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Civilian Radioactive Waste Management System
Management & Operating Contractor

Summary Report of Commercial Reactor Criticality Data for Sequoyah Unit 2

Revision 01

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New data added. Changes are marked with change bars in the left margin or as otherwise noted (Figures 3-1 through 3-7, Tables 3-3 and 3-4).

Acknowledgments

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1.0 INTRODUCTION

The "Summary Report of Commercial Reactor Criticality Data for Sequoyah Unit 2" contains the detailed information necessary to perform commercial reactor criticality (CRC) analyses for the Sequoyah Unit 2 reactor.

1.1 Background

The United States Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) is developing a methodology for criticality analysis to support disposal of commercial spent nuclear fuel in a geologic repository. A topical report on the disposal criticality analysis methodology is scheduled to be submitted to the United States Nuclear Regulatory Commission (NRC) for formal review in October 1998. This summary report provides data that will be used in analyses that will support the development of parts of the disposal criticality analysis methodology.

1.2 Objective

The objective of this report is to present the data required for performing analytical CRC evaluations for the Sequoyah Unit 2 reactor. Results from the CRC evaluations will support the development and validation of the neutronics models used for criticality analyses involving commercial spent nuclear fuel. These models and their validation will be discussed in the Disposal Criticality Analysis Methodology Topical Report.

1.3 Scope

The scope of this Summary Report is the presentation of data required to perform three statepoint calculations from cycles 1 and 3 of Sequoyah Unit 2. The only interface for the development of the information in this document is with Framatome Cogema Fuels (FCF). FCF is one of the teammates of the Civilian Radioactive Waste Management System Management and Operating Contractor (M&O). FCF independently requested and received permission from the Tennessee Valley Authority, the owner/operator of Sequoyah Unit 2, to publish the information related to statepoint measurements that is recorded in this document. All the information contained in this report is documented in an FCF calculational file (Reference 5). The data provided in Reference 5 was obtained from various other reports, calculations, and drawings developed under an NRC accepted quality assurance program (Reference 1) and the data has supported prior licensing submittals. The data therefore will be considered acceptable for quality affecting activities and for use in analyses affecting procurement, construction, or fabrication.

1.4 Quality Assurance

The Quality Assurance (QA) program applies to the development of this report. The data provided in this report will indirectly be used to develop the methodology for evaluating the Monitored Geologic Repository (MGR) waste package and engineered barrier segment. The QAP-2-3 (*Classification of Permanent Items*) evaluation entitled *Classification of the*

Preliminary MGDS Repository Design (Reference 2, TBV-228) has identified the waste package as an MGR (formerly MGDS) item important to safety, waste isolation, and physical protection of materials. The Waste Package responsible manager has evaluated the technical document development activity in accordance with QAP-2-0, *Conduct of Activities*. The QAP-2-0 activity evaluation, *Develop Technical Documents* (Reference 3), has determined that the preparation and review of this technical document is subject to *Quality Assurance Requirements and Description* (Reference 4) 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. No scientific and engineering software or computational software was used in the development of this report.

2.0 REACTOR DESIGN INFORMATION

This section provides general material and geometry data for modeling the Sequoyah Unit 2 reactor. Figures 2-1 through 2-11 provide pictorial representations of various components that must be modeled. A horizontal view of the vessel internals is presented in Figure 2-1. This includes the 193 fuel assemblies (FA) in the reactor core region. All dimensions in this figure are measured from the center of the reactor core. A radial view of the fuel assembly layout (along the core flat) and extending through the core liner is provided in Figure 2-2. The core liner, core barrel, thermal shield, and vessel weld liner are represented as stainless steel (SS304 from Reference 5 or A240, Type 304 from 1997 *Annual Book of ASTM Standards*, Vol. 01.03, Section 1, Iron and Steel Products, p. 37, Table 1). The pressure vessel is carbon steel (CS508 from Reference 5 or A508, Grade 2, Class 1 from *Annual Book of ASTM Standards*, Vol. 01.05, Section 1, Iron and Steel Products, p. 281, Table 1). Table 2-1 provides dimensions from the center of the core (along the core flat) to the outside surface of the pressure vessel.

Table 2-1. Dimensions from Core Center to Outside Surface of Pressure Vessel

Description	Thickness (cm)	Outer Radius (cm)
Core Center	-	00.00000
½ FA-1	10.70102	10.70102
Water	0.10160	10.80262
FA-2	21.40204	32.20466
Water	0.10160	32.30626
FA-3	21.40204	53.70830
Water	0.10160	53.80990
FA-4	21.40204	75.21194
Water	0.10160	75.31354
FA-5	21.40204	96.71558
Water	0.10160	96.81718
FA-6	21.40204	118.21922
Water	0.10160	118.32082
FA-7	21.40204	139.72286
Water	0.10160	139.82446
FA-8	21.40204	161.22650
Water	0.19350	161.4200
Core Liner	2.8575	164.2775
Water	23.6825	187.9600
Core Barrel	5.7150	193.6750
Water	7.6200	201.2950
Thermal Shield	6.9850	208.2800
Water	11.1125	219.3925
Vessel Liner	0.3175	219.71
Pressure Vessel	21.59	241.30

Figure 2-1. Horizontal View of Vessel Internals Along Core Midplane

Core Liner, Core Barrel, Thermal Shield, and
Vessel Liner = SS304. Reactor Vessel = CS508

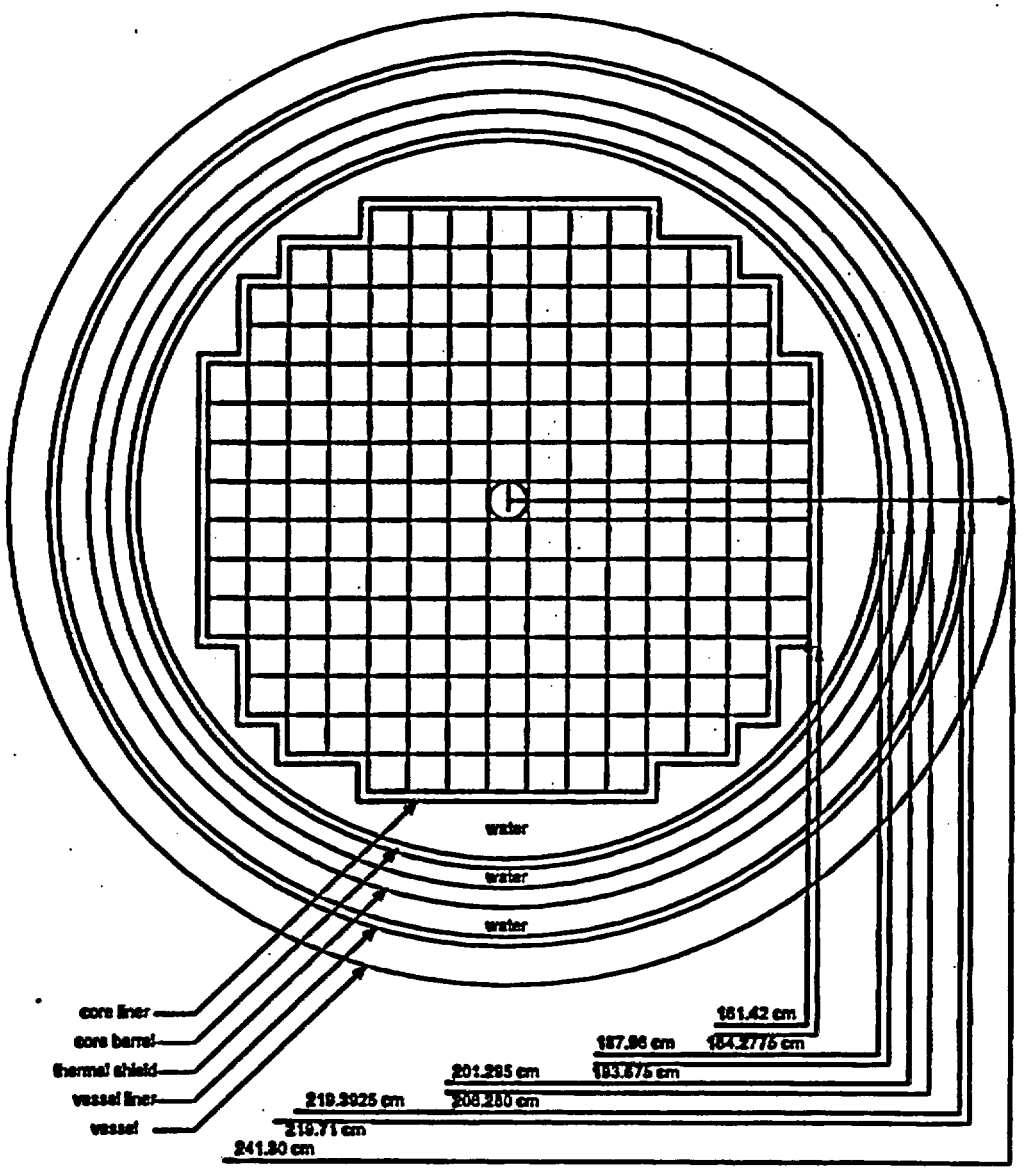


Figure 2-2. Radial View of Fuel Assembly Layout Along the Core Flat

Outside Dimensions of FA = 21.40204 cm (8.426 in)
Includes Top & Bottom Grids

Fuel Assembly Pitch = 21.50364 cm (8.466 in)

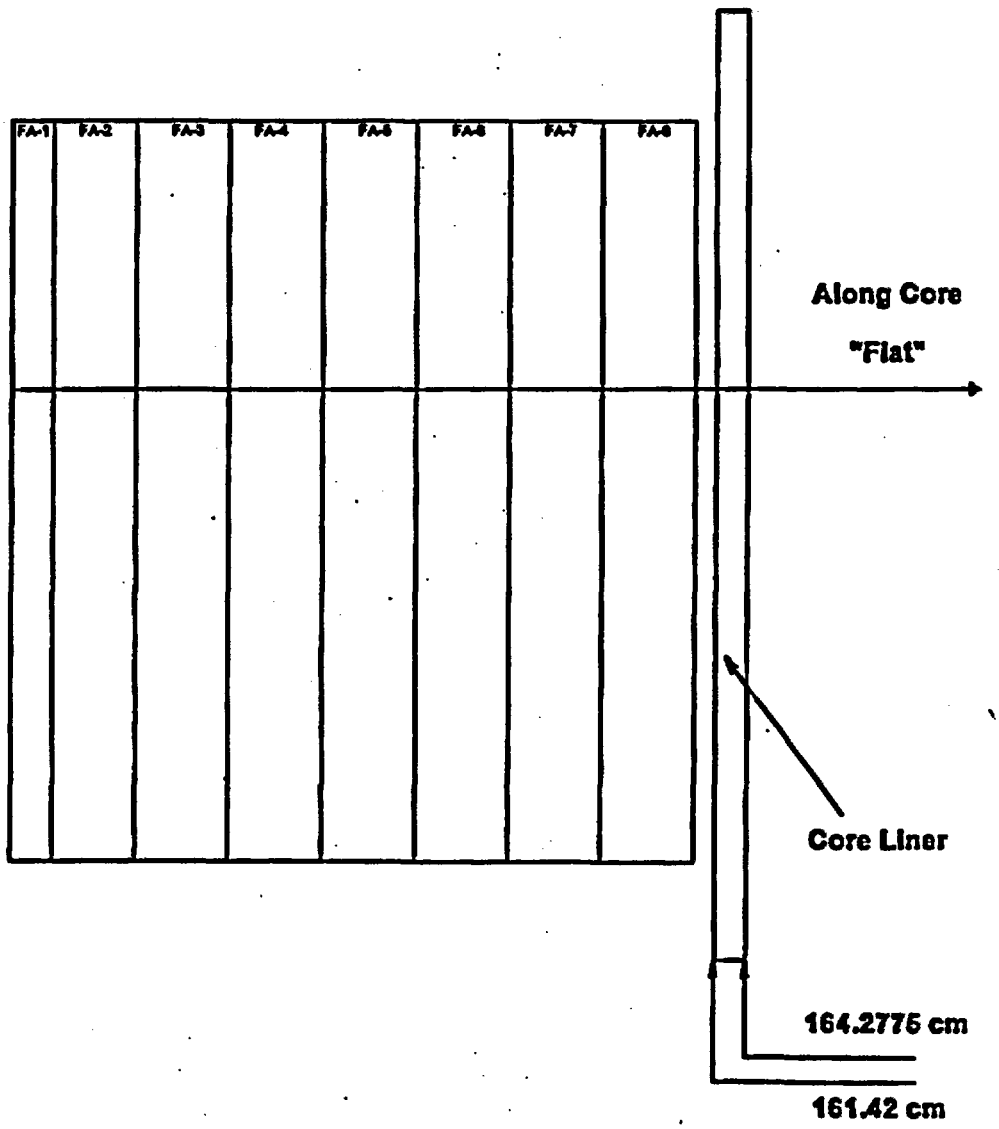


Table 2-2 summarizes fuel assembly and reactor core data used for modeling the Sequoyah Unit 2 reactor for cycles 1-3. Additional fuel cycle design, core operations, and reactor criticality statepoint information will be provided in Sections 3 and 4.

Table 2-2. Sequoyah 2 Fuel Assembly/Core Data

Fuel Assembly Array Size and Type	17 x 17 STD
Number of Fuel Pins (N_R) / Assembly	264
Number of Guide Tubes (N_{GT}) / Assembly	24
Number of Instrument Tubes (N_{IT}) / Assembly	1
Number of Assemblies in Core	193
System Pressure	2250 psia/1.551 x 10^7 Pa
Core Height (H)	365.76 cm
Pin Pitch	1.25984 cm
Fuel Pin Cladding OD (outer diameter - OD_C)	0.94996 cm
Fuel Cladding Material	zircaloy
Guide Tube Upper Region	
Length in Active Fuel Region (H_1)	308.4703 cm
Guide Tube OD (OD_{GT-U})	1.22428 cm
Guide Tube Lower Region	
Length in Active Fuel Region (H_2)	57.2897 cm
Guide Tube OD (OD_{GT-L})	1.08966 cm
Guide Tube Material	zircaloy
Instrument Tube OD (OD_{IT})	1.22428 cm
Instrument Tube Material	zircaloy
Assembly Pitch (P)	21.50364 cm
Inconel Spacer Grid Height	3.35788 cm

Grid Volume for Active Fuel Region in Single Assembly:

Volume of Inconel Grid = V_{IG} = 666.6352 cm^3

V_{M+G} = Volume of Moderator plus Grid in Fuel Assembly (excluding inside guide tubes and instrument tube)

$$= P^2 \cdot H - H \cdot \frac{\pi}{4}\left[N_R \cdot OD_C^2 + N_{IT} \cdot OD_{IT}^2\right] - N_{GT} \cdot \frac{\pi}{4}\left[H_1 \cdot OD_{GT-U}^2 + H_2 \cdot OD_{GT-L}^2\right]$$

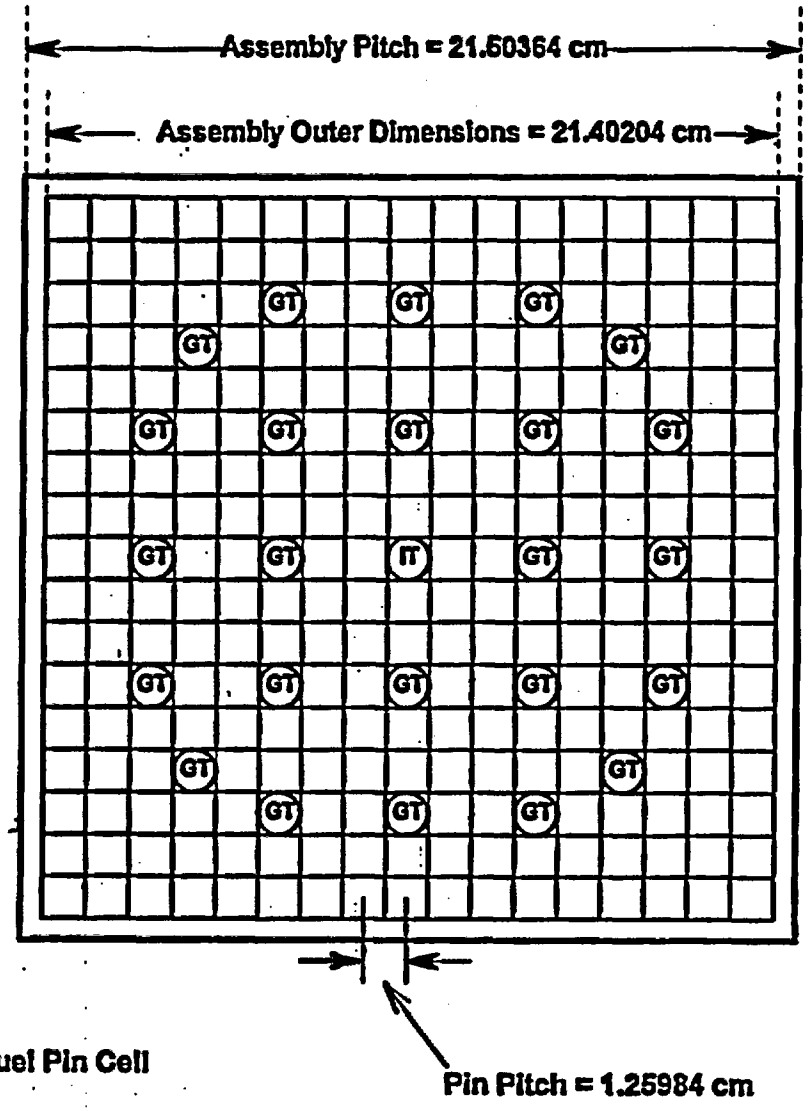
$$= 90{,}263.3285 \text{ cm}^3$$

Assembly Volume Fraction of Inconel Grid = V_{IG}/V_{M+G} = 0.0073854

(Note: The number of digits shown above for volumes and volume fractions are an artifact of the computational process and are taken directly from Reference 5).

Figure 2-3 presents a radial view of a single Westinghouse 17 x 17 standard fuel assembly (STD) showing the locations of the guide tubes, instrument tube, and fuel pins. Axial dimensions, by region, for the STD fuel assembly are presented in Figures 2-4. This assembly contains 6 Inconel intermediate spacer grids and two Inconel end spacer grids. The upper end spacer grid is above the active fuel region, whereas the lower end spacer grid and the 6 intermediate spacer grids are inside the active fuel region.

