FLORIDA POWER & LIGHT

EVALUATION OF THE

BROOKHAVEN NATIONAL LABORATORY

15x15 LATTICE STANDARD PROBLEM

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Department of Nuclear Energy

August 8, 1986

Mr. Edward Knuckles
Fuel Resources
Florida Power and Light
P.O. Box 029100
Miami, Florida 33102

Dear Mr. Knuckles:

As you requested, I have enclosed a copy of the BNL 15x15 W type fuel assembly Standard Problem. As indicated in the definition, the analysis of the Standard Problem requires an assembly depletion calculation together with a series of reactivity defect calculations. The problem includes a burnable-poison rod assembly, and both rodded and unrodded assemblies. The burnable-poison rod and rodded assemblies include strong local absorbers and, as we discussed, are not an appropriate application of the methods presently being reviewed.

If you have any questions concerning the modeling or execution of this problem, please do not hesitate to contact us.

Sincerely,

J.F. Carew, Group Leader
Core Performance Group

JFC/lr
Encs.

cc: J. G. Guppy w/o
W. Y. Kato w/o
L. Lois
M. S. Dunenfeld

FUEL ASSEMBLY STANDARD PROBLEM

The standard problem is to be calculated in two dimensions in an iterated-source mode using reflecting boundary conditions in the horizontal plane neglecting axial leakage. The following series of assembly depletion and reactivity defect calculations are to be calculated.

I. DEPLETION CALCULATIONS

Provide the following edited quantities for an assembly with and without burnable poison rods at BOL, 500, 5000, 10000, 20000, 30000 and 40000 MWD/MT*. For the controlled assembly only provide the pin powers (item-1), reaction rates (item-3) and assembly characteristics (item-4) at BOL and 30,000 MWD/MT.

1. Relative pin powers
2. Assembly volume averaged fuel pellet isotopics; U^{235}, U^{238}, Pu^{239}, Pu^{240}, Pu^{241}, Pu^{242} and calculated fission product densities [atom/barn-cm] at 500 and 40,000 MWD/MT
3. Assembly total reaction rates (A-absorption, F-fission)

   a. Fuel

U^{235} (A)	Pu^{240} (A)
U^{235} (F)	Pu^{240} (F)
U^{238} (A)	Pu^{241} (A)
U^{238} (F)	Pu^{241} (F)
Pu^{239} (A)	Pu^{242} (A)
Pu^{239} (F)	Pu^{242} (F)

   b. Clad (A)
   c. Burnable Poison (A)
   d. Water (A)
   e. Control Rod (A)

4. Assembly Characteristics

   a. k_∞ - Infinite Multiplication Factor
   b. M^2 - Migration Area [cm^2]
   c. B_M^2 - Material Buckling [cm^{-2}]
   d. β - Delayed Neutron Fraction
   e. Two-Group Inverse Neutron Velocity† [sec/cm]

5. Two-Group Collapsed Assembly Averaged Cross Sections†

   D [cm], Σ_a[cm^{-1}], Σ_r[cm^{-1}],

   $\nu\Sigma_f$[cm^{-1}], $\kappa\Sigma_f$[watt/cm], Σ_f[cm^{-1}]

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* These are editing points and do not necessarily correspond to the depletion steps.

† Thermal breakpoint assumed at 0.625 [eV]

May 8, 1985

FUEL ASSEMBLY STANDARD PROBLEM

II. REACTIVITY DEFECT CALCULATIONS

Provide the following reactivity defects (%Δ k/k) for an assembly with and without burnable poison rods at BOL and EOL (30,000 Mwd/MT):

	REACTIVITY DEFECT (%Δ k/k)*	UNPERTURBED CASE†	PERTURBED CASE
1.	Fuel Temperature (T_{fuel})	T_{fuel}^{base}	$T_{moderator}^{base}$
2.	Moderator Temperature ($T_{moderator}$)	$T_{moderator}^{base}$	$T_{moderator}^{base}$ -25°K
3.	Moderator & Fuel Temperature†† ($T_{Moderator}$ & T_{Fuel})	base moderator	68°F
		base fuel	68°F
4.	Moderator & Fuel Temperature†† ($T_{Moderator}$ & T_{Fuel})	base moderator	300°F
		base fuel	300°F
5.	Boron Concentration (N_{boron})	base boron	0 ppm
6.	Xenon Concentration (N_{xenon})	Equilibrium	0
7.	Control Rod #	Unrodded	Rodded

* It is recommended that a full flux solution be carried out for each state-point.

