RELOAD REPORT

Catawba Unit 1 Cycle 8

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1. INTRODUCTION AND SUMMARY

This report justifies the operation of the eighth cycle of Catawba Nuclear Station, Unit 1 at the rated core power level of 3411 MW_{th}. Included are the required analyses as outlined in the USNRC document "Guidance for Proposed License Amendments Relating to Refueling," July 1975.

The incoming Mark-BW fuel for Cycle 8 is the third Catawba Unit 1 reload batch supplied by B&W Fuel Company (BWFC). To support implementation of Mark-BW fuel in the McGuire and Catawba nuclear stations, Duke Power Company (DPC) developed methods and models are used to analyze the plants during normal and off-normal operation. The thermal-hydraulic analytical models are documented in topical report DPC-NE-3000P (Reference 11) and DPC-NE-3002-A (Reference 16) for non-LOCA transients and BAW-10174-A (Reference 13) for LOCA. Portions of the analytical methodology are documented in topical reports DPC-NE-3001-PA (Reference 12) and DPC-NE-2004-PA (Reference 8).

Section 2 of this report describes the operating history for fuel in Catawba Unit 1. Section 3 is a general description of the reactor core, and the fuel system design is provided in Section 4. Reactor and system parameters and conditions are summarized in Sections 5, 6, and 7. Changes to the Technical Specifications and Core Operating Limits Report (COLR) are provided in Section 8. The scope of Startup Physics Testing for Catawba Unit 1, Cycle 8 is provided in Section 9.

All of the accidents analyzed in the Final Safety Analysis Report FSAR (Reference 1) have been reviewed and are applicable for Cycle 8 operation. In those cases where Cycle 8 characteristics were conservative compared to those analyzed for previous cycles, new analyses were not performed. With the exception of the post-LOCA subcriticality and steam line break analyses, the Cycle 8 thermal-hydraulic and physics parameters are bounded by the existing Catawba FSAR Chapter 15 analyses. The results of reanalyzed accidents for Catawba Unit 1 Cycle 8 are discussed in Section 7.

Amendment Number 74 (Unit 1) and Amendment Number 68 (Unit 2) to the Catawba Nuclear Station Facility Operating License allow the removal of cycle-specific core parameter limits from Technical Specifications and require that these limits be included in a Core Operating Limits Report (COLR). The Core Operating Limits Report is submitted to the NRC upon issuance and does not require approval prior to implementation. Changes to the core operating limits are made via the Core Operating Limits Report.

The Technical Specifications have been reviewed, and the modifications required for Cycle 8 are given in Section 8. Based on the analyses performed, it has been concluded that Catawba Unit 1 Cycle 8 can be safely operated at a core power level of 3411 MW_{th}.

2. OPERATING HISTORY

The current operating cycle for Catawba Unit 1 is Cycle 7, which achieved criticality on October 18, 1992 and reached 100% full power on October 24, 1992. Cycle 7 is scheduled to shut down in October 1993 after 350 EFPD. No operating anomalies have occurred during Cycle 7 operations that would adversely affect fuel performance in Cycle 8.

Catawba Unit 1 Cycle 8 is scheduled to start up in December 1993 at a rated power level of 3411 MW_{th} and has a design cycle length of 390 ± 10EFPD.

3. GENERAL DESCRIPTION

The Catawba 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 17X17 array containing 264 fuel rods, 24 guide tubes, and 1 incore instrument tube. The Catawba 1 Cycle 8 core has 117 burned assemblies and 76 fresh assemblies. The fuel rod outside diameters are 0.360 and 0.374 inch, and the clad thicknesses are 0.0225 and 0.024 inch for the Westinghouse optimized fuel assembly (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 design loadings are 423.5 and 456.3 kg of uranium per assembly for OFA and Mark-BW fuel, respectively. The initial design enrichments of batches 7A, 8A, and 9A were 3.40, 3.55, and 3.45 w/o ^{235}U, respectively. The design enrichment of the fresh batch 10A (Mark-BW) is 3.65 w/o ^{235}U.

Figure 3-1 gives the full core loading pattern for Cycle 8. The 9 batch 7A, 36 batch 8A, and 72 batch 9A assemblies will be shuffled to new locations. One batch 7A assembly will be reinserted into the core from the spent fuel pool. The 76 fresh batch 10A assemblies will be loaded into the core in a symmetric checkerboard pattern. Figure 3-2 is a quarter core map showing the burnup and region reference number of each assembly at the beginning of Cycle 8. Figure 3-2 also provides batch average enrichment and burnup.

Cycle 8 will be operated in a feed-and-bleed mode. Core reactivity is controlled by 53 rod cluster control assemblies (RCCAs), 976 Mark-BW burnable absorbers, 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 of Mark-BW BPRA clusters and number of pins enriched to 2.5 w/0 and 2.0 w/0 B_4C-Al_2O_3 are also shown in Figure 3-3.

FIGURE 3-1
CORE LOADING PATTERN FOR CATAWBA UNIT 1 CYCLE 8

PREVIOUS CORE LOCATIONS
REGION NUMBERS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1					D-07 9	F 10	K-13 9	E-12 9	F-13 9	F 10	M-07 9				
2			F-11 8	G-06 9	F 10	L-14 9	F 10	C-14 8	F 10	E-14 9	F 10	J-06 9	K-11 8		
3		E-10 8	J-08 8	F 10	J-14 9	F 10	A-10 9	M-11 9	R-10 9	F 10	G-14 9	F 10	H-07 8	L-10 8	
4		K-09 9	F 10	C-13 8	F 10	R-09 8	F 10	E-01 7	F 10	A-09 8	F 10	N-13 8	F 10	F-09 9	
5	J-12 9	F 10	B-07 9	F 10	H-05 9	F 10	N-04 9	H-15 9	C-04 9	F 10	E-08 9	F 10	P-07 9	F 10	G-12 9
6	F 10	B-05 9	F 10	G-01 8	F 10	A-11 7	F 10	B-06 8	F 10	R-11 7	F 10	J-01 8	F 10	P-05 9	F 10
7	C-06 9	F 10	F-15 9	F 10	M-03 9	F 10	P-03 8	F 10	B-03 8	F 10	D-03 9	F 10	K-15 9	F 10	N-06 9
8	E-04 9	C-02 8	D-11 9	L-01 7	A-08 9	P-06 8	F 10	# F-11 7	F 10	B-10 8	R-08 9	E-15 7	M-05 9	N-14 8	L-12 9
9	C-10 9	F 10	F-01 9	F 10	M-13 9	F 10	P-13 8	F 10	B-13 8	F 10	D-13 9	F 10	K-01 9	F 10	N-10 9
10	F 10	B-11 9	F 10	G-15 8	F 10	A-05 7	F 10	P-10 8	F 10	R-05 7	F 10	J-15 8	F 10	P-11 9	F 10
11	J-04 9	F 10	B-09 9	F 10	L-08 9	F 10	N-12 9	H-01 9	C-12 9	F 10	H-11 9	F 10	P-09 9	F 10	G-04 9
12		K-07 9	F 10	C-03 8	F 10	R-07 8	F 10	L-15 7	F 10	A-07 8	F 10	N-03 8	F 10	F-07 9	
13		E-06 8	H-09 8	F 10	J-02 9	F 10	A-06 9	D-05 9	R-06 9	F 10	G-02 9	F 10	G-08 8	L-06 8	
14			F-05 8	G-10 9	F 10	L-02 9	F 10	N-02 8	F 10	E-02 9	F 10	J-10 9	K-05 8		
15					D-09 9	F 10	K-03 9	L-04 9	F-03 9	F 10	M-09 9				

\# Cycle 6 Reinsert

Z-ZZ YY	CYCLE 7 LOCATION REGION NUMBER

F without row designator indicates fresh fuel assembly

FIGURE 3-2

ENRICHMENT AND BOC BURNUP DISTRIBUTION FOR CATAWBA 1 CYCLE 8

	H	G	F	E	D	C	B	A
8	27760.4 26017.9 28985.5 7	.0 .0 .0 10	32822.0 30717.5 34571.4 8	10295.4 5025.8 13552.4 9	30791.4 27413.3 33059.5 7	17666.1 16996.1 18411.7 9	21182.7 19442.1 22311.4 8	17693.8 16994.6 18459.6 9
9	.0 .0 .0 10	21173.1 19147.3 22706.1 8	.0 .0 .0 10	16168.2 12090.2 18027.3 9	.0 .0 .0 10	10188.5 4291.2 14233.3 9	.0 .0 .0 10	17245.3 16467.5 18081.2 9
10	32822.0 31158.5 34356.1 8	.0 .0 .0 10	30783.9 26853.4 33789.3 7	.0 .0 .0 10	26662.3 22616.6 29474.0 8	.0 .0 .0 10	14387.0 8229.6 17146.2 9	.0 .0 .0 10
11	10317.4 5035.9 13585.6 9	16152.3 12065.9 18008.5 9	.0 .0 .0 10	16590.3 15842.0 17759.0 9	.0 .0 .0 10	16098.9 13220.1 17871.6 9	.0 .0 .0 10	16544.4 15765.8 17659.2 9
12	30791.4 27370.5 32684.2 7	.0 .0 .0 10	26641.0 22602.5 29444.6 8	.0 .0 .0 10	28822.7 24565.7 32439.0 8	.0 .0 .0 10	17236.9 16122.6 18495.0 9	
13	17666.1 16945.5 18448.9 9	10172.4 4285.0 14208.9 9	.0 .0 .0 10	16146.6 13252.4 17925.6 9	.0 .0 .0 10	28963.7 22983.2 32886.3 8	28278.9 22423.2 32368.5 8	
14	21182.7 19151.9 22658.5 8	.0 .0 .0 10	14407.8 8240.4 17172.6 9	.0 .0 .0 10	17435.3 16493.0 18596.3 9	28391.2 22620.3 32493.2 8	AVERAGE MINIMUM MAXIMUM REGION NUMBER	
15	17693.8 17027.2 18426.1 9	17309.5 16511.7 18134.7 9	.0 .0 .0 10	16287.5 15469.0 17528.1 09				

