Response to Request for Additional Information Regarding ANP-10286P, "U.S. EPR Rod Ejection Accident Methodology Topical Report"

RAI-1. *Please provide the following data that was used in the development of the cross sections in the Rod Ejection Accident (RIA) analyses:*

a. axial and radial enrichments,
b. poison loading,
c. pellet densities,
d. composition and dimensions of cladding materials, control rods, guide tubes, etc.

Response to RAI-1:

The following information is used in the development of the cross sections in the analysis of the rod ejection accident (REA). The fuel assembly data are representative of Cycle 1 and the equilibrium cycle of an 18-month core design. Table 1-1 presents the data relevant to the fuel rod, and Table 1-2 presents general fuel assembly data. Table 1-3 presents control rod data.

The fuel assembly layouts, including radial and axial U^{235} enrichment values and Gd enrichment, for the fuel types in Cycle 1 are shown in Figure 1-1 through Figure 1-7. The same information for the fuel assemblies in the equilibrium cycle are shown in Figure 1-8 through Figure 1-17. These figures are for Cycle 1 and the equilibrium cycle, respectively.

Table 1-1—Fuel Rod Data

Parameter	Value
Fuel pellet diameter	0.3225 in
Clad inner diameter	0.3291 in
Clad outer diameter	0.3740 in
Fuel pellet % theoretical density [a]	96%
Pellet end void F-factor [b]	0.990
Clad material	M5™
M5™ Clad material density	6.5 g/cm^3
M5™ Clad material composition [c] Zircaloy	100%

[a] Stack density can be calculated using the following equations:
for UO_2 fuel: $d = TD * (1-f_{void}) * f_{TD}$,
for UO_2-Gd_2O_3 fuel: $d = [TD – (2.65*P)/(P+0.67145*(1-P))] * (1-f_{void}) * f_{TD}$
where TD = theoretical density of UO_2 (10.96 g/cm^3)
f_{void} = effective pellet void volume fraction
f_{TD} = fraction of theoretical density
P = weight fraction of Gd_2O_3 in the UO_2-Gd_2O_3 fuel mixture

[b] Equivalent to $(1-f_{void})$ from equation in note (a) - includes dish void fraction and the outward land taper void fraction

[c] M5™ is a proprietary variant of Zr1NB. 100% Zr is a reasonable approximation to M5™

Table 1-2—General Fuel Assembly Data

Parameter	**Value**
Lattice Dimension	17x17
Assembly pitch	8.4661 in
Fuel rod pitch	0.496 in
Active fuel length	165.354 in
Guide tube inner diameter [a]	0.4508 in
Guide tube outer diameter [a]	0.4902 in
Guide tube material [a]	M5™ [b]
Number of spacer grids in active fuel region	8
Grid material	M5™ [b]
Mass per grid	2.822 lb_m
Grid height	1.75 in

[a] Instrument tubes have same dimensions and material as guide tubes

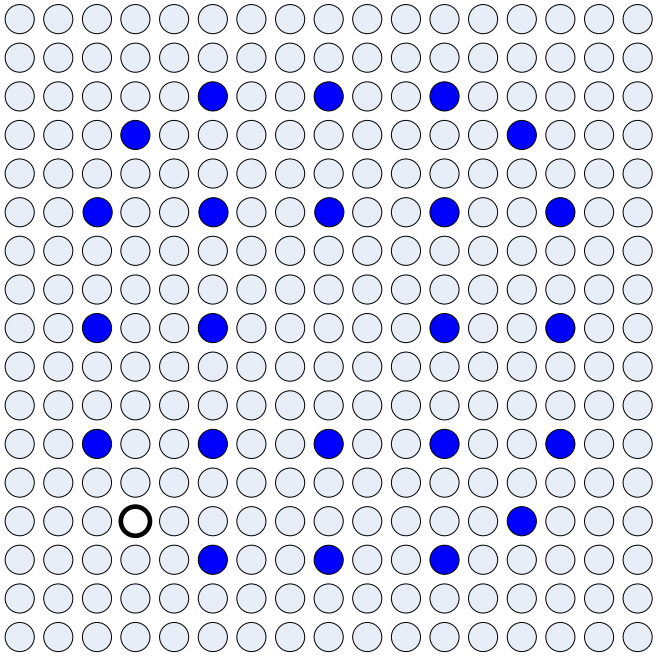
[b] See Table 1-1 for M5™ composition

Table 1-3—Control Rod Data

Parameter	Value
Absorber inner diameter	0.174 in
Absorber outer diameter [a]	0.341 in
Absorber material	AgInCd
AgInCd composition Silver (Ag) Indium (In) Cadmium (Cd)	 80% 15% 5%
AgInCd density	10.17 g/cm^3
Control rod cladding inner diameter	0.344 in
Control rod cladding outer diameter	0.381 in
Control rod cladding material	AISI 316L
Control rod cladding density	7.97 g/cm^3
Number of control rods per rod cluster control assembly	24

[a] Dimension is for upper region. Lower region is not modeled as part of the REA topical report.

Figure 1-1—Fuel Assembly Layout, Cycle 1, Batch A1
2.25 wt% U-235, No Gd



Rod Type	# of Rods	Rod Description
●	23	Guide Tube
○	1	Instrument Tube
○	265	2.25 wt% U-235

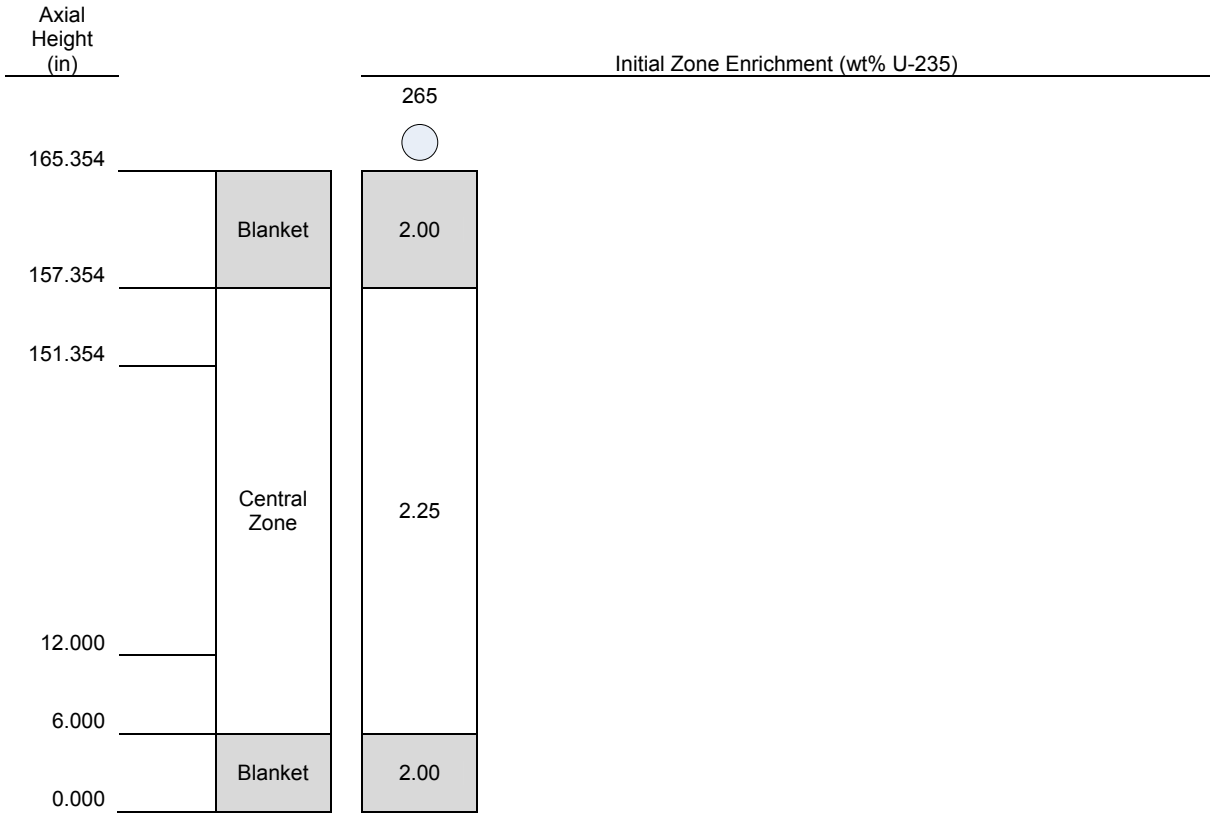
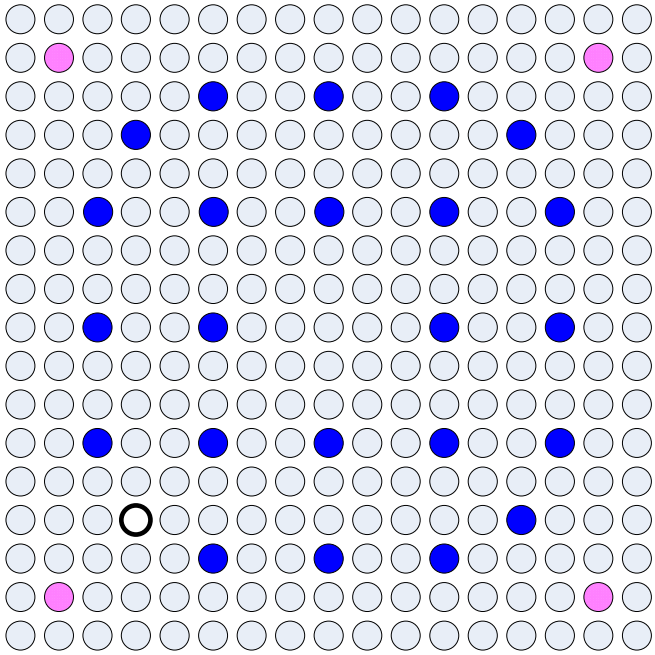


Figure 1-2—Fuel Assembly Layout, Cycle 1, Batch A2
2.25 wt% U-235, 4X4 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	261	2.25 wt% U-235
	4	2.13 wt% U-235 with 4 wt% Gd_2O_3 in the central zone

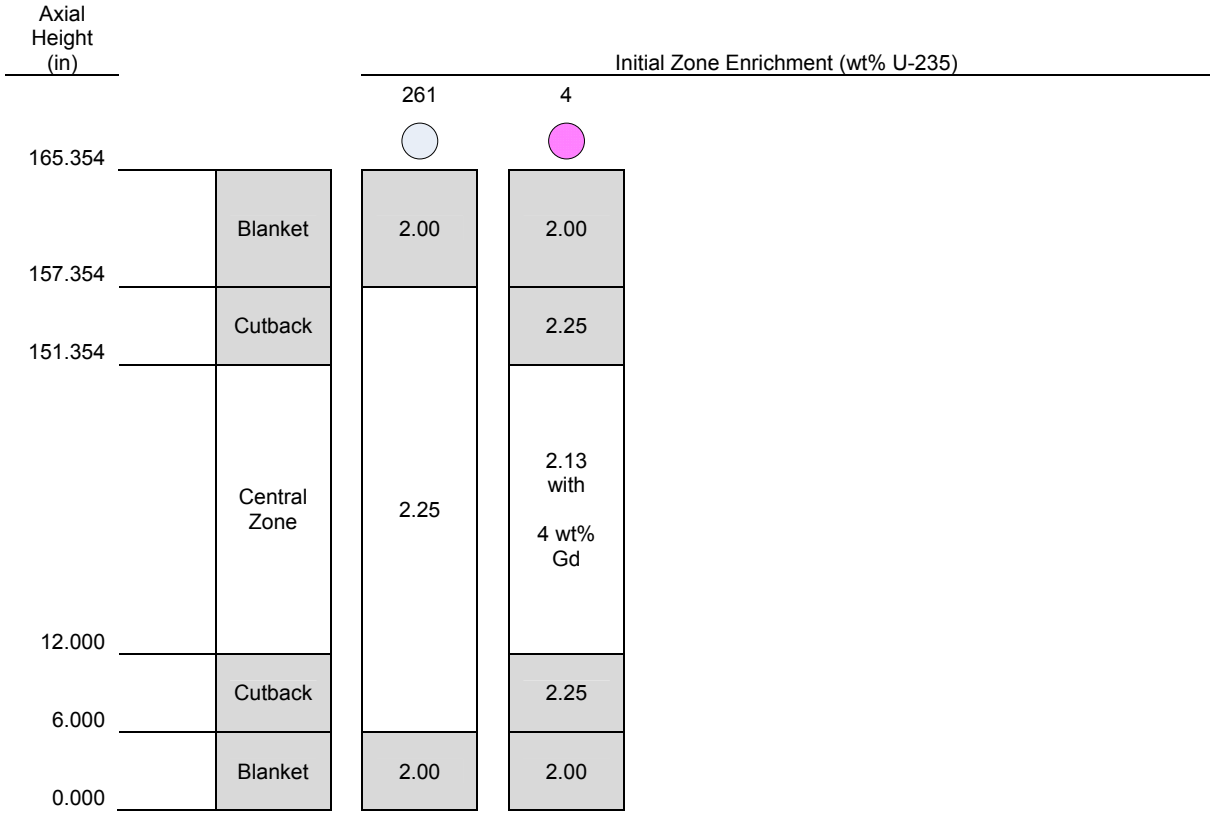
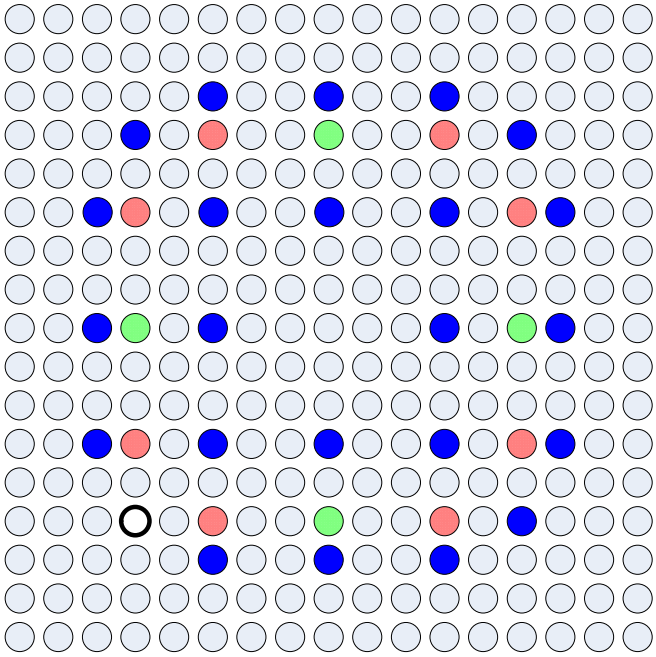