† Unperturbed parameters are at their base values indicated in the Standard Problem definition.

\# In the case of the W (17x17) assembly only the unpoisoned assembly is required.

†† Pressure is to be maintained at base value.

TABLE-1. TYPE-1 FUEL ASSEMBLY DATA

15 x 15 W Type Fuel Assembly

1. Configuration (1/8 assembly)

```
4
1 1
1 1 1
1 1 1 3
3 1 1 1 1
1 1 3 1 1 3
1 1 1 1 1 1 1
1 1 1 1 1 1 1 1
```

1 - Fuel Rod
2 - Burnable Poison Rod (BPR)
3 - Guide Thimble
4 - Instrument Thimble

Note: 1. For an unrodded or unpoisoned case replace all BPRs (2) with guide thimbles (3).

2. For a rodded case control rods are inserted in guide thimbles (3).

2. Fuel Assembly Data

Rod array	15 x 15
Fuel rods per assembly	204
Rod pitch (in)#	0.563
Assembly pitch (in)**	8.466 x 8.466
Assembly length (in)	151.0
Active fuel length (in)	144.0
Number of spacer grids†	7
Composition of spacer grid	83% Inconel 718, 17% Stainless Steel
Weight of spacer grids (lb)	15.5
Number of guide thimbles	20
Number of instrument thimbles	1

All dimensions are given at cold (68°F) conditions.
† Seven in active length.
** Center to center assembly pitch.

TABLE-1. TYPE-1 FUEL ASSEMBLY DATA (Cont.)

15 x 15 W Type Fuel Assembly

3. Fuel Rod Data

Clad O.D. (in)	0.422
Clad thickness (in)	0.0243
Diametral gap (in)	0.0075
Clad material	Zircaloy-4

4. Fuel Pellet Data

Material	UO_2 - Undished
Density (% of theoretical)	95
Enrichment (w/o)	2.25
Diameter (in)	0.3659

5. Guide Thimbles and Instrument Thimble Data

Number of guide thimbles	20
Number of instrument thimbles	1
Composition of thimbles	Zircaloy-4
Guide Thimble O.D. (in)	0.545
Guide Thimble I.D. (in)	0.515
Instrument Thimble O.D. (in)	0.545
Instrument Thimble I.D. (in)	0.515

6. Control Rod Data

Neutron absorber (w/o)	5% Cd, 15% In, 80% Ag
Absorber diameter (in)	0.347
Absorber density (lb/in^3)	0.367
Cladding material	304 Stainless Steel
Clad O.D. (in)	0.445
Clad thickness (in)	0.019
Number of control rods	20

INTRODUCTION TO ANALYSIS RESULTS

This transmittal contains the results of FPL's evaluation of Brookhaven's 15x15 lattice Standard Problem using FPL's CHEETAH/PDQ methodology. As agreed, the analysis was performed only for the unpoisoned/unrodded lattice. Due to the structure of FPL's CHEETAH/PDQ methodology, some of the data provided is slightly different from that requested:

1) Instead of providing absorption rates for all of the water in the assembly, absorption rates for the guide and instrumentation thimbles are given. This modification was agreed-to previously.

2) Reactivity defect data was generated using CHEETAH only. It is FPL's position that the pincell CHEETAH and unit-assembly CHEETAH/PDQ agree closely on these calculations, and thus CHEETAH data is sufficient for the calculation.

3) Both CHEETAH and CHEETAH/PDQ isotopics were provided for the conditions requested. It is felt that the CHEETAH data is slightly more accurate because FPL's PDQ uses simplified isotopic chains, which causes a small but acceptable difference in Pu isotopic calculations.