Region	Enrichment w/o U-235	Cycles Burned	Number of Assemblies	BOC Burnup MWD/MTU
7	3.40 (OFA)	3	9	30451
8	3.55 (MkBW)	2	36	26993
9	3.45 (MkBW)	1	72	15447
10	3.65 (MKBW)	0	76	0
Core	N/A	N/A	193	12217

FIGURE 3-7
CATAWBA UNIT 1 CYCLE 8
BURNABLE ABSORBER AND SOURCE ASSEMBLY LOCATIONS

	R	P	N	M	L	K	J	H	G	F	E	D	C	B	A
1						0				0					
2					4*		16		16		4*				
3				4*		20				20		4*			
4			4*		20		20		20		20		4*		
5		4*		20		16*				16*		20		4*	
6	0		20		16*		16		16		16*		20		0
7		16		20		16		12*		16		20		16	
8			SS				12*		12*				SS		
9		16		20		16		12*		16		20		16	
10	0		20		16*		16		16		16*		20		0
11		4*		20		16*				16*		20		4*	
12			4*		20		20		20		20		4*		
13				4*		20				20		4*			
14					4*		16		16		4*				
15						0				0					

	NUMBER OF BURNABLE ABSORBER PINS	NUMBER OF BACKPLATES
	4*	16
	12*	4
	16*	8
	16	16
	20	24
Total	976	68

* refers to assembly locations with 2.5 w/o BPs. All others have 2.0 w/o BPs.
SS = Secondary Source Location

4. FUEL SYSTEM DESIGN

4.1 Fuel Assembly Mechanical Design

The Catawba 1 Cycle 8 core will include 76 fresh Mark-BW fuel assemblies with an enrichment of 3.65 w/o ^{235}U. The re-inserted fuel assemblies in Cycle 8 will be Westinghouse OFA fuel assemblies (9) and Mark-BW fuel assemblies (108). The Mark-BW 17 x 17 Zircaloy spacer grid fuel assembly (Reference 2) is similar in design to the Westinghouse standard fuel assembly. The fuel rod outer diameter and guide tube top section, dashpot diameters, and instrument tube diameter are the same as the Westinghouse standard 17 x 17 design. The unique features of the Mark-BW design include the Zircaloy intermediate spacer grids, the spacer grid restraint system, and the use of Zircaloy grids with the standard lattice design. Mark-BW fuel design dimensions and parameters for Catawba 1 Cycle 8 are listed in Table 4-1.

4.2 Fuel Rod Design

Duke Power Company has performed generic Mark-BW mechanical analyses using the approved methodologies described in Reference 3. The generic analyses envelope the Catawba 1 Cycle 8 reinsert fuel. Critical Cycle 9 fresh fuel as-built parameters will be compared against values assumed in the generic analyses prior to cycle startup. This will determine the applicability of the analyses to the fresh fuel. The cladding collapse and minimum LHRTM limits in Table 4-1 are based upon these generic analyses.

4.2.1 Fuel Rod Cladding Collapse

The fuel rods were analyzed for creep collapse using the CROV computer code, Reference 4, and the methodology described in Reference 3. Internal pin pressures and clad temperatures used in CROV were calculated using the TACO2 computer code, Reference 5. A conservative power history which envelopes the predicted peaking for the Catawba 1 Cycle 8 fuel was analyzed. The collapse time was conservatively determined to be greater than the maximum predicted residence time for the Mark-BW fuel (Table 4-1).

4.2.2 Fuel Rod Cladding Stress

As described in Reference 3, Duke Power Company has performed a conservative generic fuel rod cladding stress analysis using the ASME pressure vessel stress intensity limits as guidelines. The maximum cladding stress intensities were shown to be within the ASME limits under all loading conditions. The generic Mark-BW cladding stress analysis includes the following conservatisms:

* Conservative cladding dimensions.
* High external pressure.
* Low internal pin pressure.
* High radial temperature gradient through the clad.

4.2.3 Fuel Rod Cladding Strain

Diametral cladding strain resulting from a local power transient is limited to 1.0%. A generic cladding strain analysis was performed using TACO2 to determine the maximum allowable local power change that the fuel could experience without exceeding the 1.0% limit. The maximum calculated local power change resulting from a worst case core maneuvering scenario was compared with the maximum allowable power change. This comparison demonstrated that margin exists to the 1.0% strain limit.

4.3 Thermal Design

The thermal performance of the Mark-BW fuel assemblies was evaluated using TACO2 with the methodology given in Reference 3. The nominal fuel parameters used to determine the generic linear heat rate to centerline melt (LHRTM) limits are given in Table 4-1. The LHRTM analysis included the following bounding conservatisms:

* Maximum gap based on as-fabricated pellet and clad data.
* Maximum incore densification based on resinter test results.

The maximum predicted Mark-BW assembly burnup at EOC 8 (in Batch 8) is 48,448 MWD/MTU and the maximum predicted fuel rod burnup (in Batch 8) is 50,518 MWD/MTU. The fuel rod internal pressure has been evaluated for the highest burnup rod using TACO2 and a conservative pin power history. The maximum internal pin pressure is less than the core exit pressure of 2280 psia.

4.4 Material Design

The Mark-BW fuel is not unique in concept, nor does it utilize different component materials. Thus, the chemical compatibility of all possible fuel-cladding-coolant-assembly interactions for the fresh fuel is identical to that of existing Westinghouse OFA and Mark-BW fuel types.

4.5 Operating Experience

Experience with the Mark-BW 17 x 17 fuel assembly design started with the irradiation of four lead assemblies in McGuire 1 Cycle 5. Three assemblies from this program completed irradiation in McGuire 1 Cycle 7 with a maximum assembly burnup of 42,756 MWD/MTU. The lead assemblies were examined after each cycle and the fuel assembly bow, twist, growth, and holddown spring set were all within nominal bounds.

Catawba 1 Cycle 8 will be the eighth reload batch of Mark-BW fuel supplied to Duke Power Company.

Table 4-1. Fuel Design Parameters and Dimensions

Mark-BW

	Batch 8	Batch 9	Batch 10
Nominal fuel rod OD, in.	0.374	0.374	0.374
Nominal fuel rod ID, in.	0.326	0.326	0.326
Nominal active fuel length, in.	144.0	144.0	144.0
Nominal fuel pellet OD, in.	0.3195	0.3195	0.3195
Fuel pellet initial density, % TD	96.0	96.0	96.0
Initial fuel enrichment, w/o ^{235}U	3.55	3.45	3.65
Estimated Max. Fuel Assembly Ave. Burnup, MWD/MTU	48,448	35,539	20,301
Cladding collapse burnup, MWD/MTU	>51,700	>57,748	>38,700
Nominal linear heat rate (LHR), kW/ft	5.43	5.43	5.43
Ave. fuel temperature @ nom. LHR, °F	1360	1360	1360
Minimum LHR to melt, kW/ft			
0-1000 MWD/MTU	21.5	21.5	21.5
> 1000 MWD/MTU	21.8	21.8	21.8

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-2010-A (Reference 6) and DPC-NE-3001-PA (Reference 12). Cycle 8 values are valid for the design cycle length (390 EFPD ± 10 EFPD). Figure 5-1 illustrates a representative relative power distribution for the beginning of Cycle 8 at full power. This case was calculated as part of the design depletion using the PDQ07 methodology as described in DPC-NF-2010-A (Reference 6). This case contained equilibrium xenon and rods in the all rods out (ARO) position.

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 is demonstrated in Table 5-2. The shutdown margin calculations include a 10% uncertainty in the available all rods in (ARI) position minus the most reactive stuck rod worth at HZP. The shutdown calculation at the end of Cycle 8 was analyzed at 400 EFPD (390 EFPD + 10 EFPD window).

5.2. Nuclear Design Methodology

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 6. 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 7. The operational limits are provided in the COLR.

