NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

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TO: MR VICTOR STELLO

FROM: FLORIDA POWER & LIGHT CO
MIAMI, FLA
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DESCRIPTION

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PLANT NAME: TURKEY POINT #3

ENCLOSURE

RELOAD SAFETY EVALUATION TURKEY POINT PLANT UNIT 4, CYCLE #3m OPERATION......

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Regulatory Docket File

February 25, 1976
L-76-68

RECEIVED MAR 1 1976 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

Director of Nuclear Reactor Regulation
Attention: Mr. Victor Stello, Jr., Director
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Stello:

Re: Turkey Point Unit 4
Docket No. 50-251
Cycle 3 Reload Fuel Submittal

Florida Power and Light Company hereby submits a description of the fuel which will be loaded into Turkey Point Unit 4 for Cycle 3 operation.

Proposed Technical Specifications relating to the refueling are being submitted under separate cover letter.

Very truly yours,

Robert E. Uhrig
Vice President

DOCKETED USNRC MAR 1 1976 U.S. NUCLEAR REGULATORY COMMISSION Mail Section

REU/MAS/

Attachment

cc: Mr. Norman C. Moseley
Jack R. Newman, Esquire

1934

RELOAD SAFETY EVALUATION

TURKEY POINT PLANT

UNIT 4, CYCLE 3

FLORIDA POWER AND LIGHT COMPANY

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1.0 INTRODUCTION AND SUMMARY

Turkey Point Unit 4 achieved initial criticality in June, 1973 and is now in its second cycle of operation. The unit is scheduled for a refueling shutdown on April 19, 1976 with Cycle 3 startup planned for late May.

The Turkey Point 4 Cycle 3 core loading pattern is shown as Figure 1. Forty of the Region 2 assemblies will be removed and replaced by forty Region 5 assemblies (see Table 1). The five Region 1 assemblies used in the core during Cycle 2 will be replaced by five Region 1 assemblies stored in the spent fuel pit during Cycle 2. Depleted borosilicate burnable poison rods will be used in Cycle 3. The location of these rods is shown in Figure 2.

This report presents an evaluation for Cycle 3 which demonstrates that the core reload will not adversely affect the safety of the plant. It is not the purpose of this report to present a reanalysis of all potential incidents. Those incidents analyzed and reported in the FSAR which could potentially be affected by fuel reload have been reviewed for the Cycle 3 design described herein. The results of new analyses have been included and the justification for the applicability of previous results from the remaining analyses is presented. It has been concluded that the Cycle 3 design does not cause the previously acceptable safety limits for any incident to be exceeded. This conclusion is based on the assumption that: (1) Cycle 2 operation is terminated after 8700 ± 1000 MWD/MTU and (2) there is adherence to plant operating limitations as clarified in proposed modifications to the Technical Specifications.

Nominal design parameters for Cycle 3 are 2200 Mwt rated power, 2250 psia system pressure, 546°F core inlet temperature, and 5.56 kw/ft average linear fuel power density (based on 144" active fuel length).

2.0 REACTOR DESIGN

2.1 Mechanical Design

The mechanical design of Region 5 fuel is dimensionally the same as Region 4 fuel. Region 5 fuel has different enrichment as noted in Table 1. Other physical design aspects of Region 5 are the same as Region 4, except that the initial prepressurization level of the fuel rods has been decreased by 65 psi.

Clad flattening time is predicted to be >30,000 EFPH for the limiting region (Region 3) using the current Westinghouse evaluation model [1]. Therefore, Region 3 has a nominal Cycle 3 allowed residence time of 13,000 EFPH (assumes a Cycle 2 lifetime of 6700 EFPH and a Cycle 1 lifetime of 10,300 EFPH). Clad flattening will not occur during Cycle 3 since this cycle will nominally operate for 6700 EFPH.

Westinghouse has had considerable experience with Zircaloy clad fuel. This experience is extensively described in WCAP 8183, "Operational Experience with Westinghouse Cores" [3]. This report is updated about every six months.

2.2 Nuclear Design

The Cycle 3 loading pattern results in a maximum F_Q of 2.32 under normal operating conditions. Table 2 provides a comparison of the Cycle 3 core kinetics characteristics with the current limit based on previously submitted accident analyses. It can be seen from the table that most of the Cycle 3 values fall within the current limits. These parameters are evaluated in Section 3.0. Table 3 provides the control rod worths and requirements. The required shutdown margin is based on a previously submitted accident analysis[4]. The available shutdown margin exceeds the minimum required.

