TABLE 4.3-1

REACTOR CORE DESCRIPTION

Active Core	
Equivalent Diameter, in.	132.7
Core Average Active Fuel Height, First Core (Hot), in.	143.7
Height-to-Diameter Ratio	1.09
Total Cross Section Area, ft^2	96.06
H_2O/U Molecular Ratio, Lattice (Cold)	2.41
Reflector Thickness and Composition	
Top - Water plus Steel, in.	~10
Bottom - Water plus Steel, in.	~10
Side - Water plus Steel, in.	~15
Fuel Assemblies	
Number	193
Rod Array	17 x 17
Rods per Assembly	264
Rod Pitch, in.	0.496
Overall Transverse Dimensions, in.	8.426 x 8.426
Fuel Weight (as UO_2), lb	222,739(V5H,V+) 217,565 (RFA)
Zircaloy Weight, lb	52,541 (V5H, V+) 53,847 (RFA)
Number of Grids per Assembly	V5H 2 Inconel (Top & Bottom) 6 Zircaloy-4 (Mid Grids) V+ 2 Inconel (Top & Bottom) 6 Zirlo[TM] (Mid Grids) RFA 2 Inconel (Top & Bottom) 1 Inconel (Protective Grid) 6 Zirlo[TM] (Mid Grids) 3 Zirlo[TM] (Intermediate Flow Mixing Grids)
Weight of Grids (Effective in Core), lb	2324 (V5H, V+) 3248 (RFA)
Number of Guide Thimbles per Assembly	24
Composition of Guide Thimbles	Zircaloy-4 (V5H) Zirlo[TM] (V+, RFA)

REACTOR CORE DESCRIPTION

Dia. of Guide Thimbles (upper part), in.	0.442 ID x 0.474 OD (V5H, V+) 0.442 ID x 0.482 OD (RFA)
Dia. of Guide Thimbles (lower part), in.	0.397 ID x 0.429 OD V5H, V+) 0.397 ID x 0.439 OD (RFA)
Dia. of Instrument Guide Thimbles, in.	0.442 ID x 0.474 OD V5H, V+) 0.442 ID x 0.482 OD (RFA)
<u>Fuel Rods</u>	
Number	50,952
Outside Diameter, in.	0.374
Diameter Gap, in.	0.0065
Clad Thickness, in.	0.0225
Clad Material	Zircaloy-4 (V5H) Zirlo™ (V+, RFA)
<u>Fuel Pellets</u>	
Material	UO_2 Sintered
Density[1]	95.5
Fuel Enrichments w/o[1]	<u>Typical Reload</u>
Region 1	4.2
Region 2	4.6
Region 3A	4.2
Region 3B	4.6
Diameter, in.	0.3225
RFA Annular Pellet I.D., in.[2]	0.155
Length, in.	0.530 (STD) 0.387 (V5H, V+) 0.387 (RFA solid)[2] 0.462 or 0.500 (RFA annular)[2]
Mass of UO_2 Per Foot of Fuel Rod, lb/ft	0.364 (V5H, V+) 0.355 (RFA)
<u>Rod Cluster Control Assemblies</u>	
Neutron Absorber	Ag-In-Cd
Composition, percent	80, 15, 5
Diameter, in.	0.381
Density, lb/in.	0.367
Clad Material	Type 316L, Ionnitride Surface
Clad Thickness, in.	0.0185
Number of Clusters, full length	53
Number of Absorber Rods per Cluster	24
Full Length Assembly Weight (dry), lb	149
<u>Burnable Absorber Rods</u>[1]	
Material (PYREX)	Borosilicate Glass
Outside Diameter, in.	0.381
Inner Tube, OD, in.	0.1815

TABLE 4.3-1 (Cont.)

REACTOR CORE DESCRIPTION

Clad Material	Stainless Steel
Inner Tube Material	Stainless Steel
Boron Loading (w/o B_2O_3 in glass rod)	12.5
Weight of Boron - 10 per foot of rod, lb/ft	0.00419
Material (WABA)	Al_2O_3 - B_4C Compound
B_4C Density (Fraction of Theoretical)	0.7
Absorber I.D., in.	0.278
Absorber O.D., in.	0.318
BA Clad Material	Zircaloy
Inner Clad Thickness, in.	0.021
Inner Clad O.D., in.	0.267
Outer Clad Thickness, in.	0.026
Outer Clad O.D., in.	0.381
Gap Material	Helium
<u>Integral Fuel Burnable Absorber</u>	
Material	ZrB_2
Content	1.570 to 2.355 mg B^{10}/in.[(1)]
<u>Excess Reactivity</u>	
Maximum Core Reactivity (Cold, Zero Power, Beginning of Cycle)[(3)]	1.200

(1) Typical reload values. Current values are given in the appropriate unit and cycle specific Core Loading Plan.