Table 5.1 Physics Parameters[a] Catawba 1 Cycles 7 and 8

	Cycle 7	Cycle 8
Design cycle length, EFPD	350	390
Design cycle burnup, MWD/MTU	13846	15231
Design average core burnup - EOC, MWD/MTU	27164	27448
Design initial core loading, MTU	86.4443	87.7523
Critical boron - BOC, ppmb, no Xe[b]		
HZP, ARO	1659	1793
HFP, ARO	1496	1621
Critical boron - EOC, ppmb		
HZP, No Xe, ARO	585	638
HFP, Eq Xe, ARO	0	0
Total Control Rod Worths - HZP, eq Xe pcm		
BOC	6580	6341
EOC[c]	7003	6710
Max ejected rod worth(d) - HZP, pcm		
BOC (D12)	497	335
EOC[c] (D12)	617	489
Max stuck rod worth - HZP, eq Xe pcm		
BOC (F10)	1384	829
EOC[c] (F10)	1274	1063
Power deficit - HZP to HFP, eq Xe pcm		
BOC	-1845	-1741
EOC[c]	-3210	-3185
Doppler coeff - HFP, pcm/°F		
BOC, no Xe	-1.20	-1.19
EOC[c], eq Xe	-1.48	-1.49
Moderator coeff - HFP, pcm/°F		
BOC, no Xe	-4.91	-3.98
EOC[c], eq Xe, 0 PPMB	-34.01	-34.68
Boron worth - HFP, pcm/ppmb		
BOC	-7.81	-7.28
EOC[c]	-8.91	-8.31

Table 5.1 Physics Parameters[a] Catawba 1 Cycles 7 and 8 (cont)

	Cycle 7	Cycle 8
Equilibrium Xenon worth - HFP, pcm		
BOC (4 EFPD)	2679	2596
EOC	2981	2812
Effective delayed neutron fraction - HFP		
BOC	0.006169	0.006269
EOC	0.005222	0.005225

(a) Cycle 7 and 8 values obtained from Duke Power Company analyses.

(b) HZP denotes hot zero power (core average 557°F Tavg); HFP denotes hot full power (590.8°F vessel Tavg).

(c) EOC physics parameters calculated at design EOC plus 10 EFPD.

(d) Ejected rod worth for banks D, C, and B inserted to HZP RIL.

Table 5-2. Shutdown Margin Calculation for Catawba 1 Cycle 8

Control Rod Worth	BOC (PCM)	EOC[(a)] (PCM)
1. All rods inserted (ARI), HZP	6341	6720
2. ARI less most reactive stuck rod, HZP	5512	5653
3. Less 10% uncertainty	4961	5088
Required Rod Worth		
4. Rod insertion allowance (RIA)	274[(b)]	373[(c)]
5. Power defect, HFP to HZP	2060[(b)]	3348[(c)]
6. Shutdown margin (total available worth minus total required worth)	2627	1367

NOTE: Required shutdown margin is 1300 PCM.

(a) EOC physics parameters calculated at 400 EFPD, i.e., design EOC plus 10 EFPD.

(b) The rod insertion allowance and power defect include penalties to account for the effects of transient xenon conditions.

(c) Cycle 8 EOC total rod worth, rod insertion allowance, and power defect explicitly calculated at transient xenon conditions.

Figure 5-1: BOC (4 EFPD), Cycle 8 Two-Dimensional Relative Power Distribution - HFP, Equilibrium Xenon

	H	G	F	E	D	C	B	A
8	1.0450 1.0718 1.0257 M N	1.2900 1.3854 1.0739 B I	1.0086 1.0478 1.0388 O M	1.2399 1.3448 1.0846 D M	.9469 .9936 1.0493 Q Q	1.1399 1.2158 1.0666 E O	.9138 1.0756 1.1771 A Q	.5083 .7311 1.4383 A Q
9	1.2896 1.3860 1.0748 I B	1.1458 1.1852 1.0344 A A	1.2480 1.3611 1.0906 P I	1.2018 1.3244 1.1020 M N	1.2196 1.3485 1.1057 Q Q	1.2815 1.3866 1.0820 E D	1.0852 1.3241 1.2201 A Q	.5709 .8820 1.5450 A Q
10	1.0084 1.0433 1.0346 M O	1.2474 1.3607 1.0908 I P	.9748 1.0309 1.0575 Q A	1.2574 1.3718 1.0910 I P	1.0905 1.1675 1.0706 E N	1.2427 1.3496 1.0861 A A	1.0992 1.2999 1.1826 D M	.7529 1.0620 1.4104 C E
11	1.2395 1.3439 1.0843 M D	1.2018 1.3246 1.1022 N M	1.2572 1.3717 1.0910 P I	1 2176 1.2931 1.0620 D L	1.2176 1.3391 1.0997 A A	1.1759 1.3056 1.1103 D E	1.1071 1.3937 1.2589 C E	.4562 .8553 1.8751 A A
12	.9469 .9925 1.0482 Q Q	1.2197 1.3493 1.1062 Q Q	1.0912 1.1683 1.0707 N E	1.2177 1.3396 1.1001 A A	1.0010 1.0952 1.0940 E C	1.1363 1.3753 1.2103 E C	.6134 1.0022 1.6339 A A	
13	1.1409 1.2164 1.0662 O E	1.2823 1.3874 1.0820 D E	1.2434 1.3504 1.0861 A A	1.1761 1.3055 1.1100 E D	1.1400 1.3764 1.2074 C E	.5728 .9136 1.5950 A A	.2503 .5833 2.3311 A A	
14	.9149 1.0690 1.1684 Q A	1.0861 1.3251 1.2200 Q A	1.0999 1.3007 1.1825 M D	1.1088 1.3950 1.2581 E C	.6150 1.0040 1.6326 A A	.2522 .5886 2.3343 A A	P (AVG) PEAK PIN PEAK/ASS PIN LOC	
15	.5085 .7335 1.4424 L B	.5709 .8823 1.5454 Q A	.7540 1.0629 1.4098 E C	.4586 .8583 1.8716 A A				

The maximum assembly power is 1.2900 at location G-8.

The maximum pin power is 1.3950 at location E-14.

The maximum pin to assembly factor is 2.3343 at location C-14.

6. THERMAL-HYDRAULIC DESIGN

The generic and cycle-specific analyses supporting Cycle 8 operation were performed by Duke Power Company using the methodology described in Reference 8. Cycle 8 was analyzed using Duke's Statistical Core Design (SCD) methodology. Uncertainties on parameters that affect DNB performance are statistically combined to determine a Statistical DNBR limit (SDL). Using the BWCMV correlation, Reference 9, a generic SDL of 1.40 was calculated using a set of generic uncertainties given in Reference 8. The system parameter uncertainties used in Reference 8 and given in Table 6-1 bound the uncertainties specifically calculated for Catawba. Reactor core safety limits for Cycle 8 are based on a full Mark-BW core and a design $F\Delta H$ of 1.50. The Cycle 8 nominal thermal-hydraulic design conditions are given in Table 6-2.

The Mark-BW fuel assembly was designed to be hydraulically compatible with Westinghouse optimized fuel (OFA). BWFC has performed a series of flow tests to verify the compatibility of the two designs. The tests showed that the total pressure drop across the OFA fuel is 2.4% higher than the pressure drop across the Mark-BW fuel, Reference 2. A generic transition core analysis was performed to determine the DNBR impact of this difference.

Since the Mark-BW fuel has a lower overall pressure drop than the OFA design, a Mark-BW assembly in a mixed core will tend to have more flow through it and consequently more DNB margin than the same assembly in an all Mark-BW core. Conversely, flow will be forced out of the OFA fuel in a mixed core; thus, the need to calculate a DNBR penalty for the OFA fuel. A generic transition core DNBR penalty was determined by modeling a conservative core configuration with one OFA assembly as the hot assembly. The rest of the core was modeled as Mark-BW fuel. A number of statepoints and peaking conditions were analyzed, yielding a maximum DNBR penalty of 3.8% for the OFA fuel.

To provide design flexibility, margin is added to the SDL to determine a design DNBR limit (DDL). For the generic Mark-BW and Catawba 1 Cycle 8 analyses, the DDL is 1.55 (10.7% margin above the SDL). The DNBR penalties, such as the OFA transition core penalty, that must be assessed against the margin are given in Table 6-3.

Table 6-1
System Uncertainties Included in the
Statistical Core Design Analysis

Reference 8

Parameter	Uncertainty	Distribution
Core power	+/- 2 %	Normal
RCS flow	+/- 2.2 %	Normal
Core bypass flow	+/- 1.5 %	Uniform
Pressure	+/- 30 psi	Uniform
Inlet temperature	+/- 4 °F	Uniform

Table 6-2.
Nominal Thermal-Hydraulic Design Conditions

Catawba 1 Cycle 8

Core power, MW_{th}	3411
Core exit pressure, psia	2280
Vessel ave. temperature, °F	590.8
RCS flow, gpm	382,000
Core bypass flow, %	7.5
Reference design FΔH	1.50
Reference design axial shape	1.55 Cosine
CHF correlation	BWCMV
Statistical DNBR limit	1.40
Design DNBR limit	1.55

Table 6-3.
DNBR Penalties

Statistical DNBR limit	1.40
Design DNBR limit	1.55
DNBR margin	10.7 %

DNBR Penalty	Mark-BW	OFA
Transition core	0 %	3.8 %
Instrumentation/hardware	5.6 %	2.8 %
Flow Anomaly	0.5 %	0.5 %
Rod bow	0 %	3.5 %
Total DNBR penalty	6.1 %	10.6 %
Available DNBR Margin	**4.6 %**	**0.1 %**

7. ACCIDENT ANALYSIS

Safety Analysis

Each FSAR accident listed below has been examined with respect to changes in Cycle 8 parameters to determine the effect of the Cycle 8 reload and to ensure that thermal performance during hypothetical transients is not degraded.

