu-243	Pu-244	Am-241
Am-242	Am-243	Am-242m	Cm-241	Cm-242	Cm-243	Cm-244	Cm-245	Cm-246
Cm-247	Cm-248	Bk-249	Cf-249	Cf-250	Cf-251	Cf-252	Cf-253	Es-253

The fuel composition is composed of the initial oxygen mass in the fresh UO_2 and the mass of each of the actinides and fission products of the depleted fuel composition which are available in the 44-group library. There are some isotopes listed in the ORIGEN output of the spent fuel composition which are not available in the 44-group library. These isotopes are excluded from the initial charge composition for the continuation of the fuel assembly depletion. A listing of all excluded isotopes and their abundance in grams per node is retained in the CRAFT generated "*.notes" file corresponding to the SAS2H calculation for which the initial charge composition is obtained. The total mass of all isotopes (including oxygen) in the fuel composition is calculated to assist in determining the weight percentages of each isotope in the composition and the density of the composition. The fuel composition is then defined as an arbitrary material specification in the SAS2H input deck with the appropriate nodal fuel temperature applied.

Excluding the isotopic concentrations from the ORIGEN-S output, that are not available in the 44-group library, from the fuel charge composition of a subsequent depletion calculation has a negligible effect on the neutron spectrum. The neutron spectrum must be predicted correctly during the SAS2H depletion calculations to obtain the proper cell-weighting of the cross-sections. For an absorber isotope to have a significant effect on the neutron spectrum, the absorber isotope must be present in a significant quantity and have a significant absorption cross-section. Three simple calculations were performed to demonstrate that the isotopes excluded from the continuation SAS2H depletion calculations (as identified in the "*.notes" files) do not effect the neutron spectrum significantly enough to result in a change in the final depleted composition. The first two of the three calculations represent a simple fuel depletion calculation that was split into parts and continued via CRAFT. The third of these calculations is a continuous calculation equivalent to the simple depletion represented by the first two calculations. The final depleted isotopic results at the end of the second calculation (the second

part of the total depletion composed of the first two calculations) are identical to the final depleted isotopic results obtained from the third calculation. The SAS2H input decks for these three calculations are presented in Figure 4.9.1-1 through Figure 4.9.1-3.

Figure 4.9.1-1 Calculation 1 of the Isotopic Exclusion Test Depletion Calculation

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-01 (Cyc-1B,     .0 to Cyc-1B,  75.0 EFPD)
44group          latticecell
'
'    fuel density based on mass of uranium per assembly & total pellet stack
'    volume to account for fuel volume loss to pellet chamfers
'
'      material specification input
'
uo2 1 den=10.121 1  929.8 92234  .016 92235 1.930 92236  .009 92238 98.045 end
kr-83         1   0   1-21    929.8   end
kr-85         1   0   1-21    929.8   end
sr-90         1   0   1-21    929.8   end
y-89          1   0   1-21    929.8   end
mo-95         1   0   1-21    929.8   end
zr-93         1   0   1-21    929.8   end
zr-94         1   0   1-21    929.8   end
zr-95         1   0   1-21    929.8   end
nb-94         1   0   1-21    929.8   end
tc-99         1   0   1-21    929.8   end
rh-103        1   0   1-21    929.8   end
rh-105        1   0   1-21    929.8   end
ru-101        1   0   1-21    929.8   end
ru-106        1   0   1-21    929.8   end
pd-105        1   0   1-21    929.8   end
pd-108        1   0   1-21    929.8   end
ag-109        1   0   1-21    929.8   end
sb-124        1   0   1-21    929.8   end
xe-131        1   0   1-21    929.8   end
xe-132        1   0   1-21    929.8   end
xe-135        1   0   1-21    929.8   end
xe-136        1   0   1-21    929.8   end
cs-134        1   0   1-21    929.8   end
cs-135        1   0   1-21    929.8   end
cs-137        1   0   1-21    929.8   end
ba-136        1   0   1-21    929.8   end
la-139        1   0   1-21    929.8   end
ce-144        1   0   1-21    929.8   end
nd-143        1   0   1-21    929.8   end
nd-145        1   0   1-21    929.8   end
pm-147        1   0   1-21    929.8   end
pm-148        1   0   1-21    929.8   end
nd-147        1   0   1-21    929.8   end
sm-147        1   0   1-21    929.8   end
sm-149        1   0   1-21    929.8   end
sm-150        1   0   1-21    929.8   end
sm-151        1   0   1-21    929.8   end
sm-152        1   0   1-21    929.8   end
gd-155        1   0   1-21    929.8   end
eu-153        1   0   1-21    929.8   end
eu-154        1   0   1-21    929.8   end
eu-155        1   0   1-21    929.8   end
```

```
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7556    .99424      579.8    end
arbm-bormod     .7556 1 0 0 0 5000 100 3 .00052    579.8 end
arbm-spacer     .7556 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                 26000 7.0 28000 73.0 3 .00576    579.8 end
'
'
he     5   end
end comp
'
'     base reactor lattice specification
'
squarepitch    1.44272     .9398    1    3    1.0922    2     .9576    0    end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=360.172 ncycles=02 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3   .63246    2   .67310    3   .81397 500 2.97599    3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 03
power=74.181      burn=71.10      down=.00000E+00 bfrac=1.000      end
power=74.181      burn=71.10      down=10.000     bfrac=.4938      end
'
'     end of input
'
end
```

Figure 4.9.1-2 Calculation 2 of the Isotopic Exclusion Test Depletion Calculation

```
=sas2h     parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-01 (Cyc-1B,  75.0 to Cyc-1B, 142.2 EFPD)
44group          latticecell
'
'    fuel density based on mass of uranium per assembly & total pellet stack
'    volume to account for fuel volume loss to pellet chamfers
'
'      material specification input
'
arbm-fuel    10.1      216 0 0 0 8016    11.9
      2004    .837E-06       90230    .858E-08
     90232    .166E-08       91231    .365E-08       91233    .478E-09
     92232    .242E-08       92233    .679E-07       92234    .887E-02
     92235    .434           92236    .213           92237    .101E-02
     92238   84.7            93237    .209E-01       93238    .119E-04
     94236    .238E-07       94237    .242E-07       94238    .468E-02
     94239    .419           94240    .171           94241    .912E-01
     94242    .350E-01       95241    .508E-03       95601    .689E-05
     95242    .265E-09       95243    .560E-02       96242    .180E-03
     96243    .345E-05       96244    .118E-02       96245    .276E-04
     96246    .346E-05       96247    .400E-07       96248    .242E-08
      1003    .324E-05        3006    .113E-07        3007    .607E-09
```

4009	.117E-08	32072	.327E-06	32073	.914E-06
32074	.767E-06	33075	.685E-05	32076	.202E-04
34076	.148E-06	34077	.468E-04	34078	.156E-03
35079	.246E-09	34080	.796E-03	36080	.377E-08
35081	.119E-02	34082	.189E-02	36082	.299E-04
36083	.240E-02	36084	.660E-02	36085	.142E-02
37085	.522E-02	36086	.106E-01	37086	.299E-05
38086	.112E-04	37087	.138E-01	38087	.674E-07
38088	.196E-01	38089	.923E-02	39089	.170E-01
38090	.318E-01	39090	.837E-05	40090	.200E-03
39091	.140E-01	40091	.206E-01	40092	.369E-01
40093	.276E-01	41093	.695E-09	40094	.447E-01
41094	.310E-07	40095	.209E-01	41095	.104E-01
42095	.150E-01	40096	.476E-01	42096	.468E-03
42097	.455E-01	42098	.493E-01	42099	.118E-03
43099	.489E-01	44099	.171E-05	42100	.561E-01
44100	.449E-02	44101	.468E-01	44102	.466E-01
44103	.142E-01	45103	.223E-01	44104	.346E-01
46104	.617E-02	45105	.402E-05	46105	.177E-01
44106	.183E-01	46106	.130E-01	46107	.149E-01
47107	.280E-09	46108	.971E-02	48108	.942E-08
47109	.636E-02	46110	.287E-02	48110	.198E-02
47111	.672E-04	48111	.141E-02	48112	.759E-03
48113	.746E-05	49113	.699E-07	48114	.773E-03
50114	.142E-08	48601	.392E-05	49115	.109E-03
50115	.111E-04	48116	.312E-03	50116	.121E-03
50117	.299E-03	50118	.236E-03	50119	.247E-03
50120	.242E-03	51121	.249E-03	50122	.316E-03
52122	.121E-04	50123	.153E-04	51123	.274E-03
52123	.617E-07	50124	.527E-03	51124	.556E-05
52124	.423E-05	50125	.925E-05	51125	.613E-03
52125	.263E-04	50126	.124E-02	51126	.105E-05
52126	.198E-04	52601	.327E-03	53127	.246E-02
52128	.556E-02	54128	.908E-04	52611	.615E-03
53129	.106E-01	54129	.333E-06	52130	.219E-01
54130	.369E-03	53131	.137E-02	54131	.274E-01
52132	.217E-03	54132	.626E-01	54133	.129E-02
55133	.697E-01	54134	.917E-01	55134	.609E-02
56134	.316E-03	54135	.948E-11	55135	.453E-02
56135	.127E-05	54136	.155	55136	.546E-04
56136	.424E-03	55137	.763E-01	56137	.421E-03
56138	.761E-01	57139	.719E-01	56140	.537E-02
57140	.813E-03	58140	.712E-01	58141	.168E-01
59141	.495E-01	58142	.678E-01	59142	.209E-08
60142	.601E-03	58143	.544E-05	59143	.535E-02
60143	.451E-01	58144	.483E-01	60144	.263E-01
60145	.405E-01	60146	.398E-01	60147	.159E-02
61147	.151E-01	62147	.758E-03	60148	.228E-01
61148	.590E-04	61601	.839E-04	62148	.244E-02
61149	.280E-04	62149	.765E-03	60150	.108E-01
62150	.206E-01	61151	.312E-06	62151	.973E-03
63151	.348E-06	62152	.912E-02	63152	.354E-06
64152	.407E-06	62153	.994E-05	63153	.702E-02
62154	.263E-02	63154	.107E-02	64154	.129E-04
63155	.314E-03	64155	.160E-05	63156	.615E-03
64156	.282E-02	63157	.278E-09	64157	.257E-04
64158	.153E-02	65159	.159E-03	64160	.674E-04
65160	.845E-05	66160	.386E-05	66161	.232E-04
66162	.172E-04	66163	.117E-04	66164	.240E-05
67165	.398E-05	68166	.727E-06	68167	.123E-07

```
     1   1.0    929.8   end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o    3   den=.7556    .99424     579.8   end
arbm-bormod     .7556 1 0 0 0 5000 100 3 .00024    579.8 end
arbm-spacer     .7556 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                26000 7.0 28000 73.0 3 .00576    579.8 end
'
'
he     5   end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272    .9398   1   3   1.0922   2    .9576   0   end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=360.172 ncycles=01 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3  .63246   2  .67310   3  .81397 500 2.97599   3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 03
power=27.597     burn=29.10     down=14.792     bfrac=1.000     end
'
'     end of input
'
end
```

Figure 4.9.1-3 Calculation 3 of the Isotopic Exclusion Test Depletion Calculation

```
=sas2h    parm=skipshipdata
Crystal River, Unit 3 Assy-03, Node-01 {Cyc-1B,     .0 to Cyc-1B,   75.0 EFPD}
44group         latticecell
'
'   fuel density based on mass of uranium per assembly & total pellet stack
'   volume to account for fuel volume loss to pellet chamfers
'
'     material specification input
'
uo2 1 den=10.121 1  929.8 92234  .016 92235 1.930 92236  .009 92238 98.045 end
kr-83        1   0   1-21    929.8   end
kr-85        1   0   1-21    929.8   end
sr-90        1   0   1-21    929.8   end
y-89         1   0   1-21    929.8   end
mo-95        1   0   1-21    929.8   end
zr-93        1   0   1-21    929.8   end
zr-94        1   0   1-21    929.8   end
zr-95        1   0   1-21    929.8   end
nb-94        1   0   1-21    929.8   end
tc-99        1   0   1-21    929.8   end
rh-103       1   0   1-21    929.8   end
rh-105       1   0   1-21    929.8   end
```

```
ru-101        1    0    1-21     929.8    end
ru-106        1    0    1-21     929.8    end
pd-105        1    0    1-21     929.8    end
pd-108        1    0    1-21     929.8    end
ag-109        1    0    1-21     929.8    end
sb-124        1    0    1-21     929.8    end
xe-131        1    0    1-21     929.8    end
xe-132        1    0    1-21     929.8    end
xe-135        1    0    1-21     929.8    end
xe-136        1    0    1-21     929.8    end
cs-134        1    0    1-21     929.8    end
cs-135        1    0    1-21     929.8    end
cs-137        1    0    1-21     929.8    end
ba-136        1    0    1-21     929.8    end
la-139        1    0    1-21     929.8    end
ce-144        1    0    1-21     929.8    end
nd-143        1    0    1-21     929.8    end
nd-145        1    0    1-21     929.8    end
pm-147        1    0    1-21     929.8    end
pm-148        1    0    1-21     929.8    end
nd-147        1    0    1-21     929.8    end
sm-147        1    0    1-21     929.8    end
sm-149        1    0    1-21     929.8    end
sm-150        1    0    1-21     929.8    end
sm-151        1    0    1-21     929.8    end
sm-152        1    0    1-21     929.8    end
gd-155        1    0    1-21     929.8    end
eu-153        1    0    1-21     929.8    end
eu-154        1    0    1-21     929.8    end
eu-155        1    0    1-21     929.8    end
arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000 0.10 26000 0.20 50000 1.40
           40000 98.18 2 1.0 640.0 end
'
'     material composition of moderator within unit cell
'     with smeared inconel spacer grids
h2o   3   den=.7556    .99424      579.8    end
arbm-bormod     .7556 1 0 0 0 5000 100 3 .00052    579.8 end
arbm-spacer     .7556 5 0 0 0 14000 2.5 22000 2.5 24000 15.0
                26000 7.0 28000 73.0 3 .00576    579.8 end
'
'
he    5   end
end comp
'
'     base reactor lattice specification
'
squarepitch   1.44272     .9398    1    3    1.0922    2     .9576    0    end
more data szf=0.50 end
'
'     assembly specification
'
npin/assembly=208 fuelngth=360.172 ncycles=03 nlib/cyc=1 lightel=0
printlevel=05 inplevel=2 numztotal=05 mxrepeats=1 mixmod=3 facmesh=.50 end
  3   .63246    2   .67310    3   .81397 500 2.97599    3 2.99939
'
'     assembly depletion/decay parameters
'
'   Cycle-1B, one-eighth core assembly number 03
power=74.181      burn=71.10      down=.00000E+00 bfrac=1.000      end
power=74.181      burn=71.10      down=10.000     bfrac=.4938      end
```

```
power=27.597      burn=29.10      down=14.792      bfrac=.4615      end
'
'      end of input
'
end
```

The burnable poison initial charge composition for continuing a fuel assembly depletion calculation is developed using the depleted abundances of B-10 and B-11 in the burnable poison material. These depleted abundances of B-10 and B-11 are obtained from the appropriate previous SAS2H depletion and decay calculation's output. The depletion of other isotopes in the burnable poison composition are not tracked in the CRAFT calculation. The isotopes in the burnable poison material other than B-10 and B-11 are respecified in the burnable poison composition of the continuing depletion calculation with their initial abundances. The total mass of all isotopes in the burnable poison composition is calculated to assist in determining the weight percentages of each isotope in the composition and the density of the composition. The burnable poison composition is then defined as an arbitrary material specification in the SAS2H input deck with the nodal moderator temperature applied.

4.9.2 Calculations Performed within the CONTINUATION_WRITER Subroutine

- The density of the fuel composition in the CRAFT generated continuing depletion SAS2H input deck must be calculated by the CONTINUATION_WRITER subroutine. This calculation is performed by simply dividing the total mass of the charge fuel composition (including oxygen) in the node by the total fuel volume in the node. The charge fuel composition (excluding oxygen) is obtained from the appropriate previous SAS2H calculation's output. The oxygen contribution and fuel volume of the node are calculated in the same manner as previously described in the STANDARD_WRITER subroutine description.

- The weight percentages of each isotope in the depleted initial charge compositions for the fuel and burnable poison are calculated by using the following equation.

$$\textit{Weight Percent of Constituent in Material} = \frac{\textit{Mass of Constituent}}{\textit{Total Material Mass}} * 100$$

- The default burnable poison material is Al_2O_3-B_4C. If this burnable poison material is specified for use in the BPRA of a continuing depletion calculation, the initial mass abundances of the aluminum, oxygen, and carbon in the fresh material must be calculated for use is defining the depleted burnable material composition for the continuation case. The first step in calculating the mass abundances of these elements is to use the following equation to calculate the mass of B_4C in the Al_2O_3-B_4C material in the node.

$$\begin{matrix} B_4C\ Mass \\ in\ Node \end{matrix} = \left(\frac{B_4C\ wt\%\ in\ Al_2O_3\text{-}B_4C}{100}\right) * \begin{pmatrix} Density\ of \\ Al_2O_3\text{-}B_4C \end{pmatrix} * \begin{pmatrix} Burnable\ Poison \\ Volume\ in\ Node \end{pmatrix}$$

The carbon mass in the Al_2O_3-B_4C material of the node may then be calculated using the following equation.

$$Carbon\ Mass\ in\ Al_2O_3\text{-}B_4 = (B_4C\ Mass\ in\ Node) * (0.217374)$$

The aluminum mass in the Al_2O_3-B_4C of the node is calculated using the following equation.

$$\begin{matrix} Aluminum\ Mass \\ in\ Al_2O_3\text{-}B_4C \end{matrix} = \left(\frac{100 - B_4C\ wt\%}{100}\right) * \begin{pmatrix} Density\ of \\ Al_2O_3\text{-}B_4C \end{pmatrix} * \begin{pmatrix} Burnable\ Poison \\ Volume\ in\ Node \end{pmatrix} * \left(\frac{2 * 26.981539}{101.961278}\right)$$

The oxygen mass in the Al_2O_3-B_4C of the node is calculated using the following equation.

$$\begin{matrix} Oxygen\ Mass \\ in\ Al_2O_3\text{-}B_4C \end{matrix} = \left[\left(\frac{100 - B_4C\ wt\%}{100}\right) * \begin{pmatrix} Density\ of \\ Al_2O_3\text{-}B_4C \end{pmatrix} * \begin{pmatrix} Burnable\ Poison \\ Volume\ in\ Node \end{pmatrix}\right] - \begin{pmatrix} Aluminum\ Mass \\ in\ Al_2O_3\text{-}B_4C \end{pmatrix}$$

The total mass of the Al_2O_3-B_4C material in the node for the continuation case is the sum of the aluminum, oxygen, and carbon masses calculated from the fresh burnable poison description, plus the depleted B-10 and B-11 masses in the burnable poison of the node obtained from the appropriate previous SAS2H depletion and decay calculation's output. The volume of the burnable poison material in the node must be calculated using the following equation for use in calculating the density of the depleted burnable poison material.

$$\begin{matrix} Volume\ of \\ Burnable\ Poison \\ in\ Node \end{matrix} = \begin{matrix} Burnable\ Poison \\ (Cross\text{-}Sectional\ Area) \\ in\ a\ BPR \end{matrix} * \begin{pmatrix} Number\ of\ BPR's \\ in\ Assembly \end{pmatrix} * (Node\ Height)$$

where the burnable poison cross-sectional area is defined in the CRAFT input deck.

The density of the depleted burnable poison for the continuing depletion SAS2H case is calculated by dividing the total mass of the depleted burnable poison material in the node by the burnable poison volume in the node. The weight percentages of the constituents of the Al_2O_3-B_4C material are calculated and used by CRAFT in generating the SAS2H input deck.

- The CRAFT code has the ability to model burnable poison materials other than Al_2O_3-B_4C. If a burnable poison material other than Al_2O_3-B_4C is specified, the CONTINUATION_WRITER subroutine must calculate the appropriate depleted composition for the continuing depletion SAS2H case. The first step in determining the depleted burnable poison material composition is to calculate the total mass of the depleted burnable poison in the node using the following equation.

$$\begin{array}{c}\text{Depleted Burnable}\\ \text{Poison Total Mass}\\ \text{in Node}\end{array} = \sum_{\substack{\text{All Isotopes}\\ \text{Other Than}\\ B\text{-}10 \text{ and } B\text{-}11}} \left[\left(\frac{\text{Isotope wt\%}}{100}\right)*\left(\begin{array}{c}\text{Original Burnable}\\ \text{Poison Density}\end{array}\right)\right] + \begin{array}{c}B\text{-}10 \text{ and } B\text{-}11 \text{ Mass}\\ \text{in Node from Previous}\\ \text{Depletion Calculation}\end{array}$$

The density of the depleted burnable poison composition is then calculated by dividing the total depleted burnable poison mass in the node by the total burnable poison material volume in the node.

The weight percents of the constituents of the burnable poison composition other than B-10 and B-11 are calculated using the following equation.

$$\begin{array}{c}\text{Weight Percent of}\\ \text{Constituent in}\\ \text{Burnable Poison other}\\ \text{than } B\text{-}10 \text{ and } B\text{-}11\end{array} = \frac{\left(\frac{\begin{array}{c}\text{Original wt\%}\\ \text{of Constituent}\end{array}}{100}\right)*\left(\begin{array}{c}\text{Original Burnable}\\ \text{Poison Density}\end{array}\right)*\left(\begin{array}{c}\text{Burnable Poison}\\ \text{Volume in Node}\end{array}\right)}{\text{Total Mass of Depleted Burnable Poison in Node}} * 100$$

The weight percentages of the constituents of the burnable poison material are calculated and used by CRAFT in generating the SAS2H input deck.

4.10 CUTTER Subroutine

The cutter subroutine creates a consolidated output file for each CRAFT generated SAS2H calculation. This output file contains the time/date stamp from the SAS2H calculation output file, the echo of the SAS2H input deck from the SAS2H output file, and the portion of the final ORIGEN calculation's output produced as part of the SAS2H calculation which contains the light element, actinide, and fission product material compositions relevant to CRC evaluations. The output files generated by the CUTTER subroutine contain the statepoint calculation's base filename followed by the "*.cut" suffix. Section 8 contains a detailed description of the CRAFT generated filenames.

4.11 RETRIEVER Subroutine

The RETRIEVER subroutine reads through the appropriate "*.cut" file to obtain the fuel and burnable poison initial charge compositions for the next SAS2H calculation. Additionally, the RETRIEVER subroutine writes a file which contains a listing of all isotopes and their

concentrations which were present in the ORIGEN output of the SAS2H calculation, but not utilized in the initial charge composition of the next SAS2H calculation. This file is identified by the initial filename identifier corresponding to the SAS2H case which is being generated followed by a "*.notes" suffix. The RETRIEVER subroutine calculates the total mass of the depleted fuel composition in the node which will be used as the initial charge for the next SAS2H calculation. The total oxygen mass in the node, which is calculated in the CONTINUATION_WRITER subroutine, is included in the total fuel mass calculated by RETRIEVER. The weight percentages of each isotope in the fuel composition are then calculated by RETRIEVER to be transferred through an array designation to the CONTINUATION_WRITER subroutine where they will be implemented into the appropriate SAS2H input deck.

4.12 ZEROS Subroutine

The ZEROS subroutine is a utility for converting integer values less than 100 to a two character string representation with leading zeros if necessary.

5. CRAFT Input Summary

The following table summarizes the input card formats and parameters required to perform a CRAFT calculation. The CRAFT input deck filename must be "datain".

Card Number	Special Notes	Card Format	Card Description
1		1 Character	[Y] to signal that this case should pick up from a previous statepoint, any other character equals alternative
1A	★	Integer	Relative cycle number at which to begin the calculation {If Input Card (IC) 1 = "Y"}
1B	★	Integer	Relative statepoint number within the startup cycle at which to begin the calculation {If IC 1 = "Y"}
2		21 Characters	Problem identifier (i.e.,, Crystal River, Unit 3)
3		3 Characters	Problem prefix to be used as an identifier in all filenames
4		15 Characters	SCALE cross-section library to be utilized by SAS2H
5		Real	wt% U-235 enrichment in UO_2
6		Real	Mass of U per assembly (g)
7		Real	Number of fuel rods in assembly
8		Real	Rod pitch in assembly (cm)
9		Real	Fuel pellet diameter (cm)
10		Real	Fuel rod cladding inner diameter (cm)
11		Real	Fuel rod cladding outer diameter (cm)
12		Real	Active fuel length (cm)
13		1 Character	[Y] to indicate that the assembly contains axial blanket fuel, any other character equals alternative
13A	★	Real	wt% U-235 enrichment in UO_2 for axial blanket fuel {If IC 13 = "Y"}

Card Number	Special Notes	Card Format	Card Description
13B	★	Integer	Number of CRC axial nodes containing axial blanket fuel {If IC 13 = "Y"}
13C	★, ℜ	Integer	CRC axial node number(s) (1=top node) containing axial blanket fuel {If IC 13 = "Y"}
14		7 Characters	Spacer grid material identification (ZIRC-4, INCONEL, SS304, SS304S, SS316, SS316S)
14A		Real	Volume fraction of spacer grids in the moderator of the fuel assembly
15		10 Characters	Fuel cladding material identification (ZIRC-4 or ZIRCALLOY4, SS304, SS304S, SS316, SS316S)
15A		Real	Average fuel cladding temperature (K)
16		1 Character	[Y] to indicate if a cladding specification other than Zirc-4 is required by any CR, BPR, or APSR
16A	★	Integer	Total number of special cladding material compositions to be specified other than Zirc-4 {If IC 16 = "Y"}
16B	★, ℜ	Integer	Material mixture number to be used in SAS2H calculations for special cladding composition {If IC 16 = "Y"}
16C	★, ℜ	6 Characters	Special cladding material identification (INCONEL, SS304, SS304S, SS316, SS316S) {If IC 16 = "Y"}
17		Real	System pressure (psia)
18		1 Character	[Y] to indicate if the assembly ever contains a BPRA, any other character equals alternative
18A	★	Integer	Number of reactor cycles in which the assembly contains a BPRA {If IC 18 = "Y"}
18B	★	Integer, Integer	Number of different BPRA designs inserted in assembly throughout its irradiation history, Number of BP material used other than Al_2O_3-B_4C {If IC 18 = "Y"}

Card Number	Special Notes	Card Format	Card Description
18C	★, ℜ	Real, Real, Real, Integer, Integer, Integer	Density of burnable poison (g/cc), B_4C wt% in burnable poison, Cross-sectional area of burnable poison in BPR (cm^2), Number of BPR's in BPRA, SAS2H material mixture number for BPR cladding, SAS2H material mixture number for BP material {If IC 18 = "Y"}
18D	★, ℜ	Integer	Number of radial zones in BPRA Path B model {If IC 18 = "Y"}
18E	★, ℜ	Integer, Real	Material mixture number for zone of BPRA Path B model, Outer radii (cm) for zone of BPRA Path B model (This combination must be specified from inner zone to outer zone.) {If IC 18 = "Y"}
18F	★, ℜ	Integer, Real	Material mixture number for zone of Path B model with removed BPRA, Outer radii (cm) for zone of Path B model with removed BPRA (This combination must be specified from inner zone to outer zone.) {If IC 18 = "Y"}
18G	★, ℜ	Integer, Real	Material mixture number for zone of Path B model for BPRA region above the BP absorber region, Outer radii (cm) for zone of Path B model for BPRA region above the BP absorber region (This combination must be specified from inner zone to outer zone.) {If IC 18 = "Y"}
18H	★, ℜ	5 Characters, Integer	Material in BPR above the BP absorber material (i.e., "AL2O3"), Corresponding SAS2H material mixture number {If IC 18 = "Y"}
18I	★, ℜ	Integer	Number of isotopes in material composition above the BP absorber material in the BPR {If IC 18 = "Y"} & {Value #1 of IC 18H ≠ "AL2O3"}

Card Number	Special Notes	Card Format	Card Description
18J	★, ℜ	Integer, Real	SCALE nuclide identifier in material composition above the BP absorber material in the BPR, Corresponding wt% of nuclide in material composition {If IC 18 = "Y"} & {Value #1 of IC 18H ≠ "AL2O3"}
18K	★	Integer	SAS2H material mixture number to be used for the BP material specified in 18L and 18M {If IC 18 = "Y"} & {Value #2 of IC 18B > 0}
18L	★	Integer	Number of isotopes in the BP absorber material mixture {If IC 18 = "Y"} & {Value #2 of IC 18B > 0}
18M	★, ℜ	Integer, Real	SCALE nuclide identifier in BP absorber material mixture, wt% for nuclide in mixture {If IC 18 = "Y"} & {Value #2 of IC 18B > 0}
18N	★, ℜ	Integer, Integer, Integer, Integer	Relative cycle number containing BPRA, Relative BPRA design number, Top axial node containing BPRA, Bottom axial node containing BPRA {If IC 18 = "Y"}
19		Integer	Number of radial zones in standard Path B model
20	ℜ	Integer, Real	Material mixture number for zone of standard Path B model, Outer radii (cm) for zone of standard Path B model (This combination must be specified from inner zone to outer zone.)
21		Integer	Number of cross-section libraries to be created per irradiation step
22		Integer	SAS2H print level
23		Real	Zone mesh factor for use by XSDRNPM
24		7 Character	[SPECIAL] to indicate the input of 7 XSDRNPM calculational control parameters to follow, any other character string indicates no XSDRNPM calculational control parameter input

Card Number	Special Notes	Card Format	Card Description
24A	✯	Real	XSDRNPM calculational control parameter: Spatial Mesh Factor (SZF < 1 for finer, SZF > 1 for coarser), Default = 1 {If IC 24 = "SPECIAL"}
24B	✯	Integer	XSDRNPM calculational control parameter: Order of Angular Quadrature, Default = 8 {If IC 24 = "SPECIAL"}
24C	✯	Integer	XSDRNPM calculational control parameter: Maximum Number of Inner Iterations, Default = 20 {If IC 24 = "SPECIAL"}
24D	✯	Integer	XSDRNPM calculational control parameter: Maximum Number of Outer Iterations, Default = 25 {If IC 24 = "SPECIAL"}
24E	✯	Real	XSDRNPM calculational control parameter: Overall Convergence Criteria, Default = 0.0001 {If IC 24 = "SPECIAL"}
24F	✯	Real	XSDRNPM calculational control parameter: Scalar Flux Point Convergence, Default = 0.0001 {If IC 24 = "SPECIAL"}
24G	✯	Integer	XSDRNPM calculational control parameter: IUS = 1 for upscatter scaling to speed convergence, IUS = 0 for no scaling, Default = 0 {If IC 24 = "SPECIAL"}
25		Integer	Number of reactor cycles in which the assembly is inserted
26	ℜ	2 Characters	Reactor cycle identifier in which assembly is inserted
27	ℜ	Integer	Number of CRC statepoints in reactor cycle in which the assembly is inserted (BOC is always considered statepoint 1 in a cycle)
28	ℜ	Real	Statepoint EFPD
29	ℜ	Real	Length to statepoint in calendar days
30	ℜ	Real	Downtime at statepoint

Card Number	Special Notes	Card Format	Card Description
31	ℜ	Real	Days of downtime at EOC
32	ℜ	Real	Total cycle length in EFPD
33	ℜ	Real	Total cycle length in calendar days
34	ℜ	Integer	Integer position of assembly in cycle
35		1 Character	Flag to signal if constant or variable irradiation step histories will be specified [Y=variable, N=constant]
36	★, ℜ	Integer	Relative cycle number to which the following boron letdown data applies {If IC 35 = "N"}
37	★, ℜ	Integer	Relative statepoint number in the relative cycle to which the following boron letdown data applies (BOC statepoint equals 1) {If IC 35 = "N"}
38	★, ℜ	Real	Irradiation step length in EFPD {If IC 35 = "N"}
39	★, ℜ	Real	Number of irradiation steps to next statepoint {If IC 35 = "N"}
40	★, ℜ	Real	Mid-point ppmb concentration for irradiation step {If IC 35 = "N"}
41	★, ℜ	Integer	Relative cycle number to which the following boron letdown data applies {If IC 35 = "Y"}
42	★, ℜ	Integer	Relative statepoint number in the relative cycle to which the following boron letdown data applies (BOC statepoint equals 1) {If IC 35 = "Y"}
43	★, ℜ	Real	Number of irradiation steps to next statepoint {If IC 35 = "Y"}
44	★, ℜ	Real, Real	Irradiation step length in EFPD, Mid-point ppmb concentration for irradiation step {If IC 35 = "Y"}
45		Integer	Number of axial nodes for CRC calculation

Card Number	Special Notes	Card Format	Card Description
46	ℜ	Real, Real	Node number, Node height (cm)
47		6 Characters	'RODDED' if any control rod assembly data is to be provided, any other character string equals alternative
47A	★	Integer	Number of previously defined irradiation steps in which the assembly contains a CRA {If IC 47 = "RODDED"}
47B	★, ℜ	Integer, Integer, Integer, Integer, Integer, Integer, Integer	Relative cycle number containing the CRA, Relative statepoint in cycle (BOC=stpt 1), Relative irradiation step number, Top axial node number containing CRA, Bottom axial node number containing CRA, CRA absorber material mixture, CRA design description number {If IC 47 = "RODDED"}
47C	★	Integer	Number of different CRA absorber material mixtures that will be specified for use in this fuel assembly {If IC 47 = "RODDED"}
47D	★, ℜ	Integer	SAS2H material mixture identifier for CRA absorber material mixture {If IC 47 = "RODDED"}
47E	★, ℜ	Integer	Number of isotopes in CRA absorber material mixture {If IC 47 = "RODDED"}
47F	★, ℜ	Integer, Real	SCALE nuclide identifier in CRA absorber material mixture, wt% for nuclide in mixture {If IC 47 = "RODDED"}
47G	★	Integer	Number of different CRA designs that will be specified for use with this fuel assembly {If IC 47 = "RODDED"}
47H	★, ℜ	Real, Integer	CRA absorber material density for design, SAS2H material mixture number for CR cladding in CRA design {If IC 47 = "RODDED"}

Card Number	Special Notes	Card Format	Card Description
47I	★, ℜ	Integer	Number of radial zones in the Path B unit cell model for the assembly containing CRA design {If IC 47 = "RODDED"}
47J	★, ℜ	Integer, Real	Zone mixture identifier for use in CRA design Path B unit cell model, Corresponding zone outer radii (cm) {If IC 47 = "RODDED"}
47K	★, ℜ	Integer, Real	Zone mixture identifier for use in Path B unit cell model after the CRA is removed, Corresponding zone outer radii (cm) {If IC 47 = "RODDED"}
48		6 Characters	'RODDED' if any axial power shaping rod assembly data is to be provided, any other character string equals alternative
48A	★	Integer	Number of previously defined irradiation steps in which the assembly contains an APSR assembly {If IC 48 = "RODDED"}
48B	★, ℜ	Integer, Integer, Integer, Integer, Integer, Integer, Integer, Integer	Relative cycle number containing the APSR, Relative statepoint in cycle (BOC=stpt 1), Relative irradiation step number in cycle, Top axial node number containing APSR, Bottom axial node number containing APSR, APSR absorber material mixture number, APSR assembly design description number, APSR follow rod material mixture number {If IC 48 = "RODDED"}
48C	★	Integer	Number of different APSR assembly absorber material mixtures that will be specified for use with this fuel assembly {If IC 48 = "RODDED"}
48D	★, ℜ	Integer	SAS2H material mixture identifier for APSR assembly absorber material mixture {If IC 48 = "RODDED"}
48E	★, ℜ	Integer	Number of isotopes in APSR assembly absorber material mixture {If IC 48 = "RODDED"}

Card Number	Special Notes	Card Format	Card Description
48F	★, ℜ	Integer, Real	SCALE nuclide identifier in APSR absorber material mixture, wt% for nuclide in mixture {If IC 48 = "RODDED"}
48G	★	Integer	Number of different APSR assembly designs that will be specified for use with this fuel assembly {If IC 48 = "RODDED"}
48H	★, ℜ	Real, Integer	APSR absorber material density for APSR assembly design, SAS2H material mixture number for APSR cladding in APSRA design {If IC 48 = "RODDED"}
48I	★, ℜ	Integer	Number of radial zones in the Path B unit cell model for the assembly containing APSR assembly design {If IC 48 = "RODDED"}
48J	★, ℜ	Integer, Real	Zone mixture identifier for use in APSR assembly design Path B unit cell model, Corresponding zone outer radii (cm) {If IC 48 = "RODDED"}
48K	★, ℜ	Integer, Real	Zone mixture identifier for use in Path B unit cell model after the APSR assembly is removed, Corresponding zone outer radii (cm) {If IC 48 = "RODDED"}
48L	★, ℜ	Integer, Real	Zone mixture identifier for use in Path B unit cell model for the follow rod section of the APSR assembly, Corresponding zone outer radii (cm) {If IC 48 = "RODDED"}
49	ℜ	Integer	Number of axial nodes for fuel temperature input
50	ℜ	Real, Real	Axial node number for fuel temperature input, Corresponding axial node height (cm)
51	ℜ	Real	Axial node fuel temperature input data (F)
52	ℜ	Integer	Number of axial nodes for moderator specific volume input
53	ℜ	Real, Real	Axial node number for moderator specific volume input, Corresponding axial node height (cm)

Card Number	Special Notes	Card Format	Card Description
54	ℜ	Real	Axial node moderator specific volume input data (ft^3/lb)
55	ℜ	Integer	Number of axial nodes for burnup input data
56	ℜ	Real, Real	Axial node number for burnup input, Corresponding axial node height (cm)
57	ℜ	Real	Axial node burnup input data (GWd/MTU)

★: The existence of these input cards is dependent on certain previous input card values. The detailed descriptions for these input cards in Section 7 explain the various dependencies.

ℜ: These are recursive input cards that must be entered multiple times in a specific grouping format. The detailed descriptions for the recursive input cards in Section 7 explain the specific grouping formats and number of required input iterations.

▮: The continuous shaded boxes in the special notes column indicate groupings of recursive input cards. The format and content of these recursive groupings are explained in the detailed input descriptions in Section 7.

6. CRAFT Code Limits and Execution Instructions

The following listing describes the CRAFT code limitations.

1) The maximum number of irradiation steps allowed in a given CRAFT generated SAS2H input deck is 23.
2) The maximum number of isotopes allowed in a CR or APSR absorber material specification is 10.
3) The maximum number of concentric zones allowed in a SAS2H Path B model is 15.
4) The maximum number of axial nodes allowed in any axial format is 50.
5) The maximum number of reactor cycles in which an assembly may be inserted is 10.
6) The maximum number of CRC statepoints allowed in a single reactor cycle (BOC counts as one statepoint) is 20.
7) The maximum number of BPRA design description specifications allowed is 10.
8) The maximum number of different CR absorber material mixtures allowed is 25.
9) The maximum number of CRA design description specifications allowed is 10.
10) The maximum number of APSR absorber material mixtures allowed is 25.
11) The maximum number of APSRA design description specifications allowed is 10.

The procedure for performing a fuel assembly depletion calculation with CRAFT Version 1.0 consists of the following four steps:

1) Create a CRAFT input deck for the assembly depletion calculation.
2) Assure that the CRAFT executable file, the CRAFT input deck entitled "datain", the "batch43" executable file, and the "sedexecute" executable file are in the same directory. The "batch43" executable file is a script file which is used by CRAFT to execute the SCALE code system. An ASCII listing of the "batch43" script is shown in Table 6-1. The "sedexecute" executable file is a script file which is used in conjunction with the CRAFT code to create the consolidated output files described in Section 8 of this document. An ASCII listing of the "sedexecute" script is shown in Table 6-2.
3) Assure that the "sed" line editor is loaded onto the computer system and is in the command path (i.e., executable from the command line through the issuance of the "sed" command).
4) Execute CRAFT.

Table 6-1 Listing of the "batch43" Script Required for the Execution of CRAFT

```
#!/bin/csh
if ( ! ( $?SCALE ) )   setenv SCALE /neutronics/Scale4.3
setenv CMDS $SCALE/cmds
set pid=`$CMDS/ppid`
setenv TMPDIR /users/wright/scale4.3/tmp
if ( -e $1 ) then
  set input=$1
  set output=$1:r.output
  set msgs=$1:r.msgs
else if ( -e $1.inp ) then
  set input=$1.inp
  set output=$1.out
  set msgs=$1.msg
else if ( -e $1.input ) then
  set input=$1.input
  set output=$1.output
  set msgs=$1.msgs
else
  echo ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  echo          "the input file you specified does not exist"
  echo ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
  exit
endif
$CMDS/scale43 $input $output >& $msgs
rm -r $TMPDIR
```

The stucture of the "batch43" script shown in Table 6-1 is only understandable if examined in the context in which it is used in the CRAFT code.

Table 6-2 Listing of the "sedexecute" Script Required for the Execution of CRAFT

```
print
'************************************************************************'
```

