Appendix 4A. Tables

Table 4-1. Core Design, Thermal, and Hydraulic Data

Reactor	
Rated Heat Output, MWt	2,568
Vessel Coolant Inlet Temperature, 100% power, F	557.8
Vessel Coolant Outlet Temperature, 100% power, F	602.4
Core Outlet Temperature, 100% power	606.2
Core Operating Pressure, psia	2200
Reactor Coolant flow, % design flow	108.5
Note: The following parameters specified below are based on the fuel assembly nomenclature.	
Core and Fuel Assemblies [1]	
Total Number of Fuel Assemblies in Core	177
Number of Fuel Rods per Fuel Assembly	208
Number of Control Rod Guide Tubes per Assembly	16
Number of In-Core Instrumentation Positions per Fuel Assembly	1
Fuel Rod Outside Diameter, in.	
Mk-B10	0.430
Mk-B11, Mk-B11A	0.416
Mk-B-HTP	0.430
Clad Thickness, in.	
Mk-B10 to B10E	0.0265
Mk B-10F, Mk B-10G, and Mk B-10L	0.0250
Mk-B11, Mk-B11A	0.0240
Mk-B-HTP	0.0250
Fuel Rod Pitch, in.	0.568
Fuel Assembly Pitch Spacing, in.	8.587
Fuel Assembly Overall Length (Typical), in.	
Mk-B2 to B10L, Mk-B11 and Mk-B11A	165.695
Mk-B-HTP	165.895
Unit Cell Metal/Water Ratio (Volume Basis)	0.82
Fuel	
Material	UO_2

Form	Dished-End, Cylindrical Pellets
Pellet Diameter, in.	
MK B-10 to B-10E	0.3700
MK B-10F, MK B-10G, and MK B-10L	0.3735
Mk-B11, Mk-B11A	0.3615
Mk-B-HTP	0.3735
Active Length, in.	
MK B10 to B-10E	140.5 - 140.7
MK B-10F, MK B-10G, and MK B-10L	142.3
Mk-B11, Mk-B11A	143.05
Mk-B-HTP	143.0
Density, % of Theoretical	
Mk B-10 to B-10E	95.0
Mk B-10F, Mk B-10G, and Mk B-10L	96.0
Mk-B11, Mk-B11A	96.0
Mk-B-HTP	96.0
Heat Transfer and Fluid Flow at Rated Power [2]	
Total Heat Transfer Surface in Core, ft^2	
Mk-B10 to B-10E	48,525
Mk-B10F, Mk-B10G and Mk-B10L	49,147
Mk-B11, Mk-B11A	47,797
Mk-B-HTP	49,389
Average Heat Flux, Btu/hr-ft^2	
Mk-B10 to B-10E	175.7×10^3
Mk-B10F, Mk-B10G and Mk-B10L	173.5×10^3
Mk-B11, Mk-B11A	178.4×10^3
Mk-B-HTP	177.5×10^3
Maximum Heat Flux, Btu/hr-ft^2	
Mk-B10 to B-10E	452×10^3
Mk-B10F, Mk-B10G and Mk-B10L	446×10^3
Mk-B11, Mk-B11A	458×10^3
MK-B-HTP	456×10^3