2.3 Thermal and Hydraulic Design

No significant variations in thermal margins will result from the Cycle 3 reload. The present DNB core limits have been found to be conservative.

While fuel properties were such that the original ECCS analysis for Turkey Point [7] was not applicable to Turkey Point Unit 4 for the early part of Cycle 2, the Turkey Point Unit 4 fuel has had sufficient exposure (see FPL letter L-75-380, July 29, 1975)[8] so that the basic ECCS analysis again represents a conservative calculation for Cycle 3. An ECCS analysis which takes into account rod bowing was submitted to the Regulatory Staff on November 26, 1975[9] as part of the Turkey Point Unit 3 reload submittal. That analysis showed that there is sufficient margin to operate Unit 3 safely under the present Technical Specifications. As the stored energy in the fuel for Cycle 3 of Turkey Point Unit 4 is no greater than that of the fuel in Unit 3, and the propensity for rod bowing is no greater, the ECCS analysis of November 26, 1975 is also conservative with respect to Unit 4 and no changes in the present Technical Specification core power limits are required.

Likewise, as part of the Unit 3, Cycle 3 reload submittal, a discussion of the rod bow effect on DNB margin was presented on November 21, 1975[10]. It was concluded that for Turkey Point 3 the various design margins in the calculational model exceeded the DNB penalty for rod bow effects and that therefore no additional restrictions are required. Similar reasoning is applicable to Turkey Point Unit 4 because it has the same type of fuel assemblies and operates with the same power density as Unit 3. Therefore, it is concluded that the present DNB core limits are conservative.

3.0 POWER CAPABILITY AND ACCIDENT EVALUATION

3.1 Power Capability

This section reviews the plant power capability considering the consequences of those incidents examined in the FSAR using the previously accepted design bases. It is concluded that the core reload will not adversely affect the ability to safely operate at 100% rated power during Cycle 3. For the overpower transient, a maximum local rod power limit of 21.8 kw/ft corresponds to the fuel centerline temperature limit of 4700°F for Region 3 fuel. This can be accomodated with margin in the Cycle 3 core. The time dependent densification model(2) was used for this evaluation. The LOCA limit is met by maintaining F_Q at or below 2.32.

3.2 Accident Evaluation

The effects of the reload on the design basis and postulated incidents analyzed in the FSAR(4) have been examined. In most cases, it was found that the effects can be accommodated within the conservatism of the initial assumptions used in the previous applicable safety analysis. For that incident which was reanalyzed, it was determined that the applicable design basis limits are not exceeded, and therefore the conclusions presented in the FSAR are still valid.

This reload can typically affect accident analyses input parameters in three major areas: kinetics characteristics, control rod worths, and core peaking factors. Cycle 3 parameters in each of these three areas were examined as discussed below to ascertain whether new accident analyses are required.

Kinetics Parameters - A comparison of Cycle 3 kinetics parameters with current limits is given in Table 2. Most of the Cycle 3 coefficients remain within the bounds of current limits. The small changes in core physics parameters have a negligible effect on transient analysis. Therefore, no additional accident analysis is required due to changes in these parameters.

Control Rod Worths - Changes in control rod worths may affect shutdown margin, differential rod worths, and ejected rod worths. Table 3 shows that Cycle 3 shutdown margin is adequate. Table 2 shows that the reactivity insertion rate due to control rod withdrawal is not greater than was previously analyzed. Cycle 3 ejected rod worths are less than the current limits.

Core Peaking Factors - Evaluation of peaking factors for the rod out of position and dropped RCCA incidents shows that DNBR is maintained above 1.3. For the dropped bank incident, the turbine runback setpoint is sufficient to prevent a DNBR less than 1.3. Peaking factors following control rod ejection were less for Cycle 3 than the current limits.

3.3 Incidents Reanalyzed

The end of cycle full power rod ejection incident was re-evaluated since the average fuel temperature conservatively assumed at the initial hot spot linear power density exceeded that previously used in this incident* by approximately 260°F. The effect of the initially higher fuel temperature is to increase the peak transient fuel and clad temperature following rod ejection, but by less than 260°F. Since

*This fuel temperature was used only for the end of life ejected rod analysis. Fuel temperatures previously used in other incidents are unaffected.

the peak fuel and clad temperatures obtained for the previous analysis were well below the limiting criteria[5], the results with the 260°F increase (shown in Table 4) still do not cause the criteria to be exceeded. The limiting case for the rod ejection incident actually occurs at the beginning of life for which the parameters are as described in the previous analysis[5].