```
> $1.cut
print '*    Date and Time Validation Stamp for the Execution of the SAS2H Case
  *' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print ' ' >> $1.cut
sed -n $3,$4p $1.output >> $1.cut
print ' ' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print '*           Echo of SAS2H Input Deck Obtained from SAS2H Output
  *' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print ' ' >> $1.cut
sed -n "/1          primary module access and input record/,/      '     end
of input/p" $1.output >> $1.cut
print ' ' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print '* SAS2H Output Relevant to CRC Evaluations Obtained from Final ORIGEN
Case *' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print ' ' >> $1.cut
sed -n "$2,/0 halt/p" $1.output >> $1.cut
print ' ' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print '*        End of Extracted SAS2H Output Relevant to CRC Evaluations
  *' >> $1.cut
print
'*******************************************************************************'
>> $1.cut
print ' ' >> $1.cut
```

The stucture of the "sedexecute" script shown in Table 6-1 is only understandable if examined in the context in which it is used in the "CUTTER" subroutine of the CRAFT code. The "sed" command issued in the "sedexecute" script initiates the execution of the sed line editor.

7. Detailed Descriptions of CRAFT Input Cards

Input Card Number		Detailed Description
1	:	The CRAFT code is capable of continuing an assembly depletion/decay calculation from a statepoint other than the BOC statepoint of relative cycle number one. The requirements for continuing a CRAFT calculation from an arbitrary statepoint include the following-- 1) all CRAFT input for the statepoints prior to the continuation statepoint must be specified in the CRAFT input deck for the continuation calculation; 2) all "*.cut" files from the last statepoint calculation prior to the continuation statepoint, for each node, must be present in the CRAFT execution directory. If the CRAFT calculation is a continuation calculation, an uppercase letter "Y" should be placed in column 1 of this card. Otherwise, any character other than "Y" will signal that the CRAFT calculation is to begin from BOC of relative cycle number one as defined in the CRAFT input deck.
1A	:	This card should only be specified if the value of card number 1 is "Y". This card should contain an integer value representing the relative cycle number as specified in the CRAFT input deck from which the calculation should commence. The relative cycle number refers to the sequential cycle number in which the assembly is inserted. The relative cycle number is not the cycle identifier. For example, if a CRAFT calculation is to be performed for an assembly inserted in the actual reactor cycles 1 and 4, input data for the assembly would be provided to CRAFT for cycles 1 and 4, in that order. Cycle 1 would be considered relative cycle number 1, and cycle 4 would be considered relative cycle number 2.
1B	:	This card should only be specified if the value of card number 1 is "Y". This card should contain an integer value representing the relative statepoint, within the continuation relative cycle number provided on card 1A, from which the calculation should commence.

Input Card Number		Detailed Description
2	:	This card should contain a 21 character problem identifier which will be placed on all SAS2H input decks and echoed throughout the SAS2H output. The problem identifier must be placed in columns 1 through 21 of this card. An example of a problem identifier would be "Crystal River, Unit 3".
3	:	This card should contain a 3 character prefix which will be used as the initial 3 characters of each file generated in the CRAFT calculation. The prefix must be placed in columns 1 through 3 of this card. An example of a prefix meaningful for use with the problem identifier example previously provided would be "CR3".
4	:	This card should contain the identifier for the SCALE cross-section library which is to be used in all of the SAS2H calculations generated by the CRAFT calculation. Available SCALE cross-section libraries include the following-- 1) 44GROUPNDF5 or 44group; 2) 27BURNUPLIB; 3) 27GROUPNDF4; 4) 238GROUPNDF5; 5) HANSEN-ROACH. The 44group cross-section library is recommended for use in all CRAFT calculations relevant to Commercial Reactor Critical evaluations.
5	:	This card should contain the weight percent of U-235 in the UO_2 fuel of the assembly. This value should not be adjusted to compensate for axial blanket fuel. Axial blanket fuel descriptions provided later in the CRAFT input deck will override the enrichment specified on this card as appropriate.
6	:	This card should contain the total mass of uranium metal in the fuel assembly in units of grams per assembly.
7	:	This card should contain the number of fuel rods in the assembly.
8	:	This card should contain the rod pitch in the assembly in units of cm.

Input Card Number		Detailed Description
9	:	This card should contain the nominal fuel pellet diameter in the assembly in units of cm.
10	:	This card should contain the nominal fuel rod cladding inner diameter in the assembly in units of cm.
11	:	This card should contain the nominal fuel rod cladding outer diameter in the assembly in units of cm.
12	:	This card should contain the nominal active fuel length in the assembly in units of cm.
13	:	The CRAFT code is capable of modeling fuel assemblies which utilize axial blanket fuel designs. If the assembly utilizes an axial blanket fuel design, an uppercase letter "Y" should be placed in column 1 of this card. If the assembly does not utilize an axial blanket fuel design, any character other than "Y" should be specified.
13A	:	This card should only be specified if the value of card number 13 is "Y". This card should contain the weight percent of U-235 in the UO_2 fuel of the axial blanket region of the assembly.
13B	:	This card should only be specified if the value of card number 13 is "Y". This card should contain an integer number representing the number of CRC axial nodes that will contain the axial blanket fuel.
13C	:	This card should only be specified if the value of card number 13 is "Y". This card should contain a single integer value which identifies a CRC axial node containing axial blanket fuel. This input card must be repeated a number of times equal to the value specified on input card 13B.
14	:	This card should contain a 7 character name, beginning in column 1, which specifies the spacer grid material. The currently available spacer grid material specifications include--

1) ZIRC-4
2) INCONEL
2) SS304
3) SS304S
4) SS316
5) SS316S.

Input Card Number		Detailed Description
14A	:	This card should contain a value representing the volume fraction of the moderated region of the fuel assembly which is displaced by spacer grid material. The sum of the moderator volume fraction and the spacer grid volume fraction should equal one. The moderator and spacer grid volumes present in the assembly-to-assembly spacing region may also be included in calculation of the spacer grid volume fraction to be input on this card.
15	:	This card should contain the identification of the fuel cladding material. The identification must be specified in columns 1 through 10. The currently available cladding material specifications include-- 1) Zirc-4 or ZIRCALLOY4 2) INCONEL 3) SS304 4) SS304S 5) SS316 6) SS316S.
15A	:	This card should contain an average fuel rod cladding temperature value in units of degrees Kelvin that will be used consistently throughout the CRAFT generated SAS2H calculations.
16	:	The CRAFT code is capable of modeling CRA's, APSRA's, and BPRA's with cladding material compositions other than the default Zirc-4. If any cladding material must be specified other than the default Zirc-4, an uppercase letter "Y" should be placed in column 1 of this card. If Zirc-4 is the only cladding material utilized in the CRAFT calculation, any character other than "Y" should be specified.
16A	:	This card should only be specified if the value of card number 16 is "Y". This card should contain an integer value specifying the number of additional cladding materials to be specified other than the default cladding material Zirc-4.

Input Card Number		Detailed Description

Input cards 16B and 16C represent an input grouping that must be specified recursively for each cladding material as denoted on input card 16A. This means that input cards 16B and 16C would be input for the first cladding material, and then input again for the second cladding material, etc., until all of the cladding materials other than Zirc-4 which are utilized in the CRAFT calculation, as specified on input card 16A, have been described.

16B : This card should only be specified if the value of card number 16 is "Y". This card should contain an integer value representing the material mixture number which corresponds to a cladding material specification that may be specified in the SAS2H input decks generated by the CRAFT calculation.

16C : This card should only be specified if the value of card number 16 is "Y". This card should contain either a 5 or 6 character identifier corresponding to the cladding material. The cladding material identifiers currently available in CRAFT include the following--

1) SS304
2) SS304S
3) SS316
4) SS316S.
5) INCONEL

17 : This card should contain the system pressure in units of psi.

18 : The CRAFT code is capable of modeling an assembly that contains a BPRA. Usually, fuel assemblies may contain a BPRA in one cycle but not in subsequent cycles. If the fuel assembly for which the CRAFT calculation is to be performed contains a BPRA in any of its specified reactor cycles, an uppercase letter "Y" should be placed in column 1 of this card. Any other character signifies that the assembly never contains a BPRA.

18A : This card should only be specified if the value of card number 18 is "Y". This card should contain an integer value representing the number of reactor cycles in which the fuel assembly contains a BPRA.

Input Card Number		Detailed Description
18B	:	This card should only be specified if the value of card number 18 is "Y". This card should contain two integer values delineated by spaces. The first value represents the number of different BPRA designs inserted in the fuel assembly during its irradiation history. The second value represents the number of BP absorber materials other than the default, Al_2O_3-B_4C, which are utilized during the irradiation of the assembly as specified in the CRAFT calculation.

Input cards 18C through 18J represent an input grouping that must be specified recursively for each BPRA design as denoted on input card 18B. This means that input cards 18C through 18J would be input for BPRA design 1, and then input again for BPRA design 2, etc., until all of the number of BPRA designs specified on input card 18B have been described.

18C	:	This card should only be specified if the value of card number 18 is "Y". This card should contain 6 values delineated by spaces. The first value should be the density of the Al_2O_3-B_4C burnable absorber material. The second value should be the weight percent of the B_4C in the Al_2O_3-B_4C absorber material. The third value should be the cross-sectional area of the burnable poison material in a single BPR. The fourth value should be the number of BPR's in the BPRA. The fifth value should be the BPR cladding material mixture number to be utilized in the CRAFT generated SAS2H calculations. The sixth value should be the BP absorber material mixture number to be utilized in the CRAFT generated SAS2H calculations.
18D	:	This card should only be specified if the value of card number 18 is "Y". This card should contain the integer number of radial zones that will be used to describe the SAS2H Path B model for the assembly node containing the BPRA.
18E	:	This card should only be specified if the value of card number 18 is "Y". This card contains the description of a single radial zone in the SAS2H Path B model for the assembly containing the BPRA. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 18D.

Input Card Number		Detailed Description
18F	:	This card should only be specified if the value of card number 18 is "Y". If an assembly contains a BPRA in one cycle but not in another, an alternative SAS2H Path B model must be provided that describes the assembly after removal of the BPRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the BPRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly node with the BPRA removed. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 18D.
18G	:	This card should only be specified if the value of card number 18 is "Y". Some BPR designs incorporate a non-absorbing region above the poison region in the BPR. To accomodate this type of BPR design an alternative SAS2H Path B model must be provided that describes the BPR assembly above the poison region of the BPR. This alternative Path B model must contain the same number of radial zones as the Path B model with the BPRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly node containing the BPRA region above the poison region of the BPR. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 18D.

Input Card Number		Detailed Description
18H	:	This card should only be specified if the value of card number 18 is "Y". This card contains a five character entry followed by an integer entry. This card should contain the 5 character string "AL2O3" if the material in the non-absorbing region of the BPR (above the poison region of the BPR) is composed of Al2O3. Any other character string indicates that a material other than Al2O3 is present in the BPR above the poison region. The integer entry of this card should be the SAS2H material mixture number for the material within the BPR above the BP absorbing region.
18I	:	This card should only be specified if the value of card number 18 is "Y", and the character string specified on input card 18H is not "AL2O3". This card should contain an integer value indicating the number of isotopes in the composition of the material contained within the BPR above the poison region.
18J	:	This card should only be specified if the value of card number 18 is "Y", and the character string specified on input card 18H is not "AL2O3". This card should contain an integer value and a floating-point value. The first value specified on this card should be an integer representing the SCALE nuclide identifier for a constituent of the material composition within the BPR above the poison region. The second value should be a floating-point value representing the corresponding wt% of this nuclide in the material composition. This input card should be repeated a number of times equal to that specified on input card 18I.
18K	:	This card should only be specified if the last value of card number 18B is greater than zero. This card should contain an integer value representing the SAS2H material mixture number for the BP absorber material being specified on cards 18L and 18M.
18L	:	This card should only be specified if the last value of card number 18B is greater than zero. This card should contain an integer value specifying the number of isotopes in the BP absorber material mixture specified on input card 18K.

Input Card Number		Detailed Description
18M	:	This card should only be specified if the last value of card number 18B is greater than zero. This card should contain two values delineated by spaces. The first value should be the SCALE nuclide identifier corresponding to a constituent of the BP absorber material mixture specified on input card 18K. The second value should be the weight percent of the nuclide, identified by the first value, in the BP absorber material mixture specified on input card 18K. If the BP absorber material contains boron, the SCALE nuclide identifiers for B-10 and B-11 must be specified explicitly. This input card must be repeated a number of times equal to that specified on input card 18L such that data for all nuclides in the BP absorber material mixture are provided, and the sum of the weight percents of the nuclides in the mixture equals 100.
18N	:	This card should only be specified if the value of card number 18 is "Y". This input card contains four integer values delineated by spaces. The first value is the relative cycle number containing a BPRA. The second value is the relative BPRA design number corresponding to the order in which information was provided in the groupings of input cards 18C through 18F. The third value is the upper CRC axial node number containing the BPRA (the topmost CRC node number is always considered 1). The fourth value is the lower CRC axial node number containing the BPRA. This input card must be repeated a number of times equal to the value specified on input card 18A.
19	:	This card should contain an integer value representing the number of radial zones in the SAS2H Path B model for the fuel assembly as it would be if the assembly never contained a BPRA, a CRA, or an APSR assembly during its irradiation history. This is called the standard Path B model.
20	:	This card contains the description of a single radial zone in the standard Path B model for the fuel assembly. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius (cm) of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 19.

Input Card Number		Detailed Description
21	:	This card should contain an integer value representing the number of cross-section libraries that are to be produced for each irradiation step in the SAS2H calculations generated by CRAFT. The number of cross-section libraries per irradiation step for CRC evaluations should be set to 1.
22	:	This card should contain an integer value representing the SAS2H print level desired for the output of SAS2H calculations generated by CRAFT. The minimum print level allowed for CRC evaluations is 5. A complete listing and description of the available print levels is provided on page S2.5.18 of reference 1.
23	:	This card should contain the zone mesh factor that should be utilized by XSDRNPM in the SAS2H calculations generated by CRAFT. A description of the zone mesh factor is provided on page S2.5.5 of reference 1.
24	:	The CRAFT calculation allows the specification of special XSDRNPM control parameters that will be utilized in SAS2H calculations generated by CRAFT. If any of the special control parameters described in cards 24A through 24G are to be specified, the character string "SPECIAL" must be provided in columns 1 through 7 of this card. Any other character string specification indicates that the default XSDRNPM control parameters are to be utilized.
24A	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter SZF. The size of the largest spatial mesh interval can be adjusted by entering a value for SZF. SZF less than 1 indicates a finer mesh spacing. SZF greater than one indicates a coarser mesh spacing. SZF equal to 1 is the default.
24B	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter ISN. The ISN value specifies the order of angular quadrature for XSDRNPM. Quadrature sets are geometry-dependent quantities that are defaulted to a value of 8.

Input Card Number		Detailed Description
24C	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter IIM. The IIM value specifies the maximum number of inner iterations to be used by XSDRNPM. The default value is 20.
24D	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter ICM. The ICM value specifies the maximum number of outer iterations to be used by XSDRNPM. The default value is 25.
24E	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter EPS. The EPS value specifies the overall convergence criteria. This value is used by XSDRNPM after each outer iteration to determine if the problem has converged. The default value of EPS is 0.0001. A smaller value tightens the convergence criteria, and a larger value loosens the convergence criteria.
24F	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter PTC. The PTC value specifies the point flux convergence criteria used by XSDRNPM to determine if convergence has been achieved after an inner iteration. The default value of PTC is 0.0001. A smaller value tightens the convergence criteria, and a larger value loosens the convergence criteria.
24G	:	This card should only be specified if the value of card number 24 is "SPECIAL". This card contains the XSDRNPM calculational control parameter IUS. The IUS value is a flag to direct XSDRNPM to use an upscatter scaling technique to accelerate the solution or force convergence. The default value is 0, which indicates that upscatter scaling is not used. An IUS value of 1 directs XSDRNPM to use the upscatter scaling technique. The default value is 0.
25	:	This card should specify an integer number of reactor cycles in which the fuel assembly is inserted in the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 26 through 34 represent an input grouping that must be specified recursively for each reactor cycle in which the fuel assembly is inserted in the CRAFT calculation as denoted on input card 25. This means that input cards 26 through 34 would be input for the first reactor cycle, and then input again for the second reactor cycle, etc., until all of the number of reactor cycles specified on input card 25 have been described.

26	:	This card should contain a 2 character reactor cycle identifier that will be used to identify the cycle on appropriate SAS2H input decks generated by the CRAFT calculation. For example, if the first reactor cycle were identified as "Cycle-1A", the value of this input card should be "1A". If a reactor cycle were identified as "Cycle-1", the value of this input card should be "01", etc...
27	:	This card should contain an integer value specifying the number of CRC statepoints in the reactor cycle specified on input card number 25. The BOC is always considered statepoint 1 in a CRC evaluation. For example, if the reactor cycle specified on card 25 contained one mid-cycle CRC statepoint, the value specified on this card would be 2.

Input cards 28 through 30 represent an input grouping that must be specified recursively for each CRC statepoint in the reactor cycle as denoted on input card 27. This means that input cards 28 through 30 would be input for the first statepoint (BOC), and then input again for the second statepoint, etc., until all of the number of CRC statepoints in the reactor cycle as specified on input card 27 have been described.

28	:	This card should contain a value specifying the EFPD for the statepoint. If the first statepoint in a reactor cycle (BOC) is being described, the value of this card should be 0.
29	:	This card should contain a value specifying the length in calendar days from the BOC to the CRC statepoint. If the first statepoint in a reactor cycle (BOC) is being described, the value of this card should be 0.
30	:	This card should contain a value specifying the downtime in calendar days for the reactor shutdown at the CRC statepoint. If the first statepoint in a reactor cycle (BOC) is being described, the value of this card should be 0.
31	:	This card should contain a value specifying the downtime in calendar days at the EOC reactor shutdown.

Input Card Number		Detailed Description
32	:	This card should contain a value specifying the total EFPD for the reactor cycle from the BOC startup to the EOC shutdown.
33	:	This card should contain a value specifying the total cycle length in calendar days from the BOC startup to the EOC shutdown.
34	:	This card should contain an integer value less than 100 that specifies the position of the fuel assembly in the symmetrical representation of the reactor core. Typically, a CRC evaluation is performed using core symmetry to reduce the overall calculation time required to perform the evaluation. When core symmetry is used, the input parameters utilized in the CRAFT calculation for each node of an assembly are the average of the parameters from each symmetric core location corresponding to the assembly node. Usually, one-eighth core symmetry is utilized in performing CRC evaluations.
35	:	This card should contain a single character to signal to CRAFT whether variable or constant irradiation step description data will be provided. The variable irradiation step description input allows the specification of unique irradiation step durations for each irradiation step in a statepoint calculation. This option may be useful when modeling rodded cycles. The constant irradiation step duration applies the same irradiation step length to a specified number of irradiation steps in a given statepoint calculation. The character "Y" placed in column one of the input card specifies variable irradiation step duration input. The character "N" placed in column one of the input card specifies constant irradiation step duration input.

Input cards 36 through 40 should be specified only if the value of input card 35 is "N". Input cards 36 through 40 represent an input grouping that must be specified recursively for each reactor cycle in which the fuel assembly is inserted in the CRAFT calculation as denoted on input card 25. This means that input cards 36 through 40 would be input for the first reactor cycle, and then input again for the second reactor cycle, etc., until all of the number of reactor cycles specified on input card 25 have been described.

Input Card Number		Detailed Description
36	:	This card should only be specified if the value of card number 35 is "N". This card should contain an integer value specifying the relative cycle number to which the input data provided in the current grouping of input cards 36 through 40 apply. For example, if the CRAFT calculation involved two reactor cycles labeled Cycle-1 and Cycle-5, the relative cycle number corresponding to Cycle-5 would be specified as 2.

Input cards 37 through 40 represent an input grouping that must be specified recursively for the SAS2H calculations commencing from each statepoint in the relative reactor cycle specified on input card 36. This means that input cards 37 through 40 would be input for the first statepoint calculation (BOC to statepoint 2) in the reactor cycle, and then input again for the second statepoint calculation (perhaps statepoint 2 to statepoint 3) in the reactor cycle, etc., until all of the statepoint calculations in the reactor cycle, as specified on input card 27 corresponding to the appropriate reactor cycle, have been described. The last iteration of input cards 37 through 40 for a given reactor cycle should correspond to the last mid-cycle statepoint to EOC SAS2H calculation.

37	:	This card should only be specified if the value of card number 35 is "N". This card should contain an integer value corresponding to the relative statepoint calculation number in the reactor cycle for which input data is being provided. The BOC to mid-cycle statepoint 2 calculation is always considered relative statepoint calculation 1. The last mid-cycle statepoint to EOC calculation is always considered the last relative statepoint calculation in a given reactor cycle.
38	:	This card should only be specified if the value of card number 35 is "N". This card should contain a value specifying the irradiation step length in EFPD for the SAS2H statepoint calculation for which input data is being provided. If the value on input card 35 is "N", the CRAFT code only allows the use of a fixed irradiation step length in each generated SAS2H calculation. However, different irradiation step lengths may be specified for different CRAFT generated SAS2H calculations.
39	:	This card should only be specified if the value of card number 35 is "N". This card should contain an integer value specifying the number of irradiation steps to be utilized in the CRAFT generated SAS2H calculation corresponding to the statepoint calculation for which input data is being provided.

Input Card Number		Detailed Description
40	:	This card should only be specified if the value of card number 35 is "N". This card should contain the soluble boron concentration in units of ppmb at the mid-point of a given irradiation step in the current statepoint calculation for which input data is being provided. This input card must be repeated a number of times equal to that specified on input card 39. The order of repetition of this input card should be such that the initial ppmb concentration corresponds to the first irradiation step, and the final ppmb concentration corresponds to the last irradiation step in the statepoint calculation of interest.

Input cards 41 through 44 should be specified only if the value of input card 35 is "Y". Input cards 41 through 44 represent an input grouping that must be specified recursively for each reactor cycle in which the fuel assembly is inserted in the CRAFT calculation as denoted on input card 25. This means that input cards 41 through 44 would be input for the first reactor cycle, and then input again for the second reactor cycle, etc., until all of the number of reactor cycles specified on input card 25 have been described.

41	:	This card should only be specified if the value of card number 35 is "Y". This card should contain an integer value specifying the relative cycle number to which the input data provided in the current grouping of input cards 41 through 44 apply. For example, if the CRAFT calculation involved two reactor cycles labeled Cycle-1 and Cycle-5, the relative cycle number corresponding to Cycle-5 would be specified as 2.

Input cards 42 through 44 represent an input grouping that must be specified recursively for the SAS2H calculations commencing from each statepoint in the relative reactor cycle specified on input card 41. This means that input cards 42 through 44 would be input for the first statepoint calculation (BOC to statepoint 2) in the reactor cycle, and then input again for the second statepoint calculation (perhaps statepoint 2 to statepoint 3) in the reactor cycle, etc., until all of the statepoint calculations in the reactor cycle, as specified on input card 27 corresponding to the appropriate reactor cycle, have been described. The last iteration of input cards 42 through 44 for a given reactor cycle should correspond to the last mid-cycle statepoint to EOC SAS2H calculation.

Input Card Number		Detailed Description
42	:	This card should only be specified if the value of card number 35 is "Y". This card should contain an integer value corresponding to the relative statepoint calculation number in the reactor cycle for which input data is being provided. The BOC to mid-cycle statepoint 2 calculation is always considered relative statepoint calculation 1. The last mid-cycle statepoint to EOC calculation is always considered the last relative statepoint calculation in a given reactor cycle.
43	:	This card should only be specified if the value of card number 35 is "Y". This card should contain an integer value specifying the number of irradiation steps to be utilized in the CRAFT generated SAS2H calculation corresponding to the statepoint calculation for which input data is being provided.
44	:	This card should only be specified if the value of card number 35 is "Y". This card should contain two real values delineated by spaces. The first value on this card should specify the irradiation step length in EFPD for the SAS2H statepoint calculation for which input data is being provided. The second value on this card should specify the soluble boron concentration in units of ppmb at the mid-point of a given irradiation step in the current statepoint calculation for which input data is being provided. This input card must be repeated a number of times equal to that specified on input card 43. The order of repetition of this input card should be such that the initial ppmb concentration corresponds to the first irradiation step, and the final ppmb concentration corresponds to the last irradiation step in the statepoint calculation of interest.
45	:	This card should contain an integer value corresponding to the number of axial nodes utilized in the CRC evaluation.
46	:	This card contains two integer values delineated by spaces. The first value specifies an axial node number in the CRC axial format. The second value specifies the corresponding node height in units of cm. This card must be repeated a number of times equal to that specified on input card 45. The repetition of this card should be performed such that the CRC axial node data is provided in sequential order (i.e., node 1 through node N, where N is the final node). Node 1should always be specified as the top node of the fuel assembly.

Input Card Number		Detailed Description
47	:	The CRAFT code is capable of modeling an assembly that contains a CRA. If the fuel assembly for which the CRAFT calculation is to be performed contains a CRA in any of its specified reactor cycles, the character string "RODDED" should be placed in columns 1 through 6 of this card. Any other character string signifies that the assembly never contains a CRA.
47A	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of previously defined irradiation steps in the CRAFT calculation in which the fuel assembly contains a CRA.

Input Card Number		Detailed Description
47B	:	This card should only be specified if the value of card number 47 is "RODDED". This card must be repeated a number of times equal to that specified on input card 47A. This card should contain 8 integer values delineated by spaces. The first integer value specifies the relative cycle number in the CRAFT calculation in which a CRA is inserted. The second integer value specifies the relative statepoint calculation number in which a CRA is inserted in the cycle identified by the first value of this card. The BOC to statepoint 1 is always considered statepoint calculation 1. The third value specifies the relative irradiation step number in the statepoint calculation identified by the second value of this card in which the CRA is inserted. The fourth value specifies the upper CRC axial node of the axial assembly section containing the CRA in the relative irradiation step specified by the third value of this card. The top node in the CRC axial format is always node 1. The fifth value specifies the lower CRC axial node of the axial assembly section containing the CRA in the relative irradiation step specified by the third value of this card. The CRAFT code is capable of modeling numerous CRA absorber material mixtures and CRA designs for insertion in an assembly throughout its irradiation history. The sixth value specifies the CRA absorber material mixture number for SAS2H corresponding to the CRA described on this card. The CRA absorber material specifications and mixture numbers are specified on input cards 47C through 47F. The seventh value specifies the CRA design description number corresponding to the CRA described on this card. The CRA design inputs are specified on input cards 47G through 47K. The CRA design description number corresponds to the relative position in which the relevant CRA design description input is provided in the CRAFT input deck.
47C	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of different CRA absorber material mixtures which must be specified for use in the various CRA designs which are inserted in the fuel assembly during its irradiation history relevant to the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 47D through 47F represent an input grouping that must be specified recursively for each CRA absorber material mixture used in the CRAFT calculation as denoted on input card 47C. This means that input cards 47D through 47F would be input for the first CRA absorber material mixture, and then input again for the second CRA absorber material mixture, etc., until all of the CRA absorber material mixtures specified on input card 47C have been described.

47D	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value denoting the material mixture number that should be utilized in the CRAFT generated SAS2H calculations to identify the CRA absorber material mixture for which input is being provided.
47E	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of isotopes in the CRA absorber material mixture specified on input card 47D.
47F	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain two values delineated by spaces. The first value should be the SCALE nuclide identifier corresponding to a constituent of the CRA absorber material mixture specified on input card 47D. The second value should be the weight percent of the nuclide, identified by the first value, in the CRA absorber material mixture specified on input card 47D. This input card must be repeated a number of times equal to that specified on input card 47E such that data for all nuclides in the CRA absorber material mixture are provided, and the sum of the weight percents of the nuclides in the mixture equals 100.
47G	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of different CRA design descriptions that will be specified for use in the CRAFT calculation.

Input cards 47H through 47K represent an input grouping that must be specified recursively for each CRA design used in the CRAFT calculation as denoted on input card 47G. This means that input cards 47H through 47K would be input for the first CRA design description, and then input again for the second CRA design description, etc., until all of the CRA design descriptions specified on input card 47G have been described. The order in which the CRA design descriptions are provided determines the relative CRA design number which corresponds to the description.

Input Card Number		Detailed Description
47H	:	This card should only be specified if the value of card number 47 is "RODDED". This card contains two values delineated by spaces. The first value should specify the absorber material density in units of g/cc for the CRA design for which input is being provided. The second value should be an integer specifying the SAS2H material mixture number for the CR cladding in the CRA design for which input is being provided.
47I	:	This card should only be specified if the value of card number 47 is "RODDED". This card should contain an integer value specifying the number of radial zones utilized in the SAS2H Path B model for the fuel assembly containing the CRA design for which input is being provided.
47J	:	This card should only be specified if the value of card number 47 is "RODDED". This card contains the description of a single radial zone in the SAS2H Path B model for the fuel assembly containing the CRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 47I.
47K	:	This card should only be specified if the value of card number 47 is "RODDED". If an assembly contains a CRA in one cycle but not in another, an alternative SAS2H Path B model must be provided that describes the assembly after removal of the CRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the CRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly after the removal of the CRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 47I.

Input Card Number		Detailed Description
48	:	The CRAFT code is capable of modeling a fuel assembly that contains a APSRA. If the fuel assembly for which the CRAFT calculation is to be performed contains an APSRA in any of its specified reactor cycles, the character string "RODDED" should be placed in columns 1 through 6 of this card. Any other character string signifies that the assembly never contains an APSRA.
48A	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of previously defined irradiation steps in the CRAFT calculation in which the fuel assembly contains an APSRA.

Input Card Number		Detailed Description
48B	:	This card should only be specified if the value of card number 48 is "RODDED". This card must be repeated a number of times equal to that specified on input card 48A. This card should contain 7 integer values delineated by spaces. The first integer value specifies the relative cycle number in the CRAFT calculation in which a APSRA is inserted. The second integer value specifies the relative statepoint calculation number in which a APSRA is inserted in the cycle identified by the first value of this card. The BOC to statepoint 1 is always considered statepoint calculation 1. The third value specifies the relative irradiation step number in the statepoint calculation identified by the second value of this card in which the APSRA is inserted. The fourth value specifies the upper CRC axial node of the axial assembly section containing the APSRA in the relative irradiation step specified by the third value of this card. The top node in the CRC axial format is always node 1. The fifth value specifies the lower CRC axial node of the axial assembly section containing the APSRA in the relative irradiation step specified by the third value of this card. The CRAFT code is capable of modeling numerous APSRA absorber material mixtures and APSRA designs for insertion in an assembly throughout its irradiation history. The sixth value specifies the APSRA absorber material mixture number for SAS2H corresponding to the APSRA described on this card. The APSRA absorber material specifications and mixture numbers are specified on input cards 48C through 48F. The seventh value specifies the APSRA design description number corresponding to the APSRA described on this card. The APSRA design inputs are specified on input cards 48G through 48K. The APSRA design description number corresponds to the relative position in which the relevant APSRA design description input is provided in the CRAFT input deck. The eighth value is the SAS2H material mixture number corresponding to the APSR follow rod material.
48C	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of different APSRA absorber material mixtures which must be specified for use in the various APSRA designs which are inserted in the fuel assembly during its irradiation history relevant to the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 48D through 48F represent an input grouping that must be specified recursively for each APSRA absorber material mixture used in the CRAFT calculation as denoted on input card 48C. This means that input cards 48D through 48F would be input for the first APSRA absorber material mixture, and then input again for the second APSRA absorber material mixture, etc., until all of the APSRA absorber material mixtures specified on input card 48C have been described.

48D	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value denoting the material mixture number that should be utilized in the CRAFT generated SAS2H calculations to identify the APSRA absorber material mixture for which input is being provided.
48E	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of isotopes in the APSRA absorber material mixture specified on input card 48D.
48F	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain two values delineated by spaces. The first value should be the SCALE nuclide identifier corresponding to a constituent of the APSRA absorber material mixture specified on input card 48D. The second value should be the weight percent of the nuclide, identified by the first value, in the APSRA absorber material mixture specified on input card 48D. This input card must be repeated a number of times equal to that specified on input card 48E such that data for all nuclides in the APSRA absorber material mixture are provided, and the sum of the weight percents of the nuclides in the mixture equals 100.
48G	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of different APSRA design descriptions that will be specified for use in the CRAFT calculation.

Input Card Number		Detailed Description

Input cards 48H through 48L represent an input grouping that must be specified recursively for each APSRA design used in the CRAFT calculation as denoted on input card 48G. This means that input cards 48H through 48L would be input for the first APSRA design description, and then input again for the second APSRA design description, etc., until all of the APSRA design descriptions specified on input card 48G have been described. The order in which the APSRA design descriptions are provided determines the relative APSRA design number which corresponds to the description.

48H	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain two values delineated by spaces. The first value should specify the absorber material density in units of g/cc for the APSRA design for which input is being provided. The second value should be an integer specifying the SAS2H material mixture for the APSR cladding in the APSRA for which input is being provided.
48I	:	This card should only be specified if the value of card number 48 is "RODDED". This card should contain an integer value specifying the number of radial zones utilized in the SAS2H Path B model for the fuel assembly containing the APSRA design for which input is being provided.
48J	:	This card should only be specified if the value of card number 48 is "RODDED". This card contains the description of a single radial zone in the SAS2H Path B model for the fuel assembly containing the APSRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 48I.

Input Card Number		Detailed Description
48K	:	This card should only be specified if the value of card number 48 is "RODDED". If an assembly contains a APSRA in one cycle but not in another, an alternative SAS2H Path B model must be provided that describes the assembly after removal of the APSRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the APSRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the assembly after the removal of the APSRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 48I.
48L	:	This card should only be specified if the value of card number 48 is "RODDED". APSRA designs typically utilize follow rods which are not of the same material composition as the APSR cladding. To facilitate modeling of the APSR follow rod region, an alternative SAS2H Path B model must be provided that describes the follow rod region of the APR's above the poison region in the APSRA. This alternative Path B model must contain the same number of radial zones as the Path B model with the APSRA inserted. This card contains the description of a single radial zone in the SAS2H Path B model for the follow rod region of the APSRA design for which input is being provided. This card should contain two values delineated by spaces. The first of which should be an integer value representing the SAS2H material mixture number for the Path B model radial zone which this card represents. The second value should be the outer radius of the Path B model radial zone which this card represents. This input card must be repeated a number of times equal to that specified on input card 48I.

Input Card Number		Detailed Description

Input cards 49 through 51 represent an input grouping that must be specified recursively for each statepoint calculation to be generated by the CRAFT calculation. This means that input cards 49 through 51 would be input for the first statepoint calculation (BOC to statepoint 2 of relative cycle number 1), and then input again for the second statepoint calculation, etc., until all of the statepoint calculations to be generated by CRAFT have been addressed (the final statepoint calculation would be that ending at the final statepoint in the last relative cycle).

49	:	This card should contain an integer value specifying the number of axial nodes in the axial format in which the current fuel temperature input data is being provided.
50	:	This card should contain two values delineated by spaces. The first value should be the appropriate node number in the fuel temperature axial format for the statepoint calculation for which input is being provided. The second value should be the node height corresponding to the axial node number identified by the first value. This input card specification should be repeated the number of times identified on input card 49. The nodal format input specified with this card should be ordered sequentially such that node 1 represents the top node of the fuel assembly.
51	:	This card should contain an exposure weighted average fuel temperature value in units of degrees Fahrenheit for the appropriate node in the fuel temperature input axial format corresponding to the statepoint calculation for which input data is being provided. This input card specification should be repeated the number of times identified on input card 49. The data provided in the sequential repetition of this input card should be ordered to correspond to the nodal input format described by the previous repetition of input card 50.

Input cards 52 through 54 represent an input grouping that must be specified recursively for each statepoint calculation to be generated by the CRAFT calculation. This means that input cards 52 through 54 would be input for the first statepoint calculation (BOC to statepoint 2 of relative cycle number 1), and then input again for the second statepoint calculation, etc., until all of the statepoint calculations to be generated by CRAFT have been addressed (the final statepoint calculation would be that ending at the final statepoint in the last relative cycle).

52	:	This card should contain an integer value specifying the number of axial nodes in the axial format in which the current moderator specific volume input data is being provided.

Input Card Number		Detailed Description
53	:	This card should contain two values delineated by spaces. The first value should be the appropriate node number in the moderator specific volume axial format for the statepoint calculation for which input is being provided. The second value should be the node height corresponding to the axial node number identified by the first value. This input card specification should be repeated the number of times identified on input card 52. The nodal format input specified with this card should be ordered sequentially such that node 1 represents the top node of the fuel assembly.
54	:	This card should contain an exposure weighted average moderator specific volume value in units of ft^3/lb for the appropriate node in the moderator specific volume input axial format corresponding to the statepoint calculation for which input data is being provided. This input card specification should be repeated the number of times identified on input card 52. The data provided in the sequential repetition of this input card should be ordered to correspond to the nodal input format described by the previous repetition of input card 53.

Input cards 55 through 57 represent an input grouping that must be specified recursively for each statepoint calculation to be generated by the CRAFT calculation. This means that input cards 55 through 57 would be input for the first statepoint calculation (BOC to statepoint 2 of relative cycle number 1), and then input again for the second statepoint calculation, etc., until all of the statepoint calculations to be generated by CRAFT have been addressed (the final statepoint calculation would be that ending at the final statepoint in the last relative cycle).

55	:	This card should contain an integer value specifying the number of axial nodes in the axial format in which the current burnup input data is being provided.
56	:	This card should contain two values delineated by spaces. The first value should be the appropriate node number in the burnup axial format for the statepoint calculation for which input is being provided. The second value should be the node height corresponding to the axial node number identified by the first value. This input card specification should be repeated the number of times identified on input card 55. The nodal format input specified with this card should be ordered sequentially such that node 1 represents the top node of the fuel assembly.

Input Card Number		Detailed Description
57	:	This card should contain an exposure weighted average burnup value in units of GWd/MTU corresponding to the total burnup of the node at the beginning of the statepoint calculation for which input data is being provided. This input card specification should be repeated the number of times identified on input card 55. The data provided in the sequential repetition of this input card should be ordered to correspond to the nodal input format described by the previous repetition of input card 56.

8. CRAFT Output Description

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

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

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

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

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

The "*.input" files contain a CRAFT generated SAS2H input deck. The "*.output" files contain a complete SAS2H calculation output file. The "*.cut" files contain the corresponding SAS2H input deck followed by an output extraction, from the final ORIGEN pass of the SAS2H calculation, which contains data relevant to CRC evaluations. The "*.msgs" files contain the standard run-time messages associated with the SAS2H calculation. The "*.notes" files contain a

listing of the isotopes and their concentration which were left behind in generating the initial charge fuel composition for a continuation SAS2H calculation. The "*.notes" files are only generated for CRAFT generated SAS2H calculations which are continuing depletion and decay calculations. The "*.cut" and "*.notes" files contain all of the information which is required to perform CRC evaluations or repeat calculations as necessary for quality assurance purposes. The remainder of the CRAFT generated files may be discarded once the "*.cut" and "*.notes" files have been produced correctly.

9. Modifications Made Between CRAFT Version 1.0 and Version 2.0

One line of the CRAFT source code was modified to create CRAFT Version 2.0. The Version 2.0 code modification is documented in this section. The modification does not affect the validity of any of the previous results obtained using CRAFT Version 1.0.

The modified line of source code is found on page 59 of Appendix A. In Version 1.0, this line of source code was entered in the following manner:

"IF (BPMIX(BPRA_DESCRIPTION_ID).EQ.0) THEN".

In Version 2.0, this line of source code was changed to the following:

"IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
(BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN".

The purpose of this modification is to allow the CRAFT input for the burnable poison SAS2H material mixture identifier to be specified as "4" for a calculation that will determine an initial charge specification for a depleted burnable poison material. This omission in CRAFT Version 1.0, only affects the operation of CRAFT in developing SAS2H input decks that require the development of a continuing depletion calculation containing a depleted burnable poison charge specification (whose SAS2H material mixture number was entered in the CRAFT input deck as "4").

10. References

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

2) S. M. Bowman, O. W. Hermann, and M. C. Brady. *Scale-4 Analysis of Pressurized Water Reactor Critical Configurations: Volume 2-Sequoyah Unit 2 Cycle 3*, Oak Ridge National Laboratory, Document Number: ORNL/TM-12294/V2.

3) F. W. Walker, J. R. Parrington, and F. Feiner. *Nuclides and Isotopes, Fourteenth Edition*, General Electric Company, 1989.

Attachment II

CRAFT Version 2.0 Fortran Source Code Listing

This is Appendix A: CRAFT Version 2.0 Fortran Source Code Listing of the CRAFT User Information Documented in Attachment I

```
      PROGRAM CRAFT
*****************************************************************
*     Commercial Reactor Assembly Follow Taskmaster             *
*****************************************************************
*     This code writes the SAS2H input decks necessary to       *
*     perform depletion and decay calculations on an assembly   *
*     required in subsequent Commercial Reactor Critical        *
*     evaluations.  The code controls the SAS2H input deck      *
*     creation such that a new SAS2H input deck is developed    *
*     to perform depletion and decay calculations between CRC   *
*     statepoints in a given sequence.  The depletion and       *
*     decay of the fuel assembly through all CRC statepoints    *
*     is simulated as a continuous process by using feed fuel   *
*     isotopics from the previous calculation in the sequence.  *
*****************************************************************
*
      INTEGER*4 BPZONE(10), BPMA(15,10), LMA(15,10), LUZONE,
     c LMB(15), NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM(20), MONUM(20), BUNUM(20), CT1, CT2,
     c APSRINS(10,20,23,50), APSRSTEPNUM,
     c APSRMIXNUM, APSRMIXID(25),
     c CRINS(10,20,23,50), CRSTEPNUM,
     c CRMIXNUM, CRMIXID(25), CRNUMISOS(25),
     c CRISOID(25,10), AXBLANK(50), AXBLANKNODNUM,
     c STPTS(10), CYCPOS(10), APSRNUMISOS(25), APSRISOID(25,10),
     c STPTSUM, BPRADESNUM, CRDESNUM, CRZONE(10), CRMA(15,10),
     c LMC(15,10), APSRDESNUM, APSRZONE(10), APSRMA(15,10),
     c LMD(15,10), BPCYCID, BPTN(10), BPBN(10), DES, BPCYCNUM,
     c BPDESID(10), CRDES(10,20,23,50), APSRDES(10,20,23,50),
     c RELATIVE_STPT_NUM, RELATIVE_APSR_MIX_ID,
     c STPTTALLY(20), CT1START, CT2START, CLADTOT, CLADDESNUM(10),
     c BPRCLAD(10), CRCLAD(10), APSRCLAD(10), BPMIXNUM, BPMIX(10),
     c BPMIXID(10), BPNUMISOS(20), BPISOID(10,20), VARSTEPNUM(10,20),
     c BPRFM(15,10), BPFMNUMISOS(25), BPFISOID(25,10), ABOVEBPNUM(10),
     c APSRFM(15,10), APSRFOLLOWMIX(10,20,23,50)
*
      REAL CLTEMP, PRESS, BPDEN(10), BPRA(15,10), CRISOWTPCT(25,10),
     c LRA(15,10), LRB(15), MESH, SZF, EPS, PTC, APSRISOWTPCT(25,10),
     c NODES(50,2), BLETDOWN(10,20,25), AXBLANKRICH, STPTDAT(10,20,3),
     c FTNDES(50,2,20), FTDAT(50,20), MONDES(50,2,20), MODAT(50,20),
     c BUNDES(50,2,20), BUDAT(50,20), RICH, FMASS, RODS, CYCLEN(10,2),
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN(10), CRDEN(10),
     c CRRA(15,10), LRC(15,10), APSRDEN(10), APSRRA(15,10), LRD(15,10),
     c BPWTPCT(10), HTOT, FDHT(20), MDHT(20), BDHT(20), FTIN(50,20),
     c MOIN(50,20), BUIN(50,20), GRAMS(50), POWER(50,20),
     c FTFINAL(50,20), MODDENFINAL(50,20), MODTEMPFINAL(50,20),
     c DENDAT(29,10), BPISOWTPCT(10,20), BPXSECT(10), UCSPACERFRAC,
     c VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50), BPRFR(15,10),
     c BPFISOWTPCT(25,10), APSRFR(15,10)
*
      CHARACTER REACT*21, PREFIX*3, AXBLANKET*1, BPRFLAG*1,
     c FUELCLAD*10, FLAG2*7, CYCLEID(10)*2, CRSTAT*6,
     c APSRSTAT*6, LIB*15, NM*31, CLADDESNAME(10)*7,
     c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
*     Data input for table of subcooled water density (g/cc) at
*     various temperatures (F) and pressures (psia).
*     (REFERENCE: Radiation Shielding Information Center Number
*     CCC-545, "SCALE 4.2, Modular Code System for Performing
*     Standardized Computer Analyses for Licensing Evaluation,
```

```
*     Volume 1, Page S2.5.14, Table S2.5.2.)
*
      DATA ((DENDAT(E,Q),Q=1,10),E=1,29) /0.0,3000.0,2500.0,
     c 2000.0,1500.0,1000.0,
     c 800.0,600.0,400.0,200.0,50.0,1.0084,1.0069,1.0055,1.0040,
     c 1.0025,1.0019,
     c 1.0013,1.0007,1.000,100,1.0018,1.0004,0.9989,0.9975,0.9960,
     c 0.9954,0.9948,0.9942,0.9936,150.0,0.9893,0.9878,0.9864,0.9849,
     c 0.9834,0.9828,0.9822,0.9815,0.9809,200,0.9725,0.9709,0.9694,
     c 0.9679,0.9663,0.9656,0.9650,0.9644,0.9637,250.0,0.9522,0.9505,
     c 0.9489,0.9472,0.9455,0.9449,0.9442,0.9435,0.9428,300,0.9289,
     c 0.9271,0.9252,0.9234,0.9215,0.9208,0.9200,0.9192,0.9185,350.0,
     c 0.9026,0.9006,0.8985,0.8964,0.8943,0.8934,0.8925,0.8916,0,
     c 400.0,0.8733,0.8709,0.8685,0.8660,0.8634,0.8624,0.8613,0.8603,0,
     c 450.0,0.8405,0.8375,0.8345,0.8314,0.8281,0.8268,0.8255,0,0,
     c 500.0,0.8029,0.7992,0.7952,0.7911,0.7869,0.7851,0,0,0,
     c 510.0,0.7947,0.7907,0.7866,0.7822,0.7776,0,0,0,0,
     c 520.0,0.7862,0.7820,0.7776,0.7729,0.7680,0,0,0,0,
     c 530.0,0.7775,0.7729,0.7682,0.7632,0.7579,0,0,0,0,
     c 540.0,0.7683,0.7635,0.7584,0.7530,0.7472,0,0,0,0,
     c 550.0,0.7589,0.7537,0.7482,0.7423,0,0,0,0,0,
     c 560.0,0.7490,0.7434,0.7374,0.7310,0,0,0,0,0,
     c 570.0,0.7386,0.7326,0.7261,0.7190,0,0,0,0,0,
     c 580.0,0.7278,0.7212,0.7141,0.7062,0,0,0,0,0,
     c 590.0,0.7164,0.7092,0.7012,0.6923,0,0,0,0,0,
     c 600.0,0.7043,0.6963,0.6874,0,0,0,0,0,0,
     c 610.0,0.6915,0.6825,0.6724,0,0,0,0,0,0,
     c 620.0,0.6777,0.6676,0.6558,0,0,0,0,0,0,
     c 630.0,0.6629,0.6512,0.6370,0,0,0,0,0,0,
     c 640.0,0.6467,0.6329,0,0,0,0,0,0,0,
     c 650.0,0.6288,0.6119,0,0,0,0,0,0,0,
     c 660.0,0.6086,0.5866,0,0,0,0,0,0,0,
     c 670.0,0.5850,0,0,0,0,0,0,0,0,
     c 680.0,0.5559,0,0,0,0,0,0,0,0/
*
      write (*,*) 'calling data_aquisition'
      CALL DATA_AQUISITION (BPZONE, BPMA,
     c LMB, NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM, MONUM, BUNUM, APSRINS,
     c APSRSTEPNUM, APSRMIXNUM, APSRMIXID, CRINS,
     c CRSTEPNUM, CRMIXNUM, CRMIXID, CRNUMISOS,
     c CRISOID, AXBLANK, AXBLANKNODNUM, STPTS,
     c CYCPOS, APSRNUMISOS, APSRISOID, STPTSUM,
     c BPRADESNUM, CRDESNUM, CRZONE, CRMA, LMC,
     c APSRDESNUM, APSRZONE, APSRMA, LMD,
     c BPCYCID, BPTN, BPBN, DES, BPCYCNUM, BPDESID,
     c CRDES, APSRDES, LMA, LUZONE,
     c CLTEMP, PRESS, BPDEN, BPRA, CRISOWTPCT,
     c LRA, LRB, MESH, SZF, EPS, PTC, APSRISOWTPCT,
     c NODES, BLETDOWN, AXBLANKRICH, STPTDAT,
     c FTNDES, FTDAT, MONDES, MODAT,
     c BUNDES, BUDAT, RICH, FMASS, RODS, CYCLEN,
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN, CRDEN,
     c CRRA, LRC, APSRDEN, APSRRA, LRD,
     c BPWTPCT, REACT, PREFIX, AXBLANKET, BPRFLAG,
     c FUELCLAD, FLAG2, CYCLEID, CRSTAT,
     c APSRSTAT, LIB, BPXSECT, BPRODS, CT1START,
     c CT2START, CLADTOT, CLADDESNUM, CLADDESNAME,
     c BPRCLAD, CRCLAD, APSRCLAD, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
```

```
c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
c BPRFM, BPFMNUMISOS, BPFISOID, ABOVEBPNUM, APSRFM,
c BPRFR, BPFISOWTPCT, APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
 write (*,*) 'calling std_height'
 CALL STD_HEIGHT (AXNUM, FTNUM,
c MONUM, BUNUM, HTOT, NODES, STPTSUM,
c FDHT, FTNDES, MDHT, MONDES,
c BDHT, BUNDES)
*
 write (*,*) 'calling fueltemp_format'
 CALL FUELTEMP_FORMAT (STPTSUM, AXNUM, FTNUM,
c NODES, FTNDES, FTDAT, FTIN)
*
 write (*,*) 'calling modspecvol_format'
 CALL MODSPECVOL_FORMAT (STPTSUM, AXNUM, MONUM,
c NODES, MONDES, MODAT, MOIN)
*
 write (*,*) 'calling burnup_format'
 CALL BURNUP_FORMAT (STPTSUM, AXNUM, BUNUM,
c NODES, BUNDES, BUDAT, BUIN)
*
 write (*,*) 'calling power_calcs'
 CALL POWER_CALCS (NBR, AXNUM, STPTSUM, STPTTALLY,
c STPTS, GRAMS, FMASS, NODES, HTOT, BUIN,
c STPTDAT, POWER, CYCLEN, STEPCONTROL, VARBLETDOWN,
c VARSTEPNUM, VARPOWER)
*
 write (*,*) 'calling units_conversion'
 CALL UNITS_CONVERSION (STPTSUM, AXNUM, FTFINAL,
c FTIN, MODDENFINAL, MOIN, PRESS, MODTEMPFINAL,
c DENDAT)
*
 write (*,*) 'calling execution_control'
 CALL EXECUTION_CONTROL (NBR, RELATIVE_STPT_NUM,
c CT1, CT2, CT3, AXNUM, CYCPOS, AXBLANK,
c BPDESID, CRINS, CRDES,
c CRMIXNUM, CRMIXID, CRNUMISOS, CRISOID,
c APSRINS, APSRMIXNUM, APSRMIXID,
c RELATIVE_APSR_MIX_ID, APSRNUMISOS,
c APSRISOID, ISN, IIM, ICM, IUS, PLEVEL,
c BPZONE, BPMA, CRZONE, CRMA,
c LMC, APSRZONE, APSRMA, LMD,
c BPTN, BPBN, STPTS, APSRDES,
c STPTDAT, AXBLANKRICH, GRAMS,
c NODES, RODS, RICH, FTFINAL,
c MODDENFINAL, MODTEMPFINAL,
c BLETDOWN, BPWTPCT, BPDEN, CRDEN,
c CRISOWTPCT, APSRDEN, APSRISOWTPCT,
c PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
c BPRA, CRRA, LRC, APSRRA,
c LRD, POWER, CYCDOWN, PREFIX,
c NM, CYCLEID, REACT, LIB, AXBLANKET,
c FUELCLAD, BPRFLAG, CRSTAT, APSRSTAT, FLAG2,
c LUZONE, LMB, LRB, BPXSECT, BPRODS,
c CT1START, CT2START, STPTTALLY, CLADTOT,
c CLADDESNUM, CLADDESNAME, BPRCLAD, CRCLAD,
c APSRCLAD, CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
```

```
     c VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
      END


*****************************************************************
*     Reactor and Problem Data Acquisition Subroutine           *
*****************************************************************
      SUBROUTINE DATA_AQUISITION (BPZONE, BPMA,
     c LMB, NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM, MONUM, BUNUM, APSRINS,
     c APSRSTEPNUM, APSRMIXNUM, APSRMIXID, CRINS,
     c CRSTEPNUM, CRMIXNUM, CRMIXID, CRNUMISOS,
     c CRISOID, AXBLANK, AXBLANKNODNUM, STPTS,
     c CYCPOS, APSRNUMISOS, APSRISOID, STPTSUM,
     c BPRADESNUM, CRDESNUM, CRZONE, CRMA, LMC,
     c APSRDESNUM, APSRZONE, APSRMA, LMD,
     c BPCYCID, BPTN, BPBN, DES, BPCYCNUM, BPDESID,
     c CRDES, APSRDES, LMA, LUZONE,
     c CLTEMP, PRESS, BPDEN, BPRA, CRISOWTPCT,
     c LRA, LRB, MESH, SZF, EPS, PTC, APSRISOWTPCT,
     c NODES, BLETDOWN, AXBLANKRICH, STPTDAT,
     c FTNDES, FTDAT, MONDES, MODAT,
     c BUNDES, BUDAT, RICH, FMASS, RODS, CYCLEN,
     c PITCH, FOD, CID, COD, LENGTH, CYCDOWN, CRDEN,
     c CRRA, LRC, APSRDEN, APSRRA, LRD,
     c BPWTPCT, REACT, PREFIX, AXBLANKET, BPRFLAG,
     c FUELCLAD, FLAG2, CYCLEID, CRSTAT,
     c APSRSTAT, LIB, BPXSECT, BPRODS, CT1START,
     c CT2START, CLADTOT, CLADDESNUM, CLADDESNAME,
     c BPRCLAD, CRCLAD, APSRCLAD, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c BPRFM, BPFMNUMISOS, BPFISOID, ABOVEBPNUM, APSRFM,
     c BPRFR, BPFISOWTPCT, APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
      INTEGER*4 BPZONE(10), BPMA(15,10), LMA(15,10), LUZONE,
     c LMB(15), NLIB, PLEVEL, ISN, IIM, ICM, IUS, NBR, AXNUM,
     c FTNUM(20), MONUM(20), BUNUM(20), CT1, CT2, CT3,
     c APSRINS(10,20,23,50), APSRSTEPNUM, APSRCYC, APSRSTEP,
     c TOPN, BOTN, APSRMIX, APSRMIXNUM, APSRMIXID(25),
     c CRINS(10,20,23,50), CRSTEPNUM, CRCYC, CRSTEP, CYCHOLDER,
     c CRMIX, STPTHOLDER, CRMIXNUM, CRMIXID(25), CRNUMISOS(25),
     c CRISOID(25,10), AXBLANK(50), AXBLANKNODNUM, AXBLANKTEMP,
     c STPTS(10), CYCPOS(10), APSRNUMISOS(25), APSRISOID(25,10),
     c STPTSUM, BPRADESNUM, CRDESNUM, CRZONE(10), CRMA(15,10),
     c LMC(15,10), APSRDESNUM, APSRZONE(10), APSRMA(15,10),
     c LMD(15,10), BPCYCID, BPTN(10), BPBN(10), DES, BPCYCNUM,
     c BPDESID(10), CRDES(10,20,23,50), APSRDES(10,20,23,50),
     c BPRODS(10), CT1START, CT2START, APSRSTPT, CRSTPT,
     c CLADTOT, CLADDESNUM(10), BPRCLAD(10), CRCLAD(10),
     c APSRCLAD(10), BPMIXNUM, BPMIX(10), BPMIXID(10),
     c BPNUMISOS(20), BPISOID(10,20), VARSTEPNUM(10,20),
     c BPRFM(15,10), BPFMNUMISOS(25), BPFISOID(25,10),
     c ABOVEBPNUM(10), APSRFM(15,10), FMIX, APSRFOLLOWMIX(10,20,23,50)
*
      REAL CLTEMP, PRESS, BPDEN(10), BPRA(15,10), CRISOWTPCT(25,10),
     c LRA(15,10), LRB(15), MESH, SZF, EPS, PTC, APSRISOWTPCT(25,10),
```