Average Power Density in Core, kW/ℓ	
Mk-B10 to B-10E	85.46
Mk-B10F, Mk-B10G and Mk-B10L	84.38
Mk-B11, Mk-B11A	83.94
Mk-B-HTP	83.97
Average Thermal Output, kW/ft of Fuel Rod	
Mk-B10, Mk-B10D, and Mk-B10E	5.8
Mk-B10F, Mk-B10G, Mk-B10L, Mk-B11 and Mk-B11A	5.7
Mk-B-HTP	5.7
Maximum Thermal Output, kW/ft of Fuel Rod	
Mk-B10, Mk-B10D and Mk-B10E	14.9
Mk-B10F, Mk-B10G and Mk-B10L	14.7
Mk-B11, Mk-B11A	14.6
Mk-B-HTP	14.6
Average Core Fuel Temperature, F	
Mk-B10,Mk-B10D and Mk-B10E	1215
Mk-B10F, Mk-B10G and Mk-B10L	1162
Mk-B11, Mk-B11A	1175
Mk-B-HTP	1162
Total Reactor Coolant Flow, lb/hr (108.5% Design Flow)	142.3×10^6
Core Flow Area (Effective for Heat Transfer), ft^2	
Mk-B10 though Mk-B10L	49.645
Mk-B11, Mk-B11A	52.032
Mk-B-HTP	49.620
Core Coolant Average Velocity, fps (108.5% Design Flow)	
Mk-B10 through Mk-B10L (7.00% Bypass Flow)	15.94
Mk-B11, Mk-B11A (7.50% Bypass Flow)	15.13
Mk-B-HTP (6.49% Bypass Flow)	16.04
Power Distribution	
Maximum/Average Power Ratio, Radial x Local ($F_{\Delta h}$ Nuclear)	1.714
Maximum/Average Power Ratio, Axial (F_z Nuclear)	1.5 cos
Overall Power Ratio (F_q Nuclear)	2.57
Power Generated in Fuel and Cladding, %	97.3

Hot Channel Factors	
Power Peaking Factor (F_Q)	
Mk-B10, Mk-B10D and Mk-B10E	1.0107
Mk-B10F, Mk-B10G and Mk-B10L	1.0132
Mk-B11, Mk-B11A	1.0133
Mk-B-HTP	1.0132
Hot Spot Maximum/Average Heat Flux Ratio	
(F_q nuc and mech)	
Mk-B10, Mk-B10D and Mk-B10E	2.71
Mk-B10F to B10L ,Mk-B11 and Mk-B11A	2.72
Mk-B-HTP	2.64
Flow Area Reduction Factor(F_A) for MK-B10 through Mk-B10L, Mk-B11, Mk-B11A, and MK-B-HTP	
Unit/CRGT Bundle Cells	0.98
IGT Bundle Cells	0.97
DNB Data	
Design Overpower (% Rated Power)	112
CHF Correlation	
Mk-B10 through Mk-B10L	BWC
Mk-B11, Mk-B11A	BWU-Z with FB11 Multiplier
Mk-B-HTP	BHTP
DNB Limit - Non SCD	
Mk-B10 through Mk-B10L	1.18
Mk-B11, Mk-B11A	1.19
Mk-B-HTP	Proprietary
DNB Limit – SCD	
Mk-B10 through Mk-B10L	1.43
Mk-B11, Mk-B11A	1.33
Mk-B-HTP	1.34
Typical minimum DNBR	
Mk-B10 through Mk-B10L	2.47
Mk-B11, Mk-B11A	2.76
Mk-B-HTP	2.58

Note:

1. Parameters are based on cold dimensions for each of the respective fuel assembly designs, as applicable.
2. Based on reference peaking and active fuel length for each fuel rod type specified at BOL conditions.

Table 4-2. Fuel Assembly Components

Item	Material	Dimensions (In)
Fuel Clad (in.)		
Mk B-10 through B10E	Zircaloy-4	0.430 OD x 0.377 ID
Mk B-10F through Mk B-10L	Zircaloy-4	0.430 OD x 0.380 ID
Mk-B11, Mk-B11A	M5	0.416 OD x 0.368 ID
Mk-B-HTP	M5	0.430 OD x 0.380 ID
Fuel Rod Length (Typical), in.		
Mk-B10 to B10L		154.16
Mk-B11, Mk-B11A		155.30
Mk-B-HTP		155.00
Fuel Assembly:		
Overall Length B10, B11 and B11A (Typical), in.		165.695
Overall Length B-HTP (Typical), in.		165.895
Control Rod Guide Tube (in.)		
Mk-B10 to Mk-B10L	Zircaloy-4	0.530 OD x 0.016 wall
Mk-B11	Zircaloy-4	0.530 OD x 0.016 wall
Mk-B11A	M5	0.530 OD x 0.016 wall
Mk-B-HTP	M5	0.530 OD x 0.016 wall
Instrumentation Tube (in.)		
Mk-B10 to B10L	Zircaloy-4	0.493 OD x 0.441 ID
Mk-B11, Mk-B11A	Zircaloy-4	0.493 OD x 0.441 ID
Mk-B-HTP	M5	0.493 OD x 0.400 ID
End Fittings		
Mk-B10 to B10L	Stainless Steel (Castings)	
Mk-B11, Mk-B11A	Stainless Steel	
Mk-B-HTP	Stainless Steel	
End Spacer Grid		
Mk B-10 to Mk B-10L	Inconel-718	0.020 thick exteriors 0.018 thick interiors