4) CHEETAH does not edit information for the fast group inverse neutron velocity; code modifications would be required to edit this value. Therefore, only thermal group inverse velocities are provided. Inverse neutron velocity data has never been used explicitly in FPL's physics calculations, and its need is not apparent. Therefore, it is felt that CHEETAH's 'shortcoming' in this respect is of little consequence.

5) CHEETAH does not edit delayed neutron fractions, and of course, PDQ does not calculate them. The delayed neutron data was generated by hand using fission rates from PDQ and documented isotope-dependent delayed neutron fractions.

If you have any questions on the attached data, please contact E. Knuckles (305) 552-3444 or K. Hoskins (305) 552-3437.

BNL STANDARD PROBLEM ANALYSIS

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

FIGURE 1

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
150 MWD/MTU

1.005	.983						
.979	.979	1.000					
1.025	1.012	1.043					
	1.060	1.067	1.065	1.039			
1.040	1.050		1.040	1.032			
.977	.989	1.010	.985	.984	.997	.965	
.954	.957	.961	.961	.955	.953	.945	.941

CHEETAH/PDQ DATA

FIGURE 2

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
500 MWD/MTU

1.005	.983						
.979	.979	1.000					
1.025	1.012	1.043					
	1.060	1.067	1.065	1.039			
1.040	1.050		1.040	1.032			
.977	.989	1.010	.985	.984	.997	.965	
.954	.957	.961	.961	.955	.953	.945	.941

CHEETAH/PDQ DATA

FIGURE 3

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
5000 MWD/MTU

1.004	.984						
.980	.980	1.000					
1.023	1.012	1.039					
	1.055	1.061	1.060	1.036			
1.036	1.046		1.037	1.029			
.979	.990	1.010	.987	.986	.998	.968	
.957	.960	.964	.964	.958	.957	.949	.946

CHEETAH/PDQ DATA

FIGURE 4

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
10000 MWD/MTU

1.004	.987						
.984	.984	1.001					
1.020	1.011	1.033					
	1.046	1.051	1.050	1.031			
1.031	1.038		1.032	1.025			
.983	.992	1.008	.989	.988	.998	.972	
.964	.966	.970	.969	.965	.963	.956	.953

CHEETAH/PDQ DATA

FIGURE 5

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
20000 MWD/MTU

1.002	.993						
.992	.992	1.002					
1.013	1.008	1.021					
	1.028	1.031	1.030	1.020			
1.019	1.023		1.020	1.016			
.990	.996	1.005	.994	.993	.997	.982	
.977	.979	.981	.981	.978	.976	.971	.969

CHEETAH/PDQ DATA

FIGURE 6

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
30000 MWD/MTU

1.001	.996						
.996	.996	1.002					
1.007	1.005	1.011					
	1.015	1.016	1.016	1.012			
1.010	1.012		1.011	1.009			
.995	.998	1.002	.997	.997	.998	.990	
.988	.989	.990	.990	.988	.987	.984	.982

CHEETAH/PDQ DATA

FIGURE 7

'BNL' STANDARD PROBLEM
15x15 W LATTICE
RELATIVE PIN POWERS
40000 MWD/MTU

1.000	.997						
.997	.997	1.000					
1.004	1.002	1.007					
	1.009	1.010	1.010	1.007			
1.006	1.008		1.007	1.006			
.997	.998	1.001	.998	.998	.999	.994	
.992	.993	.994	.994	.993	.992	.991	.990

CHEETAH/PDQ DATA

TABLE 1

BNL STANDARD PROBLEM
Koo VS BURNUP
CHEETAH PINCELL VS. CHEETAH/PDQ

Burnup (MWD/MTU)	Koo: CHEETAH Only		Koo: CHEETAH/PDQ 15x15 Lattice	△ PCM+
0	1.14129		1.14058	55
150	1.10463		1.10300	133
500	1.09916		1.09764	125
1000	1.09589		1.09425	136
5000	NC		1.05562	-
10000	1.00496		1.00347	147
20000	.91865		.91672	229
30000	.84832		.84626	286
40000	.79355		.79194	256
Total △K (pcm) 0-40 K Bu (PCM)	38396	(.5% diff)	38598	