```
      c NODES(50,2), BLETDOWN(10,20,25), AXBLANKRICH, STPTDAT(10,20,3),
      c FTNDES(50,2,20), FTDAT(50,20), MONDES(50,2,20), MODAT(50,20),
      c BUNDES(50,2,20), BUDAT(50,20), RICH, FMASS, RODS, CYCLEN(10,2),
      c PITCH, FOD, CID, COD, LENGTH, CYCDOWN(10), CRDEN(10),
      c CRRA(15,10), LRC(15,10), APSRDEN(10), APSRRA(15,10), LRD(15,10),
      c BPWTPCT(10), BPXSECT(10), BPISOWTPCT(10,20), UCSPACERFRAC,
      c VARBLETDOWN(10,20,25,25), BPRFR(15,10), BPFISOWTPCT(25,10),
      c APSRFR(15,10)
*
       CHARACTER REACT*21, PREFIX*3, AXBLANKET*1, BPRFLAG*1,
      c FUELCLAD*10, FLAG2*7, CYCLEID(10)*2, CRSTAT*6,
      c APSRSTAT*6, LIB*15, PICKUPFLAG*1, CLADFLAG*1, CLADDESNAME(10)*7,
      c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
*     Hardwired ASSYFOLLOW limitations:
*******************************************************************************
*******
*     Maximum number of irradiation steps in a given SAS2H input deck = 23.
    *
*     Maximum number of isotopes in a CR or APSR material composition = 10.
    *
*     Maximum number of concentric zones in a Path B Model = 15.
    *
*     Maximum number of axial nodes in any axial format = 50.
    *
*     Maximum number of reactor cycles in which an assembly may be inserted =
10.   *
*     Maximum number of CRC statepoints allowed in a given cycle = 20.
    *
*     Maximum number of BPRA designs = 10.
    *
*     Maximum number of CR absorber material mixtures = 25.
    *
*     Maximum number of CRA designs = 10.
    *
*     Maximum number of APSR absorber material mixtures = 25.
    *
*     Maximum number of APSR assembly designs = 10.
    *
*******************************************************************************
*******
*
      OPEN (UNIT=10, FILE='datain', STATUS='OLD')
      REWIND (UNIT=10)
      READ (10,2) PICKUPFLAG ! PICKUPFLAG is a signal to begin the assembly
*                              depletion and decay calculation at a point
*                              other than the beginning of the assembly's
*                              irradiation history as specified in the input
*                              deck
    2 FORMAT(A1)
      IF (PICKUPFLAG.EQ.'Y') THEN
         READ(10,*) CT1START
         READ(10,*) CT2START
      ELSE
         CT1START=1
         CT2START=1
      ENDIF
*
      READ (10,10) REACT    ! REACT is the problem identification
*                            (up to 21 characters).
```

```
      READ (10,20) PREFIX  ! PREFIX is a 3 character prefix to be
*                           placed at the beginning of all SAS2H
*                           input decks produced.
      READ (10,40) LIB     ! LIB is a 15 character identification
*                           of the cross-section library requested
*                           for use in the SCALE code system.
   10 FORMAT (A21)
   20 FORMAT (A3)
   30 FORMAT (A2)
   40 FORMAT (A15)
*
*     Fuel Batch Data Acquisition
*
      READ (10,*) RICH   ! RICH is the fuel assy wt% U-235 in UO2
*                          enrichment.
      READ (10,*) FMASS  ! FMASS is the fuel assy loading of
*                          uranium in g/assy.
      READ (10,*) RODS   ! RODS is the number of fuel rods in the assy.
      READ (10,*) PITCH  ! PITCH is the fuel rod pitch in the assy.
      READ (10,*) FOD    ! FOD is the fuel rod outer diameter in cm.
      READ (10,*) CID    ! CID is the clad inner diameter in cm.
      READ (10,*) COD    ! COD is the clad outer diameter in cm.
      READ (10,*) LENGTH ! LENGTH is the active fuel length in cm.
      READ (10,70) AXBLANKET ! Flag for axial blanket modelling.
   70 FORMAT(A1)
      IF (AXBLANKET.EQ.'Y') THEN
         READ (10,*) AXBLANKRICH ! Axial blanket fuel U-235 enrichment.
*        Initialize AXBLANK array
         DO 80 CT1=1,50
            AXBLANK(CT1)=0
   80    CONTINUE
*        Gather data for AXBLANK array
         READ (10,*) AXBLANKNODNUM ! Number of nodes with axial
*                                    blanket fuel.
         DO 90 CT1=1,AXBLANKNODNUM
            READ (10,*) AXBLANKTEMP ! Node containing axial
*                                     blanket fuel.
            AXBLANK(AXBLANKTEMP)=1 ! Identify axial blanket fuel
*                                    node location in AXBLANK.
   90    CONTINUE
      ENDIF
*     Spacer data acquisition
      READ (10,92) SPACERMAT
   92 FORMAT(A7)
      READ (10,*) UCSPACERFRAC
*     Cladding data acquisition
      READ (10,100) FUELCLAD
  100 FORMAT (A10)
      READ (10,*) CLTEMP
      READ (10,101) CLADFLAG
  101 FORMAT (A1)
      IF (CLADFLAG.EQ.'Y') THEN
         READ(10,*) CLADTOT
         DO 108 CT1=1,CLADTOT
            READ(10,*) CLADDESNUM(CT1)
            READ(10,105) CLADDESNAME(CT1)
  105       FORMAT (A7)
  108    CONTINUE
      ENDIF
*     System Pressure
```

```
      READ (10,*) PRESS
      READ (10,110) BPRFLAG
  110 FORMAT (A1)
      IF (BPRFLAG.EQ.'Y') THEN
         READ(10,*) BPCYCNUM  ! Number of cycles with BPRA
         READ(10,*) BPRADESNUM, BPMIXNUM
         DO 145 CT2=1,BPRADESNUM
*           Get BP density, B4C wt% in Al2O3-B4C,
*           BP x-sectional area, # BP rods, and BPR clad mix num
            READ (10,*) BPDEN(CT2), BPWTPCT(CT2), BPXSECT(CT2),
     c      BPRODS(CT2), BPRCLAD(CT2), BPMIX(CT2)
*           Larger BPRA unit cell data acquisition
            READ (10,*) BPZONE(CT2)
            DO 112 CT1=1,BPZONE(CT2)
               READ (10,*) BPMA(CT1,CT2), BPRA(CT1,CT2)
  112       CONTINUE
*           Larger standard unit cell for use with BPRAs
            DO 114 CT1=1,BPZONE(CT2)
               READ (10,*) LMA(CT1,CT2), LRA(CT1,CT2)
  114       CONTINUE
            DO 116 CT1=1,BPZONE(CT2)
               READ(10,*) BPRFM(CT1,CT2), BPRFR(CT1,CT2)
  116       CONTINUE
            READ(10,118) ABOVEBP(CT2), ABOVEBPNUM(CT2)
  118       FORMAT (A5,1X,I3)
            IF (ABOVEBP(CT2).NE.'AL2O3') THEN
               READ (10,*) BPFMNUMISOS(CT2)
               DO 120 CT1=1,BPFMNUMISOS(CT2)
                  READ (10,*) BPFISOID(CT2,CT1),
     c            BPFISOWTPCT(CT2,CT1)
  120          CONTINUE
            ENDIF
  145    CONTINUE
         DO 147 CT1=1,10
            DO 146 CT2=1,20
               BPISOID(CT1,CT2)=0
               BPISOWTPCT(CT1,CT2)=0.0
  146       CONTINUE
  147    CONTINUE
         IF (BPMIXNUM.NE.0) THEN
            DO 150 CT1=1,BPMIXNUM
               READ (10,*) BPMIXID(CT1) ! SAS2H Mixture ID for CR
               READ (10,*) BPNUMISOS(CT1)
               DO 149 CT2=1,BPNUMISOS(CT1)
                  READ (10,*) BPISOID(CT1,CT2), BPISOWTPCT(CT1,CT2)
  149          CONTINUE
  150       CONTINUE
         ENDIF
         DO 156 CT1=1,10
            BPDESID(CT1)=0
  156    CONTINUE
         DO 157 CT1=1,BPCYCNUM
            READ(10,*) BPCYCID, BPDESID(BPCYCID), BPTN(BPCYCID),
     c      BPBN(BPCYCID)
  157    CONTINUE
      ENDIF
*     Larger standard unit cell
      READ (10,*) LUZONE
      DO 170 CT1=1,LUZONE
         READ (10,*) LMB(CT1), LRB(CT1)
```

```
  170 CONTINUE
*     Contol parameter data acquisition
      READ (10,*) NLIB
      READ (10,*) PLEVEL
      READ (10,*) MESH
      READ (10,180) FLAG2
  180 FORMAT (A7)
      IF (FLAG2.EQ.'SPECIAL') THEN
         READ (10,*) SZF
         READ (10,*) ISN
         READ (10,*) IIM
         READ (10,*) ICM
         READ (10,*) EPS
         READ (10,*) PTC
         READ (10,*) IUS
      ENDIF
*     Reactor history data acquisition
      READ (10,*) NBR
      DO 210 CT1=1,NBR
         READ (10,190) CYCLEID(CT1)
  190    FORMAT (A2)
         READ (10,*) STPTS(CT1)
         DO 200 CT2=1,STPTS(CT1)
            READ (10,*) STPTDAT(CT1,CT2,1)
            READ (10,*) STPTDAT(CT1,CT2,2)
            READ (10,*) STPTDAT(CT1,CT2,3)
  200    CONTINUE
         READ (10,*) CYCDOWN(CT1)
         READ (10,*) CYCLEN(CT1,1)
         READ (10,*) CYCLEN(CT1,2)
         READ (10,*) CYCPOS(CT1)
  210 CONTINUE
      STEPCONTROL='N'
      READ (10,212) STEPCONTROL
  212 FORMAT(A1)
      IF (STEPCONTROL.EQ.'N') THEN
         DO 220 CT1=1,NBR
            READ (10,*) CYCHOLDER
            DO 217 CT2=1,STPTS(CYCHOLDER)
               READ (10,*) STPTHOLDER
               READ (10,*) BLETDOWN(CYCHOLDER,STPTHOLDER,1)
               READ (10,*) BLETDOWN(CYCHOLDER,STPTHOLDER,2)
               DO 213 CT3=3,(INT(BLETDOWN(CYCHOLDER,STPTHOLDER,2))+2)
                  READ (10,*) BLETDOWN(CYCHOLDER,STPTHOLDER,CT3)
  213          CONTINUE
  217       CONTINUE
  220    CONTINUE
      ELSEIF (STEPCONTROL.EQ.'Y') THEN
         DO 240 CT1=1,NBR
            READ (10,*) CYCHOLDER
            DO 235 CT2=1,STPTS(CYCHOLDER)
               READ (10,*) STPTHOLDER
               READ (10,*) VARSTEPNUM(CYCHOLDER,STPTHOLDER)
               DO 230 CT3=1,VARSTEPNUM(CYCHOLDER,STPTHOLDER)
                  READ (10,*) VARBLETDOWN(CYCHOLDER,STPTHOLDER,CT3,1),
     c            VARBLETDOWN(CYCHOLDER,STPTHOLDER,CT3,2)
  230          CONTINUE
  235       CONTINUE
  240    CONTINUE
      ENDIF
```

```
      READ (10,*) AXNUM
      DO 260 CT1=1,AXNUM
         READ (10,250) NODES(CT1,1), NODES(CT1,2)
  250    FORMAT (F3.0,1X,F10.7)
  260 CONTINUE
*     Control Rod Data Aquisition
      READ (10,270) CRSTAT
  270 FORMAT (A6)
      IF (CRSTAT.EQ.'RODDED') THEN
         DO 300 CT1=1,10
            DO 295 CT2=1,20
               DO 290 CT3=1,23
                  DO 280 CT4=1,50
                     CRINS(CT1,CT2,CT3,CT4)=0
  280             CONTINUE
  290          CONTINUE
  295       CONTINUE
  300    CONTINUE
         READ (10,*) CRSTEPNUM ! Number of pre-defined irradiation steps
*                              in which the assembly contains a control
*                              rod assembly.
         DO 320 CT1=1,CRSTEPNUM
            READ (10,*) CRCYC, CRSTPT, CRSTEP, TOPN, BOTN, CRMIX, DES
            DO 310 CT2=TOPN,BOTN
               CRINS(CRCYC,CRSTPT,CRSTEP,CT2)=CRMIX
               CRDES(CRCYC,CRSTPT,CRSTEP,CT2)=DES
  310       CONTINUE
  320    CONTINUE
      READ (10,*) CRMIXNUM
      DO 340 CT1=1,CRMIXNUM
         READ (10,*) CRMIXID(CT1) ! SAS2H Mixture ID for CR
         READ (10,*) CRNUMISOS(CT1)
         DO 330 CT2=1,CRNUMISOS(CT1)
            READ(10,*) CRISOID(CT1,CT2), CRISOWTPCT(CT1,CT2)
  330    CONTINUE
  340 CONTINUE
      READ(10,*) CRDESNUM
      DO 349 CT2=1,CRDESNUM
         READ(10,*) CRDEN(CT2), CRCLAD(CT2)
         READ(10,*) CRZONE(CT2)
         DO 344 CT1=1,CRZONE(CT2)
            READ(10,*) CRMA(CT1,CT2), CRRA(CT1,CT2)
  344    CONTINUE
         DO 347 CT1=1,CRZONE(CT2)
            READ(10,*) LMC(CT1,CT2), LRC(CT1,CT2)
  347    CONTINUE
  349 CONTINUE
      ENDIF
*     Axial Power Shaping Rod Data Aquisition
      READ (10,350) APSRSTAT
  350 FORMAT (A6)
      IF (APSRSTAT.EQ.'RODDED') THEN
         DO 380 CT1=1,10
            DO 375 CT2=1,20
               DO 370 CT3=1,23
                  DO 360 CT4=1,50
                     APSRINS(CT1,CT2,CT3,CT4)=0
  360             CONTINUE
  370          CONTINUE
  375       CONTINUE
```

```
 380    CONTINUE
        READ (10,*) APSRSTEPNUM ! Number of pre-defined irradiation steps
*                               in which the assembly contains an axial
*                               power shaping rod assembly.
        DO 400 CT1=1,APSRSTEPNUM
           READ (10,*) APSRCYC, APSRSTPT, APSRSTEP, TOPN, BOTN,
     c     APSRMIX, DES, FMIX
           DO 390 CT2=TOPN,BOTN
              APSRINS(APSRCYC,APSRSTPT,APSRSTEP,CT2)=APSRMIX
              APSRDES(APSRCYC,APSRSTPT,APSRSTEP,CT2)=DES
              APSRFOLLOWMIX(APSRCYC,APSRSTPT,APSRSTEP,CT2)=FMIX
 390       CONTINUE
 400    CONTINUE
      READ (10,*) APSRMIXNUM
      DO 410 CT1=1,APSRMIXNUM
         READ (10,*) APSRMIXID(CT1) ! SAS2H Mixture ID for APSR's
         READ (10,*) APSRNUMISOS(CT1)
         DO 405 CT2=1,APSRNUMISOS(CT1)
            READ(10,*) APSRISOID(CT1,CT2), APSRISOWTPCT(CT1,CT2)
 405    CONTINUE
 410  CONTINUE
      READ(10,*) APSRDESNUM
      DO 429 CT2=1,APSRDESNUM
         READ(10,*) APSRDEN(CT2), APSRCLAD(CT2)
         READ(10,*) APSRZONE(CT2)
         DO 412 CT1=1,APSRZONE(CT2)
            READ(10,*) APSRMA(CT1,CT2), APSRRA(CT1,CT2)
 412    CONTINUE
        DO 414 CT1=1,APSRZONE(CT2)
           READ(10,*) LMD(CT1,CT2), LRD(CT1,CT2)
 414    CONTINUE
        DO 416 CT1=1,APSRZONE(CT2)
           READ(10,*) APSRFM(CT1,CT2), APSRFR(CT1,CT2)
 416    CONTINUE
 429  CONTINUE
      ENDIF
      STPTSUM=0
      DO 430 CT1=1,10
         STPTSUM=STPTSUM+STPTS(CT1)
 430  CONTINUE
*     Acquisition of fuel temperature data for each node
        DO 470 CT1=1,(STPTSUM-1)
           READ (10,*) FTNUM(CT1)
           DO 450 CT2=1,FTNUM(CT1)
             READ (10,440) FTNDES(CT2,1,CT1), FTNDES(CT2,2,CT1)
 440         FORMAT (F3.0,1X,F10.7)
 450       CONTINUE
           DO 460 CT2=1,FTNUM(CT1)
              READ (10,*) FTDAT(CT2,CT1)
 460       CONTINUE
 470    CONTINUE
*     Acquisition of moderator specific volume data for each node
        DO 510 CT1=1,(STPTSUM-1)
           READ (10,*) MONUM(CT1)
           DO 490 CT2=1,MONUM(CT1)
              READ (10,480) MONDES(CT2,1,CT1), MONDES(CT2,2,CT1)
 480          FORMAT (F3.0,1X,F10.7)
 490       CONTINUE
           DO 500 CT2=1,MONUM(CT1)
              READ (10,*) MODAT(CT2,CT1)
```

```
  500       CONTINUE
  510    CONTINUE
*     Acquisition of nodal burnup data for each statepoint in each cycle
        DO 550 CT1=1,STPTSUM
           READ (10,*) BUNUM(CT1)
           DO 530 CT2=1,BUNUM(CT1)
              READ (10,520) BUNDES(CT2,1,CT1), BUNDES(CT2,2,CT1)
  520         FORMAT (F3.0,1X,F10.7)
  530       CONTINUE
            DO 540 CT2=1,BUNUM(CT1)
               READ (10,*) BUDAT(CT2,CT1)
  540       CONTINUE
  550    CONTINUE

        RETURN
        END


*****************************************************************
*   Subroutine to standardize the assembly height to            *
*   the desired CRC assembly height.                            *
*****************************************************************
        SUBROUTINE STD_HEIGHT (AXNUM, FTNUM,
       c MONUM, BUNUM, HTOT, NODES, STPTSUM,
       c FDHT, FTNDES, MDHT, MONDES,
       c BDHT, BUNDES)
*
        INTEGER*4 AXNUM, CT1, CT2, FTNUM(20), MONUM(20), BUNUM(20),
       c STPTSUM
*
        REAL HTOT, NODES(50,2), FDHT(20), FTNDES(50,2,20),
       c MDHT(20), MONDES(50,2,20), BDHT(20), BUNDES(50,2,20)
*
*
        HTOT=0
        DO 10 CT1=1,AXNUM
           HTOT=HTOT+NODES(CT1,2)
   10   CONTINUE
        DO 30 CT1=1,STPTSUM
           FDHT(CT1)=0
           DO 20 CT2=1,FTNUM(CT1)
              FDHT(CT1)=FDHT(CT1)+FTNDES(CT2,2,CT1)
   20      CONTINUE
   30   CONTINUE
        DO 50 CT1=1,STPTSUM
           MDHT(CT1)=0
           DO 40 CT2=1,MONUM(CT1)
              MDHT(CT1)=MDHT(CT1)+MONDES(CT2,2,CT1)
   40      CONTINUE
   50   CONTINUE
        DO 70 CT1=1,STPTSUM
           BDHT(CT1)=0
           DO 60 CT2=1,BUNUM(CT1)
              BDHT(CT1)=BDHT(CT1)+BUNDES(CT2,2,CT1)
   60      CONTINUE
   70   CONTINUE
        DO 90 CT1=1,STPTSUM
           DO 80 CT2=1,FTNUM(CT1)
              FTNDES(CT2,2,CT1)=FTNDES(CT2,2,CT1)*(HTOT/FDHT(CT1))
   80      CONTINUE
```

```
 90 CONTINUE
    DO 110 CT1=1,STPTSUM
       DO 100 CT2=1,MONUM(CT1)
          MONDES(CT2,2,CT1)=MONDES(CT2,2,CT1)*(HTOT/MDHT(CT1))
100    CONTINUE
110 CONTINUE
    DO 130 CT1=1,STPTSUM
       DO 120 CT2=1,BUNUM(CT1)
          BUNDES(CT2,2,CT1)=BUNDES(CT2,2,CT1)*(HTOT/BDHT(CT1))
120    CONTINUE
130 CONTINUE

    RETURN
    END


*****************************************************************
*   Subroutine to convert fuel temperature input nodal formats  *
*   into the requested CRC nodal format                         *
*****************************************************************
      SUBROUTINE FUELTEMP_FORMAT (STPTSUM, AXNUM, FTNUM,
     c NODES, FTNDES, FTDAT, FTIN)
*
      INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, FTNUM(20)
*
      REAL HCTOLD, HCT, SUM, NODES(50,2), FTHOLD, FTHCT,
     c FTNDES(50,2,20), FTDAT(50,20), FTIN(50,20)
*
      DO 30 CT1=1,STPTSUM
         HCTOLD=0
         HCT=0
         DO 20 CT2=1,AXNUM
            SUM=0
            HCTOLD=HCT
            HCT=HCT+NODES(CT2,2)
            FTHOLD=0
            FTHCT=0
            DO 10 CT3=1,FTNUM(CT1)
               FTHOLD=FTHCT
               FTHCT=FTHCT+FTNDES(CT3,2,CT1)
               IF ((FTHOLD.LT.HCTOLD).AND.(FTHCT.GT.HCTOLD).AND.
     c             (FTHCT.LT.HCT)) THEN
                  SUM=SUM+(((FTHCT-HCTOLD)/NODES(CT2,2))
     c                *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.EQ.HCTOLD).AND.(FTHCT.EQ.HCT)) THEN
                  SUM=SUM+FTDAT(CT3,CT1)
               ENDIF
               IF ((FTHOLD.GT.HCTOLD).AND.(FTHOLD.LT.HCT).AND.
     c             (FTHCT.GT.HCT)) THEN
                  SUM=SUM+(((HCT-FTHOLD)/NODES(CT2,2))
     c                *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.EQ.HCTOLD).AND.(FTHCT.GT.HCTOLD).AND.
     c             (FTHCT.LT.HCT)) THEN
                  SUM=SUM+(((FTHCT-FTHOLD)/NODES(CT2,2))
     c                *FTDAT(CT3,CT1))
               ENDIF
               IF ((FTHOLD.GT.HCTOLD).AND.(FTHCT.LT.HCT)) THEN
                  SUM=SUM+(((FTHCT-FTHOLD)/NODES(CT2,2))
```

```
     c                *FTDAT(CT3,CT1))
                   ENDIF
                   IF ((FTHOLD.GT.HCTOLD).AND.(FTHOLD.LT.HCT).AND.
     c                (FTHCT.EQ.HCT)) THEN
                      SUM=SUM+(((FTHCT-FTHOLD)/NODES(CT2,2))
     c                   *FTDAT(CT3,CT1))
                   ENDIF
                   IF ((FTHOLD.LT.HCTOLD).AND.(FTHCT.EQ.HCT)) THEN
                      SUM=SUM+FTDAT(CT3,CT1)
                   ENDIF
                   IF ((FTHOLD.LT.HCTOLD).AND.(FTHCT.GT.HCT)) THEN
                      SUM=SUM+FTDAT(CT3,CT1)
                   ENDIF
                   IF ((FTHOLD.EQ.HCTOLD).AND.(FTHCT.GT.HCT)) THEN
                      SUM=SUM+FTDAT(CT3,CT1)
                   ENDIF
   10           CONTINUE
                FTIN(CT2,CT1)=SUM
   20       CONTINUE
   30    CONTINUE

         RETURN
         END


*********************************************************************
*   Subroutine to convert moderator specific volume input nodal     *
*   formats into the requested CRC nodal format                     *
*********************************************************************
         SUBROUTINE MODSPECVOL_FORMAT (STPTSUM, AXNUM, MONUM,
        c NODES, MONDES, MODAT, MOIN)
*
         INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, MONUM(20)
*
         REAL HCTOLD, HCT, SUM, NODES(50,2), MOHOLD, MOHCT,
        c MONDES(50,2,20), MODAT(50,20), MOIN(50,20)
*
         DO 30 CT1=1,STPTSUM
            HCTOLD=0
            HCT=0
            DO 20 CT2=1,AXNUM
               SUM=0
               HCTOLD=HCT
               HCT=HCT+NODES(CT2,2)
               MOHOLD=0
               MOHCT=0
               DO 10 CT3=1,MONUM(CT1)
                  MOHOLD=MOHCT
                  MOHCT=MOHCT+MONDES(CT3,2,CT1)
                  IF ((MOHOLD.LT.HCTOLD).AND.(MOHCT.GT.HCTOLD).AND.
     c               (MOHCT.LT.HCT)) THEN
                     SUM=SUM+(((MOHCT-HCTOLD)/NODES(CT2,2))
     c                  *MODAT(CT3,CT1))
                  ENDIF
                  IF ((MOHOLD.EQ.HCTOLD).AND.(MOHCT.EQ.HCT)) THEN
                     SUM=SUM+MODAT(CT3,CT1)
                  ENDIF
                  IF ((MOHOLD.GT.HCTOLD).AND.(MOHOLD.LT.HCT).AND.
     c               (MOHCT.GT.HCT)) THEN
                     SUM=SUM+(((HCT-MOHOLD)/NODES(CT2,2))
```

```
c                *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.EQ.HCTOLD).AND.(MOHCT.GT.HCTOLD).AND.
c                  (MOHCT.LT.HCT)) THEN
                   SUM=SUM+(((MOHCT-MOHOLD)/NODES(CT2,2))
c                     *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.GT.HCTOLD).AND.(MOHCT.LT.HCT)) THEN
                   SUM=SUM+(((MOHCT-MOHOLD)/NODES(CT2,2))
c                     *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.GT.HCTOLD).AND.(MOHOLD.LT.HCT).AND.
c                  (MOHCT.EQ.HCT)) THEN
                   SUM=SUM+(((MOHCT-MOHOLD)/NODES(CT2,2))
c                     *MODAT(CT3,CT1))
                ENDIF
                IF ((MOHOLD.LT.HCTOLD).AND.(MOHCT.EQ.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
                IF ((MOHOLD.LT.HCTOLD).AND.(MOHCT.GT.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
                IF ((MOHOLD.EQ.HCTOLD).AND.(MOHCT.GT.HCT)) THEN
                   SUM=SUM+MODAT(CT3,CT1)
                ENDIF
   10        CONTINUE
             MOIN(CT2,CT1)=SUM
   20     CONTINUE
   30 CONTINUE

      RETURN
      END


*************************************************************************
*   Subroutine to convert burnup input nodal formats into the           *
*   requested CRC nodal format                                          *
*************************************************************************
      SUBROUTINE BURNUP_FORMAT (STPTSUM, AXNUM, BUNUM,
     c NODES, BUNDES, BUDAT, BUIN)
*
      INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, BUNUM(20)
*
      REAL HCTOLD, HCT, SUM, NODES(50,2), BUHOLD, BUHCT,
     c BUNDES(50,2,20), BUDAT(50,20), BUIN(50,20)
*
      DO 30 CT1=1,STPTSUM
         HCTOLD=0
         HCT=0
         DO 20 CT2=1,AXNUM
            SUM=0
            HCTOLD=HCT
            HCT=HCT+NODES(CT2,2)
            BUHOLD=0
            BUHCT=0
            DO 10 CT3=1,BUNUM(CT1)
               BUHOLD=BUHCT
               BUHCT=BUHCT+BUNDES(CT3,2,CT1)
               IF ((BUHOLD.LT.HCTOLD).AND.(BUHCT.GT.HCTOLD).AND.
     c            (BUHCT.LT.HCT)) THEN
```

```
                  SUM=SUM+(((BUHCT-HCTOLD)/NODES(CT2,2))
     c               *BUDAT(CT3,CT1))
                ENDIF
                IF ((BUHOLD.EQ.HCTOLD).AND.(BUHCT.EQ.HCT)) THEN
                   SUM=SUM+BUDAT(CT3,CT1)
                ENDIF
                IF ((BUHOLD.GT.HCTOLD).AND.(BUHOLD.LT.HCT).AND.
     c             (BUHCT.GT.HCT)) THEN
                   SUM=SUM+(((HCT-BUHOLD)/NODES(CT2,2))
     c                *BUDAT(CT3,CT1))
                ENDIF
                IF ((BUHOLD.EQ.HCTOLD).AND.(BUHCT.GT.HCTOLD).AND.
     c             (BUHCT.LT.HCT)) THEN
                   SUM=SUM+(((BUHCT-BUHOLD)/NODES(CT2,2))
     c                *BUDAT(CT3,CT1))
                ENDIF
                IF ((BUHOLD.GT.HCTOLD).AND.(BUHCT.LT.HCT)) THEN
                   SUM=SUM+(((BUHCT-BUHOLD)/NODES(CT2,2))
     c                *BUDAT(CT3,CT1))
                ENDIF
                IF ((BUHOLD.GT.HCTOLD).AND.(BUHOLD.LT.HCT).AND.
     c             (BUHCT.EQ.HCT)) THEN
                   SUM=SUM+(((BUHCT-BUHOLD)/NODES(CT2,2))
     c                *BUDAT(CT3,CT1))
                ENDIF
                IF ((BUHOLD.LT.HCTOLD).AND.(BUHCT.EQ.HCT)) THEN
                   SUM=SUM+BUDAT(CT3,CT1)
                ENDIF
                IF ((BUHOLD.LT.HCTOLD).AND.(BUHCT.GT.HCT)) THEN
                   SUM=SUM+BUDAT(CT3,CT1)
                ENDIF
                IF ((BUHOLD.EQ.HCTOLD).AND.(BUHCT.GT.HCT)) THEN
                   SUM=SUM+BUDAT(CT3,CT1)
                ENDIF
   10         CONTINUE
              BUIN(CT2,CT1)=SUM
   20      CONTINUE
   30   CONTINUE

        RETURN
        END


*************************************************************************
*     Subroutine to calculate nodal powers for each reactor cycle       *
*************************************************************************
      SUBROUTINE POWER_CALCS (NBR, AXNUM, STPTSUM, STPTTALLY,
     c STPTS, GRAMS, FMASS, NODES, HTOT, BUIN,
     c STPTDAT, POWER, CYCLEN, STEPCONTROL, VARBLETDOWN,
     c VARSTEPNUM, VARPOWER)
*
      INTEGER*4 CT1, NBR, AXNUM, CT2, CT3, CYCLENUMBER, STPTNUMBER,
     c STPTSUM, STPTTALLY(20), STPTS(10), VARSTEPNUM(10,20), CT4
*
      REAL GRAMS(50), FMASS, NODES(50,2), HTOT, BURN, BUIN(50,20),
     c DAYS, STPTDAT(10,20,3), POWER(50,20), CYCLEN(10,2),
     c VARPOWER(10,20,25,50), VARBLETDOWN(10,20,25,25),
     c TOTALBURNDAYS
*
      CHARACTER STEPCONTROL*1
```

```
*
      DO 10 CT1=1,10
         STPTTALLY(CT1)=0
   10 CONTINUE
      STPTTALLY(1)=STPTS(1)
      IF (NBR.GE.2) THEN
         DO 20 CT1=2,NBR
            STPTTALLY(CT1)=STPTTALLY(CT1-1)+STPTS(CT1)
   20    CONTINUE
      ENDIF
      IF (STEPCONTROL.EQ.'N') THEN
       DO 50 CT1=1,AXNUM
         GRAMS(CT1)=FMASS*(NODES(CT1,2)/HTOT)
         DO 40 CT2=1,(STPTSUM-1)
            BURN=BUIN(CT1,(CT2+1))-BUIN(CT1,CT2)
            IF (NBR.GE.2) THEN
               DO 30 CT3=2,NBR
                  IF((CT2.LE.STPTTALLY(CT3)).AND.
     c               (CT2.GT.STPTTALLY(CT3-1))) THEN
                     CYCLENUMBER=CT3
                  ELSEIF (CT2.LE.STPTTALLY(1)) THEN
                     CYCLENUMBER=1
                  ENDIF
   30          CONTINUE
            ELSEIF (NBR.EQ.1) THEN
               CYCLENUMBER=1
            ENDIF
            IF (CYCLENUMBER.EQ.1) THEN
               STPTNUMBER=CT2
            ELSEIF (CYCLENUMBER.GT.1) THEN
               STPTNUMBER=CT2-STPTTALLY(CYCLENUMBER-1)
            ENDIF
            IF (STPTNUMBER.EQ.STPTS(CYCLENUMBER)) THEN
               DAYS=CYCLEN(CYCLENUMBER,1)-
     c         STPTDAT(CYCLENUMBER,STPTNUMBER,1)
            ELSE
               DAYS=STPTDAT(CYCLENUMBER,(STPTNUMBER+1),1)-
     c         STPTDAT(CYCLENUMBER,STPTNUMBER,1)
            ENDIF
            POWER(CT1,CT2)=BURN*GRAMS(CT1)*(1.0/1000.0)*(1/DAYS)
   40    CONTINUE
   50  CONTINUE
      ELSEIF (STEPCONTROL.EQ.'Y') THEN
       DO 100 CT1=1,AXNUM
         GRAMS(CT1)=FMASS*(NODES(CT1,2)/HTOT)
         DO 90 CT2=1,(STPTSUM-1)
            IF (NBR.GE.2) THEN
               DO 70 CT3=2,NBR
                  IF((CT2.LE.STPTTALLY(CT3)).AND.
     c               (CT2.GT.STPTTALLY(CT3-1))) THEN
                     CYCLENUMBER=CT3
                  ELSEIF (CT2.LE.STPTTALLY(1)) THEN
                     CYCLENUMBER=1
                  ENDIF
   70          CONTINUE
            ELSEIF (NBR.EQ.1) THEN
               CYCLENUMBER=1
            ENDIF
            IF (CYCLENUMBER.EQ.1) THEN
               STPTNUMBER=CT2
```

```
            ELSEIF (CYCLENUMBER.GT.1) THEN
               STPTNUMBER=CT2-STPTTALLY(CYCLENUMBER-1)
            ENDIF
            TOTALBURNDAYS=0.0
            DO 75 CT4=1,VARSTEPNUM(CYCLENUMBER,STPTNUMBER)
               TOTALBURNDAYS=TOTALBURNDAYS+
     c         VARBLETDOWN(CYCLENUMBER,STPTNUMBER,CT4,1)
    75       CONTINUE
            DO 80 CT4=1,VARSTEPNUM(CYCLENUMBER,STPTNUMBER)
               DAYS=VARBLETDOWN(CYCLENUMBER,STPTNUMBER,CT4,1)
               BURN=(BUIN(CT1,(CT2+1))-BUIN(CT1,CT2))*
     c         (DAYS/TOTALBURNDAYS)
               VARPOWER(CYCLENUMBER,STPTNUMBER,CT4,CT1)=BURN*
     c         GRAMS(CT1)*(1.0/1000.0)*(1/DAYS)
    80       CONTINUE
    90    CONTINUE
   100  CONTINUE
        ENDIF

        RETURN
        END


*************************************************************************
*     Subroutine to convert fuel temperature units and calculate        *
*     moderator specific volumes and densities with the correct units   *
*************************************************************************
        SUBROUTINE UNITS_CONVERSION (STPTSUM, AXNUM, FTFINAL,
       c FTIN, MODDENFINAL, MOIN, PRESS, MODTEMPFINAL, DENDAT)
*
        INTEGER*4 CT1, CT2, CT3, STPTSUM, AXNUM, COL1, COL2, ROW1, ROW2
*
        REAL FTFINAL(50,20), FTIN(50,20), MODDENFINAL(50,20), MOIN(50,20),
       c PRESS, DENDAT(29,10), P1, P2, DENCOL(29), T, MODTEMPFINAL(50,20)
*
        DO 50 CT1=1,STPTSUM
           DO 40 CT2=1,AXNUM
              FTFINAL(CT2,CT1)=((FTIN(CT2,CT1)-32.0)*(5.0/9.0))
     c                        +273.15
              MODDENFINAL(CT2,CT1)=(1/(MOIN(CT2,CT1)*62.42691))
              DO 10 CT3=2,10
                 IF ((PRESS.LT.DENDAT(1,CT3)).AND.
     c           (PRESS.GT.DENDAT(1,(CT3+1)))) THEN
                    P1=DENDAT(1,CT3)
                    P2=DENDAT(1,(CT3+1))
                    COL1=CT3
                    COL2=(CT3+1)
                 ELSEIF (PRESS.EQ.DENDAT(1,CT3)) THEN
                    P1=PRESS
                    P2=DENDAT(1,(CT3+1))
                    COL1=CT3
                    COL2=(CT3+1)
                 ENDIF
    10        CONTINUE
              DO 20 CT3=2,29
                 DENCOL(CT3)=((PRESS-P2)*((DENDAT(CT3,COL1)
     c           -DENDAT(CT3,COL2))/(P1-P2)))+DENDAT(CT3,COL2)
    20        CONTINUE
              DO 30 CT3=2,29
                 IF ((MODDENFINAL(CT2,CT1).LT.DENCOL(CT3)).AND.
```

```
c              (MODDENFINAL(CT2,CT1).GT.DENCOL(CT3+1))) THEN
               ROW1=CT3
               ROW2=CT3+1
               T=(((MODDENFINAL(CT2,CT1)-DENCOL(ROW2))*
c                (DENDAT(ROW1,1)-DENDAT(ROW2,1)))/(DENCOL(ROW1)
c               -DENCOL(ROW2)))+DENDAT(ROW2,1)
            ELSEIF ((MODDENFINAL(CT2,CT1)).EQ.DENCOL(CT3)) THEN
               T=DENDAT(CT3,1)
            ENDIF
 30       CONTINUE
          MODTEMPFINAL(CT2,CT1)=((T-32.0)*(5.0/9.0))+273.15
 40    CONTINUE
 50 CONTINUE

    RETURN
    END


*************************************************************************
*     SAS2H Input Deck Creation and Execution Control Subroutine        *
*************************************************************************
      SUBROUTINE EXECUTION_CONTROL (NBR, RELATIVE_STPT_NUM,
     c          CT1, CT2, CT3, AXNUM, CYCPOS, AXBLANK,
     c          BPDESID, CRINS, CRDES,
     c          CRMIXNUM, CRMIXID, CRNUMISOS, CRISOID,
     c          APSRINS, APSRMIXNUM, APSRMIXID,
     c          RELATIVE_APSR_MIX_ID, APSRNUMISOS,
     c          APSRISOID, ISN, IIM, ICM, IUS, PLEVEL,
     c          BPZONE, BPMA, CRZONE, CRMA,
     c          LMC, APSRZONE, APSRMA, LMD,
     c          BPTN, BPBN, STPTS, APSRDES,
     c          STPTDAT, AXBLANKRICH, GRAMS,
     c          NODES, RODS, RICH, FTFINAL,
     c          MODDENFINAL, MODTEMPFINAL,
     c          BLETDOWN, BPWTPCT, BPDEN, CRDEN,
     c          CRISOWTPCT, APSRDEN, APSRISOWTPCT,
     c          PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
     c          BPRA, CRRA, LRC, APSRRA,
     c          LRD, POWER, CYCDOWN, PREFIX,
     c          NM, CYCLEID, REACT, LIB, AXBLANKET,
     c          FUELCLAD, BPRFLAG, CRSTAT, APSRSTAT, FLAG2,
     c          LUZONE, LMB, LRB, BPXSECT, BPRODS, CT1START,
     c          CT2START, STPTTALLY, CLADTOT, CLADDESNUM,
     c          CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c          CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c          BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c          SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c          VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c          ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c          APSRFR, ABOVEBP, APSRFOLLOWMIX)
*
      INTEGER*4 CT1, CT2, CT3, NBR, RELATIVE_STPT_NUM,
     c          AXNUM, CYCPOS(10), AXBLANK(50),
     c          BPDESID(10), CRINS(10,20,23,50), CRDES(10,20,23,50),
     c          CRMIXNUM, CRMIXID(25), CRNUMISOS(25), CRISOID(25,10),
     c          APSRINS(10,20,23,50), APSRMIXNUM, APSRMIXID(25),
     c          RELATIVE_APSR_MIX_ID, APSRNUMISOS(25),
     c          APSRISOID(25,10), ISN, IIM, ICM, IUS, PLEVEL,
     c          BPZONE(10), BPMA(15,10), CRZONE(10), CRMA(15,10),
     c          LMC(15,10), APSRZONE(10), APSRMA(15,10), LMD(15,10),
```

```
      c          BPTN(10), BPBN(10), STPTS(10), APSRDES(10,20,23,50),
      c          BPRODS(10), SYSTEM, SASEXERESULT,
      c          CARRYCOUNTER, CT1START, CT2START, CT2GOVALUE,
      c          STPTTALLY(20), CT2ENDVALUE, CLADTOT, CLADDESNUM(10),
      c          BPRCLAD(10), CRCLAD(10), APSRCLAD(10), BPMIXNUM,
      c          BPMIX(10), BPMIXID(10), BPNUMISOS(20), BPISOID(10,20),
      c          VARSTEPNUM(10,20), BPRFM(15,10), BPFMNUMISOS(25),
      c          BPFISOID(25,10), ABOVEBPNUM(10), APSRFM(15,10),
      c          APSRFOLLOWMIX(10,20,23,50), APSRINSOLD(10,20,23,50)
*
       REAL      STPTDAT(10,20,3), AXBLANKRICH, GRAMS(50),
      c          NODES(50,2), RODS, RICH, FTFINAL(50,20),
      c          MODDENFINAL(50,20), MODTEMPFINAL(50,20),
      c          BLETDOWN(10,20,25), BPWTPCT(10), BPDEN(10), CRDEN(10),
      c          CRISOWTPCT(25,10), APSRDEN(10), APSRISOWTPCT(25,10),
      c          PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
      c          BPRA(15,10), CRRA(15,10), LRC(15,10), APSRRA(15,10),
      c          LRD(15,10), POWER(50,20), CYCDOWN(10), BPXSECT(10),
      c          FINALDOWNTIME, MASSTOTAL, FUELISOWTPCT(1000),
      c          BPRAISOVALUE(2), LEFTVAL(1000), CLTEMP,
      c          BPISOWTPCT(10,20), UCSPACERFRAC,
      c          VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50),
      c          BPRFR(15,10), BPFISOWTPCT(25,10), APSRFR(15,10)
*
       CHARACTER PREFIX*3, NM*31, CYCLEID(10)*2, REACT*21, LIB*15,
      c          AXBLANKET*1, FUELCLAD*10, BPRFLAG*1, CRSTAT*6,
      c          APSRSTAT*6, FLAG2*7, SASEXECOMMAND*33,
      c          PREVIOUSNAME*25, FUELISONAME(1000)*5,
      c          BPRAISONAME(2)*6, LEFTLIST(1000)*6,
      c          CLADDESNAME(10)*7, SPACERMAT*7, STEPCONTROL*1,
      c          ABOVEBP(10)*5
*
       LOGICAL  BPRA_INSERTED
*
       RELATIVE_STPT_NUM=0
       DO 30 CT3=1,AXNUM
        IF (CT1START.EQ.1) THEN
           RELATIVE_STPT_NUM=CT2START-1
        ELSE
           RELATIVE_STPT_NUM=STPTTALLY(CT1START-1)+CT2START-1
        ENDIF
        DO 20 CT1=CT1START,NBR
*  CT1 is the insertion cycle incrementer
          IF (CT1.EQ.CT1START) THEN
             CT2GOVALUE=CT2START
          ELSE
             CT2GOVALUE=1
          ENDIF
          IF (CT1.EQ.NBR) THEN
             CT2ENDVALUE=STPTS(CT1)-1
          ELSE
             CT2ENDVALUE=STPTS(CT1)
          ENDIF
*  CT2 is the statepoint incrementer within cycle CT1
          DO 10 CT2=CT2GOVALUE,CT2ENDVALUE
                RELATIVE_STPT_NUM=RELATIVE_STPT_NUM+1
                IF ((CT1.EQ.1).AND.(CT2.EQ.1)) THEN
                CALL STANDARD_WRITER (RELATIVE_STPT_NUM, CT1,
     c          CT2, CT3, AXNUM, CYCPOS, AXBLANK,
     c          BPDESID, CRINS, CRDES,
```

```
c          CRMIXNUM, CRMIXID, CRNUMISOS, CRISOID,
c          APSRINS, APSRMIXNUM, APSRMIXID,
c          RELATIVE_APSR_MIX_ID, APSRNUMISOS,
c          APSRISOID, ISN, IIM, ICM, IUS, PLEVEL,
c          BPZONE, BPMA, CRZONE, CRMA,
c          LMC, APSRZONE, APSRMA, LMD,
c          BPTN, BPBN, STPTS, APSRDES,
c          STPTDAT, AXBLANKRICH, GRAMS,
c          NODES, RODS, RICH, FTFINAL,
c          MODDENFINAL, MODTEMPFINAL,
c          BLETDOWN, BPWTPCT, BPDEN, CRDEN,
c          CRISOWTPCT, APSRDEN, APSRISOWTPCT,
c          PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH,
c          BPRA, CRRA, LRC, APSRRA,
c          LRD, POWER, CYCDOWN, PREFIX,
c          NM, CYCLEID, REACT, LIB, AXBLANKET,
c          FUELCLAD, BPRFLAG, CRSTAT, APSRSTAT, FLAG2,
c          LUZONE, LMB, LRB, PREVIOUSNAME, FINALDOWNTIME,
c          BPRA_INSERTED, CLADTOT, CLADDESNUM,
c          CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
c          CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
c          BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
c          SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
c          VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
c          ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
c          APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START,
c          CT2GOVALUE, APSRINSOLD)
           SASEXECOMMAND(1:8)='batch43 '
           SASEXECOMMAND(9:33)=NM(1:25)
           SASEXERESULT=SYSTEM(SASEXECOMMAND)
           IF (SASEXERESULT.LT.0) THEN
              WRITE (*,*) 'AN ERROR OCCURRED DURING SAS2H',
c             'EXECUTION OF ', NM(1:25)
           ENDIF
           CALL CUTTER (NM)
        ELSE
           CALL CONTINUATION_WRITER (RELATIVE_STPT_NUM,
c          CT1, CT2, CT3, AXNUM, CYCPOS, AXBLANK, BPDESID,
c          CRINS, CRDES, CRMIXNUM, CRMIXID,
c          CRNUMISOS, CRISOID, APSRINS,
c          APSRMIXNUM, APSRMIXID, RELATIVE_APSR_MIX_ID,
c          APSRNUMISOS, APSRISOID, ISN, IIM, ICM, IUS,
c          PLEVEL, BPZONE, BPMA, CRZONE, CRMA,
c          LMC, APSRZONE, APSRMA, LMD,
c          BPTN, BPBN, STPTS, APSRDES,
c          STPTDAT, AXBLANKRICH, GRAMS,
c          NODES, RODS, RICH, FTFINAL, MODDENFINAL,
c          MODTEMPFINAL, BLETDOWN, BPWTPCT,
c          BPDEN, CRDEN, CRISOWTPCT, APSRDEN,
c          APSRISOWTPCT, PITCH, FOD, COD, CID, SZF,
c          EPS, PTC, MESH, BPRA, CRRA, LRC, APSRRA,
c          LRD, POWER, CYCDOWN, PREFIX, NM,
c          CYCLEID, REACT, LIB, AXBLANKET, FUELCLAD,
c          BPRFLAG, CRSTAT, APSRSTAT, FLAG2, LUZONE,
c          LMB, LRB, MASSTOTAL, FUELISONAME, FUELISOWTPCT,
c          BPRAISONAME, BPRAISOVALUE, LEFTLIST, CARRYCOUNTER,
c          BPXSECT, BPRODS, PREVIOUSNAME, FINALDOWNTIME,
c          LEFTVAL, BPRA_INSERTED, CLADTOT, CLADDESNUM,
c          CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
c          CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
```

```
     c          BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c          SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c          VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c          ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c          APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START,
     c          CT2GOVALUE, APSRINSOLD)
                SASEXECOMMAND(1:8)='batch43 '
                SASEXECOMMAND(9:33)=NM(1:25)
                SASEXERESULT=SYSTEM(SASEXECOMMAND)
                IF (SASEXERESULT.LT.0) THEN
                   WRITE (*,*) 'AN ERROR OCCURRED DURING SAS2H',
     c             'EXECUTION OF ', NM(1:25)
                ENDIF
                CALL CUTTER (NM)
             ENDIF
  10    CONTINUE
  20  CONTINUE
  30 CONTINUE