Item	Material	Dimensions (In)
Mk-B11, Mk-B11A	Inconel-718	0.020 thick exteriors 0.018 thick interiors
Mk-B-HTP	Inconel-718	
Intermediate Spacer Grid		0.025 thick exteriors 0.013 thick exteriors
MK-B10 to MK-B10L	Zircaloy-4	0.021 thick exteriors 0.018 thick interiors
Mk-B11, Mk-B11A	Zircaloy-4	0.021 thick exteriors 0.018 thick interiors
Mk-B-HTP	M5	0.026 thick exteriors 0.014 thick interiors
Spacer Sleeve		
Mk-B10 to B10L	Zircaloy-4	0.554 OD x 0.502 ID
Mk-B11, Mk-B11A	Zircaloy-4	0.554 OD x 0.502 ID
Mk-B-HTP	M5	0.554 OD x 0.502 ID

Fuel Assembly Design:	Fuel Assembly Burnup
Mk B-10 through Mk B-10L, Mk-B11, Mk-B11A, and Mk-B-HTP	Consistent with a Maximum rod burnup of 62,000 MWD/MTU (Reference 15) of Section 4.2.5

Note:

1. Typical geometry. Batch specific is reported in individual reload reports.
2. Mk-B9 fuel rods are used in Mk-B10 and Mk-B10D/E fuel assembly designs. Mk-B10 design fuel rods are used in Mk-B10F/G/L fuel assembly designs (See Table 4-23).

Table 4-3. Nuclear Design Data

	Oconee I	Oconee II	Oconee III
Fuel Assembly Volume Fractions			
(Mk-B11, Mk-B11A)			
Fuel	0.291	0.291	0.291
Moderator	0.607	0.607	0.607
Zircaloy (includes M5 cladding)	0.091	0.091	0.091
Void	0.011 1.000	0.011 1.000	0.011 1.000
(Mk-B-HTP)			
Fuel	0.310	0.310	0.310
Moderator	0.582	0.582	0.582
Zircaloy (includes M5 cladding)	0.097	0.097	0.097
Void	0.011 1.000	0.011 1.000	0.011 1.000
Total UO_2 (Metric Tons)			
First Cycle	94.1	93.1	93.1
Deleted Row per 2008 Update			
Equilibrium (Mk-B11, Mk-B11A)	92.2	92.2	92.2
Equilibrium (Mk-B-HTP)[1]	98.2 / 97.8	98.2 / 97.8	98.2 / 97.8
Core Dimensions, in.			
Equivalent Diameter	128.9	128.9	128.9
Deleted Row per 2008 Update			
Nominal Active Height (Mk-B11, B11A)	143.1	143.1	143.1
Nominal Active Height (Mk-B-HTP)	143.0	143.0	143.0
Unit Cell H_2O to U Atomic Ratio (Fuel Assembly)			
Cold	2.85	2.88	2.88
Hot	2.04	2.06	2.06
Full-Power Lifetime, Days			
First Cycle	309	440	479
Equilibrium Cycle[2]	480 / 700	480 / 700	480 / 700
Fuel Irradiation, MWD/MTU			
First Cycle Average	9,582	14,396	14,978