4.0. REFERENCES

1. George, R. A., et al "Revised Clad Flattening Model", WCAP 8377 (Proprietary) and WCAP 8381 (Non Proprietary), July 1974.

2. Hellman, J. M. (Ed.), "Fuel Densification Experimental Results and Model for Reactor Operation", WCAP 8218-P-A, March 1975 (Proprietary) and WCAP 8219-A, March 1975 (Non Proprietary).

3. Plocido, V. J. and Schreiber, R. E., "Operational Experience with Westinghouse Cores", WCAP 8183, Revision 3, May 1975.

4. Final Safety Analysis Report, Turkey Point Units Number 3 and 4.

5. "Fuel Densification, Turkey Point Plant Unit Number 3", WCAP 8074 (Proprietary) and WCAP 8075 (Non Proprietary), February 1973.

6. Turkey Point Plant Unit 3, Docket Number 50-250, Cycle 3 Reload Fuel Submittal and Proposed Amendment to Facility Operating License DPR-31, September 9, 1975 (Attachment to Letter from Robert E. Uhrig to Roger S. Boyd).

7. Turkey Point Plant Units 3 and 4, Docket Numbers 50-250 and 50-251, FSAR ECCS Final Acceptance Criteria, March 10, 1975 (attachment to letter from Robert E. Uhrig to George Lear).

8. Turkey Point Plant Units 3 and 4, Docket Numbers 50-250 and 50-251, Proposed Amendment to Facility Operating Licenses DPR-31 and DPR-41, July 29, 1975 (attachment to letter from Robert E. Uhrig to Angelo Giambusso).

9. Turkey Point Plant Unit 3, Docket Number 50-250, Cycle 3 Reload Fuel Submittal Additional Information, November 26, 1975, (Letter from Robert E. Uhrig to Roger S. Boyd).

10. Turkey Point Plant Unit 3, Docket Number 50-250, Cycle 3 Reload Fuel Submittal Additional Information, November 21, 1975 (Letter from Robert E. Uhrig to Roger S. Boyd).

Table 1

Turkey Point 4 - Cycle 3

Fuel Assembly Design Parameters

Region	1	2	3	4	5
Enrichment (w/o U-235)	1.85	2.56	3.11	2.55	3.00
Density (% Theoretical)*	93.8	92.9	92.8	94.3	95.0
Number of Assemblies	5	12	48	52	40
Approximate Burnup at Beginning of Cycle 3 (MWD/MTU)	14700	23900	21400	7400	0

* All regions except Region 5 are as-built values; Region 5 is the nominal value, however, an average density of 94.5% theoretical was used in thermal evaluations.

Table 2

Turkey Point Unit 4

Kinetics Characteristics

	Current Limit[4, 5]	Cycle 2	Cycle 3
Moderator Temperature Coefficient, $(\Delta\rho/°F)\times10^4$	-3.5 to +0.3*	-3.5 to 0	-3.5 to 0
Doppler Coefficient $(\Delta\rho/°F)\times10^5$	-1.6 to -1.0	-2.6 to -1.0	-2.6 to -1.0
Delayed Neutron Fraction, β_{eff}, (%)	.50 to .72	.50 to .59	.50 to .72
Prompt Neutron Lifetime (μsec)	14 to 18	20	20 (max.)
Maximum Differential Rod Worth of Two Banks Moving Together at HZP (pcm/in)**	80	80	80

* The positive coefficient does not occur at operating conditions

** pcm ≡ $10^{-5}\Delta\rho$

Table 3

Turkey Point 4 - Cycle 2 and 3

Shutdown Requirements and Margins

	Cycle 2 BOC	Cycle 2 EOC	Cycle 3 BOC	Cycle 3 EOC
Control Rod Worth (%Δρ)				
All Rods Inserted Less Worst Stuck Rod	6.97	6.52	5.86	5.84
(1) Less 10%	6.27	5.87	5.27	5.25
Control Rod Requirements (%Δρ)				
Reactivity Defects (Doppler, Tavg, Void, Redistribution)	1.66	2.70	1.73	2.71
Rod Insertion Allowance	.70	.70	.50	.50
(2) Total Requirements	2.36	3.40	2.23	3.21
Shutdown Margin [(1)-(2)] (%Δρ)	3.91	2.47	3.04	2.04
Required Shutdown Margin (%Δρ)	1.00	1.77	1.00	1.77