(2) Robust Fuel Assembly (RFA) uses annular pellets at the top & bottom 6" of the fuel stack height. Middle 132" of fuel stack height is solid pellets. The RFA annular pellet length starting with Salem Unit 1 Region 17 and Salem Unit 2 Region 15 is 0.500 inches.

(3) Typical reload value. This parameter is cycle-specific and is a function of energy requirements and number of burnable absorbers used.

TABLE 4.3-2

NUCLEAR DESIGN PARAMETERS

Core Average Linear Power, kW/ft, including densification effects	5.52
Total Heat Flux Hot Channel Factor, F_Q including densification effects	2.40
Nuclear Enthalpy Rise Hot Channel Factor,(1)	
$F^N_{\Delta H}$	RFA = 1.65, V5H = 1.57
Reactivity Coefficients	
Doppler Coefficient	See Figures 4.3-17 and 4.3-18
Moderator Temperature Coefficient at Operating Conditions, pcm/°F(2)	0 to -44
Boron Coefficient in Primary Coolant, pcm/ppm	-16 to -6
Rodded Moderator Density Coefficient at Operating Conditions, pcm/gm/cc	$\leq +0.52 \times 10^5$

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(1) Cycle-specific values based on accident analysis. The Core Operating Limits Report (COLR) contains the current cycle limits.

(2) Note: 1 pcm = (percent mille) 10^{-5} $\Delta\rho$ where $\Delta\rho$ is calculated from two statepoint values of k_{eff} by $\ln (k_2/k_1)$.

TABLE 4.3-2 (Cont'd)

NUCLEAR DESIGN PARAMETERS

Delayed Neutron Fraction and Lifetime	
β_{eff} BOL, (EOL)	0.0075 (0.0044)
Control Rod Worths	
Rod Requirements	See Table 4.3-3
Maximum Bank Worth, pcm	< 2000
Maximum Ejected Rod Worth	See Chapter 15
Boron Concentrations[3]	
Refueling CB, ARI (K<0.95)	≥ 2050
To control at HZP, ARO, (K=1.0)	1700 - 1950
To control at HFP, ARO, (K=1.0):	
0 MWD/MTU, No Xenon	1400 - 1700
150 MWD/MTU, Eq Xenon	1000 - 1250
1000 MWD/MTU, Eq Xenon	1000 - 1250

(3) Typical reload values. Current cycle values are given in the appropriate NDR or COLR.

TABLE 4.3-3

REACTIVITY REQUIREMENTS FOR ROD CLUSTER CONTROL ASSEMBLIES

	Reactivity Effects, Percent	Beginning-of-Life[1]	End-of Life[1]
	Control requirements		
	Fuel temperature (Doppler), %Δp	1.32	1.30
	Moderator temperature, %Δp	0.11	1.25
	Void, %Δp	0.01	0.05
	Redistribution, %Δp	0.50	0.85
	Rod Insertion Allowance, %Δp	0.50	0.50
	Rod Misalignment Relaxation Penalty, %Δp	0.12	0.12
2.	Total Control, %Δp	2.56	4.07
3.	Estimated Rod Cluster Control Assembly Worth (53 Rods)		
	a. All full length assemblies inserted, %Δp	8.595	8.00
	b. All but one (highest worth) assemblies inserted, %Δp	6.85	6.30
4.	Estimated Rod Cluster Control Assembly credit with 10 percent adjustment to accommodate uncertainties (3b - 10 percent), %Δp	6.17	5.67
5.	Shutdown margin available (4-2), %Δp	3.61	1.60[2]

(1) Typical reload values. See Plant Operations Package Table 10 for limiting End-of-Life cycle specific rack-up.

(2) The design basis minimum shutdown is 1.3 percent.

TABLE 4.3-4

AXIAL STABILITY INDEX

PWR CORE WITH A 12-FOOT HEIGHT

Burnup (MWD/T)	F_Z	C_B (ppm)	Stability Index (hr^{-1}) Exp	Stability Index (hr^{-1}) Calc
1550	1.34	1065	-0.041	-0.032
7700	1.27	700	-0.014	-0.006
		Difference:	+0.027	+0.026

TABLE 4.3-5

TYPICAL NEUTRON FLUX LEVELS (n/cm^2-sec) AT FULL POWER

	E > 1.0 Mev	5.53 Kev < E ≤ 1.0 Mev	0.625 ev ≤ E < 5.53 Kev	E < .625 ev $(nv)_0$
Core Center	6.51×10^{13}	1.12×10^{14}	8.50×10^{13}	3.00×10^{13}
Core Outer Radius at Midheight	3.23×10^{13}	5.74×10^{13}	4.63×10^{13}	8.60×10^{12}
Core Top, on Axis	1.53×10^{13}	2.42×10^{13}	2.10×10^{13}	1.63×10^{13}
Core Bottom, on Axis	2.36×10^{13}	3.94×10^{13}	3.50×10^{13}	1.46×10^{13}
Pressure Vessel Inner Wall, Azimuthal Peak, Core Midheight	2.77×10^{10}	5.75×10^{10}	6.03×10^{10}	8.38×10^{10}