Figure 2-3. Radial View of a Single 17 x 17 STD Fuel Assembly



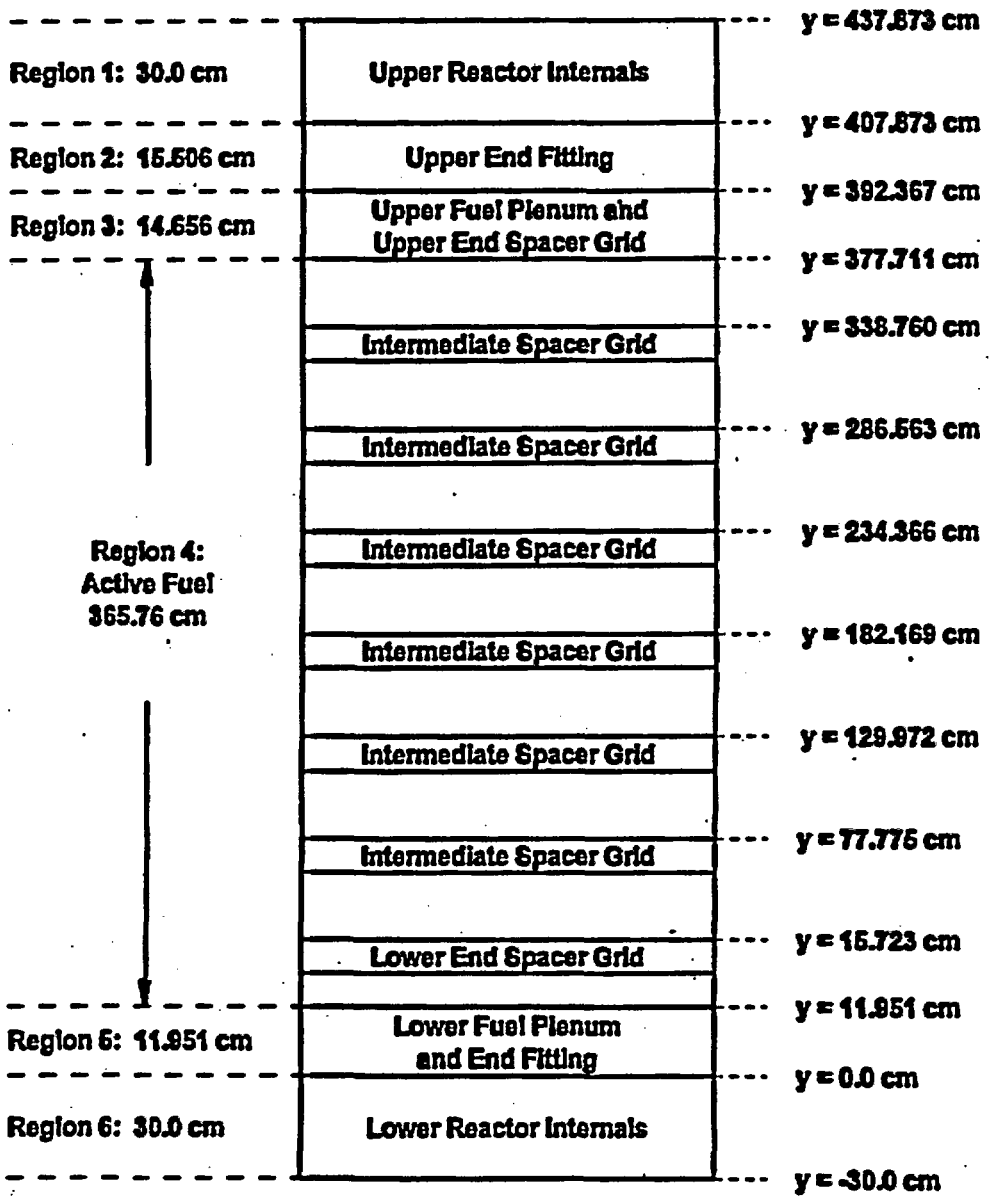
Fuel Pin Cell

GT Guide Tube

IT Instrument Tube

Note: Assembly outer dimension is less than 17 times the pin pitch. The outermost cells (except corners) are rectangular and not square like the other cells

Figure 2-4. Axial Dimensions by Region for 17 x 17 STD Fuel Assembly



Figures 2-5 through 2-7 provide axial dimensions for the guide tubes, instrument tube, and fuel pins shown in Figure 2-3 for the Westinghouse 17 x 17 standard fuel assembly. Figures 2-8 through 2-11 provide axial dimensions for rod cluster control assemblies (RCCAs) with rods at 0% withdrawn, pyrex burnable poison rod assemblies (BPRAs), wet annular burnable absorber (WABA) type BPRAs, and thimble plugs that are attached to BPRAs at empty locations.

Regions 1 and 6, in Figures 2-4 through 2-11, are represented as homogenized regions of stainless steel and water. Regions 2, 3, and 5 contain various combinations of guide tubes, instrument tube, and fuel rod assemblies (no fuel pellets), as well as other materials (stainless steel, Inconel, and water). The fraction of guide tubes, instrument tube, and fuel rod assemblies will be represented explicitly in these regions. (Note: the fuel rod assemblies do not extend to region 2.) The other materials will be homogenized within the remaining portions of the regions. The water inside the guide tubes and instrument tube will be represented explicitly within the respective tubes. The volume fractions of other materials, by region, for the Westinghouse 17 x 17 standard fuel assembly are presented in Table 2-3.

Table 2-3. Volume Fractions for Non-Fuel Regions for Non-Control Assemblies (STD)

	Volume Fractions*		
Region	SS	Inc	Water
1	0.1770	0.0	0.8230
2	0.1243	0.0168	0.8589
3	0.0031	0.0264	0.9705
5	0.1625	0.0	0.8375
6	0.1720	0.0	0.8280

* The volume fractions presented exclude the guide tubes, instrument tube, and fuel rod assembly portions of these regions.

Note: Inc = Inconel
SS = Stainless Steel

The fuel rods are contained in regions 3, 4, and 5. Region 4 is modeled explicitly. Regions 3 and 5 contain various amounts of stainless steel and zircaloy in the fuel rod assembly which represent plenum springs and end caps. In addition, these regions also contain helium and fission gases, as well as the zircaloy cladding. The fuel rod assembly volume fractions for materials in these regions for the Westinghouse 17 x 17 standard fuel assembly are as follows:

Table 2-4. STD Fuel Rod Assembly Volume Fractions for Regions 3 and 5

	Fuel Rod Assembly Volume Fractions			
Region	SS	Zr	Cladding*	Gas
3	0.0764	0.0513	0.2173	0.6550
5	0.1241	0.1685	0.1898	0.5176

* The zircaloy (Zr) cladding extends from Y = 8.278 cm to Y = 391.615 cm. For all 264 rods, 13.904 cm length of fuel cladding is included in region 3 and 3.673 cm length of fuel cladding is included in region 5.

Figure 2-5. Axial Dimensions for Guide Tubes for STD Fuel Assembly

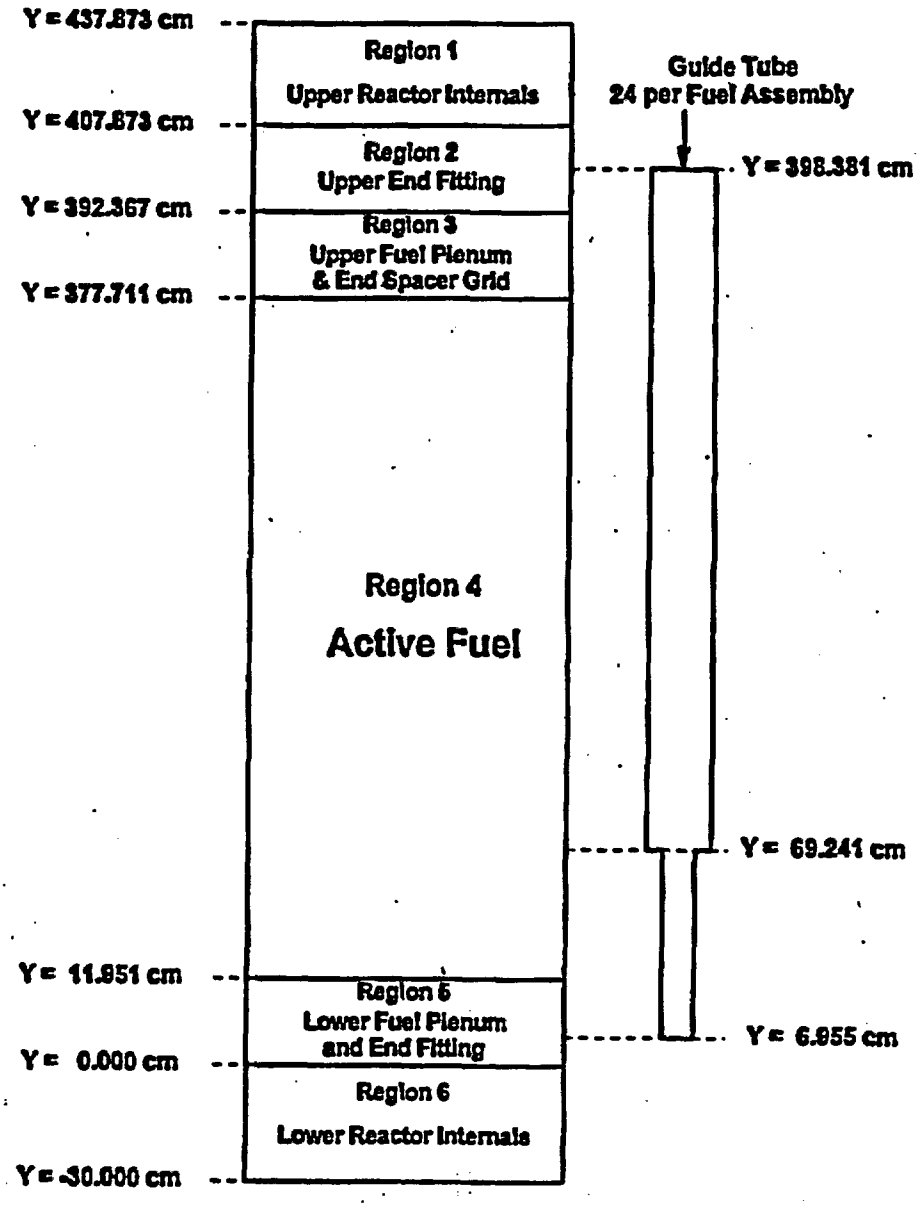


Figure 2-6. Instrument Tube Axial Dimensions for STD Fuel Assembly

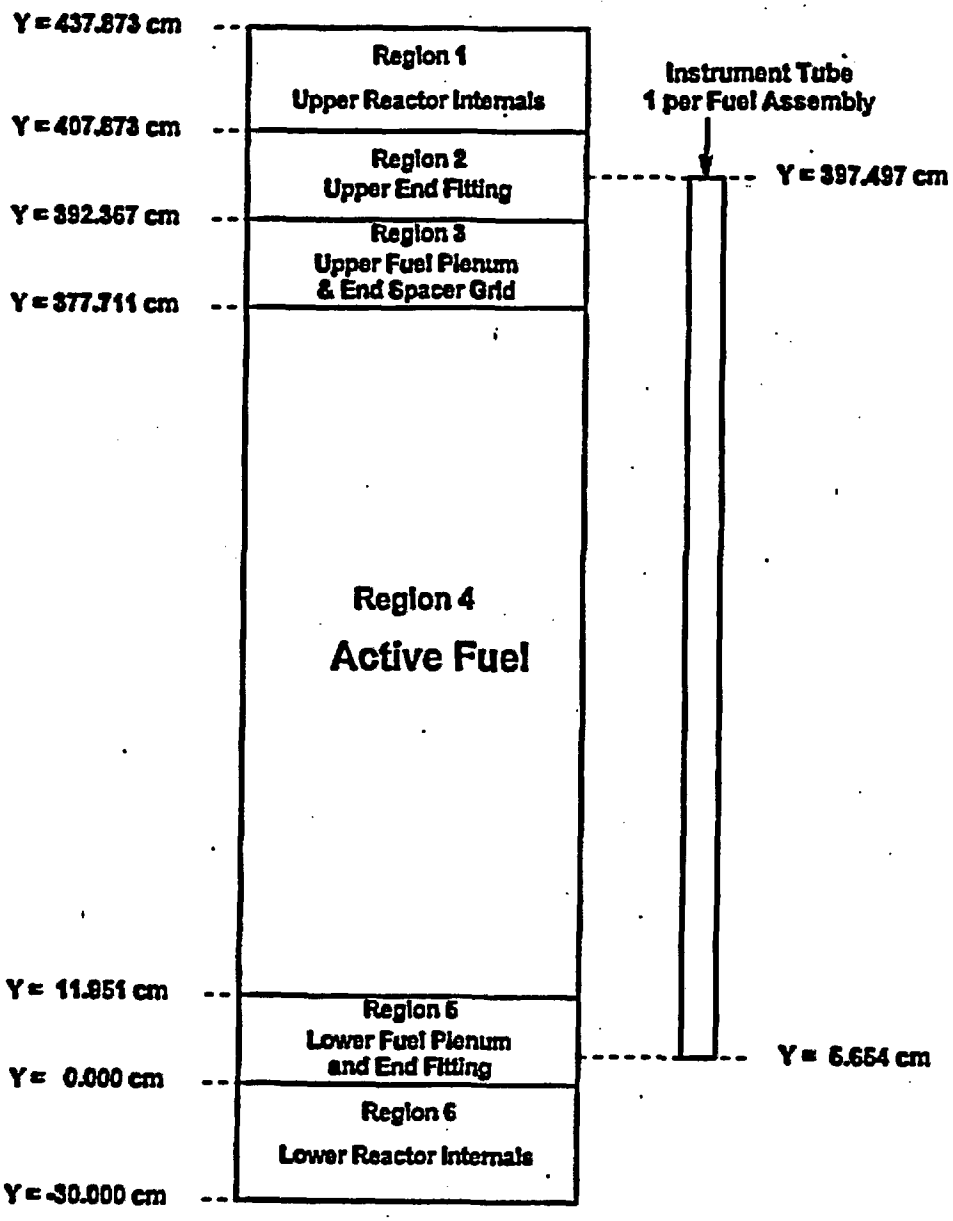


Figure 2-7. Fuel Rod Assembly Axial Dimensions for STD Fuel Assembly

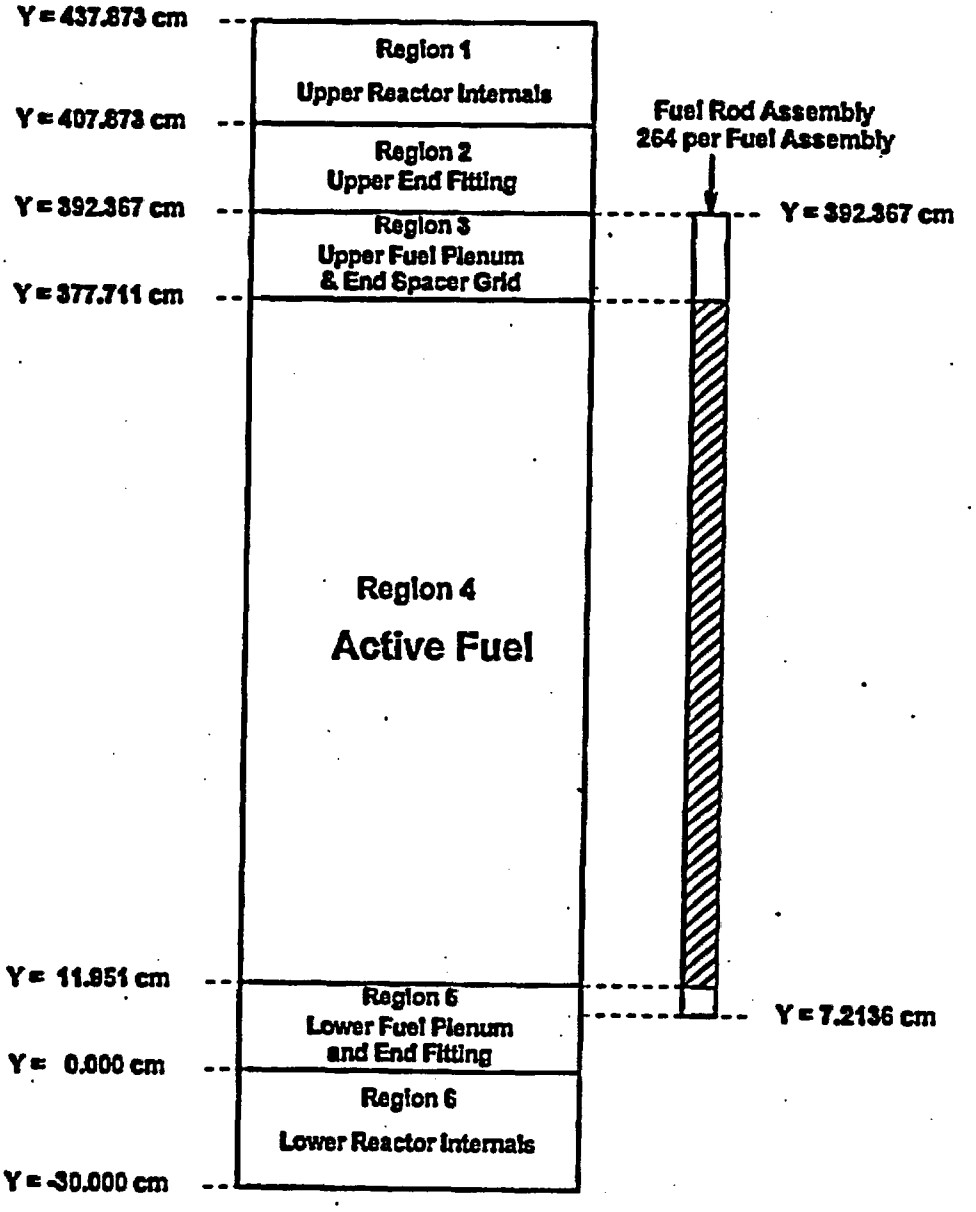


Figure 2-8 provides axial dimensions for a fully inserted (0% withdrawn) control rod for a STD fuel assembly.

RCCA Materials/Dimensions:

Lower cap - stainless steel (diameter = 0.96774 cm)

Cladding - stainless steel (Clad OD = 0.96774 cm, Clad ID = 0.87376 cm, where OD = outer diameter, ID = inner diameter)

Absorber - Ag-In-Cd (diameter = 0.86614 cm)

Spacer - stainless steel (diameter = 0.8585 cm)

Upper plenum/spring area - Volume Fractions:

Clad - Stainless Steel	= 0.1848
Spring - Inconel	= 0.2784
Gas	= 0.5368

Upper cap - stainless steel (diameter = 0.96774 cm)

Upper stem - stainless steel (diameter = 0.5563 cm)

RCCA Volume Fractions:

The control rods are represented explicitly in regions 2, 3, and 4. The remainder of materials (excluding fuel rods, instrument tube, and guide tubes) are homogenized in regions 1, 2, and 3. The volume fractions of these materials (including non-RCCA materials) for RCCAs with rods at 0% withdrawn (WD) are given in Table 2-5.