* Koo Includes Gap $+\Delta = (K_1 - K_2) \times 10^5/(K_1 K_2)$

NC = Not Calculated

TABLE 2

BNL STANDARD PROBLEM
ASSEMBLY VOLUME AVERAGED ISOTOPICS +
(ATOMS/BARN-CM)

	500 MWD/MTU		40000 MWD/MTU	
ISOTOPE	CHEETAH*	CHEETAH/PDQ	CHEETAH*	CHEETAH/PDQ
U-235	1.52783-4	1.52846-4	1.62489-5	1.64792-5
U-238	6.72361-3	6.72366-3	6.49624-3	6.49561-3
Pu-239	2.15215-6	2.10674-6	3.18613-5	3.23974-5
Pu-240	3.12530-8	2.99997-8	1.74465-5	1.73614-5
Pu-241	8.50277-10	7.80787-10	9.84268-6	9.96180-6
Pu-242	4.33328-12	2.78212-12	6.83477-6	6.80422-6
F.P.	3.62248-6	3.56379-6	2.76862-4	2.76709-4

+ Does not include gap

* CHEETAH values multiplied by $\frac{204}{225}$ to generate Assembly Average Number Density

TABLE 3

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 150 MWD/MTU | CHEETAH/PDQ

Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	1.56352+15	1.29104+15
U238	9.45297+14	8.43912+13
Pu239	2.00797+13	1.28006+13
Pu240	8.35486+10	1.77856+8
Pu241	3.49011+8	2.56530+8
Pu242	Negligible	Negligible
Fuel Clad	3.73028+13	N/A
Guide Thimble +	7.28549+13	N/A

+ Includes all guide and instrument thimbles

TABLE 4

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 500 MWD/MTU		CHEETAH/PDQ
Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	1.52719+15	1.26049+15
U238	9.48370+14	8.49224+13
Pu239	6.55157+13	4.17759+13
Pu240	9.48220+11	2.02607+9
Pu241	2.27823+10	1.67431+10
Pu242	1.20408+7	1.58321+5
Fuel Clad	3.73862+13	N/A
Guide Thimble +	7.25663+13	N/A

+ Includes all guide and instrument thimbles

TABLE 5

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 5000 MWD/MTU — CHEETAH/PDQ

Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	1.19578+15	9.84034+14
U238	9.82341+14	8.94758+13
Pu239	4.60838+14	2.94725+14
Pu240	5.36008+13	1.33530+11
Pu241	1.26463+13	9.30947+12
Pu242	1.09866+11	1.44502+9
Fuel Clad	3.84739+13	N/A
Guide Thimble +	7.18785+13	N/A

+ Includes all guide and instrument thimbles

TABLE 6

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 10000 MWD/MTU — CHEETAH/PDQ

Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	9.53631+14	7.83317+14
U238	1.03321+15	9.43427+13
Pu239	7.04087+14	4.51209+14
Pu240	1.26690+14	3.74773+11
Pu241	5.56667+13	4.10199+13
Pu242	1.10237+12	1.44792+10
Fuel Clad	4.02897+13	N/A
Guide Thimble +	7.40278+13	N/A

+ Includes all guide and instrument thimbles

TABLE 7

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 20000 MWD/MTU — CHEETAH/PDQ

Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	6.14829+14	5.04276+14
U238	1.13881+15	1.02962+14
Pu239	9.66854+14	6.20990+14
Pu240	2.42656+14	8.82582+11
Pu241	1.76133+14	1.29898+14
Pu242	8.06785+12	1.08373+11
Fuel Clad	4.42858+13	N/A
Guide Thimble +	8.10735+13	N/A

+ Includes all guide and instrument thimbles

TABLE 8

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 30000 MWD/MTU CHEETAH/PDQ

Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	3.78592+14	3.10399+14
U238	1.24103+15	1.10509+14
Pu239	1.11670+15	7.18031+14
Pu240	3.30378+14	1.32205+12
Pu241	2.85334+14	2.10482+14
Pu242	2.10127+13	2.95212+11
Fuel Clad	4.83097+13	N/A
Guide Thimble +	8.90989+13	N/A