- Increase in feedwater flow
- Excessive load increases
- Steam system piping failure
- Turbine trip
- Feedwater system pipe break
- Partial loss of forced reactor coolant flow
- Complete loss of forced reactor coolant flow
- Reactor coolant pump shaft seizure (locked rotor)
- Uncontrolled rod bank withdrawal from subcritical or low power startup condition
- Uncontrolled rod bank withdrawal at power
- Dropped rod/rod bank
- Statically misaligned rod
- Single rod withdrawal
- Startup of an inactive reactor coolant pump
- Boron dilution
- Rod ejection
- Steam generator tube failure
- Loss-of-coolant accidents

With the exception of two analyses, the Catawba 1 Cycle 8 thermal-hydraulic and physics parameters are bounded by the existing CNS FSAR Chapter 15 analyses. In addition, the post-LOCA boron precipitation and post-LOCA containment sump pH analyses given in CNS FSAR Chapter 6 have been reanalyzed. The analyses are as follows.

The steam line break event is reanalyzed with a more positive boron worth, because the boron worth calculated for Catawba 1 Cycle 8 is more positive than the boron worth assumption in the current analysis. The steam line break event is analyzed for two cases. One case assumes offsite power is maintained, and the other case assumes that offsite power is lost. The results of the reanalysis demonstrate that the existing limiting case is unchanged by the change in boron worth, and remains limiting. The reanalysis requires no Technical Specification changes.

Post-LOCA subcriticality is reanalyzed for Catawba Unit 1 with higher boron concentrations in the refueling water storage tank (RWST) and the cold leg accumulators (CLA), because the post-LOCA subcriticality for Catawba 1 Cycle 8 fails the acceptance criteria with the existing RWST and CLA boron concentrations. Post-LOCA subcriticality is reanalyzed for Unit 1 with an RWST minimum boron concentration of 2175 ppm and a CLA minimum boron concentration of 2000 ppm. The results of the reanalysis demonstrate that the Catawba 1 Cycle 8 values are acceptable. Based on the reanalysis, the RWST minimum boron concentration limit is increased from 2000 ppm to 2175 ppm, and the CLA minimum boron concentration limit is increased from 1900 ppm to 2000 ppm. In addition, the RWST and CLA maximum boron concentration limits are increased from 2100 ppm to 2275 ppm in order to preserve operating

margin. The Technical Specification changes due to the reanalysis are provided in Section 8 of this report.

The increase in the RWST and CLA maximum boron concentration limits necessitates a reanalysis of the post-LOCA boron precipitation evaluation. The results of the reanalysis demonstrate that, with the increased RWST and CLA boron concentrations, post-LOCA boron precipitation is prevented with a reduction in the hot leg recirculation initiation time from 9 hours to 7 hours.

The increase in the RWST and CLA maximum boron concentration limits also necessitates a reanalysis of the post-LOCA containment sump pH. The results of the analysis demonstrate that the existing allowable pH range in the Technical Specification Bases is acceptable. Therefore, the reanalysis requires no Technical Specification changes.

In addition, the positive breakpoint and slope of the f(ΔI) function of the overtemperature delta T (OTΔT) reactor trip function has been reevaluated for the Cycle 8 reload design. The results of the evaluation demonstrate that the current slope of the f(ΔI) function is overly conservative with respect to optimal core operation. The Technical Specification changes due to the evaluation are provided in Section 8 of this report.

8. PROPOSED MODIFICATIONS TO LICENSING BASIS DOCUMENTS

Revisions to the Technical Specifications have been proposed for Cycle 8 operation due to the impact of the Cycle 8 core design on the post-LOCA subcriticality analysis, and an evaluation of the OTDT f(ΔI) function. Table 8-1 presents the Technical Specification changes required for Cycle 8 operation. Revisions to the Core Operating Limits Report (COLR) are limited to numerical values, and do not involve any changes to the list of parameters reported.

Table 8-1
Technical Specification Changes

Specification	Description of Change
Table 2.2-1 Note (iii)*	Reduce magnitude of positive f(ΔI) slope from 2.316 to 1.525.
3.1.2.5*	Increase refueling water storage tank minimum boron concentration from 2000 ppm to 2175 ppm.
3.1.2.6*	Increase refueling water storage tank minimum boron concentration from 2000 ppm to 2175 ppm.
3.5.1*	Increase cold leg accumulator boron concentration range from 1900-2100 ppm to 2000-2275 ppm. Increase cold leg accumulator volume weighted average boron concentrations for ACTION c.
3.5.4*	Increase refueling water storage tank boron concentration range from 2000-2100 ppm to 2175-2275 ppm.
3.9.1*	Increase RCS minimum boron concentration from 2000 ppm to 2175 ppm.

* Change applicable only to Catawba Unit 1.

TABLE 2.2-1 (Continued)
TABLE NOTATIONS (Continued)

NOTE 1: (Continued)

$T' \leq$ 590.8°F (Nominal T_{avg} allowed by Safety Analysis);

K_3 = 0.001414;

P = Pressurizer pressure, psig;

P' = 2235 psig (Nominal RCS operating pressure);

S = Laplace transform operator, s^{-1};

and $f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with gains to be selected based on measured instrument response during plant STARTUP tests such that:

(i) For $q_t - q_b$ between -39.9% and +3.0%,

$f_1(\Delta I) = 0$, where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent of RATED THERMAL POWER;

(ii) For each percent ΔI that the magnitude of $q_t - q_b$ is more negative than -39.9%, the ΔT Trip Setpoint shall be automatically reduced by 3.910% of ΔT_o; and

(iii) For each percent ΔI that the magnitude of $q_t - q_b$ is more positive than +3.0%, the ΔT Trip Setpoint shall be automatically reduced by ~~2.316%~~ of ΔT_o.
1.525% (Unit 1)

NOTE 2: The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than 3.0%.

NOTE 1: (Continued)

$T' \leq$ 590.8°F (Nominal T_{avg} allowed by Safety Analysis);

K_3 = 0.001414;

P = Pressurizer pressure, psig;

P' = 2235 psig (Nominal RCS operating pressure);

S = Laplace transform operator, s^{-1};

and $f_1(\Delta I)$ is a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with gains to be selected based on measured instrument response during plant STARTUP tests such that:

(i) For $q_t - q_b$ between -39.9% and +3.0%,

$f_1(\Delta I) = 0$, where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent of RATED THERMAL POWER;

(ii) For each percent ΔI that the magnitude of $q_t - q_b$ is more negative than -39.9%, the ΔT Trip Setpoint shall be automatically reduced by 3.910% of ΔT_o; and

(iii) For each percent ΔI that the magnitude of $q_t - q_b$ is more positive than +3.0%, the ΔT Trip Setpoint shall be automatically reduced by 2.316% (Unit 2) of ΔT_o.

NOTE 2: The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than 3.0%.

BORATED WATER SOURCE - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.2.5 As a minimum, one of the following borated water sources shall be OPERABLE:

a. A Boric Acid Storage System with:

1) A minimum contained borated water volume of 12,000 gallons,

2) A minimum boron concentration of 7000 ppm, and

3) A minimum solution temperature of 65°F.

b. The refueling water storage tank with:

1) A minimum contained borated water volume of 45,000 gallons,

2) A minimum boron concentration of ~~2000~~ 2175 ppm, and

3) A minimum solution temperature of 70°F.

APPLICABILITY: MODES 5 and 6. (Unit 1)

ACTION:

With no borated water source OPERABLE, suspend all operations involving CORE ALTERATIONS or positive reactivity changes.

SURVEILLANCE REQUIREMENTS

4.1.2.5 The above required borated water source shall be demonstrated OPERABLE:

a. At least once per 7 days by:

1) Verifying the boron concentration of the water,

2) Verifying the contained borated water volume, and

3) Verifying the boric acid storage tank solution temperature when it is the source of borated water.

b. At least once per 24 hours by verifying the refueling water storage tank temperature when it is the source of borated water and the outside air temperature is less than 70°F.

BORATED WATER SOURCE - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.2.5 As a minimum, one of the following borated water sources shall be OPERABLE:

a. A Boric Acid Storage System with:

1) A minimum contained borated water volume of 12,000 gallons,

2) A minimum boron concentration of 7000 ppm, and

3) A minimum solution temperature of 65°F.

b. The refueling water storage tank with:

1) A minimum contained borated water volume of 45,000 gallons,

2) A minimum boron concentration of 2000 ppm, and

3) A minimum solution temperature of 70°F.

APPLICABILITY: MODES 5 and 6. (Unit 2)

ACTION:

With no borated water source OPERABLE, suspend all operations involving CORE ALTERATIONS or positive reactivity changes.

SURVEILLANCE REQUIREMENTS

4.1.2.5 The above required borated water source shall be demonstrated OPERABLE:

a. At least once per 7 days by:

1) Verifying the boron concentration of the water,

2) Verifying the contained borated water volume, and

3) Verifying the boric acid storage tank solution temperature when it is the source of borated water.

b. At least once per 24 hours by verifying the refueling water storage tank temperature when it is the source of borated water and the outside air temperature is less than 70°F.