      RETURN
      END


*****************************************************************
*     Subroutine to write standard beginning of assembly life   *
*     SAS2H input decks                                         *
*****************************************************************
      SUBROUTINE STANDARD_WRITER (RELATIVE_STPT_NUM, CT1, CT2, CT3,
     c AXNUM, CYCPOS, AXBLANK, BPDESID,
     c CRINS, CRDES, CRMIXNUM, CRMIXID,
     c CRNUMISOS, CRISOID, APSRINS,
     c APSRMIXNUM, APSRMIXID, RELATIVE_APSR_MIX_ID,
     c APSRNUMISOS, APSRISOID, ISN, IIM, ICM, IUS,
     c PLEVEL, BPZONE, BPMA, CRZONE, CRMA,
     c LMC, APSRZONE, APSRMA, LMD,
     c BPTN, BPBN, STPTS, APSRDES,
     c STPTDAT, AXBLANKRICH, GRAMS,
     c NODES, RODS, RICH, FTFINAL, MODDENFINAL,
     c MODTEMPFINAL, BLETDOWN, BPWTPCT,
     c BPDEN, CRDEN, CRISOWTPCT, APSRDEN,
     c APSRISOWTPCT, PITCH, FOD, COD, CID, SZF, EPS, PTC,
     c MESH, BPRA, CRRA, LRC, APSRRA,
     c LRD, POWER, CYCDOWN, PREFIX, NM,
     c CYCLEID, REACT, LIB, AXBLANKET, FUELCLAD,
     c BPRFLAG, CRSTAT, APSRSTAT, FLAG2, LUZONE, LMB, LRB,
     c PREVIOUSNAME, FINALDOWNTIME, BPRA_INSERTED, CLADTOT,
     c CLADDESNUM, CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START, CT2GOVALUE,
     c APSRINSOLD)
*
      INTEGER*4 RELATIVE_STPT_NUM, CT1, CT2, CT3, AXNUM,
     c NUMSTPT1, NUMSTPT2, NUMSTPT3, CYCPOS(10), AXBLANK(50),
     c BPDESID(10), BPRA_DESCRIPTION_ID, CT4, CT5, CRINS(10,20,23,50),
     c CR_MIXTURE_ID, CR_DESCRIPTION, CRDES(10,20,23,50), CRMIXNUM,
     c CRMIXID(25), RELATIVE_CR_MIX_ID, CRNUMISOS(25),
```

```
c CRISOID(25,10), APSRINS(10,20,23,50), APSR_MIXTURE_ID,
c APSR_DESCRIPTION, APSRMIXNUM, APSRMIXID(25),
c RELATIVE_APSR_MIX_ID, APSRNUMISOS(25), APSRISOID(25,10),
c ISN, IIM, ICM, IUS, PLEVEL, BPZONE(10), BPMA(15,10),
c CRZONE(10), CRMA(15,10), LMC(15,10), APSRZONE(10),
c APSRMA(15,10), LMD(15,10), BPTN(10), BPBN(10), STPTS(10),
c APSRDES(10,20,23,50), LUZONE, LMB(15), NUMSTPT4, NUMSTPT5,
c NUMSTPT6, CLADTOT, CLADDESNUM(10), BPRCLAD(10), CRCLAD(10),
c APSRCLAD(10), APSRCLNUM, CRCLNUM, BPRCLNUM, BPMIXNUM,
c BPMIX(10), BPMIXID(10), BPNUMISOS(20), BPISOID(10,20),
c VARSTEPNUM(10,20), BPRFM(15,10), BPFMNUMISOS(25),
c BPFISOID(25,10), ABOVEBPNUM(10), APSRFM(15,10),
c APSRFOLLOWMIX(10,20,23,50), FOLNODKEEP,
c FOLSTEPKEEP, APSRFOLNUM, APSRFOLLOWDATA(10,20,23,50),
c CT1START, CT2GOVALUE, APSRINSOLD(10,20,23,50)
*
      REAL STPTDAT(10,20,3), ENR, AXBLANKRICH, OXYGMS, GRAMS(50),
     c UO2GMS, FVOL, PI, NODES(50,2), RODS, FDEN, WT234,
     c WT235, WT236, WT238, RICH, FTFINAL(50,20),
     c MODDENFINAL(50,20), MODTEMPFINAL(50,20), BLETDOWN(10,20,25),
     c BPWTPCT(10), BPDEN(10), ALFRAC, OFRAC, CRDEN(10),
     c CRISOWTPCT(25,10), APSRDEN(10), APSRISOWTPCT(25,10),
     c PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH, BPRA(15,10),
     c CRRA(15,10), LRC(15,10), APSRRA(15,10), LRD(15,10),
     c DOWNTIME, BORON_FRACTION, POWER(50,20), CYCDOWN(10), LRB(15),
     c FINALDOWNTIME, CLTEMP, BPISOWTPCT(10,20), UCSPACERFRAC,
     c BORATEDMODVF, BORONVF, UCMODREGIONDEN,
     c VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50),
     c BPRFR(15,10), BPFISOWTPCT(25,10), APSRFR(15,10)
*
      CHARACTER CHNODE*2, CHID*2, PREFIX*3, CHSTPT1*1, CHSTPT2*1,
     c CHSTPT3*1, NM*31, CYCLEID(10)*2, REACT*21, LIB*15,
     c AXBLANKET*1, FUELCLAD*10, BPRFLAG*1, CRSTAT*6, APSRSTAT*6,
     c FLAG2*7, IRRAD_STEPS*2, PLEVELCH*2, BPZONECH*2, CRZONECH*2,
     c APSRZONECH*2, LUZONECH*2, PREVIOUSNAME*25, ASSYPOSITION*2,
     c CHSTPT4*1, CHSTPT5*1, CHSTPT6*1, CLADDESNAME(10)*7,
     c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
      LOGICAL BPRA_INSERTED, CR_INSERTED, CRCOMPFLAG, APSR_INSERTED,
     c APSRCOMPFLAG, BPRA_FOLLOW, APSRBOTFLAG, FOLLOWIN
*
      PI=3.14159265359
*  Determination of the input deck filename
         CALL ZEROS(CT3,CHNODE)
         CALL ZEROS(CYCPOS(CT1),CHID)
         NUMSTPT1=INT(STPTDAT(CT1,CT2,1)/100.0)
         CHSTPT1=CHAR(NUMSTPT1+48)
         NUMSTPT2=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100))/10.0)
         CHSTPT2=CHAR(NUMSTPT2+48)
         NUMSTPT3=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100)-
     c   (NUMSTPT2*10)))
         CHSTPT3=CHAR(NUMSTPT3+48)
         IF (CT2.LT.STPTS(CT1)) THEN
            NUMSTPT4=INT(STPTDAT(CT1,(CT2+1),1)/100.0)
            CHSTPT4=CHAR(NUMSTPT4+48)
            NUMSTPT5=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100))/10.0)
            CHSTPT5=CHAR(NUMSTPT5+48)
            NUMSTPT6=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100)-
     c      (NUMSTPT5*10)))
            CHSTPT6=CHAR(NUMSTPT6+48)
```

```
            ELSEIF (CT2.EQ.STPTS(CT1)) THEN
               NUMSTPT4=INT(STPTDAT((CT1+1),1,1)/100.0)
               CHSTPT4=CHAR(NUMSTPT4+48)
               NUMSTPT5=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100))/10.0)
               CHSTPT5=CHAR(NUMSTPT5+48)
               NUMSTPT6=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100)-
     c         (NUMSTPT5*10)))
               CHSTPT6=CHAR(NUMSTPT6+48)
            ENDIF
            NM(1:3)=PREFIX
            NM(4:4)='A'
            NM(5:6)=CHID
            NM(7:7)='N'
            NM(8:9)=CHNODE
            NM(10:11)='DC'
            NM(12:13)=CYCLEID(CT1)
            NM(14:14)='T'
            NM(15:15)=CHSTPT1
            NM(16:16)=CHSTPT2
            NM(17:17)=CHSTPT3
            NM(18:19)='AC'
            IF (CT2.EQ.STPTS(CT1)) THEN
               NM(20:21)=CYCLEID(CT1+1)
            ELSE
               NM(20:21)=CYCLEID(CT1)
            ENDIF
            NM(22:22)='T'
            NM(23:23)=CHSTPT4
            NM(24:24)=CHSTPT5
            NM(25:25)=CHSTPT6
            NM(26:31)='.input'
            PREVIOUSNAME=NM(1:25)
*     Open and rewind the input deck file
            OPEN(UNIT=100, FILE=NM, STATUS='UNKNOWN')
            REWIND(UNIT=100)
*     Write first section of input deck
            WRITE (100,10)
     10     FORMAT ('=sas2h',T11,'parm=skipshipdata')
            IF (CT2.LT.STPTS(CT1)) THEN
               WRITE (100,20) REACT, CHID, CHNODE,
       c       NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
       c       STPTDAT(CT1,(CT2+1),1)
     20        FORMAT (A21,1X,'Assy-',A2,
       c       ', Node-',A2,1X,
       c       '{Cyc-',A2,', 'F5.1,' to Cyc-',
       c       A2,', ',F5.1,' EFPD}')
            ELSEIF (CT2.EQ.STPTS(CT1)) THEN
               WRITE (100,25) REACT, CHID, CHNODE,
       c       NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
       c       STPTDAT((CT1+1),1,1)
     25        FORMAT (A21,1X,'Assy-',A2,
       c       ', Node-',A2,1X,
       c       '{Cyc-',A2,', 'F5.1,' to Cyc-',
       c       A2,', ',F5.1,' EFPD}')
            ENDIF
            WRITE (100,30) LIB
     30     FORMAT (A15,1X,'latticecell')
            WRITE (100,40)
     40     FORMAT ('''')
            WRITE (100,50)
```

```
   50    FORMAT ('''   fuel density based on mass of uranium per',
     c   ' assembly',T56,'& total pellet stack')
         WRITE (100,60)
   60    FORMAT ('''   volume to account for fuel volume loss to',
     c   ' pellet c',T55,'hamfers')
         WRITE (100,70)
   70    FORMAT ('''')
*  Write second section of input deck (material specifications)
         WRITE (100,80)
   80    FORMAT ('''',5X,'material specification input')
         WRITE (100,90)
   90    FORMAT ('''')
*  Calculate initital fuel parameters depending upon whether or not the

*  node represents axial blanket fuel
         IF ((AXBLANKET.EQ.'Y').AND.(AXBLANK(CT3).EQ.1)) THEN
            ENR=AXBLANKRICH
            OXYGMS=(GRAMS(CT3)*2*15.994915)/(((ENR/100)*235.043915)+
     c      (((0.007731*((ENR)**1.0837))/100)*234.040904)+
     c      (((0.0046*ENR)/100)*236.045637)+(((100-(0.007731*
     c      (ENR**1.0837))-(ENR)-(0.0046*ENR))/100)*238.05077))
            UO2GMS=GRAMS(CT3)+OXYGMS
            FVOL=(PI/4)*(FOD**2)*(NODES(CT3,2))*(RODS)
            FDEN=UO2GMS/FVOL
            WT234=0.007731*(ENR**1.0837)
            WT235=ENR
            WT236=0.0046*ENR
            WT238=100.0-WT234-ENR-WT236
         ELSE
            ENR=RICH
            OXYGMS=(GRAMS(CT3)*2*15.994915)/(((ENR/100)*235.043915)+
     c      (((0.007731*((ENR)**1.0837))/100)*234.040904)+
     c      (((0.0046*ENR)/100)*236.045637)+(((100-(0.007731*
     c      (ENR**1.0837))-(ENR)-(0.0046*ENR))/100)*238.05077))
            UO2GMS=GRAMS(CT3)+OXYGMS
            FVOL=(PI/4)*(FOD**2)*(NODES(CT3,2))*(RODS)
            FDEN=UO2GMS/FVOL
            WT234=0.007731*(ENR**1.0837)
            WT235=ENR
            WT236=0.0046*ENR
            WT238=100.0-WT234-ENR-WT236
         ENDIF
*  Write fuel composition input description
         IF (FDEN.LT.(10.0)) THEN
            WRITE (100,100) FDEN, FTFINAL(CT3,RELATIVE_STPT_NUM), WT234,
     c      WT235, WT236, WT238
  100       FORMAT ('uo2 1 den=',F5.3,1X,'1',1X,F6.1,1X,'92234',1X,F5.3,
     c      1X,'92235',1X,F5.3,1X,'92236',1X,F5.3,1X,'92238',1X,F6.3,1X,
     c      'end')
         ELSE
            WRITE (100,110) FDEN, FTFINAL(CT3,RELATIVE_STPT_NUM), WT234,
     c      WT235, WT236, WT238
  110       FORMAT ('uo2 1 den=',F6.3,1X,'1',1X,F6.1,1X,'92234',1X,F5.3,
     c      1X,'92235',1X,F5.3,1X,'92236',1X,F5.3,1X,'92238',1X,F6.3,1X,
     c      'end')
         ENDIF
         WRITE (100,120) FTFINAL(CT3,RELATIVE_STPT_NUM)
  120    FORMAT ('kr-83        1   0   1-21    ',F6.1,'   end')
         WRITE (100,130) FTFINAL(CT3,RELATIVE_STPT_NUM)
  130    FORMAT ('kr-85        1   0   1-21    ',F6.1,'   end')
```

```
      WRITE (100,140) FTFINAL(CT3,RELATIVE_STPT_NUM)
140   FORMAT ('sr-90        1   0   1-21   ',F6.1,'   end')
      WRITE (100,150) FTFINAL(CT3,RELATIVE_STPT_NUM)
150   FORMAT ('y-89         1   0   1-21   ',F6.1,'   end')
      WRITE (100,160) FTFINAL(CT3,RELATIVE_STPT_NUM)
160   FORMAT ('mo-95        1   0   1-21   ',F6.1,'   end')
      WRITE (100,170) FTFINAL(CT3,RELATIVE_STPT_NUM)
170   FORMAT ('zr-93        1   0   1-21   ',F6.1,'   end')
      WRITE (100,180) FTFINAL(CT3,RELATIVE_STPT_NUM)
180   FORMAT ('zr-94        1   0   1-21   ',F6.1,'   end')
      WRITE (100,190) FTFINAL(CT3,RELATIVE_STPT_NUM)
190   FORMAT ('zr-95        1   0   1-21   ',F6.1,'   end')
      WRITE (100,200) FTFINAL(CT3,RELATIVE_STPT_NUM)
200   FORMAT ('nb-94        1   0   1-21   ',F6.1,'   end')
      WRITE (100,210) FTFINAL(CT3,RELATIVE_STPT_NUM)
210   FORMAT ('tc-99        1   0   1-21   ',F6.1,'   end')
      WRITE (100,220) FTFINAL(CT3,RELATIVE_STPT_NUM)
220   FORMAT ('rh-103       1   0   1-21   ',F6.1,'   end')
      WRITE (100,230) FTFINAL(CT3,RELATIVE_STPT_NUM)
230   FORMAT ('rh-105       1   0   1-21   ',F6.1,'   end')
      WRITE (100,240) FTFINAL(CT3,RELATIVE_STPT_NUM)
240   FORMAT ('ru-101       1   0   1-21   ',F6.1,'   end')
      WRITE (100,250) FTFINAL(CT3,RELATIVE_STPT_NUM)
250   FORMAT ('ru-106       1   0   1-21   ',F6.1,'   end')
      WRITE (100,260) FTFINAL(CT3,RELATIVE_STPT_NUM)
260   FORMAT ('pd-105       1   0   1-21   ',F6.1,'   end')
      WRITE (100,270) FTFINAL(CT3,RELATIVE_STPT_NUM)
270   FORMAT ('pd-108       1   0   1-21   ',F6.1,'   end')
      WRITE (100,280) FTFINAL(CT3,RELATIVE_STPT_NUM)
280   FORMAT ('ag-109       1   0   1-21   ',F6.1,'   end')
      WRITE (100,290) FTFINAL(CT3,RELATIVE_STPT_NUM)
290   FORMAT ('sb-124       1   0   1-21   ',F6.1,'   end')
      WRITE (100,300) FTFINAL(CT3,RELATIVE_STPT_NUM)
300   FORMAT ('xe-131       1   0   1-21   ',F6.1,'   end')
      WRITE (100,310) FTFINAL(CT3,RELATIVE_STPT_NUM)
310   FORMAT ('xe-132       1   0   1-21   ',F6.1,'   end')
      WRITE (100,320) FTFINAL(CT3,RELATIVE_STPT_NUM)
320   FORMAT ('xe-135       1   0   1-21   ',F6.1,'   end')
      WRITE (100,330) FTFINAL(CT3,RELATIVE_STPT_NUM)
330   FORMAT ('xe-136       1   0   1-21   ',F6.1,'   end')
      WRITE (100,340) FTFINAL(CT3,RELATIVE_STPT_NUM)
340   FORMAT ('cs-134       1   0   1-21   ',F6.1,'   end')
      WRITE (100,350) FTFINAL(CT3,RELATIVE_STPT_NUM)
350   FORMAT ('cs-135       1   0   1-21   ',F6.1,'   end')
      WRITE (100,360) FTFINAL(CT3,RELATIVE_STPT_NUM)
360   FORMAT ('cs-137       1   0   1-21   ',F6.1,'   end')
      WRITE (100,370) FTFINAL(CT3,RELATIVE_STPT_NUM)
370   FORMAT ('ba-136       1   0   1-21   ',F6.1,'   end')
      WRITE (100,380) FTFINAL(CT3,RELATIVE_STPT_NUM)
380   FORMAT ('la-139       1   0   1-21   ',F6.1,'   end')
      WRITE (100,390) FTFINAL(CT3,RELATIVE_STPT_NUM)
390   FORMAT ('ce-144       1   0   1-21   ',F6.1,'   end')
      WRITE (100,400) FTFINAL(CT3,RELATIVE_STPT_NUM)
400   FORMAT ('nd-143       1   0   1-21   ',F6.1,'   end')
      WRITE (100,410) FTFINAL(CT3,RELATIVE_STPT_NUM)
410   FORMAT ('nd-145       1   0   1-21   ',F6.1,'   end')
      WRITE (100,420) FTFINAL(CT3,RELATIVE_STPT_NUM)
420   FORMAT ('pm-147       1   0   1-21   ',F6.1,'   end')
      WRITE (100,430) FTFINAL(CT3,RELATIVE_STPT_NUM)
430   FORMAT ('pm-148       1   0   1-21   ',F6.1,'   end')
```

```
      WRITE (100,440) FTFINAL(CT3,RELATIVE_STPT_NUM)
440   FORMAT ('nd-147       1   0   1-21   ',F6.1,'   end')
      WRITE (100,450) FTFINAL(CT3,RELATIVE_STPT_NUM)
450   FORMAT ('sm-147       1   0   1-21   ',F6.1,'   end')
      WRITE (100,460) FTFINAL(CT3,RELATIVE_STPT_NUM)
460   FORMAT ('sm-149       1   0   1-21   ',F6.1,'   end')
      WRITE (100,470) FTFINAL(CT3,RELATIVE_STPT_NUM)
470   FORMAT ('sm-150       1   0   1-21   ',F6.1,'   end')
      WRITE (100,480) FTFINAL(CT3,RELATIVE_STPT_NUM)
480   FORMAT ('sm-151       1   0   1-21   ',F6.1,'   end')
      WRITE (100,490) FTFINAL(CT3,RELATIVE_STPT_NUM)
490   FORMAT ('sm-152       1   0   1-21   ',F6.1,'   end')
      WRITE (100,500) FTFINAL(CT3,RELATIVE_STPT_NUM)
500   FORMAT ('gd-155       1   0   1-21   ',F6.1,'   end')
      WRITE (100,510) FTFINAL(CT3,RELATIVE_STPT_NUM)
510   FORMAT ('eu-153       1   0   1-21   ',F6.1,'   end')
      WRITE (100,520) FTFINAL(CT3,RELATIVE_STPT_NUM)
520   FORMAT ('eu-154       1   0   1-21   ',F6.1,'   end')
      WRITE (100,530) FTFINAL(CT3,RELATIVE_STPT_NUM)
530   FORMAT ('eu-155       1   0   1-21   ',F6.1,'   end')
*  Write cladding material specifications
*  Additional cladding material specifications may be added to the
*  following IF statement as required
      IF ((FUELCLAD.EQ.'ZIRC-4    ').OR.
     c  (FUELCLAD.EQ.'ZIRCALLOY4')) THEN
         WRITE (100,532)
532      FORMAT ('arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000',
     c    ' 0.10 26000 0.20 50000 1.40')
         WRITE (100,535) CLTEMP
535      FORMAT (T12,'40000 98.18 2 1.0 ',F5.1,' end')
      ELSEIF (FUELCLAD.EQ.'SS304     ') THEN
         WRITE (100,537)
537      FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c    ' 2.0 26304 69.5 28304 9.5')
         WRITE (100,540) CLTEMP
540      FORMAT (T12,'2 1.0 ',F5.1,' end')
      ELSEIF (FUELCLAD.EQ.'SS304S    ') THEN
         WRITE (100,542)
542      FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c    ' 2.0 26000 69.5 28000 9.5')
         WRITE (100,545) CLTEMP
545      FORMAT (T13,'2 1.0 ',F5.1,' end')
      ELSEIF (FUELCLAD.EQ.'SS316     ') THEN
         WRITE (100,547)
547      FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c    ' 1.0 24304 17.0 25055 2.0')
         WRITE (100,550)
550      FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
         WRITE (100,552) CLTEMP
552      FORMAT (T12,'2 1.0 ',F5.1,' end')
      ELSEIF (FUELCLAD.EQ.'SS316S    ') THEN
         WRITE (100,555)
555      FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c    ' 1.0 24000 17.0 25055 2.0')
         WRITE (100,557)
557      FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
         WRITE (100,559) CLTEMP
559      FORMAT (T13,'2 1.0 ',F5.1,' end')
      ENDIF
*  Write moderator material specifications
```

```
      BORATEDMODVF=1.0-UCSPACERFRAC
      IF (STEPCONTROL.EQ.'N') THEN
         BORONVF=BLETDOWN(CT1,CT2,3)*(1E-6)*BORATEDMODVF
      ELSEIF (STEPCONTROL.EQ.'Y') THEN
         BORONVF=VARBLETDOWN(CT1,CT2,1,2)*(1E-6)*BORATEDMODVF
      ENDIF
      WRITE (100,560)
560   FORMAT ('''')
      IF ((SPACERMAT.EQ.'ZIRC-4 ').AND.
     c (UCSPACERFRAC.GT.(0.0))) THEN
         WRITE (100,561)
561      FORMAT ('''     material composition of moderator',
     c   ' within unit cell')
         WRITE (100,562)
562      FORMAT ('''     with smeared zirc-4 spacer grids')
         UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c   BORATEDMODVF)+(6.56*UCSPACERFRAC)
         IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
            WRITE (100,563) UCMODREGIONDEN, BORATEDMODVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
563         FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
         ELSE
            WRITE (100,564) UCMODREGIONDEN, BORATEDMODVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
564         FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
         ENDIF
         WRITE (100,565) UCMODREGIONDEN, BORONVF,
     c   MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
565      FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c   1X,F6.5,1X,F7.1,1X,'end')
         WRITE (100,566) UCMODREGIONDEN
566      FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 8016 0.12',
     c   ' 24000 0.10 26000 0.25')
         WRITE (100,567) UCSPACERFRAC,
     c   MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
567      FORMAT (T17'50000 1.40 40000 98.18 3',1X,F6.5,1X,
     c   F7.1,1X,'end')
      ELSEIF ((SPACERMAT.EQ.'INCONEL').AND.
     c (UCSPACERFRAC.GT.(0.0))) THEN
         WRITE (100,568)
568      FORMAT ('''     material composition of moderator',
     c   ' within unit cell')
         WRITE (100,569)
569      FORMAT ('''     with smeared inconel spacer grids')
         UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c   BORATEDMODVF)+(8.3*UCSPACERFRAC)
         IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
            WRITE (100,570) UCMODREGIONDEN, BORATEDMODVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
570         FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
         ELSE
            WRITE (100,571) UCMODREGIONDEN, BORATEDMODVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
571         FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
         ENDIF
         WRITE (100,572) UCMODREGIONDEN, BORONVF,
     c   MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
572      FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c   1X,F6.5,1X,F7.1,1X,'end')
         WRITE (100,573) UCMODREGIONDEN
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573         FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 14000 2.5',
   c        ' 22000 2.5 24000 15.0')
            WRITE (100,574) UCSPACERFRAC,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
574         FORMAT (T17'26000 7.0 28000 73.0 3',1X,F6.5,1X,
   c        F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS316  ').AND.
   c     (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,575)
575         FORMAT ('''     material composition of moderator',
   c        ' within unit cell')
            WRITE (100,576)
576         FORMAT ('''     with smeared ss316 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
   c        BORATEDMODVF)+(7.75*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,577) UCMODREGIONDEN, BORATEDMODVF,
   c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
577            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,578) UCMODREGIONDEN, BORATEDMODVF,
   c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
578            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,579) UCMODREGIONDEN, BORONVF,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
579         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
   c        1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,580) UCMODREGIONDEN
580         FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
   c        ' 14000 1.0 24304 17.0 25055 2.0')
            WRITE (100,581) UCSPACERFRAC,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
581         FORMAT (T5'26304 65.42 28304 12.0 42000 2.5 3',1X,F6.5,1X,
   c        F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS316S ').AND.
   c     (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,582)
582         FORMAT ('''     material composition of moderator',
   c        ' within unit cell')
            WRITE (100,583)
583         FORMAT ('''     with smeared ss316s spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
   c        BORATEDMODVF)+(7.75*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,584) UCMODREGIONDEN, BORATEDMODVF,
   c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
584            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,585) UCMODREGIONDEN, BORATEDMODVF,
   c           MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
585            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,586) UCMODREGIONDEN, BORONVF,
   c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
586         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
   c        1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,587) UCMODREGIONDEN
587         FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
   c        ' 14000 1.0 24000 17.0 25055 2.0')
```

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            WRITE (100,588) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
588         FORMAT (T5'26000 65.42 28000 12.0 42000 2.5 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS304  ').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,589)
589         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,590)
590         FORMAT ('''     with smeared ss304 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.92*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
              WRITE (100,591) UCMODREGIONDEN, BORATEDMODVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
591           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
              WRITE (100,592) UCMODREGIONDEN, BORATEDMODVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
592           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,593) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
593         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,594) UCMODREGIONDEN
594         FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24304 19.0',
     c      ' 25055 2.0 26304 69.5 28304 9.5')
            WRITE (100,595) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
595         FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS304S ').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,596)
596         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,597)
597         FORMAT ('''     with smeared ss304s spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.92*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
              WRITE (100,598) UCMODREGIONDEN, BORATEDMODVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
598           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
              WRITE (100,599) UCMODREGIONDEN, BORATEDMODVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
599           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,600) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
600         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,601) UCMODREGIONDEN
601         FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24000 19.0',
     c      ' 25055 2.0 26000 69.5 28000 9.5')
            WRITE (100,602) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
602         FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
```

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      ELSEIF (UCSPACERFRAC.EQ.(0.0)) THEN
         WRITE (100,603)
603      FORMAT ('''     material composition of moderator',
     c   ' within unit cell')
         WRITE (100,604)
604      FORMAT ('''     with no smeared spacer grids')
         UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c   BORATEDMODVF)
         IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
            WRITE (100,605) UCMODREGIONDEN, BORATEDMODVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
605         FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
         ELSE
            WRITE (100,606) UCMODREGIONDEN, BORATEDMODVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
606         FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
         ENDIF
         WRITE (100,607) UCMODREGIONDEN, BORONVF,
     c   MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
607      FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c   1X,F6.5,1X,F7.1,1X,'end')
      ENDIF
      WRITE (100,608)
608   FORMAT ('''')
*  Write BPRA material specifications
*  BPR follow specifications
      BPRA_FOLLOW=.FALSE.
      IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c   (CT3.LT.BPTN(CT1))) THEN
         BPRA_FOLLOW=.TRUE.
         BPRA_DESCRIPTION_ID=BPDESID(CT1)
         WRITE(100,610)
610      FORMAT('''')
         WRITE(100,612)
612      FORMAT('''',5X,'BPR above the BP absorber region')
         WRITE(100,614)
614      FORMAT('''')
         IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c   (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
           DO 616 CT5=1,10
            IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
             BPRCLNUM=CT5
             EXIT
            ENDIF
616        CONTINUE
           IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
            WRITE (100,618)
618         FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c      ' 2.0 26304 69.5 28304 9.5')
            WRITE (100,620) CLADDESNUM(BPRCLNUM), CLTEMP
620         FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
            WRITE (100,622)
622         FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c      ' 2.0 26000 69.5 28000 9.5')
            WRITE (100,624) CLADDESNUM(BPRCLNUM), CLTEMP
624         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
            WRITE (100,626)
626         FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
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     c          ' 1.0 24304 17.0 25055 2.0')
                WRITE (100,628)
628             FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
                WRITE (100,630) CLADDESNUM(BPRCLNUM), CLTEMP
630             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
                WRITE (100,632)
632             FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c          ' 1.0 24000 17.0 25055 2.0')
                WRITE (100,633)
633             FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                WRITE (100,634) CLADDESNUM(BPRCLNUM), CLTEMP
634             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
                WRITE (100,635)
635             FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c          ' 22000 2.5 24000 15.0')
                WRITE (100,636)
636             FORMAT (T13,'26000 7.0 28000 73.0')
                WRITE (100,637) CLADDESNUM(BPRCLNUM), CLTEMP
637             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ENDIF
             ENDIF
             IF (ABOVEBP(BPDESID(CT1)).EQ.'AL2O3') THEN
                ALFRAC=(((BPDEN(BPDESID(CT1)))*2.0*26.981539)/
     c          (101.9631))/BPDEN(BPDESID(CT1))
                OFRAC=1.0-ALFRAC
                IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                   WRITE (100,638) ABOVEBPNUM(BPDESID(CT1)),
     c             BPDEN(BPDESID(CT1)), ALFRAC,
     c             MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
638                FORMAT ('al',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c             1X,F7.1,1X,'end')
                   WRITE (100,640) ABOVEBPNUM(BPDESID(CT1)),
     c             BPDEN(BPDESID(CT1)), OFRAC,
     c             MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
640                FORMAT ('o',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c             1X,F7.1,1X,'end')
                ELSE
                   WRITE (100,642) ABOVEBPNUM(BPDESID(CT1)),
     c             BPDEN(BPDESID(CT1)), ALFRAC,
     c             MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
642                FORMAT ('al',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c             1X,F7.1,1X,'end')
                   WRITE (100,644) ABOVEBPNUM(BPDESID(CT1)),
     c             BPDEN(BPDESID(CT1)), OFRAC,
     c             MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
644                FORMAT ('o',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c             1X,F7.1,1X,'end')
                ENDIF
             ELSE
                WRITE (100,*) 'arbm-bp    ',
     c          BPDEN(BPRA_DESCRIPTION_ID),
     c          '    ', BPFMNUMISOS(BPRA_DESCRIPTION_ID),
     c          '   0   0   0'
                DO 650 CT4=1,BPFMNUMISOS(BPRA_DESCRIPTION_ID)
                   WRITE (100,648)
     c             BPFISOID(BPRA_DESCRIPTION_ID,CT4),
     c             BPFISOWTPCT(BPRA_DESCRIPTION_ID,CT4)
648                FORMAT (10X,I6,3X,F10.5)
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 650          CONTINUE
              WRITE (100,*) '           ',
     c        ABOVEBPNUM(BPRA_DESCRIPTION_ID),
     c        ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM),
     c        '   end'
            ENDIF
          ENDIF
*  Actual BPRA specifications
          BPRA_INSERTED=.FALSE.
          IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c       (CT3.GE.BPTN(CT1)).AND.(CT3.LE.BPBN(CT1))) THEN
             BPRA_INSERTED=.TRUE.
             BPRA_DESCRIPTION_ID=BPDESID(CT1)
             WRITE (100,685)
 685         FORMAT ('''')
             IF (BPMIX(BPRA_DESCRIPTION_ID).EQ.0) THEN
                WRITE (100,690) BPWTPCT(BPDESID(CT1))
 690            FORMAT ('''',5X,'Al2O3-B4C burnable absorber pellet',1X,
     c          'specification (',F4.2,1X,'wt% b4c)')
             ELSE
                WRITE (100,695)
 695            FORMAT ('''',5X,'burnable absorber pellet ',
     c          'specification')
             ENDIF
             WRITE (100,700)
 700         FORMAT ('''')
*  Write B4C material specification
             IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c       (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
               DO 701 CT5=1,10
                IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
                 BPRCLNUM=CT5
                 EXIT
                ENDIF
 701           CONTINUE
               IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
                WRITE (100,702)
 702            FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c          ' 2.0 26304 69.5 28304 9.5')
                WRITE (100,703) CLADDESNUM(BPRCLNUM), CLTEMP
 703            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
                WRITE (100,704)
 704            FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c          ' 2.0 26000 69.5 28000 9.5')
                WRITE (100,705) CLADDESNUM(BPRCLNUM), CLTEMP
 705            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
                WRITE (100,706)
 706            FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c          ' 1.0 24304 17.0 25055 2.0')
                WRITE (100,707)
 707            FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
                WRITE (100,708) CLADDESNUM(BPRCLNUM), CLTEMP
 708            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
                WRITE (100,709)
 709            FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c          ' 1.0 24000 17.0 25055 2.0')
                WRITE (100,710)
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  710          FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
               WRITE (100,711) CLADDESNUM(BPRCLNUM), CLTEMP
  711          FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
               WRITE (100,712)
  712          FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c         ' 22000 2.5 24000 15.0')
               WRITE (100,713)
  713          FORMAT (T13,'26000 7.0 28000 73.0')
               WRITE (100,714) CLADDESNUM(BPRCLNUM), CLTEMP
  714          FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ENDIF
            ENDIF
*  Material specification for AL2O3-B4C
            IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c      (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
               IF (BPWTPCT(BPDESID(CT1)).NE.(0.0)) THEN
                  IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                     WRITE (100,718) BPDEN(BPDESID(CT1)),
     c               (BPWTPCT(BPDESID(CT1))/100.0),
     c               MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  718                FORMAT ('b4c   4   den=',F4.3,1X,F7.5,1X,F7.1,1X,
     c               'end')
                  ELSE
                     WRITE (100,720) BPDEN(BPDESID(CT1)),
     c               (BPWTPCT(BPDESID(CT1))/100.0),
     c               MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  720                FORMAT ('b4c   4   den=',F5.3,1X,F7.5,1X,F7.1,1X,
     c               'end')
                  ENDIF
               ENDIF
*  Calculate aluminum and oxygen material specifications
               ALFRAC=(((((100.0-BPWTPCT(BPDESID(CT1)))/100.0)*
     c         BPDEN(BPDESID(CT1)))*2.0*26.981539)/(101.9631))/
     c         BPDEN(BPDESID(CT1))
               OFRAC=1.0-(BPWTPCT(BPDESID(CT1))/100.0)-ALFRAC
               IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                  WRITE (100,734) BPDEN(BPDESID(CT1)), ALFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  734             FORMAT ('al    4   den=',F4.3,1X,F7.5,1X,F7.1,1X,'end')
                  WRITE (100,736) BPDEN(BPDESID(CT1)), OFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  736             FORMAT ('o     4   den=',F4.3,1X,F7.5,1X,F7.1,1X,'end')
               ELSE
                  WRITE (100,738) BPDEN(BPDESID(CT1)), ALFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  738             FORMAT ('al    4   den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
                  WRITE (100,740) BPDEN(BPDESID(CT1)), OFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  740             FORMAT ('o     4   den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
               ENDIF
            ELSE
*  Material specification for BP other than Al2O3-B4C
               DO 742 CT4=1,BPMIXNUM
                  IF (BPMIXID(CT4).EQ.BPMIX(BPRA_DESCRIPTION_ID)) THEN
                     RELATIVE_BP_MIX_ID=CT4
                  ENDIF
  742             CONTINUE
               WRITE (100,*) 'arbm-bp   ', BPDEN(BPRA_DESCRIPTION_ID),
     c         '   ', BPNUMISOS(RELATIVE_BP_MIX_ID),
```

```
     c          '   0   0   0'
                DO 750 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                   WRITE (100,745) BPISOID(RELATIVE_BP_MIX_ID,CT4),
     c             BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)
   745              FORMAT (10X,I6,3X,F10.5)
   750           CONTINUE
                 WRITE (100,*) '          ', BPMIX(BPRA_DESCRIPTION_ID),
     c           ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
              ENDIF
           ENDIF
*  Write control rod material specification
           CR_INSERTED=.FALSE.
           IF (CRSTAT.EQ.'RODDED') THEN
              CRCOMPFLAG=.FALSE.
              DO 760 CT4=1,23
                 IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                    CRCOMPFLAG=.TRUE.
                    CR_INSERTED=.TRUE.
                    CR_MIXTURE_ID=CRINS(CT1,CT2,CT4,CT3)
                    CR_DESCRIPTION=CRDES(CT1,CT2,CT4,CT3)
                    EXIT
                 ENDIF
   760        CONTINUE
              IF (CRCOMPFLAG.EQ..TRUE.) THEN
                 DO 770 CT4=1,CRMIXNUM
                    IF (CRMIXID(CT4).EQ.CR_MIXTURE_ID) THEN
                       RELATIVE_CR_MIX_ID=CT4
                    ENDIF
   770              CONTINUE
                    WRITE (100,780)
   780              FORMAT ('''')
                    WRITE (100,790)
   790              FORMAT ('''',T5,' control rod material specification')
                    WRITE (100,800)
   800              FORMAT ('''')
                 IF (CRCLAD(CR_DESCRIPTION).NE.0) THEN
                   DO 801 CT5=1,10
                    IF (CRCLAD(CR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
                     CRCLNUM=CT5
                     EXIT
                    ENDIF
   801             CONTINUE
                   IF (CLADDESNAME(CRCLNUM).EQ.'SS304   ') THEN
                    WRITE (100,802)
   802              FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c              '2.0 26304 69.5 28304 9.5')
                    WRITE (100,803) CLADDESNUM(CRCLNUM), CLTEMP
   803              FORMAT (T12,I2,' 1.0 ',F5.1,' end')
                   ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS304S ') THEN
                    WRITE (100,804)
   804              FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c              '2.0 26000 69.5 28000 9.5')
                    WRITE (100,805) CLADDESNUM(CRCLNUM), CLTEMP
   805              FORMAT (T13,I2,' 1.0 ',F5.1,' end')
                   ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316   ') THEN
                    WRITE (100,806)
   806              FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c              '1.0 24304 17.0 25055 2.0')
                    WRITE (100,807)
   807              FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
```

```
                WRITE (100,808) CLADDESNUM(CRCLNUM), CLTEMP
808             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316S ') THEN
                WRITE (100,809)
809             FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c          '1.0 24000 17.0 25055 2.0')
                WRITE (100,810)
810             FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                WRITE (100,811) CLADDESNUM(CRCLNUM), CLTEMP
811             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(CRCLNUM).EQ.'INCONEL') THEN
                WRITE (100,812)
812             FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c          ' 22000 2.5 24000 15.0')
                WRITE (100,813)
813             FORMAT (T13,'26000 7.0 28000 73.0')
                WRITE (100,814) CLADDESNUM(CRCLNUM), CLTEMP
814             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ENDIF
              ENDIF
                WRITE (100,*) 'arbm-cr    ', CRDEN(CR_DESCRIPTION),
     c          '    ', CRNUMISOS(RELATIVE_CR_MIX_ID), '    0    0    0'
                DO 820 CT4=1,CRNUMISOS(RELATIVE_CR_MIX_ID)
                   WRITE (100,815) CRISOID(RELATIVE_CR_MIX_ID,CT4),
     c             CRISOWTPCT(RELATIVE_CR_MIX_ID, CT4)
815                FORMAT (10X,I5,3X,F10.5)
820             CONTINUE
                WRITE (100,*) '           ', CR_MIXTURE_ID, ' 1.0 ',
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
             ENDIF
          ENDIF
*  Write APSR material specification
          IF ((CT1.EQ.CT1START).AND.(CT2.EQ.CT2GOVALUE).AND.
     c    (CT3.EQ.1)) THEN
          DO 824 CT4=1,10
             DO 823 CT5=1,20
                DO 822 CT6=1,23
                   DO 821 CT7=1,50
                      APSRINSOLD(CT4,CT5,CT6,CT7)=
     c                APSRINS(CT4,CT5,CT6,CT7)
821                CONTINUE
822             CONTINUE
823          CONTINUE
824       CONTINUE
          ENDIF
          APSR_INSERTED=.FALSE.
          IF (APSRSTAT.EQ.'RODDED') THEN
             DO 830 CT4=1,23
                APSRBOTFLAG=.FALSE.
                DO 825 CT5=50,1,-1
                   IF ((APSRINSOLD(CT1,CT2,CT4,CT5).NE.0).AND.
     c             (APSRBOTFLAG.EQ..FALSE.)) THEN
                      APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT5)
                      APSRBOTFLAG=.TRUE.
                      FOLNODKEEP=CT5
                      FOLSTEPKEEP=CT4
                   ENDIF
                   IF ((APSRINSOLD(CT1,CT2,CT4,CT5).EQ.0).AND.
     c             (APSRBOTFLAG.EQ..TRUE.)) THEN
                      APSRINS(CT1,CT2,CT4,CT5)=
```

```
     c                APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
                      APSRFOLLOWDATA(CT1,CT2,CT4,CT5)=3
                   ENDIF
825             CONTINUE
830          CONTINUE
             FOLLOWIN=.FALSE.
             DO 831 CT4=1,23
                IF (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3) THEN
                   FOLLOWIN=.TRUE.
                   EXIT
                ENDIF
831          CONTINUE
             IF (FOLLOWIN.EQ..TRUE.) THEN
                WRITE (100,832)
832             FORMAT ('''')
                WRITE (100,834)
834             FORMAT ('''',T5,' APSR follow rod material',
     c          ' specification')
                WRITE (100,836)
836             FORMAT ('''')
             IF ((APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.0)
     c       .AND.
     c       (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.2)) THEN
               DO 838 CT5=1,10
                IF (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
     c          .EQ.CLADDESNUM(CT5)) THEN
                 APSRFOLNUM=CT5
                 EXIT
                ENDIF
838            CONTINUE
               IF (CLADDESNAME(APSRFOLNUM).EQ.'SS304   ') THEN
                WRITE (100,840)
840             FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c          '2.0 26304 69.5 28304 9.5')
                WRITE (100,842) CLADDESNUM(APSRFOLNUM), CLTEMP
842             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS304S ') THEN
                WRITE (100,844)
844             FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c          '2.0 26000 69.5 28000 9.5')
                WRITE (100,846) CLADDESNUM(APSRFOLNUM), CLTEMP
846             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316   ') THEN
                WRITE (100,848)
848             FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c          '1.0 24304 17.0 25055 2.0')
                WRITE (100,850)
850             FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
                WRITE (100,852) CLADDESNUM(APSRFOLNUM), CLTEMP
852             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316S ') THEN
                WRITE (100,854)
854             FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c          '1.0 24000 17.0 25055 2.0')
                WRITE (100,856)
856             FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                WRITE (100,858) CLADDESNUM(APSRFOLNUM), CLTEMP
858             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'INCONEL') THEN
                WRITE (100,860)
```

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860           FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
   c          ' 22000 2.5 24000 15.0')
              WRITE (100,862)
862           FORMAT (T13,'26000 7.0 28000 73.0')
              WRITE (100,864) CLADDESNUM(APSRFOLNUM), CLTEMP
864           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
            ENDIF
          ENDIF
          ENDIF
          APSRCOMPFLAG=.FALSE.
          DO 865 CT4=1,23
             IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
   c         (APSRINS(CT1,CT2,CT4,CT3).NE.
   c         APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP))) THEN
                APSRCOMPFLAG=.TRUE.
                APSR_INSERTED=.TRUE.
                APSR_MIXTURE_ID=APSRINS(CT1,CT2,CT4,CT3)
                APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT3)
                EXIT
             ENDIF
865       CONTINUE
          IF (APSRCOMPFLAG.EQ..TRUE.) THEN
             DO 866 CT4=1,APSRMIXNUM
                IF (APSRMIXID(CT4).EQ.APSR_MIXTURE_ID) THEN
                   RELATIVE_APSR_MIX_ID=CT4
                ENDIF
866             CONTINUE
                WRITE (100,868)
868             FORMAT ('''')
                WRITE (100,870)
870             FORMAT ('''',T5,' axial power shaping rod material',
   c            ' specification')
                WRITE (100,880)
880             FORMAT ('''')
          IF (APSRCLAD(APSR_DESCRIPTION).NE.0) THEN
            DO 881 CT5=1,10
             IF (APSRCLAD(APSR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
              APSRCLNUM=CT5
              EXIT
             ENDIF
881         CONTINUE
            IF (CLADDESNAME(APSRCLNUM).EQ.'SS304  ') THEN
             WRITE (100,882)
882          FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
   c         '2.0 26304 69.5 28304 9.5')
             WRITE (100,883) CLADDESNUM(APSRCLNUM), CLTEMP
883          FORMAT (T12,I2,' 1.0 ',F5.1,' end')
            ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS304S ') THEN
             WRITE (100,884)
884          FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
   c         '2.0 26000 69.5 28000 9.5')
             WRITE (100,885) CLADDESNUM(APSRCLNUM), CLTEMP
885          FORMAT (T13,I2,' 1.0 ',F5.1,' end')
            ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316  ') THEN
             WRITE (100,886)
886          FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
   c         '1.0 24304 17.0 25055 2.0')
             WRITE (100,887)
887          FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
             WRITE (100,888) CLADDESNUM(APSRCLNUM), CLTEMP
```

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  888           FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316S ') THEN
                WRITE (100,889)
  889           FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c          '1.0 24000 17.0 25055 2.0')
                WRITE (100,890)
  890           FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                WRITE (100,891) CLADDESNUM(APSRCLNUM), CLTEMP
  891           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'INCONEL') THEN
                WRITE (100,892)
  892           FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c          ' 22000 2.5 24000 15.0')
                WRITE (100,893)
  893           FORMAT (T13,'26000 7.0 28000 73.0')
                WRITE (100,894) CLADDESNUM(APSRCLNUM), CLTEMP
  894           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ENDIF
             ENDIF
                WRITE (100,*) 'arbm-apsr    ', APSRDEN(APSR_DESCRIPTION),
     c          '    ', APSRNUMISOS(RELATIVE_APSR_MIX_ID), '    0    0    0'
                DO 900 CT4=1,APSRNUMISOS(RELATIVE_APSR_MIX_ID)
                   WRITE (100,895) APSRISOID(RELATIVE_APSR_MIX_ID,CT4),
     c             APSRISOWTPCT(RELATIVE_APSR_MIX_ID, CT4)
  895              FORMAT (10X,I5,3X,F10.5)
  900           CONTINUE
                WRITE (100,*) '           ', APSR_MIXTURE_ID, ' 1.0 ',
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '    end'
             ENDIF
          ENDIF
*  Write fuel rod fill gas material specification
          WRITE (100,910)
  910     FORMAT ('''')
          WRITE (100,920)
  920     FORMAT ('he    5    end')
          WRITE (100,930)
  930     FORMAT ('end comp')
*  Write base reactor lattice specifications
          WRITE (100,940)
  940     FORMAT ('''')
          WRITE (100,950)
  950     FORMAT ('''     base reactor lattice specification')
          WRITE (100,960)
  960     FORMAT ('''')
          WRITE (100,970) PITCH, FOD, COD, CID
  970     FORMAT ('squarepitch',3X,F7.5,3X,F6.4,3X,'1    3',3X,F6.4,
     c    3X,'2',3X,F6.4,3X,'0    end')
* The following writing routine for 'SPECIAL' input data
* has not been formatted to compensate for FORTRAN's ingenious
* incapability to print leading zeros in numeric fields.
* Errors will occur in the FIDO input if null space exists
* between an equal sign and the appropriate value.  Therefore,
* the IIM and ICM factors must always be at least 10.
          IF (FLAG2.EQ.'SPECIAL') THEN
             IF (SZF.LT.1) THEN
                WRITE (100,980) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  980           FORMAT ('more data',1X,'szf=0',F3.2,1X,'isn=',I1,1X,
     c          'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c          1X,'ius=',I1,3X,'end')
             ELSE
```

