

3. GENERAL DESCRIPTION

The McGuire Unit 1 reactor core is described in detail in Chapter 4 of the FSAR (Reference 1). The core consists of 193 assemblies, each of which is a 17-by-17 array containing 264 fuel rods, 24 guide tubes, and 1 incore instrument tube. There are 117 burned FAs in the core; 116 FAs are of the Westinghouse Optimized Fuel Assembly (OFA) design; 1 FA is a reconstituted Mark-BW special cladding assembly. The reconstituted Mark-BW FA contains 9 fresh fuel rods containing natural uranium dioxide pellets. This Mark-BW special cladding assembly was reconstituted after being discharged from McGuire Unit 1 Cycle 6. The 76 fresh FA's are of the Mark-BW design (Reference 2); Two of these fresh FAs are Mark-BW special cladding assemblies (Reference 3). The fuel rod outside diameters are 0.360 and 0.374 inches, and the wall thicknesses are 0.0225 and 0.024 inches for the OFA and Mark-BW designs, respectively. The Mark-BW fuel consists of dished end, cylindrical pellets of uranium dioxide, (See Table 4-1 for data). The average nominal fuel loadings are 421.40, 454.66, 424.67, 425.78, and 454.91 kg of uranium per fuel assembly in batches 7A, 7C, 8A, 9A, and 10A, respectively. The initial enrichments of batches 7A, 7C, 8A and 9A were 3.40, 2.92, 3.60, and 3.75 wt% ^{235}U , respectively. The design enrichment of fresh batch 10 is 3.75 wt% ^{235}U .

The 39 batch 8A and 76 batch 9A assemblies will be shuffled to new locations. One batch 7C FA discharged at the end of Cycle 6 will be reinserted as the center assembly. One batch 7A FA discharged at the end of Cycle 6 will be reinserted at location G-11. The 76 fresh batch 10 assemblies will be loaded into the core in a basically symmetric checkerboard pattern. Figure 3-2 is a quarter core map showing the burnup and region reference number with corresponding initial enrichments of each assembly at the beginning of Cycle 8.

Cycle 8 will be operated in a feed-and-bleed mode. Core reactivity is controlled by 53 rod cluster control assemblies (RCCAs), 64 BPRAs, and soluble boron shim. The Cycle 8 locations of the 53 rod cluster control assemblies with their respective designations are indicated in Figure 3-3. The Cycle 8 locations and number of pins of 3.0 wt% $\text{B}_4\text{C-Al}_2\text{O}_3$ BPRA clusters are shown in Figure 3-4.