	Oconee I	Oconee II	Oconee III
Deleted Row per 2008 Update			
Equilibrium Cycle Average (Mk-B11 & B11A)	15,172	15,172	15,172
Equilibrium Cycle Average (Mk-B-HTP)[3]	14,241 / 20,854	14,241 / 20,854	14,241 / 20,854
Fuel Loading, wt% U-235			
Core Average First Cycle	2.10	2.62	2.56
First Reload Average	3.15	2.64	2.54
Typical Core Average Equilibrium Cycle			
Nominal Loading[3]	4.00 / 4.74	4.00 / 4.74	4.00 / 4.74
Radial-Zoned Loading[3]	3.70 / N/A	3.70 / N/A	3.70 / N/A
Axial Blanket Loading	2.00-2.50	2.00-2.50	2.00-2.50
Control Data			
Control Rod Material	Ag-In-Cd	Ag-In-Cd	Ag-In-Cd
Number of Full Length CRA's	61	61	61
Control Rod Cladding Material	INC-625	INC-625	INC-625
APSR Material	INC-600	INC-600	INC-600
Number of APSR's	8	8	8
APSR Cladding Material	SS 304	SS 304	SS 304

Note:

1. The first value is for LEU HTP fuel. The second value is for Gadolinia-bearing HTP fuel.
2. 480 EFPD is the equilibrium 18 month cycle length; 700 EFPD is the equilibrium 24 month cycle length.
3. The first value is typical of 18 month cycles and the second value is typical of 24 month cycles.

Table 4-4. Typical Fuel Cycle Excess Reactivity, HFP Samarium

Cycle Time (EFPD)	18 Month Cycle Excess Reactivity (%Δk/k) at Specified Condition[1]			
	70°F, No Xe	300°F, No Xe	HZP, No Xe	HFP, No Xe
0	18.58	17.33	15.10	13.11
50	17.88	16.65	14.35	12.43
100	17.18	15.96	13.59	11.48
200	15.39	14.19	11.64	9.24
300	13.61	12.43	9.69	6.99
450	10.66	9.44	6.57	3.38
480	9.92	8.68	5.72	2.59
Cycle Time (EFPD)	**24 Month Cycle Excess Reactivity (%Δk/k) at Specified Condition[2]**			
	60°F, No Xe	**300°F, No Xe**	**HZP, No Xe**	**HFP, No Xe**
0	16.77	15.57	13.06	11.07
50	16.16	15.00	12.54	10.55
100	15.55	14.42	12.02	10.03
200	14.93	13.87	11.44	9.37
300	14.31	13.32	10.86	8.70
400	13.36	12.35	9.74	7.44
500	12.05	11.01	8.31	5.83
693	8.92	7.86	4.99	2.50

Note:

1. 18 Month Data from 0 to 300 EFPD were derived with CRG-8 at 30% WD, and data from 450 to 480 EFPD were derived with CRG-8 at 100% WD.
2. 24 Month Data from 0 to 500 EFPD were derived with CRG-8 at 35%WD, and data at 693 EFPD were derived with CRG-8 at 100% WD.

Table 4-5. Effective Multiplication Factor k_{eff} Single Fuel Assembly[1]

	Hot	0.77
	Cold[2]	0.87

Note:

1. Based on an enrichment of 3.5 weight percent.
2. A center-to-center assembly pitch of 21 in. is required for this k_{eff} in cold, unborated water with no xenon or samarium.

Table 4-6. Shutdown Margin Calculation for Typical Oconee Fuel Cycle

18 Month Cycle	**BOC, %Δk/k**	**EOC, %Δk/k**
Available Rod Worth		
Total rod worth, HZP	7.76	8.65
Worth reduction due to burnup of poison material	-0.40	-0.40
Maximum stuck rod, HZP	-1.17	-1.55
Net worth	6.19	6.70
Less 10% uncertainty	0.62	0.67
Total available worth	5.57	6.03
Required Rod Worth		
Power deficit, HFP to HZP	1.34	3.01
Max allowable inserted rod worth	0.40	0.53
Total required worth	1.74	3.54
Shutdown margin (total available worth minus total required worth)	3.83	2.49
24 Month Cycle	**BOC, %Δk/k**	**EOC, %Δk/k**
Available Rod Worth		
Total rod worth, HZP	8.11	8.65
Worth reduction due to burnup of poison material	-0.40	-0.40
Maximum stuck rod, HZP	-1.39	-1.50
Net worth	6.31	6.75
Less 10% uncertainty	0.63	0.67
Total available worth	5.68	6.07
Required Rod Worth		
Power deficit, HFP to HZP	1.55	3.02
Max allowable inserted rod worth	0.36	0.48
Total required worth	1.91	3.50
Shutdown margin (total available worth minus total required worth)	3.77	2.57