+ Includes all guide and instrument thimbles

TABLE 9

BNL 15x15 W LATTICE
ASSEMBLY TOTAL REACTION RATES

Burnup 40000 MWD/MTU CHEETAH/PDQ

Isotope	Absorption (sec^{-1})	Fission (sec^{-1})
U235	2.16928+14	1.77837+14
U238	1.32572+15	1.16663+14
Pu239	1.21128+15	7.79313+14
Pu240	3.93506+14	1.64580+12
Pu241	3.65295+14	2.69482+14
Pu242	3.67806+13	5.45228+11
Fuel Clad	5.18130+13	N/A
Guide Thimble +	9.64036+13	N/A

+ Includes all guide and instrument thimbles

TABLE 10

BNL STANDARD PROBLEM
GUIDE & INSTRUMENT TUBE ABSORPTION RATES*
CHEETAH/PDQ

BURNUP (MWD/MTU)	ϕ^1	ϕ^2	Σ_a^1	Σ_a^2	ABSORPTION (SEC^{-1})
150	2.41258+14	3.60425+13	7.14340-4	4.19280-2	7.28549+13
500	2.42935+14	3.58549+13	7.14340-4	4.19280-2	7.25663+13
5000	2.57197+14	3.52328+13	7.14340-4	4.19280-2	7.18785+13
10000	2.72720+14	3.61529+13	7.14340-4	4.19280-2	7.40278+13
20000	3.00919+14	3.95556+13	7.14340-4	4.19280-2	8.10735+13
30000	3.26786+14	4.35380+13	7.14340-4	4.19280-2	8.90989+13
40000	3.54857+14	4.70856+13	7.14340-4	4.19280-2	9.64036+13

* Calculated by

$Vol \cdot (\phi^1 \cdot \Sigma_a^1 + \phi^2 \Sigma_a^2)$ of Guide and Instrument Tube REGION

$Vol = 43.27507\ cm^2$

TABLE 11

BNL 15x15 W LATTICE
ASSEMBLY CHARACTERISTICS*

BURNUP (MWD/MTU)	Koo +	M^2 (cm^2)	B^2 (cm^{-2})	β (x1000)	Inverse Neutron Velocity Thermal Group
150	1.10300	54.22	1.900-3	7.02	2.56409-6
500	1.09764	54.13	1.804-3	6.93	2.56266-6
5000	1.05562	53.55	1.039-3	6.15	2.56321-6
10000	1.00347	53.07	6.539-5	5.64	2.56742-6
20000	.91672	51.86	-1.606-3	5.06	2.57818-6
30000	.84626	50.90	-3.020-3	4.71	2.58759-6
40000	.79194	50.15	-4.149-3	4.48	2.59468-6

+ Koo includes gap

TABLE 12

BNL STANDARD PROBLEM
DELAYED NEUTRON FRACTIONS

Burnup
(MWD/MTU)

150

Isotope i	β_i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	1.29104+15	8.39176+12
U238	.0157	8.43912+13	1.32494+12
Pu239	.0021	1.28006+13	2.68813+10
Pu240	.0026	1.77856+8	4.62426+5
Pu241	.0052	2.56530+8	1.33396+6
TOTAL		1.38823+15	9.74358+12

$$\overline{\beta} = \sum_i \beta_i \cdot FRi / \sum_i FRi = .00702$$

500

Isotope i	β_i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	1.26049+15	8.19319+12
U238	.0157	8.49224+13	1.33328+12
Pu239	.0021	4.17759+13	8.77294+10
Pu240	.0026	2.02607+9	5.26778+6
Pu241	.0052	1.67431+10	8.70641+7
TOTAL		1.38721+15	9.61429+12

$$\overline{\beta} = \sum_i \beta_i \cdot FRi / \sum_i FRi = .00693$$

TABLE 13

BNL STANDARD PROBLEM
DELAYED NEUTRON FRACTIONS

Burnup
(MWD/MTU)