CORE LOADING DIAGRAM FOR MCGUIRE UNIT 1 CYCLE 8

			J61 9A K-13	K06 10A F	J02 9A K-11	K31 10A F	J73 9A F-11	K36 10A F	J43 9A F-13						
		J42 9A J-14	J34 9A D-13	K55 10A F	J41 9A L-04	K57 10A F	H10 8A N-14	K09 9A F	J33 9A E-04	K71 10A F	J05 9A M-13	J70 9A G-14			
		J07 9A B-07	J39 9A K-07	K13 10A F	J30 9A G-04	K48 10A F	H64 8A K-15	J28 9A H-15	H51 8A F-15	K50 10A F	J46 9A J-04	K41 10A F	J65 9A F-07	J32 9A F-07	
		J18 9A C-12	K46# 10A F	H73 8A F-04	K30 10A F	H34 8A H-01	K33 10A F	J14 9A G-06	K01 10A F	H21 8A L-01	K54 10A F	H53 8A B-04	K28 10A F	J26 9A N-12	
	J12 9A C-06	K15 10A F	J16 9A M-09	K64 10A F	J23 9A E-08	J58 9A E-14	H44 8A R-09	K62 10A F	H16 8A A-09	J21 9A L-14	J27 9A H-11	K52 10A F	J40 9A D-09	K76 10A F	J51 9A N-06
	K51 10A F	J28 9A M-05	K47 10A F	H07 8A R-11	J72 9A B-11	J22 9A J-06	K60 10A F	H62 8A P-13	K14 10A F	J63 9A H-07	J20 9A F-11	H39 8A A-11	K66 10A F	J52 9A D-05	K12 10A F
	J66 9A H-06	K32 10A F	H30 8A A-06	K59 10A F	H24 8A G-01	K39 10A F	H42 8A M-02	K63 10A F	H43 8A D-02	K65 10A F	H26 8A J-01	K75 10A F	H54 8A R-06	K07 10A F	J47 9A L-06
	K74 10A F	H29 8A C-14	J38 9A A-08	J60 9A J-06	K08 10A F	H76 8A B-13	K22 10A F	G72* 7C F-10	K11 10A F	H20 8A P-03	K23 10A F	J19 9A G-10	J74 9A R-08	H12 8A N-14	K38 10A F
	J53 9A B-10	K37 10A F	H72 8A A-10	K16 10A F	H01 8A G-15	K56 10A F	H71 8A M-14	K44 10A F	H55 8A D-14	K67 10A F	H23 8A J-15	K40 10A F	H49 8A R-10	K17 10A F	J10 9A L-10
	K29 10A F	J04 9A M-11	K10 10A F	H67 8A R-05	J76 9A B-05	J44 9A H-09	K09 10A F	H02 8A B-03	K19 10A F	J11 9A G-08	J54 9A P-05	H37 8A A-05	K53 10A F	J69 9A D-11	K68 10A F
	J68 9A C-10	K20 10A F	J59 9A M-07	K04 10A F	J64 9A H-05	J57 9A E-02	H75 8A R-07	K02 10A F	G19* 7A K-07	J31 9A L-02	J08 9A L-08	K27 10A F	J75 9A D-07	K73 10A F	J29 9A N-10
	J01 9A C-04	K69 10A F	H47 8A F-12	K72 10A F	H57 8A E-15	K26 10A F	J09 9A J-10	K24 10A F	H03 8A L-15	K49 10A F	H15 8A B-12	K45# 10A F	J50 9A N-04		
	J17 9A B-09	J56 9A K-09	K35 10A F	J45 9A G-12	K18 10A F	H68 8A K-01	J06 9A H-01	H27 8A F-01	K05 10A F	J49 9A J-12	K61 10A F	J67 9A F-09	J37 9A P-09		
	J36 9A J-02	J48 9A D-03	K43 10A F	J24 9A L-12	K34 10A F	H66 8A C-02	K21 10A F	J35 9A E-12	K42 10A F	J03 9A M-03	J55 9A G-02				
				J71 9A K-03	K70 10A F	J15 9A K-05	K58 10A F	J62 9A F-05	K25 10A F	J13 9A F-03					

XXX	REGION REFERENCE NUMBER
YY	REGION NUMBER
Z-ZZ	CYCLE 7 LOCATIONS

* Full core locations H-08 and G-11 refer to Cycle 6 locations.
Assemblies K45 and K46, in locations C-12 and N-04, respectively, are MKBW special cladding assemblies.