BORATED WATER SOURCES - OPERATING

LIMITING CONDITION FOR OPERATION

3.1.2.6 As a minimum, the following borated water source(s) shall be OPERABLE as required by Specification 3.1.2.2:

a. A Boric Acid Storage System with:

1) A minimum contained borated water volume of 22,000 gallons,

2) A minimum boron concentration of 7000 ppm, and

3) A minimum solution temperature of 65°F.

b. The refueling water storage tank with:

1) A contained borated water volume of at least 363,513 gallons,

2) A minimum boron concentration of ~~2000~~ 2175 ppm,

3) A minimum solution temperature of 70°F, and

4) A maximum solution temperature of 100°F.

APPLICABILITY: MODES 1, 2, 3, and 4. (Unit 1)

ACTION:

a. With the Boric Acid Storage System inoperable and being used as one of the above required borated water sources, restore the system to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 1% $\Delta k/k$ at 200°F; restore the Boric Acid Storage System to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

b. With the refueling water storage tank inoperable, restore the tank to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

BORATED WATER SOURCES - OPERATING

LIMITING CONDITION FOR OPERATION

3.1.2.6 As a minimum, the following borated water source(s) shall be OPERABLE as required by Specification 3.1.2.2:

a. A Boric Acid Storage System with:

1) A minimum contained borated water volume of 22,000 gallons,

2) A minimum boron concentration of 7000 ppm, and

3) A minimum solution temperature of 65°F.

b. The refueling water storage tank with:

1) A contained borated water volume of at least 363,513 gallons,

2) A minimum boron concentration of 2000 ppm,

3) A minimum solution temperature of 70°F, and

4) A maximum solution temperature of 100°F.

APPLICABILITY: MODES 1, 2, 3, and 4. (Unit 2)

ACTION:

a. With the Boric Acid Storage System inoperable and being used as one of the above required borated water sources, restore the system to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to at least 1% $\Delta k/k$ at 200°F; restore the Boric Acid Storage System to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.

b. With the refueling water storage tank inoperable, restore the tank to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

3/4.5 EMERGENCY CORE COOLING SYSTEMS

3/4.5.1 ACCUMULATORS

COLD LEG INJECTION

LIMITING CONDITION FOR OPERATION

3.5.1 Each cold leg injection accumulator shall be OPERABLE with:

a. The discharge isolation valve open,

b. A contained borated water volume of between 7704 and 8004 gallons,

c. A boron concentration of between ~~1900~~ 2000 and ~~2100~~ 2215 ppm,

d. A nitrogen cover-pressure of between 585 and 678 psig, and

e. A water level and pressure channel OPERABLE.

APPLICABILITY: MODES 1, 2, and 3*. (Unit 1)

ACTION:

a. With one cold leg injection accumulator inoperable, except as a result of a closed isolation valve or boron concentration less than ~~1900~~ 2000 ppm, restore the inoperable accumulator to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours.

b. With one cold leg injection accumulator inoperable due to the isolation valve being closed, either immediately open the isolation valve or be in at least HOT STANDBY within 6 hours and in HOT SHUTDOWN within the following 6 hours.

c. With one accumulator inoperable due to boron concentration less than ~~1900~~ 2000 ppm and:

1) The volume weighted average boron concentration of the accumulators ~~1900~~ 2000 ppm or greater, restore the inoperable accumulator to OPERABLE status within 24 hours of the low boron determination or be in at least HOT STANDBY within the next 6 hours and reduce Reactor Coolant System pressure to less than 1000 psig within the following 6 hours.

2) The volume weighted average boron concentration of the accumulators less than ~~1900~~ 2000 ppm but greater than ~~1000~~ 1900 ppm, restore the inoperable accumulator to OPERABLE status or return the volume weighted average boron concentration of the accumulators to greater than ~~1900~~ 2000 ppm and

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*Reactor Coolant System pressure above 1000 psig.

LIMITING CONDITION FOR OPERATION (Continued)

ACTION: (Continued)

enter ACTION c.1 within 6 hours of the low boron determination or be in HOT STANDBY within the next 6 hours and reduce Reactor Coolant System pressure to less than 1000 psig within the following 6 hours.

3) The volume weighted average boron concentration of the accumulators ~~1800~~ 1900 ppm or less, return the volume weighted average boron concentration of the accumulators to greater than ~~1800~~ 1900 ppm and enter ACTION c.2 within 1 hour of the low boron determination or be in HOT STANDBY within the next 6 hours and reduce Reactor Coolant System pressure to less than 1000 psig within the following 6 hours.

SURVEILLANCE REQUIREMENTS

4.5.1 Each cold leg injection accumulator shall be demonstrated OPERABLE:

a. At least once per 12 hours by:

1) Verifying, by the absence of alarms, the contained borated water volume and nitrogen cover-pressure in the tanks, and

2) Verifying that each cold leg injection accumulator isolation valve is open.

b. At least once per 31 days and within 6 hours after each solution volume increase of greater than or equal to 75 gallons by verifying the boron concentration of the accumulator solution;

c. At least once per 31 days when the Reactor Coolant System pressure is above 2000 psig by verifying that power is removed from the isolation valve operators on Valves NI54A, NI65B, NI76A, and NI88B and that the respective circuit breakers are padlocked; and

d. At least once per 18 months by verifying that each cold leg injection accumulator isolation valve opens automatically under each of the following conditions:**

1) When an actual or a simulated Reactor Coolant System pressure signal exceeds the P-11 (Pressurizer Pressure Block of Safety Injection) Setpoint, and

2) Upon receipt of a Safety Injection test signal.

** This surveillance need not be performed until prior to entering HOT STANDBY following the Unit 1 refueling.

3/4.5.1 ACCUMULATORS

COLD LEG INJECTION

LIMITING CONDITION FOR OPERATION

3.5.1 Each cold leg injection accumulator shall be OPERABLE with:

a. The discharge isolation valve open,

b. A contained borated water volume of between 7704 and 8004 gallons,

c. A boron concentration of between 1900 and 2100 ppm,

d. A nitrogen cover-pressure of between 585 and 678 psig, and

e. A water level and pressure channel OPERABLE.

APPLICABILITY: MODES 1, 2, and 3*. (Unit 2)

ACTION:

a. With one cold leg injection accumulator inoperable, except as a result of a closed isolation valve or boron concentration less than 1900 ppm, restore the inoperable accumulator to OPERABLE status within 1 hour or be in at least HOT STANDBY within the next 6 hours and in HOT SHUTDOWN within the following 6 hours.

b. With one cold leg injection accumulator inoperable due to the isolation valve being closed, either immediately open the isolation valve or be in at least HOT STANDBY within 6 hours and in HOT SHUTDOWN within the following 6 hours.

c. With one accumulator inoperable due to boron concentration less than 1900 ppm and:

1) The volume weighted average boron concentration of the accumulators 1900 ppm or greater, restore the inoperable accumulator to OPERABLE status within 24 hours of the low boron determination or be in at least HOT STANDBY within the next 6 hours and reduce Reactor Coolant System pressure to less than 1000 psig within the following 6 hours.

2) The volume weighted average boron concentration of the accumulators less than 1900 ppm but greater than 1800 ppm, restore the inoperable accumulator to OPERABLE status or return the volume weighted average boron concentration of the accumulators to greater than 1900 ppm and

*Reactor Coolant System pressure above 1000 psig.

LIMITING CONDITION FOR OPERATION (Continued)

ACTION: (Continued)

enter ACTION c.1 within 6 hours of the low boron determination or be in HOT STANDBY within the next 6 hours and reduce Reactor Coolant System pressure to less than 1000 psig within the following 6 hours.

3) The volume weighted average boron concentration of the accumulators 1800 ppm or less, return the volume weighted average boron concentration of the accumulators to greater than 1800 ppm and enter ACTION c.2 within 1 hour of the low boron determination or be in HOT STANDBY within the next 6 hours and reduce Reactor Coolant System pressure to less than 1000 psig within the following 6 hours.

SURVEILLANCE REQUIREMENTS

4.5.1 Each cold leg injection accumulator shall be demonstrated OPERABLE:

a. At least once per 12 hours by:

   1) Verifying, by the absence of alarms, the contained borated water volume and nitrogen cover-pressure in the tanks, and

   2) Verifying that each cold leg injection accumulator isolation valve is open.

b. At least once per 31 days and within 6 hours after each solution volume increase of greater than or equal to 75 gallons by verifying the boron concentration of the accumulator solution;

c. At least once per 31 days when the Reactor Coolant System pressure is above 2000 psig by verifying that power is removed from the isolation valve operators on Valves NI54A, NI65B, NI76A, and NI88B and that the respective circuit breakers are padlocked; and

d. At least once per 18 months by verifying that each cold leg injection accumulator isolation valve opens automatically under each of the following conditions:**

   1) When an actual or a simulated Reactor Coolant System pressure signal exceeds the P-11 (Pressurizer Pressure Block of Safety Injection) Setpoint, and

   2) Upon receipt of a Safety Injection test signal.

** This surveillance need not be performed until prior to entering HOT STANDBY following the Unit 1 refueling.

3/4.5.4 REFUELING WATER STORAGE TANK

LIMITING CONDITION FOR OPERATION

3.5.4 The refueling water storage tank shall be OPERABLE with:

a. A minimum contained borated water volume of 363,513 gallons,

b. A boron concentration of between ~~2000~~ 2175 and ~~2100~~ 2215 ppm of boron,

c. A minimum solution temperature of 70°F, and

d. A maximum solution temperature of 100°F.