Table 2-5. Volume Fractions for STD Assemblies with RCCAs (0% Withdrawn) for Regions 1 - 3

	Volume Fractions (Rods 0% WD)		
Region	SS	Inc	Water
1	0.1907	0.0035	0.8058
2	0.1444	0.0218	0.8338
3*	0.0031	0.0264	0.9705

* Region 3 volume fractions are the same as for non-control assemblies (Table 2-3).

For fully withdrawn control rods (100% withdrawn) the volume fractions presented in Table 2-3 (for STD non-control assemblies) should be used.

Figure 2-8. Axial Dimensions for RCCAs (Rods 0% Withdrawn) for STD Fuel Assembly

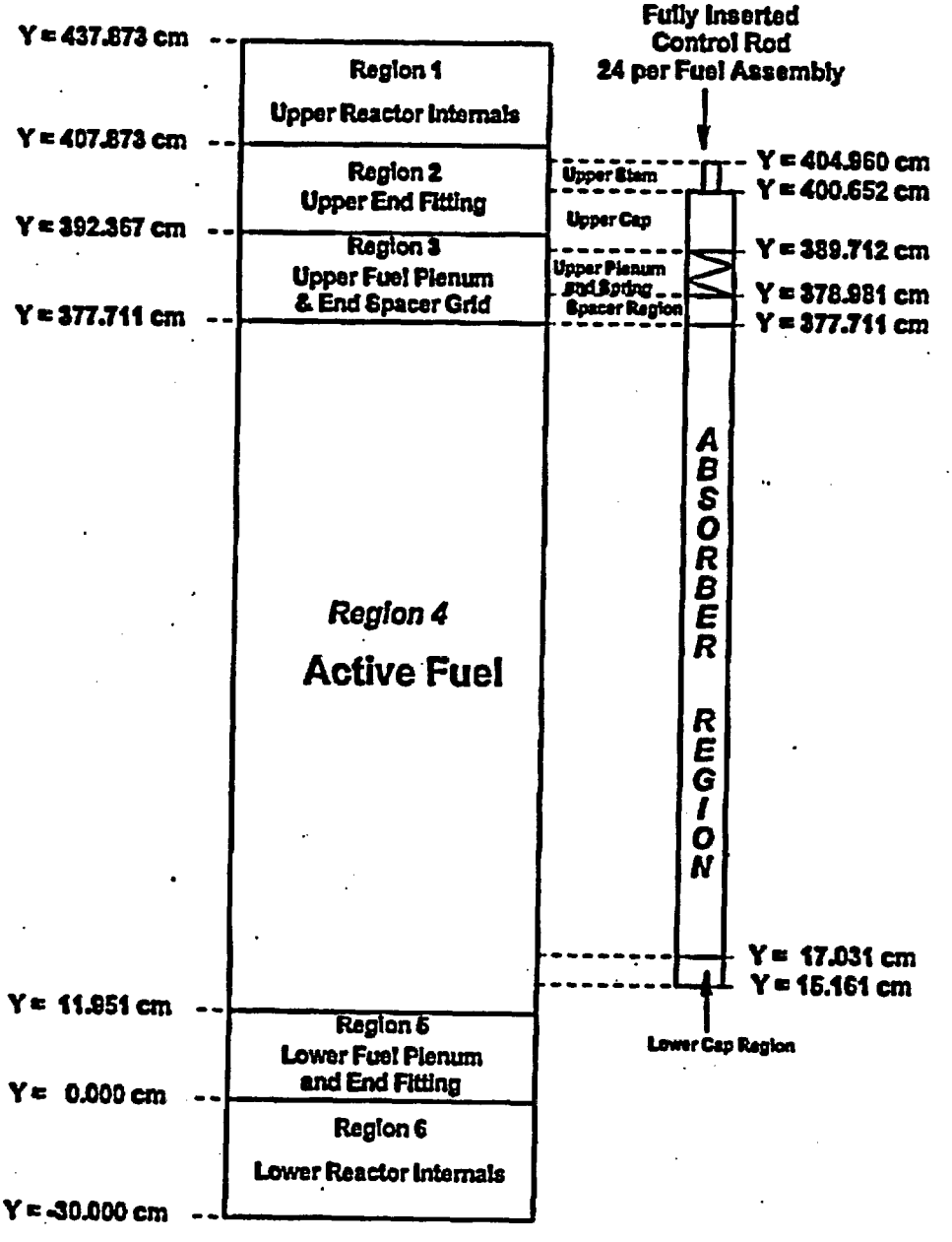


Figure 2-9 provides axial dimensions for the pyrex burnable absorber rod assembly. Figure 2-10 provides axial dimensions for the wet annular burnable absorber (WABA) rod assembly. These dimensions are applicable for the STD fuel assembly.

Pyrex BPRA Materials/Dimensions:

Lower cap - stainless steel (diameter = 0.96774 cm)

Cladding - stainless steel Outer tube - OD = 0.96774 cm, ID = 0.87376 cm
Inner tube - OD = 0.46101 cm, ID = 0.42799 cm

Absorber - B_2O_3-SiO_2 Pyrex tube - OD = 0.85344 cm, ID = 0.48260 cm

Upper plenum region - stainless steel clad (outer tube), helium gas in annulus

Upper cap - stainless steel (diameter = 0.96774 cm)

Upper stem - stainless steel (diameter = 0.54356 cm)

WABA Materials/Dimensions:

Lower cap - zircaloy (OD = 0.96774 cm, ID = 0.254 cm)
Water annulus (diameter = 0.254 cm)

Cladding - zircaloy Outer tube - OD = 0.96774 cm, ID = 0.8357 cm
Inner tube - OD = 0.6782 cm, ID = 0.5715 cm

Absorber - B_4C-Al_2O_3 WABA - OD = 0.8077 cm, ID = 0.7061 cm
Helium in gap between absorber and cladding

Water annulus - diameter = 0.5715 cm

Upper plenum region - zircaloy clad OD = 0.96774 cm, Volume Fractions: zircaloy = 0.3967
Water = 0.6033

Upper cap - zircaloy (diameter = 0.96774 cm)

Upper stem - zircaloy (diameter = 0.54356 cm)

BPRA Volume Fractions:

The burnable poison and other materials inside the guide tubes are represented explicitly through region 3 and into region 2. This includes most of the upper end cap. The BPRA upper structure (beyond the end cap) is homogenized with the other assembly components within region 2. The volume fractions of these materials (including non-BPRA materials) are given in Tables 2-6. For STD fuel assemblies the volume fractions are the same for both Pyrex and WABA. There are 24 locations (guide tubes) for rod insertion in the fuel assembly. The number of burnable poison rods varies from 8 to 24 among the BPRAs for cycles 1 through 3 of Sequoyah 2. A thimble plug (Figure 2-11) is used for any empty location where a burnable poison (BP) rod is not installed.

Table 2-6. Volume Fractions for STD Fuel Assemblies with WABA or Pyrex BPRAs for Regions 2 - 3

	Volume Fractions BPRAs		
Region	SS	Inc	Water
2	0.1649	0.0228	0.8123
3*	0.0031	0.0264	0.9705

* Region 3 volume fractions are the same as for non-control assemblies (Table 2-3).

Figure 2-9. Axial Dimensions for Pyrex BPRAs for STD Fuel Assembly

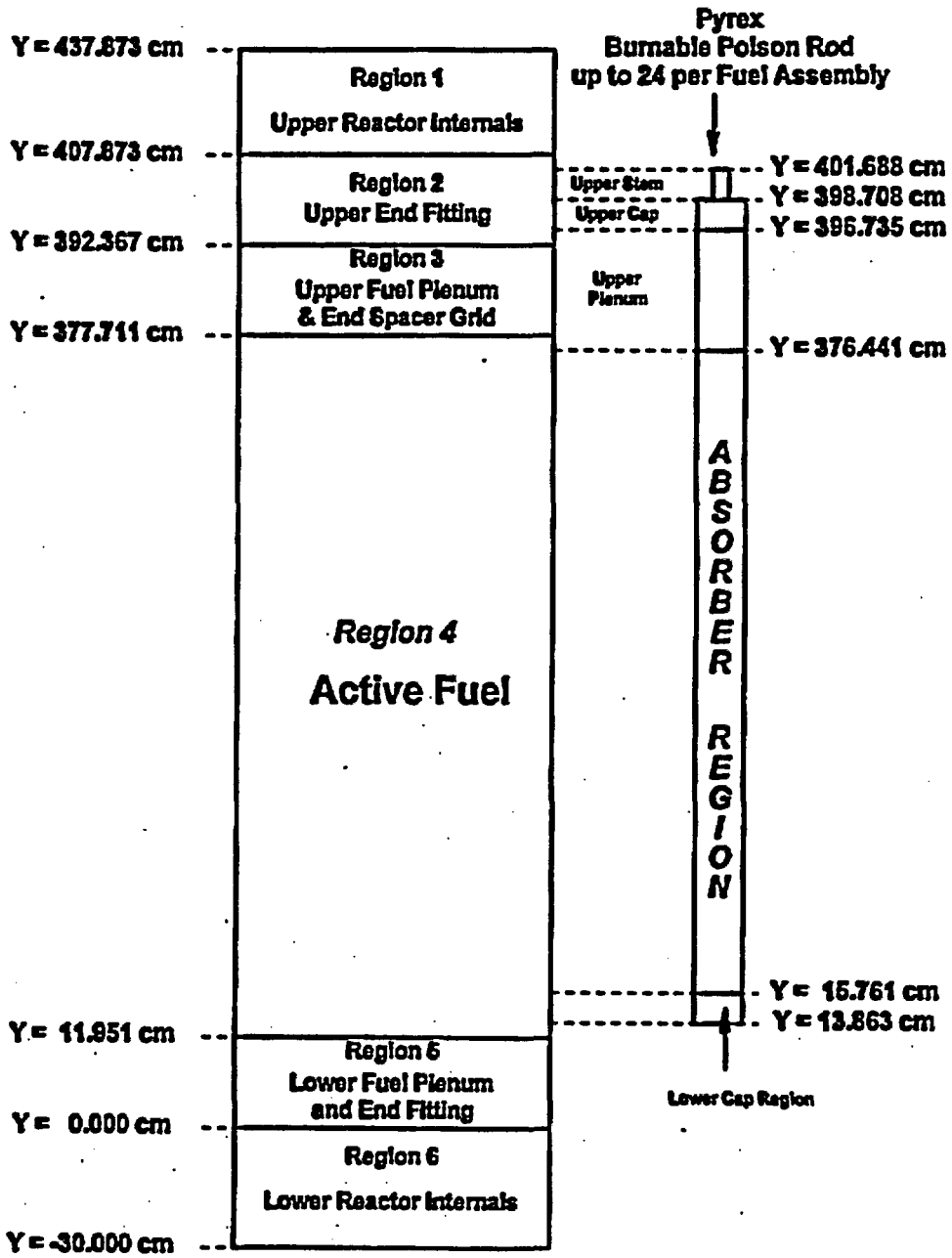


Figure 2-10. Axial Dimensions for WABA BPRAs for STD Fuel Assembly

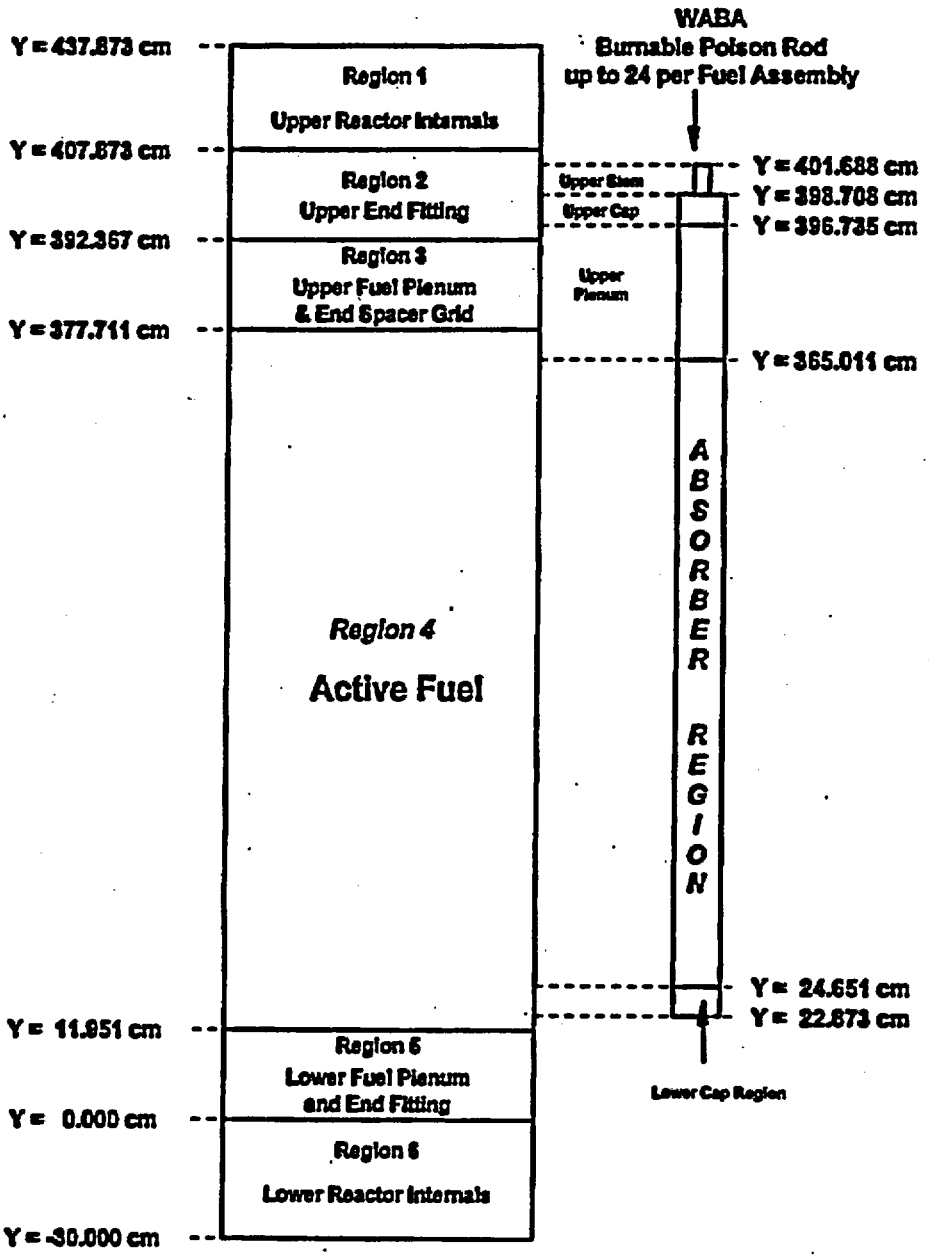
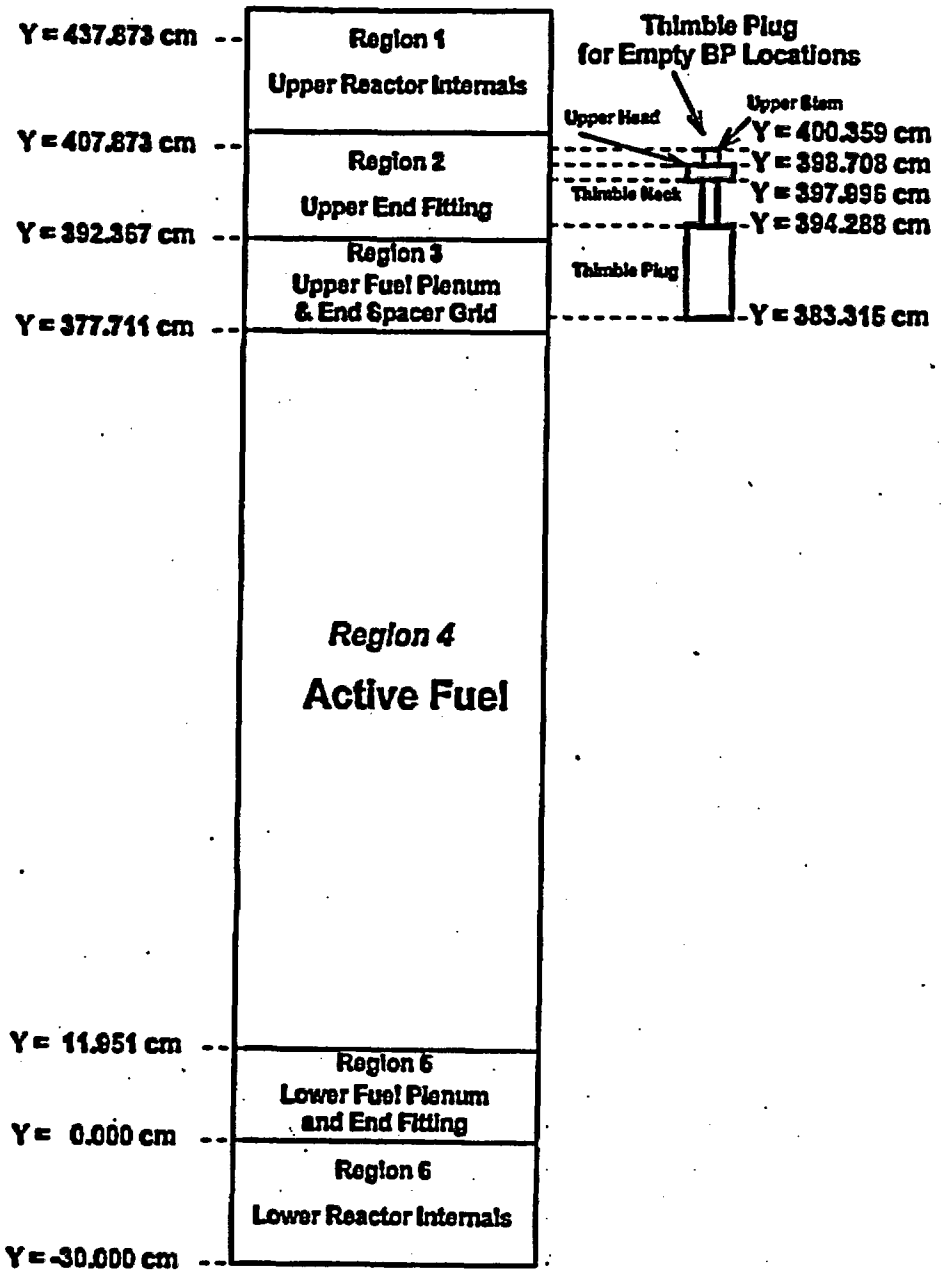


Figure 2-11. Axial Dimensions for Thimble Plug for STD Fuel Assembly



Thimble Plug Materials/Dimensions:

Thimble plug - stainless steel (diameter = 1.08204 cm)

Thimble neck - stainless steel (diameter = 0.4826 cm)

Upper head - stainless steel (diameter = 0.96774 cm)

Upper stem - stainless steel (diameter = 0.54356 cm)

3.0 FUEL CYCLE DESIGN INFORMATION

This section provides fuel assembly design data for cycles 1 through 3 of the Sequoyah Unit 2 reactor. Material and geometry data for the fuel assembly components along with cycle length data are presented in Section 3.1. The fuel assembly locations for each cycle, fuel enrichments and number of burnable absorber rods for each assembly, and control rod bank locations are presented in Section 3.2.