Note:

1. Required shutdown margin is 1.00% Δk/k.
2. The power deficit calculation was done with a three-dimensional code.

Table 4-7. Moderator Temperature Coefficient (For the First Cycle)

Conditions	Oconee I	Oconee II	Oconee III
1. Core size, no. fuel assemblies	177	177	177
2. Core average enrichment w/o U-235	2.10	2.62	2.56
3. Avg Power density, MWt/assembly	14.508	14.508	14.508
4. Initial critical conditions (hot full power, clean)			
a. Boron concentration, ppm	1200	1341	1291
b. CRA inserted worth, % Δk/k [a]	2.1	1.0	1.0
c. Burnable poison worth, % Δk/k	0.0	4.0	4.0
d. Moderator temperature coefficient, [10^{-4} (Δk/k)/F][b]	+0.27	+0.03	-0.01
5. Threshold value of moderator temperature coefficient, [10^{-4} (Δk/k)/F][c]	+1	>+1	>+1
6. Moderator temperature coefficient at hot full power, equilibrium xenon, BOL, [10^{-4} (Δk/k)/F][b]	-0.30	-0.50	-0.54
7. Most positive value of moderator temperature coefficient used in safety analysis, [10^{-4} (Δk/k)/F][c]	+0.9	+0.9	+0.9
8. Most negative value of moderator temperature coefficient used in safety analyses [10^{-4} (Δk/k)/F][c]	-3.5	-3.5	-3.5

Note:

a. Inserted rod worth shown for Oconee 1 results from 3-D calculations and reflects transient group worth, APSR's, and partial Doppler insertion.

b. See Section 4.3.2.4.4.

c. Value is applicable to current safety analyses.

Table 4-8. BOL Distributed-Temperature Moderator Coefficients, 100% Power, 1200 ppm Boron (O1C01)

Type of Temperature Change	T_{in} (°F)	T_{out} (°F)	$\alpha_m \left(x10^{-4} \frac{\Delta\rho}{°F_m}\right)$
1. T_{in}constant, T_{out} change	554.03 554.03	606.90 609.33	+0.14
2. T_{in} and T_{out} change	554.03 555.00	606.90 607.73	+0.27
3. T_{in} change T_{out} constant	554.03 551.20	606.90 606.79	+0.36

Table 4-9. BOL Distributed-Temperature Moderator Coefficients, vs Power, No Xenon

% Power (% Full Power)	$\alpha_m (x\,10^{-4} \frac{\Delta\rho}{°F_m})$ Oconee 1, Cycle 1 (1200 ppm)	Typical 18 Month Reload Cycle (Boron Search)
0	-	+0.44 (2010 ppm)
15	+0.42	+0.13 (1991 ppm)
60	+0.30	-0.08 (1905 ppm)
95	-	-0.23 (1845 ppm)
100	+0.27	-0.25 (1837 ppm)
% Power (% Full Power)	**Oconee 1, Cycle 1 (1200 ppm)**	**Typical 24 Month Reload Cycle (Boron Search)**
0	--	+0.08 (1975 ppm)
15	+0.42	--
20	--	-0.36 (1915 ppm)
60	+0.30	--
80	--	-0.64 (1808 ppm)
100	+0.27	-0.73 (1771 ppm)

Table 4-10. BOL Distributed-Temperature Moderator Coefficient, 100% Full Power

	$\alpha_m (x\ 10^{-4} \frac{\Delta\rho}{°F\ m})$	
	0 Days (NoXe)	4 Days (EqXe)
Oconee 1, Cycle 1	+0.27 (1200 ppm)	-0.30 (920 ppm)
Typical 18 Month Reload Cycle	-0.25 (1837 ppm)	-0.59 (1481 ppm)
Typical 24 Month Reload Cycle	-0.73 (1771 ppm)	-1.07 (1374 ppm)