APPLICABILITY: MODES 1, 2, 3, and 4. (Unit 1)

ACTION:

With the refueling water storage tank inoperable, restore the tank to OPERABLE status within 1 hour or be in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.5.4 The refueling water storage tank shall be demonstrated OPERABLE:

a. At least once per 7 days by:

1) Verifying the contained borated water level in the tank, and

2) Verifying the boron concentration of the water.

b. At least once per 24 hours by verifying the refueling water storage tank temperature when the outside air temperature is less than 70°F or greater than 100°F.

3/4.5.4 REFUELING WATER STORAGE TANK

LIMITING CONDITION FOR OPERATION

3.5.4 The refueling water storage tank shall be OPERABLE with:

a. A minimum contained borated water volume of 363,513 gallons,

b. A boron concentration of between 2000 and 2100 ppm of boron,

c. A minimum solution temperature of 70°F, and

d. A maximum solution temperature of 100°F.

APPLICABILITY: MODES 1, 2, 3, and 4. (Unit 2)

ACTION:

With the refueling water storage tank inoperable, restore the tank to OPERABLE status within 1 hour or be in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.5.4 The refueling water storage tank shall be demonstrated OPERABLE:

a. At least once per 7 days by:

1) Verifying the contained borated water level in the tank, and

2) Verifying the boron concentration of the water.

b. At least once per 24 hours by verifying the refueling water storage tank temperature when the outside air temperature is less than 70°F or greater than 100°F.

3/4.9 REFUELING OPERATIONS

3/4.9.1 BORON CONCENTRATION

LIMITING CONDITION FOR OPERATION

3.9.1 The boron concentration of all filled portions of the Reactor Coolant System and the refueling canal shall be maintained uniform and sufficient to ensure that the more restrictive of the following reactivity conditions is met either:

a. A K_{eff} of 0.95 or less, or

b. A boron concentration of greater than or equal to ~~2000~~ 2175 ppm.

APPLICABILITY: MODE 6.* (Unit 1)

ACTION:

With the requirements of the above specification not satisfied, immediately suspend all operations involving CORE ALTERATIONS or positive reactivity changes and initiate and continue boration at greater than or equal to 30 gpm of a solution containing greater than or equal to 7000 ppm boron or its equivalent until K_{eff} is reduced to less than or equal to 0.95 or the boron concentration is restored to greater than or equal to 2000 ppm, whichever is the more restrictive.

SURVEILLANCE REQUIREMENTS

4.9.1.1 The more restrictive of the above two reactivity conditions shall be determined prior to:

a. Removing or unbolting the reactor vessel head, and

b. Withdrawal of any full-length control rod in excess of 3 feet from its fully inserted position within the reactor vessel.

4.9.1.2 The boron concentration of the Reactor Coolant System and the refueling canal shall be determined by chemical analysis at least once per 72 hours.

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*The reactor shall be maintained in MODE 6 whenever fuel is in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

3/4.9 REFUELING OPERATIONS

3/4.9.1 BORON CONCENTRATION

LIMITING CONDITION FOR OPERATION

3.9.1 The boron concentration of all filled portions of the Reactor Coolant System and the refueling canal shall be maintained uniform and sufficient to ensure that the more restrictive of the following reactivity conditions is met either:

a. A K_{eff} of 0.95 or less, or

b. A boron concentration of greater than or equal to 2000 ppm.

APPLICABILITY: MODE 6.* (Unit 2)

ACTION:

With the requirements of the above specification not satisfied, immediately suspend all operations involving CORE ALTERATIONS or positive reactivity changes and initiate and continue boration at greater than or equal to 30 gpm of a solution containing greater than or equal to 7000 ppm boron or its equivalent until K_{eff} is reduced to less than or equal to 0.95 or the boron concentration is restored to greater than or equal to 2000 ppm, whichever is the more restrictive.

SURVEILLANCE REQUIREMENTS

4.9.1.1 The more restrictive of the above two reactivity conditions shall be determined prior to:

a. Removing or unbolting the reactor vessel head, and

b. Withdrawal of any full-length control rod in excess of 3 feet from its fully inserted position within the reactor vessel.

4.9.1.2 The boron concentration of the Reactor Coolant System and the refueling canal shall be determined by chemical analysis at least once per 72 hours.

*The reactor shall be maintained in MODE 6 whenever fuel is in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

BORATION SYSTEMS (Continued)

MARGIN from expected operating conditions of 1.3% $\Delta k/k$ after xenon decay and cooldown to 200°F. The maximum expected boration capability requirement occurs at EOL from full power equilibrium xenon conditions and requires 9,851 gallons of 7000 ppm borated water from the boric acid storage tanks or 57,107 gallons of ~~2000~~ 2175 ppm borated water for Unit 1 and 2000 ppm borated water for Unit 2 from the refueling water storage tank.

The Technical Specification requires 22,000 gallons of 7000 ppm borated water from the boric acid tanks to be available in Modes 1-4. This volume is based on the required volume for maintaining shutdown margin, unusable volume (to allow for a full suction pipe), instrument error, and additional margin to account for different cores and conservatism as follows:

Modes 1-4 Boric Acid Tank

Required volume for maintaining SDM	9,851 gallons
5% Additional Margin	496 gallons
Unusable Volume (to maintain full suction pipe)	7,230 gallons
14" of water equivalent	
Vortexing (4" of water above top of suction pipe	2,066 gallons
Instrumentation Error (Based on Total Loop Acc. for 1&2 NV5740 loops) - 2" of water equivalent	1,550 gallons
	21,193 gallons

This value is increased to 22,000 gallons for additional margin.

A similar approach is taken for calculating the required Refueling Water Storage Tank volume:

When the temperature of one or more cold legs drops below 285°F in Mode 4, the potential for low temperature overpressurization of the reactor vessel makes it necessary to render one charging pump INOPERABLE and at least one safety injection pump INOPERABLE. The limitation for a maximum of one centrifugal charging pump to be OPERABLE and the Surveillance Requirement to verify all charging pumps except the required OPERABLE pump to be inoperable below 285°F provides assurance that a mass addition pressure transient can be relieved by the operation of a single PORV.

Refueling Water Storage Tank Requirements For Maintaining SDM - Modes 1-4

Required Volume for Maintaining SDM	57,107 gallons
Unusable Volume (below nozzle)	13,442 gallons
Instrument Inaccuracy	11,307 gallons
Vortexing	13,247 gallons
	95,103 gallons

The Technical Specification Volume 363,513 gallons was determined by correcting the tank's low level setpoint (level at which makeup is added to

BORATION SYSTEMS (Continued)

tank) for instrument inaccuracy. This level provides the maximum available volume to account for shutdown margin, worst case single failure, adequate containment sump volume for transfer to recirculation, and sufficient volume above the switchover initiation level such that no operator action is required prior to ten minutes after the initiation of the accident.

With the coolant temperature below 200°F, one Boron Injection flow path is acceptable without single failure consideration on the basis of the stable reactivity condition of the reactor and the additional restrictions prohibiting CORE ALTERATIONS and positive reactivity changes in the event the single Boron Injection flow path becomes inoperable.

The boron capability required below 200°F is sufficient to provide a SHUTDOWN MARGIN of 1% Δk/k after xenon decay and cooldown from 200°F to 140°F. This condition requires either 585 gallons of 7000 ppm borated water from the boric acid storage tanks or 3500 gallons of ~~2000~~ 2175 ppm borated water for Unit 1 and 2000 ppm borated water for Unit 2 from the refueling water storage tank.

The Boric Acid Tank and Refueling Water Storage Tank volumes required in Modes 5-6 to provide necessary SDM are based on the following inputs as discussed previously:

Boric Acid Tank

Required Volume for maintaining SDM	585 gallons
Unusable Volume, Vortexing, Inst. Error	10,846 gallons
5% additional margin	33 gallons
	11,464 gallons

This value is increased to the Technical Specification value of 12,000 gallons for additional margin.

Refueling Water Storage Tank

Required Volume for Maintaining SDM	3,500 gallons
Water Below the Nozzle	13,442 gallons
Instrument Inaccuracy	11,307 gallons
Vortexing	13,247 gallons
	41,496 gallons

This value is increased to the Technical Specification value of 45,000 gallons for additional margin.

The contained water volume limits include allowance for water not available because of discharge line location and other physical characteristics.

BASES

3/4.5.1 ACCUMULATORS

The OPERABILITY of each Reactor Coolant System accumulator ensures that a sufficient volume of borated water will be immediately forced into the reactor core through each of the cold legs from the cold leg injection accumulators and directly into the reactor vessel from the upper head injection accumulators in the event the Reactor Coolant System pressure falls below the pressure of the accumulators. This initial surge of water into the core provides the initial cooling mechanism during large pipe ruptures.

The limits on accumulator volume, boron concentration and pressure ensure that the assumptions used for accumulator injection in the safety analysis are met.

The allowed down time for the accumulators are variable based upon boron concentration to ensure that the reactor is shutdown following a LOCA and that any problems are corrected in a timely manner. Subcriticality is assured when boron concentration is above ~~1800 ppm~~, so additional down time is allowed when concentration is above ~~1800 ppm~~. A concentration of less than ~~1900 ppm~~ in any single accumulator or as a volume weighted average may be indicative of a problem, such as valve leakage, but since reactor shutdown is assured, additional time is allowed to restore boron concentration in the accumulators.

this value

The accumulator power operated isolation valves are considered to be "operating bypasses" in the context of IEEE Std. 279-1971, which requires that bypasses of a protective function be removed automatically whenever permissive conditions are not met. In addition, as these accumulator isolation valves fail to meet single failure criteria, removal of power to the valves is required.