```
               WRITE (100,990) SZF, ISN, IIM, ICM, EPS, PTC, IUS
 990           FORMAT ('more data',1X,'szf=',F4.2,1X,'isn=',I1,1X,
     c         'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c         1X,'ius=',I1,3X,'end')
            ENDIF
         ELSEIF (FLAG2.NE.'SPECIAL') THEN
            IF (MESH.LT.1) THEN
               WRITE (100,1000) MESH
 1000          FORMAT ('more data',1X,'szf=0',F3.2,1X,'end')
            ELSE
               WRITE (100,1010) MESH
 1010          FORMAT ('more data',1X,'szf=',F4.2,1X,'end')
            ENDIF
         ENDIF
*  Write assembly specifications
         WRITE (100,1020)
 1020    FORMAT ('''')
         WRITE (100,1030)
 1030    FORMAT ('''     assembly specification')
         WRITE (100,1040)
 1040    FORMAT ('''')
         IF (STEPCONTROL.EQ.'Y') THEN
            CALL ZEROS(VARSTEPNUM(CT1,CT2),IRRAD_STEPS)
         ELSEIF (STEPCONTROL.EQ.'N') THEN
            CALL ZEROS(INT(BLETDOWN(CT1,CT2,2)),IRRAD_STEPS)
         ENDIF
*  Assembly specification if no BPRA, no CR, and no APSR is inserted
         IF ((BPRA_INSERTED.EQ..FALSE.).AND.(CR_INSERTED.EQ..FALSE.)
     c   .AND.(APSR_INSERTED.EQ..FALSE.)
     c   .AND.(BPRA_FOLLOW.EQ..FALSE.)
     c   .AND.(FOLLOWIN.EQ..FALSE.)) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1041) RODS, NODES(CT3,2), IRRAD_STEPS
 1041          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1042) RODS, NODES(CT3,2), IRRAD_STEPS
 1042          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1043) RODS, NODES(CT3,2), IRRAD_STEPS
 1043          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(LUZONE,LUZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1044) PLEVELCH, LUZONECH, MESH
 1044          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1045) PLEVELCH, LUZONECH, MESH
 1045          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            DO 1047 CT4=1,LUZONE
               IF (MOD(CT4,6).EQ.0) THEN
```

```
                  WRITE (100,*)
               ENDIF
               WRITE (100,1046) LMB(CT4), LRB(CT4)
1046           FORMAT (I3,1X,F7.5,1X,$)
1047        CONTINUE
            WRITE (100,*)
         ENDIF
*  Assembly specification if BPRA is inserted
         IF (BPRA_FOLLOW.EQ..TRUE.) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1050) RODS, NODES(CT3,2), IRRAD_STEPS
1050           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1052) RODS, NODES(CT3,2), IRRAD_STEPS
1052           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1054) RODS, NODES(CT3,2), IRRAD_STEPS
1054           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1056) PLEVELCH, BPZONECH, MESH
1056           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1058) PLEVELCH, BPZONECH, MESH
1058           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            DO 1062 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
               IF (MOD(CT4,6).EQ.0) THEN
                  WRITE (100,*)
               ENDIF
               WRITE (100,1060) BPRFM(CT4,BPRA_DESCRIPTION_ID),
     c         BPRFR(CT4,BPRA_DESCRIPTION_ID)
1060           FORMAT (I3,1X,F7.5,1X,$)
1062        CONTINUE
            WRITE (100,*)
         ENDIF
         IF (BPRA_INSERTED.EQ..TRUE.) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1098) RODS, NODES(CT3,2), IRRAD_STEPS
1098           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1100) RODS, NODES(CT3,2), IRRAD_STEPS
1100           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1103) RODS, NODES(CT3,2), IRRAD_STEPS
1103           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
```

```
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1104) PLEVELCH, BPZONECH, MESH
 1104          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1106) PLEVELCH, BPZONECH, MESH
 1106          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            DO 1110 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
               IF (MOD(CT4,6).EQ.0) THEN
                  WRITE (100,*)
               ENDIF
               WRITE (100,1108) BPMA(CT4,BPRA_DESCRIPTION_ID),
     c         BPRA(CT4,BPRA_DESCRIPTION_ID)
 1108          FORMAT (I3,1X,F7.5,1X,$)
 1110       CONTINUE
            WRITE (100,*)
         ENDIF
*  Assembly specification if CR is inserted
         IF (CR_INSERTED.EQ..TRUE.) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1120) RODS, NODES(CT3,2), IRRAD_STEPS
 1120          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1130) RODS, NODES(CT3,2), IRRAD_STEPS
 1130          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1140) RODS, NODES(CT3,2), IRRAD_STEPS
 1140          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(CRZONE(CR_DESCRIPTION),CRZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1150) PLEVELCH, CRZONECH, MESH
 1150          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=0',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1160) PLEVELCH, CRZONECH, MESH
 1160          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=0',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            IF (STEPCONTROL.EQ.'N') THEN
             DO 1169 CT4=1,INT(BLETDOWN(CT1,CT2,2))
               IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                  DO 1164 CT5=1,CRZONE(CR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
```

```
                  WRITE (100,1162) CRMA(CT5,CR_DESCRIPTION),
     c            CRRA(CT5,CR_DESCRIPTION)
1162              FORMAT (I3,1X,F7.5,1X,$)
1164           CONTINUE
               WRITE (100,*)
            ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
               DO 1168 CT5=1,CRZONE(CR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1166) LMC(CT5,CR_DESCRIPTION),
     c            LRC(CT5,CR_DESCRIPTION)
1166              FORMAT (I3,1X,F7.5,1X,$)
1168           CONTINUE
               WRITE (100,*)
            ENDIF
1169        CONTINUE
         ELSEIF (STEPCONTROL.EQ.'Y') THEN
          DO 1210 CT4=1,VARSTEPNUM(CT1,CT2)
            IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
               DO 1180 CT5=1,CRZONE(CR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1170) CRMA(CT5,CR_DESCRIPTION),
     c            CRRA(CT5,CR_DESCRIPTION)
1170              FORMAT (I3,1X,F7.5,1X,$)
1180           CONTINUE
               WRITE (100,*)
            ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
               DO 1200 CT5=1,CRZONE(CR_DESCRIPTION)
                  IF (MOD(CT5,6).EQ.0) THEN
                     WRITE (100,*)
                  ENDIF
                  WRITE (100,1190) LMC(CT5,CR_DESCRIPTION),
     c            LRC(CT5,CR_DESCRIPTION)
1190              FORMAT (I3,1X,F7.5,1X,$)
1200           CONTINUE
               WRITE (100,*)
            ENDIF
1210        CONTINUE
         ENDIF
      ENDIF
*  Assembly specification if APSR is inserted
      IF ((APSR_INSERTED.EQ..TRUE.).OR.(FOLLOWIN.EQ..TRUE.)) THEN
         IF (NODES(CT3,2).GE.(100.0)) THEN
            WRITE (100,1220) RODS, NODES(CT3,2), IRRAD_STEPS
1220        FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
            WRITE (100,1230) RODS, NODES(CT3,2), IRRAD_STEPS
1230        FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
            WRITE (100,1240) RODS, NODES(CT3,2), IRRAD_STEPS
1240        FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c      'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
         ENDIF
         CALL ZEROS(PLEVEL,PLEVELCH)
```

```
            CALL ZEROS(APSRZONE(APSR_DESCRIPTION),APSRZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1250) PLEVELCH, APSRZONECH, MESH
1250           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=0',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1252) PLEVELCH, APSRZONECH, MESH
1252           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=0',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            IF (STEPCONTROL.EQ.'N') THEN
             DO 1268 CT4=1,INT(BLETDOWN(CT1,CT2,2))
               IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
                  DO 1258 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1256) APSRMA(CT5,APSR_DESCRIPTION),
     c               APSRRA(CT5,APSR_DESCRIPTION)
1256                 FORMAT (I3,1X,F7.5,1X,$)
1258              CONTINUE
                  WRITE (100,*)
               ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
                  DO 1262 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1260) APSRFM(CT5,APSR_DESCRIPTION),
     c               APSRFR(CT5,APSR_DESCRIPTION)
1260                 FORMAT (I3,1X,F7.5,1X,$)
1262              CONTINUE
                  WRITE (100,*)
               ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1266 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1264) LMD(CT5,APSR_DESCRIPTION),
     c               LRD(CT5,APSR_DESCRIPTION)
1264                 FORMAT (I3,1X,F7.5,1X,$)
1266              CONTINUE
                  WRITE (100,*)
               ENDIF
1268          CONTINUE
            ELSEIF (STEPCONTROL.EQ.'Y') THEN
             DO 1310 CT4=1,VARSTEPNUM(CT1,CT2)
               IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
                  DO 1280 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1270) APSRMA(CT5,APSR_DESCRIPTION),
     c               APSRRA(CT5,APSR_DESCRIPTION)
1270                 FORMAT (I3,1X,F7.5,1X,$)
1280              CONTINUE
```

```
                  WRITE (100,*)
                ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c          (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
                  DO 1290 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1285) APSRFM(CT5,APSR_DESCRIPTION),
     c               APSRFR(CT5,APSR_DESCRIPTION)
 1285                FORMAT (I3,1X,F7.5,1X,$)
 1290             CONTINUE
                  WRITE (100,*)
                ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1300 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1295) LMD(CT5,APSR_DESCRIPTION),
     c               LRD(CT5,APSR_DESCRIPTION)
 1295                FORMAT (I3,1X,F7.5,1X,$)
 1300             CONTINUE
                  WRITE (100,*)
                ENDIF
 1310          CONTINUE
             ENDIF
           ENDIF
*  Write assembly depletion/decay parameters
           WRITE (100,1320)
 1320      FORMAT ('''')
           WRITE (100,1330)
 1330      FORMAT ('''     assembly depletion/decay parameters')
           WRITE (100,1340)
 1340      FORMAT ('''')
           CALL ZEROS(CYCPOS(CT1),ASSYPOSITION)
           WRITE (100,1350) CYCLEID(CT1), ASSYPOSITION
 1350      FORMAT ('''',T5,'Cycle-',A2,', one-eighth core',
     c     ' assembly number ',A2)
           IF (STEPCONTROL.EQ.'N') THEN
            DO 1380 CT4=3,(INT(BLETDOWN(CT1,CT2,2))+2)
              IF (CT4.LT.(BLETDOWN(CT1,CT2,2)+2)) THEN
                 DOWNTIME=0.0
                 BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c           BLETDOWN(CT1,CT2,3))
                 WRITE (100,1360) POWER(CT3,RELATIVE_STPT_NUM),
     c           BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1360            FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c           G10.5,1X,'bfrac=',G9.4,1X,'end')
               ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c         (CT2.LT.STPTS(CT1))) THEN
                 DOWNTIME=STPTDAT(CT1,(CT2+1),3)
                 BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c           BLETDOWN(CT1,CT2,3))
                 WRITE (100,1365) POWER(CT3,RELATIVE_STPT_NUM),
     c           BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1365            FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c           G10.5,1X,'bfrac=',G9.4,1X,'end')
               ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c         (CT2.EQ.STPTS(CT1))) THEN
                 DOWNTIME=CYCDOWN(CT1)
                 BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
```

```
     c          BLETDOWN(CT1,CT2,3))
                WRITE (100,1370) POWER(CT3,RELATIVE_STPT_NUM),
     c          BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1370           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ENDIF
 1380       CONTINUE
           ELSEIF (STEPCONTROL.EQ.'Y') THEN
            DO 1388 CT4=1,VARSTEPNUM(CT1,CT2)
              IF (CT4.LT.VARSTEPNUM(CT1,CT2)) THEN
                DOWNTIME=0.0
                BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c          VARBLETDOWN(CT1,CT2,1,2))
                WRITE (100,1382) VARPOWER(CT1,CT2,CT4,CT3),
     c          VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1382           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c        (CT2.LT.STPTS(CT1))) THEN
                DOWNTIME=STPTDAT(CT1,(CT2+1),3)
                BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c          VARBLETDOWN(CT1,CT2,1,2))
                WRITE (100,1384) VARPOWER(CT1,CT2,CT4,CT3),
     c          VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1384           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c        (CT2.EQ.STPTS(CT1))) THEN
                DOWNTIME=CYCDOWN(CT1)
                BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c          VARBLETDOWN(CT1,CT2,1,2))
                WRITE (100,1386) VARPOWER(CT1,CT2,CT4,CT3),
     c          VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1386           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ENDIF
 1388       CONTINUE
           ENDIF
*  Store final downtime for use in extraction script 'sedexecute.exe'
           FINALDOWNTIME=DOWNTIME
*  Write input deck closing statement
           WRITE (100,1390)
 1390      FORMAT ('''')
           WRITE (100,1400)
 1400      FORMAT ('''     end of input')
           WRITE (100,1410)
 1410      FORMAT ('''')
           WRITE (100,1420)
 1420      FORMAT ('end')
           CLOSE(UNIT=100)

       RETURN
       END


*************************************************************************
*     Subroutine to write continuation depletion/decay SAS2H            *
*     input decks utilizing fuel and burnable poison compositions       *
*     from the assembly's previous depletion/decay calculation          *
*     en-route to the final CRC depletion/decay calculation             *
```

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************************************************************************
      SUBROUTINE CONTINUATION_WRITER (RELATIVE_STPT_NUM, CT1, CT2,
     c CT3, AXNUM, CYCPOS, AXBLANK, BPDESID,
     c CRINS, CRDES, CRMIXNUM, CRMIXID,
     c CRNUMISOS, CRISOID, APSRINS,
     c APSRMIXNUM, APSRMIXID, RELATIVE_APSR_MIX_ID,
     c APSRNUMISOS, APSRISOID, ISN, IIM, ICM, IUS,
     c PLEVEL, BPZONE, BPMA, CRZONE, CRMA,
     c LMC, APSRZONE, APSRMA, LMD,
     c BPTN, BPBN, STPTS, APSRDES,
     c STPTDAT, AXBLANKRICH, GRAMS,
     c NODES, RODS, RICH, FTFINAL, MODDENFINAL,
     c MODTEMPFINAL, BLETDOWN, BPWTPCT,
     c BPDEN, CRDEN, CRISOWTPCT, APSRDEN,
     c APSRISOWTPCT, PITCH, FOD, COD, CID, SZF, EPS, PTC,
     c MESH, BPRA, CRRA, LRC, APSRRA,
     c LRD, POWER, CYCDOWN, PREFIX, NM,
     c CYCLEID, REACT, LIB, AXBLANKET, FUELCLAD,
     c BPRFLAG, CRSTAT, APSRSTAT, FLAG2, LUZONE, LMB, LRB,
     c MASSTOTAL, FUELISONAME, FUELISOWTPCT, BPRAISONAME,
     c BPRAISOVALUE, LEFTLIST, CARRYCOUNTER, BPXSECT, BPRODS,
     c PREVIOUSNAME, FINALDOWNTIME, LEFTVAL, BPRA_INSERTED, CLADTOT,
     c CLADDESNUM, CLADDESNAME, BPRCLAD, CRCLAD, APSRCLAD,
     c CLTEMP, BPMIXNUM, BPMIX, BPMIXID,
     c BPNUMISOS, BPISOID, BPISOWTPCT, UCSPACERFRAC,
     c SPACERMAT, STEPCONTROL, VARBLETDOWN, VARSTEPNUM,
     c VARPOWER, BPRFM, BPFMNUMISOS, BPFISOID,
     c ABOVEBPNUM, APSRFM, BPRFR, BPFISOWTPCT,
     c APSRFR, ABOVEBP, APSRFOLLOWMIX, CT1START, CT2GOVALUE,
     c APSRINSOLD)
*
      INTEGER*4 RELATIVE_STPT_NUM, CT1, CT2, CT3, AXNUM,
     c NUMSTPT1, NUMSTPT2, NUMSTPT3, CYCPOS(10), AXBLANK(50),
     c BPDESID(10), BPRA_DESCRIPTION_ID, CT4, CT5, CRINS(10,20,23,50),
     c CR_MIXTURE_ID, CR_DESCRIPTION, CRDES(10,20,23,50), CRMIXNUM,
     c CRMIXID(25), RELATIVE_CR_MIX_ID, CRNUMISOS(25),
     c CRISOID(25,10), APSRINS(10,20,23,50), APSR_MIXTURE_ID,
     c APSR_DESCRIPTION, APSRMIXNUM, APSRMIXID(25),
     c RELATIVE_APSR_MIX_ID, APSRNUMISOS(25), APSRISOID(25,10),
     c ISN, IIM, ICM, IUS, PLEVEL, BPZONE(10), BPMA(15,10),
     c CRZONE(10), CRMA(15,10), LMC(15,10), APSRZONE(10),
     c APSRMA(15,10), LMD(15,10), BPTN(10), BPBN(10), STPTS(10),
     c APSRDES(10,20,23,50), LUZONE, LMB(15), CARRYCOUNTER,
     c FUELISOTOPENUMBER, BPRODS(10), PNMCT1, PNMCT2, PNUMSTPT1,
     c PNUMSTPT2, PNUMSTPT3, NUMSTPT4, NUMSTPT5, NUMSTPT6,
     c PNUMSTPT4, PNUMSTPT5, PNUMSTPT6, CLADTOT, CLADDESNUM(10),
     c BPRCLAD(10), CRCLAD(10), APSRCLAD(10), BPRCLNUM, CRCLNUM,
     c APSRCLNUM, BPMIXNUM, BPMIX(10), BPMIXID(10), BPNUMISOS(10),
     c BPISOID(10,20), VARSTEPNUM(10,20), BPRFM(15,10),
     c BPFMNUMISOS(25), BPFISOID(25,10), ABOVEBPNUM(10),
     c APSRFM(15,10), APSRFOLLOWMIX(10,20,23,50),
     c FOLNODKEEP, FOLSTEPKEEP, APSRFOLNUM, APSRINSOLD(10,20,23,50),
     c APSRFOLLOWDATA(10,20,23,50), CT1START, CT2GOVALUE
*
      REAL STPTDAT(10,20,3), ENR, AXBLANKRICH, OXYGMS, GRAMS(50),
     c FVOL, PI, NODES(50,2), RODS, FDEN,
     c RICH, FTFINAL(50,20),
     c MODDENFINAL(50,20), MODTEMPFINAL(50,20), BLETDOWN(10,20,25),
     c BPWTPCT(10), BPDEN(10), ALFRAC, OFRAC, CRDEN(10),
     c CRISOWTPCT(25,10), APSRDEN(10), APSRISOWTPCT(25,10),
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      c PITCH, FOD, COD, CID, SZF, EPS, PTC, MESH, BPRA(15,10),
      c CRRA(15,10), LRC(15,10), APSRRA(15,10), LRD(15,10),
      c DOWNTIME, BORON_FRACTION, POWER(50,20), CYCDOWN(10), LRB(15),
      c MASSTOTAL, FUELISOWTPCT(1000), BPRAISOVALUE(2), BPXSECT(10),
      c BPVOL, FINALDOWNTIME, LEFTVAL(1000), CLTEMP,
      c BPISOWTPCT(10,20), UCSPACERFRAC, BORATEDMODVF,
      c BORONVF, UCMODREGIONDEN, B4CMASS, ALMASS, OMASS, CMASS,
      c NEWBPMASSTOTAL, NEWBPDEN, ALWTPCT, OWTPCT, CWTPCT, B10WTPCT,
      c B11WTPCT, VARBLETDOWN(10,20,25,25), VARPOWER(10,20,25,50),
      c BPRFR(15,10), BPFISOWTPCT(25,10), APSRFR(15,10)
*
       CHARACTER CHNODE*2, CHID*2, PREFIX*3, CHSTPT1*1, CHSTPT2*1,
      c CHSTPT3*1, NM*31, CYCLEID(10)*2, REACT*21, LIB*15,
      c AXBLANKET*1, FUELCLAD*10, BPRFLAG*1, CRSTAT*6, APSRSTAT*6,
      c FLAG2*7, IRRAD_STEPS*2, PLEVELCH*2, BPZONECH*2, CRZONECH*2,
      c APSRZONECH*2, LUZONECH*2, FUELISONAME(1000)*5, BPRAISONAME(2)*6,
      c LEFTLIST(1000)*6, PREVIOUSNAME*25, PCHSTPT1*1, PCHSTPT2*1,
      c PCHSTPT3*1, ASSYPOSITION*2, CHSTPT4*1, CHSTPT5*1, CHSTPT6*1,
      c PCHSTPT4*1, PCHSTPT5*1, PCHSTPT6*1, PCHID*2, CLADDESNAME(10)*7,
      c SPACERMAT*7, STEPCONTROL*1, ABOVEBP(10)*5
*
       LOGICAL BPRA_INSERTED, CR_INSERTED, CRCOMPFLAG, APSR_INSERTED,
      c APSRCOMPFLAG, BPRA_FOLLOW, APSRBOTFLAG, FOLLOWIN
*
       PI=3.14159265359
*  Determination of the input deck filename
          CALL ZEROS(CT3,CHNODE)
          CALL ZEROS(CYCPOS(CT1),CHID)
          IF ((CT2-1).EQ.0) THEN
             PNMCT1=CT1-1
             PNMCT2=STPTS(PNMCT1)
          ELSE
             PNMCT1=CT1
             PNMCT2=CT2-1
          ENDIF
          CALL ZEROS(CYCPOS(PNMCT1),PCHID)
*  Determine new filename
          NUMSTPT1=INT(STPTDAT(CT1,CT2,1)/100.0)
          CHSTPT1=CHAR(NUMSTPT1+48)
          NUMSTPT2=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100))/10.0)
          CHSTPT2=CHAR(NUMSTPT2+48)
          NUMSTPT3=INT((STPTDAT(CT1,CT2,1)-(NUMSTPT1*100)-
       c   (NUMSTPT2*10)))
          CHSTPT3=CHAR(NUMSTPT3+48)
          IF (CT2.LT.STPTS(CT1)) THEN
             NUMSTPT4=INT(STPTDAT(CT1,(CT2+1),1)/100.0)
             CHSTPT4=CHAR(NUMSTPT4+48)
             NUMSTPT5=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100))/10.0)
             CHSTPT5=CHAR(NUMSTPT5+48)
             NUMSTPT6=INT((STPTDAT(CT1,(CT2+1),1)-(NUMSTPT4*100)-
       c     (NUMSTPT5*10)))
             CHSTPT6=CHAR(NUMSTPT6+48)
          ELSEIF (CT2.EQ.STPTS(CT1)) THEN
             NUMSTPT4=INT(STPTDAT((CT1+1),1,1)/100.0)
             CHSTPT4=CHAR(NUMSTPT4+48)
             NUMSTPT5=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100))/10.0)
             CHSTPT5=CHAR(NUMSTPT5+48)
             NUMSTPT6=INT((STPTDAT((CT1+1),1,1)-(NUMSTPT4*100)-
       c     (NUMSTPT5*10)))
             CHSTPT6=CHAR(NUMSTPT6+48)
```

```
            ENDIF
            NM(1:3)=PREFIX
            NM(4:4)='A'
            NM(5:6)=CHID
            NM(7:7)='N'
            NM(8:9)=CHNODE
            NM(10:11)='DC'
            NM(12:13)=CYCLEID(CT1)
            NM(14:14)='T'
            NM(15:15)=CHSTPT1
            NM(16:16)=CHSTPT2
            NM(17:17)=CHSTPT3
            NM(18:19)='AC'
            IF (CT2.EQ.STPTS(CT1)) THEN
               NM(20:21)=CYCLEID(CT1+1)
            ELSE
               NM(20:21)=CYCLEID(CT1)
            ENDIF
            NM(22:22)='T'
            NM(23:23)=CHSTPT4
            NM(24:24)=CHSTPT5
            NM(25:25)=CHSTPT6
            NM(26:31)='.input'
      *  Determine previous filename
            PNUMSTPT1=INT(STPTDAT(PNMCT1,PNMCT2,1)/100.0)
            PCHSTPT1=CHAR(PNUMSTPT1+48)
            PNUMSTPT2=INT((STPTDAT(PNMCT1,PNMCT2,1)-
         c  (PNUMSTPT1*100))/10.0)
            PCHSTPT2=CHAR(PNUMSTPT2+48)
            PNUMSTPT3=INT((STPTDAT(PNMCT1,PNMCT2,1)-(PNUMSTPT1*100)-
         c  (PNUMSTPT2*10)))
            PCHSTPT3=CHAR(PNUMSTPT3+48)
            IF (PNMCT2.LT.STPTS(PNMCT1)) THEN
               PNUMSTPT4=INT(STPTDAT(PNMCT1,(PNMCT2+1),1)/100.0)
               PCHSTPT4=CHAR(PNUMSTPT4+48)
               PNUMSTPT5=INT((STPTDAT(PNMCT1,(PNMCT2+1),1)-
         c     (PNUMSTPT4*100))/10.0)
               PCHSTPT5=CHAR(PNUMSTPT5+48)
               PNUMSTPT6=INT((STPTDAT(PNMCT1,(PNMCT2+1),1)-
         c     (PNUMSTPT4*100)-(PNUMSTPT5*10)))
               PCHSTPT6=CHAR(PNUMSTPT6+48)
            ELSEIF (PNMCT2.EQ.STPTS(PNMCT1)) THEN
               PNUMSTPT4=INT(STPTDAT((PNMCT1+1),1,1)/100.0)
               PCHSTPT4=CHAR(PNUMSTPT4+48)
               PNUMSTPT5=INT((STPTDAT((PNMCT1+1),1,1)-
         c     (PNUMSTPT4*100))/10.0)
               PCHSTPT5=CHAR(PNUMSTPT5+48)
               PNUMSTPT6=INT((STPTDAT((PNMCT1+1),1,1)-(PNUMSTPT4*100)-
         c     (PNUMSTPT5*10)))
               PCHSTPT6=CHAR(PNUMSTPT6+48)
            ENDIF
            PREVIOUSNAME(1:3)=PREFIX
            PREVIOUSNAME(4:4)='A'
            PREVIOUSNAME(5:6)=PCHID
            PREVIOUSNAME(7:7)='N'
            PREVIOUSNAME(8:9)=CHNODE
            PREVIOUSNAME(10:11)='DC'
            IF (CT2.EQ.1) THEN
               PREVIOUSNAME(12:13)=CYCLEID(CT1-1)
            ELSE
```

```
            PREVIOUSNAME(12:13)=CYCLEID(CT1)
         ENDIF
         PREVIOUSNAME(14:14)='T'
         PREVIOUSNAME(15:15)=PCHSTPT1
         PREVIOUSNAME(16:16)=PCHSTPT2
         PREVIOUSNAME(17:17)=PCHSTPT3
         PREVIOUSNAME(18:19)='AC'
         PREVIOUSNAME(20:21)=CYCLEID(CT1)
         PREVIOUSNAME(22:22)='T'
         PREVIOUSNAME(23:23)=PCHSTPT4
         PREVIOUSNAME(24:24)=PCHSTPT5
         PREVIOUSNAME(25:25)=PCHSTPT6
*  Open and rewind the input deck file
         OPEN(UNIT=100, FILE=NM, STATUS='UNKNOWN')
         REWIND(UNIT=100)
*  Write first section of input deck
         WRITE (100,10)
   10    FORMAT ('=sas2h',T11,'parm=skipshipdata')
         IF (CT2.LT.STPTS(CT1)) THEN
            WRITE (100,20) REACT, CHID, CHNODE,
     c      NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
     c      STPTDAT(CT1,(CT2+1),1)
   20       FORMAT (A21,1X,'Assy-',A2,
     c      ', Node-',A2,1X,
     c      '{Cyc-',A2,', 'F5.1,' to Cyc-',
     c      A2,', ',F5.1,' EFPD}')
         ELSEIF (CT2.EQ.STPTS(CT1)) THEN
            WRITE (100,25) REACT, CHID, CHNODE,
     c      NM(12:13), STPTDAT(CT1,CT2,1), NM(20:21),
     c      STPTDAT((CT1+1),1,1)
   25       FORMAT (A21,1X,'Assy-',A2,
     c      ', Node-',A2,1X,
     c      '{Cyc-',A2,', 'F5.1,' to Cyc-',
     c      A2,', ',F5.1,' EFPD}')
         ENDIF
         WRITE (100,30) LIB
   30    FORMAT (A15,1X,'latticecell')
         WRITE (100,40)
   40    FORMAT ('''')
         WRITE (100,50)
   50    FORMAT ('''   fuel density based on mass of uranium per',
     c   ' assembly',T56,'& total pellet stack')
         WRITE (100,60)
   60    FORMAT ('''   volume to account for fuel volume loss to',
     c   ' pellet c',T55,'hamfers')
         WRITE (100,70)
   70    FORMAT ('''')
*  Write second section of input deck (material specifications)
         WRITE (100,80)
   80    FORMAT ('''',5X,'material specification input')
         WRITE (100,90)
   90    FORMAT ('''')
*  Calculate initital fuel parameters depending upon whether or not the

*  node represents axial blanket fuel
         IF ((AXBLANKET.EQ.'Y').AND.(AXBLANK(CT3).EQ.1)) THEN
            ENR=AXBLANKRICH
         ELSE
            ENR=RICH
         ENDIF
```

```
            OXYGMS=(GRAMS(CT3)*2*15.994915)/(((ENR/100)*235.043915)+
          c   (((0.007731*((ENR)**1.0837))/100)*234.040904)+
          c   (((0.0046*ENR)/100)*236.045637)+(((100-(0.007731*
          c   (ENR**1.0837))-(ENR)-(0.0046*ENR))/100)*238.05077))
      *  Determine if the burnable poison charge isotopics should be retrieved
            BPRA_INSERTED=.FALSE.
            IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
          c      (CT3.GE.BPTN(CT1)).AND.(CT3.LE.BPBN(CT1))) THEN
               BPRA_INSERTED=.TRUE.
            ENDIF
      *  Call subroutine to retrieve charge for fuel and bp isotopics
            CALL RETRIEVER (OXYGMS, MASSTOTAL,
          c   FUELISONAME, FUELISOWTPCT, BPRAISONAME,
          c   BPRAISOVALUE, LEFTLIST, CARRYCOUNTER,
          c   PREVIOUSNAME, LEFTVAL, NM, BPRA_INSERTED)
      *  Calculate the nodal fuel volume, fuel density, and oxygen wt%
            FVOL=(PI/4)*(FOD**2)*(NODES(CT3,2))*(RODS)
            FDEN=MASSTOTAL/FVOL
            OXYWTPCT=(OXYGMS/MASSTOTAL)*100.0
            FUELISOTOPENUMBER=CARRYCOUNTER+1
      *  Write fuel composition input description
            IF (FDEN.LT.(10.0)) THEN
               WRITE (100,100) FDEN, FUELISOTOPENUMBER, OXYWTPCT
      100      FORMAT ('arbm-fuel',1X,G10.3,1X,I3,1X,'0 0 0',1X,
          c      '8016',1X,G10.3)
            ELSE
               WRITE (100,110) FDEN, FUELISOTOPENUMBER, OXYWTPCT
      110      FORMAT ('arbm-fuel',1X,G10.3,1X,I3,1X,'0 0 0',1X,
          c      '8016',1X,G10.3)
            ENDIF
            DO 130 CT4=1,CARRYCOUNTER
               IF (MOD(CT4,3).EQ.0) THEN
                  WRITE (100,*)
               ENDIF
               WRITE (100,120) FUELISONAME(CT4), FUELISOWTPCT(CT4)
      120      FORMAT (5X,A5,1X,G10.3,1X,$)
      130   CONTINUE
            WRITE (100,*)
            WRITE (100,140) FTFINAL(CT3,RELATIVE_STPT_NUM)
      140   FORMAT (5X,'1',3X,'1.0',3X,F6.1,'   end')
      *  Write cladding material specifications
      *  Additional cladding material specifications may be added to the
      *  following IF statement as required
            IF ((FUELCLAD.EQ.'ZIRC-4    ').OR.
          c   (FUELCLAD.EQ.'ZIRCALLOY4')) THEN
               WRITE (100,532)
      532      FORMAT ('arbm-zirc4 6.56 5 0 0 0 8016 0.12 24000',
          c      ' 0.10 26000 0.20 50000 1.40')
               WRITE (100,535) CLTEMP
      535      FORMAT (T12,'40000 98.18 2 1.0 ',F5.1,' end')
            ELSEIF (FUELCLAD.EQ.'SS304     ') THEN
               WRITE (100,537)
      537      FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
          c      ' 2.0 26304 69.5 28304 9.5')
               WRITE (100,540) CLTEMP
      540      FORMAT (T12,'2 1.0 ',F5.1,' end')
            ELSEIF (FUELCLAD.EQ.'SS304S    ') THEN
               WRITE (100,542)
      542      FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
          c      ' 2.0 26000 69.5 28000 9.5')
```

```
            WRITE (100,545) CLTEMP
  545       FORMAT (T13,'2 1.0 ',F5.1,' end')
          ELSEIF (FUELCLAD.EQ.'SS316     ') THEN
            WRITE (100,547)
  547       FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c      ' 1.0 24304 17.0 25055 2.0')
            WRITE (100,550)
  550       FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
            WRITE (100,552) CLTEMP
  552       FORMAT (T12,'2 1.0 ',F5.1,' end')
          ELSEIF (FUELCLAD.EQ.'SS316S    ') THEN
            WRITE (100,555)
  555       FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c      ' 1.0 24000 17.0 25055 2.0')
            WRITE (100,557)
  557       FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
            WRITE (100,559) CLTEMP
  559       FORMAT (T13,'2 1.0 ',F5.1,' end')
          ENDIF
*  Write moderator material specifications
          BORATEDMODVF=1.0-UCSPACERFRAC
          IF (STEPCONTROL.EQ.'N') THEN
            BORONVF=BLETDOWN(CT1,CT2,3)*(1E-6)*BORATEDMODVF
          ELSEIF (STEPCONTROL.EQ.'Y') THEN
            BORONVF=VARBLETDOWN(CT1,CT2,1,2)*(1E-6)*BORATEDMODVF
          ENDIF
          WRITE (100,560)
  560     FORMAT ('''')
          IF ((SPACERMAT.EQ.'ZIRC-4 ').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,561)
  561       FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,562)
  562       FORMAT ('''     with smeared zirc-4 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(6.56*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
              WRITE (100,563) UCMODREGIONDEN, BORATEDMODVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  563         FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
              WRITE (100,564) UCMODREGIONDEN, BORATEDMODVF,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  564         FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,565) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  565       FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,566) UCMODREGIONDEN
  566       FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 8016 0.12',
     c      ' 24000 0.10 26000 0.25')
            WRITE (100,567) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  567       FORMAT (T17'50000 1.40 40000 98.18 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'INCONEL').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,568)
```

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568         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,569)
569         FORMAT ('''     with smeared inconel spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(8.3*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,570) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
570            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,571) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
571            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,572) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
572         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,573) UCMODREGIONDEN
573         FORMAT ('arbm-spacer',3X,F6.4,1X,'5 0 0 0 14000 2.5',
     c      ' 22000 2.5 24000 15.0')
            WRITE (100,574) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
574         FORMAT (T17'26000 7.0 28000 73.0 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS316  ').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,575)
575         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,576)
576         FORMAT ('''     with smeared ss316 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.75*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,577) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
577            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,578) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
578            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,579) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
579         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,580) UCMODREGIONDEN
580         FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
     c      ' 14000 1.0 24304 17.0 25055 2.0')
            WRITE (100,581) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
581         FORMAT (T5'26304 65.42 28304 12.0 42000 2.5 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
          ELSEIF ((SPACERMAT.EQ.'SS316S ').AND.
     c    (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,582)
582         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
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```
            WRITE (100,583)
583         FORMAT ('''     with smeared ss316s spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.75*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,584) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
584            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,585) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
585            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,586) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
586         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,587) UCMODREGIONDEN
587         FORMAT ('arbm-spacer',3X,F6.4,1X,'7 0 0 0 6012 0.08',
     c      ' 14000 1.0 24000 17.0 25055 2.0')
            WRITE (100,588) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
588         FORMAT (T5'26000 65.42 28000 12.0 42000 2.5 3',1X,F6.5,1X,
     c      F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS304  ').AND.
     c   (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,589)
589         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,590)
590         FORMAT ('''     with smeared ss304 spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c      BORATEDMODVF)+(7.92*UCSPACERFRAC)
            IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
               WRITE (100,591) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
591            FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
            ELSE
               WRITE (100,592) UCMODREGIONDEN, BORATEDMODVF,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
592            FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
            ENDIF
            WRITE (100,593) UCMODREGIONDEN, BORONVF,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
593         FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c      1X,F6.5,1X,F7.1,1X,'end')
            WRITE (100,594) UCMODREGIONDEN
594         FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24304 19.0',
     c      ' 25055 2.0 26304 69.5 28304 9.5')
            WRITE (100,595) UCSPACERFRAC,
     c      MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
595         FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
         ELSEIF ((SPACERMAT.EQ.'SS304S ').AND.
     c   (UCSPACERFRAC.GT.(0.0))) THEN
            WRITE (100,596)
596         FORMAT ('''     material composition of moderator',
     c      ' within unit cell')
            WRITE (100,597)
597         FORMAT ('''     with smeared ss304s spacer grids')
            UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
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```
     c       BORATEDMODVF)+(7.92*UCSPACERFRAC)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,598) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   598           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,599) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   599           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
             ENDIF
             WRITE (100,600) UCMODREGIONDEN, BORONVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   600       FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c       1X,F6.5,1X,F7.1,1X,'end')
             WRITE (100,601) UCMODREGIONDEN
   601       FORMAT ('arbm-spacer',3X,F6.4,1X,'4 0 0 0 24000 19.0',
     c       ' 25055 2.0 26000 69.5 28000 9.5')
             WRITE (100,602) UCSPACERFRAC,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   602       FORMAT (T15'3',1X,F6.5,1X,F7.1,1X,'end')
          ELSEIF (UCSPACERFRAC.EQ.(0.0)) THEN
             WRITE (100,603)
   603       FORMAT (''     material composition of moderator',
     c       ' within unit cell')
             WRITE (100,604)
   604       FORMAT (''     with no smeared spacer grids')
             UCMODREGIONDEN=(MODDENFINAL(CT3,RELATIVE_STPT_NUM)*
     c       BORATEDMODVF)
             IF (MODDENFINAL(CT3,RELATIVE_STPT_NUM).LT.(1.0)) THEN
                WRITE (100,605) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   605           FORMAT ('h2o   3   den=',F5.4,3X,F6.5,3X,F7.1,3X,'end')
             ELSE
                WRITE (100,606) UCMODREGIONDEN, BORATEDMODVF,
     c          MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   606           FORMAT ('h2o   3   den=',F6.4,3X,F6.5,3X,F7.1,3X,'end')
             ENDIF
             WRITE (100,607) UCMODREGIONDEN, BORONVF,
     c       MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   607       FORMAT ('arbm-bormod',3X,F6.4,1X,'1 0 0 0 5000 100 3',
     c       1X,F6.5,1X,F7.1,1X,'end')
          ENDIF
          WRITE (100,608)
   608    FORMAT ('''')
*  Write BPRA material specifications
*  BPR follow specifications
          BPRA_FOLLOW=.FALSE.
          IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c       (CT3.LT.BPTN(CT1))) THEN
             BPRA_FOLLOW=.TRUE.
             BPRA_DESCRIPTION_ID=BPDESID(CT1)
             WRITE(100,610)
   610       FORMAT('''')
             WRITE(100,612)
   612       FORMAT('''',5X,'BPR above the BP absorber region')
             WRITE(100,614)
   614       FORMAT('''')
             IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c       (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
               DO 616 CT5=1,10
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                IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
                 BPRCLNUM=CT5
                 EXIT
                ENDIF
616            CONTINUE
               IF (CLADDESNAME(BPRCLNUM).EQ.'SS304   ') THEN
                WRITE (100,618)
618             FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c          ' 2.0 26304 69.5 28304 9.5')
                WRITE (100,620) CLADDESNUM(BPRCLNUM), CLTEMP
620             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
                WRITE (100,622)
622             FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c          ' 2.0 26000 69.5 28000 9.5')
                WRITE (100,624) CLADDESNUM(BPRCLNUM), CLTEMP
624             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316   ') THEN
                WRITE (100,626)
626             FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c          ' 1.0 24304 17.0 25055 2.0')
                WRITE (100,628)
628             FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
                WRITE (100,630) CLADDESNUM(BPRCLNUM), CLTEMP
630             FORMAT (T12,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
                WRITE (100,632)
632             FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c          ' 1.0 24000 17.0 25055 2.0')
                WRITE (100,633)
633             FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
                WRITE (100,634) CLADDESNUM(BPRCLNUM), CLTEMP
634             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
                WRITE (100,635)
635             FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c          ' 22000 2.5 24000 15.0')
                WRITE (100,636)
636             FORMAT (T13,'26000 7.0 28000 73.0')
                WRITE (100,637) CLADDESNUM(BPRCLNUM), CLTEMP
637             FORMAT (T13,I2,' 1.0 ',F5.1,' end')
               ENDIF
              ENDIF
              IF (ABOVEBP(BPDESID(CT1)).EQ.'AL2O3') THEN
                 ALFRAC=(((BPDEN(BPDESID(CT1)))*2.0*26.981539)/
     c           (101.9631))/BPDEN(BPDESID(CT1))
                 OFRAC=1.0-ALFRAC
                 IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                    WRITE (100,638) ABOVEBPNUM(BPDESID(CT1)),
     c              BPDEN(BPDESID(CT1)), ALFRAC,
     c              MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
638                 FORMAT ('al',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c              1X,F7.1,1X,'end')
                    WRITE (100,640) ABOVEBPNUM(BPDESID(CT1)),
     c              BPDEN(BPDESID(CT1)), OFRAC,
     c              MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
640                 FORMAT ('o',3X,I3,3X,'den=',F4.3,1X,F7.5,
     c              1X,F7.1,1X,'end')
                 ELSE
                    WRITE (100,642) ABOVEBPNUM(BPDESID(CT1)),
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     c            BPDEN(BPDESID(CT1)), ALFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   642            FORMAT ('al',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c            1X,F7.1,1X,'end')
                  WRITE (100,644) ABOVEBPNUM(BPDESID(CT1)),
     c            BPDEN(BPDESID(CT1)), OFRAC,
     c            MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
   644            FORMAT ('o',3X,I3,3X,'den=',F5.3,1X,F7.5,
     c            1X,F7.1,1X,'end')
               ENDIF
            ELSE
               WRITE (100,*) 'arbm-bp    ',
     c         BPDEN(BPRA_DESCRIPTION_ID),
     c         '    ', BPFMNUMISOS(BPRA_DESCRIPTION_ID),
     c         '    0    0    0'
               DO 650 CT4=1,BPFMNUMISOS(BPRA_DESCRIPTION_ID)
                  WRITE (100,648)
     c            BPFISOID(BPRA_DESCRIPTION_ID,CT4),
     c            BPFISOWTPCT(BPRA_DESCRIPTION_ID,CT4)
   648             FORMAT (10X,I6,3X,F10.5)
   650          CONTINUE
                WRITE (100,*) '           ',
     c          ABOVEBPNUM(BPRA_DESCRIPTION_ID),
     c          ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM),
     c          '   end'
            ENDIF
         ENDIF
*  Actual BPRA specifications
         BPRA_INSERTED=.FALSE.
         IF ((BPRFLAG.EQ.'Y').AND.(BPDESID(CT1).NE.0).AND.
     c      (CT3.GE.BPTN(CT1)).AND.(CT3.LE.BPBN(CT1))) THEN
            BPRA_INSERTED=.TRUE.
            BPRA_DESCRIPTION_ID=BPDESID(CT1)
            WRITE (100,685)
   685      FORMAT ('''')
            IF (BPMIX(BPRA_DESCRIPTION_ID).EQ.0) THEN
               WRITE (100,690) BPWTPCT(BPDESID(CT1))
   690         FORMAT ('''',5X,'Al2O3-B4C burnable absorber pellet',1X,
     c         'specification (',F4.2,1X,'wt% b4c)')
            ELSE
               WRITE (100,695)
   695         FORMAT ('''',5X,'burnable absorber pellet ',
     c         'specification')
            ENDIF
            WRITE (100,700)
   700      FORMAT ('''')
*  Write B4C material specification
            IF ((BPRCLAD(BPDESID(CT1)).NE.0).AND.
     c      (BPRCLAD(BPDESID(CT1)).NE.2)) THEN
              DO 701 CT5=1,10
               IF (BPRCLAD(BPDESID(CT1)).EQ.CLADDESNUM(CT5)) THEN
                BPRCLNUM=CT5
                EXIT
               ENDIF
   701         CONTINUE
               IF (CLADDESNAME(BPRCLNUM).EQ.'SS304  ') THEN
                WRITE (100,702)
   702          FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055',
     c          ' 2.0 26304 69.5 28304 9.5')
                WRITE (100,703) CLADDESNUM(BPRCLNUM), CLTEMP
```

```
703           FORMAT (T12,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS304S ') THEN
              WRITE (100,704)
704           FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055',
     c        ' 2.0 26000 69.5 28000 9.5')
              WRITE (100,705) CLADDESNUM(BPRCLNUM), CLTEMP
705           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316  ') THEN
              WRITE (100,706)
706           FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000',
     c        ' 1.0 24304 17.0 25055 2.0')
              WRITE (100,707)
707           FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
              WRITE (100,708) CLADDESNUM(BPRCLNUM), CLTEMP
708           FORMAT (T12,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'SS316S ') THEN
              WRITE (100,709)
709           FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000',
     c        ' 1.0 24000 17.0 25055 2.0')
              WRITE (100,710)
710           FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
              WRITE (100,711) CLADDESNUM(BPRCLNUM), CLTEMP
711           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ELSEIF (CLADDESNAME(BPRCLNUM).EQ.'INCONEL') THEN
              WRITE (100,712)
712           FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c        ' 22000 2.5 24000 15.0')
              WRITE (100,713)
713           FORMAT (T13,'26000 7.0 28000 73.0')
              WRITE (100,714) CLADDESNUM(BPRCLNUM), CLTEMP
714           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ENDIF
            ENDIF
*  Material specification if it is a BOC to statepoint 1 calculation
            IF (CT2.EQ.1) THEN
*  Material specification for AL2O3-B4C
             IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c       (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
               IF (BPWTPCT(BPDESID(CT1)).NE.(0.0)) THEN
                  IF (BPDEN(BPDESID(CT1)).LT.(1.0)) THEN
                     WRITE (100,715) BPDEN(BPDESID(CT1)),
     c               (BPWTPCT(BPDESID(CT1))/100.0),
     c               MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
715                  FORMAT ('b4c   4   den=',F4.3,1X,F7.5,1X,F7.1,1X,
     c               'end')
                  ELSE
                     WRITE (100,716) BPDEN(BPDESID(CT1)),
     c               (BPWTPCT(BPDESID(CT1))/100.0),
     c               MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
716                  FORMAT ('b4c   4   den=',F5.3,1X,F7.5,1X,F7.1,1X,
     c               'end')
                  ENDIF
               ENDIF
*  Calculate aluminum and oxygen material specifications
               ALFRAC=(((((100.0-BPWTPCT(BPDESID(CT1)))/100)*
     c         BPDEN(BPDESID(CT1)))*2*26.981539)/(101.9631))/
     c         BPDEN(BPDESID(CT1))
               OFRAC=1-(BPWTPCT(BPDESID(CT1))/100.0)-ALFRAC
               WRITE (100,718) BPDEN(BPDESID(CT1)), ALFRAC,
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
```