FIGURE 3-2

ENRICHMENT AND BOC BURNUP DISTRIBUTION FOR McGUIRE UNIT 1 CYCLE 8

	H	G	F	E	D	C	B	A
8	26689.0	0	22507.4	0	21751.1	12817.6	22509.9	0
	28503.7	0	25952.9	0	22841.4	16748.5	25194.5	0
	7C	10A	8A	10A	9A	9A	8A	10A
9	0	25649.3	0	26301.2	0	25731.4	0	21548.4
	0	28207.9	0	30386.1	0	30294.1	0	22469.8
	10A	8A	10A	8A	10A	8A	10A	9A
10	22507.4	0	20390.3	17601.7	22188.4	0	21186.6	0
	25185.8	0	22256	21248	26843.4	0	22368.3	0
	8A	10A	9A	9A	8A	10A	9A	10A
11	0	26284.8	17609.7	21573.4	0	21162.4	0	21322.3
	0	30337.5	21264.8	23124.0	0	22249.5	0	22354.5
	10A	8A/7A	9A	9A	10A	9A	10A	9A
12	21751.1	0	22175.9	0	25676.2	0	19585.8	
	22772.0	0	26821.6	0	28228.7	0	21861.7	
	9A	10A	8A	10A	8A	10A	9A	
13	12848.3	25794.6	0	21169.5	0	21753.8	18906.9	
	16795.4	30308.1	0	22257.8	0	22960.5	21560.1	
	9A	8A	10A	9A	10A	9A	9A	
14	22509.9	0	21214.2	0	19575.1	18916.9	AVERAGE	
	25942.8	0	22383.9	0	21855.6	21571	MAXIMUM	
	8A	10A	9A	10A	9A	9A	REGION NO.	
15	0	21572.4	0	21338.8				
	0	22474.3	0	22368.5				
	10A	9A	10A	9A				

REGION	FUEL TYPE	ENRICHMENT W/O U-235	CYCLES BURNED	NUMBER OF ASSEMBLIES	BOC BURNUP MWD/MTU
7A	(OFA)	3.40	2	1	24,481
7C	(MK-BW) *	2.92	2	1	26,689
8A	(OFA)	3.60	2	39	24,435
9A	(OFA)	3.75	1	76	20,053
10A	(MK-BW)	3.75	0	76	0
CORE				193	13,071

* MKBW Reconstituted demonstration assembly

NOTE: Core locations J-05, G-05, J-11 are region 8A assemblies and core location G-11 is a region 7A assembly. The BOC burnup for the assembly at core location G-11 is 24,481 MWD/MTU.

5. NUCLEAR DESIGN

5.1 Physics Characteristics

Table 5-1 provides the core physics parameters for Cycles 7 and 8. The values were generated using the methodology described in DPC-NF-2010A (Reference 7) and are valid for the design cycle length (370 EFPD plus 10 EFPD). Figure 5-1 illustrates a representative relative power distribution for the beginning of Cycle 8 at full power. This case was calculated by using the PDQ07 methodology as described in DPC-NF-2010A (Reference 7) as part of the design depletion. This case contained equilibrium xenon and rods in the All Rods Out (ARO) position.

Ultrasonic testing of fuel assemblies to be loaded in McGuire 1 Cycle 8 discovered a failed fuel rod in assembly H63. This assembly was scheduled to be loaded in core location G-11. The replacement assembly, G19, has neutronic characteristics similar to assembly H63. An evaluation of the reload design with this replacement assembly showed negligible changes in core characteristics and confirmed the applicability of the original reload safety evaluation performed for McGuire Unit 1 Cycle 8.

During verification of the control rod insertion limits specified in the COLR, calculated ejected rod worths and their adherence to acceptance criteria were considered. The adequacy of the shutdown margin with Cycle 8 stuck rod worths is demonstrated in Table 5-2. The shutdown margin calculations include a 10% uncertainty available rod worth. The shutdown calculation at the end of Cycle 8 was analyzed at 380 EFPD.

5.2. Changes in Nuclear Design

The core design changes for Cycle 8 include the use of Mk-BW fuel assemblies and BPRAs with variable numbers of poison rods as described in Section 3.

The Cycle 8 physics parameters appearing in this report were calculated with the PDQ07 and EPRI-NODE-P codes. These codes and methods were approved by the NRC as documented in Reference 7. The PDQ07 calculations were performed in two dimensions; the EPRI-NODE-P calculations were performed in three dimensions. The Reactor Protection System (RPS) limits and Operational limits for the core were verified by analyses for this fuel cycle using methodology approved by the NRC in Reference 8 and are provided in the COLR. Revisions to the COLR for Cycle 8 are presented in Section 8.