Pellet O.D. dimensions are used to calculate cladding strain because the strain itself is caused by pellet thermal expansion. There are three major conditions in this calculation that make it conservative. The first is the extreme power change that is used to simulate the worst case peaking. The second is that the pellet is assumed to be in hard contact at inititation of the ramp. This is a conservative assumption since the power ramp is initiated from a very low power level and pellet/cladding contact is not expected to occur at this low linear heat rate. The third conservatism is that the pellet is non-compliant and that all of the pellet thermal expansion results directly in cladding strain.

4.4 Cladding Stress Analysis

The methodology of Reference 1 has been revised. The current methodology is consistent with that of References 5 and 12. 1

The static stress analysis uses design stress intensity limits on mechanical properties based on the requirements of ASME Code Article III-2000. Thus, the design stress intensity value for Zircaloy-4 is the lowest of the following:

(1) one-third of the specified minimum tensile strength at room temperature

(2) one third of the tensile strength at temperature

(3) two-thirds of the specified minimum yield strength at room temperature

(4) two-thirds of the yield strength at temperature

10. J. F. Stolz (NRC) to R. J. Rodriguez (SMUD), letter "Rancho Seco Nuclear Generating Station - Evaluation of Mark-BZ Fuel Assembly Design", November 16, 1984.

11. H. B. Tucker to J. F. Stolz, Oconee Nuclear Station Docket Nos. 50-269, -270, -287, March 8, 1985.

12. Oconee Unit 3, Cycle 9 Reload Report DPC-RD-2005 June 1985. 1

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4. Ejected Rod Worths

- This section deleted -

5.3 Comparison of Calculated and Measured Results

A comparison of calculated and measured isothermal temperature coefficients at HZP and BOC for Oconee Unit 1, Cycles 7 and 8 is presented in Table 5-1. The agreement between these calculated and measured coefficients is very good; all values are well within 0.3×10^{-4} $\Delta\rho/°F$ acceptance criteria. 1

5.4 Summary

The comparison between calculated and measured isothermal temperature coefficients indicates that the CASMO based EPRI-NODE-P is an adequate predictor of isothermal temperature coefficients.

Table 5-1

Oconee 1 Cycles 7 and 8
Isothermal Temperature Coefficients at HZP, BOC

Cycle	Boron Conc, PPM	Temp. Coeff, 10^{-4} $\Delta\rho/°F$ Calculated	Measured	Difference 10^{-4} $\Delta\rho/°F$
7	1610	+0.229	+0.273	+0.044
8	1635	+0.08	+0.11	+0.03

1

3.3 Comparisons of CASMO to Criticals

An earlier version of CASMO has been benchmarked against the hot criticals at the Kritz facility. The version of CASMO used at Duke Power has improved flexibility and has certain edit capabilities not found in the early version. The transport theory calculations are the same in each version and hence the benchmarking discussed in Reference 2 applies to the CASMO used at Duke Power.

The results of the two PWR assembly experiments are given in Table 3-2. These experiments were performed with lattice configurations and dimensions which are similar to standard PWR assemblies. The actual dimensions are proprietary and have not been published.

The results of the two PWR experiments are combined to better represent assembly configurations present in Oconee cores. Current cycles contain assemblies which contain lumped burnable poisons as well as assemblies without burnable poisons. The Kritz experiment with burnable poisons was performed at less than 100 PPMB and the other experiment was performed at approximately 1000 PPMB. This range of boron concentrations is representative of Oconee fuel cycles. The results are given in Table 3-2 and give a CASMO to experiment deviation of 1.7%.

3.4 Conclusions

The bounding PDQ to CASMO pin power difference and the CASMO to experiment error can be statistically combined to give the expected radial-local uncertainty factor for CASMO based reload design. This factor is calculated as:

$$F_{R-L} = \sqrt{.014^2 + .017^2} = 0.022$$

This 2.2% conservatively accounts for pin power error from the quarter-core PDQ07 model.

Table 3-2

CASMO vs. Experiment - Kritz Criticals

Fission Rate Deviations

Deviation = 100 * (CASMO-EXPERIMENT)/EXPERIMENT

15x15 PWR MO_2 with Absorbers and Water Holes		14x14 PWR MO_2 with Water Holes	
1.4	0.9	1.7	-0.7
3.5	0.3	1.8	0.5
-2.7	2.0	0.1	-0.2
1.7	0.0	-0.7	-0.1
3.9	2.1	0.1	-0.7
0.1	1.6	1.2	-0.3
-0.4	-1.1	0.6	-3.5
1.2	-3.0	1.4	-0.8
-0.4	-0.6	-0.6	-0.4
-2.4	-3.9		
0.4	-1.6		
1.2	-2.7		
	-0.6		

Mean	0.007%
Std. Dev	1.70%

1

Figure 3-4A

Octant Assembly Pinwise Powers
3.28 w/o U235, 1.0 w/o B_4C
700 ppm, HFP
20,000 MWD/MTU

	K-eff	Max Pin	
PDQ	1.01674	1.021	
CASMO	1.01830	1.027	

IT								
1.017 1.020	1.014 1.014							
0.998 0.992	1.010 1.014	BP						
0.989 0.984	1.000 0.995	1.013 1.016	1.017 1.014					
0.987 0.982	0.998 0.994	1.013 1.016	1.021* 1.027*	BP				
0.988 0.982	1.003 1.006	BP	1.016 1.023	1.007 1.011	0.994 0.990			
0.986 0.981	0.995 0.992	1.004 1.009	0.999 0.995	0.989 0.983	0.984 0.978	0.984 0.979		
0.992 0.994	0.994 0.995	0.997 0.998	0.995 0.996	0.992 0.993	0.990 0.992	0.993 0.995	1.003 1.010	PDQ CASMO

Figure 3-4B

Octant Assembly Pinwise Powers
3.28 w/o U235, BPR Removed
700 ppm, HFP
20,000 MWD/MTU

	K-eff	Max Pin
PDQ	1.02862	1.070
CASMO	1.02764	1.074

IT								
1.005 1.010	1.016 1.012							
0.993 0.989	1.028 1.035	GT						
0.984 0.981	1.013 1.003	1.047 1.052	1.058 1.045					
0.981 0.978	1.011 1.001	1.049 1.053	1.070* 1.074*	GT				
0.981 0.978	1.019 1.026	GT	1.055 1.060	1.029 1.036	0.993 0.985			
0.971 0.968	0.993 0.986	1.016 1.024	1.002 0.993	0.976 0.970	0.960 0.955	0.951 0.947		
0.966 0.972	0.972 0.975	0.978 0.980	0.974 0.975	0.964 0.967	0.957 0.960	0.955 0.958	0.962 0.971	PDQ CASMO