```
 718          FORMAT ('al    4   den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
              WRITE (100,720) BPDEN(BPDESID(CT1)), OFRAC,
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
 720          FORMAT ('o     4   den=',F5.3,1X,F7.5,1X,F7.1,1X,'end')
            ELSE
*  Material specification for BP other than Al2O3-B4C
              DO 722 CT4=1,BPMIXNUM
                 IF (BPMIXID(CT4).EQ.BPMIX(BPRA_DESCRIPTION_ID)) THEN
                    RELATIVE_BP_MIX_ID=CT4
                 ENDIF
 722          CONTINUE
              WRITE (100,*) 'arbm-bp   ', BPDEN(BPRA_DESCRIPTION_ID),
     c        '   ', BPNUMISOS(RELATIVE_BP_MIX_ID),
     c        '   0   0   0'
              DO 726 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                 WRITE (100,724) BPISOID(RELATIVE_BP_MIX_ID,CT4),
     c           BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)
 724             FORMAT (10X,I6,3X,F10.5)
 726          CONTINUE
              WRITE (100,*) '          ', BPMIX(BPRA_DESCRIPTION_ID),
     c        ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
            ENDIF
*  Material specification if it is not a BOC to statepoint 1 calculation
           ELSEIF(CT2.NE.1) THEN
            BPVOL=BPXSECT(BPRA_DESCRIPTION_ID)*
     c      BPRODS(BPRA_DESCRIPTION_ID)*NODES(CT3,2)
*  Material specification for AL2O3-B4C
            IF ((BPMIX(BPRA_DESCRIPTION_ID).EQ.0).OR.
     c      (BPMIX(BPRA_DESCRIPTION_ID).EQ.4)) THEN
              B4CMASS=(BPWTPCT(BPDESID(CT1))/100.0)*
     c        BPDEN(BPDESID(CT1))*BPVOL
              ALMASS=((((100-BPWTPCT(BPDESID(CT1)))/100.0)*
     c        BPDEN(BPDESID(CT1)))*BPVOL)*((2*26.981539)/101.961278)
              OMASS=((((100-BPWTPCT(BPDESID(CT1)))/100.0)*
     c        BPDEN(BPDESID(CT1)))*BPVOL)-ALMASS
              CMASS=B4CMASS*0.217374
              NEWBPMASSTOTAL=ALMASS+OMASS+CMASS+BPRAISOVALUE(1)+
     c        BPRAISOVALUE(2)
              NEWBPDEN=NEWBPMASSTOTAL/BPVOL
              ALWTPCT=(ALMASS/NEWBPMASSTOTAL)*100.0
              OWTPCT=(OMASS/NEWBPMASSTOTAL)*100.0
              CWTPCT=(CMASS/NEWBPMASSTOTAL)*100.0
              B10WTPCT=(BPRAISOVALUE(1)/NEWBPMASSTOTAL)*100.0
              B11WTPCT=(BPRAISOVALUE(2)/NEWBPMASSTOTAL)*100.0
              IF (BPWTPCT(BPDESID(CT1)).NE.(0.0)) THEN
                 WRITE (100,728) NEWBPDEN
 728             FORMAT ('arbm-bp',1X,F7.3,1X,'5 0 0 0')
                 IF (BPRAISOVALUE(1).NE.0) THEN
                    WRITE (100,730) BPRAISONAME(1),
     c              B10WTPCT
 730                FORMAT(5X,A6,1X,G10.3)
                 ENDIF
                 IF (BPRAISOVALUE(2).NE.0) THEN
                    WRITE (100,732) BPRAISONAME(2),
     c              B11WTPCT
 732                FORMAT(5X,A6,1X,G10.3)
                 ENDIF
                 WRITE (100,734) CWTPCT
 734             FORMAT (5X,' 6012',1X,G10.3)
              ELSE
```

```
                  WRITE (100,736) NEWBPDEN
  736             FORMAT ('arbm-bp',1X,F7.3,1X,'2 0 0 0')
                ENDIF
*  Calculate aluminum and oxygen material specifications
                WRITE (100,738) ALWTPCT, OWTPCT
  738           FORMAT (5X,'13027',1X,F7.3,1X,' 8016',1X,F7.3)
                WRITE (100,740) MODTEMPFINAL(CT3,RELATIVE_STPT_NUM)
  740           FORMAT (5X,'4',1X,'1.0',1X,F6.1,1X,'end')
              ELSE
*  Material specification for BP other than Al2O3-B4C
                DO 742 CT4=1,BPMIXNUM
                   IF (BPMIXID(CT4).EQ.BPMIX(BPRA_DESCRIPTION_ID)) THEN
                      RELATIVE_BP_MIX_ID=CT4
                   ENDIF
  742           CONTINUE
                NEWBPMASSTOTAL=0.0
                DO 743 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                 IF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5010) THEN
                    NEWBPMASSTOTAL=NEWBPMASSTOTAL+BPRAISOVALUE(1)
                 ELSEIF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5011)
     c           THEN
                    NEWBPMASSTOTAL=NEWBPMASSTOTAL+BPRAISOVALUE(2)
                 ELSE
                    NEWBPMASSTOTAL=NEWBPMASSTOTAL+
     c              ((BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)/100.0)*
     c              BPDEN(BPRA_DESCRIPTION_ID)*BPVOL)
                 ENDIF
  743           CONTINUE
                NEWBPDEN=NEWBPMASSTOTAL/BPVOL
                WRITE (100,*) 'arbm-bp    ', NEWBPDEN,
     c          '    ', BPNUMISOS(RELATIVE_BP_MIX_ID),
     c          '   0    0    0'
                DO 750 CT4=1,BPNUMISOS(RELATIVE_BP_MIX_ID)
                 IF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5010) THEN
                    IF (BPRAISOVALUE(1).NE.0) THEN
                       WRITE (100,744) BPRAISONAME(1),
     c                 ((BPRAISOVALUE(1)/NEWBPMASSTOTAL)*100.0)
  744                  FORMAT(5X,A6,1X,G10.3)
                    ENDIF
                 ELSEIF (BPISOID(RELATIVE_BP_MIX_ID,CT4).EQ.5011)
     c           THEN
                    IF (BPRAISOVALUE(2).NE.0) THEN
                       WRITE (100,746) BPRAISONAME(2),
     c                 ((BPRAISOVALUE(2)/NEWBPMASSTOTAL)*100.0)
  746                  FORMAT(5X,A6,1X,G10.3)
                    ENDIF
                 ELSE
                    WRITE (100,748) BPISOID(RELATIVE_BP_MIX_ID,CT4),
     c              (((BPISOWTPCT(RELATIVE_BP_MIX_ID,CT4)/100.0)*
     c              BPDEN(BPRA_DESCRIPTION_ID)*BPVOL)/
     c              NEWBPMASSTOTAL)*100.0
  748               FORMAT (10X,I6,3X,F10.5)
                 ENDIF
  750           CONTINUE
                WRITE (100,*) '           ', BPMIX(BPRA_DESCRIPTION_ID),
     c          ' 1.0 ',MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
              ENDIF
            ENDIF
          ENDIF
*  Write control rod material specification
```

```
      CR_INSERTED=.FALSE.
      IF (CRSTAT.EQ.'RODDED') THEN
         CRCOMPFLAG=.FALSE.
         DO 760 CT4=1,23
            IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
               CRCOMPFLAG=.TRUE.
               CR_INSERTED=.TRUE.
               CR_MIXTURE_ID=CRINS(CT1,CT2,CT4,CT3)
               CR_DESCRIPTION=CRDES(CT1,CT2,CT4,CT3)
               EXIT
            ENDIF
760      CONTINUE
         IF (CRCOMPFLAG.EQ..TRUE.) THEN
            DO 770 CT4=1,CRMIXNUM
               IF (CRMIXID(CT4).EQ.CR_MIXTURE_ID) THEN
                  RELATIVE_CR_MIX_ID=CT4
               ENDIF
770         CONTINUE
            WRITE (100,780)
780         FORMAT ('''')
            WRITE (100,790)
790         FORMAT ('''',T5,' control rod material specification')
            WRITE (100,800)
800         FORMAT ('''')
         IF (CRCLAD(CR_DESCRIPTION).NE.0) THEN
           DO 801 CT5=1,10
            IF (CRCLAD(CR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
             CRCLNUM=CT5
             EXIT
            ENDIF
801        CONTINUE
           IF (CLADDESNAME(CRCLNUM).EQ.'SS304   ') THEN
            WRITE (100,802)
802         FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c      '2.0 26304 69.5 28304 9.5')
            WRITE (100,803) CLADDESNUM(CRCLNUM), CLTEMP
803         FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS304S ') THEN
            WRITE (100,804)
804         FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c      '2.0 26000 69.5 28000 9.5')
            WRITE (100,805) CLADDESNUM(CRCLNUM), CLTEMP
805         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316   ') THEN
            WRITE (100,806)
806         FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c      '1.0 24304 17.0 25055 2.0')
            WRITE (100,807)
807         FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
            WRITE (100,808) CLADDESNUM(CRCLNUM), CLTEMP
808         FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'SS316S ') THEN
            WRITE (100,809)
809         FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c      '1.0 24000 17.0 25055 2.0')
            WRITE (100,810)
810         FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
            WRITE (100,811) CLADDESNUM(CRCLNUM), CLTEMP
811         FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(CRCLNUM).EQ.'INCONEL') THEN
```

```
                WRITE (100,812)
  812           FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c          ' 22000 2.5 24000 15.0')
                WRITE (100,813)
  813           FORMAT (T13,'26000 7.0 28000 73.0')
                WRITE (100,814) CLADDESNUM(CRCLNUM), CLTEMP
  814           FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ENDIF
            ENDIF
               WRITE (100,*) 'arbm-cr    ', CRDEN(CR_DESCRIPTION),
     c         '   ', CRNUMISOS(RELATIVE_CR_MIX_ID), '   0   0   0'
               DO 820 CT4=1,CRNUMISOS(RELATIVE_CR_MIX_ID)
                  WRITE (100,815) CRISOID(RELATIVE_CR_MIX_ID,CT4),
     c            CRISOWTPCT(RELATIVE_CR_MIX_ID, CT4)
  815             FORMAT (10X,I5,3X,F10.5)
  820           CONTINUE
               WRITE (100,*) '          ', CR_MIXTURE_ID, ' 1.0 ',
     c         MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
            ENDIF
         ENDIF
*  Write APSR material specification
         IF ((CT1.EQ.CT1START).AND.(CT2.EQ.CT2GOVALUE).AND.
     c   (CT3.EQ.1)) THEN
         DO 824 CT4=1,10
            DO 823 CT5=1,20
               DO 822 CT6=1,23
                  DO 821 CT7=1,50
                     APSRINSOLD(CT4,CT5,CT6,CT7)=
     c               APSRINS(CT4,CT5,CT6,CT7)
  821             CONTINUE
  822           CONTINUE
  823        CONTINUE
  824     CONTINUE
         ENDIF
         APSR_INSERTED=.FALSE.
         IF (APSRSTAT.EQ.'RODDED') THEN
            DO 830 CT4=1,23
               APSRBOTFLAG=.FALSE.
               DO 825 CT5=50,1,-1
                  IF ((APSRINSOLD(CT1,CT2,CT4,CT5).NE.0).AND.
     c            (APSRBOTFLAG.EQ..FALSE.)) THEN
                     APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT5)
                     APSRBOTFLAG=.TRUE.
                     FOLNODKEEP=CT5
                     FOLSTEPKEEP=CT4
                  ENDIF
                  IF ((APSRINSOLD(CT1,CT2,CT4,CT5).EQ.0).AND.
     c            (APSRBOTFLAG.EQ..TRUE.)) THEN
                     APSRINS(CT1,CT2,CT4,CT5)=
     c               APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
                     APSRFOLLOWDATA(CT1,CT2,CT4,CT5)=3
                  ENDIF
  825           CONTINUE
  830        CONTINUE
             FOLLOWIN=.FALSE.
             DO 831 CT4=1,23
                IF (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3) THEN
                FOLLOWIN=.TRUE.
                EXIT
                ENDIF
```

```
831         CONTINUE
            IF (FOLLOWIN.EQ..TRUE.) THEN
               WRITE (100,832)
832            FORMAT ('''')
               WRITE (100,834)
834            FORMAT ('''',T5,' APSR follow rod material',
     c         ' specification')
               WRITE (100,836)
836            FORMAT ('''')
            IF ((APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.0)
     c      .AND.
     c      (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP).NE.2)) THEN
              DO 838 CT5=1,10
               IF (APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP)
     c         .EQ.CLADDESNUM(CT5)) THEN
                APSRFOLNUM=CT5
                EXIT
               ENDIF
838           CONTINUE
              IF (CLADDESNAME(APSRFOLNUM).EQ.'SS304   ') THEN
               WRITE (100,840)
840            FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c         '2.0 26304 69.5 28304 9.5')
               WRITE (100,842) CLADDESNUM(APSRFOLNUM), CLTEMP
842            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS304S ') THEN
               WRITE (100,844)
844            FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c         '2.0 26000 69.5 28000 9.5')
               WRITE (100,846) CLADDESNUM(APSRFOLNUM), CLTEMP
846            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316   ') THEN
               WRITE (100,848)
848            FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c         '1.0 24304 17.0 25055 2.0')
               WRITE (100,850)
850            FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
               WRITE (100,852) CLADDESNUM(APSRFOLNUM), CLTEMP
852            FORMAT (T12,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'SS316S ') THEN
               WRITE (100,854)
854            FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c         '1.0 24000 17.0 25055 2.0')
               WRITE (100,856)
856            FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
               WRITE (100,858) CLADDESNUM(APSRFOLNUM), CLTEMP
858            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ELSEIF (CLADDESNAME(APSRFOLNUM).EQ.'INCONEL') THEN
               WRITE (100,860)
860            FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c         ' 22000 2.5 24000 15.0')
               WRITE (100,862)
862            FORMAT (T13,'26000 7.0 28000 73.0')
               WRITE (100,864) CLADDESNUM(APSRFOLNUM), CLTEMP
864            FORMAT (T13,I2,' 1.0 ',F5.1,' end')
              ENDIF
            ENDIF
            ENDIF
            APSRCOMPFLAG=.FALSE.
            DO 865 CT4=1,23
```

```
            IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c      (APSRINS(CT1,CT2,CT4,CT3).NE.
     c      APSRFOLLOWMIX(CT1,CT2,FOLSTEPKEEP,FOLNODKEEP))) THEN
               APSRCOMPFLAG=.TRUE.
               APSR_INSERTED=.TRUE.
               APSR_MIXTURE_ID=APSRINS(CT1,CT2,CT4,CT3)
               APSR_DESCRIPTION=APSRDES(CT1,CT2,CT4,CT3)
               EXIT
            ENDIF
 865     CONTINUE
         IF (APSRCOMPFLAG.EQ..TRUE.) THEN
            DO 866 CT4=1,APSRMIXNUM
               IF (APSRMIXID(CT4).EQ.APSR_MIXTURE_ID) THEN
                  RELATIVE_APSR_MIX_ID=CT4
               ENDIF
 866           CONTINUE
               WRITE (100,868)
 868           FORMAT ('''')
               WRITE (100,870)
 870           FORMAT ('''',T5,' axial power shaping rod material',
     c         ' specification')
               WRITE (100,880)
 880           FORMAT ('''')
         IF (APSRCLAD(APSR_DESCRIPTION).NE.0) THEN
           DO 881 CT5=1,10
            IF (APSRCLAD(APSR_DESCRIPTION).EQ.CLADDESNUM(CT5)) THEN
             APSRCLNUM=CT5
             EXIT
            ENDIF
 881       CONTINUE
           IF (CLADDESNAME(APSRCLNUM).EQ.'SS304  ') THEN
            WRITE (100,882)
 882        FORMAT ('arbm-ss304 7.92 4 0 0 0 24304 19.0 25055 ',
     c      '2.0 26304 69.5 28304 9.5')
            WRITE (100,883) CLADDESNUM(APSRCLNUM), CLTEMP
 883        FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS304S ') THEN
            WRITE (100,884)
 884        FORMAT ('arbm-ss304s 7.92 4 0 0 0 24000 19.0 25055 ',
     c      '2.0 26000 69.5 28000 9.5')
            WRITE (100,885) CLADDESNUM(APSRCLNUM), CLTEMP
 885        FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316  ') THEN
            WRITE (100,886)
 886        FORMAT ('arbm-ss316 7.75 7 0 0 0 6012 0.08 14000 ',
     c      '1.0 24304 17.0 25055 2.0')
            WRITE (100,887)
 887        FORMAT (T12,'26304 65.42 28304 12.0 42000 2.5')
            WRITE (100,888) CLADDESNUM(APSRCLNUM), CLTEMP
 888        FORMAT (T12,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'SS316S ') THEN
            WRITE (100,889)
 889        FORMAT ('arbm-ss316s 7.75 7 0 0 0 6012 0.08 14000 ',
     c      '1.0 24000 17.0 25055 2.0')
            WRITE (100,890)
 890        FORMAT (T13,'26000 65.42 28000 12.0 42000 2.5')
            WRITE (100,891) CLADDESNUM(APSRCLNUM), CLTEMP
 891        FORMAT (T13,I2,' 1.0 ',F5.1,' end')
           ELSEIF (CLADDESNAME(APSRCLNUM).EQ.'INCONEL') THEN
            WRITE (100,892)
```

```
  892          FORMAT ('arbm-inconel 8.3 5 0 0 0 14000 2.5',
     c         ' 22000 2.5 24000 15.0')
               WRITE (100,893)
  893          FORMAT (T13,'26000 7.0 28000 73.0')
               WRITE (100,894) CLADDESNUM(APSRCLNUM), CLTEMP
  894          FORMAT (T13,I2,' 1.0 ',F5.1,' end')
             ENDIF
           ENDIF
              WRITE (100,*) 'arbm-apsr   ', APSRDEN(APSR_DESCRIPTION),
     c        '   ', APSRNUMISOS(RELATIVE_APSR_MIX_ID), '   0   0   0'
              DO 900 CT4=1,APSRNUMISOS(RELATIVE_APSR_MIX_ID)
                 WRITE (100,895) APSRISOID(RELATIVE_APSR_MIX_ID,CT4),
     c           APSRISOWTPCT(RELATIVE_APSR_MIX_ID, CT4)
  895            FORMAT (10X,I5,3X,F10.5)
  900         CONTINUE
              WRITE (100,*) '          ', APSR_MIXTURE_ID, ' 1.0 ',
     c        MODTEMPFINAL(CT3,RELATIVE_STPT_NUM), '   end'
           ENDIF
        ENDIF
*  Write fuel rod fill gas material specification
        WRITE (100,910)
  910   FORMAT ('''')
        WRITE (100,920)
  920   FORMAT ('he    5   end')
        WRITE (100,930)
  930   FORMAT ('end comp')
*  Write base reactor lattice specifications
        WRITE (100,940)
  940   FORMAT ('''')
        WRITE (100,950)
  950   FORMAT ('''     base reactor lattice specification')
        WRITE (100,960)
  960   FORMAT ('''')
        WRITE (100,970) PITCH, FOD, COD, CID
  970   FORMAT ('squarepitch',3X,F7.5,3X,F6.4,3X,'1   3',3X,F6.4,
     c  3X,'2',3X,F6.4,3X,'0   end')
* The following writing routine for 'SPECIAL' input data
* has not been formatted to compensate for FORTRAN's ingenious
* incapability to print leading zeros in numeric fields.
* Errors will occur in the FIDO input if null space exists
* between an equal sign and the appropriate value.  Therefore,
* the IIM and ICM factors must always be at least 10.
        IF (FLAG2.EQ.'SPECIAL') THEN
           IF (SZF.LT.1) THEN
              WRITE (100,980) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  980         FORMAT ('more data',1X,'szf=0',F3.2,1X,'isn=',I1,1X,
     c        'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c        1X,'ius=',I1,3X,'end')
           ELSE
              WRITE (100,990) SZF, ISN, IIM, ICM, EPS, PTC, IUS
  990         FORMAT ('more data',1X,'szf=',F4.2,1X,'isn=',I1,1X,
     c        'iim=',I2,1X,'icm=',I2,1X,'eps=0',G7.2,1X,'ptc=0',G7.2,
     c        1X,'ius=',I1,3X,'end')
           ENDIF
        ELSEIF (FLAG2.NE.'SPECIAL') THEN
           IF (MESH.LT.1) THEN
              WRITE (100,1000) MESH
 1000         FORMAT ('more data',1X,'szf=0',F3.2,1X,'end')
           ELSE
              WRITE (100,1010) MESH
```

```
 1010          FORMAT ('more data',1X,'szf=',F4.2,1X,'end')
            ENDIF
         ENDIF
*  Write assembly specifications
         WRITE (100,1020)
 1020    FORMAT ('''')
         WRITE (100,1030)
 1030    FORMAT ('''     assembly specification')
         WRITE (100,1040)
 1040    FORMAT ('''')
         IF (STEPCONTROL.EQ.'Y') THEN
            CALL ZEROS(VARSTEPNUM(CT1,CT2),IRRAD_STEPS)
         ELSEIF (STEPCONTROL.EQ.'N') THEN
            CALL ZEROS(INT(BLETDOWN(CT1,CT2,2)),IRRAD_STEPS)
         ENDIF
*  Assembly specification if no BPRA, no CR, and no APSR is inserted
         IF ((BPRA_INSERTED.EQ..FALSE.).AND.(CR_INSERTED.EQ..FALSE.)
     c   .AND.(APSR_INSERTED.EQ..FALSE.)
     c   .AND.(BPRA_FOLLOW.EQ..FALSE.)
     c   .AND.(FOLLOWIN.EQ..FALSE.)) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1041) RODS, NODES(CT3,2), IRRAD_STEPS
 1041          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1042) RODS, NODES(CT3,2), IRRAD_STEPS
 1042          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1043) RODS, NODES(CT3,2), IRRAD_STEPS
 1043          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(LUZONE,LUZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1044) PLEVELCH, LUZONECH, MESH
 1044          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1045) PLEVELCH, LUZONECH, MESH
 1045          FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            DO 1047 CT4=1,LUZONE
               IF (MOD(CT4,6).EQ.0) THEN
                  WRITE (100,*)
               ENDIF
               WRITE (100,1046) LMB(CT4), LRB(CT4)
 1046          FORMAT (I3,1X,F7.5,1X,$)
 1047       CONTINUE
            WRITE (100,*)
         ENDIF
*  Assembly specification if BPRA is inserted
         IF (BPRA_FOLLOW.EQ..TRUE.) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1050) RODS, NODES(CT3,2), IRRAD_STEPS
```

```
1050          FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c        'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1052) RODS, NODES(CT3,2), IRRAD_STEPS
1052           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1054) RODS, NODES(CT3,2), IRRAD_STEPS
1054           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1056) PLEVELCH, BPZONECH, MESH
1056           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1058) PLEVELCH, BPZONECH, MESH
1058           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F4.2,1X,'end')
            ENDIF
            DO 1062 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
               IF (MOD(CT4,6).EQ.0) THEN
                  WRITE (100,*)
               ENDIF
               WRITE (100,1060) BPRFM(CT4,BPRA_DESCRIPTION_ID),
     c         BPRFR(CT4,BPRA_DESCRIPTION_ID)
1060           FORMAT (I3,1X,F7.5,1X,$)
1062        CONTINUE
            WRITE (100,*)
         ENDIF
         IF (BPRA_INSERTED.EQ..TRUE.) THEN
            IF (NODES(CT3,2).GE.(100.0)) THEN
               WRITE (100,1098) RODS, NODES(CT3,2), IRRAD_STEPS
1098           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c      (NODES(CT3,2).GE.(10.0))) THEN
               WRITE (100,1100) RODS, NODES(CT3,2), IRRAD_STEPS
1100           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
               WRITE (100,1102) RODS, NODES(CT3,2), IRRAD_STEPS
1102           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c         'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
            ENDIF
            CALL ZEROS(PLEVEL,PLEVELCH)
            CALL ZEROS(BPZONE(BPRA_DESCRIPTION_ID),BPZONECH)
            IF (MESH.LT.(1.0)) THEN
               WRITE (100,1104) PLEVELCH, BPZONECH, MESH
1104           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c         'numztotal=',A2,1X,'mxrepeats=1',1X,
     c         'mixmod=3 facmesh=',F3.2,1X,'end')
            ELSE
               WRITE (100,1106) PLEVELCH, BPZONECH, MESH
1106           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
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     c          'numztotal=',A2,1X,'mxrepeats=1',1X,
     c          'mixmod=3 facmesh=',F4.2,1X,'end')
             ENDIF
             DO 1110 CT4=1,BPZONE(BPRA_DESCRIPTION_ID)
                IF (MOD(CT4,6).EQ.0) THEN
                   WRITE (100,*)
                ENDIF
                WRITE (100,1108) BPMA(CT4,BPRA_DESCRIPTION_ID),
     c          BPRA(CT4,BPRA_DESCRIPTION_ID)
 1108           FORMAT (I3,1X,F7.5,1X,$)
 1110        CONTINUE
             WRITE (100,*)
          ENDIF
*  Assembly specification if CR is inserted
          IF (CR_INSERTED.EQ..TRUE.) THEN
             IF (NODES(CT3,2).GE.(100.0)) THEN
                WRITE (100,1120) RODS, NODES(CT3,2), IRRAD_STEPS
 1120           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c       (NODES(CT3,2).GE.(10.0))) THEN
                WRITE (100,1130) RODS, NODES(CT3,2), IRRAD_STEPS
 1130           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
                WRITE (100,1140) RODS, NODES(CT3,2), IRRAD_STEPS
 1140           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c          'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
             ENDIF
             CALL ZEROS(PLEVEL,PLEVELCH)
             CALL ZEROS(CRZONE(CR_DESCRIPTION),CRZONECH)
             IF (MESH.LT.(1.0)) THEN
                WRITE (100,1150) PLEVELCH, CRZONECH, MESH
 1150           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=0',1X,
     c          'mixmod=3 facmesh=',F3.2,1X,'end')
             ELSE
                WRITE (100,1160) PLEVELCH, CRZONECH, MESH
 1160           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c          'numztotal=',A2,1X,'mxrepeats=0',1X,
     c          'mixmod=3 facmesh=',F4.2,1X,'end')
             ENDIF
             IF (STEPCONTROL.EQ.'N') THEN
              DO 1168 CT4=1,INT(BLETDOWN(CT1,CT2,2))
                IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                   DO 1162 CT5=1,CRZONE(CR_DESCRIPTION)
                      IF (MOD(CT5,6).EQ.0) THEN
                         WRITE (100,*)
                      ENDIF
                      WRITE (100,1161) CRMA(CT5,CR_DESCRIPTION),
     c                CRRA(CT5,CR_DESCRIPTION)
 1161                 FORMAT (I3,1X,F7.5,1X,$)
 1162              CONTINUE
                   WRITE (100,*)
                ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                   DO 1166 CT5=1,CRZONE(CR_DESCRIPTION)
                      IF (MOD(CT5,6).EQ.0) THEN
                         WRITE (100,*)
                      ENDIF
                      WRITE (100,1164) LMC(CT5,CR_DESCRIPTION),
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     c                LRC(CT5,CR_DESCRIPTION)
  1164                FORMAT (I3,1X,F7.5,1X,$)
  1166             CONTINUE
                   WRITE (100,*)
                ENDIF
  1168          CONTINUE
              ELSEIF (STEPCONTROL.EQ.'Y') THEN
               DO 1210 CT4=1,VARSTEPNUM(CT1,CT2)
                 IF (CRINS(CT1,CT2,CT4,CT3).NE.0) THEN
                    DO 1180 CT5=1,CRZONE(CR_DESCRIPTION)
                       IF (MOD(CT5,6).EQ.0) THEN
                          WRITE (100,*)
                       ENDIF
                       WRITE (100,1170) CRMA(CT5,CR_DESCRIPTION),
     c                 CRRA(CT5,CR_DESCRIPTION)
  1170                 FORMAT (I3,1X,F7.5,1X,$)
  1180              CONTINUE
                    WRITE (100,*)
                 ELSEIF (CRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                    DO 1200 CT5=1,CRZONE(CR_DESCRIPTION)
                       IF (MOD(CT5,6).EQ.0) THEN
                          WRITE (100,*)
                       ENDIF
                       WRITE (100,1190) LMC(CT5,CR_DESCRIPTION),
     c                 LRC(CT5,CR_DESCRIPTION)
  1190                 FORMAT (I3,1X,F7.5,1X,$)
  1200              CONTINUE
                    WRITE (100,*)
                 ENDIF
  1210          CONTINUE
              ENDIF
           ENDIF
*  Assembly specification if APSR is inserted
           IF ((APSR_INSERTED.EQ..TRUE.).OR.(FOLLOWIN.EQ..TRUE.)) THEN
              IF (NODES(CT3,2).GE.(100.0)) THEN
                 WRITE (100,1220) RODS, NODES(CT3,2), IRRAD_STEPS
  1220           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F7.3,1X,
     c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
              ELSEIF ((NODES(CT3,2).LT.(100.0)).AND.
     c        (NODES(CT3,2).GE.(10.0))) THEN
                 WRITE (100,1230) RODS, NODES(CT3,2), IRRAD_STEPS
  1230           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F6.3,1X,
     c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
              ELSEIF (NODES(CT3,2).LT.(10.0)) THEN
                 WRITE (100,1240) RODS, NODES(CT3,2), IRRAD_STEPS
  1240           FORMAT ('npin/assembly=',I3,1X,'fuelngth=',F5.3,1X,
     c           'ncycles=',A2,1X,'nlib/cyc=1 lightel=0')
              ENDIF
              CALL ZEROS(PLEVEL,PLEVELCH)
              CALL ZEROS(APSRZONE(APSR_DESCRIPTION),APSRZONECH)
              IF (MESH.LT.(1.0)) THEN
                 WRITE (100,1250) PLEVELCH, APSRZONECH, MESH
  1250           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c           'numztotal=',A2,1X,'mxrepeats=0',1X,
     c           'mixmod=3 facmesh=',F3.2,1X,'end')
              ELSE
                 WRITE (100,1252) PLEVELCH, APSRZONECH, MESH
  1252           FORMAT ('printlevel=',A2,1X,'inplevel=2',1X,
     c           'numztotal=',A2,1X,'mxrepeats=0',1X,
     c           'mixmod=3 facmesh=',F4.2,1X,'end')
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            ENDIF
            IF (STEPCONTROL.EQ.'N') THEN
             DO 1268 CT4=1,INT(BLETDOWN(CT1,CT2,2))
               IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
                  DO 1258 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1256) APSRMA(CT5,APSR_DESCRIPTION),
     c               APSRRA(CT5,APSR_DESCRIPTION)
 1256                FORMAT (I3,1X,F7.5,1X,$)
 1258             CONTINUE
                  WRITE (100,*)
               ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
                  DO 1262 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1260) APSRFM(CT5,APSR_DESCRIPTION),
     c               APSRFR(CT5,APSR_DESCRIPTION)
 1260                FORMAT (I3,1X,F7.5,1X,$)
 1262             CONTINUE
                  WRITE (100,*)
               ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1266 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1264) LMD(CT5,APSR_DESCRIPTION),
     c               LRD(CT5,APSR_DESCRIPTION)
 1264                FORMAT (I3,1X,F7.5,1X,$)
 1266             CONTINUE
                  WRITE (100,*)
               ENDIF
 1268         CONTINUE
            ELSEIF (STEPCONTROL.EQ.'Y') THEN
             DO 1310 CT4=1,VARSTEPNUM(CT1,CT2)
               IF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).NE.3)) THEN
                  DO 1280 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1270) APSRMA(CT5,APSR_DESCRIPTION),
     c               APSRRA(CT5,APSR_DESCRIPTION)
 1270                FORMAT (I3,1X,F7.5,1X,$)
 1280             CONTINUE
                  WRITE (100,*)
               ELSEIF ((APSRINS(CT1,CT2,CT4,CT3).NE.0).AND.
     c         (APSRFOLLOWDATA(CT1,CT2,CT4,CT3).EQ.3)) THEN
                  DO 1290 CT5=1,APSRZONE(APSR_DESCRIPTION)
                     IF (MOD(CT5,6).EQ.0) THEN
                        WRITE (100,*)
                     ENDIF
                     WRITE (100,1285) APSRFM(CT5,APSR_DESCRIPTION),
     c               APSRFR(CT5,APSR_DESCRIPTION)
 1285                FORMAT (I3,1X,F7.5,1X,$)
 1290             CONTINUE
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                  WRITE (100,*)
                ELSEIF (APSRINS(CT1,CT2,CT4,CT3).EQ.0) THEN
                  DO 1300 CT5=1,APSRZONE(APSR_DESCRIPTION)
                    IF (MOD(CT5,6).EQ.0) THEN
                      WRITE (100,*)
                    ENDIF
                    WRITE (100,1295) LMD(CT5,APSR_DESCRIPTION),
     c              LRD(CT5,APSR_DESCRIPTION)
 1295               FORMAT (I3,1X,F7.5,1X,$)
 1300             CONTINUE
                  WRITE (100,*)
                ENDIF
 1310          CONTINUE
              ENDIF
            ENDIF
*  Write assembly depletion/decay parameters
            WRITE (100,1320)
 1320       FORMAT ('''')
            WRITE (100,1330)
 1330       FORMAT ('''     assembly depletion/decay parameters')
            WRITE (100,1340)
 1340       FORMAT ('''')
            CALL ZEROS(CYCPOS(CT1),ASSYPOSITION)
            WRITE (100,1350) CYCLEID(CT1), ASSYPOSITION
 1350       FORMAT ('''',T5,'Cycle-',A2,', one-eighth core',
     c      ' assembly number ',A2)
            IF (STEPCONTROL.EQ.'N') THEN
             DO 1380 CT4=3,(INT(BLETDOWN(CT1,CT2,2))+2)
               IF (CT4.LT.(BLETDOWN(CT1,CT2,2)+2)) THEN
                  DOWNTIME=0.0
                  BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c            BLETDOWN(CT1,CT2,3))
                  WRITE (100,1360) POWER(CT3,RELATIVE_STPT_NUM),
     c            BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1360             FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c            G10.5,1X,'bfrac=',G9.4,1X,'end')
               ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c         (CT2.LT.STPTS(CT1))) THEN
                  DOWNTIME=STPTDAT(CT1,(CT2+1),3)
                  BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c            BLETDOWN(CT1,CT2,3))
                  WRITE (100,1365) POWER(CT3,RELATIVE_STPT_NUM),
     c            BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1365             FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c            G10.5,1X,'bfrac=',G9.4,1X,'end')
               ELSEIF ((CT4.EQ.(INT(BLETDOWN(CT1,CT2,2))+2)).AND.
     c         (CT2.EQ.STPTS(CT1))) THEN
                  DOWNTIME=CYCDOWN(CT1)
                  BORON_FRACTION=(BLETDOWN(CT1,CT2,CT4)/
     c            BLETDOWN(CT1,CT2,3))
                  WRITE (100,1370) POWER(CT3,RELATIVE_STPT_NUM),
     c            BLETDOWN(CT1,CT2,1), DOWNTIME, BORON_FRACTION
 1370             FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c            G10.5,1X,'bfrac=',G9.4,1X,'end')
               ENDIF
 1380        CONTINUE
            ELSEIF (STEPCONTROL.EQ.'Y') THEN
             DO 1388 CT4=1,VARSTEPNUM(CT1,CT2)
               IF (CT4.LT.VARSTEPNUM(CT1,CT2)) THEN
                  DOWNTIME=0.0
```

```
                BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c          VARBLETDOWN(CT1,CT2,1,2))
                WRITE (100,1382) VARPOWER(CT1,CT2,CT4,CT3),
     c          VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1382           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c        (CT2.LT.STPTS(CT1))) THEN
                DOWNTIME=STPTDAT(CT1,(CT2+1),3)
                BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c          VARBLETDOWN(CT1,CT2,1,2))
                WRITE (100,1384) VARPOWER(CT1,CT2,CT4,CT3),
     c          VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1384           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ELSEIF ((CT4.EQ.VARSTEPNUM(CT1,CT2)).AND.
     c        (CT2.EQ.STPTS(CT1))) THEN
                DOWNTIME=CYCDOWN(CT1)
                BORON_FRACTION=(VARBLETDOWN(CT1,CT2,CT4,2)/
     c          VARBLETDOWN(CT1,CT2,1,2))
                WRITE (100,1386) VARPOWER(CT1,CT2,CT4,CT3),
     c          VARBLETDOWN(CT1,CT2,CT4,1), DOWNTIME, BORON_FRACTION
 1386           FORMAT ('power=',G10.5,1X,'burn=',G9.4,1X,'down=',
     c          G10.5,1X,'bfrac=',G9.4,1X,'end')
              ENDIF
 1388       CONTINUE
            ENDIF
*  Store final downtime for use in extraction script 'sedexecute.exe'
            FINALDOWNTIME=DOWNTIME
*  Write input deck closing statement
            WRITE (100,1390)
 1390       FORMAT ('''')
            WRITE (100,1400)
 1400       FORMAT ('''     end of input')
            WRITE (100,1410)
 1410       FORMAT ('''')
            WRITE (100,1420)
 1420       FORMAT ('end')
            CLOSE(UNIT=100)

      RETURN
      END

*************************************************************
*     This subroutine cuts the final ORIGEN output in  *
*     the SAS2H output file down to the essential      *
*     data needed for the CRC calculations.            *
*************************************************************
      SUBROUTINE CUTTER (NM)
*
      INTEGER*4 LINECOUNTER, CUTLINE, NUM1, NUM2,
     c NUM3, NUM4, NUM5, NUM6, NUM7, SEDEXERESULT,
     c VERIFCOUNTER, VERIFCUTLINE, VERIFENDCUTLINE,
     c OUTPUTREMOVALRESULT
*
      CHARACTER NM*31, OUTPUTFILE*32, BPLABEL*14,
     c LINVAL*7, SEDEXECOMMAND*60, FORMATLABEL*29,
     c VERIFLABEL*14, VERIFLINVAL*7, VERIFENDLINVAL*7,
     c OUTPUTREMOVAL*35
*
```

```
      LOGICAL BPFIND, NUMZEROFLAG, VERIFFIND
*
      OUTPUTFILE(1:25)=NM(1:25)
      OUTPUTFILE(26:32)='.output'
      OPEN (UNIT=700, FILE=OUTPUTFILE, STATUS='OLD')
      REWIND(700)
      LINECOUNTER=0
      BPFIND=.FALSE.
      DO 14 WHILE (BPFIND.EQ..FALSE.)
         LINECOUNTER=LINECOUNTER+1
         READ(700,12) BPLABEL
   12    FORMAT (T98,A14)
         IF (BPLABEL.EQ.'light elements') THEN
            READ(700,*)
            READ(700,13) FORMATLABEL
   13       FORMAT (T46,A29)
            IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
               BPFIND=.TRUE.
            ELSE
               BACKSPACE(700)
               BACKSPACE(700)
            ENDIF
         ENDIF
   14 CONTINUE
      NUMZEROFLAG=.FALSE.
      CUTLINE=LINECOUNTER-2
               NUM1=INT(CUTLINE/1000000.0)
               IF ((NUM1.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(1:1)=' '
               ELSE
                  LINVAL(1:1)=CHAR(NUM1+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM2=INT((CUTLINE-(NUM1*1000000))/100000.0)
               IF ((NUM2.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(2:2)=' '
               ELSE
                  LINVAL(2:2)=CHAR(NUM2+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM3=INT((CUTLINE-(NUM2*100000)-
     c         (NUM1*1000000))/10000.0)
               IF ((NUM3.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(3:3)=' '
               ELSE
                  LINVAL(3:3)=CHAR(NUM3+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM4=INT((CUTLINE-(NUM3*10000)-
     c         (NUM2*100000)-(NUM1*1000000))/1000.0)
               IF ((NUM4.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(4:4)=' '
               ELSE
                  LINVAL(4:4)=CHAR(NUM4+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM5=INT((CUTLINE-(NUM4*1000)-(NUM3*10000)-
     c         (NUM2*100000)-(NUM1*1000000))/100.0)
               IF ((NUM5.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(5:5)=' '
```

```
               ELSE
                  LINVAL(5:5)=CHAR(NUM5+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM6=INT((CUTLINE-(NUM5*100)-(NUM4*1000)-
     c         (NUM3*10000)-(NUM2*100000)-
     c         (NUM1*1000000))/10.0)
               IF ((NUM6.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  LINVAL(6:6)=' '
               ELSE
                  LINVAL(6:6)=CHAR(NUM6+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM7=INT(CUTLINE-(NUM6*10)-(NUM5*100)-
     c         (NUM4*1000)-(NUM3*10000)-(NUM2*100000)-
     c         (NUM1*1000000))
               LINVAL(7:7)=CHAR(NUM7+48)
      REWIND(700)
      VERIFCOUNTER=0
      VERIFFIND=.FALSE.
      DO 30 WHILE (VERIFFIND.EQ..FALSE.)
         VERIFCOUNTER=VERIFCOUNTER+1
         READ(700,20) VERIFLABEL
20       FORMAT (T45,A14)
         IF (VERIFLABEL.EQ.'program:  sas2') THEN
            VERIFFIND=.TRUE.
         ENDIF
30    CONTINUE
      NUMZEROFLAG=.FALSE.
      VERIFCUTLINE=VERIFCOUNTER-12
      VERIFENDCUTLINE=VERIFCOUNTER+18
               NUM1=INT(VERIFCUTLINE/1000000.0)
               IF ((NUM1.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(1:1)=' '
               ELSE
                  VERIFLINVAL(1:1)=CHAR(NUM1+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM2=INT((VERIFCUTLINE-(NUM1*1000000))/100000.0)
               IF ((NUM2.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(2:2)=' '
               ELSE
                  VERIFLINVAL(2:2)=CHAR(NUM2+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM3=INT((VERIFCUTLINE-(NUM2*100000)-
     c         (NUM1*1000000))/10000.0)
               IF ((NUM3.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(3:3)=' '
               ELSE
                  VERIFLINVAL(3:3)=CHAR(NUM3+48)
                  NUMZEROFLAG=.TRUE.
               ENDIF
               NUM4=INT((VERIFCUTLINE-(NUM3*10000)-
     c         (NUM2*100000)-(NUM1*1000000))/1000.0)
               IF ((NUM4.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
                  VERIFLINVAL(4:4)=' '
               ELSE
                  VERIFLINVAL(4:4)=CHAR(NUM4+48)
                  NUMZEROFLAG=.TRUE.
```

```
            ENDIF
            NUM5=INT((VERIFCUTLINE-(NUM4*1000)-(NUM3*10000)-
     c      (NUM2*100000)-(NUM1*1000000))/100.0)
            IF ((NUM5.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFLINVAL(5:5)=' '
            ELSE
               VERIFLINVAL(5:5)=CHAR(NUM5+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM6=INT((VERIFCUTLINE-(NUM5*100)-(NUM4*1000)-
     c      (NUM3*10000)-(NUM2*100000)-
     c      (NUM1*1000000))/10.0)
            IF ((NUM6.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFLINVAL(6:6)=' '
            ELSE
               VERIFLINVAL(6:6)=CHAR(NUM6+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM7=INT(VERIFCUTLINE-(NUM6*10)-(NUM5*100)-
     c      (NUM4*1000)-(NUM3*10000)-(NUM2*100000)-
     c      (NUM1*1000000))
            VERIFLINVAL(7:7)=CHAR(NUM7+48)
            NUM1=INT(VERIFENDCUTLINE/1000000.0)
            IF ((NUM1.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFENDLINVAL(1:1)=' '
            ELSE
               VERIFENDLINVAL(1:1)=CHAR(NUM1+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM2=INT((VERIFENDCUTLINE-(NUM1*1000000))/100000.0)
            IF ((NUM2.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFENDLINVAL(2:2)=' '
            ELSE
               VERIFENDLINVAL(2:2)=CHAR(NUM2+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM3=INT((VERIFENDCUTLINE-(NUM2*100000)-
     c      (NUM1*1000000))/10000.0)
            IF ((NUM3.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFENDLINVAL(3:3)=' '
            ELSE
               VERIFENDLINVAL(3:3)=CHAR(NUM3+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM4=INT((VERIFENDCUTLINE-(NUM3*10000)-
     c      (NUM2*100000)-(NUM1*1000000))/1000.0)
            IF ((NUM4.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFENDLINVAL(4:4)=' '
            ELSE
               VERIFENDLINVAL(4:4)=CHAR(NUM4+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM5=INT((VERIFENDCUTLINE-(NUM4*1000)-(NUM3*10000)-
     c      (NUM2*100000)-(NUM1*1000000))/100.0)
            IF ((NUM5.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFENDLINVAL(5:5)=' '
            ELSE
               VERIFENDLINVAL(5:5)=CHAR(NUM5+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
```

```
            NUM6=INT((VERIFENDCUTLINE-(NUM5*100)-(NUM4*1000)-
     c      (NUM3*10000)-(NUM2*100000)-
     c      (NUM1*1000000))/10.0)
            IF ((NUM6.EQ.0).AND.(NUMZEROFLAG.EQ..FALSE.)) THEN
               VERIFENDLINVAL(6:6)=' '
            ELSE
               VERIFENDLINVAL(6:6)=CHAR(NUM6+48)
               NUMZEROFLAG=.TRUE.
            ENDIF
            NUM7=INT(VERIFENDCUTLINE-(NUM6*10)-(NUM5*100)-
     c      (NUM4*1000)-(NUM3*10000)-(NUM2*100000)-
     c      (NUM1*1000000))
            VERIFENDLINVAL(7:7)=CHAR(NUM7+48)
      SEDEXECOMMAND(1:11)='sedexecute '
      SEDEXECOMMAND(12:36)=NM(1:25)
      SEDEXECOMMAND(37:37)=' '
      SEDEXECOMMAND(38:44)=LINVAL
      SEDEXECOMMAND(45:45)=' '
      SEDEXECOMMAND(46:52)=VERIFLINVAL
      SEDEXECOMMAND(53:53)=' '
      SEDEXECOMMAND(54:60)=VERIFENDLINVAL
      SEDEXERESULT=SYSTEM(SEDEXECOMMAND)
      IF (SEDEXERESULT.LT.0) THEN
         WRITE (*,*) 'AN ERROR OCCURRED DURING OUTPUT',
     c   'EXTRACTION FROM ', NM(1:25), '.output'
      ENDIF
      OUTPUTREMOVAL(1:3)='rm '
      OUTPUTREMOVAL(4:28)=NM(1:25)
      OUTPUTREMOVAL(29:35)='.output'
      OUTPUTREMOVALRESULT=SYSTEM(OUTPUTREMOVAL)
      IF (OUTPUTREMOVALRESULT.LT.0) THEN
         WRITE (*,*) 'AN ERROR OCCURRED DURING ',
     c   'DELETION OF ', NM(1:25), '.output'
      ENDIF

      RETURN
      END


*************************************************************
*     This subroutine retrieves the fuel and burnable       *
*     poison composition information from the previous      *
*     depletion and decay calculation for the assembly.     *
*************************************************************
      SUBROUTINE RETRIEVER (OXYGMS, MASSTOTAL,
     c FUELISONAME, FUELISOWTPCT, BPRAISONAME,
     c BPRAISOVALUE, LEFTLIST, CARRYCOUNTER,
     c PREVIOUSNAME, LEFTVAL, NM, BPRA_INSERTED)
*
      INTEGER*4 COLUMNSTART, COLUMNEND, ISONUMBER, CT1,
     c LEFTCOUNTER, CARRYCOUNTER, CT2, ISOFLAG(1000), Z
*
      REAL ISOVALUE(1000), BPRAISOVALUE(2), MASSTOTAL,
     c FUELISOVALUE(1000), FUELISOWTPCT(1000), OXYGMS,
     c LEFTVAL(1000)
*
      CHARACTER ROWFLAG*7, COL1*8, COL2*8, COL3*8, COL4*8,
     c COL5*8, COL6*8, COL7*8, COL8*8, ACTINIDELABEL*9,
     c FORMATLABEL*29, ISOLABEL*6, ISONAME(1000)*6,
     c FISSPRODLABEL*16, BPRAISONAME(2)*6, ORIGNAME(297)*6,
```

```
      c LIBRARYID(297)*5, FUELISONAME(1000)*5, LEFTLIST(1000)*6,
      c PREVIOUSNAME*25, RETRIEVALFILE*29, BPLABEL*14, NM*31,
      c NOTESFILE*31
*
       LOGICAL ROWFLAGLOG, ACTINIDEFIND, FISSPRODFIND, BPFIND,
      c BPRA_INSERTED
*
       DATA (LIBRARYID(Z),Z=1,297) /' 1001',
      c ' 1002',' 1003',' 2003',' 2004',' 3006',
      c ' 3007',' 4009',' 5010',' 5011',' 6012',' 7014',
      c ' 7015',' 8016',' 8017',' 9019','11023','12000',
      c '13027','14000','15031','16000','16032','17000',
      c '19000','20000','22000','23000','24000','25055',
      c '26000','27059','28000','29000','31000','32072',
      c '32073','32074','32076','33075','34074','34076',
      c '34077','34078','34080','34082','35079','35081',
      c '36078','36080','36082','36083','36084','36085',
      c '36086','37085','37086','37087','38084','38086',
      c '38087','38088','38089','38090','39089','39090',
      c '39091','40000','40090','40091','40092','40093',
      c '40094','40095','40096','41093','41094','41095',
      c '42000','42092','42094','42095','42096','42097',
      c '42098','42099','42100','43099','44096','44098',
      c '44099','44100','44101','44102','44103','44104',
      c '44105','44106','45103','45105','46102','46104',
      c '46105','46106','46107','46108','46110','47107',
      c '47109','47111','48000','48106','48108','48110',
      c '48111','48112','48113','48114','48116','48601',
      c '49113','49115','50112','50114','50115','50116',
      c '50117','50118','50119','50120','50122','50123',
      c '50124','50125','50126','51121','51123','51124',
      c '51125','51126','52120','52122','52123','52124',
      c '52125','52126','52128','52130','52132','52601',
      c '52611','53127','53129','53130','53131','53135',
      c '54124','54126','54128','54129','54130','54131',
      c '54132','54133','54134','54135','54136','55133',
      c '55134','55135','55136','55137','56134','56135',
      c '56136','56137','56138','56140','57139','57140',
      c '58140','58141','58142','58143','58144','59141',
      c '59142','59143','60142','60143','60144','60145',
      c '60146','60147','60148','60150','61147','61148',
      c '61149','61151','61601','62144','62147','62148',
      c '62149','62150','62151','62152','62153','62154',
      c '63000','63151','63152','63153','63154','63155',
      c '63156','63157','64152','64154','64155','64156',
      c '64157','64158','64160','65159','65160','66160',
      c '66161','66162','66163','66164','67165','68166',
      c '68167','71175','71176','72000','72174','72176',
      c '72177','72178','72179','72180','73181','73182',
      c '74000','74182','74183','74184','74186','75185',
      c '75187','79197','82000','83209','90230','90232',
      c '91231','91233','92232','92233','92234','92235',
      c '92236','92237','92238','93237','93238','94236',
      c '94237','94238','94239','94240','94241','94242',
      c '94243','94244','95241','95242','95243','95601',
      c '96241','96242','96243','96244','96245','96246',
      c '96247','96248','97249','98249','98250','98251',
      c '98252','98253','99253'/
       DATA (ORIGNAME(Z),Z=1,297) /' h  1 ',
      c ' h  2 ',' h  3 ','he  3 ','he  4 ','li  6 ',
```