5000

Isotope i	β_i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	9.84034+14	6.39622+12
U238	.0157	8.94758+13	1.40477+12
Pu239	.0021	2.94725+14	6.18923+11
Pu240	.0026	1.33530+11	3.47178+08
Pu241	.0052	9.30947+12	4.84092+10
TOTAL		1.37767+15	8.46867+12

$$\overline{\beta} = \sum_i \beta_i \cdot FRi / \sum_i FRi = .00615$$

10000

Isotope i	i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	7.83317+14	5.09156+12
U238	.0157	9.43427+13	1.48118+12
Pu239	.0021	4.51209+14	9.47539+11
Pu240	.0026	3.74773+11	9.74410+8
Pu241	.0052	4.10199+13	2.13303+11
TOTAL		1.37026+15	7.7416+12

$$\overline{\beta} = \sum_i \beta_i \cdot FRi / \sum_i FRi = .00564$$

TABLE 14

BNL STANDARD PROBLEM
DELAYED NEUTRON FRACTIONS

Burnup
(MWD/MTU)

20000

Isotope i	β_i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	5.04276+14	3.27779+12
U238	.0157	1.02962+14	1.61650+12
Pu239	.0021	6.20990+14	1.30408+12
Pu240	.0026	8.82582+11	2.29471+9
Pu241	.0052	1.29898+14	6.75470+11
TOTAL		1.35901+15	6.87613+12

$$\bar{\beta} = \sum_i \beta_i \cdot FR_i / \sum_i FR_i = .00506$$

30000

Isotope i	β_i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	3.10399+14	2.01759+12
U238	.0157	1.10509+14	1.73500+12
Pu239	.0021	7.18031+14	1.50787+12
Pu240	.0026	1.32205+12	3.43733+9
Pu241	.0052	2.10482+14	1.09451+12
TOTAL		1.35074+15	6.35841+12

$$\bar{\beta} = \sum_i \beta_i \cdot FR_i / \sum_i FR_i = .00471$$

TABLE 15

BNL STANDARD PROBLEM
DELAYED NEUTRON FRACTIONS

Burnup
(MWD/MTU)

40000

Isotope i	β_i	Fission Rate i	$\beta \cdot$ Fission Rate i
U235	.0065	1.77837+14	1.15594+12
U238	.0157	1.16663+14	1.83161+12
Pu239	.0021	7.79313+14	1.63656+12
Pu240	.0026	1.64580+12	4.27908+9
Pu241	.0052	2.69482+14	1.40131+12
TOTAL		1.34494+15	6.02970+12

$$\overline{\beta} = \sum_i \beta_i \cdot FRi / \sum_i FRi = .00448$$

TABLE 16

BNL STANDARD PROBLEM
THERMAL GROUP INVERSE NEUTRON VELOCITY*

Burnup	Wigner/Wilkins 1/v ++	1/v (sec cm^{-1})
150	.564099	2.56409-6
500	.563784	2.56266-6
5000+	.563906	2.56321-6
10000	.564832	2.56742-6
20000	.567198	2.57818-6
30000	.569269	2.58759-6
40000	.57083	2.59468-6

*Calculated by:

$$W/W\ 1/v \times .454546\text{-}5\ \frac{sec}{cm}$$

\+ Interpolated from 4 & 6K Values

++ CHEETAH Values

TABLE 17

BNL 15x15 W LATTICE
TWO-GROUP COLLAPSED ASSEMBLY AVERAGED XSECS* +++

Burnup	Group	D (cm)	Σ_a (cm^{-1})	Σ_r (cm^{-1})	$\nu\Sigma_f$ (cm^{-1})	$\kappa\Sigma_f$ (Watt/cm)	Σ_f^{+} (cm^{-1})
150	1	1.37894	8.86503-3	1.84526-2	5.49472-3	7.07781-14	2.25684-3
	2	5.19697-1	1.38900-1	-	1.85413-1	2.53622-12	7.61545-2
500	1	1.37947	8.88390-3	1.84622-2	5.48826-3	7.06071-14	2.24444-3
	2	5.18838-1	1.40884-1	-	1.87131-1	2.55096-12	7.65279-2
5000++	1	1.38472	9.33700-3	1.82688-2	5.32781-3	6.67044-14	2.09739-3
	2	5.14464-1	1.51924-1	-	1.97934-1	2.61741-12	7.79203-2
10000	1	1.39080	9.85909-3	1.80721-1	5.12030-3	6.41531-14	1.96107-3
	2	5.12633-1	1.56427-1	-	1.98134-1	2.56470-12	7.58851-2
20000	1	1.38347	1.05605-2	1.79050-2	4.73447-3	5.81039-14	1.74656-3
	2	5.12285-1	1.57195-1	-	1.87337-1	2.35580-12	6.91092-2
30000	1	1.37628	1.10441-2	1.78793-2	4.41605-3	5.33640-14	1.58785-3
	2	5.13251-1	1.54961-1	-	1.73663-1	2.14142-12	6.24430-2
40000	1	1.37137	1.14743-2	1.78430-2	4.18144-3	4.99914-14	1.47748-3
	2	5.14182-1	1.52523-1	-	1.62512-1	1.97763-12	5.74222-2

\+ Calculated by dividing $\nu\Sigma_f$ by ν in CHEETAH output
++ value interpolated from 4; 6K values
+++ Thermal MND
* CHEETAH/PDQ values

TABLE 18

BNL STANDARD PROBLEM
REACTIVITY DEFECT CALCULATIONS+

Reactivity Defect	150 MWD/MTU %ΔK/K	30000 MWD/MTU %ΔK/K
Fuel Temp	.8899	1.3533
Mod. Temp*	- .0546	- .3954
Mod. + Fuel* @ 68°F	.6693	-3.7450
Mod. + Fuel* @ 300°F	.6240	-1.3990
Boron	8.0948	9.4095
Xenon	2.6233	2.7788

$$+ \ \% \ \Delta K/K = \frac{K_{perturbed} - K_{base}}{K_{perturbed} * K_{base}} \times 100$$

* Calculation maintains 700 ppm & HFP equilibrium xenon.

DISTRIBUTION
Docket File w/o encl.
PAD#2 Rdg w/o encl.
D. McDonald w/encl.
D. Miller w/encl.

October 20, 1986

DOCKET NO(S). 50-250 and 50-251

(See attached list of addressees)

SUBJECT: FLORIDA POWER AND LIGHT COMPANY
TURKEY POINT PLANT UNITS 3 AND 4

The following documents concerning our review of the subject facility are transmitted for your information.

- ☐ Notice of Receipt of Application, dated ____________.
- ☐ Draft/Final Environmental Statment, dated ____________.
- ☐ Notice of Availability of Draft/Final Environmental Statement, dated ____________.
- ☐ Safety Evaluation Report, or Supplement No. ______, dated ____________.
- ☐ Notice of Hearing on Application for Construction Permit, dated ____________.
- ☐ Notice of Consideration of Issuance of Facility Operating License, dated ____________.
- ☐ Monthly Notice; Applications and Amendments to Operating Licenses Involving no Significant Hazards Considerations, dated ____________.
- ☐ Application and Safety Analysis Report, Volume ____________.
- ☐ Amendment No. ______ to Application/SAR dated ____________.
- ☐ Construction Permit No. CPPR- ______, Amendment No. ______ dated ____________.
- ☐ Facility Operating License No. ______, Amendment No. ______, dated ____________.
- ☐ Order Extending Construction Completion Date, dated ____________.
- ☒ Other *(Specify)* July 1986 operating status reports & operating summary & June 1986 Operating data report.

Division of PWR Licensing-A
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc:

OFFICE➤	LA:PAD#2						
SURNAME➤	DMiller:ab						
DATE➤	10/20/86						

NRC FORM 318 (1/84) NRCM 0240

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[illegible]

[illegible]

[illegible]

cc: Chief
Division of Ecological Services
Bureau of Sport Fisheries & Wildlife
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U.S. Environmental Protection Agency
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