Table 4

RESULTS OF ROD EJECTION ANALYSIS

MAXIMUM FUEL AND CLAD TEMPERATURES AT THE HOT SPOT

END OF LIFE, HOT FULL POWER

	Previous Analysis(5)	Cycle 3
Fuel Average Temperature(°F)	3180	3440
Fuel Centerline Temperature(°F)	4275	4535
Clad Average Temperature(°F)	1835	2095

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

X — Fuel Region

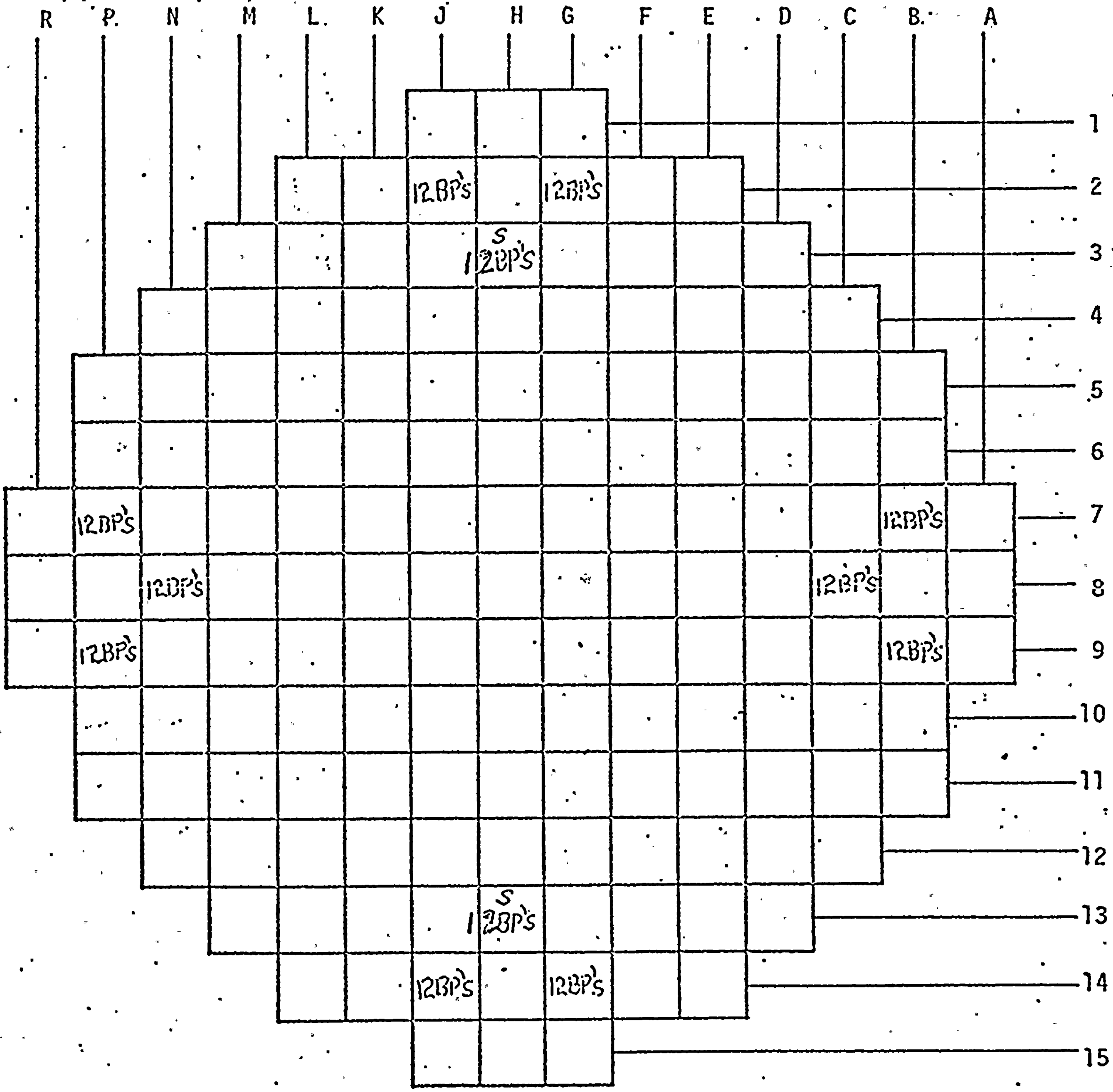