```
c 'li  7 ','be  9 ',' b 10 ',' b 11 ',' c 12 ',
c ' n 14 ',' n 15 ',' o 16 ',' o 17 ',' f 19 ',
c 'na 23 ',' mg   ','al 27 ',' si   ',' p 31 ',
c '  s   ',' s 32 ',' cl   ','  k   ',' ca   ',
c ' ti   ','  v   ',' cr   ','mn 55 ',' fe   ',
c 'co 59 ',' ni   ',' cu   ',' ga   ','ge 72 ',
c 'ge 73 ','ge 74 ','ge 76 ','as 75 ','se 74 ',
c 'se 76 ','se 77 ','se 78 ','se 80 ','se 82 ',
c 'br 79 ','br 81 ','kr 78 ','kr 80 ','kr 82 ',
c 'kr 83 ','kr 84 ','kr 85 ','kr 86 ','rb 85 ',
c 'rb 86 ','rb 87 ','sr 84 ','sr 86 ','sr 87 ',
c 'sr 88 ','sr 89 ','sr 90 ',' y 89 ',' y 90 ',
c ' y 91 ',' zr   ','zr 90 ','zr 91 ','zr 92 ',
c 'zr 93 ','zr 94 ','zr 95 ','zr 96 ','nb 93 ',
c 'nb 94 ','nb 95 ',' mo   ','mo 92 ','mo 94 ',
c 'mo 95 ','mo 96 ','mo 97 ','mo 98 ','mo 99 ',
c 'mo100 ','tc 99 ','ru 96 ','ru 98 ','ru 99 ',
c 'ru100 ','ru101 ','ru102 ','ru103 ','ru104 ',
c 'ru105 ','ru106 ','rh103 ','rh105 ','pd102 ',
c 'pd104 ','pd105 ','pd106 ','pd107 ','pd108 ',
c 'pd110 ','ag107 ','ag109 ','ag111 ',' cd   ',
c 'cd106 ','cd108 ','cd110 ','cd111 ','cd112 ',
c 'cd113 ','cd114 ','cd116 ','cd115m','in113 ',
c 'in115 ','sn112 ','sn114 ','sn115 ','sn116 ',
c 'sn117 ','sn118 ','sn119 ','sn120 ','sn122 ',
c 'sn123 ','sn124 ','sn125 ','sn126 ','sb121 ',
c 'sb123 ','sb124 ','sb125 ','sb126 ','te120 ',
c 'te122 ','te123 ','te124 ','te125 ','te126 ',
c 'te128 ','te130 ','te132 ','te127m','te129m',
c ' i127 ',' i129 ',' i130 ',' i131 ',' i135 ',
c 'xe124 ','xe126 ','xe128 ','xe129 ','xe130 ',
c 'xe131 ','xe132 ','xe133 ','xe134 ','xe135 ',
c 'xe136 ','cs133 ','cs134 ','cs135 ','cs136 ',
c 'cs137 ','ba134 ','ba135 ','ba136 ','ba137 ',
c 'ba138 ','ba140 ','la139 ','la140 ','ce140 ',
c 'ce141 ','ce142 ','ce143 ','ce144 ','pr141 ',
c 'pr142 ','pr143 ','nd142 ','nd143 ','nd144 ',
c 'nd145 ','nd146 ','nd147 ','nd148 ','nd150 ',
c 'pm147 ','pm148 ','pm149 ','pm151 ','pm148m',
c 'sm144 ','sm147 ','sm148 ','sm149 ','sm150 ',
c 'sm151 ','sm152 ','sm153 ','sm154 ',' eu   ',
c 'eu151 ','eu152 ','eu153 ','eu154 ','eu155 ',
c 'eu156 ','eu157 ','gd152 ','gd154 ','gd155 ',
c 'gd156 ','gd157 ','gd158 ','gd160 ','tb159 ',
c 'tb160 ','dy160 ','dy161 ','dy162 ','dy163 ',
c 'dy164 ','ho165 ','er166 ','er167 ','lu175 ',
c 'lu176 ',' hf   ','hf174 ','hf176 ','hf177 ',
c 'hf178 ','hf179 ','hf180 ','ta181 ','ta182 ',
c '  w   ',' w182 ',' w183 ',' w184 ',' w186 ',
c 're185 ','re187 ','au197 ',' pb   ','bi209 ',
c 'th230 ','th232 ','pa231 ','pa233 ',' u232 ',
c ' u233 ',' u234 ',' u235 ',' u236 ',' u237 ',
c ' u238 ','np237 ','np238 ','pu236 ','pu237 ',
c 'pu238 ','pu239 ','pu240 ','pu241 ','pu242 ',
c 'pu243 ','pu244 ','am241 ','am242 ','am243 ',
c 'am242m','cm241 ','cm242 ','cm243 ','cm244 ',
c 'cm245 ','cm246 ','cm247 ','cm248 ','bk249 ',
c 'cf249 ','cf250 ','cf251 ','cf252 ','cf253 ',
c 'es253 '/
*
```

```
      RETRIEVALFILE(1:25)=PREVIOUSNAME
      RETRIEVALFILE(26:29)='.cut'
      NOTESFILE(1:25)=NM(1:25)
      NOTESFILE(26:31)='.notes'
      OPEN(UNIT=300, FILE=RETRIEVALFILE, STATUS='OLD')
      OPEN(UNIT=500, FILE=NOTESFILE, STATUS='UNKNOWN')
      REWIND(300)
      REWIND(500)
      DO 5 CT1=1,1000
         ISOVALUE(CT1)=0.0
         FUELISOVALUE(CT1)=0.0
         FUELISOWTPCT(CT1)=0.0
         LEFTVAL=0.0
         ISONAME='       '
         FUELISONAME='      '
         LEFTLIST='       '
         ISOFLAG=0
    5 CONTINUE
      ROWFLAGLOG=.FALSE.
      DO 11 WHILE (ROWFLAGLOG.EQ..FALSE.)
         READ (300,10) ROWFLAG, COL1, COL2, COL3,
     c   COL4, COL5, COL6, COL7, COL8
   10    FORMAT (T15,A7,T24,A8,T34,A8,T44,A8,T54,A8,
     c   T64,A8,T74,A8,T84,A8,T94,A8)
         IF (ROWFLAG.EQ.'initial') THEN
            ROWFLAGLOG=.TRUE.
         ENDIF
   11 CONTINUE
      IF (COL1.NE.'         ') THEN
         COLUMNSTART=23
         COLUMNEND=32
      ENDIF
      IF (COL2.NE.'         ') THEN
         COLUMNSTART=33
         COLUMNEND=42
      ENDIF
      IF (COL3.NE.'         ') THEN
         COLUMNSTART=43
         COLUMNEND=52
      ENDIF
      IF (COL4.NE.'         ') THEN
         COLUMNSTART=53
         COLUMNEND=62
      ENDIF
      IF (COL5.NE.'         ') THEN
         COLUMNSTART=63
         COLUMNEND=72
      ENDIF
      IF (COL6.NE.'         ') THEN
         COLUMNSTART=73
         COLUMNEND=82
      ENDIF
      IF (COL7.NE.'         ') THEN
         COLUMNSTART=83
         COLUMNEND=92
      ENDIF
      IF (COL8.NE.'         ') THEN
         COLUMNSTART=93
         COLUMNEND=102
      ENDIF
```

```
*  Get B-10 and B-11 composition data for BPRA
      IF (BPRA_INSERTED.EQ..TRUE.) THEN
         BPRAISOVALUE(1)=0.0
         BPRAISOVALUE(2)=0.0
         BPRAISONAME(1)='      '
         BPRAISONAME(2)='      '
         REWIND(300)
         BPFIND=.FALSE.
         DO 14 WHILE (BPFIND.EQ..FALSE.)
            READ(300,12) BPLABEL
12          FORMAT (T98,A14)
            IF (BPLABEL.EQ.'light elements') THEN
               READ(300,*)
               READ(300,13) FORMATLABEL
13             FORMAT (T46,A29)
               IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
                  BPFIND=.TRUE.
               ENDIF
            ENDIF
14       CONTINUE
         DO 24 CT1=1,25
            READ (300,22) BPRAISONAME(1)
22          FORMAT(T6,A6)
            IF (BPRAISONAME(1).EQ.' b 10 ') THEN
               BACKSPACE(300)
               EXIT
            ENDIF
24       CONTINUE
         READ (300,26) BPRAISONAME(1), BPRAISOVALUE(1)
26          FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
         READ (300,29) BPRAISONAME(2), BPRAISOVALUE(2)
29          FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
         IF (BPRAISONAME(1).EQ.' b 10 ') THEN
            BPRAISONAME(1)='  5010'
         ENDIF
         IF (BPRAISONAME(2).EQ.' b 11 ') THEN
            BPRAISONAME(2)='  5011'
         ENDIF
      ENDIF
*  Get fuel composition data
      REWIND(300)
      ACTINIDEFIND=.FALSE.
      DO 50 WHILE (ACTINIDEFIND.EQ..FALSE.)
         READ(300,30) ACTINIDELABEL
30       FORMAT (T103,A9)
         IF (ACTINIDELABEL.EQ.'actinides') THEN
            READ(300,*)
            READ(300,40) FORMATLABEL
40          FORMAT (T46,A29)
            IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
               ACTINIDEFIND=.TRUE.
            ENDIF
         ENDIF
50    CONTINUE
      READ(300,*)
      READ(300,*)
      ISOLABEL='      '
      ISONUMBER=0
      DO 70 WHILE (ISOLABEL.NE.'tal    ')
         ISONUMBER=ISONUMBER+1
```

```
      READ(300,60) ISONAME(ISONUMBER), ISOVALUE(ISONUMBER)
 60   FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
      ISOLABEL=ISONAME(ISONUMBER)
      IF (ISOLABEL.EQ.'tal    ') THEN
         ISONAME(ISONUMBER)='      '
         ISOVALUE(ISONUMBER)=0
      ENDIF
 70 CONTINUE
    ISONUMBER=ISONUMBER-1
    REWIND(300)
    FISSPRODFIND=.FALSE.
    DO 110 WHILE (FISSPRODFIND.EQ..FALSE.)
       READ(300,90) FISSPRODLABEL
 90    FORMAT (T96,A16)
       IF (FISSPRODLABEL.EQ.'fission products') THEN
          READ(300,*)
          READ(300,100) FORMATLABEL
100       FORMAT (T46,A29)
          IF (FORMATLABEL.EQ.'nuclide concentrations, grams') THEN
             FISSPRODFIND=.TRUE.
          ENDIF
       ENDIF
110 CONTINUE
    READ(300,*)
    READ(300,*)
    ISOLABEL='      '
    DO 130 WHILE (ISOLABEL.NE.'tal    ')
       ISONUMBER=ISONUMBER+1
       READ(300,120) ISONAME(ISONUMBER), ISOVALUE(ISONUMBER)
120    FORMAT(T6,A6,T<COLUMNSTART>,G10.2)
       ISOLABEL=ISONAME(ISONUMBER)
       IF (ISOLABEL.EQ.'      ') THEN
          ISONUMBER=ISONUMBER-1
          READ(300,*)
          READ(300,*)
          READ(300,*)
          READ(300,*)
          READ(300,*)
       ENDIF
       IF (ISOLABEL.EQ.'tal    ') THEN
          ISONAME(ISONUMBER)='      '
          ISOVALUE(ISONUMBER)=0
       ENDIF
130 CONTINUE
    ISONUMBER=ISONUMBER-1
    WRITE (500,*) 'FUEL COMPOSITION'
    DO 140 CT1=1,ISONUMBER
       WRITE (500,*) ISONAME(CT1), '     ', ISOVALUE(CT1)
140 CONTINUE
    WRITE (500,*)
    IF (BPRA_INSERTED.EQ..TRUE.) THEN
       WRITE (500,*) 'B-10 AND B-11 IN BPRA'
       DO 150 CT1=1,2
          WRITE (500,*) BPRAISONAME(CT1), '     ',
   c      BPRAISOVALUE(CT1)
150    CONTINUE
    ENDIF
    MASSTOTAL=OXYGMS
    LEFTCOUNTER=0
    CARRYCOUNTER=0
```

```
      DO 190 CT1=1,ISONUMBER
         DO 180 CT2=1,297
            IF (ISONAME(CT1).EQ.ORIGNAME(CT2)) THEN
               CARRYCOUNTER=CARRYCOUNTER+1
               ISOFLAG(CT1)=1
               FUELISONAME(CARRYCOUNTER)=LIBRARYID(CT2)
               FUELISOVALUE(CARRYCOUNTER)=ISOVALUE(CT1)
            ENDIF
            IF ((CT2.EQ.297).AND.(ISOFLAG(CT1).NE.1)) THEN
               LEFTCOUNTER=LEFTCOUNTER+1
               LEFTLIST(LEFTCOUNTER)=ISONAME(CT1)
               LEFTVAL(LEFTCOUNTER)=ISOVALUE(CT1)
            ENDIF
  180    CONTINUE
  190 CONTINUE
      DO 195 CT1=1,CARRYCOUNTER
         MASSTOTAL=MASSTOTAL+FUELISOVALUE(CT1)
  195 CONTINUE
      DO 200 CT1=1,CARRYCOUNTER
         FUELISOWTPCT(CT1)=(FUELISOVALUE(CT1)/MASSTOTAL)*100.0
  200 CONTINUE
      WRITE (500,*) 'SAS2H FUEL COMPOSITION INPUT FROM ORIGIN OUTPUT'
      DO 230 CT1=1,CARRYCOUNTER
         WRITE (500,*) FUELISONAME(CT1), '      ', FUELISOVALUE(CT1)
  230 CONTINUE
      WRITE (500,*) 'ISOTOPES IN ORIGIN OUTPUT LEFT OUT OF SAS2H INPUT'
      DO 240 CT1=1,LEFTCOUNTER
         WRITE (500,*) LEFTLIST(CT1), '      ', LEFTVAL(CT1)
  240 CONTINUE

      RETURN
      END

*************************************************************************
*      Two digit integer conversion subroutine which adds leading zeros      *
*************************************************************************
      SUBROUTINE ZEROS(IN,CHOUT)

      INTEGER*4 IN
      CHARACTER CHOUT*2, CH1, CH2

      CH1=CHAR((IN/10)+48)
      CH2=CHAR((IN-(INT(IN/10)*10))+48)
      CHOUT(1:1)=CH1
      CHOUT(2:2)=CH2

      RETURN
      END
```

Attachment III

Assembly B15 CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.64                    : U-235 wt% enrichment in U of UO2
468620                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.939038                : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
3                       : # of insertion reactor cycles
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212                     : Total cycle length in calendar days
15                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
309                     : Length to stpt in calendar days
13.333                  : Downtime at stpt
73                      : Days of downtime at EOC
323.0                   : Total cycle EFPD
416                     : Total cycle length in calendar days
11                      : Integer position of assembly in cycle
04                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
```

```
228.1                    : Stpt EFPD
308                      : Length to stpt in calendar days
15.167                   : Downtime at stpt
253.0                    : Stpt EFPD
350                      : Length to stpt in calendar days
24.0                     : Downtime at stpt
127                      : Days of downtime at EOC
336.6                    : Total cycle EFPD
464                      : Total cycle length in calendar days
13                       : 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
55.5                     : Irradiation step length in EFPD
3                        : # of irradiation steps to next stpt
688.93                   : ppmb
527.51                   : ppmb
353.48                   : ppmb
2                        : Relative insertion cycle #
1                        : Relative stpt # in insertion cycle
56.167                   : Irradiation step length in EFPD
3                        : # of irradiation steps to next stpt
880.38                   : ppmb
694.68                   : ppmb
536.65                   : ppmb
2                        : Relative stpt # in insertion cycle
40.75                    : Irradiation step length in EFPD
2                        : # of irradiation steps to next stpt
382.60                   : ppmb
267.17                   : ppmb
3                        : Relative stpt # in insertion cycle
36.5                     : Irradiation step length in EFPD
2                        : # of irradiation steps to next stpt
234.64                   : ppmb
128.17                   : ppmb
3                        : Relative insertion cycle #
1                        : Relative stpt # in insertion cycle
76.233                   : Irradiation step length in EFPD
3                        : # of irradiation steps to next stpt
787.34                   : ppmb
625.59                   : ppmb
373.77                   : ppmb
2                        : Relative stpt # in insertion cycle
24.9                     : Irradiation step length in EFPD
1                        : # of irradiation steps to next stpt
218.65                   : ppmb
3                        : Relative stpt # in insertion cycle
41.8                     : Irradiation step length in EFPD
2                        : # of irradiation steps to next stpt
225.91                   : ppmb
105.94                   : 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-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
844.5
1023.2
1126.0
1172.8
1193.8
1204.0
1209.9
1213.0
1212.3
1206.2
1194.9
1180.1
1164.7
1150.5
1137.6
1116.6
1051.1
859.4
18                          : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1109.3
1348.5
1454.5
1481.6
1476.1
1457.8
1432.0
1403.9
1388.9
1398.7
1429.5
1475.3
1525.6
1552.7
1556.3
1536.8
1449.2
1181.4
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1128.2
1290.7
1346.1
1345.7
1333.2
1321.6
1312.0
1301.0
1289.1
1285.3
1289.8
1299.6
1316.2
1338.6
1355.2
```

```
1352.9
1313.9
1141.5
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1128.2
1290.7
1346.1
1345.7
1333.2
1321.6
1312.0
1301.0
1289.1
1285.3
1289.8
1299.6
1316.2
1338.6
1355.2
1352.9
1313.9
1141.5
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
934.5
```

```
1079.1
1164.8
1222.9
1267.1
1301.2
1326.7
1342.1
1340.9
1314.6
1271.7
1229.5
1195.5
1175.2
1170.9
1165.7
1130.7
984.8
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1018.9
1123.9
1156.2
1157.1
1148.6
1140.0
1135.0
1134.7
1135.8
1130.7
1118.0
1105.0
1095.3
1093.1
1104.6
1121.2
1112.2
1019.8
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
```

```
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0227
0.0226
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0237
0.0236
0.0235
0.0233
0.0232
0.0230
0.0229
0.0228
0.0227
0.0226
```

```
0.0224
0.0223
0.0222
0.0221
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
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 (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
```

```
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
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 (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
0.0226
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 (Stpt2-4 to Stpt3-4)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                      : # of burnup axial nodes (BOC-2)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
```

```
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1.572
2.700
3.390
3.710
3.840
3.886
3.894
3.885
3.866
3.841
3.820
3.808
3.806
3.809
3.793
3.660
3.168
1.901
18                          : # of burnup axial nodes (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.782
7.908
9.707
10.487
10.777
10.844
10.791
10.641
10.442
10.329
10.369
10.535
10.799
11.079
11.177
10.834
9.513
5.952
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
6.522
10.549
12.732
13.595
13.871
13.910
13.829
13.641
13.394
13.258
13.323
13.559
13.941
14.387
```

```
14.612
14.245
12.638
8.076
18                          : # of burnup axial nodes (BOC-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
8.118
12.898
15.421
16.420
16.747
16.791
16.691
16.475
16.234
16.150
16.286
16.584
16.982
17.347
17.414
16.859
14.978
9.686
18                          : # of burnup axial nodes (Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
```

```
11.978
18.922
22.699
24.368
25.077
25.353
25.399
25.253
24.947
24.640
24.520
24.633
24.955
25.402
25.669
25.128
22.565
14.847
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
12.473
19.653
23.537
25.241
25.958
26.233
26.278
26.132
25.823
25.506
25.379
25.493
25.823
26.290
26.590
26.066
23.450
15.480
```

Attachment IV

Assembly B20a CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.64                    : U-235 wt% enrichment in U of UO2
468620                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.939038                : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
3                       : # of insertion reactor cycles
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212                     : Total cycle length in calendar days
20                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
309                     : Length to stpt in calendar days
13.333                  : Downtime at stpt
73                      : Days of downtime at EOC
323.0                   : Total cycle EFPD
416                     : Total cycle length in calendar days
09                      : Integer position of assembly in cycle
04                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
```

```
228.1                   : Stpt EFPD
308                     : Length to stpt in calendar days
15.167                  : Downtime at stpt
253.0                   : Stpt EFPD
350                     : Length to stpt in calendar days
24.0                    : Downtime at stpt
127                     : Days of downtime at EOC
336.6                   : Total cycle EFPD
464                     : Total cycle length in calendar days
01                      : 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
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
76.233                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
787.34                  : ppmb
625.59                  : ppmb
373.77                  : ppmb
2                       : Relative stpt # in insertion cycle
24.9                    : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
218.65                  : ppmb
3                       : Relative stpt # in insertion cycle
41.8                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
225.91                  : ppmb
105.94                  : 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-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1037.1
1298.0
1437.7
1502.4
1533.1
1550.2
1562.2
1570.6
1571.8
1559.9
1534.2
1502.9
1473.8
1450.2
1430.3
1396.6
1300.5
1033.6
18                          : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1053.4
1263.8
1357.2
1380.2
1374.3
1361.1
1349.4
1344.8
1351.8
1372.2
1400.9
1428.3
1447.0
1454.3
1452.2
1436.2
1368.8
1142.1
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
```

```
1292.0
1262.8
1106.8
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
1292.0
1262.8
1106.8
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
885.2
```

```
1008.1
1082.9
1143.2
1192.5
1229.3
1255.6
1273.0
1279.5
1272.8
1253.1
1225.0
1195.2
1169.5
1150.6
1133.3
1100.7
971.1
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
999.1
1095.9
1124.9
1121.3
1106.9
1092.7
1081.7
1074.3
1068.6
1062.9
1056.4
1050.2
1046.0
1046.0
1051.1
1058.0
1051.4
976.8
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
```

```
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0235
0.0234
0.0233
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
```

```
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
```

```
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0228
0.0226
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 (Stpt2-4 to Stpt3-4)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                      : # of burnup axial nodes (BOC-2)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
```

```
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.693
4.526
5.615
6.113
6.322
6.402
6.421
6.404
6.352
6.277
6.206
6.167
6.167
6.181
6.134
5.863
5.048
3.056
18                          : # of burnup axial nodes (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
5.526
9.151
11.307
12.290
12.687
12.823
12.854
12.852
12.861
12.913
13.013
13.133
13.236
13.282
13.177
12.664
11.095
6.968
18                          : # of burnup axial nodes (Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
7.148
11.631
14.168
15.233
15.612
15.718
15.731
15.728
15.757
15.852
16.009
16.192
16.364
16.494
```

```
16.462
15.915
14.085
9.018
18                          : # of burnup axial nodes (BOC-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
8.735
13.948
16.805
17.999
18.429
18.553
18.580
18.602
18.672
18.821
19.023
19.210
19.329
19.343
19.149
18.424
16.339
10.581
18                          : # of burnup axial nodes (Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
```

```
12.246
19.408
23.446
25.334
26.179
26.552
26.744
26.882
27.013
27.147
27.254
27.299
27.277
27.200
26.963
26.107
23.405
15.467
18                    : # of burnup axial nodes (Stpt3-4)
1     17.7800         : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
12.701
20.076
24.216
26.144
26.999
27.370
27.558
27.695
27.826
27.959
28.066
28.111
28.091
28.020
27.793
26.941
24.195
16.041
```

Attachment V

Assembly B20b1 CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.64                    : U-235 wt% enrichment in U of UO2
468620                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.939038                : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
3                       : # of insertion reactor cycles
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212                     : Total cycle length in calendar days
20                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
325.8                   : Length to stpt in calendar days
13.333                  : Downtime at stpt
664                     : Days of downtime at EOC
323.0                   : Total cycle EFPD
416                     : Total cycle length in calendar days
09                      : Integer position of assembly in cycle
05                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
```

```
388.5                   : Stpt EFPD
470                     : Length to stpt in calendar days
4.958                   : Downtime at stpt
163.0                   : Days of downtime at EOC
484.4                   : Total cycle EFPD
593.0                   : Total cycle length in calendar days
01                      : 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
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
77.7                    : Irradiation step length in EFPD
5                       : # of irradiation steps to next stpt
1050.61                 : ppmb
835.81                  : ppmb
641.59                  : ppmb
427.28                  : ppmb
225.73                  : ppmb
2                       : Relative stpt # in insertion cycle
47.95                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
92.03                   : ppmb
2.35                    : 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-2 to EOC-2)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1037.1
1298.0
1437.7
1502.4
1533.1
1550.2
1562.2
1570.6
1571.8
1559.9
1534.2
1502.9
1473.8
1450.2
1430.3
1396.6
1300.5
1033.6
18                      : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
```

```
16     20.0025
17     20.0025
18     22.3520
1053.4
1263.8
1357.2
1380.2
1374.3
1361.1
1349.4
1344.8
1351.8
1372.2
1400.9
1428.3
1447.0
1454.3
1452.2
1436.2
1368.8
1142.1
18                      : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
1292.0
1262.8
1106.8
18                      : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800          : Node #, node height (cm)
```

```
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
1292.0
1262.8
1106.8
18                          : # of fuel temp axial nodes (BOC-5 to Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
936.1
1013.8
1021.3
1008.6
994.8
984.6
```

```
978.3
975.7
976.0
978.0
980.0
981.1
980.9
979.4
977.4
973.9
959.9
886.8
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0235
0.0234
0.0233
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (BOC-5 to Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0229
```

```
0.0228
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
0.0216
18                      : # of burnup axial nodes (BOC-2)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                      : # of burnup axial nodes (BOC-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
```

```
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.693
4.526
5.615
6.113
6.322
6.402
6.421
6.404
6.352
6.277
6.206
6.167
6.167
6.181
6.134
5.863
5.048
3.056
18                          : # of burnup axial nodes (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
5.526
9.151
11.307
12.290
12.687
12.823
12.854
12.852
12.861
12.913
```

```
13.013
13.133
13.236
13.282
13.177
12.664
11.095
6.968
18                      : # of burnup axial nodes (Stpt3-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
7.148
11.631
14.168
15.233
15.612
15.718
15.731
15.728
15.757
15.852
16.009
16.192
16.364
16.494
16.462
15.915
14.085
9.018
18                      : # of burnup axial nodes (BOC-5)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
```

```
15     20.0025
16     20.0025
17     20.0025
18     22.3520
8.735
13.948
16.805
17.999
18.429
18.553
18.580
18.602
18.672
18.821
19.023
19.210
19.329
19.343
19.149
18.424
16.339
10.581
18                          : # of burnup axial nodes (Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
14.867
22.963
27.028
28.563
29.031
29.100
29.055
29.021
29.063
29.210
29.412
29.580
29.645
29.555
29.184
28.120
25.154
16.690
```

Attachment VI

Assembly B20b2 CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.64                    : U-235 wt% enrichment in U of UO2
468620                  : Grams of U per assembly
208                     : Number of fuel rods in assembly
1.44272                 : Pin-pitch in assembly (cm)
0.939038                : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
3                       : # of insertion reactor cycles
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
164.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212                     : Total cycle length in calendar days
20                      : Integer position of assembly in cycle
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
325.8                   : Length to stpt in calendar days
13.333                  : Downtime at stpt
1420                    : Days of downtime at EOC
323.0                   : Total cycle EFPD
416.0                   : Total cycle length in calendar days
09                      : Integer position of assembly in cycle
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
01                      : 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
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
3                       : 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
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-2 to EOC-2)
1      17.7800            : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1037.1
1298.0
1437.7
1502.4
1533.1
1550.2
1562.2
1570.6
1571.8
1559.9
1534.2
1502.9
1473.8
1450.2
1430.3
1396.6
1300.5
1033.6
18                        : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1      17.7800            : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
```

```
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1053.4
1263.8
1357.2
1380.2
1374.3
1361.1
1349.4
1344.8
1351.8
1372.2
1400.9
1428.3
1447.0
1454.3
1452.2
1436.2
1368.8
1142.1
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
```

```
1291.6
1292.0
1262.8
1106.8
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
1292.0
1262.8
1106.8
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
```

```
949.6
1054.6
1077.1
1080.3
1078.4
1075.6
1072.5
1068.7
1063.5
1056.6
1048.8
1041.0
1034.4
1028.8
1023.3
1015.0
992.6
900.4
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
970.4
1046.0
1056.9
1048.7
1038.8
1030.6
1024.0
1018.3
1012.7
1006.8
1001.2
996.9
995.0
995.5
998.4
1001.3
992.8
923.4
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
```

```
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0236
0.0235
0.0234
0.0233
0.0231
0.0230
0.0229
0.0228
0.0226
```

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0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
```

```
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (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
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0217
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
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
18                              : # of burnup axial nodes (BOC-2)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
```

```
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.693
4.526
5.615
6.113
6.322
6.402
6.421
6.404
6.352
6.277
6.206
6.167
6.167
6.181
6.134
5.863
5.048
3.056
18                          : # of burnup axial nodes (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
5.526
9.151
11.307
12.290
12.687
12.823
12.854
12.852
12.861
12.913
13.013
13.133
13.236
13.282
13.177
12.664
11.095
6.968
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
7.148
11.631
14.168
15.233
15.612
15.718
15.731
15.728
15.757
15.852
16.009
16.192
16.364
```

```
16.494
16.462
15.915
14.085
9.018
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
8.735
13.948
16.805
17.999
18.429
18.553
18.580
18.602
18.672
18.821
19.023
19.210
19.329
19.343
19.149
18.424
16.339
10.581
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
10.300
16.307
19.522
20.856
21.355
21.523
21.578
21.615
21.684
21.814
21.981
22.123
22.192
22.150
21.887
21.048
18.695
12.172
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
16.097
24.495
28.537
30.009
30.470
30.567
30.555
30.529
30.531
30.588
30.683
30.771
30.813
30.773
30.515
29.584
26.676
17.903
```

Attachment VII

Assembly B20b3 CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.64                       : U-235 wt% enrichment in U of UO2
468620                     : Grams of U per assembly
208                        : Number of fuel rods in assembly
1.44272                    : Pin-pitch in assembly (cm)
0.939038                   : 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)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
3                          : # of insertion reactor cycles
02                         : Insertion reactor cycle identifier
1                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
164.0                      : Days of downtime at EOC
166.5                      : Total cycle EFPD
212                        : Total cycle length in calendar days
20                         : Integer position of assembly in cycle
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
193                        : Length to stpt in calendar days
16.792                     : Downtime at stpt
250.0                      : Stpt EFPD
325.8                      : Length to stpt in calendar days
13.333                     : Downtime at stpt
2294                       : Days of downtime at EOC
323.0                      : Total cycle EFPD
416.0                      : Total cycle length in calendar days
09                         : 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
01                      : 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
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
3                       : 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-2 to EOC-2)
1      17.7800             : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1037.1
1298.0
1437.7
1502.4
1533.1
1550.2
1562.2
```

```
1570.6
1571.8
1559.9
1534.2
1502.9
1473.8
1450.2
1430.3
1396.6
1300.5
1033.6
18                          : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1053.4
1263.8
1357.2
1380.2
1374.3
1361.1
1349.4
1344.8
1351.8
1372.2
1400.9
1428.3
1447.0
1454.3
1452.2
1436.2
1368.8
1142.1
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
```

```
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
1292.0
1262.8
1106.8
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1086.0
1240.7
1292.0
1289.0
1274.8
1262.6
1254.9
1251.3
1251.7
1255.7
1261.4
1266.5
1271.8
1280.7
1291.6
1292.0
```

```
1262.8
1106.8
18                          : # of fuel temp axial nodes (BOC-7 to Stpt2-7)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
963.3
1080.3
1117.7
1131.5
1134.6
1133.5
1130.5
1126.5
1121.5
1115.3
1108.3
1101.4
1094.9
1088.0
1078.7
1062.8
1029.5
928.2
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
980.1
1060.8
```

```
1077.6
1072.5
1064.5
1058.4
1054.7
1053.1
1052.7
1053.0
1054.5
1057.8
1063.1
1070.1
1078.4
1084.4
1073.6
990.5
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
980.1
1060.8
1077.6
1072.5
1064.5
1058.4
1054.7
1053.1
1052.7
1053.0
1054.5
1057.8
1063.1
1070.1
1078.4
1084.4
1073.6
990.5
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
991.8
1064.3
1074.0
1067.7
1060.3
1053.2
1048.1
1044.7
1042.6
1041.1
1040.4
1041.2
1044.2
1049.4
1055.9
1058.5
1052.2
981.2
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
991.8
1064.3
1074.0
1067.7
1060.3
1053.2
1048.1
1044.7
1042.6
1041.1
1040.4
```

```
1041.2
1044.2
1049.4
1055.9
1058.5
1052.2
981.2
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0235
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
```

```
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0235
0.0234
0.0233
0.0231
0.0230
0.0229
0.0228
0.0226
0.0225
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
```

```
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
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 (BOC-7 to Stpt2-7)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
```

```
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-7 to Stpt3-7)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0232
0.0232
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
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0219
```

```
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt5-7 to Stpt6-7)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0232
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0219
0.0218
0.0217
0.0216
18                          : # of burnup axial nodes (BOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
```

```
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.693
4.526
5.615
6.113
6.322
6.402
6.421
6.404
6.352
6.277
6.206
6.167
6.167
6.181
6.134
5.863
5.048
3.056
18                          : # of burnup axial nodes (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
```

```
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
5.526
9.151
11.307
12.290
12.687
12.823
12.854
12.852
12.861
12.913
13.013
13.133
13.236
13.282
13.177
12.664
11.095
6.968
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
7.148
11.631
14.168
15.233
15.612
15.718
15.731
15.728
15.757
15.852
```

```
16.009
16.192
16.364
16.494
16.462
15.915
14.085
9.018
18                          : # of burnup axial nodes (BOC-7)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
8.735
13.948
16.805
17.999
18.429
18.553
18.580
18.602
18.672
18.821
19.023
19.210
19.329
19.343
19.149
18.424
16.339
10.581
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
12.970
20.372
24.317
26.003
26.670
26.913
26.999
27.042
27.103
27.213
27.351
27.458
27.480
27.368
26.978
25.893
23.035
15.152
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
13.560
21.234
25.294
27.014
27.686
27.925
28.005
28.044
28.102
28.209
28.347
28.455
28.481
28.374
27.985
26.882
23.947
15.795
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
14.127
22.057
26.217
27.960
28.628
28.857
28.927
28.956
29.006
29.108
29.240
29.346
29.374
29.269
28.881
27.763
24.762
16.373
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
17.066
26.200
30.790
32.602
33.241
```

```
33.428
33.466
33.479
33.522
33.624
33.766
33.895
33.964
33.917
33.588
32.470
29.212
19.625
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
17.423
26.690
31.321
33.137
33.770
33.950
33.985
33.996
34.039
34.141
34.285
34.416
34.489
34.450
34.129
33.017
29.736
20.017
```

Attachment VIII

Assembly B21a CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.64                       : U-235 wt% enrichment in U of UO2
468620                     : Grams of U per assembly
208                        : Number of fuel rods in assembly
1.44272                    : Pin-pitch in assembly (cm)
0.939038                   : 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)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
3                          : # of insertion reactor cycles
02                         : Insertion reactor cycle identifier
1                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
164.0                      : Days of downtime at EOC
166.5                      : Total cycle EFPD
212                        : Total cycle length in calendar days
21                         : Integer position of assembly in cycle
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
193                        : Length to stpt in calendar days
16.792                     : Downtime at stpt
250.0                      : Stpt EFPD
309                        : Length to stpt in calendar days
13.333                     : Downtime at stpt
73                         : Days of downtime at EOC
323.0                      : Total cycle EFPD
416                        : Total cycle length in calendar days
13                         : Integer position of assembly in cycle
04                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
```

```
228.1                   : Stpt EFPD
308                     : Length to stpt in calendar days
15.167                  : Downtime at stpt
253.0                   : Stpt EFPD
350                     : Length to stpt in calendar days
24.0                    : Downtime at stpt
127                     : Days of downtime at EOC
336.6                   : Total cycle EFPD
464                     : Total cycle length in calendar days
22                      : 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
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
76.233                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
787.34                  : ppmb
625.59                  : ppmb
373.77                  : ppmb
2                       : Relative stpt # in insertion cycle
24.9                    : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
218.65                  : ppmb
3                       : Relative stpt # in insertion cycle
41.8                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
225.91                  : ppmb
105.94                  : 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-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
806.9
967.6
1065.0
1111.2
1132.9
1144.0
1150.4
1153.8
1153.2
1146.8
1135.0
1120.0
1104.8
1090.8
1075.5
1046.6
974.8
804.3
18                          : # of fuel temp axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1085.1
1321.1
1426.5
1458.9
1459.9
1446.2
1422.2
1393.1
1375.0
1380.5
1407.8
1453.0
1505.0
1536.7
1541.5
1515.9
1419.7
1147.7
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1118.8
1278.8
1336.0
1340.6
1332.3
1323.5
1315.7
1305.9
1294.6
1290.9
1295.7
1306.3
1324.0
1347.2
1364.5
```

```
1362.6
1319.4
1140.1
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1118.8
1278.8
1336.0
1340.6
1332.3
1323.5
1315.7
1305.9
1294.6
1290.9
1295.7
1306.3
1324.0
1347.2
1364.5
1362.6
1319.4
1140.1
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
934.9
```

```
1082.9
1184.5
1263.9
1324.1
1367.1
1396.1
1413.1
1408.9
1371.6
1311.6
1257.6
1218.8
1202.9
1213.2
1223.7
1195.9
1037.1
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1029.0
1144.8
1185.2
1188.1
1177.2
1165.9
1159.6
1159.3
1160.3
1151.6
1131.2
1111.9
1098.7
1096.1
1112.7
1137.1
1133.6
1041.0
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
```

```
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0236
0.0235
0.0234
0.0233
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
```

```
0.0224
0.0223
0.0222
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0235
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
```

```
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0235
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0236
0.0235
0.0234
0.0233
0.0232
0.0230
0.0229
0.0227
0.0226
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
0.0234
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                      : # of burnup axial nodes (BOC-2)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
```

```
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1.363
2.375
3.017
3.329
3.465
3.518
3.532
3.525
3.504
3.475
3.447
3.428
3.419
3.408
3.354
3.166
2.665
1.557
18                          : # of burnup axial nodes (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.478
7.444
9.154
9.914
10.215
10.297
10.248
10.080
9.838
9.662
9.640
9.772
10.034
10.323
10.398
9.983
8.622
5.285
18                              : # of burnup axial nodes (Stpt3-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
6.158
9.999
12.092
12.952
13.260
13.329
13.261
13.060
12.767
12.561
12.557
12.754
13.134
13.587
```

```
13.786
13.344
11.682
7.334
18                          : # of burnup axial nodes (BOC-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
7.632
12.199
14.635
15.639
16.004
16.083
15.998
15.769
15.480
15.320
15.384
15.648
16.058
16.453
16.523
15.914
13.979
8.895
18                          : # of burnup axial nodes (Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
```

```
11.485
18.297
22.177
24.033
24.883
25.241
25.323
25.157
24.726
24.182
23.842
23.847
24.176
24.748
25.202
24.753
22.172
14.499
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
11.978
19.033
23.038
24.941
25.803
26.160
26.241
26.073
25.631
25.063
24.707
24.707
25.047
25.648
26.150
25.729
23.100
15.165
```

Attachment IX

Assembly B28a CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.64                       : U-235 wt% enrichment in U of UO2
468620                     : Grams of U per assembly
208                        : Number of fuel rods in assembly
1.44272                    : Pin-pitch in assembly (cm)
0.939038                   : 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 0.20 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. #
2 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.
```

```
3                       : # of insertion reactor cycles
02                      : Insertion reactor cycle identifier
1                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
653.0                   : Days of downtime at EOC
166.5                   : Total cycle EFPD
212                     : Total cycle length in calendar days
28                      : Integer position of assembly in cycle
04                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
228.1                   : Stpt EFPD
308                     : Length to stpt in calendar days
15.167                  : Downtime at stpt
253.0                   : Stpt EFPD
350                     : Length to stpt in calendar days
24.0                    : Downtime at stpt
883.0                   : Days of downtime at EOC
336.6                   : Total cycle EFPD
464                     : Total cycle length in calendar days
04                      : Integer position of assembly in cycle
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
03                      : 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
55.5                    : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
688.93                  : ppmb
527.51                  : ppmb
353.48                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
76.233                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
787.34                  : ppmb
625.59                  : ppmb
373.77                  : ppmb
2                       : Relative stpt # in insertion cycle
24.9                    : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
218.65                  : ppmb
3                       : Relative stpt # in insertion cycle
```

```
41.8                        : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
225.91                      : ppmb
105.94                      : ppmb
3                           : 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
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-2 to EOC-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
```

```
18    22.3520
812.3
980.2
1091.6
1154.4
1188.2
1206.1
1215.9
1221.2
1221.0
1213.4
1198.5
1179.4
1160.4
1142.9
1123.1
1087.7
1006.1
822.6
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
991.2
1211.2
1359.2
1480.6
1565.9
1620.0
1655.9
1686.3
1706.0
1702.2
1674.8
1633.8
1588.0
1543.9
1516.7
1488.6
1408.0
1173.2
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
```

```
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1111.4
1283.6
1365.4
1375.0
1359.8
1343.5
1332.8
1329.5
1331.2
1331.2
1326.7
1319.8
1312.9
1310.4
1317.7
1325.3
1298.9
1149.2
18                          : # of fuel temp axial nodes (Stpt3-4 to EOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1111.4
1283.6
1365.4
1375.0
1359.8
1343.5
1332.8
1329.5
```

```
1331.2
1331.2
1326.7
1319.8
1312.9
1310.4
1317.7
1325.3
1298.9
1149.2
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
1008.8
1140.3
1171.5
1175.8
1174.0
1170.5
1166.5
1161.4
1156.0
1152.0
1149.8
1148.8
1148.2
1145.8
1138.0
1121.3
1086.4
967.0
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
1026.8
1120.9
1140.3
1131.6
1119.1
1108.3
1099.3
1091.2
1084.3
1080.0
1078.7
1079.9
1083.5
1088.1
1091.2
1089.8
1071.3
979.0
18                          : # of mod spec vol axial nodes (BOC-2 to EOC-2)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0227
0.0226
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0221
0.0221
0.0220
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
```

```
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
0.0227
0.0226
0.0224
0.0223
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0237
0.0236
0.0234
```

```
0.0233
0.0232
0.0230
0.0229
0.0228
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 (Stpt3-4 to EOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0237
0.0236
0.0234
0.0233
0.0232
0.0230
0.0229
0.0228
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 (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
0.0234
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-6 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
0.0233
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-2)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
0.0
18                          : # of burnup axial nodes (BOC-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
```

```
17     20.0025
18     22.3520
1.406
2.485
3.227
3.637
3.844
3.939
3.974
3.974
3.950
3.911
3.869
3.838
3.819
3.793
3.710
3.468
2.893
1.680
18                          : # of burnup axial nodes (Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
5.231
8.653
11.058
12.475
13.232
13.645
13.918
14.144
14.299
14.285
14.123
13.899
13.665
13.496
13.397
13.004
11.550
7.630
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
```

```
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
5.722
9.408
11.969
13.450
14.222
14.635
14.907
15.139
15.303
15.296
15.137
14.917
14.687
14.526
14.443
14.054
12.532
8.334
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
7.683
12.312
15.282
16.838
17.566
17.905
18.110
```

```
18.315
18.516
18.594
18.537
18.406
18.204
17.985
17.784
17.228
15.395
10.371
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
9.423
14.978
18.403
20.157
20.988
21.390
21.640
21.874
22.089
22.174
22.116
21.971
21.741
21.470
21.175
20.448
18.264
12.288
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
15.946
24.356
28.870
30.865
31.686
32.021
32.199
32.365
32.522
32.570
32.506
32.384
32.201
31.978
31.676
30.759
27.801
19.018
```

Attachment X

Assembly C8 CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.62                       : 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)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
3                          : # of insertion reactor cycles
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
193                        : Length to stpt in calendar days
16.792                     : Downtime at stpt
250.0                      : Stpt EFPD
325.8                      : Length to stpt in calendar days
13.333                     : Downtime at stpt
73.0                       : Days of downtime at EOC
323.0                      : Total cycle EFPD
416.0                      : Total cycle length in calendar days
08                         : Integer position of assembly in cycle
04                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
228.1                      : Stpt EFPD
308                        : Length to stpt in calendar days
15.167                     : Downtime at stpt
253.0                      : Stpt EFPD
348.167                    : Length to stpt in calendar days
24.0                       : Downtime at stpt
1757                       : Days of downtime at EOC
336.6                      : Total cycle EFPD
464.0                      : Total cycle length in calendar days
```

```
08                    : 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
29                    : 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
56.167                : Irradiation step length in EFPD
3                     : # of irradiation steps to next stpt
880.38                : ppmb
694.68                : ppmb
536.65                : ppmb
2                     : Relative stpt # in insertion cycle
40.75                 : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
382.60                : ppmb
267.17                : ppmb
3                     : Relative stpt # in insertion cycle
36.5                  : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
234.64                : ppmb
128.17                : ppmb
2                     : Relative insertion cycle #
1                     : Relative stpt # in insertion cycle
76.233                : Irradiation step length in EFPD
3                     : # of irradiation steps to next stpt
787.34                : ppmb
625.59                : ppmb
373.77                : ppmb
2                     : Relative stpt # in insertion cycle
24.90                 : Irradiation step length in EFPD
1                     : # of irradiation steps to next stpt
218.65                : ppmb
3                     : Relative stpt # in insertion cycle
41.8                  : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
225.91                : ppmb
105.94                : ppmb
3                     : 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-3 to Stpt2-3)
1      17.7800             : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
```

```
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
776.6
914.3
997.0
1033.1
1044.6
1044.3
1039.1
1033.8
1032.2
1036.7
1047.4
1062.0
1076.1
1089.8
1107.4
1115.4
1052.9
856.5
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
850.9
1001.0
1070.2
1090.2
1093.2
1091.4
1089.2
1087.9
1088.0
1089.7
1093.3
1099.2
1110.0
1134.6
1171.0
```

```
1174.5
1120.7
936.7
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
850.9
1001.0
1070.2
1090.2
1093.2
1091.4
1089.2
1087.9
1088.0
1089.7
1093.3
1099.2
1110.0
1134.6
1171.0
1174.5
1120.7
936.7
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
735.9
```

```
834.4
894.0
929.3
952.9
969.7
980.6
985.4
983.3
974.4
960.2
944.3
929.5
917.5
909.9
910.3
898.1
794.2
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
820.3
921.0
955.6
961.3
959.2
955.1
951.9
950.3
949.4
948.0
945.5
942.6
941.3
945.1
961.7
987.8
974.8
874.1
18                          : # of fuel temp axial nodes (Stpt3-4 to EOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
```

```
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
820.3
921.0
955.6
961.3
959.2
955.1
951.9
950.3
949.4
948.0
945.5
942.6
941.3
945.1
961.7
987.8
974.8
874.1
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
755.5
829.8
861.2
868.2
867.5
864.7
861.4
858.2
855.2
852.6
```

```
850.4
848.4
846.0
841.6
832.3
816.7
789.8
722.4
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
777.6
843.3
858.6
854.4
848.0
843.1
840.0
938.5
838.1
838.5
839.6
841.4
843.8
845.7
845.3
841.3
828.0
764.4
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
777.6
843.3
858.6
854.4
848.0
843.1
840.0
838.5
838.1
838.5
839.6
841.4
843.8
845.7
845.3
841.3
828.0
764.4
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
792.0
857.4
868.9
862.1
854.2
848.3
844.5
842.2
841.0
840.3
840.1
840.6
841.7
842.9
842.7
840.3
830.6
771.9
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
792.0
857.4
868.9
862.1
854.2
848.3
844.5
842.2
841.0
840.3
840.1
840.6
841.7
842.9
842.7
840.3
830.6
771.9
18                      : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0224
0.0224
0.0224
0.0223
0.0223
```

```
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0226
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
```

```
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0226
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
```

```
0.0217
0.0216
0.0216
0.0216
18                                  : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800                      : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0225
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                                  : # of mod spec vol axial nodes (Stpt3-4 to EOC-4)
1      17.7800                      : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
```

```
0.0225
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (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
0.0217
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
0.0219
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
0.0219
```

```
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 burnup axial nodes (BOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1.225
2.111
2.665
2.931
3.044
3.080
3.075
3.050
3.023
3.010
3.023
3.064
3.131
3.230
3.359
3.375
2.956
1.776
18                          : # of burnup axial nodes (Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1.977
3.348
4.163
4.528
```

```
4.671
4.712
4.707
4.682
4.659
4.656
4.689
4.765
4.894
5.116
5.408
5.433
4.775
2.913
18                          : # of burnup axial nodes (BOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.690
4.532
5.686
6.293
6.561
6.654
6.676
6.674
6.677
6.704
6.761
6.842
6.941
7.089
7.266
7.139
6.242
3.838
18                          : # of burnup axial nodes (Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
4.306
7.205
8.994
9.922
10.360
10.547
10.621
10.640
10.634
10.625
10.633
10.670
10.752
10.936
11.249
11.299
10.139
6.379
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
4.533
7.564
9.418
10.369
10.812
11.000
11.073
11.093
11.088
11.080
11.089
11.129
11.216
```

```
11.409
11.744
11.825
10.643
6.722
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
5.354
8.897
11.109
12.226
12.715
12.902
12.966
12.987
13.002
13.030
13.080
13.151
13.244
13.405
13.669
13.641
12.243
7.778
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
7.088
11.791
14.683
16.121
16.754
17.003
17.091
17.117
17.127
17.147
17.186
17.241
17.304
17.398
17.519
17.226
15.323
9.726
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
7.337
12.182
15.136
16.591
17.224
17.470
17.554
17.576
17.583
17.602
17.641
17.698
17.763
17.857
17.975
17.666
15.718
9.989
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
7.581
12.558
15.567
17.033
17.663
17.902
17.979
17.996
17.999
18.015
18.053
18.109
18.174
18.268
18.382
18.060
16.074
10.229
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
8.906
14.547
17.804
19.306
19.914
20.126
20.182
20.186
```

```
20.185
20.201
20.245
20.313
20.397
20.511
20.631
20.275
18.123
11.652
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
9.079
14.797
18.079
19.581
20.186
20.393
20.447
20.450
20.448
20.465
20.509
20.578
20.664
20.781
20.904
20.546
18.378
11.834
```