Figure 1-3—Fuel Assembly Layout, Cycle 1, Batch B1
2.70 wt% U-235, 8X8 + 4X4 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	253	2.70 wt% U-235
	4	2.56 wt% U-235 with 4 wt% Gd_2O_3 in the central zone
	8	1.89 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

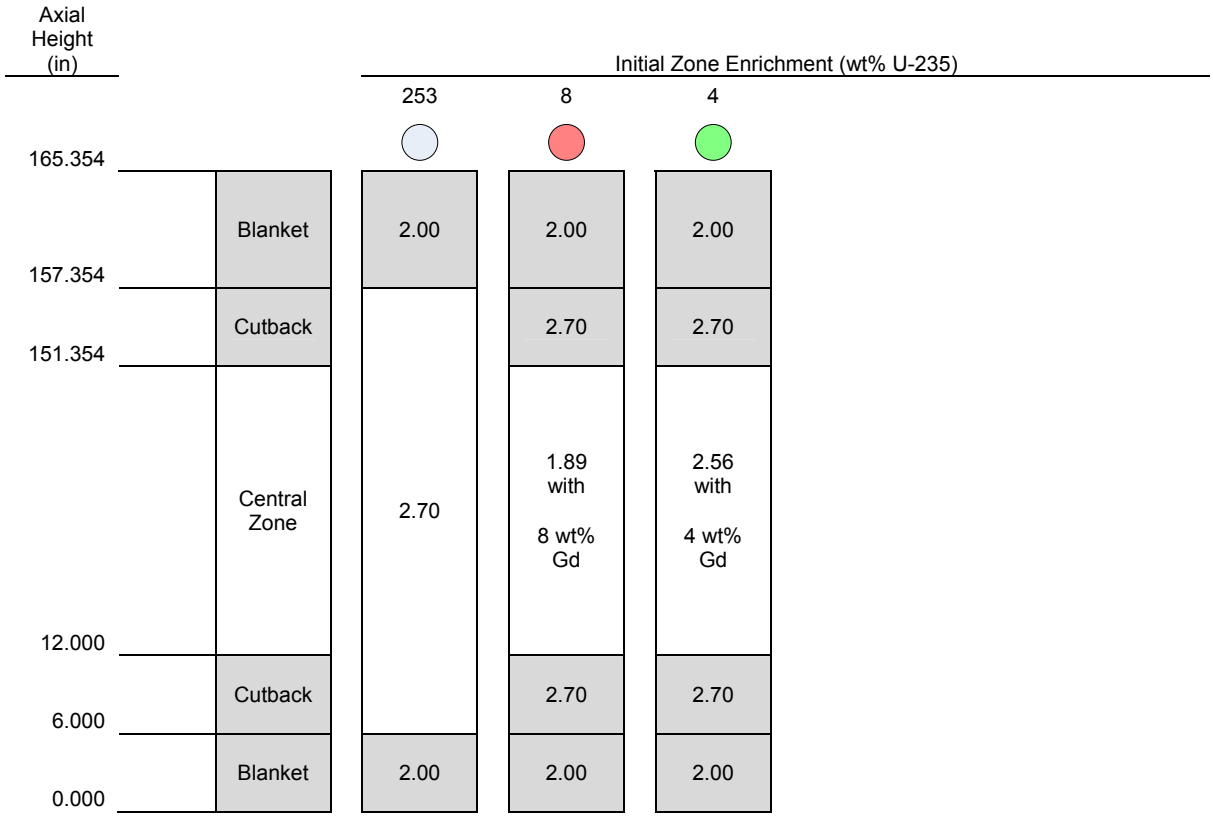
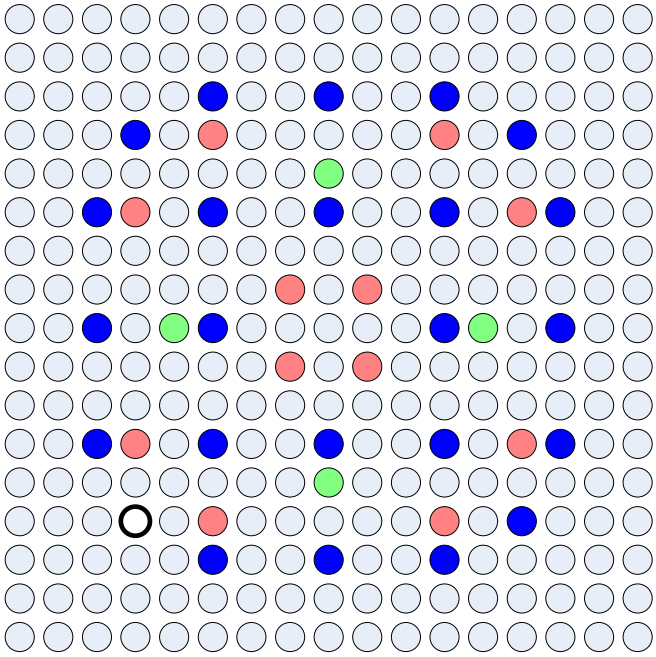


Figure 1-4—Fuel Assembly Layout, Cycle 1, Batch B2
2.70 wt% U-235, 12X8 + 4X2 Gd



Rod Type	# of Rods	Rod Description
●	23	Guide Tube
○	1	Instrument Tube
●	249	2.70 wt% U-235
●	4	2.56 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
●	12	1.89 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

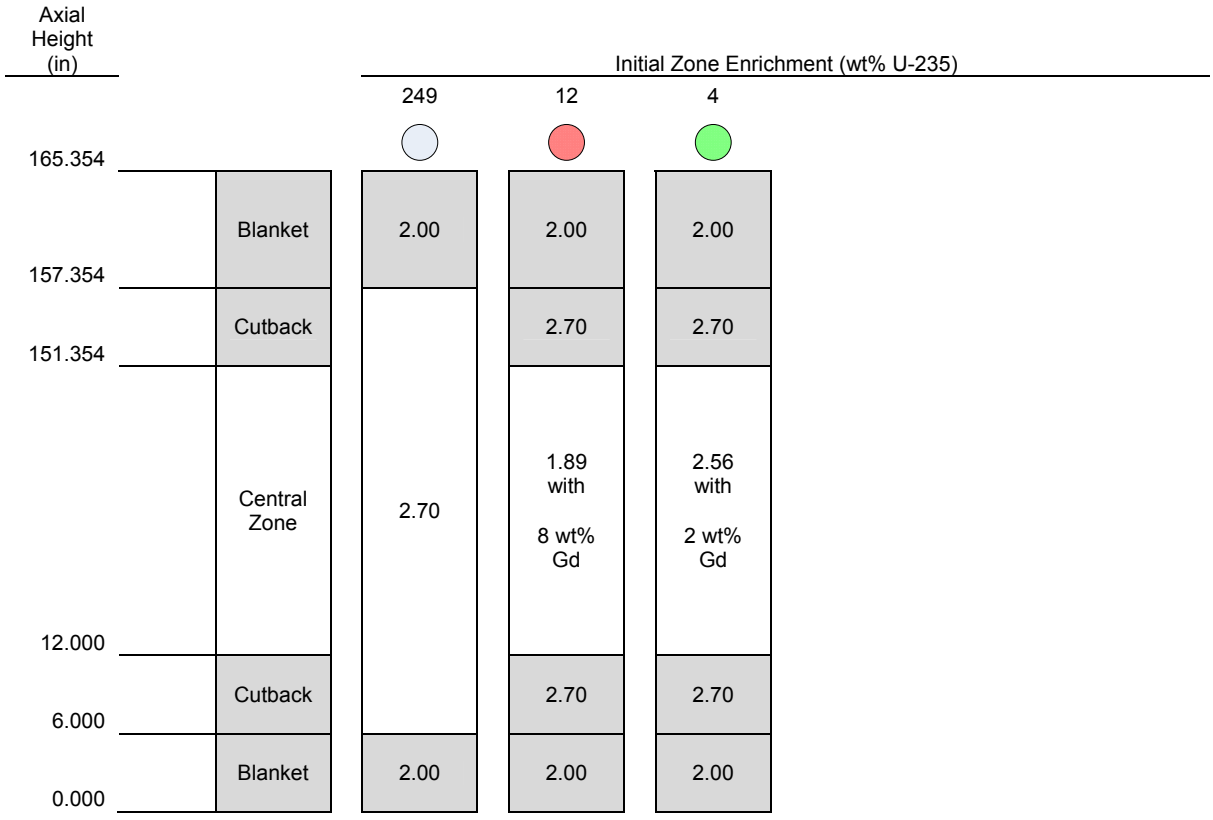
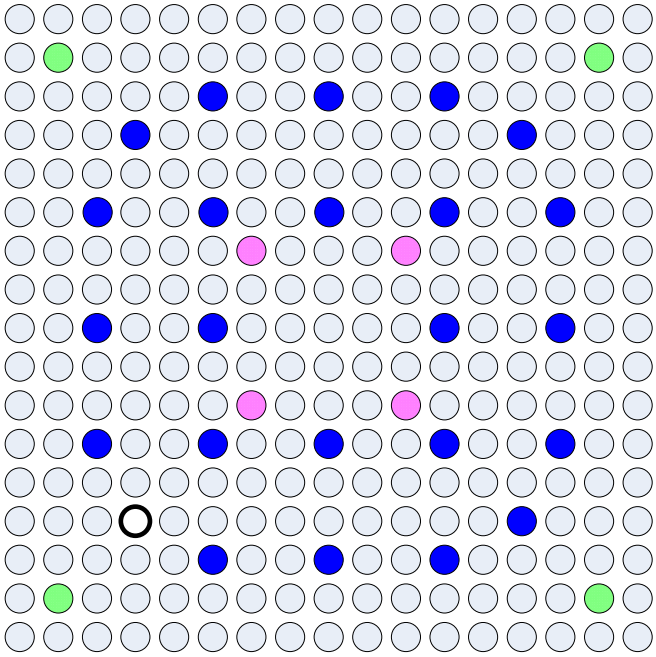


Figure 1-5—Fuel Assembly Layout, Cycle 1, Batch C1
2.70 wt% U-235, 4X6 + 4X2 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	257	3.25 wt% U-235
	4	3.08 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
	4	2.76 wt% U-235 with 6 wt% Gd_2O_3 in the central zone

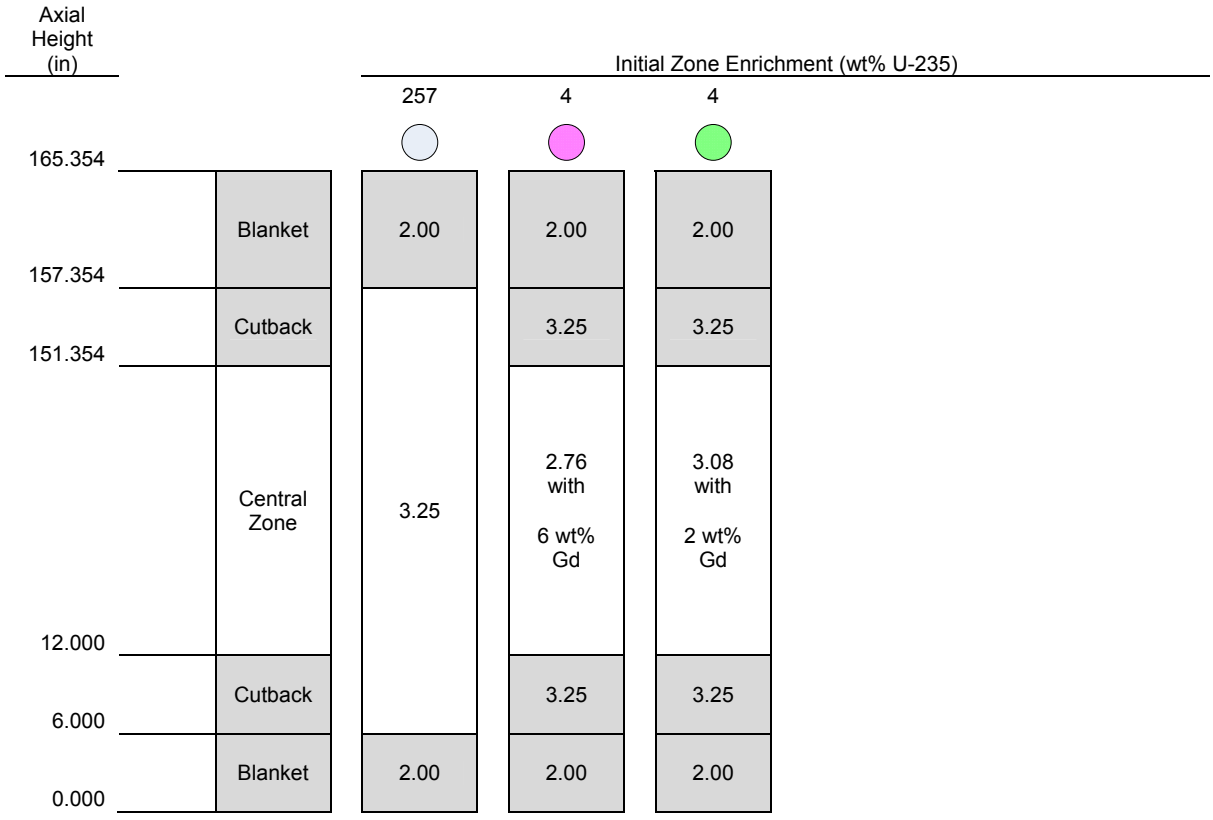
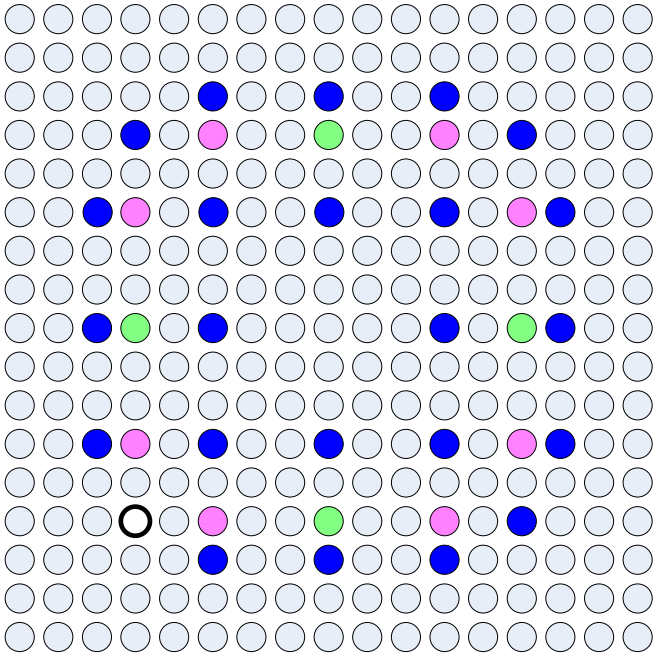