* — Removable Rod Assembly

Figure 1

Turkey Point Unit 4 Cycle 3 Loading Pattern

Figure 2

TURKEY POINT UNIT 4 CYCLE 3
SOURCE AND BURNABLE POISON LOCATIONS



S BP's - Source Location
- Depleted Burnable Poisons

Figure 3

Control Group Insertion Limits for Unit 4

Three Loop Operation

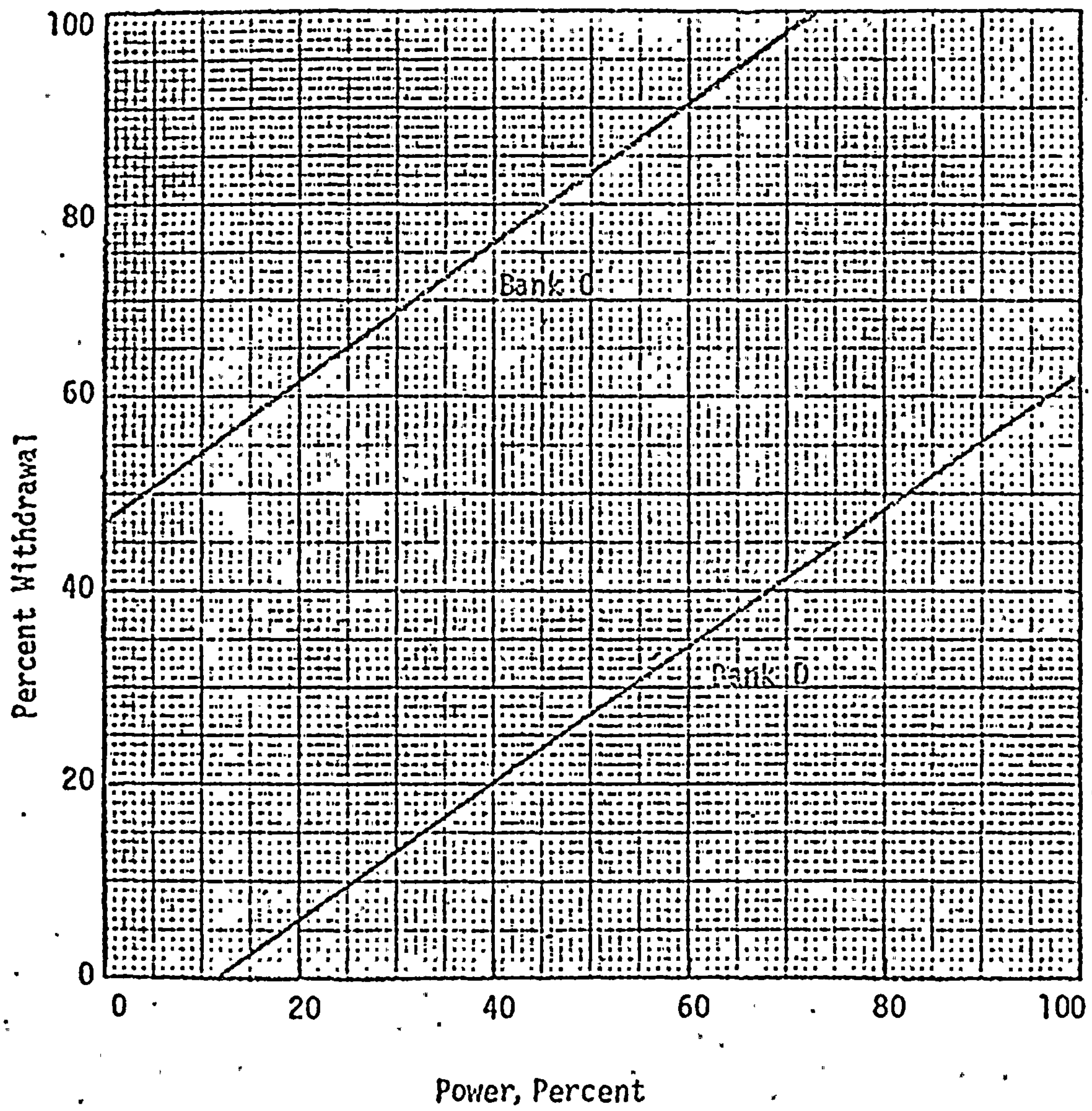


Figure 4

Control Group Insertion Limits for Unit 4

Two Loop Operation