3.1 Fuel Batch Data

Material and geometry data for each fresh fuel batch present in cycles 1-3 are given in Table 3-1. This includes the cycle in which the fuel was first loaded, the fuel assembly type, the enrichment and kilograms of uranium in each fuel assembly (by batch), the diameter of the fuel pellets, the BPRA type, and the type of fuel assembly grid material. The radial dimensions of the fuel clad, instrument tube, and guide tube are also presented. In addition, material and radial dimensions for RCCAs and BPRAs are provided. This data should be used in modeling each fuel assembly type for burnup calculations and the reactor criticality calculations for the statepoints defined in Table 3-2.

The length of each fuel cycle, expressed as effective-full-power-days (EFPD), is provided in Table 3-2. The time during each cycle where statepoint criticality data was measured is also presented.

Table 3-1. Fuel Assembly/Pin/Cycle Description for Cycles 1-3

Cycle	Fresh Fuel Batch	Assembly Type	wt% U235	kgU/ Assembly	FP Pellet OD (cm)	FP Clad OD (cm)	FP Clad ID (cm)	FA Grid Material	BPRA Type
1	1	STD	2.10	458.88	0.81915	0.94996	0.83566	Inconel	Pyrex
	2	STD	2.60	458.88	0.81915	0.94996	0.83566	Inconel	Pyrex
	3	STD	3.10	458.88	0.81915	0.94996	0.83566	Inconel	Pyrex
2	4	STD	3.50	458.97	0.81915	0.94996	0.83566	Inconel	WABA
3	5A	STD	3.80	461.50	0.81915	0.94996	0.83566	Inconel	WABA
	5B	STD	3.60	460.71	0.81915	0.94996	0.83566	Inconel	WABA

FP - Fuel Pin; FA - Fuel Assembly; BPRA - Burnable Poison Rod Assembly
OD - outer diameter; ID - inner diameter

Description	Material	OD (cm)	ID (cm)
Instrument Tube	zircaloy	1.22428	1.14300
Guide Tube (Upper Region)	zircaloy	1.22428	1.14300
(Lower Region)	zircaloy	1.08966	1.00838

RCCAs	
Pellet Material	Ag-In-Cd
Fraction of Pellet Materials	Ag(80%), In(15.0%), Cd(5.0%)
Pellet Density	10.16 g/cc
Pellet OD	0.86614 cm
Clad Material	SS304
Clad OD	0.96774 cm
Clad ID	0.87376 cm

BPRAs (Annular)	Pyrex	WABA
Material	B_2O_3-SiO_2	B_4C-Al_2O_3
Boron Loading	12.5 wt% B_2O_3	14.0 wt% B_4C
	0.00624 g/cm (B-10)	0.006165 g/cm (B-10)
Absorber OD	0.85344 cm	0.8077 cm
Absorber ID	0.48260 cm	0.7061 cm
Clad Material	SS304	zircaloy
Outer Clad OD	0.96774 cm	0.96774 cm
Outer Clad ID	0.87376 cm	0.83570 cm
Inner Clad OD	0.46101 cm	0.67820 cm
Inner Clad ID	0.42799 cm	0.57150 cm

Table 3-2. Cycle Length and Time During Cycle Statepoint Data Measured for Cycles 1-3

Cycle	End-of-Cycle EFPD	Statepoint Number*	Time of Measurement EFPD
1	389.3	SP36	0.0
2	297.0	-	-
3	377.3	SP37	0.0
		SP38	210.9

* The unique statepoint numbers SP36, SP37, and SP38 are assigned to Sequoyah Unit 2 data.

3.2 Fuel Assembly Data

The fuel assembly loadings for each cycle are presented in Figures 3-1 through 3-3. A one-eighth core representation is used, where the fuel assembly at the center of the core is in location H8. Included in these figures are the location of the fuel assemblies in the current cycle, the location in a previous cycle (if applicable), the cycle that the fuel was first inserted, and the fuel batch number for each fuel assembly. The enrichment of U-235 (by batch), the locations of BPRAs, and number of burnable poison (BP) rods in each, and the location of the various control rod banks are also presented. The fuel assemblies with BPRAs may contain different number of BP rods (i.e., 8 to 24 BP rods). The location of these BP rods in a fuel assembly along with the orientation of the assembly in the reactor core are presented in Figure 3-4.

Each fuel assembly is given a unique alphanumeric designation which is then used in tracking the fuel assembly through its entire period of operation. This includes both the time that each fuel assembly was in the reactor during reactor operation (i.e., producing power) and the time spent in a non-power producing mode (e.g., in the reactor during shutdown or in the spent fuel pool).

Starting with the letter A for cycle 1, each subsequent cycle is assigned a unique letter designation (B for cycle 2, C for cycle 3). In addition, each one-eighth core location is assigned a unique number. As noted in Table 2-2, the Sequoyah Unit 2 reactor contains 193 fuel assemblies. Assuming eighth core symmetry reduces this number to 31 fuel assemblies represented. Thus, the assemblies are numbered 1 through 31. Starting at the center of the core, location H8 is number 1. Numbers 2 through 8 are assigned to locations G8 through A8. Proceeding from left to right (then down), number 9 is assigned to location G9, number 15 to location A9, number 16 to location F10, number 22 to location E11, etc., to number 31 being assigned to location B13.

Using this nomenclature, the assemblies in cycle 1 are labeled A1 (for H8) through A31 (for B13). For subsequent cycles, a complete set of labels is not required since a combination of

burned and fresh fuel is used. From Figure 3-6 it is seen that the first fresh fuel assembly encountered in cycle 2 is in location B9. Thus, the cycle 2 labeling for new fuel starts with assembly B14. Figures 3-5 through 3-7 were constructed by applying this nomenclature to the fuel assembly location data given in Figures 3-1 through 3-3. Note that the nomenclature accommodates the shuffling of symmetric components of fuel assemblies to two separate locations in the one-eighth core representation. This is seen in Figure 3-6 where assembly A21 from core location A10 (representing 8 fuel assemblies in the core) in cycle 1 was shuffled for cycle 2 to core locations C8 and G8 (each representing 4 fuel assemblies in the core). The assembly represented at location G8 was then given the identification A21a.

From Figure 3-7, it is seen that one-eighth core symmetry is not maintained in cycle 3. Fuel assemblies in one-eighth core symmetric locations C9 and G13 in cycle 3 come from locations E10 and G8 respectively in cycle 2, which are not one-eighth core symmetric locations. In addition, these assemblies started in cycle 1 in locations A11 and A10, which are also non-one-eighth core symmetric locations. Similarly, fuel assemblies in locations B13 and C14 come from locations C12 and E9 in cycle 2, which are not one-eighth core symmetric locations. Thus, a full core representation should be analyzed for cycle 3 (SP37 and SP38).

Figure 3-1. Cycle 1 One-Eighth Core Loading for Sequoyah Unit 2
(Note: This figure was changed from REV 00)

	H	G	F	E	D	C	B	A
8	F(1) 1	F(1) 1	F(1) 1	F(1) 2	F(1) 1	F(1) 2	F(1) 1	F(1) 3
9		F(1) 1	F(1) 2	F(1) 1	F(1) 2	F(1) 1	F(1) 2	F(1) 3
10			F(1) 1	F(1) 2	F(1) 1	F(1) 2	F(1) 1	F(1) 3
11				F(1) 1	F(1) 2	F(1) 1	F(1) 2	F(1) 3
12					F(1) 1	F(1) 2	F(1) 3	
13						F(1) 3	F(1) 3	

CR	= Previous FA position Column/Row (C/R) - 1/8th Core
F	= Cycle FA was Fresh (F)
B	= Fuel Batch (B)

Cycle	Batch	Wt% U-235
1	1	2.10
	2	2.60
	3	3.10

BPRA Loading	
Fuel Assembly Location	Number BP Rods/ Assembly
B11, B13	8
A8, A10	10
G8, B9	12
D9, C10, D11, C12	16
E8, C8, F9, E10	20

Control Rod Bank	Core Location
CA	F8
CB	B10
CC	B8, F10
CD	H8,D8, D12

Figure 3-2. Cycle 2 One-Eighth Core Loading for Sequoyah Unit 2
(Note: This figure was added to REV 01)

	H	G	F	E	D	C	B	A
8	B10 F(1) 1	A10 F(1) 3	B9 F(1) 2	A8 F(1) 3	C12 F(1) 2	A10 F(1) 3	B10 F(1) 1	C8 F(1) 2
9		B9 F(1) 2	A9 F(1) 3	B12 F(1) 3	C10 F(1) 2	E10 F(1) 2	F(2) 4	F(2) 4
10			C12 F(1) 2	A11 F(1) 3	F9 F(1) 2	F(2) 4	D9 F(1) 2	F(2) 4
11				E8 F(1) 2	B13 F(1) 3	D11 F(1) 2	F(2) 4	F(2) 4
12					C13 F(1) 3	B11 F(1) 2	F(2) 4	
13						F(2) 4	F(2) 4	

CR	= Previous FA position Column/Row (C/R) - 1/8th Core
F	= Cycle FA was Fresh (F)
B	= Fuel Batch (B)

Cycle	Batch	Wt% U-235
3	1	2.10
	2	2.60
	3	3.10
	4	3.60

BPRA Loading	
Fuel Assembly Location	Number BP Rods/ Assembly
B9, C13	8
B11, C10	12

Control Rod Bank	Core Location
CA	F8
CB	B10
CC	B8, F10
CD	H8, D8 D12

Figure 3-3. Cycle 3 One-Eighth Core Loading for Sequoyah Unit 2
(Note: This figure was added to REV 01)

	H	G	F	E	D	C	B	A
8	E10 F(1) 3	F(3) 6B	C13 F(2) 4	F(3) 6B	A8 F(1) 2	F(3) 6B	C8 F(1) 3	F(3) 6B
9		D12 F(1) 3	B11 F(2) 4	B9 F(2) 4	B12 F(2) 4	E10* F(1) 3	F(3) 6A	F(3) 6A
10			E8 F(1) 3	F(3) 6B	F9 F(1) 3	F(3) 6A	D11 F(1) 3	F(3) 6A
11				E9 F(1) 3	A9 F(2) 4	C10 F(2) 4	F(3) 6A	B13 F(2) 4
12					C12 F(1) 2	A10 F(2) 4	A11 F(2) 4	
13		G8* F(1) 3				F(3) 6B	C12^A F(1) 2	
14						E9^A F(1) 3		

* Not one-eighth core symmetric
^A Not one-eighth core symmetric

CR	= Previous FA position Column/Row (C/R) - 1/8th Core
F	= Cycle FA was Fresh (F)
B	= Fuel Batch (B)

Cycle	Batch	Wt% U-235
3	2	2.60
	3	3.10
	4	3.60
	6A	3.80
	6B	3.60

BPRA Loading	
Fuel Assembly Location	Number BP Rods/ Assembly
B11	8
C8, E10	12
B9, G8	16
C10	20
E8	24

Control Rod Bank	Core Location
CA	F8
CB	B10
CC	B8, F10
CD	H8, D8 D12

Figure 3-4. Burnable Poison Rod Locations within a Fuel Assembly (Note: This figure was changed for REV 01)

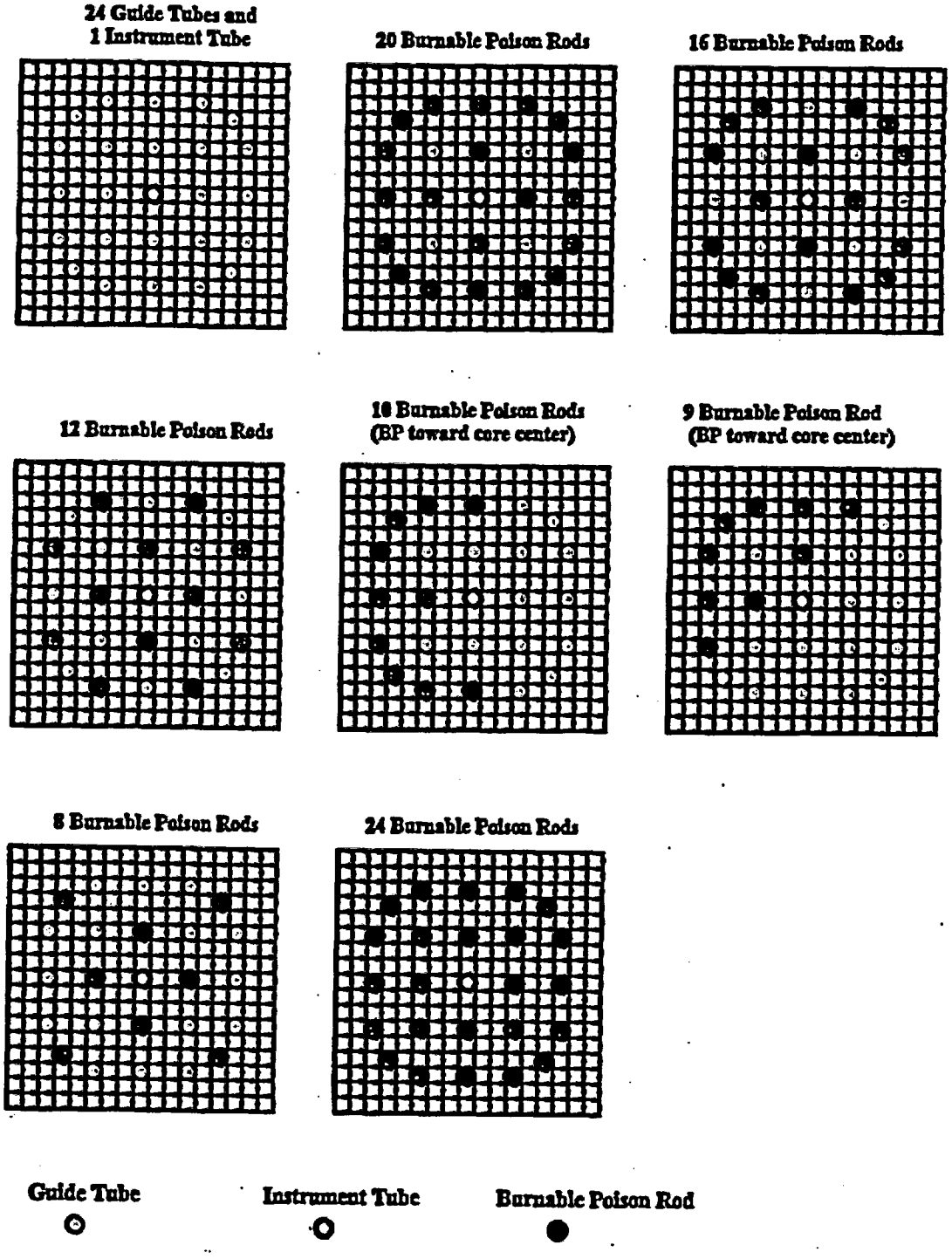


Figure 3-5. Cycle 1 Fuel Assembly Identification & Locations for Sequoyah 2
(Note: This figure was added to REV 01)

	H	G	F	E	D	C	B	A
8	A1	A2	A3	A4	A5	A6	A7	A8
9		A9	A10	A11	A12	A13	A14	A15
10			A16	A17	A18	A19	A20	A21
11				A22	A23	A24	A25	A26
12					A27	A28	A29	
13						A30	A31	

A Cycle 1
B Cycle 2
C Cycle 3

Figure 3-6. Cycle 2 Fuel Assembly Identification & Locations for Sequoyah 2
(Note: This figure was added to REV 01)

	H	G	F	E	D	C	B	A
8	A20	A21a	A14	A8	A28	A21	A20a	A6
9		A14a	A15	A29	A19	A17	B14	B15
10			A28a	A26	A10	B19	A12	B21
11				A4	A31	A23	B25	B26
12					A30	A25	B29	
13						B30	B31	

A Cycle 1
B Cycle 2
C Cycle 3

Figure 3-7. Cycle 3 Fuel Assembly Identification & Locations for Sequoyah 2
(Note: This figure was added to REV 01)

	H	G	F	E	D	C	B	A
8	A26	C2	B30	C4	A6	C6	A21	C8
9		A30	B25	B14	B29	A26a*	C14	C15
10			A8	C17	A15	C19	A31	C21
11				A29	B15	B19	C25	B31
12					A25	B21	B26	
13		A21a*				C30	A25a^	
14						A29a^		

* Not one-eighth core symmetric
^ Not one-eighth core symmetric

A Cycle 1
B Cycle 2
C Cycle 3

To aid in the burnup calculations, and thus the generation of isotopic data for the statepoint calculations, the information provided in Figures 3-1 through 3-7 was reduced to two tables. Table 3-3 traces each fuel assembly (and subsequent split by shuffling symmetric components to more than one location, if applicable), by assembly identification and cycle, from the time the assembly was first inserted in the reactor through cycle 3. Those assemblies which split for a subsequent cycle (i.e., with an "a" designator) carry a hyphen (-) designator in the cycle column to indicate those cycles where the assemblies are present prior to the split. This will aid the burnup calculation process by indicating where redundant data generation is not required. Note that only those fuel assemblies which contribute to the statepoint calculations in cycle 3 are included in this table. These are the fuel assemblies that require burnup calculations. The location of each assembly in each cycle in indicated by the coordinates given in the figures (e.g., H8, B13).