Table 4-11. Power Coefficients of Reactivity

Power (% Full Power)	$\alpha_p (x\,10^{-4}\,\frac{\Delta\rho}{\%\Delta P})$ Oconee 1, Cycle 1 (1200 ppm)	Typical 18 Month Reload Cycle (Boron search)
15	-2.04	-1.24 (1991 ppm)
60	-1.56	-1.10 (1905 ppm)
100	-1.11	-1.07 (1837 ppm)
Power (% Full Power)	**Oconee 1, Cycle 1 (1200 ppm)**	**Typical 24 Month Reload Cycle (Boron search)**
15	-2.04	-1.43 (1930 ppm)
60	-1.56	-1.35 (1842 ppm)
100	-1.11	-1.32 (1774 ppm)

Table 4-12. pH Characteristics

^{7}Li, ppm	T_{mod}, °F	Boron Concen., ppm	pH Units
0.5	70	1,800	5.0
2.0	70	1,800	5.6
0.5	580	1,200	7.0
2.0	580	1,200	7.5
0.5	580	17	7.2
2.0	580	17	7.8
0.5	70	17	7.9
2.0	70	17	8.5

Table 4-13. Design Methods

Unit	Initial Cycle	Design Methods
1	16	Section 4.3.3.1.1
2	15	Section 4.3.3.1.1
3	16	Section 4.3.3.1.1

Table 4-14. Deleted per 1999 Update

Table 4-15. Deleted per 1997 Update

Table 4-16. Internals Vent Valve Materials

Valve Part Name	Material and Form	Material Specification No.
Valve Body	304 S.S. Casting [1]	ASTM A351-CF8
Valve Disc	304 S.S. Casting [1]	ASTM A351-CF8
Disc Shaft	431 S.S. Bar [2]	ASTM A276 Type 431 Cond. T
Shaft Bushings	Stellite No. 6	
Retaining Rings (Top and Bottom)	15-5 pH (H1100) S.S. forgings	AMS 5658
Ring Jack Screws	"A-286 Superalloy" S.S. [3]	AMS 5737 C
Jackscrew Bushings	431 S.S. Bar	ASTM A276 Type 431 Cond. A
Misc. Fasteners, covers, locking devices, etc.	304 S.S. plate bar, etc.	ASTM A240 ASTM A276

Note:

1. Carbide solution annealed, C_{max} 0.08%, Co_{max} 0.2%
2. Heat treated and tempered to Brinnel Hardness Number (BHN) range of 290-320.
3. Heat treated to produce a BHN of 248 min.

The hinge assembly consists of a shaft, two valve body journal receptacles, two halve disc journal receptacles, and four flanged shaft journals (bushings). Loose clearances are used between the shaft and journal inside diameters, and between the journal outside diameters and their receptacles. The hinge assembly is shown and the clearance gaps are identified in Figure 4-30. The bushing clearances are listed in Table 4-17.

The valve disc hinge journal contains integral exercise lugs for remote operation of the disc with the valve installed in the core support shield.

Table 4-17. Vent Valve Shaft & Bushing Clearances Clearance Gaps are illustrated in Figure 4-30

A.	Cold Clearance Dimensions @ 70°F			
Bushing I.D. Shaft O.D.	1.500 1.490 .010	to to to	1.505 1.485 .020	 clearance (Gaps 1, 2, 7 & 8)
Body I.D. Bushing O.D.	2.000 1.997 .003	to to to	2.003 1.995 .008	 clearance (Gaps 3, 4, 5 & 6)
Bushing End Clearance Gaps 9 + 10				
Body Lugs Disc Hub	5.752 4.746 1.006 .996 0.10	to to to to to	5,75 6 4,74 2 1.01 4 .992 0.22	End Clearance (Gaps 9 + 10)
Bushing Flange	.249 .248	x 4 = x 4 =	 .996 .992	