Figure 1-6—Fuel Assembly Layout, Cycle 1, Batch C2
3.25 wt% U-235, 8X6 + 4X2 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	253	3.25 wt% U-235
	4	3.08 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
	8	2.76 wt% U-235 with 6 wt% Gd_2O_3 in the central zone

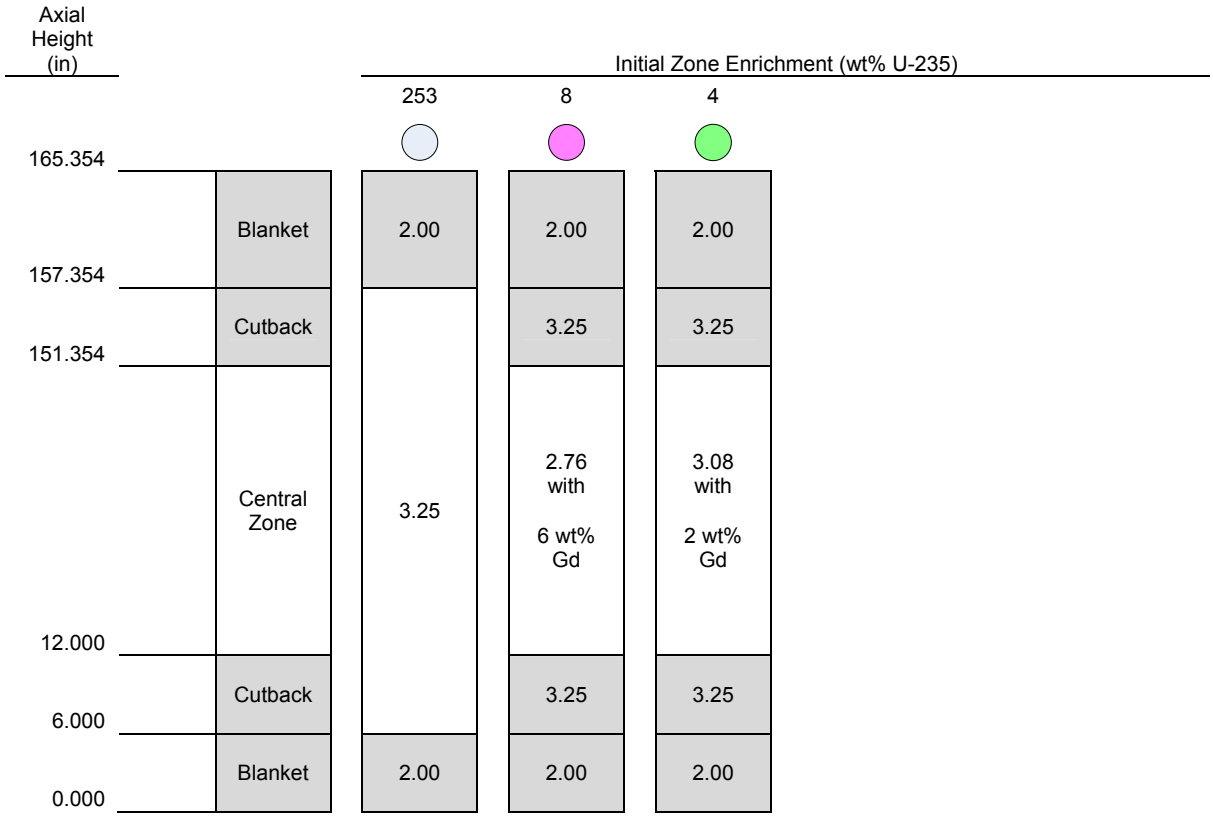
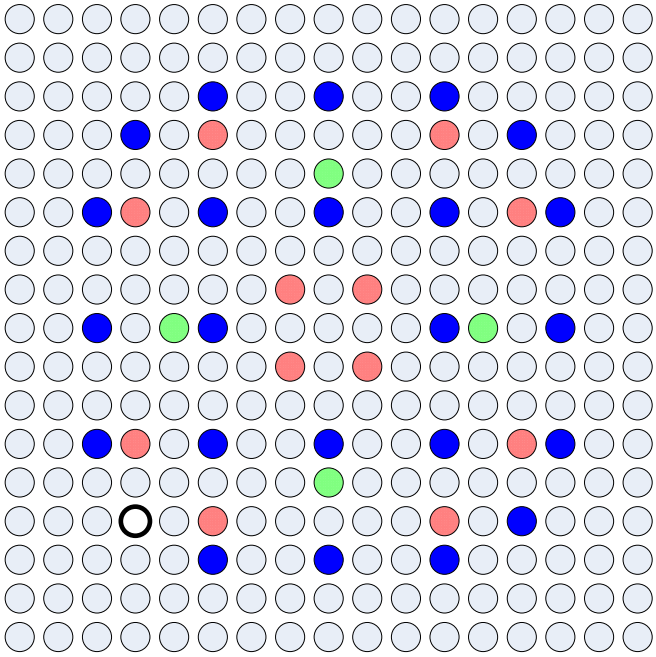


Figure 1-7—Fuel Assembly Layout, Cycle 1, Batch C3
3.25 wt% U-235, 12X8 + 4X2 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	249	3.25 wt% U-235
	4	3.08 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
	12	2.27 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

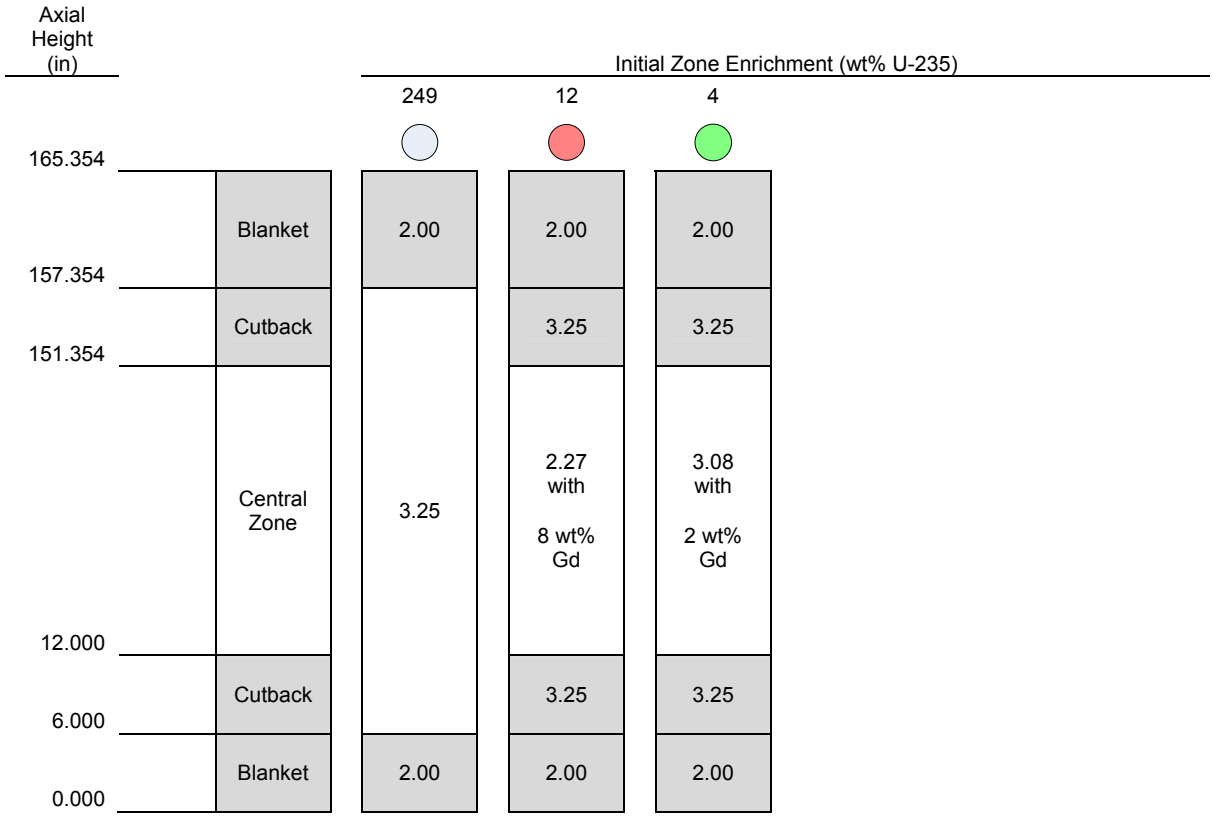
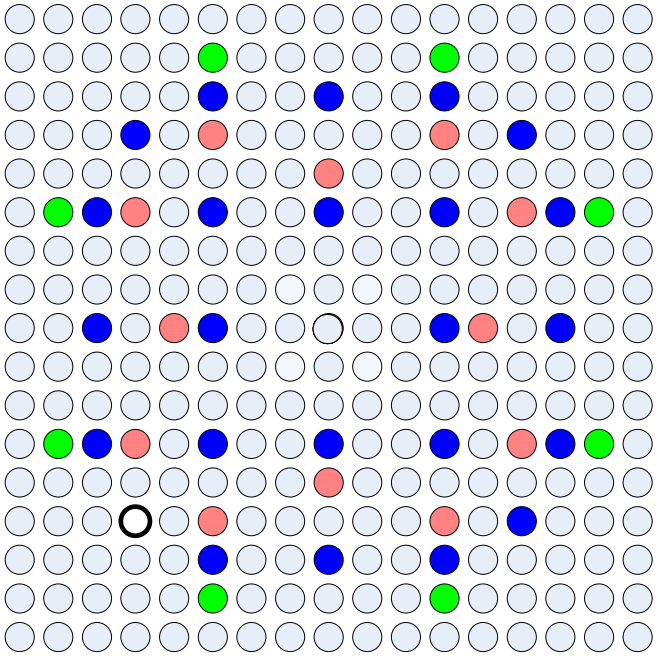


Figure 1-8—Fuel Assembly Layout, Equilibrium Cycle, Batch XX1
4.30 wt% U-235 12X8 + 8X2 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	245	4.30 wt% U-235
	8	4.08 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
	12	3.01 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

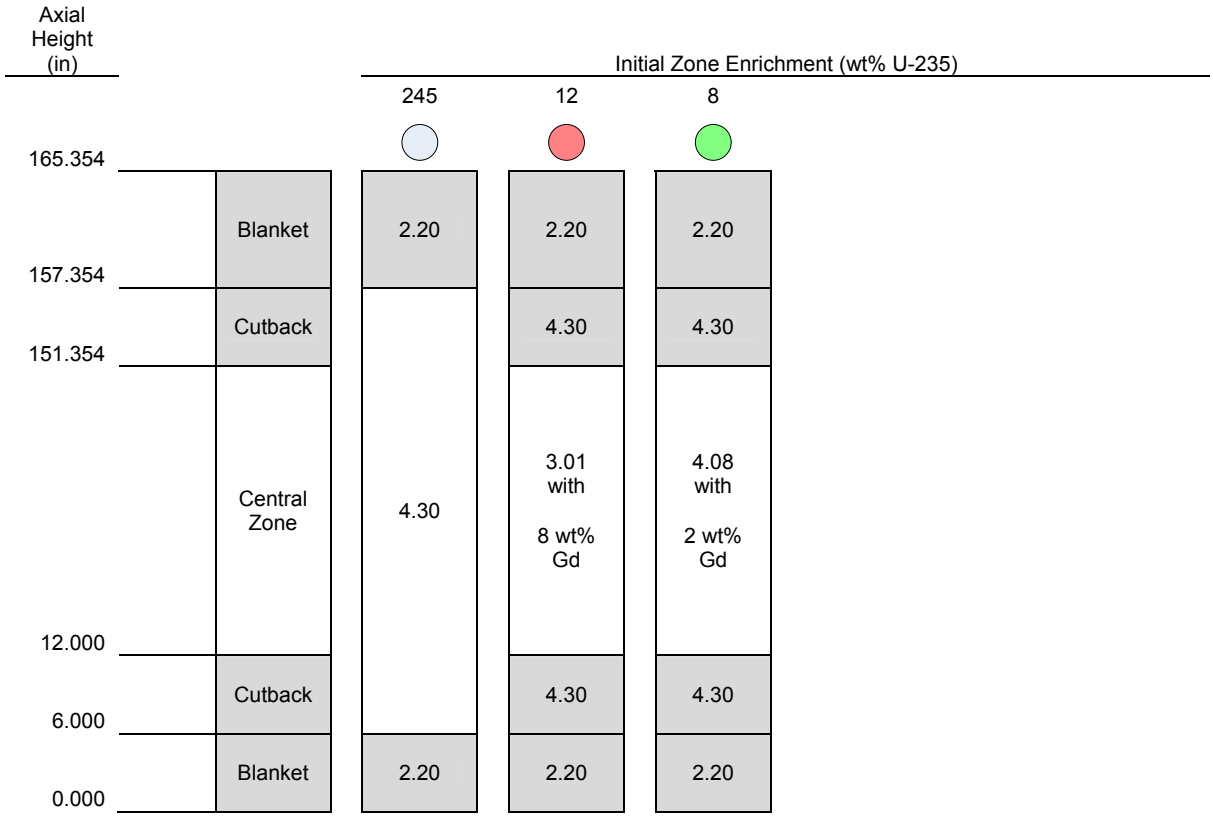
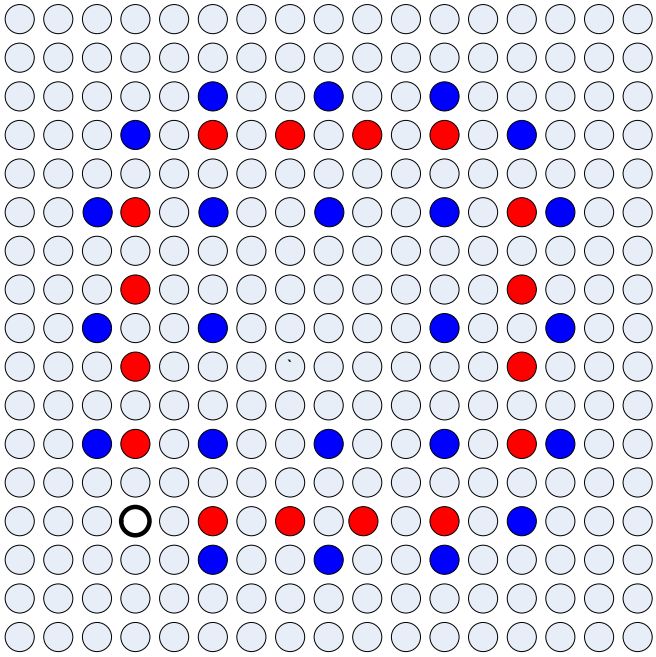