Table 3-4 is a repeat of portions of Table 3-3 where control rod bank insertion and burnable absorber loadings are given for those assemblies that contained control rods or burnable absorber rods during cycle operation. Control rod insertion and burnable absorber (BA) rods must be modeled in the burnup calculations for those assemblies and axial locations where either type of rod are present. (More data concerning control rod insertion time by axial node is given in Section 4.) The rod bank indicator CD is given for those assemblies and cycles where rod bank CD was inserted. (This is the only bank inserted during normal cycle operation.) The burnable absorber loadings are given as the number of burnable absorber (or burnable poison) rods present in the fuel assembly. For those cycles where the rod bank or the burnable absorber rods are not present, the assemblies' presence in the core is indicated with an "X".

Table 3-3. Fuel Assembly Locations by Cycle for Burnup Calculations (Note: This table was added to REV 01)

Assembly Number/Batch	Assembly Location in Cycle 1	2	3	Comments
				Cycle 1
A6/2	C8	A8	D8	* For cycle 3 assemblies A21a and A26a are in 1/8th core symmetric locations, but do not have 1/8th core symmetric properties. ^ Assemblies A25a and A29a are also in 1/8th core symmetric locations in cycle 3, but do not have 1/8th core symmetric properties.
A8/3	A8	E8	F10	
A15/3	A9	F9	D10	
A21/3	A10	C8	B8	
A21a/3	-	G8	G13*	
A25/2	B11	C12	D12	
A25a/2	-	-	B13^	
A26/3	A11	E10	H8	
A26a/3	-	-	C9*	
A29/3	B12	E9	E11	
A29a/3	-	-	C14^	
A30/3	C13	D12	G9	
A31/3	B13	D11	B10	
				Cycle 2
B14/4		B9	E9	
B15/4		A9	D11	
B19/4		C10	C11	
B21/4		A10	C12	
B25/4		B11	F9	
B26/4		A11	B12	
B29/4		B12	D9	
B30/4		C13	F8	
B31/4		B13	A11	
				Cycle 3
C2/5B			G8	Based on above comments for cycle 1 (i.e., * and ^), cycle 3 statepoints should be analyzed with full core geometry.
C4/5B			E8	
C6/5B			C8	
C8/5B			A8	
C14/5A			B9	
C15/5A			A9	
C17/5B			E10	
C19/5A			C10	
C21/5A			A10	
C25/5A			B11	
C30/5B			C13	

Table 3-4. Control Rod and BA Loading by Cycle for Burnup Calculations (Note: This table was added to REV 01)

Assembly Number/Batch	Number of BA Rods or Rod Bank ID# / Assembly Location in Cycle 1	2	3	Comments
				Cycle 1
A6/2	20/C8	X	CD/D8	BA ⇒ Pyrex
A8/3	10/A8	X	X	
A21/3	10/A10	X	X	
A21a/3	10/A10	X	X	
A25/2	9/B11	X	CD/D12	
A25a/2	9/B11	X	X	
A26/3	X	X	CD/H8	
A30/3	X	CD/D12	X	
A31/3	9/B13	X	X	
				Cycle 2
B14/4		8/B9	X	BA ⇒ WABA
B19/4		12/C10	X	
B25/4		12/B11	X	
B30/4		8/C13	X	
				Cycle 3
C2/5B			16/G8	BA ⇒ WABA
C4/5B			24/E8	
C6/5B			12/C8	
C14/5A			16/B9	
C17/5B			12/E10	
C19/5A			20/C10	
C25/5A			8/B11	

4.0 CORE OPERATIONS AND STATEPOINT INFORMATION

This section provides core operations data for the burnup calculations required to generate isotopic concentrations for the statepoint evaluations. The measured critical conditions for the statepoints evaluated are also contained in this section.

4.1 Core Follow Data

The use of commercial reactor criticality data for model validation requires detailed knowledge of how the reactor was operated for the lifetime of every fuel assembly contributing to the criticality database. This is necessary in order to adequately model the conditions for burnup calculations at each axial location of each fuel assembly represented in the reactor core for each statepoint evaluation. Thus, core follow calculations based on core operation data are used to provide local conditions as a function of time to be used for all burnup calculations performed in support of the statepoint evaluations. In addition, measured global data such as rod insertions and boron letdown data are also provided.

The core follow calculations provide three-dimensional thermal-hydraulic (TH) feedback and burnup data. These data are presented at axial node locations. The nodal spacings for the axial nodes are presented in Table 4-1, where node 1 represents the top axial node in the reactor core. Tables 4-2 through 4-34 provide axial burnup profiles for each assembly at each datapoint or statepoint along with axial fuel temperature and moderator specific volume distributions used in the burnup calculations between datapoints or statepoints. The statepoint evaluations for Sequoyah 2 occur at BOL (0 EFPD of cycle 1), BOC of cycle 3 (0 EFPD), and 210.9 EFPD of cycle 3. The modeling of fuel assembly operating history for assemblies which were first inserted prior to cycle 3 requires burnup, fuel temperature, and moderator specific volume data for the cycles since the fuel was first inserted into the core. These data are provided at datapoints for the cycles prior to cycle 3 and at statepoints for cycle 3. The data is also given by axial node location.

Control rod insertion time (by axial node) for each assembly with a control rod inserted during core operation is provided in Tables 4-35 through 4-38. This data was also obtained from the core follow calculations based on core operation data. In addition, boron letdown data for cycles 1, 2, and 3 are provided in Table 4-39. The data provided in Table 4-39 are coefficients from a linear regression fit of core operation data for each cycle.

Table 4-1. Axial Node Spacings for Sequoyah 2 Burnup Calculations

Axial Node	Node Spacings (cm)
1	22.86
2	22.86
3	22.86
4	22.86
5	22.86
6	22.86
7	22.86
8	22.86
9	22.86
10	22.86
11	22.86
12	22.86
13	22.86
14	22.86
15	22.86
16	22.86

Table 4-2. Burnup and TH Feedback Parameters by Axial Node for Assembly A6

Axial	Burnup	SP36 to DP1		Burnup	DP1 to DP2		Burnup	DP2 to DP3	
Node	DP1	T-Fuel	Spec.Vol	DP2	T-Fuel	Spec.Vol	DP3	T-Fuel	Spec.Vol
1	2.324	835.5	0.0241	6.422	961.1	0.0242	8.558	820.0	0.0227
2	4.693	1048.9	0.0240	12.057	1159.7	0.0240	15.350	888.1	0.0226
3	6.555	1202.1	0.0238	15.680	1226.5	0.0238	19.358	890.8	0.0225
4	7.810	1296.5	0.0236	17.478	1232.9	0.0235	21.239	879.9	0.0224
5	8.631	1355.0	0.0234	18.293	1211.8	0.0233	22.045	872.0	0.0223
6	9.162	1390.3	0.0232	18.646	1185.6	0.0231	22.372	865.7	0.0222
7	9.503	1411.3	0.0229	18.801	1163.0	0.0229	22.508	861.2	0.0221
8	9.715	1424.1	0.0227	18.889	1146.9	0.0227	22.587	858.0	0.0220
9	9.831	1431.4	0.0225	18.971	1138.1	0.0225	22.665	855.4	0.0219
10	9.855	1433.7	0.0223	19.064	1137.4	0.0223	22.758	853.2	0.0218
11	9.759	1428.4	0.0220	19.146	1145.3	0.0221	22.842	851.3	0.0217
12	9.474	1409.7	0.0218	19.132	1162.1	0.0219	22.830	849.9	0.0216
13	8.875	1365.7	0.0216	18.797	1184.0	0.0217	22.485	848.8	0.0215
14	7.765	1277.6	0.0215	17.630	1194.3	0.0216	21.236	845.6	0.0214
15	5.879	1120.0	0.0213	14.571	1145.5	0.0214	17.834	837.2	0.0213
16	3.085	857.0	0.0213	8.321	963.9	0.0213	10.455	766.9	0.0213

Axial	Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	11.026	796.9	0.0228	14.243	831.8	0.0234
2	18.940	845.2	0.0227	24.922	962.8	0.0233
3	23.243	848.6	0.0226	30.319	988.5	0.0231
4	25.166	850.4	0.0225	32.671	983.2	0.0229
5	25.970	853.4	0.0224	33.655	977.0	0.0228
6	26.303	857.7	0.0223	34.032	970.9	0.0226
7	26.459	862.4	0.0222	34.184	964.9	0.0224
8	26.564	866.6	0.0221	34.258	958.9	0.0223
9	26.671	869.9	0.0220	34.309	952.7	0.0222
10	26.792	872.3	0.0219	34.352	946.1	0.0220
11	26.908	874.3	0.0218	34.368	939.0	0.0219
12	26.938	877.1	0.0217	34.276	931.3	0.0217
13	26.646	881.5	0.0216	33.839	922.8	0.0216
14	25.420	886.3	0.0215	32.417	912.7	0.0215
15	21.795	879.6	0.0214	28.340	897.8	0.0214
16	13.224	820.8	0.0213	17.965	838.0	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-3. Burnup and TH Feedback Parameters by Axial Node for Assembly A8

Axial	Burnup	SP36 to DP1		Burnup	DP1 to DP2		Burnup	DP2 to DP3	
Node	DP1	T-Fuel	Spec.Vol	DP2	T-Fuel	Spec.Vol	DP3	T-Fuel	Spec.Vol
1	1.789	766.6	0.0230	4.866	859.8	0.0231	8.993	1060.0	0.0239
2	3.417	913.3	0.0230	8.617	1003.6	0.0230	14.892	1178.8	0.0237
3	4.631	1020.1	0.0229	10.864	1051.9	0.0228	17.695	1179.7	0.0235
4	5.456	1087.6	0.0228	12.017	1053.6	0.0227	18.731	1147.0	0.0233
5	5.995	1128.9	0.0226	12.560	1039.8	0.0226	19.025	1117.2	0.0231
6	6.343	1153.7	0.0225	12.802	1023.0	0.0224	19.058	1096.3	0.0229
7	6.565	1167.8	0.0223	12.913	1008.1	0.0223	19.024	1082.3	0.0227
8	6.704	1176.2	0.0222	12.980	997.5	0.0222	18.992	1072.5	0.0225
9	6.782	1181.1	0.0221	13.044	992.0	0.0220	18.983	1064.8	0.0223
10	6.799	1182.9	0.0219	13.114	992.1	0.0219	19.003	1058.4	0.0222
11	6.737	1179.8	0.0218	13.175	998.2	0.0218	19.044	1053.9	0.0220
12	6.550	1167.3	0.0216	13.163	1009.7	0.0217	19.065	1053.7	0.0218
13	6.151	1137.1	0.0215	12.917	1022.9	0.0216	18.923	1060.9	0.0217
14	5.405	1073.5	0.0214	12.082	1026.1	0.0214	18.195	1074.3	0.0215
15	4.125	956.6	0.0213	9.969	989.7	0.0213	15.790	1070.5	0.0214
16	2.179	767.1	0.0213	5.705	839.6	0.0213	9.674	959.8	0.0213

Axial	Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	12.975	890.7	0.0238	18.301	935.8	0.0237
2	20.594	949.6	0.0237	28.165	1011.8	0.0236
3	23.801	971.3	0.0236	32.131	1034.5	0.0234
4	24.847	998.6	0.0234	33.462	1038.2	0.0232
5	25.093	1017.5	0.0232	33.837	1035.8	0.0230
6	25.107	1030.6	0.0230	33.905	1031.1	0.0228
7	25.087	1041.4	0.0228	33.890	1025.4	0.0226
8	25.085	1049.8	0.0227	33.857	1019.3	0.0224
9	25.107	1055.8	0.0225	33.820	1012.9	0.0223
10	25.156	1059.9	0.0223	33.783	1006.2	0.0221
11	25.234	1063.1	0.0221	33.748	998.6	0.0220
12	25.327	1067.8	0.0219	33.694	989.7	0.0218
13	25.323	1077.5	0.0218	33.499	978.5	0.0217
14	24.773	1091.8	0.0216	32.665	962.5	0.0215
15	22.243	1094.8	0.0214	29.498	934.3	0.0214
16	14.378	1005.4	0.0213	19.522	853.5	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-4. Burnup and TH Feedback Parameters by Axial Node for Assembly A15

Axial	Burnup	SP36 to DP1		Burnup	DP1 to DP2		Burnup	DP2 to DP3	
Node	DP1	T-Fuel	Spec.Vol	DP2	T-Fuel	Spec.Vol	DP3	T-Fuel	Spec.Vol
1	1.963	785.9	0.0232	5.273	878.0	0.0231	9.638	1060.9	0.0239
2	3.732	943.9	0.0232	9.221	1019.2	0.0230	15.669	1173.5	0.0237
3	5.032	1054.8	0.0230	11.529	1061.6	0.0229	18.434	1171.2	0.0235
4	5.912	1123.7	0.0229	12.708	1062.6	0.0228	19.458	1138.2	0.0232
5	6.486	1166.0	0.0228	13.264	1047.9	0.0226	19.748	1108.0	0.0230
6	6.857	1191.1	0.0226	13.515	1029.8	0.0225	19.777	1086.7	0.0228
7	7.095	1205.3	0.0225	13.633	1014.2	0.0223	19.740	1072.3	0.0227
8	7.246	1213.9	0.0223	13.708	1003.2	0.0222	19.706	1062.2	0.0225
9	7.333	1219.3	0.0221	13.780	997.5	0.0221	19.699	1054.1	0.0223
10	7.356	1221.8	0.0220	13.858	997.5	0.0220	19.722	1047.5	0.0222
11	7.296	1219.6	0.0218	13.927	1003.6	0.0218	19.768	1043.0	0.0220
12	7.104	1208.1	0.0217	13.921	1015.6	0.0217	19.798	1042.8	0.0218
13	6.687	1178.3	0.0215	13.680	1030.3	0.0216	19.663	1049.4	0.0217
14	5.898	1113.7	0.0214	12.837	1035.2	0.0215	18.930	1062.7	0.0215
15	4.529	993.5	0.0213	10.683	1002.1	0.0213	16.484	1059.5	0.0214
16	2.408	789.5	0.0213	6.206	858.2	0.0213	10.172	951.0	0.0213

Axial	Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	13.826	915.1	0.0238	18.692	904.1	0.0236
2	21.492	976.0	0.0237	28.439	976.4	0.0235
3	24.566	988.1	0.0235	32.296	1001.5	0.0233
4	25.535	998.2	0.0234	33.610	1009.4	0.0231
5	25.754	1010.3	0.0232	34.002	1009.2	0.0229
6	25.760	1022.5	0.0230	34.094	1006.2	0.0227
7	25.736	1033.3	0.0228	34.102	1001.9	0.0226
8	25.732	1041.8	0.0226	34.092	997.1	0.0224
9	25.754	1047.9	0.0225	34.078	991.9	0.0222
10	25.804	1051.8	0.0223	34.066	986.2	0.0221
11	25.886	1054.9	0.0221	34.055	979.7	0.0219
12	25.984	1059.4	0.0219	34.021	971.5	0.0218
13	25.984	1068.7	0.0218	33.837	960.6	0.0216
14	25.427	1082.8	0.0216	32.995	944.7	0.0215
15	22.857	1086.0	0.0214	29.824	916.6	0.0214
16	14.833	997.3	0.0213	19.824	842.0	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-5. Burnup and TH Feedback Parameters by Axial Node for Assembly A21

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	1.650	749.8	0.0229	4.496	838.3	0.0229	8.227	1038.4	0.0239
2	3.154	885.8	0.0228	7.975	975.6	0.0228	13.715	1157.3	0.0238
3	4.272	984.7	0.0227	10.057	1023.8	0.0227	16.425	1170.2	0.0235
4	5.031	1048.8	0.0226	11.126	1027.0	0.0226	17.520	1149.6	0.0233
5	5.526	1087.0	0.0225	11.628	1013.6	0.0224	17.903	1128.7	0.0231
6	5.844	1110.0	0.0224	11.849	997.4	0.0223	18.012	1113.6	0.0229
7	6.046	1123.5	0.0222	11.948	983.4	0.0222	18.037	1103.7	0.0227
8	6.172	1131.6	0.0221	12.008	973.5	0.0221	18.050	1097.0	0.0225
9	6.241	1136.2	0.0220	12.064	968.4	0.0220	18.077	1091.8	0.0224
10	6.255	1137.7	0.0219	12.126	968.5	0.0219	18.123	1087.4	0.0222
11	6.197	1134.6	0.0217	12.180	974.1	0.0218	18.174	1084.3	0.0220
12	6.023	1122.5	0.0216	12.165	984.5	0.0216	18.183	1083.9	0.0219
13	5.655	1093.1	0.0215	11.931	996.8	0.0215	18.000	1087.9	0.0217
14	4.967	1033.8	0.0214	11.148	1000.0	0.0214	17.225	1094.3	0.0215
15	3.788	924.0	0.0213	9.179	962.5	0.0213	14.871	1080.7	0.0214
16	1.999	749.2	0.0212	5.237	818.0	0.0213	9.082	964.0	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	12.145	905.0	0.0240	16.853	906.3	0.0237
2	19.408	975.1	0.0238	26.255	978.9	0.0236
3	22.617	1000.0	0.0237	30.355	1009.5	0.0234
4	23.794	1026.3	0.0235	31.982	1020.7	0.0232
5	24.173	1044.1	0.0233	32.617	1024.2	0.0230
6	24.287	1056.1	0.0231	32.892	1024.7	0.0228
7	24.343	1066.3	0.0229	33.052	1023.7	0.0227
8	24.400	1074.7	0.0227	33.177	1022.1	0.0225
9	24.473	1081.1	0.0225	33.291	1020.2	0.0223
10	24.564	1085.9	0.0223	33.396	1018.1	0.0221
11	24.668	1090.2	0.0222	33.481	1015.0	0.0220
12	24.758	1095.8	0.0220	33.501	1010.1	0.0218
13	24.701	1105.0	0.0218	33.289	1001.1	0.0217
14	24.055	1117.3	0.0216	32.313	984.5	0.0215
15	21.482	1115.6	0.0214	28.986	950.6	0.0214
16	13.842	1016.0	0.0213	19.102	863.9	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-6. Burnup and TH Feedback Parameters by Axial Node for Assembly A21a