B.	Hot Clearance Differential Change from 70 to 580°F		
Shaft:	A286	9.8×10^{-6} in/in/F	
Bushing:	Stellite #6	8.1×10^{-6}	
Bodies:	CF8 Stainless	9.82×10^{-6}	
	$\Delta T = 580 - 70 = 510$		
Shaft Bushing I.D.	$\Delta D = D\alpha\Delta T = 1.5\ (9.8 \times 10^{-6})\ 510$ = $= 1.5\ (8.1 \times 10^{-6})$ 510 =	.0075 .0062 –.0013 decrease	
Bushing O.D. Body I.D.	$= 2\ (8.1 \times 10^{-6})\ 510 =$ $= 2\ (9.82 \times 10^{-6})\ 510 =$	.0083 .010 +.0017 increase	
Bushing Endplay Hot			

CF8 Body Stellite # 6 Bushing Flange	$\Delta L = 1\ (9.82 \times 10^{-6})\ 510 =$ $= 1\ (8.1 \times 10^{-6})\ 510 =$	.0050 <u>.0041</u> .0009 increase

Table 4-18. Control Rod Assembly Data

Item		Data
	Number of CRA	61
A.	Standard CRA Design	
	Number of Control Rods per Assembly	16
	Outside Diameter of Control Rod, in.	0.440
	Cladding Thickness, in.	0.021
	Cladding Material	Type 304 SS, Cold-Worked
	End Plug Material	Type 304 SS, Annealed
	Spider Material	SS Grade CF3M
	Poison Material	80% Ag, 15% In, 5% Cd
	Female Coupling Material	Type 304 SS, Annealed
	Length of Poison Section, in.	134
	Stroke of Control Rod, in.	139
B.	Plant-Life CRA Design[1]	
	Number of Control Rods per Assembly	16
	Outside Diameter of Control Rod, in.	0.441
	Cladding Thickness, in.	0.023
	Cladding Material	Inconel 625
	End Plug Material	Inconel 625
	Spider Material	SS Grade CF3M
	Poison Material	80% Ag, 15% In, 5% Cd
	Female Coupling Material	Type 304 SS, Annealed
	Length of Poison Section, in.	139
	Stroke of Control Rod, in.	139

Note:

1. The plant-life CRA is prepressurized with Helium.

Table 4-19. Axial Power Shaping Rod Assembly Data

Item	Data
Gray APSR Design	
Number of Axial Power Shaping Rod Assemblies	8
Number of Axial Power Shaping Rods per Assembly	16
Outside Diameter of Axial Power Shaping Rod, in.	0.440
Cladding Thickness, in.	0.027
Cladding Material	Type 304 SS, Stainless Steel Cold-Worked
Plug Material	Type 304 or Type 308 SS, Annealed
Poison Material	Inconel - 600
Spider Material	SS Grade CF3M
Female Coupling Material	Type 304 SS, Annealed
Length of Poison Section, in.	63
Stroke of Control Rod, in.	139

Table 4-20. Burnable Poison Rod Assembly Data

Item	Data
Number of Burnable Poison Rods per Assembly	16
Outside Diameter of Burnable Poison Rod, in.	0.430
Cladding Thickness, in.	0.035
Cladding Material	Zircaloy-4, Cold Worked
End Cap Material	Zircaloy-4, Annealed
Poison Material	B_4C in. Al_2O_3
Length of Poison Section, in. [1]	126 / 123.2
Spider Material	SS Grade CF3M
Coupling Mechanism Material	Type 304 SS, Annealed

Note:

1. The poison length was 126” in the feed fuel up through cycle O1C27. The length changed to 123.2” beginning with the feed fuel in O2C26 to align with the gadolinia-bearing fuel which was introduced in O2C26.