The limits for operation with an accumulator inoperable for any reason except an isolation valve closed minimizes the time exposure of the plant to a LOCA event occurring concurrent with failure of an additional accumulator which may result in unacceptable peak cladding temperatures. If a closed isolation valve cannot be immediately opened, the full capability of one accumulator is not available and prompt action is required to place the reactor in a mode where this capability is not required.

1900 ppm for Unit 1 and 1800 ppm for Unit 2

2000 ppm for Unit 1 and 1900 ppm for Unit 2

BASES

3/4.9.1 BORON CONCENTRATION

The limitations on reactivity conditions during REFUELING ensure that: (1) the reactor will remain subcritical during CORE ALTERATIONS, and (2) a uniform boron concentration is maintained for reactivity control in the water volume having direct access to the reactor vessel. These limitations are consistent with the initial conditions assumed for the boron dilution incident in the safety analyses. The value of 0.95 or less for K_{eff} includes a 1% $\Delta k/k$ conservative allowance for uncertainties. Similarly, the boron concentration value of ~~2000 ppm~~ 2175 ppm for Unit 1 and 2000 ppm for Unit 2 or greater includes a conservative uncertainty allowance of 50 ppm boron.

3/4.9.2 INSTRUMENTATION

The OPERABILITY of the Boron Dilution Mitigation System ensures that monitoring capability is available to detect changes in the reactivity condition of the core.

3/4.9.3 DECAY TIME

The minimum requirement for reactor subcriticality prior to movement of irradiated fuel assemblies in the reactor vessel ensures that sufficient time has elapsed to allow the radioactive decay of the short-lived fission products. This decay time is consistent with the assumptions used in the safety analyses.

3/4.9.4 CONTAINMENT BUILDING PENETRATIONS

The requirements on containment building penetration closure and OPERABILITY of the Reactor Building Containment Purge System ensure that a release of radioactive material within containment will be restricted from leakage to the environment or filtered through the HEPA filters and activated carbon adsorbers prior to release to the atmosphere. The OPERABILITY and closure restrictions are sufficient to restrict radioactive material release from a fuel element rupture based upon the lack of containment pressurization potential while in the REFUELING MODE. Operation of the Reactor Building Containment Purge System and the resulting iodine removal capacity are consistent with the assumption of the safety analysis. Operation of the system with the heaters operating to maintain low humidity using automatic control for at least 10 continuous hours in a 31-day period is sufficient to reduce the buildup of moisture on the adsorbers and HEPA filters. ANSI N510-1980 will be used as a procedural guide for surveillance testing.

9. STARTUP PHYSICS TESTING

The standard scope of reload startup physics testing conducted at Duke Power Westinghouse units is summarized below (Reference 1). The purpose of the test program is to provide assurance that the reactor core is loaded correctly and can be operated as designed.

Zero Power Physics Testing (ZPPT)

- All Rods Out Critical Boron Concentration (AROCBC)
- Isothermal Temperature Coefficient (ITC)
- Control Rod Bank Worth (Reference 15)

Power Escalation Testing (PET)

- Flux Symmetry Check (Low Power, e.g. 30% FP)
- Core Power Distribution - CPD (Intermediate Power)
- CPD (High Power)
- All Rods Out Critical Boron Concentration - AROCBC (High Power)

All aspects of the existing program are acceptable with respect to implementation of the Duke Power Company licensing analyses and a complete reload batch of Mark-BW fuel assemblies. Therefore, operation with either a mixed Westinghouse and BWFC core or future cores with all BWFC fuel will not require any changes to the current Duke startup physics testing program

10. REFERENCES

1. Catawba Nuclear Station, Final Safety Analysis Report, Docket Nos. 50 - 413/414.

2. BAW-10172-PA, Mark-BW Mechanical Design Report, Babcock & Wilcox, Lynchburg, Virginia, December 19, 1989.

3. DPC-NE-2001-PA, Rev. 1, Fuel Mechanical Reload Analysis Methodology for Mark-BW Fuel, Duke Power Company, October 1990.

4. BAW-10084-A, Rev. 2, Program to Determine In-Reactor Performance of B&W Fuels - Cladding Creep Collapse, Babcock & Wilcox, October 1978.

5. BAW-10141-PA, Rev. 1, TACO2 - Fuel Performance Analysis, Babcock & Wilcox, June 1983.

6. DPC-NF-2010-A, McGuire Nuclear Station/Catawba Nuclear Station Nuclear Physics Methodology for Reload Design, Duke Power Company, June 1985.

7. DPC-NE-2011-PA, Nuclear Design Methodology for Core Operating Limits of Westinghouse Reactors, Duke Power Company, March 1990.

8. DPC-NE-2004-PA, McGuire and Catawba Nuclear Stations Core Thermal- Hydraulic Methodology using VIPRE-01, Duke Power Company, December 1991.

9. BAW-10159-PA, BWCMV Correlation of Critical Heat Flux in Mixing Vane Grid Fuel Assemblies, Babcock & Wilcox, July 1990.

10. BAW-10173-PA, Mark-BW Reload Safety Analysis for Catawba and McGuire, Babcock & Wilcox, Revision 2, February 20, 1991.

11. DPC-NE-3000P, Duke Power Company, Thermal-Hydraulic Transient Analysis Methodology, Revision 1, May 1989.

12. DPC-NE-3001-PA, Duke Power Company, Multidimensional Reactor Transients and Safety Analysis Physics Parameters Methodology, Revision 1, November 1991.

13. BAW-10174-A, Mark-BW Reload LOCA Analysis for the Catawba and McGuire Units, Babcock & Wilcox, May 1991.

14. BAW-10168-A, B&W Loss-of-Coolant Accident Evaluation Model For Recirculating Steam Generator Plants, Babcock & Wilcox, Lynchburg, Virginia, January 1991.

15. DPC-NE-1003-A, Revision 1, McGuire Nuclear Station/Catawba Nuclear Station Rod Swap Methodology Report for Startup Physics Testing, December 1986.

16. DPC-NE-3002-A, McGuire Nuclear Station/Catawba Nuclear Station FSAR Chapter 15 System Transient Analysis Methodology, November 1991.

ATTACHMENT 2

TECHNICAL JUSTIFICATIONS

Proposed Revision to Technical Specification Table 2.2-1 Note (iii)

This proposed Technical Specification revision decreases the magnitude of the positive $f(\Delta I)$ slope from 2.316 to 1.525. This proposed revision is applicable only to Catawba Unit 1.

Technical Justification

The positive breakpoint and slope of the $f(\Delta I)$ function of the overtemperature delta T (OTΔT) reactor trip function have been evaluated for the Cycle 8 reload design. The results of the evaluation demonstrate that the current slope of the $f(\Delta I)$ function is overly conservative with respect to optimal core operation. During cycle startup, the over conservatism in the $f(\Delta I)$ function causes an unacceptable decrease in the OTΔT margin to trip. The methodology used in the evaluation is provided in the Duke Power response to question 1 given in Reference 1. All existing licensing basis safety analyses remain valid with a positive $f(\Delta I)$ slope of 1.525.

Proposed Revision to Technical Specification 3.1.2.5 and 3.1.2.6

This proposed Technical Specification revision increases the refueling water storage tank (RWST) minimum boron concentration from 2000 ppm to 2175 ppm. This proposed revision is applicable only to Catawba Unit 1.

Technical Justification

The boron concentrations in the RWST and the cold leg accumulators (CLA) are designed to ensure long term subcriticality following a LOCA. The increases in the RWST and CLA minimum boron concentrations are required to offset:

1. The additional reactivity needed to meet the energy requirements of longer cycle lengths.
2. The increased positive reactivity inserted following the cooldown of a core with a higher percentage of B&W MkBW fuel.

MkBW fuel has a larger rod diameter than Westinghouse OFA fuel, resulting in a smaller water to uranium ratio, and thus a generally more negative moderator temperature coefficient (MTC). The more negative MTC causes more positive reactivity feedback following a LOCA, where relatively cool ECCS/containment sump water is recirculated through the reactor coolant system.

The increase in the minimum boron concentration necessitates an increase in the maximum boron concentration. The maximum boron concentration limit is evaluated to ensure boron precipitation is precluded following a LOCA. Reference 2 provides a discussion of the methodologies employed to ensure the requirements of the post-LOCA subcriticality analysis are satisfied on a cycle specific basis.

The proposed revision to Technical Specification 3.1.2.6 is required for Catawba 1 Cycle 8 operation. The proposed revision to Technical Specification 3.1.2.5 is required only to maintain consistency, in the refueling water storage tank minimum boron concentration,

between Modes 5 and 6 (Technical Specification 3.1.2.5) and Modes 1 through 4 (Technical Specification 3.1.2.6).

Proposed Revision to Technical Specification 3.5.1

This proposed Technical Specification revision reflects an increase in the required CLA minimum boron concentration, for Catawba Unit 1 only, as follows:

1. The CLA minimum boron concentration is increased from 1900 ppm to 2000 ppm.
2. The CLA maximum boron concentration is increased from 2100 ppm to 2275 ppm.
3. The CLA volume weighted average minimum boron concentration is increased from 1800 ppm to 1900 ppm.