Figure 1-9—Fuel Assembly Layout, Equilibrium Cycle, Batch XX2
4.30 wt% U-235 16X8 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	249	4.30 wt% U-235
	16	3.01 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

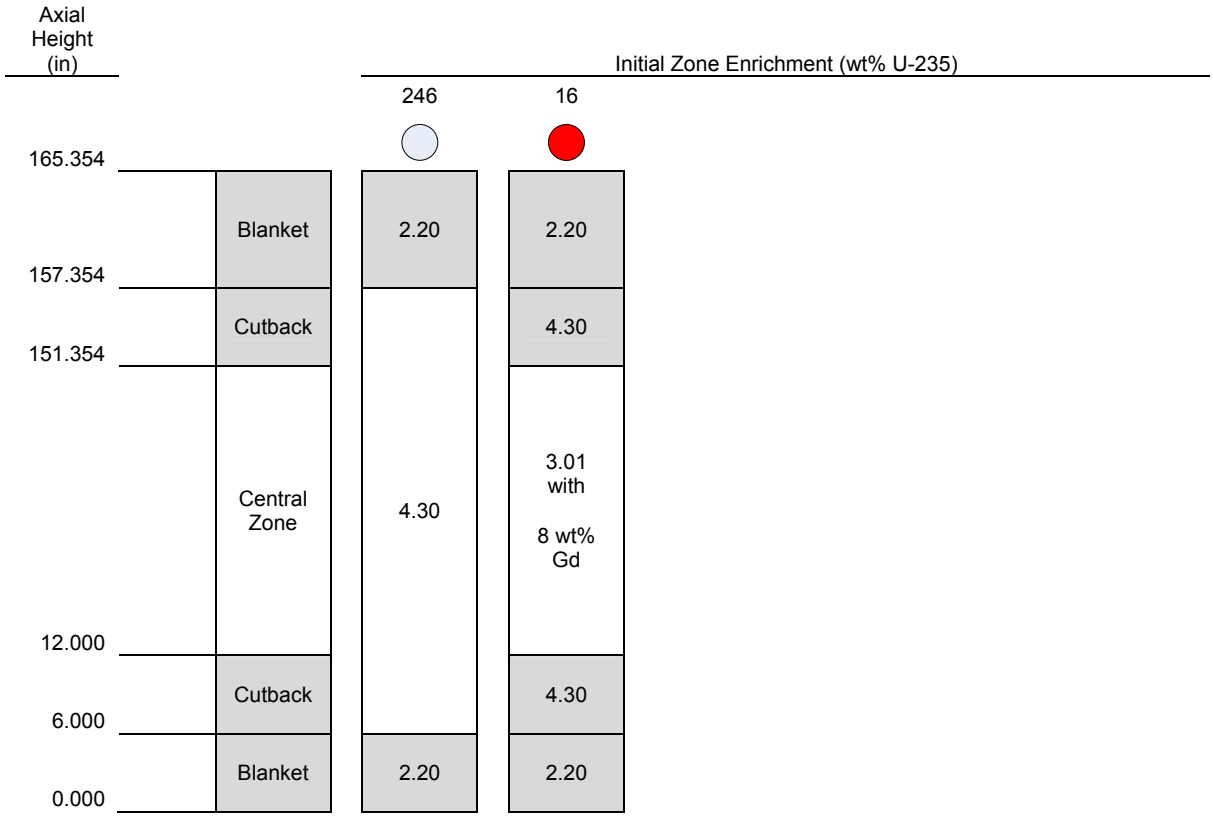
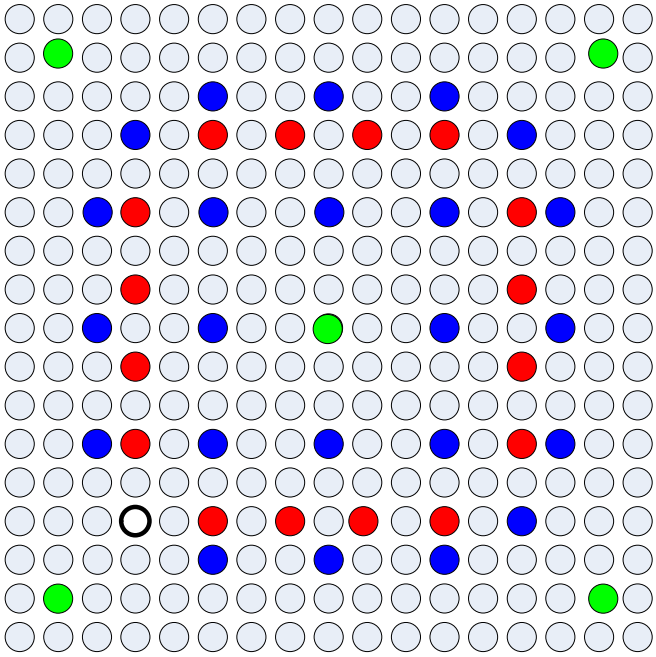


Figure 1-10—Fuel Assembly Layout, Equilibrium Cycle, Batch XX3
4.30 wt% U-235 16X8 + 5X2 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	224	4.30 wt% U-235
	5	4.08 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
	16	3.01 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

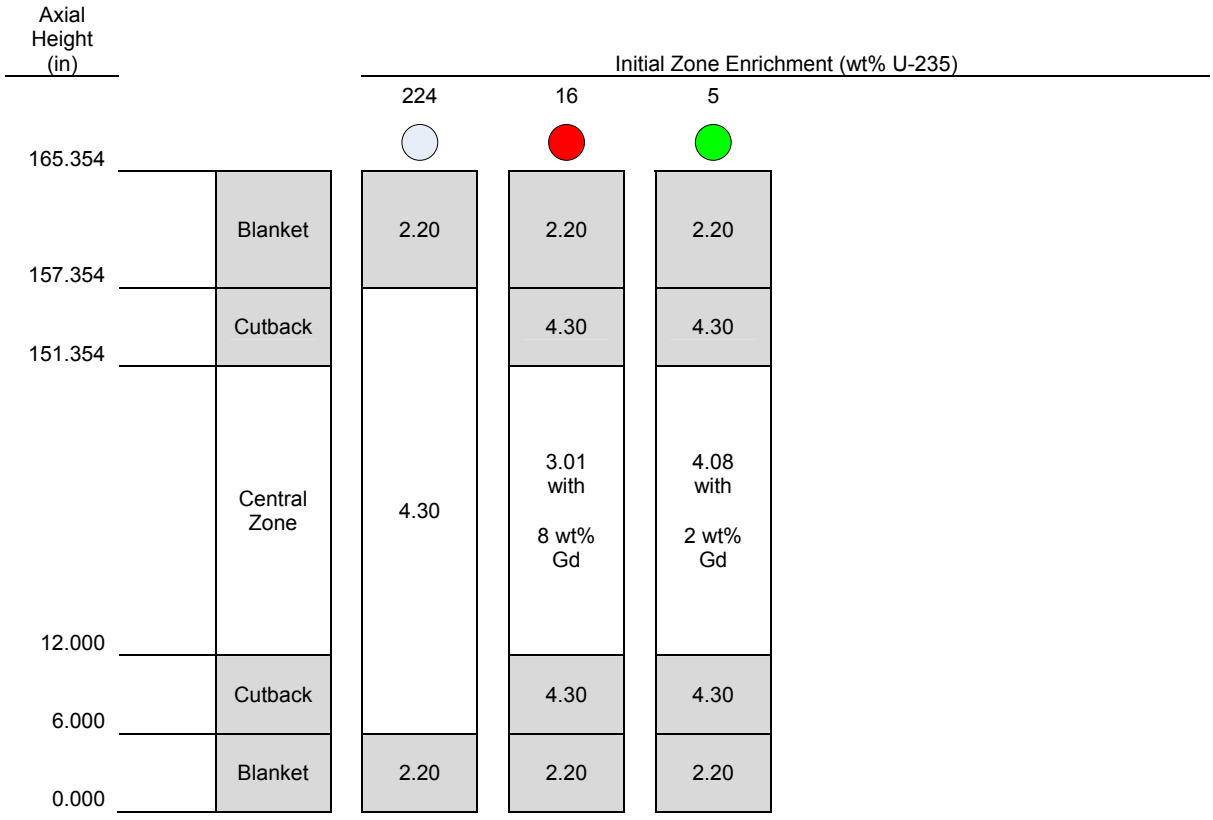
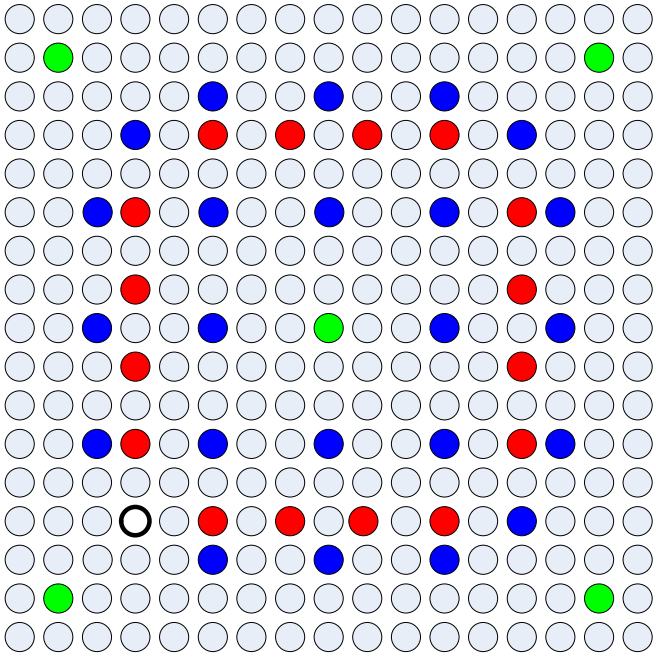


Figure 1-11—Fuel Assembly Layout, Equilibrium Cycle, Batch XX4
4.30 wt% U-235 16X8 + 5X4 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	244	4.30 wt% U-235
	5	4.08 wt% U-235 with 4 wt% Gd_2O_3 in the central zone
	16	3.01 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