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	1.650	749.8	0.0229	4.496	838.3	0.0229	8.605	1059.4	0.0239
2	3.154	885.8	0.0228	7.975	975.6	0.0228	14.264	1180.8	0.0237
3	4.272	984.7	0.0227	10.057	1023.8	0.0227	16.936	1185.1	0.0235
4	5.031	1048.8	0.0226	11.126	1027.0	0.0226	17.890	1153.3	0.0232
5	5.526	1087.0	0.0225	11.628	1013.6	0.0224	18.127	1122.9	0.0230
6	5.844	1110.0	0.0224	11.849	997.4	0.0223	18.117	1101.0	0.0228
7	6.046	1123.5	0.0222	11.948	983.4	0.0222	18.051	1086.2	0.0226
8	6.172	1131.6	0.0221	12.008	973.5	0.0221	17.994	1075.7	0.0225
9	6.241	1136.2	0.0220	12.064	968.4	0.0220	17.966	1067.5	0.0223
10	6.255	1137.7	0.0219	12.126	968.5	0.0219	17.970	1060.7	0.0221
11	6.197	1134.6	0.0217	12.180	974.1	0.0218	18.000	1056.2	0.0220
12	6.023	1122.5	0.0216	12.165	984.5	0.0216	18.021	1056.3	0.0218
13	5.655	1093.1	0.0215	11.931	996.8	0.0215	17.896	1063.5	0.0217
14	4.967	1033.8	0.0214	11.148	1000.0	0.0214	17.215	1076.1	0.0215
15	3.788	924.0	0.0213	9.179	962.5	0.0213	14.929	1068.6	0.0214
16	1.999	749.2	0.0212	5.237	818.0	0.0213	9.125	955.5	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	12.501	883.5	0.0238	17.313	911.9	0.0237
2	19.870	944.0	0.0237	26.753	982.0	0.0235
3	22.959	966.6	0.0235	30.658	1008.5	0.0233
4	23.934	994.0	0.0234	32.029	1016.6	0.0232
5	24.130	1014.4	0.0232	32.445	1018.3	0.0230
6	24.108	1029.1	0.0230	32.550	1017.3	0.0228
7	24.061	1041.2	0.0228	32.573	1015.0	0.0226
8	24.038	1050.7	0.0226	32.582	1012.1	0.0224
9	24.043	1057.4	0.0225	32.589	1008.6	0.0223
10	24.077	1061.9	0.0223	32.597	1004.6	0.0221
11	24.145	1065.1	0.0221	32.606	999.6	0.0220
12	24.238	1069.8	0.0219	32.593	992.6	0.0218
13	24.249	1079.2	0.0218	32.430	982.3	0.0217
14	23.737	1094.4	0.0216	31.621	966.6	0.0215
15	21.301	1096.4	0.0214	28.563	938.7	0.0214
16	13.737	1002.8	0.0213	18.959	862.6	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-7. Burnup and TH Feedback Parameters by Axial Node for Assembly A25

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	2.226	817.2	0.0236	5.991	922.0	0.0235	9.190	967.9	0.0238
2	4.267	998.1	0.0235	10.591	1082.1	0.0234	15.621	1076.7	0.0236
3	5.798	1126.9	0.0234	13.355	1127.3	0.0232	19.082	1089.9	0.0234
4	6.837	1204.1	0.0232	14.770	1127.0	0.0230	20.662	1076.2	0.0232
5	7.516	1250.9	0.0230	15.434	1110.6	0.0229	21.323	1061.8	0.0230
6	7.954	1278.6	0.0229	15.731	1090.4	0.0227	21.591	1052.2	0.0228
7	8.236	1295.0	0.0227	15.872	1072.8	0.0225	21.714	1045.9	0.0226
8	8.416	1305.1	0.0225	15.960	1060.3	0.0224	21.799	1041.6	0.0225
9	8.520	1311.5	0.0223	16.043	1053.6	0.0222	21.888	1038.4	0.0223
10	8.550	1314.7	0.0221	16.136	1053.3	0.0221	21.992	1035.7	0.0221
11	8.484	1312.7	0.0219	16.218	1059.8	0.0219	22.089	1033.5	0.0220
12	8.263	1300.1	0.0218	16.217	1073.0	0.0218	22.109	1032.6	0.0218
13	7.779	1266.9	0.0216	15.944	1089.2	0.0216	21.847	1033.0	0.0217
14	6.858	1195.9	0.0214	14.974	1095.2	0.0215	20.797	1033.7	0.0215
15	5.257	1062.0	0.0213	12.450	1062.5	0.0214	17.796	1019.9	0.0214
16	2.788	826.7	0.0213	7.202	903.2	0.0213	10.771	911.6	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	12.619	854.3	0.0237	15.316	783.2	0.0231
2	20.698	913.1	0.0236	25.918	903.8	0.0230
3	24.700	942.4	0.0234	30.980	930.1	0.0228
4	26.434	974.0	0.0233	33.131	926.7	0.0227
5	27.141	994.4	0.0231	34.013	921.3	0.0225
6	27.439	1007.3	0.0229	34.352	915.7	0.0224
7	27.604	1017.3	0.0228	34.508	909.8	0.0223
8	27.738	1025.1	0.0226	34.605	903.8	0.0221
9	27.876	1031.2	0.0224	34.685	897.9	0.0220
10	28.027	1035.7	0.0222	34.758	891.8	0.0219
11	28.178	1039.7	0.0221	34.811	885.3	0.0218
12	28.269	1044.5	0.0219	34.779	877.9	0.0217
13	28.103	1051.8	0.0217	34.457	869.1	0.0215
14	27.120	1059.3	0.0216	33.246	856.9	0.0214
15	23.847	1046.4	0.0214	29.437	837.6	0.0213
16	15.097	961.2	0.0213	18.981	777.2	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-8. Burnup and TH Feedback Parameters by Axial Node for Assembly A25a

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	2.226	817.2	0.0236	5.991	922.0	0.0235	9.190	967.9	0.0238
2	4.267	998.1	0.0235	10.591	1082.1	0.0234	15.621	1076.7	0.0236
3	5.798	1126.9	0.0234	13.355	1127.3	0.0232	19.082	1089.9	0.0234
4	6.837	1204.1	0.0232	14.770	1127.0	0.0230	20.662	1076.2	0.0232
5	7.516	1250.9	0.0230	15.434	1110.6	0.0229	21.323	1061.8	0.0230
6	7.954	1278.6	0.0229	15.731	1090.4	0.0227	21.591	1052.2	0.0228
7	8.236	1295.0	0.0227	15.872	1072.8	0.0225	21.714	1045.9	0.0226
8	8.416	1305.1	0.0225	15.960	1060.3	0.0224	21.799	1041.6	0.0225
9	8.520	1311.5	0.0223	16.043	1053.6	0.0222	21.888	1038.4	0.0223
10	8.550	1314.7	0.0221	16.136	1053.3	0.0221	21.992	1035.7	0.0221
11	8.484	1312.7	0.0219	16.218	1059.8	0.0219	22.089	1033.5	0.0220
12	8.263	1300.1	0.0218	16.217	1073.0	0.0218	22.109	1032.6	0.0218
13	7.779	1266.9	0.0216	15.944	1089.2	0.0216	21.847	1033.0	0.0217
14	6.858	1195.9	0.0214	14.974	1095.2	0.0215	20.797	1033.7	0.0215
15	5.257	1062.0	0.0213	12.450	1062.5	0.0214	17.796	1019.9	0.0214
16	2.788	826.7	0.0213	7.202	903.2	0.0213	10.771	911.6	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	12.621	854.3	0.0237	14.105	663.9	0.0219
2	20.701	913.1	0.0236	22.965	690.8	0.0219
3	24.703	942.4	0.0234	27.265	698.1	0.0218
4	26.437	974.0	0.0233	29.107	697.5	0.0218
5	27.144	994.4	0.0231	29.852	695.1	0.0217
6	27.443	1007.3	0.0229	30.161	692.4	0.0217
7	27.608	1017.3	0.0228	30.318	689.7	0.0216
8	27.742	1025.1	0.0226	30.435	687.2	0.0216
9	27.880	1031.2	0.0224	30.549	684.7	0.0215
10	28.032	1035.7	0.0222	30.669	682.1	0.0215
11	28.183	1039.7	0.0221	30.782	679.5	0.0214
12	28.273	1044.5	0.0219	30.823	676.6	0.0214
13	28.107	1051.8	0.0217	30.591	673.2	0.0214
14	27.124	1059.3	0.0216	29.499	668.7	0.0213
15	23.851	1046.4	0.0214	25.969	659.1	0.0213
16	15.100	961.2	0.0213	16.513	632.7	0.0212

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-9. Burnup and TH Feedback Parameters by Axial Node for Assembly A26

Axial	Burnup	SP36 to DP1		Burnup	DP1 to DP2		Burnup	DP2 to DP3	
Node	DP1	T-Fuel	Spec.Vol	DP2	T-Fuel	Spec.Vol	DP3	T-Fuel	Spec.Vol
1	1.423	721.9	0.0226	3.843	795.8	0.0226	8.250	1093.6	0.0241
2	2.720	839.8	0.0226	6.783	913.1	0.0225	13.381	1223.2	0.0239
3	3.670	924.3	0.0225	8.500	953.7	0.0224	15.646	1231.2	0.0237
4	4.311	978.6	0.0224	9.373	956.3	0.0223	16.432	1204.6	0.0234
5	4.725	1011.4	0.0223	9.776	944.7	0.0222	16.621	1177.6	0.0232
6	4.989	1030.7	0.0222	9.949	930.5	0.0221	16.613	1158.2	0.0230
7	5.155	1041.7	0.0221	10.023	918.3	0.0220	16.563	1145.4	0.0228
8	5.258	1048.1	0.0220	10.065	909.6	0.0219	16.525	1136.7	0.0226
9	5.314	1051.8	0.0219	10.105	905.0	0.0218	16.510	1130.0	0.0224
10	5.324	1053.0	0.0218	10.151	904.9	0.0218	16.521	1124.6	0.0222
11	5.274	1050.4	0.0217	10.190	909.6	0.0217	16.552	1121.1	0.0221
12	5.129	1040.3	0.0215	10.174	918.5	0.0216	16.578	1121.5	0.0219
13	4.822	1015.8	0.0215	9.981	928.7	0.0215	16.487	1128.3	0.0217
14	4.245	965.1	0.0214	9.341	931.3	0.0214	15.929	1138.6	0.0216
15	3.252	871.9	0.0213	7.736	899.6	0.0213	13.950	1126.6	0.0214
16	1.722	721.6	0.0212	4.451	777.6	0.0213	8.632	996.5	0.0213

Axial	Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	12.568	938.8	0.0241	16.308	866.2	0.0238
2	19.465	1013.4	0.0239	26.257	1016.6	0.0236
3	22.122	1029.0	0.0237	30.177	1055.1	0.0234
4	22.897	1041.5	0.0235	31.479	1055.9	0.0232
5	23.041	1055.8	0.0233	31.846	1050.7	0.0230
6	23.026	1069.8	0.0231	31.888	1044.9	0.0228
7	23.003	1081.9	0.0229	31.862	1038.8	0.0226
8	23.006	1091.6	0.0227	31.826	1032.3	0.0225
9	23.034	1098.7	0.0226	31.787	1025.5	0.0223
10	23.085	1103.7	0.0224	31.749	1018.4	0.0221
11	23.165	1107.7	0.0222	31.714	1010.5	0.0220
12	23.271	1112.9	0.0220	31.674	1001.2	0.0218
13	23.319	1122.3	0.0218	31.533	989.6	0.0217
14	22.922	1136.3	0.0216	30.848	973.8	0.0215
15	20.755	1136.2	0.0214	28.096	946.3	0.0214
16	13.543	1029.9	0.0213	18.889	871.8	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-10. Burnup and TH Feedback Parameters by Axial Node for Assembly A26a

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	1.423	721.9	0.0226	3.843	795.8	0.0226	8.250	1093.6	0.0241
2	2.720	839.8	0.0226	6.783	913.1	0.0225	13.381	1223.2	0.0239
3	3.670	924.3	0.0225	8.500	953.7	0.0224	15.646	1231.2	0.0237
4	4.311	978.6	0.0224	9.373	956.3	0.0223	16.432	1204.6	0.0234
5	4.725	1011.4	0.0223	9.776	944.7	0.0222	16.621	1177.6	0.0232
6	4.989	1030.7	0.0222	9.949	930.5	0.0221	16.613	1158.2	0.0230
7	5.155	1041.7	0.0221	10.023	918.3	0.0220	16.563	1145.4	0.0228
8	5.258	1048.1	0.0220	10.065	909.6	0.0219	16.525	1136.7	0.0226
9	5.314	1051.8	0.0219	10.105	905.0	0.0218	16.510	1130.0	0.0224
10	5.324	1053.0	0.0218	10.151	904.9	0.0218	16.521	1124.6	0.0222
11	5.274	1050.4	0.0217	10.190	909.6	0.0217	16.552	1121.1	0.0221
12	5.129	1040.3	0.0215	10.174	918.5	0.0216	16.578	1121.5	0.0219
13	4.822	1015.8	0.0215	9.981	928.7	0.0215	16.487	1128.3	0.0217
14	4.245	965.1	0.0214	9.341	931.3	0.0214	15.929	1138.6	0.0216
15	3.252	871.9	0.0213	7.736	899.6	0.0213	13.950	1126.6	0.0214
16	1.722	721.6	0.0212	4.451	777.6	0.0213	8.632	996.5	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	12.567	938.8	0.0241	17.360	911.0	0.0237
2	19.451	1013.4	0.0239	26.353	984.9	0.0236
3	22.096	1029.0	0.0237	29.863	1015.4	0.0234
4	22.867	1041.5	0.0235	31.057	1025.4	0.0232
5	23.008	1055.8	0.0233	31.428	1027.7	0.0230
6	22.992	1069.8	0.0231	31.540	1026.7	0.0228
7	22.969	1081.9	0.0229	31.586	1024.2	0.0226
8	22.971	1091.6	0.0227	31.617	1021.0	0.0225
9	22.998	1098.7	0.0226	31.643	1017.3	0.0223
10	23.048	1103.7	0.0224	31.665	1013.2	0.0221
11	23.128	1107.7	0.0222	31.683	1008.0	0.0220
12	23.233	1112.9	0.0220	31.680	1000.9	0.0218
13	23.281	1122.3	0.0218	31.548	990.1	0.0217
14	22.884	1136.3	0.0216	30.839	973.1	0.0215
15	20.722	1136.2	0.0214	28.023	942.7	0.0214
16	13.522	1029.9	0.0213	18.750	864.4	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-11. Burnup and TH Feedback Parameters by Axial Node for Assembly A29

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	2.092	799.5	0.0234	5.508	889.5	0.0233	9.743	1053.1	0.0239
2	4.020	969.2	0.0233	9.738	1036.2	0.0232	16.034	1163.7	0.0237
3	5.458	1088.2	0.0232	12.276	1080.2	0.0230	19.048	1159.0	0.0235
4	6.428	1161.5	0.0231	13.583	1081.0	0.0228	20.221	1126.4	0.0232
5	7.058	1205.0	0.0229	14.199	1064.9	0.0227	20.591	1097.7	0.0230
6	7.465	1230.5	0.0227	14.479	1045.6	0.0225	20.668	1077.3	0.0228
7	7.728	1245.6	0.0226	14.616	1029.1	0.0224	20.663	1063.7	0.0227
8	7.899	1255.2	0.0224	14.704	1017.6	0.0223	20.655	1054.1	0.0225
9	8.000	1261.6	0.0222	14.787	1011.5	0.0221	20.669	1046.4	0.0223
10	8.034	1265.2	0.0221	14.878	1011.2	0.0220	20.710	1040.1	0.0222
11	7.979	1264.2	0.0219	14.958	1017.2	0.0219	20.770	1035.7	0.0220
12	7.782	1253.7	0.0217	14.961	1029.4	0.0217	20.804	1035.2	0.0218
13	7.343	1224.4	0.0216	14.716	1044.9	0.0216	20.657	1041.1	0.0217
14	6.496	1159.9	0.0214	13.835	1052.4	0.0215	19.879	1052.8	0.0215
15	5.009	1034.3	0.0213	11.552	1020.8	0.0214	17.311	1050.7	0.0214
16	2.675	814.8	0.0213	6.745	876.5	0.0213	10.697	945.7	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	13.860	904.7	0.0238	18.660	899.5	0.0235
2	21.799	962.4	0.0237	28.700	972.2	0.0234
3	25.149	978.7	0.0235	32.822	996.0	0.0232
4	26.287	994.1	0.0234	34.276	1001.3	0.0230
5	26.595	1008.2	0.0232	34.730	999.3	0.0229
6	26.649	1020.2	0.0230	34.850	995.1	0.0227
7	26.656	1030.4	0.0228	34.874	990.0	0.0225
8	26.676	1038.4	0.0226	34.874	984.6	0.0224
9	26.719	1044.1	0.0225	34.870	978.9	0.0222
10	26.787	1047.9	0.0223	34.866	972.8	0.0221
11	26.881	1050.8	0.0221	34.861	966.0	0.0219
12	26.984	1055.3	0.0219	34.828	957.8	0.0218
13	26.970	1064.5	0.0218	34.635	947.3	0.0216
14	26.365	1078.7	0.0216	33.758	932.4	0.0215
15	23.679	1079.1	0.0214	30.477	904.2	0.0214
16	15.367	993.4	0.0213	20.208	830.4	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-12. Burnup and TH Feedback Parameters by Axial Node for Assembly A29a

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	2.092	799.5	0.0234	5.508	889.5	0.0233	9.743	1053.1	0.0239
2	4.020	969.2	0.0233	9.738	1036.2	0.0232	16.034	1163.7	0.0237
3	5.458	1088.2	0.0232	12.276	1080.2	0.0230	19.048	1159.0	0.0235
4	6.428	1161.5	0.0231	13.583	1081.0	0.0228	20.221	1126.4	0.0232
5	7.058	1205.0	0.0229	14.199	1064.9	0.0227	20.591	1097.7	0.0230
6	7.465	1230.5	0.0227	14.479	1045.6	0.0225	20.668	1077.3	0.0228
7	7.728	1245.6	0.0226	14.616	1029.1	0.0224	20.663	1063.7	0.0227
8	7.899	1255.2	0.0224	14.704	1017.6	0.0223	20.655	1054.1	0.0225
9	8.000	1261.6	0.0222	14.787	1011.5	0.0221	20.669	1046.4	0.0223
10	8.034	1265.2	0.0221	14.878	1011.2	0.0220	20.710	1040.1	0.0222
11	7.979	1264.2	0.0219	14.958	1017.2	0.0219	20.770	1035.7	0.0220
12	7.782	1253.7	0.0217	14.961	1029.4	0.0217	20.804	1035.2	0.0218
13	7.343	1224.4	0.0216	14.716	1044.9	0.0216	20.657	1041.1	0.0217
14	6.496	1159.9	0.0214	13.835	1052.4	0.0215	19.879	1052.8	0.0215
15	5.009	1034.3	0.0213	11.552	1020.8	0.0214	17.311	1050.7	0.0214
16	2.675	814.8	0.0213	6.745	876.5	0.0213	10.697	945.7	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	13.860	904.7	0.0238	15.489	673.7	0.0220
2	21.808	962.4	0.0237	24.293	704.2	0.0219
3	25.166	978.7	0.0235	27.998	714.0	0.0219
4	26.309	994.1	0.0234	29.281	715.3	0.0218
5	26.619	1008.2	0.0232	29.651	714.1	0.0218
6	26.673	1020.2	0.0230	29.729	712.1	0.0217
7	26.682	1030.4	0.0228	29.739	709.9	0.0217
8	26.702	1038.4	0.0226	29.748	707.5	0.0216
9	26.745	1044.1	0.0225	29.771	705.1	0.0216
10	26.813	1047.9	0.0223	29.810	702.7	0.0215
11	26.908	1050.8	0.0221	29.867	700.0	0.0215
12	27.011	1055.3	0.0219	29.916	696.8	0.0214
13	26.997	1064.5	0.0218	29.824	692.7	0.0214
14	26.391	1078.7	0.0216	29.085	686.5	0.0213
15	23.702	1079.1	0.0214	26.095	674.2	0.0213
16	15.382	993.4	0.0213	16.974	643.5	0.0212