Technical Justification

The technical justifications for the revisions to this Technical Specification are as follows:

1. The technical justification for the increase in the CLA minimum boron concentration from 1900 ppm to 2000 ppm is the same as the technical justification given above for the proposed increase in the RWST minimum boron concentration for Technical Specification 3.1.2.5.

2. The increase in the CLA maximum boron concentration from 2100 ppm to 2275 ppm is necessary to provide adequate operating space given the proposed increase in the CLA minimum boron concentration. The 2275 ppm value is selected to maintain the same RWST and CLA maximum boron concentration. Maintaining the same RWST and CLA maximum boron concentration will prevent makeup water, from the RWST to the CLA, causing the CLA boron concentration to exceed its maximum Technical Specification value. The proposed revision to the maximum RWST boron concentration is presented below.

   The maximum CLA boron concentration limit is evaluated to ensure boron precipitation is precluded following a LOCA. Reference 2 provides a discussion of the methodology employed to ensure the requirements of the boron precipitation analysis are satisfied on a cycle specific basis.

3. The technical justification for the increase in the CLA minimum volume weighted boron concentration from 1800 ppm to 1900 ppm is the same as the technical justification given above for the proposed increase in the RWST minimum boron concentration for Technical Specification 3.1.2.5. Calculating the volume weighted average boron concentration based on all four CLAs is valid, since, regardless of the break location, the contents of each accumulator will be emptied (either directly or indirectly) into the containment sump. A volume weighted average concentration of 1900 ppm will ensure long-term subcriticality following a LOCA.

Proposed Revision to Technical Specification 3.5.4

This proposed Technical Specification revision reflects an increase in the required RWST minimum boron concentration, for Catawba Unit 1 only, as follows:

1. The RWST minimum boron concentration is increased from 2000 ppm to 2175 ppm.
2. The RWST maximum boron concentration is increased from 2100 ppm to 2275 ppm.

Technical Justification

The technical justifications for the revisions to this Technical Specification are as follows:

1. The technical justification for the increase in the RWST minimum boron concentration from 2000 ppm to 2175 ppm is the same as the technical justification given above for the proposed increase in the RWST minimum boron concentration for Technical Specification 3.1.2.5.

2. The increase in the RWST maximum boron concentration from 2100 ppm to 2275 ppm is necessary to provide adequate operating space given the proposed increase in the RWST minimum boron concentration. The 2275 ppm value is selected to retain the same operating margin as currently exists.

   The maximum RWST boron concentration limit is evaluated to ensure boron precipitation is precluded following a LOCA. Reference 2 provides a discussion of the methodology employed to ensure the requirements of the boron precipitation analysis are satisfied on a cycle specific basis.

Proposed Revision to Technical Specification 3.9.1

This proposed Technical Specification revision reflects an increase, from 2000 ppm to 2175 ppm, in the required RCS and refueling canal minimum boron concentration during Mode 6 operation. This proposed revision is applicable only to Catawba Unit 1.

Technical Justification

This proposed revision is conservative, and is required only to maintain consistency in the boron concentration of the RCS and RWST (Technical Specification 3.1.2.5) during Mode 6 operation. The justification for the proposed change to Technical Specification 3.1.2.5 is given above.

REFERENCES FOR TECHNICAL JUSTIFICATIONS

1. Letter from T. C. McMeekin (Duke Power) to USNRC, "Catawba Nuclear Station, Docket Nos. 50-413 and 50-414, McGuire Nuclear Station, Docket Nos. 50-369 and 50-370, Supplement to Technical Specification Amendment, Relocation of Cycle-Specific Parameter Limits," April, 26 1993.

2. Letter from M. S. Tuckman (Duke Power) to USNRC, "Catawba Nuclear Station, Docket Nos. 50-413 and 50-414, McGuire Nuclear Station, Docket Nos. 50-369 and 50-370, Technical Specification Amendment, Relocation of Cycle-Specific Parameter Limits," January 13, 1993.

ATTACHMENT 3

NO SIGNIFICANT HAZARDS CONSIDERATION

The following analysis, required by 10 CFR 50.91, concludes that the proposed amendment will not involve significant hazards consideration as defined by 10 CFR 50.92.

10 CFR 50.92 states that a proposed amendment involves no significant hazards consideration if operation in accordance with the proposed amendment would not:

1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

2) Create the possibility of a new or different kind of accident from any previously evaluated; or

3) Involve a significant reduction in the margin of safety.

INCREASE IN BORON CONCENTRATION LIMITS FOR THE REFUELING WATER STORAGE TANK (RWST), COLD LEG ACCUMULATORS (CLAs), AND THE RCS & REFUELING CANAL IN MODE 6.

The minimum and maximum boron concentrations for the RWST and CLAs and the minimum volume weighted average boron concentration for the CLAs were increased for Unit 1 to offset the increase in reactivity associated with the Cycle 8 core reload. The additional boron is needed to counteract the additional reactivity which is being added to meet the energy requirements of a longer cycle length and the increased positive reactivity inserted following the cooldown of a core with a higher percentage of B&W MkBW fuel.

The increase in the required RCS and refueling canal minimum boron concentration was added only to maintain consistency between the boron concentration of the RCS and the RWST in Mode 6.

The boron concentration limits for the RWST and CLAs ensure the reactor will remain subcritical following a LOCA and that the assumptions given in the LOCA analyses will be met. As described in Section 7, Accident Analysis, the post-LOCA subcriticality reanalysis demonstrates that the revised boration limits are acceptable. An increase in the minimum boration values necessitated an increase in the maximum boration concentration limits in order to preserve operating margin. The change in maximum boration concentration limits required a reanalysis of post-LOCA boron precipitation and post-LOCA containment sump pH analyses. The results of these analyses indicate that post-LOCA boron precipitation is prevented with a reduction in the hot leg recirculation initiation time from 9 hours to 7 hours and that the allowable pH range defined in the Technical Specification Bases is maintained.

The change in boron concentration limits for the RWST, the CLAs, and the RCS & refueling canal will not increase the probability of an accident since no accident initiators are involved with this change. The reanalysis of the post-LOCA subcriticality, boron precipitation, and sump pH analyses demonstrate that the consequences of an accident previously evaluated will not be increased. The increase in the boron concentration limit for the RCS and refueling canal in Mode 6 is conservative and adds further margin to the initial conditions assumed for the boron dilution accident in the safety analysis. Therefore, the consequences of the boron dilution accident previously evaluated will not be increased.

The possibility of a new or different kind of accident from any previously evaluated will not be created since these changes are bounded by previously evaluated accidents and do not introduce any new failure modes.

These changes do not involve a significant reduction in the margin of safety since the analyses performed demonstrate that the limits imposed meet all accident analysis and design basis requirements.

INCREASE IN THE SLOPE OF THE $f_1(\Delta I)$ FUNCTION OF THE OVERTEMPERATURE DELTA T (OTΔT) REACTOR TRIP FUNCTION

The OTΔT trip provides core protection to prevent DNB for all combinations of pressure, power, coolant temperature, and axial power distribution. If axial power distribution peaks are greater than design, as indicated by the difference between top and bottom range nuclear detectors, the OTΔT reactor trip setpoint is automatically reduced when the delta flux is outside prescribed bounds (outside the -39.9% and +3.0% breakpoints). The slope of the $f_1(\Delta I)$ function being changed on Unit 1 is used to calculate the penalty imposed on the OTΔT setpoint when the percentage difference in power between the top and bottom halves of the core is more positive than 3.0% (i.e. core upper half power is 3% greater than core lower half power). The penalty varies by the percentage power difference above 3.0% times the slope of the $f_1(\Delta I)$ function.

The positive breakpoint and slope of the $f_1(\Delta I)$ function for the OTΔT reactor trip function was reevaluated for the Cycle 8 reload design. This analysis demonstrates that the current slope of the $f_1(\Delta I)$ function is overly conservative with respect to optimal core operation. During cycle startup, the conservatism in the $f_1(\Delta I)$ function causes an unacceptable decrease in the OTΔT margin to trip. The reduction of this value from 2.316 to 1.525 for Unit 1 allows for better plant operation and is bounded by the existing licensing basis safety analysis.

This change in the slope of the $f_1(\Delta I)$ function will not increase the probability of an accident since no accident initiators are involved with this change. Since all existing licensing basis safety analyses remain valid with a positive $f_1(\Delta I)$ slope of 1.525 for Unit 1, the consequences of an accident previously evaluated will not be increased.

The possibility of a new or different kind of accident from any previously evaluated will not be created since this change is bounded by previously evaluated accidents and does not introduce any new failure modes.

This change does not involve a significant reduction in the margin of safety since the analysis performed demonstrates that the new limit imposed meets all present accident analysis and design basis requirements.

ENVIRONMENTAL IMPACT STATEMENT

The proposed amendment has been reviewed against the criteria of 10 CFR 51.22 for environmental considerations. As described above, the proposed amendment does not involve any significant hazards consideration, nor a significant increase or change in the types or amounts of effluents that may be released offsite, nor a significant increase in the individual or cumulative occupational radiation exposures. Therefore, the proposed amendment meets the criteria given in 10 CFR 51.22(c)(9) for categorical exclusion from the requirement for an Environmental Impact Statement.