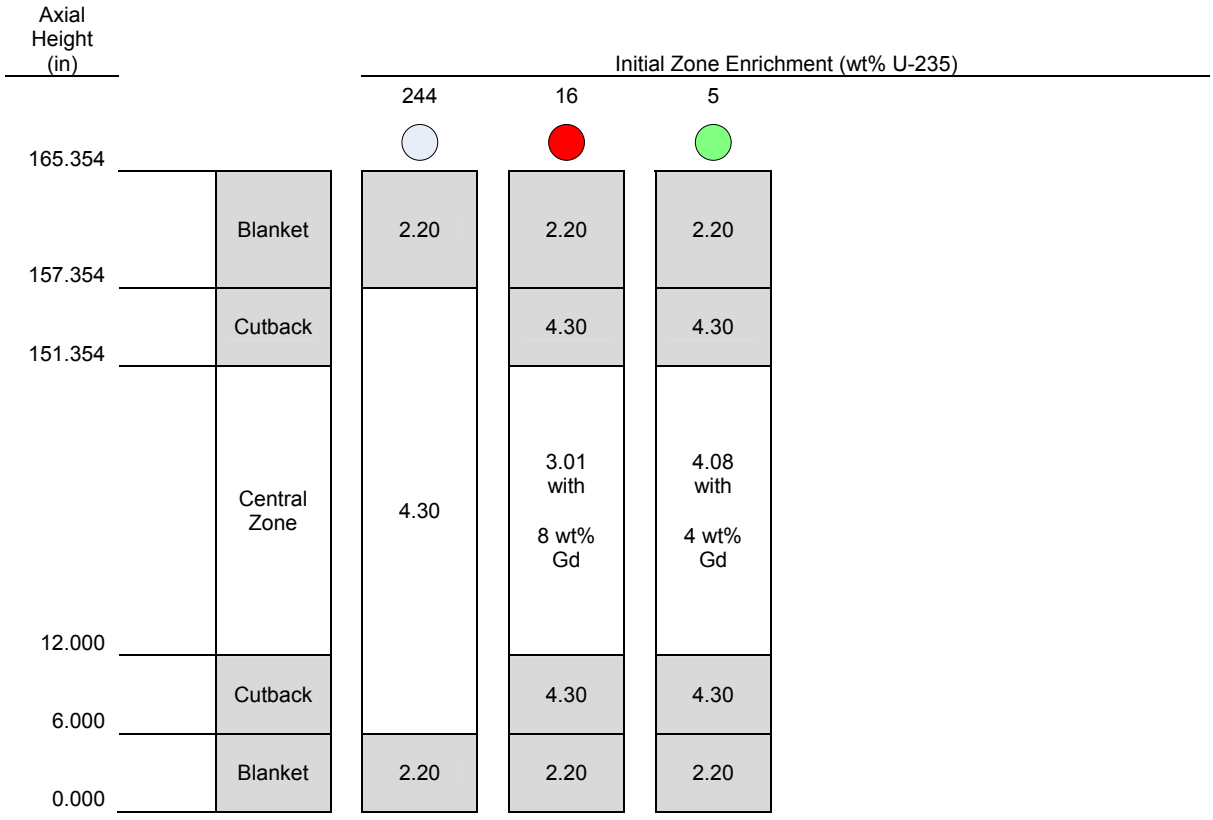
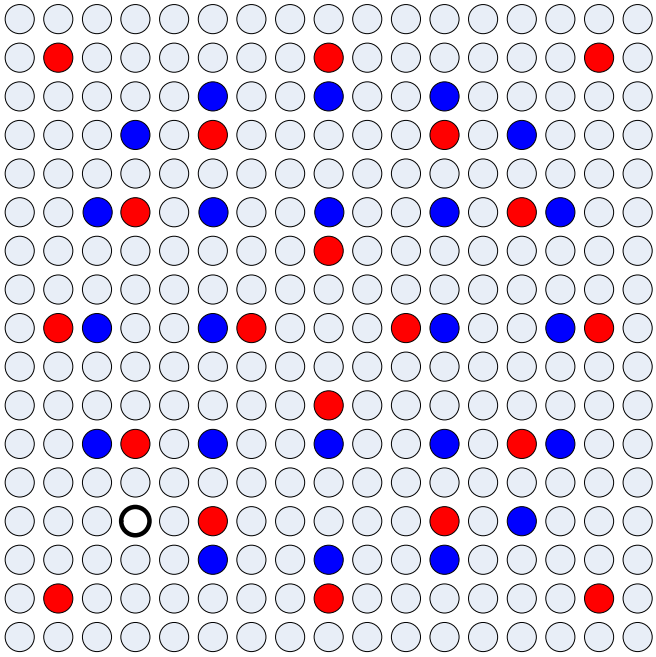


Figure 1-12—Fuel Assembly Layout, Equilibrium Cycle, Batch XX5
4.30 wt% U-235 20X8 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	245	4.30 wt% U-235
	20	3.01 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

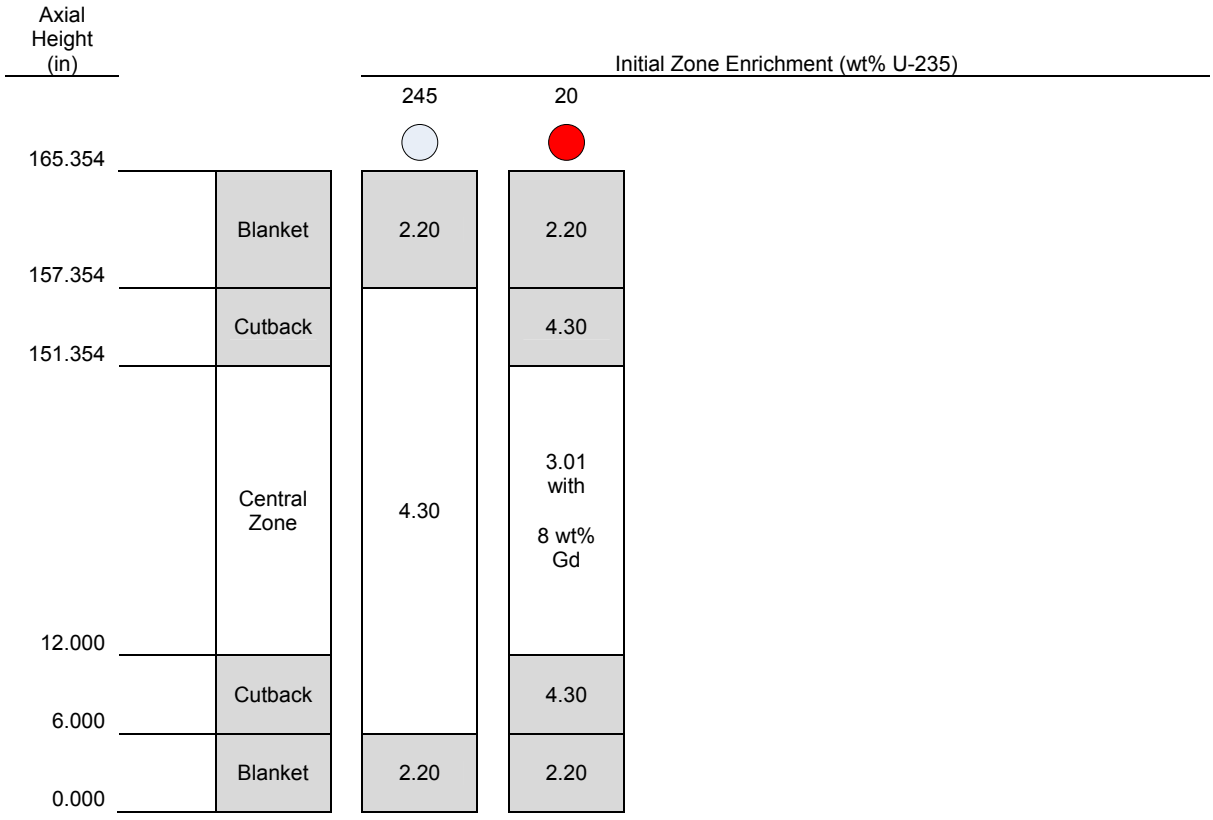
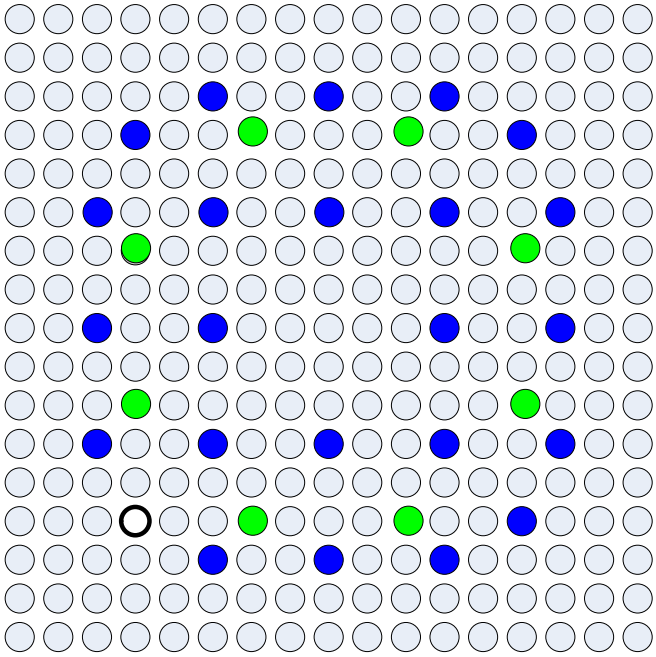


Figure 1-13—Fuel Assembly Layout, Equilibrium Cycle, Batch XX6
4.80 wt% U-235 8X2 Gd



Rod Type	# of Rods	Rod Description
●	23	Guide Tube
○	1	Instrument Tube
○	257	4.80 wt% U-235
●	8	4.56 wt% U-235 with 2 wt% Gd_2O_3 in the central zone

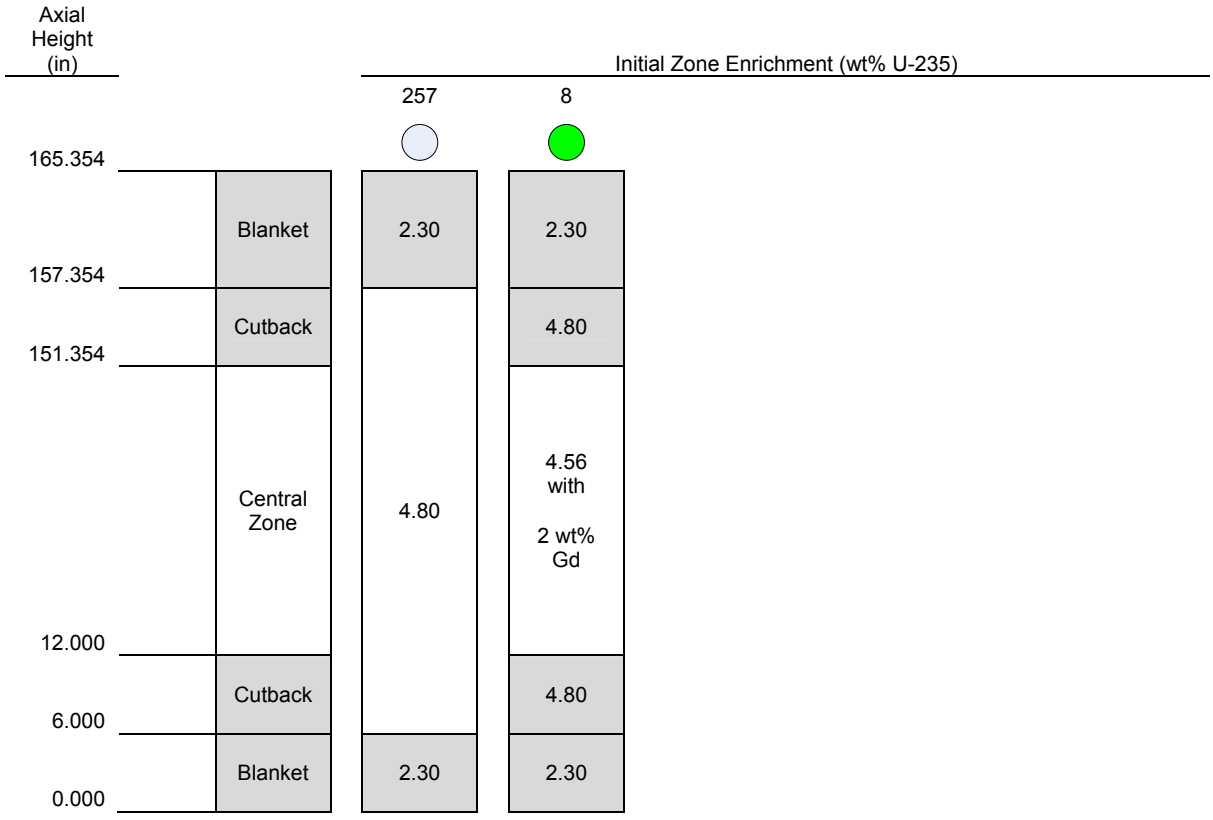
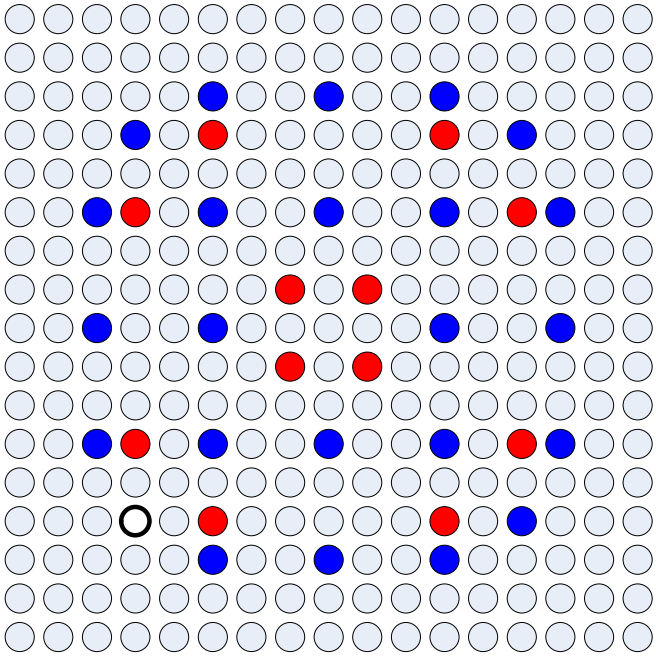


Figure 1-14—Fuel Assembly Layout, Equilibrium Cycle, Batch XX7
4.80 wt% U-235 12X8 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	253	4.80 wt% U-235
	12	3.36 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