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-13. Burnup and TH Feedback Parameters by Axial Node for Assembly A30

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	2.420	836.7	0.0239	6.290	933.2	0.0237	9.164	980.5	0.0240
2	4.727	1036.3	0.0238	11.304	1096.2	0.0236	16.696	1130.1	0.0238
3	6.474	1174.0	0.0237	14.409	1144.3	0.0234	20.780	1130.0	0.0236
4	7.646	1256.2	0.0235	16.009	1146.6	0.0232	22.462	1106.7	0.0233
5	8.409	1305.5	0.0233	16.771	1129.4	0.0230	23.131	1088.0	0.0231
6	8.907	1335.2	0.0231	17.131	1108.4	0.0228	23.399	1074.2	0.0229
7	9.236	1353.7	0.0229	17.319	1090.3	0.0226	23.526	1064.9	0.0227
8	9.453	1365.8	0.0227	17.448	1077.4	0.0225	23.620	1058.3	0.0226
9	9.588	1374.3	0.0224	17.569	1070.6	0.0223	23.720	1053.1	0.0224
10	9.643	1379.9	0.0222	17.698	1070.3	0.0221	23.836	1048.6	0.0222
11	9.592	1380.4	0.0220	17.814	1077.3	0.0220	23.951	1045.1	0.0220
12	9.370	1370.3	0.0218	17.837	1091.4	0.0218	23.995	1043.8	0.0219
13	8.856	1338.3	0.0216	17.566	1109.3	0.0217	23.769	1046.0	0.0217
14	7.851	1266.7	0.0215	16.542	1117.7	0.0215	22.752	1049.4	0.0215
15	6.070	1126.1	0.0213	13.847	1083.7	0.0214	19.678	1041.2	0.0214
16	3.254	870.3	0.0213	8.132	932.5	0.0213	12.123	939.3	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	11.965	774.7	0.0237	17.469	952.5	0.0236
2	21.752	799.9	0.0237	29.278	1006.6	0.0234
3	26.533	869.0	0.0236	34.621	1016.4	0.0232
4	28.569	979.8	0.0234	36.789	1013.4	0.0230
5	29.274	1011.0	0.0232	37.540	1006.8	0.0229
6	29.548	1024.3	0.0230	37.809	999.2	0.0227
7	29.700	1034.1	0.0229	37.922	991.5	0.0225
8	29.829	1041.6	0.0227	37.983	983.7	0.0224
9	29.965	1047.0	0.0225	38.029	975.7	0.0222
10	30.116	1050.7	0.0223	38.068	967.5	0.0220
11	30.272	1053.8	0.0221	38.093	958.8	0.0219
12	30.384	1058.2	0.0219	38.053	949.3	0.0218
13	30.272	1066.6	0.0218	37.768	938.6	0.0216
14	29.382	1078.3	0.0216	36.651	924.4	0.0215
15	26.131	1072.7	0.0214	32.902	896.9	0.0214
16	16.855	985.0	0.0213	21.794	827.2	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-14. Burnup and TH Feedback Parameters by Axial Node for Assembly A31

Axial Node	Burnup DP1	SP36 to DP1 T-Fuel	SP36 to DP1 Spec.Vol	Burnup DP2	DP1 to DP2 T-Fuel	DP1 to DP2 Spec.Vol	Burnup DP3	DP2 to DP3 T-Fuel	DP2 to DP3 Spec.Vol
1	1.271	703.5	0.0225	3.396	771.1	0.0225	7.475	1091.8	0.0243
2	2.465	811.4	0.0224	6.149	886.5	0.0224	12.476	1232.3	0.0241
3	3.371	891.8	0.0224	7.862	933.7	0.0224	14.916	1248.0	0.0238
4	3.985	944.9	0.0223	8.759	940.7	0.0223	15.859	1227.0	0.0236
5	4.384	977.1	0.0222	9.179	931.8	0.0222	16.160	1204.9	0.0233
6	4.638	996.2	0.0221	9.363	918.9	0.0221	16.231	1189.1	0.0231
7	4.801	1007.6	0.0220	9.446	907.4	0.0220	16.241	1178.9	0.0229
8	4.903	1014.5	0.0219	9.494	899.1	0.0219	16.248	1172.2	0.0227
9	4.960	1018.7	0.0218	9.539	894.7	0.0218	16.271	1167.2	0.0225
10	4.974	1020.4	0.0217	9.588	894.6	0.0217	16.311	1163.2	0.0223
11	4.931	1018.3	0.0216	9.630	899.1	0.0216	16.360	1160.6	0.0221
12	4.796	1008.7	0.0215	9.615	907.6	0.0216	16.386	1161.0	0.0219
13	4.507	985.1	0.0214	9.425	917.1	0.0215	16.269	1166.1	0.0218
14	3.964	937.1	0.0214	8.795	917.3	0.0214	15.664	1172.6	0.0216
15	3.027	848.4	0.0213	7.227	881.9	0.0213	13.649	1155.2	0.0214
16	1.599	708.7	0.0212	4.108	760.7	0.0213	8.406	1016.1	0.0213

Axial Node	Burnup SP37	DP3 to SP37 T-Fuel	DP3 to SP37 Spec.Vol	Burnup SP38	SP37 to SP38 T-Fuel	SP37 to SP38 Spec.Vol
1	11.591	918.0	0.0242	16.153	898.0	0.0236
2	18.481	993.6	0.0240	25.154	969.4	0.0235
3	21.464	1022.9	0.0239	29.024	1000.5	0.0233
4	22.511	1055.8	0.0237	30.519	1012.3	0.0231
5	22.822	1079.1	0.0235	31.081	1016.0	0.0230
6	22.908	1094.7	0.0232	31.320	1016.2	0.0228
7	22.957	1107.1	0.0230	31.462	1014.7	0.0226
8	23.016	1116.9	0.0228	31.576	1012.6	0.0224
9	23.091	1124.3	0.0226	31.678	1010.3	0.0223
10	23.182	1129.8	0.0224	31.771	1007.6	0.0221
11	23.290	1134.4	0.0222	31.849	1004.1	0.0220
12	23.403	1140.2	0.0220	31.879	998.5	0.0218
13	23.421	1149.7	0.0218	31.723	988.6	0.0216
14	22.952	1162.3	0.0216	30.896	970.0	0.0215
15	20.700	1159.6	0.0214	27.860	933.8	0.0214
16	13.465	1046.1	0.0213	18.436	849.4	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP36	0.0 / Cy1
DP1	187.06 / Cy1
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-15. Burnup and TH Feedback Parameters by Axial Node for Assembly B14

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	4.030	1133.0	0.0247	8.416	1021.5	0.0248	14.230	1010.1	0.0244
2	6.098	1331.2	0.0245	12.502	1139.3	0.0246	21.148	1129.7	0.0242
3	7.010	1402.7	0.0242	14.182	1189.7	0.0244	23.957	1160.3	0.0239
4	7.309	1417.7	0.0239	14.724	1217.5	0.0241	24.976	1165.6	0.0237
5	7.373	1414.6	0.0236	14.890	1239.7	0.0239	25.361	1164.0	0.0234
6	7.380	1409.4	0.0234	14.985	1259.7	0.0236	25.552	1159.2	0.0232
7	7.391	1406.2	0.0231	15.096	1277.5	0.0234	25.687	1152.9	0.0230
8	7.418	1405.4	0.0229	15.232	1293.0	0.0231	25.801	1146.0	0.0227
9	7.458	1406.3	0.0227	15.384	1306.3	0.0229	25.895	1138.9	0.0225
10	7.507	1408.2	0.0224	15.545	1317.6	0.0226	25.968	1131.4	0.0223
11	7.563	1411.0	0.0222	15.720	1328.8	0.0224	26.022	1123.1	0.0221
12	7.618	1414.2	0.0220	15.911	1341.1	0.0221	26.050	1113.1	0.0219
13	7.633	1414.7	0.0218	16.064	1354.3	0.0219	25.979	1100.0	0.0217
14	7.453	1398.7	0.0216	15.904	1359.3	0.0217	25.455	1080.1	0.0216
15	6.674	1326.6	0.0214	14.558	1316.2	0.0215	23.265	1045.6	0.0214
16	4.476	1107.3	0.0213	9.998	1144.7	0.0213	15.987	932.5	0.0213

Table 4-16. Burnup and TH Feedback Parameters by Axial Node for Assembly B15

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	2.762	966.7	0.0237	5.898	915.5	0.0238	10.916	983.4	0.0240
2	4.552	1158.4	0.0236	9.386	1036.4	0.0236	17.109	1108.6	0.0239
3	5.355	1227.7	0.0234	10.822	1076.5	0.0235	19.698	1146.7	0.0237
4	5.652	1246.0	0.0232	11.328	1096.5	0.0233	20.700	1152.4	0.0234
5	5.748	1247.5	0.0230	11.512	1112.0	0.0231	21.122	1149.3	0.0232
6	5.781	1245.3	0.0228	11.615	1126.3	0.0230	21.336	1143.7	0.0230
7	5.807	1243.8	0.0227	11.715	1139.3	0.0228	21.477	1137.4	0.0228
8	5.839	1243.8	0.0225	11.827	1150.7	0.0226	21.584	1130.8	0.0226
9	5.879	1245.0	0.0223	11.947	1160.4	0.0224	21.668	1124.3	0.0224
10	5.924	1247.0	0.0221	12.074	1168.6	0.0222	21.729	1117.6	0.0222
11	5.971	1249.4	0.0220	12.207	1176.1	0.0221	21.764	1110.4	0.0220
12	6.008	1251.4	0.0218	12.336	1183.6	0.0219	21.751	1101.9	0.0219
13	5.990	1249.3	0.0217	12.401	1190.9	0.0217	21.609	1090.9	0.0217
14	5.781	1230.6	0.0215	12.161	1191.4	0.0216	21.020	1075.2	0.0215
15	5.033	1159.5	0.0214	10.890	1157.2	0.0214	18.913	1041.4	0.0214
16	3.045	943.3	0.0213	6.888	997.2	0.0213	12.312	924.4	0.0213

Datapoint or Statepoint	EFPD / Cycle
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-17. Burnup and TH Feedback Parameters by Axial Node for Assembly B19

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	4.418	1172.9	0.0247	9.054	1024.4	0.0249	14.010	947.8	0.0241
2	6.370	1357.2	0.0244	12.974	1135.9	0.0247	20.566	1065.0	0.0239
3	7.170	1418.1	0.0241	14.497	1188.2	0.0244	23.258	1101.6	0.0237
4	7.366	1423.2	0.0239	14.896	1219.8	0.0242	24.217	1112.7	0.0235
5	7.347	1412.8	0.0236	14.950	1245.8	0.0239	24.565	1114.9	0.0232
6	7.295	1402.6	0.0233	14.966	1267.9	0.0237	24.738	1113.2	0.0230
7	7.263	1395.9	0.0231	15.019	1286.9	0.0234	24.870	1109.7	0.0228
8	7.254	1392.4	0.0229	15.108	1302.9	0.0232	24.989	1105.4	0.0226
9	7.263	1390.8	0.0226	15.217	1316.3	0.0229	25.094	1100.9	0.0224
10	7.283	1390.5	0.0224	15.338	1327.7	0.0227	25.181	1096.1	0.0222
11	7.317	1391.4	0.0222	15.481	1339.0	0.0224	25.254	1090.5	0.0220
12	7.366	1393.9	0.0220	15.661	1351.6	0.0222	25.307	1082.6	0.0219
13	7.406	1396.1	0.0218	15.853	1365.8	0.0219	25.276	1070.0	0.0217
14	7.307	1386.2	0.0216	15.816	1373.1	0.0217	24.820	1048.1	0.0215
15	6.698	1327.4	0.0214	14.722	1333.5	0.0215	22.776	1007.6	0.0214
16	4.770	1133.8	0.0213	10.570	1165.0	0.0213	15.942	890.5	0.0213

Table 4-18. Burnup and TH Feedback Parameters by Axial Node for Assembly B21

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	2.756	967.8	0.0238	5.890	916.0	0.0238	10.185	930.1	0.0237
2	4.577	1163.3	0.0237	9.440	1039.1	0.0237	16.306	1053.8	0.0236
3	5.419	1236.3	0.0235	10.951	1081.0	0.0235	18.993	1094.3	0.0234
4	5.755	1258.0	0.0233	11.523	1102.8	0.0234	20.076	1101.0	0.0232
5	5.880	1261.8	0.0231	11.756	1119.4	0.0232	20.548	1098.0	0.0230
6	5.934	1261.1	0.0229	11.892	1134.5	0.0230	20.795	1092.5	0.0228
7	5.974	1260.7	0.0227	12.016	1148.2	0.0228	20.962	1086.4	0.0226
8	6.018	1261.7	0.0225	12.148	1160.0	0.0226	21.097	1080.3	0.0225
9	6.070	1263.7	0.0223	12.287	1170.1	0.0224	21.212	1074.3	0.0223
10	6.126	1266.5	0.0222	12.432	1178.7	0.0223	21.307	1068.5	0.0221
11	6.182	1269.6	0.0220	12.581	1186.6	0.0221	21.378	1062.4	0.0220
12	6.223	1271.9	0.0218	12.719	1194.4	0.0219	21.397	1055.2	0.0218
13	6.198	1269.2	0.0217	12.775	1201.5	0.0217	21.264	1045.5	0.0216
14	5.964	1248.4	0.0215	12.495	1201.3	0.0216	20.629	1030.2	0.0215
15	5.165	1173.2	0.0214	11.138	1164.4	0.0214	18.390	994.2	0.0214
16	3.101	950.0	0.0213	6.997	1001.8	0.0213	11.750	878.8	0.0213

Datapoint or Statepoint	EFPD / Cycle
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-19. Burnup and TH Feedback Parameters by Axial Node for Assembly B25

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	3.682	1091.8	0.0244	7.724	988.5	0.0246	13.720	1022.9	0.0243
2	5.486	1273.7	0.0242	11.382	1106.2	0.0244	20.261	1147.8	0.0241
3	6.380	1346.6	0.0240	13.067	1155.9	0.0242	22.966	1173.7	0.0239
4	6.734	1367.3	0.0237	13.717	1187.3	0.0240	23.985	1173.4	0.0236
5	6.850	1368.7	0.0235	13.969	1212.2	0.0237	24.391	1167.0	0.0234
6	6.894	1366.3	0.0232	14.118	1233.3	0.0235	24.596	1159.4	0.0231
7	6.929	1365.0	0.0230	14.261	1251.4	0.0233	24.735	1151.3	0.0229
8	6.973	1365.5	0.0228	14.418	1267.0	0.0230	24.845	1142.9	0.0227
9	7.026	1367.4	0.0226	14.585	1280.3	0.0228	24.934	1134.4	0.0225
10	7.084	1370.2	0.0224	14.759	1291.9	0.0226	25.001	1125.7	0.0223
11	7.145	1373.5	0.0222	14.942	1302.6	0.0223	25.047	1116.5	0.0221
12	7.195	1376.4	0.0220	15.122	1313.9	0.0221	25.057	1106.1	0.0219
13	7.186	1374.7	0.0218	15.231	1325.2	0.0219	24.947	1093.7	0.0217
14	6.960	1354.2	0.0216	14.979	1326.4	0.0217	24.360	1077.4	0.0216
15	6.179	1280.4	0.0214	13.586	1281.8	0.0215	22.146	1046.9	0.0214
16	4.238	1081.2	0.0213	9.459	1119.7	0.0213	15.267	925.7	0.0213

Table 4-20. Burnup and TH Feedback Parameters by Axial Node for Assembly B26

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	2.154	882.3	0.0232	4.642	847.7	0.0233	7.904	847.9	0.0230
2	3.590	1046.5	0.0231	7.506	960.1	0.0232	12.672	946.7	0.0229
3	4.280	1111.7	0.0229	8.776	1002.5	0.0230	14.790	980.5	0.0228
4	4.568	1132.6	0.0228	9.282	1023.6	0.0229	15.673	988.4	0.0227
5	4.677	1136.6	0.0227	9.489	1039.5	0.0228	16.057	987.8	0.0225
6	4.721	1136.2	0.0225	9.603	1053.5	0.0226	16.258	984.4	0.0224
7	4.752	1135.7	0.0224	9.700	1065.5	0.0225	16.394	980.2	0.0223
8	4.784	1136.1	0.0222	9.801	1075.8	0.0223	16.505	975.9	0.0221
9	4.821	1137.5	0.0221	9.907	1084.5	0.0222	16.601	971.8	0.0220
10	4.861	1139.4	0.0220	10.017	1092.0	0.0221	16.683	967.9	0.0219
11	4.901	1141.6	0.0218	10.129	1098.8	0.0219	16.745	963.6	0.0218
12	4.925	1142.8	0.0217	10.228	1105.4	0.0218	16.762	958.3	0.0216
13	4.891	1139.0	0.0216	10.248	1110.9	0.0216	16.638	950.7	0.0215
14	4.679	1118.6	0.0215	9.972	1108.5	0.0215	16.069	937.2	0.0214
15	4.025	1051.4	0.0213	8.818	1073.0	0.0214	14.195	903.8	0.0213
16	2.413	864.9	0.0213	5.497	921.3	0.0213	8.944	803.2	0.0213

Datapoint or Statepoint	EFPD / Cycle
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-21. Burnup and TH Feedback Parameters by Axial Node for Assembly B29