Attachment XI

Assembly C25 CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.62                    : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
3                       : # of insertion reactor cycles
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
325.8                   : Length to stpt in calendar days
13.333                  : Downtime at stpt
73.0                    : Days of downtime at EOC
323.0                   : Total cycle EFPD
416.0                   : Total cycle length in calendar days
25                      : Integer position of assembly in cycle
04                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
228.1                   : Stpt EFPD
308                     : Length to stpt in calendar days
15.167                  : Downtime at stpt
253.0                   : Stpt EFPD
348.167                 : Length to stpt in calendar days
24.0                    : Downtime at stpt
127.0                   : Days of downtime at EOC
336.6                   : Total cycle EFPD
464.0                   : Total cycle length in calendar days
```

```
28                      : Integer position of assembly in cycle
05                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
388.5                   : Stpt EFPD
470                     : Length to stpt in calendar days
4.958                   : Downtime at stpt
163.0                   : Days of downtime at EOC
484.4                   : Total cycle EFPD
593.0                   : Total cycle length in calendar days
09                      : 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
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
76.233                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
787.34                  : ppmb
625.59                  : ppmb
373.77                  : ppmb
2                       : Relative stpt # in insertion cycle
24.90                   : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
218.65                  : ppmb
3                       : Relative stpt # in insertion cycle
41.8                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
225.91                  : ppmb
105.94                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
77.7                    : Irradiation step length in EFPD
5                       : # of irradiation steps to next stpt
1050.61                 : ppmb
835.81                  : ppmb
641.59                  : ppmb
427.28                  : ppmb
225.73                  : ppmb
2                       : Relative stpt # in insertion cycle
47.95                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
92.03                   : ppmb
```

```
2.35                    : 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-3 to Stpt2-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
908.8
1126.2
1249.2
1302.2
1318.3
1316.0
1304.9
1292.0
1285.7
1292.0
1311.0
1338.3
1365.3
1379.8
1370.7
1324.8
1211.7
953.5
18                      : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
976.4
1162.3
1235.8
1253.2
1252.7
1248.2
1244.1
1240.7
1238.7
1239.5
1243.1
1248.3
1254.7
1260.4
1261.5
1248.9
1194.4
1001.0
18                      : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
976.4
1162.3
1235.8
1253.2
1252.7
```

```
1248.2
1244.1
1240.7
1238.7
1239.5
1243.1
1248.3
1254.7
1260.4
1261.5
1248.9
1194.4
1001.0
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
727.4
817.9
881.1
928.2
962.5
985.6
999.8
1006.1
1004.0
993.3
976.6
958.4
942.5
930.1
918.8
900.3
859.9
758.9
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
802.3
890.2
929.5
938.3
935.2
929.9
926.2
924.9
924.5
923.2
919.9
915.3
911.1
908.7
908.5
905.8
884.9
802.5
18                      : # of fuel temp axial nodes (Stpt3-4 to EOC-4)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
802.3
890.2
929.5
938.3
935.2
929.9
926.2
924.9
924.5
923.2
919.9
915.3
911.1
908.7
```

```
908.5
905.8
884.9
802.5
18                          : # of fuel temp axial nodes (BOC-5 to Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
998.2
1099.2
1111.3
1099.8
1084.9
1073.3
1066.3
1064.2
1066.9
1072.8
1079.5
1084.5
1086.8
1086.2
1084.0
1079.3
1059.4
964.4
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
```

```
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
```

```
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
```

```
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0224
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-4 to EOC-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
```

```
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0224
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (BOC-5 to Stpt2-5)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0231
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
```

```
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1.946
3.378
4.307
4.783
```

```
5.002
5.079
5.072
5.008
4.923
4.869
4.881
4.961
5.080
5.172
5.134
4.829
4.048
2.376
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
3.080
5.222
6.523
7.134
7.390
7.473
7.462
7.392
7.300
7.249
7.280
7.397
7.568
7.712
7.693
7.314
6.241
3.754
18                          : # of burnup axial nodes (BOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.105
6.831
8.411
9.117
9.397
9.481
9.465
9.392
9.313
9.291
9.357
9.500
9.674
9.787
9.702
9.216
7.914
4.828
18                      : # of burnup axial nodes (Stpt2-4)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
5.680
9.498
11.812
12.952
13.478
13.694
13.743
13.692
13.594
13.517
13.514
13.598
13.736
```

```
13.834
13.710
13.055
11.260
6.927
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
5.895
9.841
12.226
13.395
13.930
14.146
14.195
14.144
14.046
13.970
13.968
14.054
14.197
14.300
14.179
13.516
11.677
7.203
18                          : # of burnup axial nodes (BOC-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
```

```
18     22.3520
6.675
11.036
13.587
14.777
15.282
15.459
15.475
15.407
15.314
15.263
15.298
15.420
15.583
15.682
15.534
14.815
12.839
7.974
18                          : # of burnup axial nodes (Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
13.608
21.391
25.514
27.225
27.840
27.985
27.928
27.794
27.671
27.636
27.717
27.885
28.061
28.106
27.790
26.664
23.590
15.363
```

Attachment XII

Assembly C25a CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.62                       : 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)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
3                          : # of insertion reactor cycles
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
193                        : Length to stpt in calendar days
16.792                     : Downtime at stpt
250.0                      : Stpt EFPD
325.8                      : Length to stpt in calendar days
13.333                     : Downtime at stpt
73.0                       : Days of downtime at EOC
323.0                      : Total cycle EFPD
416.0                      : Total cycle length in calendar days
25                         : Integer position of assembly in cycle
04                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
228.1                      : Stpt EFPD
308                        : Length to stpt in calendar days
15.167                     : Downtime at stpt
253.0                      : Stpt EFPD
348.167                    : Length to stpt in calendar days
24.0                       : Downtime at stpt
127.0                      : Days of downtime at EOC
336.6                      : Total cycle EFPD
464.0                      : Total cycle length in calendar days
```

```
28                      : Integer position of assembly in cycle
05                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
388.5                   : Stpt EFPD
470                     : Length to stpt in calendar days
4.958                   : Downtime at stpt
163.0                   : Days of downtime at EOC
484.4                   : Total cycle EFPD
593.0                   : Total cycle length in calendar days
16                      : 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
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
76.233                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
787.34                  : ppmb
625.59                  : ppmb
373.77                  : ppmb
2                       : Relative stpt # in insertion cycle
24.90                   : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
218.65                  : ppmb
3                       : Relative stpt # in insertion cycle
41.8                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
225.91                  : ppmb
105.94                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
77.7                    : Irradiation step length in EFPD
5                       : # of irradiation steps to next stpt
1050.61                 : ppmb
835.81                  : ppmb
641.59                  : ppmb
427.28                  : ppmb
225.73                  : ppmb
2                       : Relative stpt # in insertion cycle
47.95                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
92.03                   : ppmb
```

```
2.35                        : 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-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
908.8
1126.2
1249.2
1302.2
1318.3
1316.0
1304.9
1292.0
1285.7
1292.0
1311.0
1338.3
1365.3
1379.8
1370.7
1324.8
1211.7
953.5
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
```

```
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
976.4
1162.3
1235.8
1253.2
1252.7
1248.2
1244.1
1240.7
1238.7
1239.5
1243.1
1248.3
1254.7
1260.4
1261.5
1248.9
1194.4
1001.0
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
976.4
1162.3
1235.8
1253.2
1252.7
```

```
1248.2
1244.1
1240.7
1238.7
1239.5
1243.1
1248.3
1254.7
1260.4
1261.5
1248.9
1194.4
1001.0
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
727.4
817.9
881.1
928.2
962.5
985.6
999.8
1006.1
1004.0
993.3
976.6
958.4
942.5
930.1
918.8
900.3
859.9
758.9
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
802.3
890.2
929.5
938.3
935.2
929.9
926.2
924.9
924.5
923.2
919.9
915.3
911.1
908.7
908.5
905.8
884.9
802.5
18                    : # of fuel temp axial nodes (Stpt3-4 to EOC-4)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
802.3
890.2
929.5
938.3
935.2
929.9
926.2
924.9
924.5
923.2
919.9
915.3
911.1
908.7
```

```
908.5
905.8
884.9
802.5
18                                  : # of fuel temp axial nodes (BOC-5 to Stpt2-5)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1045.1
1154.0
1179.9
1174.8
1161.5
1148.3
1136.7
1128.8
1128.4
1135.9
1148.4
1163.3
1176.0
1180.8
1178.2
1169.3
1139.9
1031.9
18                                  : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
```

```
0.0230
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                              : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                              : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
```

```
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0231
0.0230
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0224
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
```

```
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0224
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-4 to EOC-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
```

```
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0224
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-5 to Stpt2-5)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
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
0.0232
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
```

```
18                                  : # of burnup axial nodes (BOC-3)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1.946
3.378
4.307
4.783
```

```
5.002
5.079
5.072
5.008
4.923
4.869
4.881
4.961
5.080
5.172
5.134
4.829
4.048
2.376
18                              : # of burnup axial nodes (Stpt3-3)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
3.080
5.222
6.523
7.134
7.390
7.473
7.462
7.392
7.300
7.249
7.280
7.397
7.568
7.712
7.693
7.314
6.241
3.754
18                              : # of burnup axial nodes (BOC-4)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.105
6.831
8.411
9.117
9.397
9.481
9.465
9.392
9.313
9.291
9.357
9.500
9.674
9.787
9.702
9.216
7.914
4.828
18                              : # of burnup axial nodes (Stpt2-4)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
5.680
9.498
11.812
12.952
13.478
13.694
13.743
13.692
13.594
13.517
13.514
13.598
13.736
```

```
13.834
13.710
13.055
11.260
6.927
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
5.895
9.841
12.226
13.395
13.930
14.146
14.195
14.144
14.046
13.970
13.968
14.054
14.197
14.300
14.179
13.516
11.677
7.203
18                          : # of burnup axial nodes (BOC-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
```

```
18     22.3520
6.693
11.066
13.627
14.823
15.333
15.512
15.529
15.461
15.367
15.315
15.350
15.472
15.635
15.736
15.589
14.867
12.885
8.004
18                          : # of burnup axial nodes (Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
14.661
22.943
27.383
29.291
30.011
30.171
30.035
29.728
29.410
29.260
29.366
29.702
30.141
30.425
30.212
29.015
25.701
16.854
```

Attachment XIII

Assembly C27 CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.62                       : 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)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
2                          : # of insertion reactor cycles
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
193                        : Length to stpt in calendar days
16.792                     : Downtime at stpt
250.0                      : Stpt EFPD
325.8                      : Length to stpt in calendar days
13.333                     : Downtime at stpt
73.0                       : Days of downtime at EOC
323.0                      : Total cycle EFPD
416.0                      : Total cycle length in calendar days
27                         : Integer position of assembly in cycle
04                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
228.1                      : Stpt EFPD
308                        : Length to stpt in calendar days
15.167                     : Downtime at stpt
253.0                      : Stpt EFPD
348.167                    : Length to stpt in calendar days
24.0                       : Downtime at stpt
127.0                      : Days of downtime at EOC
336.6                      : Total cycle EFPD
464.0                      : Total cycle length in calendar days
```

```
02                          : 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
56.167                      : Irradiation step length in EFPD
3                           : # of irradiation steps to next stpt
880.38                      : ppmb
694.68                      : ppmb
536.65                      : ppmb
2                           : Relative stpt # in insertion cycle
40.75                       : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
382.60                      : ppmb
267.17                      : ppmb
3                           : Relative stpt # in insertion cycle
36.5                        : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
234.64                      : ppmb
128.17                      : ppmb
2                           : Relative insertion cycle #
1                           : Relative stpt # in insertion cycle
76.233                      : Irradiation step length in EFPD
3                           : # of irradiation steps to next stpt
787.34                      : ppmb
625.59                      : ppmb
373.77                      : ppmb
2                           : Relative stpt # in insertion cycle
24.90                       : Irradiation step length in EFPD
1                           : # of irradiation steps to next stpt
218.65                      : ppmb
3                           : Relative stpt # in insertion cycle
41.8                        : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
225.91                      : ppmb
105.94                      : 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-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
```

```
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
970.2
1236.7
1390.6
1455.8
1473.7
1469.7
1456.1
1441.4
1435.4
1444.7
1469.7
1504.4
1537.4
1552.9
1540.5
1485.2
1353.7
1055.2
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1041.7
1256.0
1339.7
1355.3
1351.0
1344.1
1338.9
1335.3
```

```
1333.6
1335.3
1339.7
1345.5
1351.7
1356.9
1357.3
1344.4
1288.9
1086.9
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1041.7
1256.0
1339.7
1355.3
1351.0
1344.1
1338.9
1335.3
1333.6
1335.3
1339.7
1345.5
1351.7
1356.9
1357.3
1344.4
1288.9
1086.9
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
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
1069.8
1176.4
1277.0
1350.8
1400.6
1437.1
1461.5
1473.5
1470.4
1450.8
1417.2
1376.6
1341.7
1318.1
1297.4
1243.8
1069.6
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1039.3
1179.8
1230.2
1228.1
1212.3
1197.2
1186.4
1180.4
1177.3
1174.1
1168.9
1162.4
1156.8
1155.9
1162.2
1169.8
1161.1
```

```
1050.8
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0234
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 mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
```

```
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
```

```
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0236
0.0236
0.0235
0.0234
0.0232
0.0231
0.0229
0.0228
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
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
0.0234
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
```

```
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of burnup axial nodes (BOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
```

```
17      20.0025
18      22.3520
2.215
3.938
5.181
5.850
6.166
6.284
6.286
6.215
6.121
6.064
6.090
6.195
6.342
6.447
6.386
6.004
5.055
2.999
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
3.541
6.140
7.858
8.690
9.044
9.165
9.162
9.085
8.985
8.936
8.987
9.136
9.341
9.500
9.454
8.988
7.707
4.693
18                          : # of burnup axial nodes (BOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
```

```
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.815
8.099
10.113
11.021
11.380
11.487
11.468
11.384
11.298
11.285
11.381
11.569
11.784
11.915
11.804
11.226
9.697
5.994
18                          : # of burnup axial nodes (Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
8.304
13.712
17.207
19.047
19.927
20.331
20.517
```

```
20.593
20.614
20.617
20.631
20.666
20.719
20.748
20.608
19.905
17.655
11.381
18                          : # of burnup axial nodes (Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
8.757
14.400
18.033
19.932
20.827
21.231
21.414
21.491
21.515
21.522
21.537
21.573
21.629
21.665
21.538
20.840
18.539
12.011
```

Attachment XIV

Assembly C27a CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.62                    : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
2                       : # of insertion reactor cycles
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
325.8                   : Length to stpt in calendar days
13.333                  : Downtime at stpt
73.0                    : Days of downtime at EOC
323.0                   : Total cycle EFPD
416.0                   : Total cycle length in calendar days
27                      : Integer position of assembly in cycle
04                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
228.1                   : Stpt EFPD
308                     : Length to stpt in calendar days
15.167                  : Downtime at stpt
253.0                   : Stpt EFPD
348.167                 : Length to stpt in calendar days
24.0                    : Downtime at stpt
127.0                   : Days of downtime at EOC
336.6                   : Total cycle EFPD
464.0                   : Total cycle length in calendar days
```

```
09                          : 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
56.167                      : Irradiation step length in EFPD
3                           : # of irradiation steps to next stpt
880.38                      : ppmb
694.68                      : ppmb
536.65                      : ppmb
2                           : Relative stpt # in insertion cycle
40.75                       : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
382.60                      : ppmb
267.17                      : ppmb
3                           : Relative stpt # in insertion cycle
36.5                        : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
234.64                      : ppmb
128.17                      : ppmb
2                           : Relative insertion cycle #
1                           : Relative stpt # in insertion cycle
76.233                      : Irradiation step length in EFPD
3                           : # of irradiation steps to next stpt
787.34                      : ppmb
625.59                      : ppmb
373.77                      : ppmb
2                           : Relative stpt # in insertion cycle
24.90                       : Irradiation step length in EFPD
1                           : # of irradiation steps to next stpt
218.65                      : ppmb
3                           : Relative stpt # in insertion cycle
41.8                        : Irradiation step length in EFPD
2                           : # of irradiation steps to next stpt
225.91                      : ppmb
105.94                      : 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-3 to Stpt2-3)
1     17.7800               : Node #, node height (cm)
2     20.0025
3     20.0025
```

```
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
970.2
1236.7
1390.6
1455.8
1473.7
1469.7
1456.1
1441.4
1435.4
1444.7
1469.7
1504.4
1537.4
1552.9
1540.5
1485.2
1353.7
1055.2
18                      : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1041.7
1256.0
1339.7
1355.3
1351.0
1344.1
1338.9
1335.3
```

```
1333.6
1335.3
1339.7
1345.5
1351.7
1356.9
1357.3
1344.4
1288.9
1086.9
18                          : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
1041.7
1256.0
1339.7
1355.3
1351.0
1344.1
1338.9
1335.3
1333.6
1335.3
1339.7
1345.5
1351.7
1356.9
1357.3
1344.4
1288.9
1086.9
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
```

```
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
927.0
1081.5
1190.4
1288.4
1362.6
1413.9
1451.4
1475.6
1488.6
1485.6
1465.2
1431.9
1390.3
1354.7
1332.7
1317.4
1270.2
1091.1
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1046.0
1188.6
1236.6
1235.6
1221.3
1206.3
1195.9
1190.6
1188.2
1185.4
1180.4
1173.8
1168.2
1168.1
1178.2
1191.8
1182.9
```

```
1068.9
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0234
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 mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
```

```
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0234
0.0233
0.0232
0.0231
0.0230
0.0229
0.0227
0.0226
0.0225
0.0224
0.0223
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
```

```
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0237
0.0236
0.0235
0.0234
0.0233
0.0231
0.0230
0.0228
0.0227
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 (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
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
0.0225
0.0224
0.0223
0.0222
```

```
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
```

```
17     20.0025
18     22.3520
2.215
3.938
5.181
5.850
6.166
6.284
6.286
6.215
6.121
6.064
6.090
6.195
6.342
6.447
6.386
6.004
5.055
2.999
18                    : # of burnup axial nodes (Stpt3-3)
1      17.7800        : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
3.541
6.140
7.858
8.690
9.044
9.165
9.162
9.085
8.985
8.936
8.987
9.136
9.341
9.500
9.454
8.988
7.707
4.693
18                    : # of burnup axial nodes (BOC-4)
1      17.7800        : Node #, node height (cm)
2      20.0025
```

```
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.793
8.056
10.051
10.947
11.299
11.401
11.380
11.295
11.207
11.192
11.287
11.473
11.687
11.816
11.704
11.128
9.612
5.943
18                          : # of burnup axial nodes (Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
8.343
13.784
17.266
19.091
19.975
20.387
20.580
```

```
20.666
20.695
20.702
20.713
20.745
20.798
20.840
20.757
20.149
17.941
11.589
18                          : # of burnup axial nodes (Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
8.805
14.489
18.107
19.989
20.889
21.301
21.492
21.580
21.613
21.624
21.638
21.672
21.727
21.778
21.714
21.122
18.864
12.247
```

Attachment XV

Assembly C28 CRAFT Input Deck

```
N                       : This is not a pick-up case
Crystal River, Unit 3   : Reactor Identifier
CR3                     : Prefix Identifier for reactor
44group                 : Scale cross-section library
2.62                    : 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)
N                       : Activate BPRA tracking
5                       : # of radial zones in the standard Path B model
3 0.63246               : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                       : # of cross-section libraries per irradiation step
5                       : SAS2H output print level
0.5                     : Zone mesh factor for XSDRNPM
NO SPECIAL              : No special XSDRNPM control parameter specs.
3                       : # of insertion reactor cycles
03                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
168.5                   : Stpt EFPD
193                     : Length to stpt in calendar days
16.792                  : Downtime at stpt
250.0                   : Stpt EFPD
325.8                   : Length to stpt in calendar days
13.333                  : Downtime at stpt
73.0                    : Days of downtime at EOC
323.0                   : Total cycle EFPD
416.0                   : Total cycle length in calendar days
28                      : Integer position of assembly in cycle
04                      : Insertion reactor cycle identifier
3                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
228.1                   : Stpt EFPD
308                     : Length to stpt in calendar days
15.167                  : Downtime at stpt
253.0                   : Stpt EFPD
348.167                 : Length to stpt in calendar days
24.0                    : Downtime at stpt
127.0                   : Days of downtime at EOC
336.6                   : Total cycle EFPD
464.0                   : Total cycle length in calendar days
```

```
15                    : Integer position of assembly in cycle
05                    : Insertion reactor cycle identifier
2                     : # of stpts in cycle
0                     : Stpt EFPD
0                     : Length to stpt in calendar days
0                     : Downtime at stpt
388.5                 : Stpt EFPD
470                   : Length to stpt in calendar days
4.958                 : Downtime at stpt
163.0                 : Days of downtime at EOC
484.4                 : Total cycle EFPD
593.0                 : Total cycle length in calendar days
24                    : 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
56.167                : Irradiation step length in EFPD
3                     : # of irradiation steps to next stpt
880.38                : ppmb
694.68                : ppmb
536.65                : ppmb
2                     : Relative stpt # in insertion cycle
40.75                 : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
382.60                : ppmb
267.17                : ppmb
3                     : Relative stpt # in insertion cycle
36.5                  : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
234.64                : ppmb
128.17                : ppmb
2                     : Relative insertion cycle #
1                     : Relative stpt # in insertion cycle
76.233                : Irradiation step length in EFPD
3                     : # of irradiation steps to next stpt
787.34                : ppmb
625.59                : ppmb
373.77                : ppmb
2                     : Relative stpt # in insertion cycle
24.90                 : Irradiation step length in EFPD
1                     : # of irradiation steps to next stpt
218.65                : ppmb
3                     : Relative stpt # in insertion cycle
41.8                  : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
225.91                : ppmb
105.94                : ppmb
3                     : Relative insertion cycle #
1                     : Relative stpt # in insertion cycle
77.7                  : Irradiation step length in EFPD
5                     : # of irradiation steps to next stpt
1050.61               : ppmb
835.81                : ppmb
641.59                : ppmb
427.28                : ppmb
225.73                : ppmb
2                     : Relative stpt # in insertion cycle
47.95                 : Irradiation step length in EFPD
2                     : # of irradiation steps to next stpt
92.03                 : ppmb
```

```
2.35                        : 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-3 to Stpt2-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
791.1
948.3
1047.1
1092.7
1107.8
1107.5
1100.6
1092.7
1089.5
1094.5
1107.6
1125.5
1142.0
1149.1
1138.5
1099.5
1009.1
819.8
18                          : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
851.1
1004.5
1073.8
1092.8
1094.2
1091.1
1087.9
1085.5
1084.5
1085.3
1087.9
1091.5
1095.2
1097.8
1096.1
1081.7
1029.9
867.2
18                      : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
851.1
1004.5
1073.8
1092.8
1094.2
```

```
1091.1
1087.9
1085.5
1084.5
1085.3
1087.9
1091.5
1095.2
1097.8
1096.1
1081.7
1029.9
867.2
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
755.3
865.7
934.1
975.3
1002.3
1021.0
1033.3
1039.1
1037.2
1027.6
1012.4
995.3
980.3
969.2
962.3
954.7
922.4
800.2
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
```

```
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
840.9
947.4
985.5
992.4
989.6
985.0
981.8
980.4
980.0
979.0
976.6
973.6
972.1
975.5
987.5
1000.2
983.9
876.5
18                      : # of fuel temp axial nodes (Stpt3-4 to EOC-4)
1       17.7800         : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
840.9
947.4
985.5
992.4
989.6
985.0
981.8
980.4
980.0
979.0
976.6
973.6
972.1
975.5
```

```
987.5
1000.2
983.9
876.5
18                          : # of fuel temp axial nodes (BOC-5 to Stpt2-5)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
989.1
1106.1
1131.9
1128.9
1118.2
1106.3
1093.6
1081.9
1078.2
1084.3
1097.2
1115.5
1134.5
1142.1
1138.3
1125.7
1095.1
980.1
18                          : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
```

```
0.0225
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0226
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
```

```
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0226
0.0226
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                              : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0224
0.0224
0.0224
0.0223
0.0223
0.0222
0.0221
0.0221
0.0220
```

```
0.0220
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
0.0216
18                              : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                              : # of mod spec vol axial nodes (Stpt3-4 to EOC-4)
1       17.7800                 : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
```

```
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0226
0.0225
0.0225
0.0224
0.0223
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-5 to Stpt2-5)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
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-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1.265
2.254
2.936
3.306
```

```
3.482
3.548
3.550
3.515
3.470
3.442
3.451
3.497
3.559
3.593
3.535
3.292
2.723
1.567
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.034
3.543
4.513
4.994
5.202
5.272
5.272
5.234
5.187
5.164
5.187
5.255
5.345
5.403
5.344
5.034
4.239
2.497
18                          : # of burnup axial nodes (BOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.747
4.685
5.862
6.408
6.628
6.695
6.689
6.650
6.612
6.608
6.652
6.736
6.826
6.864
6.763
6.376
5.408
3.230
18                          : # of burnup axial nodes (Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.528
7.652
9.545
10.460
10.877
11.053
11.107
11.092
11.043
10.998
10.987
11.025
11.099
```

```
11.170
11.150
10.775
9.395
5.778
18                          : # of burnup axial nodes (Stpt3-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.776
8.043
10.007
10.948
11.371
11.548
11.601
11.587
11.539
11.495
11.487
11.528
11.608
11.689
11.685
11.322
9.906
6.119
18                          : # of burnup axial nodes (BOC-5)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
```

```
18     22.3520
5.656
9.445
11.711
12.779
13.235
13.405
13.447
13.430
13.400
13.390
13.424
13.499
13.589
13.646
13.584
13.118
11.492
7.162
18                          : # of burnup axial nodes (Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
12.247
19.518
23.552
25.341
26.035
26.208
26.088
25.777
25.441
25.291
25.401
25.748
26.226
26.571
26.478
25.522
22.587
14.645
```

Attachment XVI

Assembly C29 CRAFT Input Deck

```
N                          : This is not a pick-up case
Crystal River, Unit 3      : Reactor Identifier
CR3                        : Prefix Identifier for reactor
44group                    : Scale cross-section library
2.62                       : 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)
N                          : Activate BPRA tracking
5                          : # of radial zones in the standard Path B model
3 0.63246                  : Standard Path B model (Input Card 20)
2 0.67310
3 0.81397
500 2.97599
3 2.99939
1                          : # of cross-section libraries per irradiation step
5                          : SAS2H output print level
0.5                        : Zone mesh factor for XSDRNPM
NO SPECIAL                 : No special XSDRNPM control parameter specs.
3                          : # of insertion reactor cycles
03                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
168.5                      : Stpt EFPD
193                        : Length to stpt in calendar days
16.792                     : Downtime at stpt
250.0                      : Stpt EFPD
325.8                      : Length to stpt in calendar days
13.333                     : Downtime at stpt
73.0                       : Days of downtime at EOC
323.0                      : Total cycle EFPD
416.0                      : Total cycle length in calendar days
29                         : Integer position of assembly in cycle
04                         : Insertion reactor cycle identifier
3                          : # of stpts in cycle
0                          : Stpt EFPD
0                          : Length to stpt in calendar days
0                          : Downtime at stpt
228.1                      : Stpt EFPD
308                        : Length to stpt in calendar days
15.167                     : Downtime at stpt
253.0                      : Stpt EFPD
348.167                    : Length to stpt in calendar days
24.0                       : Downtime at stpt
127.0                      : Days of downtime at EOC
336.6                      : Total cycle EFPD
464.0                      : Total cycle length in calendar days
```

```
29                      : Integer position of assembly in cycle
05                      : Insertion reactor cycle identifier
2                       : # of stpts in cycle
0                       : Stpt EFPD
0                       : Length to stpt in calendar days
0                       : Downtime at stpt
388.5                   : Stpt EFPD
470                     : Length to stpt in calendar days
4.958                   : Downtime at stpt
163.0                   : Days of downtime at EOC
484.4                   : Total cycle EFPD
593.0                   : Total cycle length in calendar days
05                      : 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
56.167                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
880.38                  : ppmb
694.68                  : ppmb
536.65                  : ppmb
2                       : Relative stpt # in insertion cycle
40.75                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
382.60                  : ppmb
267.17                  : ppmb
3                       : Relative stpt # in insertion cycle
36.5                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
234.64                  : ppmb
128.17                  : ppmb
2                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
76.233                  : Irradiation step length in EFPD
3                       : # of irradiation steps to next stpt
787.34                  : ppmb
625.59                  : ppmb
373.77                  : ppmb
2                       : Relative stpt # in insertion cycle
24.90                   : Irradiation step length in EFPD
1                       : # of irradiation steps to next stpt
218.65                  : ppmb
3                       : Relative stpt # in insertion cycle
41.8                    : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
225.91                  : ppmb
105.94                  : ppmb
3                       : Relative insertion cycle #
1                       : Relative stpt # in insertion cycle
77.7                    : Irradiation step length in EFPD
5                       : # of irradiation steps to next stpt
1050.61                 : ppmb
835.81                  : ppmb
641.59                  : ppmb
427.28                  : ppmb
225.73                  : ppmb
2                       : Relative stpt # in insertion cycle
47.95                   : Irradiation step length in EFPD
2                       : # of irradiation steps to next stpt
92.03                   : ppmb
```

```
2.35                    : 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-3 to Stpt2-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
816.1
997.2
1113.7
1166.7
1182.7
1182.2
1174.8
1166.9
1164.0
1169.9
1184.5
1204.2
1222.0
1229.2
1217.1
1174.2
1074.3
860.3
18                      : # of fuel temp axial nodes (Stpt2-3 to Stpt3-3)
```

```
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
881.2
1053.5
1130.0
1148.9
1149.0
1145.0
1141.4
1139.1
1138.4
1139.5
1142.2
1145.7
1149.0
1151.2
1149.3
1134.9
1082.7
907.5
18                      : # of fuel temp axial nodes (Stpt3-3 to EOC-3)
1      17.7800          : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
881.2
1053.5
1130.0
1148.9
1149.0
```

```
1145.0
1141.4
1139.1
1138.4
1139.5
1142.2
1145.7
1149.0
1151.2
1149.3
1134.9
1082.7
907.5
18                          : # of fuel temp axial nodes (BOC-4 to Stpt2-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
741.7
848.3
932.3
1000.6
1050.3
1081.3
1099.4
1107.9
1106.4
1094.9
1076.2
1055.4
1036.5
1021.6
1007.4
983.9
933.4
803.1
18                          : # of fuel temp axial nodes (Stpt2-4 to Stpt3-4)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
```

```
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
831.9
944.1
993.1
1007.3
1003.8
997.4
993.0
991.4
991.1
990.1
987.1
982.6
978.4
976.2
976.0
972.3
946.4
849.8
18                          : # of fuel temp axial nodes (Stpt3-4 to EOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
831.9
944.1
993.1
1007.3
1003.8
997.4
993.0
991.4
991.1
990.1
987.1
982.6
978.4
976.2
```

```
976.0
972.3
946.4
849.8
18                      : # of fuel temp axial nodes (BOC-5 to Stpt2-5)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
1064.7
1183.0
1208.3
1203.7
1190.6
1177.3
1165.5
1157.2
1156.4
1164.0
1177.4
1193.8
1208.5
1215.0
1213.2
1203.0
1169.7
1054.1
18                      : # of mod spec vol axial nodes (BOC-3 to Stpt2-3)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
```

```
0.0227
0.0227
0.0226
0.0225
0.0225
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt2-3 to Stpt3-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
0.0228
0.0227
0.0226
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (Stpt3-3 to EOC-3)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
```

```
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0228
0.0227
0.0226
0.0226
0.0225
0.0224
0.0223
0.0223
0.0222
0.0221
0.0220
0.0220
0.0219
0.0218
0.0218
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-4 to Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0225
0.0225
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
```

```
0.0220
0.0219
0.0219
0.0218
0.0218
0.0217
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (Stpt2-4 to Stpt3-4)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
14    20.0025
15    20.0025
16    20.0025
17    20.0025
18    22.3520
0.0226
0.0225
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                      : # of mod spec vol axial nodes (Stpt3-4 to EOC-4)
1     17.7800           : Node #, node height (cm)
2     20.0025
3     20.0025
4     20.0025
5     20.0025
6     20.0025
7     20.0025
8     20.0025
9     20.0025
10    20.0025
11    20.0025
12    20.0025
13    20.0025
```

```
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0226
0.0225
0.0225
0.0224
0.0224
0.0223
0.0222
0.0222
0.0221
0.0220
0.0220
0.0219
0.0219
0.0218
0.0217
0.0217
0.0216
0.0216
18                          : # of mod spec vol axial nodes (BOC-5 to Stpt2-5)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0235
0.0235
0.0233
0.0232
0.0231
0.0229
0.0228
0.0227
0.0226
0.0225
0.0224
0.0222
0.0221
0.0220
0.0219
0.0218
0.0217
0.0216
```

```
18                          : # of burnup axial nodes (BOC-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
0.0
0.0
0.0
0.0
0.0
0.0
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 (Stpt2-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
1.370
2.487
3.306
3.766
```

```
3.988
4.073
4.080
4.045
3.998
3.970
3.983
4.036
4.104
4.139
4.068
3.788
3.137
1.810
18                          : # of burnup axial nodes (Stpt3-3)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
2.221
3.932
5.090
5.678
5.934
6.023
6.029
5.991
5.944
5.923
5.952
6.029
6.127
6.186
6.113
5.758
4.857
2.872
18                          : # of burnup axial nodes (BOC-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
```

```
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
3.038
5.232
6.612
7.262
7.525
7.606
7.603
7.565
7.528
7.529
7.582
7.677
7.775
7.813
7.696
7.261
6.173
3.702
18                          : # of burnup axial nodes (Stpt2-4)
1       17.7800             : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.719
8.143
10.446
11.690
12.286
12.540
12.625
12.622
12.574
12.522
12.503
12.531
12.588
```

```
12.602
12.432
11.793
10.124
6.183
18                                  : # of burnup axial nodes (Stpt3-4)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
18      22.3520
4.949
8.518
10.912
12.200
12.809
13.065
13.150
13.147
13.101
13.051
13.033
13.066
13.127
13.148
12.981
12.332
10.612
6.506
18                                  : # of burnup axial nodes (BOC-5)
1       17.7800                     : Node #, node height (cm)
2       20.0025
3       20.0025
4       20.0025
5       20.0025
6       20.0025
7       20.0025
8       20.0025
9       20.0025
10      20.0025
11      20.0025
12      20.0025
13      20.0025
14      20.0025
15      20.0025
16      20.0025
17      20.0025
```

```
18     22.3520
5.877
9.948
12.545
13.853
14.424
14.633
14.680
14.658
14.617
14.597
14.623
14.698
14.785
14.805
14.611
13.898
12.015
7.438
18                          : # of burnup axial nodes (Stpt2-5)
1      17.7800              : Node #, node height (cm)
2      20.0025
3      20.0025
4      20.0025
5      20.0025
6      20.0025
7      20.0025
8      20.0025
9      20.0025
10     20.0025
11     20.0025
12     20.0025
13     20.0025
14     20.0025
15     20.0025
16     20.0025
17     20.0025
18     22.3520
14.058
22.121
26.634
28.677
29.476
29.680
29.581
29.322
29.058
28.948
29.065
29.384
29.781
30.012
29.758
28.543
25.282
16.623
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B20b3/CR3A01N05DC07T000AC07T260.notes	aXXXIIf.363	7	Mar 14 1997	7773	ASCII
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C29/CR3A29N02DC04T253AC05T000.notes	aXXXIIf1.342	8	Jan 17 1997	9409	ASCII
C29/CR3A29N03DC03T168AC03T250.notes	aXXXIIf1.343	8	Jan 17 1997	9748	ASCII
C29/CR3A29N03DC03T250AC04T000.notes	aXXXIIf1.344	8	Jan 17 1997	9773	ASCII
C29/CR3A29N03DC04T000AC04T228.notes	aXXXIIf1.345	7	Jan 17 1997	8941	ASCII
C29/CR3A29N03DC04T228AC04T253.notes	aXXXIIf1.346	8	Jan 17 1997	10257	ASCII
C29/CR3A29N03DC04T253AC05T000.notes	aXXXIIf1.347	8	Jan 17 1997	9574	ASCII
C29/CR3A29N04DC03T168AC03T250.notes	aXXXIIf1.348	8	Jan 17 1997	9706	ASCII
C29/CR3A29N04DC03T250AC04T000.notes	aXXXIIf1.349	8	Jan 17 1997	9869	ASCII
C29/CR3A29N04DC04T000AC04T228.notes	aXXXIIf1.350	7	Jan 17 1997	8877	ASCII
C29/CR3A29N04DC04T228AC04T253.notes	aXXXIIf1.351	8	Jan 17 1997	10271	ASCII
C29/CR3A29N04DC04T253AC05T000.notes	aXXXIIf1.352	8	Jan 17 1997	9560	ASCII
C29/CR3A29N05DC03T168AC03T250.notes	aXXXIIf1.353	8	Jan 17 1997	9728	ASCII
C29/CR3A29N05DC03T250AC04T000.notes	aXXXIIf1.354	8	Jan 17 1997	9815	ASCII
C29/CR3A29N05DC04T000AC04T228.notes	aXXXIIf1.355	7	Jan 17 1997	8959	ASCII
C29/CR3A29N05DC04T228AC04T253.notes	aXXXIIf1.356	8	Jan 17 1997	10243	ASCII
C29/CR3A29N05DC04T253AC05T000.notes	aXXXIIf1.357	8	Jan 17 1997	9563	ASCII
C29/CR3A29N06DC03T168AC03T250.notes	aXXXIIf1.358	8	Jan 17 1997	9762	ASCII
C29/CR3A29N06DC03T250AC04T000.notes	aXXXIIf1.359	8	Jan 17 1997	9847	ASCII
C29/CR3A29N06DC04T000AC04T228.notes	aXXXIIf1.360	7	Jan 17 1997	8927	ASCII
C29/CR3A29N06DC04T228AC04T253.notes	aXXXIIf1.361	8	Jan 17 1997	10279	ASCII
C29/CR3A29N06DC04T253AC05T000.notes	aXXXIIf1.362	8	Jan 17 1997	9559	ASCII
C29/CR3A29N07DC03T168AC03T250.notes	aXXXIIf1.363	8	Jan 17 1997	9729	ASCII
C29/CR3A29N07DC03T250AC04T000.notes	aXXXIIf1.364	8	Jan 17 1997	9793	ASCII
C29/CR3A29N07DC04T000AC04T228.notes	aXXXIIf1.365	7	Jan 17 1997	8925	ASCII
C29/CR3A29N07DC04T228AC04T253.notes	aXXXIIf1.366	8	Jan 17 1997	10259	ASCII
C29/CR3A29N07DC04T253AC05T000.notes	aXXXIIf1.367	8	Jan 17 1997	9519	ASCII
C29/CR3A29N08DC03T168AC03T250.notes	aXXXIIf1.368	8	Jan 17 1997	9712	ASCII
C29/CR3A29N08DC03T250AC04T000.notes	aXXXIIf1.369	8	Jan 17 1997	9849	ASCII
C29/CR3A29N08DC04T000AC04T228.notes	aXXXIIf1.370	7	Jan 17 1997	8925	ASCII
C29/CR3A29N08DC04T228AC04T253.notes	aXXXIIf1.371	8	Jan 17 1997	10289	ASCII
C29/CR3A29N08DC04T253AC05T000.notes	aXXXIIf1.372	8	Jan 17 1997	9537	ASCII
C29/CR3A29N09DC03T168AC03T250.notes	aXXXIIf1.373	8	Jan 17 1997	9722	ASCII
C29/CR3A29N09DC03T250AC04T000.notes	aXXXIIf1.374	8	Jan 17 1997	9813	ASCII
C29/CR3A29N09DC04T000AC04T228.notes	aXXXIIf1.375	7	Jan 17 1997	8883	ASCII
C29/CR3A29N09DC04T228AC04T253.notes	aXXXIIf1.376	8	Jan 17 1997	10189	ASCII
C29/CR3A29N09DC04T253AC05T000.notes	aXXXIIf1.377	8	Jan 17 1997	9503	ASCII
C29/CR3A29N10DC03T168AC03T250.notes	aXXXIIf1.378	8	Jan 17 1997	9682	ASCII
C29/CR3A29N10DC03T250AC04T000.notes	aXXXIIf1.379	8	Jan 17 1997	9797	ASCII
C29/CR3A29N10DC04T000AC04T228.notes	aXXXIIf1.380	7	Jan 17 1997	8931	ASCII
C29/CR3A29N10DC04T228AC04T253.notes	aXXXIIf1.381	8	Jan 17 1997	10307	ASCII
C29/CR3A29N10DC04T253AC05T000.notes	aXXXIIf1.382	8	Jan 17 1997	9555	ASCII
C29/CR3A29N11DC03T168AC03T250.notes	aXXXIIf1.383	8	Jan 17 1997	9700	ASCII
C29/CR3A29N11DC03T250AC04T000.notes	aXXXIIf1.384	8	Jan 17 1997	9781	ASCII
C29/CR3A29N11DC04T000AC04T228.notes	aXXXIIf1.385	7	Jan 17 1997	8949	ASCII
C29/CR3A29N11DC04T228AC04T253.notes	aXXXIIf1.386	8	Jan 17 1997	10289	ASCII
C29/CR3A29N11DC04T253AC05T000.notes	aXXXIIf1.387	8	Jan 17 1997	9529	ASCII
C29/CR3A29N12DC03T168AC03T250.notes	aXXXIIf1.388	8	Jan 17 1997	9676	ASCII
C29/CR3A29N12DC03T250AC04T000.notes	aXXXIIf1.389	8	Jan 17 1997	9837	ASCII
C29/CR3A29N12DC04T000AC04T228.notes	aXXXIIf1.390	7	Jan 17 1997	8885	ASCII
C29/CR3A29N12DC04T228AC04T253.notes	aXXXIIf1.391	8	Jan 17 1997	10281	ASCII
C29/CR3A29N12DC04T253AC05T000.notes	aXXXIIf1.392	8	Jan 17 1997	9513	ASCII
C29/CR3A29N13DC03T168AC03T250.notes	aXXXIIf1.393	8	Jan 18 1997	9715	ASCII
C29/CR3A29N13DC03T250AC04T000.notes	aXXXIIf1.394	8	Jan 18 1997	9833	ASCII
C29/CR3A29N13DC04T000AC04T228.notes	aXXXIIf1.395	7	Jan 18 1997	8853	ASCII
C29/CR3A29N13DC04T228AC04T253.notes	aXXXIIf1.396	8	Jan 18 1997	10295	ASCII
C29/CR3A29N13DC04T253AC05T000.notes	aXXXIIf1.397	8	Jan 18 1997	9521	ASCII
C29/CR3A29N14DC03T168AC03T250.notes	aXXXIIf1.398	8	Jan 18 1997	9769	ASCII
C29/CR3A29N14DC03T250AC04T000.notes	aXXXIIf1.399	8	Jan 18 1997	9809	ASCII
C29/CR3A29N14DC04T000AC04T228.notes	aXXXIIf1.400	7	Jan 18 1997	8851	ASCII

C29/CR3A29N14DC04T228AC04T253.notes	aXXXIIf1.401	8	Jan 18 1997	10301	ASCII
C29/CR3A29N14DC04T253AC05T000.notes	aXXXIIf1.402	8	Jan 18 1997	9511	ASCII
C29/CR3A29N15DC03T168AC03T250.notes	aXXXIIf1.403	8	Jan 18 1997	9644	ASCII
C29/CR3A29N15DC03T250AC04T000.notes	aXXXIIf1.404	8	Jan 18 1997	9851	ASCII
C29/CR3A29N15DC04T000AC04T228.notes	aXXXIIf1.405	7	Jan 18 1997	8925	ASCII
C29/CR3A29N15DC04T228AC04T253.notes	aXXXIIf1.406	8	Jan 18 1997	10309	ASCII
C29/CR3A29N15DC04T253AC05T000.notes	aXXXIIf1.407	8	Jan 18 1997	9567	ASCII
C29/CR3A29N16DC03T168AC03T250.notes	aXXXIIf1.408	8	Jan 18 1997	9670	ASCII
C29/CR3A29N16DC03T250AC04T000.notes	aXXXIIf1.409	8	Jan 18 1997	9887	ASCII
C29/CR3A29N16DC04T000AC04T228.notes	aXXXIIf1.410	7	Jan 18 1997	8883	ASCII
C29/CR3A29N16DC04T228AC04T253.notes	aXXXIIf1.411	8	Jan 18 1997	10239	ASCII
C29/CR3A29N16DC04T253AC05T000.notes	aXXXIIf1.412	8	Jan 18 1997	9484	ASCII
C29/CR3A29N17DC03T168AC03T250.notes	aXXXIIf1.413	8	Jan 18 1997	9762	ASCII
C29/CR3A29N17DC03T250AC04T000.notes	aXXXIIf1.414	8	Jan 18 1997	9644	ASCII
C29/CR3A29N17DC04T000AC04T228.notes	aXXXIIf1.415	7	Jan 18 1997	8902	ASCII
C29/CR3A29N17DC04T228AC04T253.notes	aXXXIIf1.416	8	Jan 18 1997	10178	ASCII
C29/CR3A29N17DC04T253AC05T000.notes	aXXXIIf1.417	8	Jan 18 1997	9497	ASCII
C29/CR3A29N18DC03T168AC03T250.notes	aXXXIIf1.418	7	Jan 18 1997	9414	ASCII
C29/CR3A29N18DC03T250AC04T000.notes	aXXXIIf1.419	7	Jan 18 1997	9500	ASCII
C29/CR3A29N18DC04T000AC04T228.notes	aXXXIIf1.420	7	Jan 18 1997	8533	ASCII
C29/CR3A29N18DC04T228AC04T253.notes	aXXXIIf1.421	8	Jan 18 1997	9959	ASCII
C29/CR3A29N18DC04T253AC05T000.notes	aXXXIIf1.422	7	Jan 18 1997	9213	ASCII