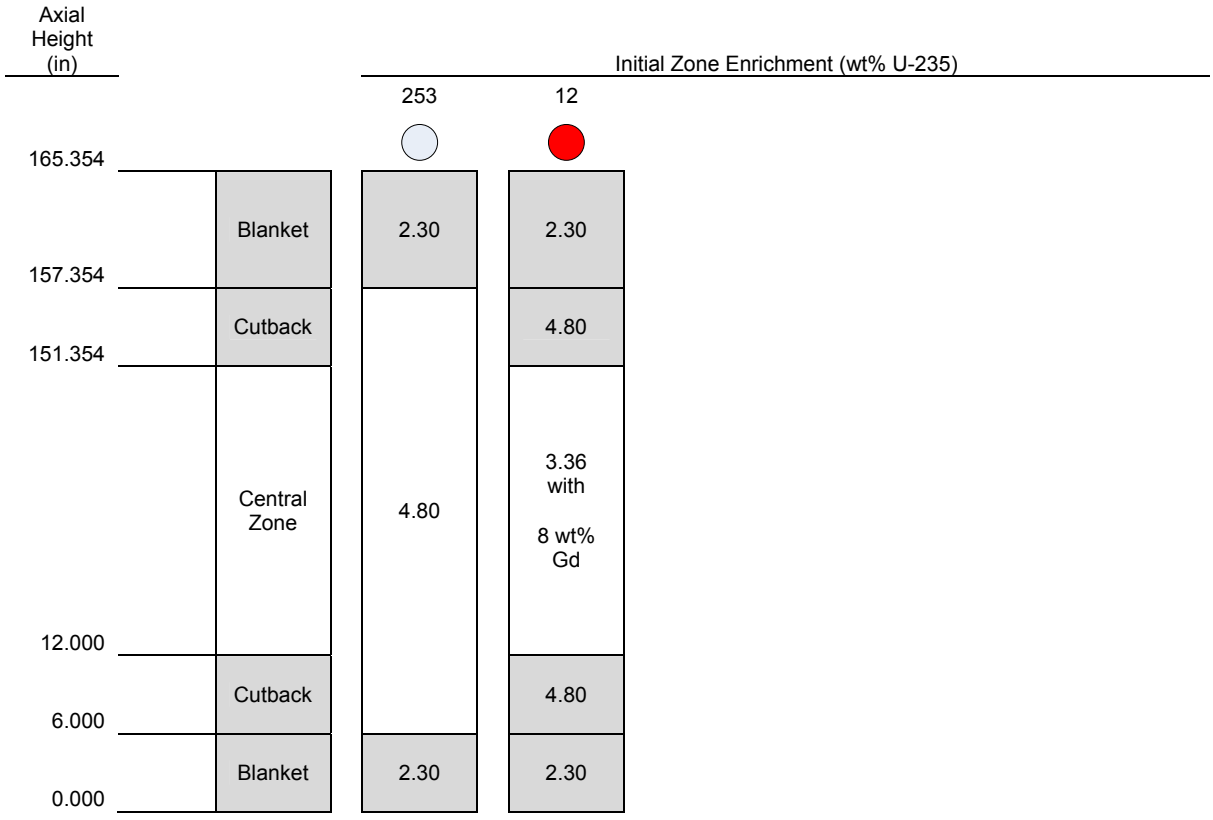
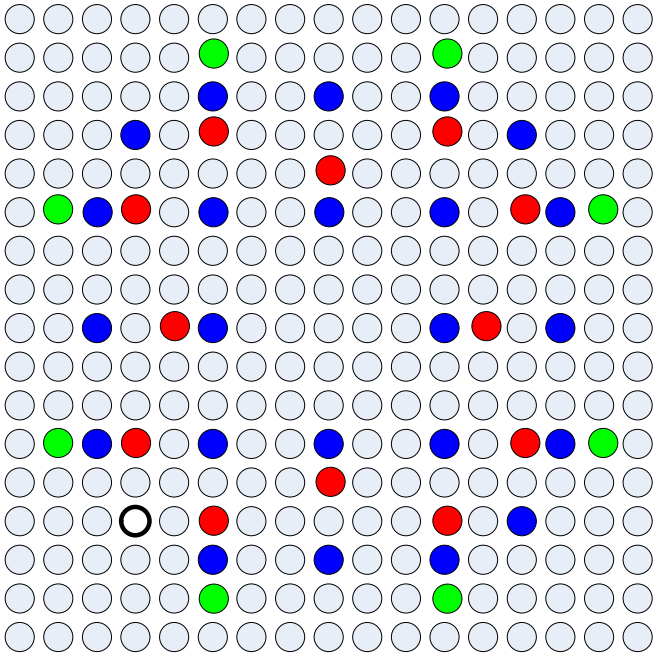


Figure 1-15—Fuel Assembly Layout, Equilibrium Cycle, Batch XX8
4.80 wt% U-235 12X8 + 8X2 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	245	4.80 wt% U-235
	8	4.56 wt% U-235 with 2 wt% Gd_2O_3 in the central zone
	12	3.36 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

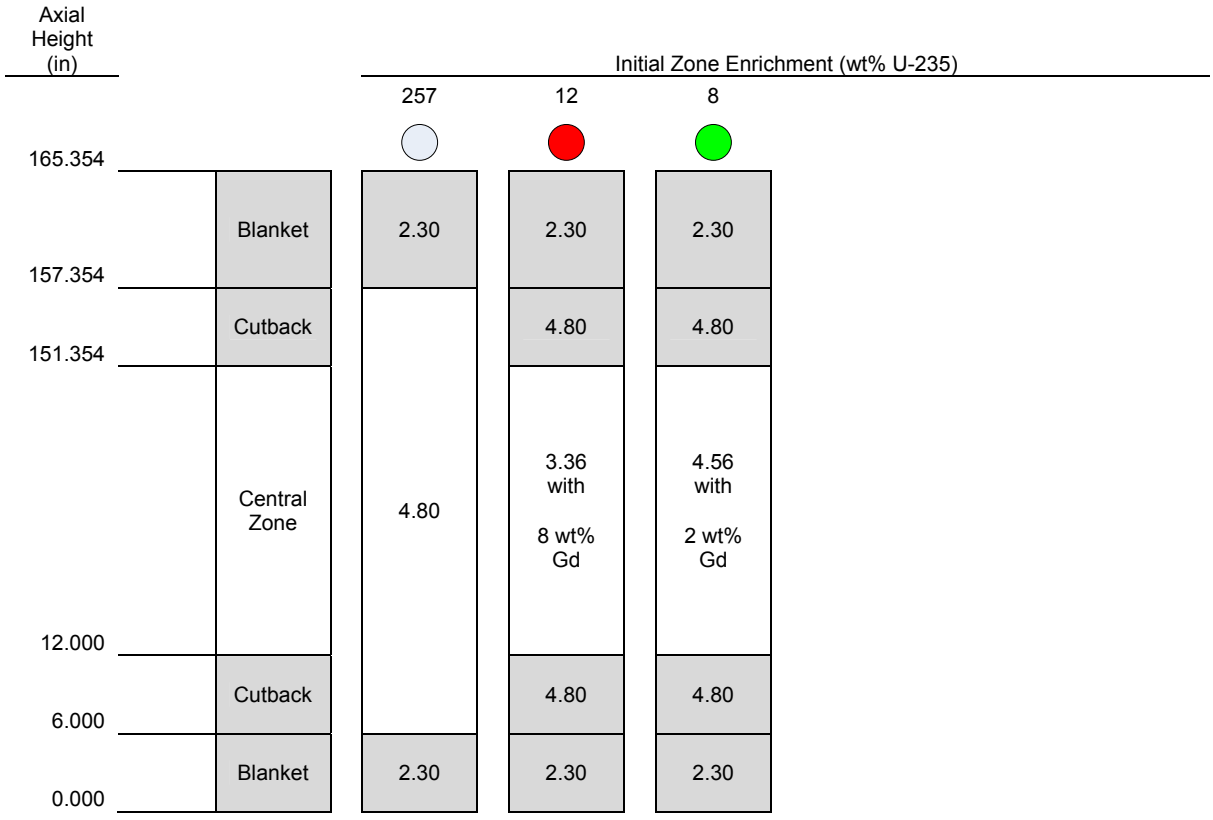
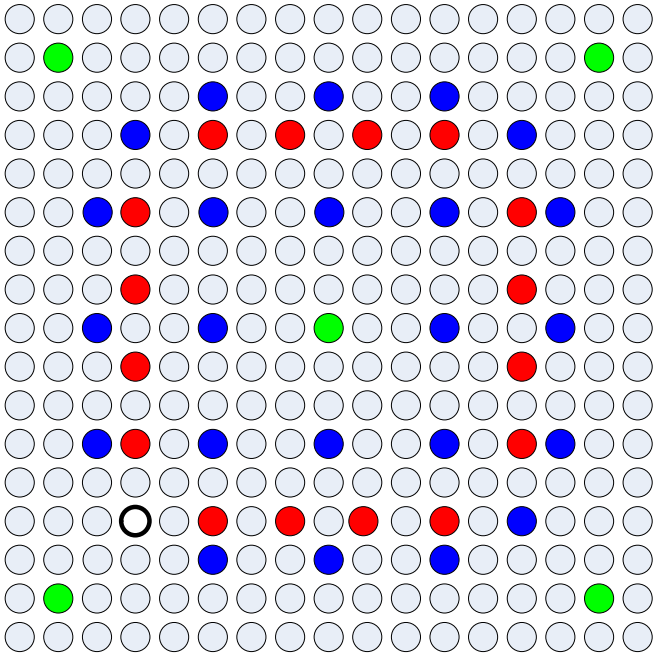


Figure 1-16—Fuel Assembly Layout, Equilibrium Cycle, Batch XX9
4.80 wt% U-235 16X8 + 5X4 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	244	4.80 wt% U-235
	5	4.56 wt% U-235 with 4 wt% Gd_2O_3 in the central zone
	16	3.36 wt% U-235 with 8 wt% Gd_2O_3 in the central zone

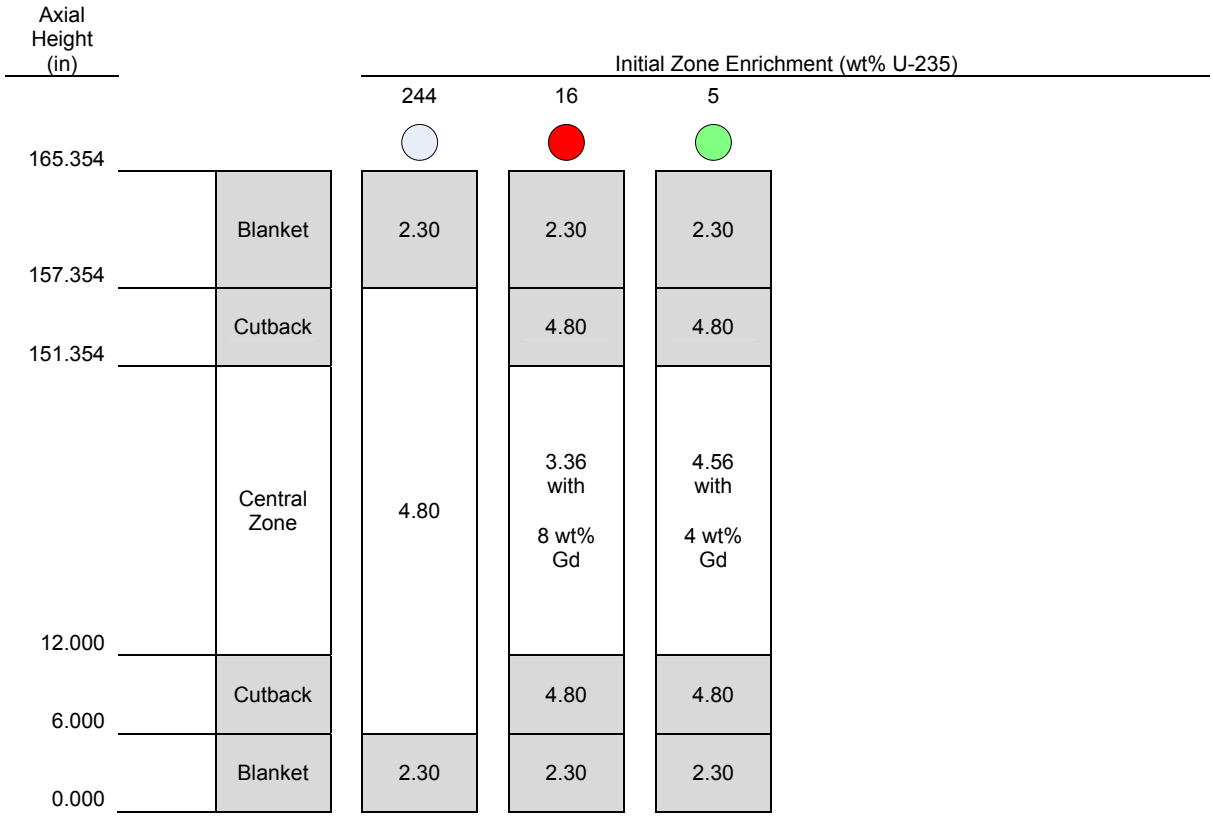
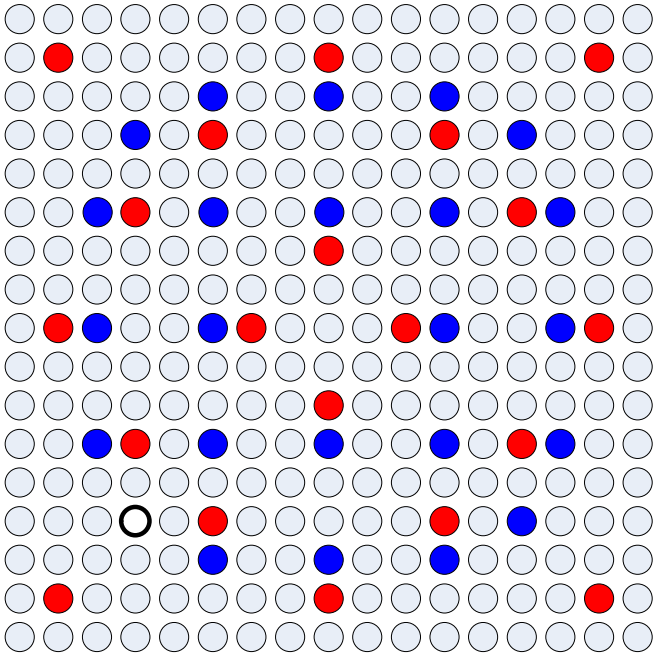
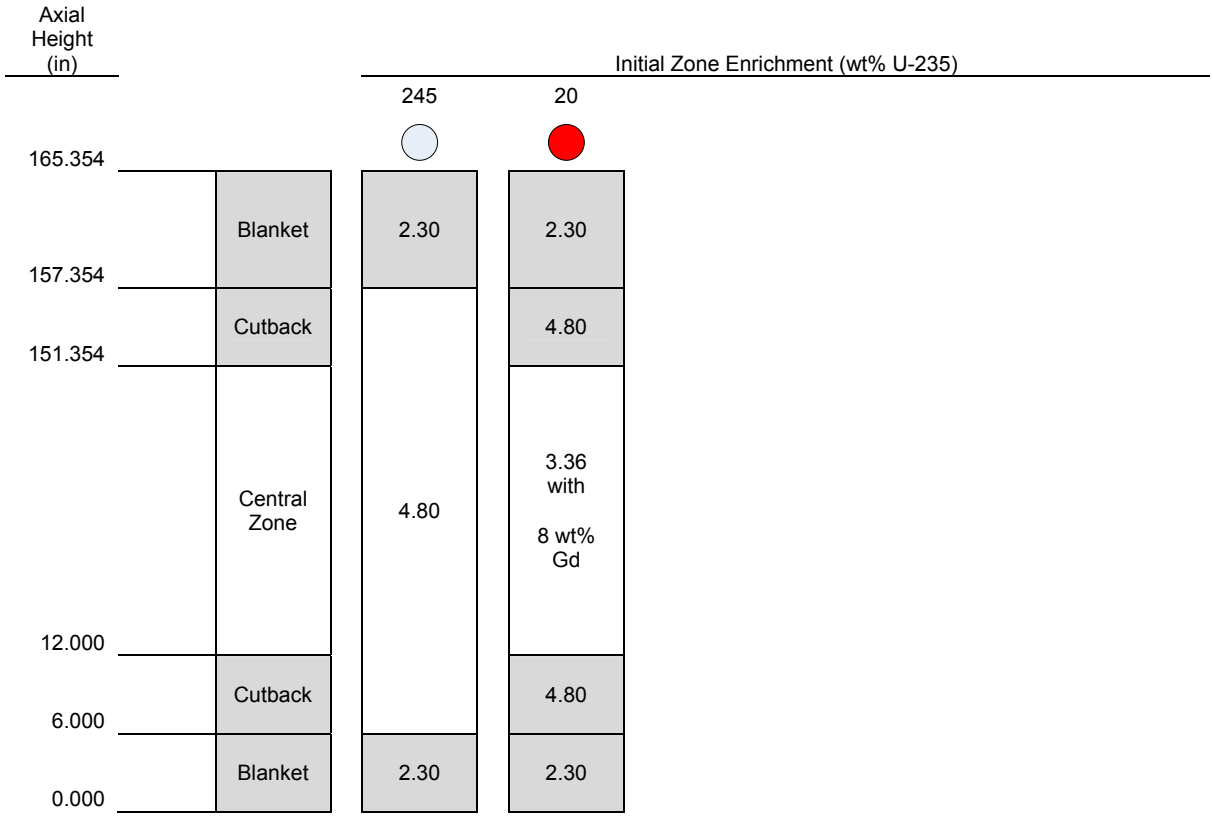