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	2.973	1005.0	0.0241	6.290	916.9	0.0240	11.627	1002.9	0.0242
2	4.921	1210.1	0.0239	10.066	1037.8	0.0239	18.158	1127.3	0.0240
3	5.848	1284.8	0.0237	11.729	1086.2	0.0237	20.954	1161.1	0.0238
4	6.225	1306.3	0.0235	12.386	1118.2	0.0235	22.091	1164.1	0.0235
5	6.364	1309.1	0.0233	12.655	1142.8	0.0233	22.588	1159.7	0.0233
6	6.423	1307.8	0.0230	12.808	1162.1	0.0231	22.845	1153.5	0.0231
7	6.468	1307.0	0.0228	12.942	1177.7	0.0229	23.015	1146.8	0.0229
8	6.516	1307.7	0.0226	13.082	1190.4	0.0227	23.148	1140.0	0.0227
9	6.572	1309.6	0.0224	13.229	1200.8	0.0225	23.255	1133.2	0.0225
10	6.632	1312.3	0.0223	13.381	1209.6	0.0224	23.337	1126.1	0.0223
11	6.692	1315.3	0.0221	13.537	1217.5	0.0222	23.391	1118.4	0.0221
12	6.737	1317.7	0.0219	13.686	1225.4	0.0220	23.396	1109.3	0.0219
13	6.716	1315.3	0.0217	13.754	1233.0	0.0218	23.263	1098.1	0.0217
14	6.477	1294.5	0.0215	13.475	1233.9	0.0216	22.660	1083.0	0.0216
15	5.645	1217.7	0.0214	12.071	1198.1	0.0214	20.481	1054.1	0.0214
16	3.440	988.1	0.0213	7.680	1033.8	0.0213	13.484	941.1	0.0213

Table 4-22. Burnup and TH Feedback Parameters by Axial Node for Assembly B30

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	3.347	1063.1	0.0244	7.013	935.6	0.0243	13.250	1047.4	0.0245
2	5.303	1262.3	0.0242	10.849	1050.3	0.0242	20.025	1173.4	0.0243
3	6.321	1339.8	0.0239	12.706	1105.6	0.0240	22.965	1200.1	0.0240
4	6.736	1361.5	0.0237	13.457	1150.5	0.0238	24.132	1199.9	0.0238
5	6.883	1363.5	0.0235	13.759	1183.1	0.0236	24.610	1193.3	0.0235
6	6.946	1361.7	0.0232	13.928	1206.0	0.0234	24.847	1185.4	0.0233
7	6.994	1360.8	0.0230	14.078	1223.8	0.0231	25.002	1177.2	0.0230
8	7.048	1361.7	0.0228	14.234	1238.2	0.0229	25.119	1169.2	0.0228
9	7.110	1363.8	0.0226	14.399	1250.1	0.0227	25.212	1161.2	0.0226
10	7.176	1366.8	0.0224	14.568	1260.2	0.0225	25.280	1152.9	0.0223
11	7.242	1370.3	0.0222	14.743	1269.5	0.0223	25.324	1144.0	0.0221
12	7.295	1373.1	0.0220	14.915	1278.8	0.0221	25.329	1133.8	0.0219
13	7.282	1371.3	0.0218	15.010	1288.0	0.0218	25.205	1121.4	0.0218
14	7.038	1350.2	0.0216	14.738	1289.2	0.0216	24.584	1104.3	0.0216
15	6.178	1272.0	0.0214	13.279	1250.3	0.0214	22.286	1074.2	0.0214
16	4.032	1055.8	0.0213	8.925	1090.8	0.0213	15.128	953.4	0.0213

Datapoint or Statepoint	EFPD / Cycle
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-23. Burnup and TH Feedback Parameters by Axial Node for Assembly B31

Axial	Burnup	DP2 to DP3		Burnup	DP3 to SP37		Burnup	SP37 to SP38	
Node	DP3	T-Fuel	Spec.Vol	SP37	T-Fuel	Spec.Vol	SP38	T-Fuel	Spec.Vol
1	2.076	877.0	0.0232	4.446	822.3	0.0232	7.029	790.0	0.0227
2	3.535	1044.1	0.0231	7.317	929.3	0.0231	11.455	875.1	0.0226
3	4.272	1111.7	0.0229	8.654	975.4	0.0230	13.496	903.4	0.0225
4	4.588	1132.5	0.0228	9.207	1004.1	0.0229	14.378	912.6	0.0224
5	4.711	1136.3	0.0227	9.438	1025.6	0.0227	14.776	914.5	0.0223
6	4.763	1135.8	0.0225	9.561	1041.9	0.0226	14.991	913.6	0.0222
7	4.798	1135.3	0.0224	9.660	1054.5	0.0225	15.144	911.7	0.0221
8	4.833	1135.7	0.0222	9.760	1064.6	0.0223	15.273	909.5	0.0220
9	4.873	1137.0	0.0221	9.863	1072.8	0.0222	15.391	907.3	0.0219
10	4.915	1138.9	0.0220	9.970	1079.7	0.0220	15.497	905.2	0.0218
11	4.956	1141.0	0.0218	10.078	1085.9	0.0219	15.586	902.7	0.0217
12	4.982	1142.2	0.0217	10.173	1092.0	0.0218	15.630	899.1	0.0216
13	4.947	1138.4	0.0216	10.191	1097.3	0.0216	15.532	892.5	0.0215
14	4.729	1117.9	0.0214	9.912	1095.2	0.0215	14.989	878.9	0.0214
15	4.049	1049.7	0.0213	8.740	1061.0	0.0214	13.171	847.9	0.0213
16	2.398	860.9	0.0213	5.403	911.8	0.0213	8.189	759.5	0.0213

Table 4-24. Burnup and TH Feedback Parameters by Axial Node for Assembly C2

Axial	Burnup	SP37 to SP38	
Node	SP38	T-Fuel	Spec.Vol
1	6.214	1156.6	0.0246
2	8.843	1332.1	0.0244
3	10.110	1400.0	0.0241
4	10.639	1414.0	0.0239
5	10.862	1411.3	0.0236
6	10.955	1405.3	0.0233
7	10.980	1399.0	0.0231
8	10.962	1393.0	0.0228
9	10.912	1387.4	0.0226
10	10.833	1381.7	0.0224
11	10.724	1375.5	0.0222
12	10.579	1367.7	0.0220
13	10.372	1356.1	0.0218
14	9.989	1332.3	0.0216
15	9.076	1271.7	0.0214
16	6.672	1106.5	0.0213

Datapoint or Statepoint	EFPD / Cycle
DP2	0.0 / Cy2
DP3	145.3 / Cy2
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup - GWd/MTU
T-Fuel - °F
Spec. Vol. - ft^3 / lbm

Table 4-25. Burnup and TH Feedback Parameters by Axial Node for Assembly C4

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	6.152	1150.1	0.0245
2	8.404	1302.2	0.0243
3	9.706	1374.2	0.0241
4	10.305	1394.0	0.0238
5	10.573	1394.7	0.0235
6	10.694	1390.6	0.0233
7	10.738	1385.4	0.0230
8	10.736	1380.0	0.0228
9	10.699	1374.7	0.0226
10	10.630	1369.3	0.0224
11	10.529	1363.2	0.0222
12	10.386	1355.2	0.0220
13	10.177	1343.1	0.0218
14	9.780	1318.1	0.0216
15	8.878	1257.7	0.0214
16	6.857	1117.8	0.0213

Table 4-26. Burnup and TH Feedback Parameters by Axial Node for Assembly C6

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	5.458	1102.6	0.0245
2	8.083	1283.4	0.0243
3	9.427	1357.8	0.0241
4	10.086	1380.8	0.0238
5	10.432	1385.8	0.0236
6	10.630	1385.8	0.0233
7	10.751	1384.5	0.0231
8	10.825	1383.0	0.0228
9	10.865	1381.6	0.0226
10	10.871	1380.3	0.0224
11	10.839	1378.2	0.0222
12	10.751	1373.9	0.0220
13	10.567	1364.3	0.0218
14	10.163	1340.4	0.0216
15	9.178	1276.6	0.0214
16	6.542	1097.0	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-27. Burnup and TH Feedback Parameters by Axial Node for Assembly C8

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	4.078	969.8	0.0240
2	6.703	1160.2	0.0238
3	7.992	1235.8	0.0236
4	8.638	1264.4	0.0234
5	9.000	1274.4	0.0232
6	9.230	1277.9	0.0230
7	9.395	1279.4	0.0228
8	9.524	1280.9	0.0226
9	9.628	1283.0	0.0224
10	9.708	1285.6	0.0222
11	9.756	1288.2	0.0220
12	9.743	1289.0	0.0219
13	9.603	1283.4	0.0217
14	9.159	1260.1	0.0215
15	7.945	1185.7	0.0214
16	4.858	967.1	0.0213

Table 4-28. Burnup and TH Feedback Parameters by Axial Node for Assembly C14

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	5.588	1104.8	0.0246
2	8.059	1270.1	0.0244
3	9.401	1347.0	0.0242
4	10.119	1378.6	0.0239
5	10.527	1390.2	0.0237
6	10.786	1394.5	0.0234
7	10.968	1396.4	0.0232
8	11.102	1397.9	0.0229
9	11.203	1399.6	0.0227
10	11.271	1401.5	0.0224
11	11.298	1402.8	0.0222
12	11.256	1401.5	0.0220
13	11.078	1393.1	0.0218
14	10.592	1365.6	0.0216
15	9.420	1292.0	0.0214
16	6.724	1109.5	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-29. Burnup and TH Feedback Parameters by Axial Node for Assembly C15

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	4.151	977.1	0.0240
2	6.801	1168.5	0.0239
3	8.113	1245.2	0.0237
4	8.776	1274.6	0.0235
5	9.147	1285.0	0.0233
6	9.384	1288.8	0.0230
7	9.554	1290.5	0.0228
8	9.686	1292.2	0.0226
9	9.794	1294.4	0.0224
10	9.878	1297.3	0.0223
11	9.928	1300.0	0.0221
12	9.917	1301.0	0.0219
13	9.774	1295.4	0.0217
14	9.318	1271.3	0.0215
15	8.083	1195.9	0.0214
16	4.963	975.5	0.0213

Table 4-30. Burnup and TH Feedback Parameters by Axial Node for Assembly C17

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	6.131	1144.6	0.0247
2	8.880	1322.0	0.0245
3	10.162	1391.3	0.0242
4	10.735	1411.3	0.0239
5	11.013	1413.5	0.0236
6	11.160	1410.6	0.0234
7	11.233	1406.5	0.0231
8	11.258	1402.4	0.0229
9	11.245	1398.7	0.0226
10	11.200	1395.0	0.0224
11	11.117	1390.7	0.0222
12	10.986	1384.5	0.0220
13	10.773	1373.7	0.0218
14	10.355	1349.5	0.0216
15	9.323	1283.7	0.0214
16	6.587	1098.8	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-31. Burnup and TH Feedback Parameters by Axial Node for Assembly C19

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	5.776	1118.8	0.0245
2	8.035	1269.2	0.0243
3	9.266	1339.0	0.0240
4	9.907	1365.7	0.0238
5	10.251	1373.5	0.0235
6	10.453	1374.6	0.0233
7	10.575	1373.6	0.0230
8	10.647	1372.1	0.0228
9	10.683	1370.6	0.0226
10	10.686	1369.1	0.0224
11	10.648	1366.6	0.0222
12	10.548	1361.6	0.0220
13	10.339	1350.4	0.0218
14	9.885	1323.1	0.0216
15	8.883	1257.7	0.0214
16	6.634	1103.2	0.0213

Table 4-32. Burnup and TH Feedback Parameters by Axial Node for Assembly C21

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	3.777	940.2	0.0237
2	6.202	1120.2	0.0235
3	7.370	1191.3	0.0234
4	7.943	1217.4	0.0232
5	8.257	1226.1	0.0230
6	8.449	1228.5	0.0228
7	8.582	1229.0	0.0226
8	8.680	1229.4	0.0225
9	8.754	1230.3	0.0223
10	8.807	1231.8	0.0221
11	8.829	1233.0	0.0220
12	8.797	1232.5	0.0218
13	8.650	1226.0	0.0216
14	8.233	1202.7	0.0215
15	7.130	1131.6	0.0214
16	4.352	926.7	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-33. Burnup and TH Feedback Parameters by Axial Node for Assembly C25

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	4.848	1039.9	0.0242
2	7.436	1220.1	0.0240
3	8.750	1294.4	0.0238
4	9.408	1321.8	0.0236
5	9.761	1329.9	0.0234
6	9.970	1331.3	0.0231
7	10.105	1330.7	0.0229
8	10.194	1330.1	0.0227
9	10.253	1329.9	0.0225
10	10.283	1330.1	0.0223
11	10.276	1329.9	0.0221
12	10.209	1327.6	0.0219
13	10.020	1318.8	0.0217
14	9.549	1292.2	0.0216
15	8.385	1218.9	0.0214
16	5.567	1023.9	0.0213

Table 4-34. Burnup and TH Feedback Parameters by Axial Node for Assembly C30

Axial Node	Burnup SP38	SP37 to SP38 T-Fuel	Spec.Vol
1	3.747	943.3	0.0235
2	6.224	1130.9	0.0234
3	7.399	1197.6	0.0232
4	7.913	1214.2	0.0231
5	8.150	1214.5	0.0229
6	8.264	1210.7	0.0227
7	8.317	1206.4	0.0225
8	8.336	1202.6	0.0224
9	8.331	1199.4	0.0222
10	8.305	1196.8	0.0221
11	8.254	1194.1	0.0219
12	8.164	1190.2	0.0218
13	7.999	1182.3	0.0216
14	7.634	1161.6	0.0215
15	6.663	1098.4	0.0214
16	4.103	905.3	0.0213

Datapoint or Statepoint	EFPD / Cycle
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Burnup	- GWd/MTU
T-Fuel	- °F
Spec. Vol.	- ft^3 / lbm

Table 4-35. Rod Insertion Time by Axial Node for Assembly A6

Axial Node	Time Rod Inserted (EFPD) SP37 to SP38
1	154.1
2	28.1
3	11.8
4	3.6
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

Table 4-36. Rod Insertion Time by Axial Node for Assembly A25

Axial Node	Time Rod Inserted (EFPD) SP37 to SP38
1	153.8
2	28.0
3	12.0
4	3.7
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

Statepoint	EFPD / Cycle
SP37	0.0 / Cy3
SP38	210.9 / Cy3

Table 4-37. Rod Insertion Time by Axial Node for Assembly A26

Axial Node	Time Rod Inserted (EFPD) SP37 to SP38
1	154.5
2	28.1
3	11.9
4	3.5
5	0.0
6	0.0
7	0.0
8	0.0
9	0.0
10	0.0
11	0.0
12	0.0
13	0.0
14	0.0
15	0.0
16	0.0

Table 4-38. Rod Insertion Time by Axial Node for Assembly A30

Axial Node	Time Rod Inserted (EFPD) DB2 to DB3	DB3 to SP37
1	79.5	104.0
2	13.1	19.4
3	0.0	12.4
4	0.0	0.0
5	0.0	0.0
6	0.0	0.0
7	0.0	0.0
8	0.0	0.0
9	0.0	0.0
10	0.0	0.0
11	0.0	0.0
12	0.0	0.0
13	0.0	0.0
14	0.0	0.0
15	0.0	0.0
16	0.0	0.0

Statepoint	EFPD / Cycle
DB2	0.0 / Cy2
DB3	145.3 / Cy2
SP37	0.0 / Cy3

Table 4-39. Critical Boron Data for Sequoyah 2 Burnup Calculations

$$ppmB = A + B \cdot EFPD$$

Cycle	A (ppmB)	B (ppmB/EFPD)
1	1003.27	-2.47
2	986.95	-3.15
3	1180.18	-3.11

4.2 Statepoint Critical Condition Measurements

Measured critical conditions for 3 reactor startups (or statepoints) are provided in Table 4-40. The data includes the initial startup of the reactor or beginning-of-life (BOL), the beginning-of-cycle (BOC) of reload cycle 3, and the reactor restart during cycles 3 of Sequoyah Unit 2. The cycle and statepoint number, along with the EFPD during the cycle for which the startup occurred, is provided. The elapsed time (in hours) since the reactor was shutdown (downtime) prior to the startup is also given for each statepoint. In addition, Table 4-40 provides the measured soluble boron concentration (ppmB), rod bank positions, and temperature of the moderator or coolant in the reactor (for each statepoint) when criticality was achieved.

Table 4-41 provides shutdown and startup dates for each cycle and statepoint. The cycle shutdown and startup dates can be used in determining the downtime for fuel assemblies that are out of the reactor for one or more cycles and are then reinserted in a later cycle.

Table 4-40. Statepoint Data for Sequoyah Unit 2 - Measured Critical Conditions

Cycle(SP)	EFPD	Downtime (hours)	ppmB	Rod Positions, cm above bottom of fuel* Bk CA	Bk CB	Bk CC	Bk CD	T(coolant) (F)
1(SP36)	0.0	0	1296	WD	WD	WD	267	547.0
3(SP37)	0.0	1943	1661	WD	WD	WD	328	549.4
3(SP38)	210.9	23,896	922	WD	WD	WD	285	545.0

Bk = Rod Bank
WD = Rod Withdrawn

* Measured from the bottom of active fuel region to bottom of control rod absorber region (See Figure 2-8).

Table 4-41. Statepoint Data for Sequoyah Unit 2 - Shutdown and Startup Dates

Cycle(SP)	EFPD	Shutdown Date	Startup Date
1(SP36)	0.0	-	05 Nov 1981
2(-)*	0.0	18 Jul 1983	12 Oct 1983
3(SP37)*	0.0	28 Sep 1984	18 Dec 1984
3(SP38)	210.9	21 Aug 1985	13 May 1988
	377.3 (EOC)	18 Jan 1989	

EOC = end-of-cycle

* Shutdown date is for previous cycle.

5.0 CONCLUSIONS

The data reported herein is acceptable for quality affecting activities and for use in analyses affecting procurement, construction, or fabrication. The classification analysis for the repository (which includes the waste package) carries TBV-228 because of the preliminary status of the basis for the MGR design. This report conservatively assumes that the resolution of TBV-228 will find the waste package to be quality affecting; consequently, use of any of the data reported herein does not need to carry TBV-228.

6.0 REFERENCES

1. *Quality Assurance Program for Framatome Cogema Fuels*, Document Number: 56-1177617-04, FCF, August 5, 1996.

2. *Classification of the Preliminary MGDS Repository Design*, Document Identifier Number (DI#) B00000000-01717-0200-00134 REV 00, Civilian Radioactive Waste Management System (CRWMS) Management and Operating Contractor (M&O).

3. QAP-2-0 Activity Evaluations, ID No. WP-06, *Develop Technical Documents*, CRWMS M&O, August 3, 1997.

4. *Quality Assurance Requirements and Description*, DOE/RW-0333P, REV 7, DOE OCRWM.

5. *Sequoyah 2 NEMO Depletion and Statepoints (HLW)*, Document Number: 32-1267112-01, FCF.