TABLE 4.3-6

COMPARISON OF MEASURED AND CALCULATED DOPPLER DEFECTS

Plant	Fuel Type	Core Burnup (MWD/MTU)	Measure (pcm)[1]	Calculated (pcm)
1	Air-filled	1800	1700	1710
2	Air-filled	7700	1300	1440
3	Air and helium filled	8460	1200	1210

(1) pcm = $10^5 \times \ln k_1/k_2$

TABLE 4.3-7

BENCHMARK CRITICAL EXPERIMENTS

Description of Experiments[1]	No. of Experiments	LEOPARD K_{eff} Using Experimental Bucklings
UO_2		
Al Clad	14	1.0012
SS Clad	19	0.9963
Borated H_2O	7	0.9989
Total	40	0.9985
U-Metal		
Al Clad	41	0.9995
Unclad	20	0.9990
Total	61	0.9993
Grand Total	101	0.9990

(1) Reported in Reference 25.

TABLE 4.3-8

SAXTON CORE II ISOTOPICS
ROD MY, AXIAL ZONE 6

Atom Ratio	Measured[1]	2σ Precision (%)	LEOPARD Calculation
U-234/U	4.65×10^{-5}	± 29	4.60×10^{-5}
U-235/U	5.74×10^{-3}	± 0.9	5.73×10^{-3}
U-236/U	3.55×10^{-4}	± 5.6	3.74×10^{4}
U-236/U	0.99386	± 0.01	0.99385
Pu-238/Pu	1.32×10^{-3}	± 2.3	1.222×10^{-3}
Pu-239/Pu	0.73971	± 0.03	0.74497
Pu-240/Pu	0.19302	± 0.2	0.19102
Pu-241/Pu	6.014×10^{-2}	± 0.3	5.74×10^{-2}
Pu-242/Pu	5.81×10^{-3}	± 0.9	5.38×10^{-3}
Pu/U[2]	5.938×10^{-2}	± 0.7	5.970×10^{-2}
Np-237/U-238	1.14×10^{-4}	± 15	0.86×10^{-4}
Am-241/Pu-239	1.23×10^{-2}	± 15	1.08×10^{-2}
Cm-242/Pu-239	1.05×10^{-4}	± 10	1.11×10^{-4}
Cm-244/Pu-239	1.09×10^{-4}	± 20	0.98×10^{-4}

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(1) Reported in Reference 26

(2) Weight ratio.

TABLE 4.3-9

CRITICAL BORON CONCENTRATIONS, HZP, BOL

Plant Type	Measured	Calculated
2-Loop, 121 Assemblies 10 foot core	1583	1589
2-Loop, 121 Assemblies 12 foot core	1625	1624
2-Loop, 121 Assemblies 12 foot core	1517	1517
3-Loop, 157 Assemblies 12 foot core	1169	1161

TABLE 4.3-10

COMPARISON OF MEASURED AND CALCULATED ROD WORTH

2-Loop Plant, 121 Assemblies, 10-foot Core	Measured (pcm)	Calculated (pcm)
Group B	1885	1893
Group A	1530	1649
Shutdown	3050	2917

ESADA Critical [(1)], 0.69 inch Pitch, 2 w/o PuO_2, 8 percent Pu^{240}, 9 Control Rods		
6.21 in. rod separation	2250	2250
2.07 in. rod separation	4220	4160
1.38 in. rod separation	4100	4010

(1) Reported in Reference 27.

TABLE 4.3-11

COMPARISON OF MEASURED AND CALCULATED MODERATOR COEFFICIENTS AT HZP, BOL

Plant Type/ Control Bank Configuration	Measured α_{iso} (1) (pcm/°F)	Calculated α_{iso} (pcm/°F)
3-Loop, 157 Assemblies		
12 foot core		
D at 160 steps	-0.50	-0.50
D in, C at 190 steps	-3.01	-2.75
D in, C at 28 steps	-7.67	-7.02
B, C, and D in	-5.16	-4.45
2-Loop, 121 Assemblies		
12 foot core		
D at 180 steps	+0.85	+1.02
D in, C at 180 steps	-2.40	-1.90
C and D in, B at 165 steps	-4.40	-5.58
B, C, and D in A at 174 steps	-8.70	-8.12

(1) Isothermal coefficients, which include the Doppler effect in the fuel.

$\alpha_{iso} = 10^5 \ln k_2/k_1 \ / \ \Delta T°F$