Figure 1-17—Fuel Assembly Layout, Equilibrium Cycle, Batch XX10
4.80 wt% U-235 20X8 Gd



Rod Type	# of Rods	Rod Description
	23	Guide Tube
	1	Instrument Tube
	245	4.80 wt% U-235
	20	3.36 wt% U-235 with 8 wt% Gd_2O_3 in the central zone



RAI-2. *Please provide the following modeling data that was used in the RIA analyses:*
a. core loading map,
b. associated 3-d nodal exposure.

Response to RAI-2:

The following information is provided to model the core at the burnups represented in the REA analysis presented in ANP-10286P. Figure 2-1 and Figure 2-2 show the core loading maps for Cycle 1 and the equilibrium cycle, respectively. Control rod locations are shown in Figure 2-3. Three shutdown banks (Banks SA, SB, and SC) and four control banks (D, C, B, A) are shown. Bank D is the lead bank.

The 3-D nodal exposures are provided in the following ASCII punch files, which are contained on the enclosed compact disc and are readable with a text editor (e.g., Microsoft Wordpad®):

Cycle 1:	c1_data_dep.pch.txt	(cksum: 3868873889 165728)
Equilibrium cycle:	eq_data_dep.pch.txt	(cksum: 1364008463 165728)

In the punch files, the 3-D nodal exposures are written to keyword 'BURNUP' in the following way (core numbering can be see in the Cycle 1 loading map shown in Figure 2-1):

- The first assembly presented is at the top left of the core map (core location F17)
- Each row is completed before the next row is started (e.g., F17…M17, D16…P16, C15…R15, etc.)
- Values are given for all fuel assemblies in the core for one complete axial layer at a time
- The first axial layer presented is at the bottom of the active fuel
- The first 'BURNUP' set corresponds to beginning-of-cycle (BOC), 4 effective fuel power days (EFPD); the second 'BURNUP' set corresponds to end-of-cycle (EOC), 547 EFPD

The 3-D nodal exposures are shown for select assemblies in Table 2-1 through Table 2-4 to enable cross checking with computer generated files.

Axial profiles for fuel and moderator temperature at BOC (4 EFPD) and EOC (547 EFPD) are given in Table 2-5 for Cycle 1 and Table 2-6 for the equilibrium cycle. These profiles are applicable to all fuel types.

A value of 3.64 percent is used for the core bypass flow.

Table 2-1—3-D Nodal Burnups (GWd/MTU) for Select Assemblies, Cycle 1, BOC (4 EFPD)

Axial Layer	Node Height (cm)	ASSEMBLY (CORE LOCATION)							
		F17	P16	J09	R08	E07	J06	N05	M01
2 - bottom	15.24	0.031	0.030	0.086	0.081	0.082	0.080	0.084	0.031
3	15.24	0.060	0.059	0.190	0.162	0.177	0.160	0.182	0.060
4	17.698	0.081	0.078	0.199	0.159	0.172	0.162	0.176	0.081
5	17.698	0.094	0.090	0.205	0.164	0.173	0.168	0.177	0.094
6	17.698	0.101	0.096	0.211	0.169	0.177	0.174	0.181	0.101
7	17.698	0.106	0.100	0.215	0.174	0.180	0.177	0.184	0.106
8	17.698	0.108	0.102	0.218	0.177	0.182	0.180	0.187	0.108
9	17.698	0.109	0.104	0.220	0.178	0.184	0.182	0.188	0.109
10	17.698	0.110	0.104	0.221	0.179	0.184	0.183	0.189	0.110
11	17.698	0.109	0.104	0.221	0.178	0.184	0.183	0.188	0.109
12	17.698	0.108	0.103	0.220	0.176	0.183	0.182	0.186	0.108
13	17.698	0.107	0.101	0.218	0.174	0.181	0.180	0.184	0.107
14	17.698	0.105	0.099	0.215	0.171	0.179	0.178	0.181	0.105
15	17.698	0.102	0.097	0.212	0.167	0.175	0.176	0.177	0.102
16	17.698	0.099	0.094	0.207	0.163	0.172	0.172	0.173	0.099
17	17.698	0.096	0.091	0.203	0.158	0.167	0.168	0.168	0.096
18	17.698	0.093	0.088	0.197	0.152	0.162	0.164	0.162	0.093
19	17.698	0.088	0.084	0.191	0.146	0.157	0.159	0.156	0.088
20	17.698	0.083	0.079	0.183	0.139	0.150	0.153	0.148	0.083
21	17.698	0.078	0.074	0.175	0.131	0.144	0.147	0.141	0.078
22	17.698	0.070	0.067	0.164	0.122	0.138	0.140	0.132	0.070
23	17.698	0.060	0.058	0.146	0.113	0.134	0.134	0.119	0.060
24	15.24	0.046	0.045	0.099	0.110	0.139	0.136	0.086	0.046
25 - top	20.32	0.023	0.023	0.036	0.053	0.064	0.068	0.032	0.023

Table 2-2—3-D Nodal Burnups (GWd/MTU) for Select Assemblies, Cycle 1, EOC (547 EFPD)

Axial Layer	Node Height (cm)	ASSEMBLY (CORE LOCATION)							
		F17	P16	J09	R08	E07	J06	N05	M01
2 - bottom	15.24	3.686	3.696	9.506	9.201	9.517	9.210	9.605	3.686
3	15.24	6.774	6.748	19.369	17.350	19.219	17.247	19.475	6.774
4	17.698	8.848	8.794	23.361	20.590	22.582	20.420	22.939	8.848
5	17.698	10.023	9.961	25.518	22.572	24.619	22.366	25.018	10.023
6	17.698	10.569	10.510	26.487	23.507	25.583	23.279	25.996	10.569
7	17.698	10.799	10.745	26.858	23.871	25.957	23.645	26.369	10.799
8	17.698	10.878	10.828	26.946	23.962	26.049	23.753	26.453	10.878
9	17.698	10.891	10.842	26.914	23.934	26.019	23.751	26.408	10.891
10	17.698	10.878	10.831	26.839	23.862	25.944	23.709	26.317	10.878
11	17.698	10.861	10.812	26.757	23.782	25.861	23.662	26.217	10.861
12	17.698	10.846	10.796	26.683	23.709	25.786	23.621	26.122	10.846
13	17.698	10.836	10.786	26.621	23.646	25.722	23.593	26.039	10.836
14	17.698	10.833	10.781	26.572	23.595	25.671	23.578	25.968	10.833
15	17.698	10.836	10.782	26.534	23.553	25.629	23.572	25.906	10.836
16	17.698	10.840	10.784	26.501	23.514	25.590	23.571	25.846	10.840
17	17.698	10.841	10.782	26.460	23.464	25.541	23.562	25.773	10.841
18	17.698	10.826	10.763	26.386	23.378	25.453	23.521	25.659	10.826
19	17.698	10.770	10.701	26.227	23.206	25.275	23.402	25.449	10.770
20	17.698	10.629	10.552	25.886	22.853	24.915	23.123	25.043	10.629
21	17.698	10.325	10.238	25.175	22.155	24.214	22.541	24.252	10.325
22	17.698	9.722	9.626	23.737	20.819	22.921	21.422	22.741	9.722
23	17.698	8.587	8.493	20.488	18.428	20.759	19.457	19.551	8.587
24	15.24	6.755	6.685	12.883	15.267	17.928	16.780	12.561	6.755
25 - top	20.32	3.646	3.627	5.023	7.795	8.827	8.993	4.898	3.646

Table 2-3—3-D Nodal Burnups (GWd/MTU) for Select Assemblies, Equilibrium Cycle, BOC (4 EFPD)

Axial Layer	Node Height (cm)	ASSEMBLY (CORE LOCATION)							
		F17	P16	J09	R08	E07	J06	N05	M01
2 - bottom	15.24	18.738	15.992	14.383	7.308	10.172	0.049	9.975	18.674
3	15.24	40.310	34.831	31.785	16.733	22.141	0.125	21.792	40.172
4	17.698	47.808	41.232	37.767	19.585	25.779	0.133	25.640	47.638
5	17.698	51.215	44.145	40.596	21.177	27.744	0.144	27.601	51.034
6	17.698	52.423	45.147	41.651	21.827	28.491	0.153	28.318	52.241
7	17.698	52.826	45.455	41.979	22.030	28.718	0.161	28.526	52.645
8	17.698	52.946	45.526	42.028	22.049	28.740	0.169	28.541	52.767
9	17.698	52.971	45.520	41.975	21.995	28.685	0.178	28.484	52.794
10	17.698	52.967	45.492	41.889	21.915	28.603	0.186	28.402	52.793
11	17.698	52.959	45.462	41.794	21.827	28.512	0.194	28.313	52.787
12	17.698	52.953	45.435	41.700	21.739	28.420	0.201	28.222	52.784
13	17.698	52.952	45.411	41.608	21.652	28.327	0.208	28.132	52.785
14	17.698	52.954	45.391	41.519	21.566	28.235	0.215	28.041	52.790
15	17.698	52.959	45.372	41.431	21.480	28.141	0.221	27.949	52.798
16	17.698	52.965	45.355	41.342	21.392	28.043	0.225	27.854	52.806
17	17.698	52.966	45.333	41.246	21.298	27.937	0.229	27.750	52.810
18	17.698	52.948	45.295	41.128	21.187	27.809	0.231	27.627	52.794
19	17.698	52.874	45.212	40.954	21.037	27.632	0.232	27.459	52.723
20	17.698	52.656	45.008	40.643	20.799	27.346	0.230	27.190	52.509
21	17.698	52.081	44.499	40.014	20.367	26.819	0.226	26.689	51.939
22	17.698	50.628	43.233	38.659	19.526	25.776	0.217	25.677	50.493
23	17.698	47.082	40.174	35.749	17.937	23.706	0.203	23.598	46.962
24	15.24	40.277	34.440	30.541	15.634	20.681	0.194	20.326	40.184
25 - top	20.32	18.771	15.883	13.784	6.812	9.560	0.076	9.340	18.728

Table 2-4—3-D Nodal Burnups (GWd/MTU) for Select Assemblies, Equilibrium Cycle, EOC (547 EFPD)

Axial Layer	Node Height (cm)	ASSEMBLY (CORE LOCATION)							
		F17	P16	J09	R08	E07	J06	N05	M01
2 - bottom	15.24	21.341	18.678	21.301	16.018	19.233	10.026	19.129	21.281
3	15.24	45.379	40.190	45.362	35.101	40.156	21.770	40.046	45.252
4	17.698	53.742	47.663	53.695	41.730	47.180	25.248	47.301	53.585
5	17.698	57.513	51.060	57.343	44.787	50.475	27.112	50.620	57.346
6	17.698	58.880	52.264	58.638	45.897	51.716	27.811	51.853	58.711
7	17.698	59.357	52.664	59.068	46.228	52.123	28.019	52.245	59.190
8	17.698	59.513	52.782	59.193	46.260	52.204	28.038	52.309	59.348
9	17.698	59.558	52.806	59.216	46.181	52.163	27.991	52.249	59.395
10	17.698	59.570	52.801	59.209	46.065	52.080	27.922	52.146	59.409
11	17.698	59.575	52.793	59.198	45.940	51.985	27.849	52.030	59.416
12	17.698	59.584	52.787	59.190	45.814	51.888	27.778	51.913	59.427
13	17.698	59.597	52.785	59.188	45.691	51.793	27.709	51.796	59.442
14	17.698	59.615	52.788	59.191	45.570	51.700	27.642	51.680	59.463
15	17.698	59.638	52.795	59.198	45.450	51.607	27.576	51.564	59.488
16	17.698	59.662	52.802	59.206	45.328	51.509	27.510	51.442	59.514
17	17.698	59.679	52.804	59.209	45.195	51.398	27.437	51.306	59.534
18	17.698	59.673	52.785	59.190	45.033	51.251	27.344	51.132	59.530
19	17.698	59.602	52.710	59.105	44.797	51.019	27.203	50.871	59.461
20	17.698	59.363	52.486	58.853	44.388	50.592	26.949	50.408	59.226
21	17.698	58.720	51.898	58.178	43.585	49.736	26.448	49.487	58.586
22	17.698	57.104	50.424	56.461	41.895	47.958	25.420	47.549	56.978
23	17.698	53.193	46.860	51.923	38.282	44.299	23.374	43.049	53.080
24	15.24	45.553	40.061	41.135	32.044	38.014	20.402	32.890	45.465
25 - top	20.32	21.434	18.646	18.141	14.292	18.139	9.416	14.380	21.393