Table 4-21. Control Rod Drive Mechanism Design Data

	Shim Safety	Axial Power Shaping
Type	Roller Nut Drive	Roller Nut Drive
Quantity	61	8
Location	Top-mounted	Top-mounted
Direction of Trip	Down	Does not trip
Velocity of Normal (Run) Withdrawal and Insertion, in./min.	30	30
Velocity of Jog Withdrawal and Insertion in./min.	3	3
Maximum Travel Time for Trip		
2/3 Insertion, sec	1.40[1]	Drive has no trip function
3/4 Insertion, sec	1.52[1]	Drive has no trip function
Length of Stroke, in.	139	139
Design Pressure, psig	2,500	2,500
Design Temperature, °F	650	650
Weight of Mechanism (App.)	940 lb	940 lb

Note:

1. These time values include rod motion only. The Technical Specification surveillance requirement for maximum control rod drop time includes, in addition, 0.14 seconds from the time the control rod drive breakers receive the signal to trip to the beginning of rod motion. This is appropriate since the elapsed time measured in the test begins with that signal to trip the CRD Breaker.

Table 4-22. Fuel Assembly / APSR Compatibility

Plant and Unit	Drive Type	Type of APSR Coupling- Spider Assembly Required for Mk-B10, Mk-B11, Mk-B11A and MK-B-HTP Fuel Designs
Deleted row(s) per 2002 Update.		
Oconee Unit 1&2	Type C APSR Drive[2]	Mk-B Standard OR Extended Coupling
Oconee Unit 3	Type C APSR Drive	Mk-B Standard OR Extended Coupling

Note:

1. The length of the Mk-B Standard and Extended Coupling APSR Hubs is 7.0 in. (nom.) and 7.57 in. (nom.), respectively. The length equals the sum of the female coupling, spider, and lower hub B, which is the distance from the bottom seating surface to the top of the female coupling.
2. Type C APSR Drive has R4C position indicators and hydraulic tension closures.

Table 4-23. Fuel Assembly Design Descriptions

Assembly Designation	Cage Design	Rod Desig n	Clad Material	Axial Blanket	Zoned Enrichment	HDS [2] Design	UEF [3] Attachment	Debris Filter
Mk-B10	B10	B9	Zirc-4	No	No	Cruciform	Lock Nut	Plug/Grid
Mk-B10D	B10	B9	Zirc-4 [1]	No	No	Cruciform	Lock Nut	Plug/Grid
Mk-B10E	B10	B9	Zirc-4	Yes	No	Cruciform	Lock Nut	Plug/Grid
Mk-B10F	B10	B10	Zirc-4	Yes	No	Cruciform	Lock Nut	Plug/Grid
Mk-B10G	B10	B10	Zirc-4	Yes	No	Cruciform	Quick Disconnect	Plug/Grid
Mk-B10L	B10	B10	Zirc-4	Yes	Yes	Cruciform	Quick Disconnect	Plug/Grid
Mk-B11	B11	B11	M5	Yes	Yes	Cruciform	Quick Disconnect	Plug/Grid
Mk-B11A	B11	B11	M5	Yes	Yes	Cruciform	Quick Disconnect	Plug/Grid
Mk B-HTP	HTP	HTP	M5	Yes	Yes	Cruciform	Recon Crimp Top Hat Nut	Fuel Guard

Note:

1. Consumer's or Smud Cladding
2. HDS = Hold Down Spring
3. UEF = Upper End Fitting

Table 4-24. Design Information for Current Demonstration Programs vs Typical FAs

Parameter	WH-177 LTA	Mk-B11A	MK-B-HTP
Hold-down Spring	3-leaf	Cruciform	Cruciform
Rod Array	15 X 15	15 X 15	15 X 15
Rods per Assembly	208	208	208
Rod Pitch, in.	0.568	0.568	0.568
Fuel Weight (as UO_2), lbs.	1149	1012	1080
Fuel Assembly weight (wet), lbs	1323	1304	1378
Number of Grids per Assembly	11	8	8
Composition of end grids	Inconel 718	Inconel 718	Inconel 718
Intermediate Support Grids	Yes	No	No
Number of Guide Thimbles per Assembly	16	16	16
Composition of Guide Thimbles	ZIRLO™	M5	M5
Fuel Rod Outside Diameter, in.	0.422	0.416	0.430
Clad Material	ZIRLO™	M5	M5
Fuel Pellet Material	UO_2	UO_2	UO_2/UO_2-Gd
Fuel Enrichments, wt%	<5	<5	<5
Overall FA Length, in	166.1	165.7	165.8