Table 2-5—Cycle 1 Axial Temperature Profiles, BOC and EOC

		BOC (4 EFPD)		EOC (547 EFPD)	
Axial Layer	Node Height (cm)	Fuel Temp (°F)	Mod Temp (°F)	Fuel Temp (°F)	Mod Temp (°F)
2 - BOTTOM	15.24	810.3	564.1	774.0	564.0
3	15.24	1066.9	565.9	961.3	565.4
4	17.698	1103.3	568.6	1041.9	567.8
5	17.698	1131.1	571.7	1088.5	570.6
6	17.698	1151.9	574.9	1111.2	573.7
7	17.698	1166.1	578.1	1121.8	576.7
8	17.698	1175.1	581.3	1126.7	579.8
9	17.698	1179.9	584.5	1129.2	582.9
10	17.698	1181.3	587.7	1130.9	585.9
11	17.698	1180.0	590.9	1132.3	588.9
12	17.698	1176.4	593.9	1133.9	591.8
13	17.698	1170.8	596.9	1135.8	594.7
14	17.698	1163.5	599.8	1137.8	597.6
15	17.698	1154.6	602.7	1140.0	600.4
16	17.698	1144.1	605.4	1142.3	603.2
17	17.698	1132.1	608.0	1144.5	606.0
18	17.698	1118.2	610.6	1145.9	608.7
19	17.698	1102.4	613.0	1145.7	611.4
20	17.698	1084.4	615.3	1141.9	614.0
21	17.698	1063.6	617.4	1131.0	616.5
22	17.698	1039.6	619.5	1107.2	618.9
23	17.698	1012.6	621.3	1060.9	621.1
24	15.24	985.5	622.9	988.7	622.8
25 - TOP	20.32	799.4	624.1	813.6	624.0

Table 2-6—Equilibrium Cycle Axial Temperature Profiles, BOC and EOC

		BOC (4 EFPD)		EOC (547 EFPD)	
Axial Layer	Node Height (cm)	Fuel Temp (°F)	Mod Temp (°F)	Fuel Temp (°F)	Mod Temp (°F)
2 - BOTTOM	15.24	715.7	563.8	763.5	563.9
3	15.24	907.4	565.1	946.8	565.5
4	17.698	949.9	567.2	1003.8	568.0
5	17.698	978.3	569.6	1032.4	570.9
6	17.698	999.2	572.2	1044.7	573.9
7	17.698	1017.4	574.9	1050.6	576.9
8	17.698	1034.8	577.6	1053.9	580.0
9	17.698	1051.8	580.4	1056.4	583.0
10	17.698	1068.3	583.2	1058.6	585.9
11	17.698	1084.2	586.1	1060.7	588.9
12	17.698	1099.1	589.1	1062.8	591.8
13	17.698	1112.9	592.0	1065.0	594.6
14	17.698	1125.3	595.0	1067.1	597.4
15	17.698	1136.0	598.0	1069.2	600.2
16	17.698	1144.8	601.0	1071.3	602.9
17	17.698	1151.4	604.0	1073.3	605.6
18	17.698	1155.3	606.9	1075.0	608.3
19	17.698	1155.8	609.8	1076.0	610.9
20	17.698	1152.0	612.6	1075.4	613.5
21	17.698	1141.9	615.3	1071.2	615.9
22	17.698	1122.0	617.9	1059.1	618.3
23	17.698	1085.5	620.3	1030.0	620.5
24	15.24	1031.6	622.2	977.1	622.3
25 - TOP	20.32	799.9	623.5	804.2	623.5

Figure 2-1—Cycle 1 Core Loading Map

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
17						A1	A1	A1	A1	A1	A1	A1					
16				A1	A1	C1	C1	C2	C2	C2	C1	C1	A1	A1			
15			A1	C1	C2	C3	B2	B2	C3	B2	B2	C3	C2	C1	A1		
14		A1	C1	C3	B1	B1	B1	A2	B2	A2	B1	B1	B1	C3	C1	A1	
13		A1	C2	B1	C3	B2	C3	B2	C3	B2	C3	B2	C3	B1	C2	A1	
12	A1	C1	C3	B1	B2	A2	B2	A1	B2	A1	B2	A2	B2	B1	C3	C1	A1
11	A1	C1	B2	B1	C3	B2	A1	B2	A1	B2	A1	B2	C3	B1	B2	C1	A1
10	A1	C2	B2	A2	B2	A1	B2	B1	B1	B1	B2	A1	B2	A2	B2	C2	A1
9	A1	C2	C3	B2	C3	B2	A1	B1	C2	B1	A1	B2	C3	B2	C3	C2	A1
8	A1	C2	B2	A2	B2	A1	B2	B1	B1	B1	B2	A1	B2	A2	B2	C2	A1
7	A1	C1	B2	B1	C3	B2	A1	B2	A1	B2	A1	B2	C3	B1	B2	C1	A1
6	A1	C1	C3	B1	B2	A2	B2	A1	B2	A1	B2	A2	B2	B1	C3	C1	A1
5		A1	C2	B1	C3	B2	C3	B2	C3	B2	C3	B2	C3	B1	C2	A1	
4		A1	C1	C3	B1	B1	B1	A2	B2	A2	B1	B1	B1	C3	C1	A1	
3			A1	C1	C2	C3	B2	B2	C3	B2	B2	C3	C2	C1	A1		
2				A1	A1	C1	C1	C2	C2	C2	C1	C1	A1	A1			
1						A1	A1	A1	A1	A1	A1	A1					

A1	2.25 wt% CZE with No Gd
A2	2.25 wt% CZE with 4 rods at 4 wt% Gd
B1	2.70 wt% CZE with 8 rods at 8 wt% and 4 rods at 4 wt% Gd
B2	2.70 wt% CZE with 12 rods at 8 wt% and 4 rods at 2 wt% Gd
C1	3.25 wt% CZE with 4 rods at 6 wt% and 4 rods at 2 wt% Gd
C2	3.25 wt% CZE with 8 rods at 6 wtT and 4 rods at 2 wt% Gd
C3	3.25 wt% CZE with 12 rods at 8 wt% and 4 rods at 2 wt% Gd

Figure 2-2—Equilibrium Cycle Core Loading Map

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
17						XX8 S 8 3	XX7 G16 2	XX10 C12 2	XX7 S12 2	XX10 C 6 2	XX7 L16 2	XX9 P13 2					
16				XX8 H16 2	XX6 D15 2	XX7 F16	XX7 G16	XX8 H16	XX7 M16 1	XX8 K16	XX7 L16	XX7 M16	XX6 P15 2	XX8 K16 2			
15			XX9 D13 2	XX6 D15	XX7 G16 1	XX10 F15	XX10 C12 1	XX6 D15 1	XX6 P15 1	XX7 S12 1	XX10 R12 1	XX10 M15	XX7 L16 1	XX6 P15	XX9 N14 2		
14		XX8 B10 2	XX6 C14	XX8 H16 1	XX9 E14	XX3 D 9 1	XX1 G14	XX4 E10 1	XX3 J14	XX4 N10 1	XX1 L14	XX5 K11 1	XX9 N14	XX8 S10 1	XX6 R14	XX8 S10 2	
13		XX6 C14 2	XX7 B11 1	XX9 D13	XX1 G14 1	XX3 F13	XX3 E12 1	XX4 H13	XX5 L10 1	XX4 K13	XX3 N12 1	XX3 M13	XX1 P11 1	XX9 P13	XX7 S11 1	XX6 R14 2	
12	XX9 E14 2	XX7 B12	XX10 C12	XX5 G10 1	XX3 E12	XX3 F 9 1	XX2 G12	XX2 F11 1	XX3 J12	XX1 L14 1	XX2 L12	XX3 J12 1	XX3 N12	XX3 J14 1	XX10 R12	XX7 S12	XX8 H 2 3
11	XX7 B11 2	XX7 B11	XX10 F15 1	XX1 D11	XX3 F13 1	XX2 F11	XX2 G12 1	XX5 H11	XX9 P13 1	XX5 K11	XX2 M11 1	XX2 M11	XX3 M13 1	XX1 P11	XX10 M15 1	XX7 S11	XX7 S11 2
10	XX10 M 3 2	XX8 B10	XX7 F16 1	XX4 H13 1	XX4 E10	XX1 D11 1	XX5 G10	XX9 D13 1	XX8 K16 1	XX9 N14 1	XX5 L10	XX2 L12 1	XX4 N10	XX4 K13 1	XX6 R14 1	XX8 S10	XX10 M15 2
9	XX7 F16 2	XX7 B12 1	XX6 C14 1	XX3 D 9	XX5 H11 1	XX3 F 9	XX9 E14 1	XX8 B10 1	XX7 S 6 2	XX8 S 8 1	XX9 N 4 1	XX3 M 9	XX5 K 7 1	XX3 P 9	XX6 R 4 1	XX7 S 6 1	XX7 M 2 2
8	XX10 F 3 2	XX8 B 8	XX6 C 4 1	XX4 H 5 1	XX4 E 8	XX2 G 6 1	XX5 G 8	XX9 E 4 1	XX8 H 2 1	XX9 P 5 1	XX5 L 8	XX1 P 7 1	XX4 N 8	XX4 K 5 1	XX7 M 2 1	XX8 S 8	XX10 F15 2
7	XX7 B 7 2	XX7 B 7	XX10 F 3 1	XX1 D 7	XX3 F 5 1	XX2 F 7	XX2 F 7 1	XX5 H 7	XX9 D 5 1	XX5 K 7	XX2 L 6 1	XX2 M 7	XX3 M 5 1	XX1 P 7	XX10 M 3 1	XX7 S 7	XX7 S 7 2
6	XX8 K16 3	XX7 B 6	XX10 C 6	XX3 J 4 1	XX3 E 6	XX3 J 6 1	XX2 G 6	XX1 G 4 1	XX3 J 6	XX2 M 7 1	XX2 L 6	XX3 M 9 1	XX3 N 6	XX5 L 8 1	XX10 R 6	XX7 S 6	XX9 N 4 2
5		XX6 C 4 2	XX7 B 7 1	XX9 D 5	XX1 D 7 1	XX3 F 5	XX3 E 6 1	XX4 H 5	XX5 G 8 1	XX4 K 5	XX3 N 6 1	XX3 M 5	XX1 L 4 1	XX9 P 5	XX7 S 7 1	XX6 R 4 2	
4		XX8 B 8 2	XX6 C 4	XX8 B 8 1	XX9 E 4	XX5 H 7 1	XX1 G 4	XX4 E 8 1	XX3 J 4	XX4 N 8 1	XX1 L 4	XX3 P 9 1	XX9 N 4	XX8 K 2 1	XX6 R 4	XX8 S 8 2	
3			XX9 E 4 2	XX6 D 3	XX7 G 2 1	XX10 F 3	XX10 C 6 1	XX7 B 6 1	XX6 D 3 1	XX6 P 3 1	XX10 R 6 1	XX10 M 3	XX7 L 2 1	XX6 P 3	XX9 P 5 2		
2				XX8 H 2 2	XX6 D 3 2	XX7 F 2	XX7 G 2	XX8 H 2	XX7 F 2 1	XX8 K 2	XX7 L 2	XX7 M 2	XX6 P 3 2	XX8 K 2 2	Fuel Type Initial Core Location Number of Burns		
1						XX9 D 5 2	XX7 G 2 2	XX10 R12 2	XX7 B 6 2	XX10 R 6 2	XX7 L 2 2	XX8 B10 3					

XX1	4.30 wt% CZE with 12 rods at 8 wt% and 8 rods at 2 wt% Gd
XX2	4.30 wt% CZE with 16 rods at 8 wt% Gd
XX3	4.30 wt% CZE with 16 rods at 8 wt% and 5 rods at 2 wt% Gd
XX4	4.30 wt% CZE with 16 rods at 8 wt% and 5 rods at 4 wt% Gd
XX5	4.30 wt% CZE with 20 rods at 8 wt% Gd
XX6	4.80 wt% CZE with 8 rods at 2 wt% Gd
XX7	4.80 wt% CZE with 12 rods at 8 wt% Gd
XX8	4.80 wt% CZE with 12 rods at 8 wt% and 8 rods at 2 wt% Gd
XX9	4.80 wt% CZE with 16 rods at 8 wt% and 5 rods at 4 wt% Gd
XX10	4.80 wt% CZE with 20 rods at 8 wt% Gd

Figure 2-3—Rod Cluster Control Assembly (RCCA) Locations

	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
17									SC								
16						C		SA		SA		C					
15			SC		A		B		D		B		A		SC		
14				SA		SB						SB		SA			
13			A		D		SC		C		SC		D		A		
12		C		SB				SA		SA				SB		C	
11			B		SC		B				B		SC		B		
10		SA				SA		SB		SB		SA				SA	
9	SC		D		C				D				C		D		SC
8		SA				SA		SB		SB		SA				SA	
7			B		SC		B				B		SC		B		
6		C		SB				SA		SA				SB		C	
5			A		D		SC		C		SC		D		A		
4				SA		SB						SB		SA			
3			SC		A		B		D		B		A		SC		
2						C		SA		SA		C					
1									SC								