Portland General Electric Company

Bart D. Withers, Vice President

July 7, 1982

Trojan Nuclear Plant
Docket 50-344
License NPF-1

Director of Nuclear Reactor Regulation
ATTN: Mr. Robert A. Clark, Chief
Operating Reactors Branch No. 3
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Clark:

Additional Evaluation of SS Rods (LCA 88)

Pursuant to a request by M. Chatterton by the NRC staff, attached is the Westinghouse evaluation of the impact of using stainless steel rods on Cycle 5 core physics and nuclear design at the Trojan Nuclear Plant. Included is a table which shows the effects of the additional SS rods on power distribution in the Cycle 5 core. This evaluation supplements the evaluation transmitted to the NRC in the Withers to Clark letter dated June 18, 1982 and is being submitted in support of LCA 88.

Sincerely,

Bart D. Withers
Vice President
Nuclear

Attachment

A001

c: Mr. Lynn Frank, Director
State of Oregon
Department of Energy

EVALUATION OF THE USE OF FUEL ASSEMBLIES CONTAINING STAINLESS STEEL FUEL ROD REPLACEMENTS IN TROJAN CYCLE 5

I. INTRODUCTION

The Trojan Cycle 5 core loading contains 22 assemblies bearing stainless steel fuel rod replacements (SS Rods). Table 1 summarizes the number of stainless steel rods by assembly and by core location. Figure 1 shows the core loading pattern for Cycle 5.

The following discussion evaluates the impact of SS rods on core physics and nuclear core design of Trojan Cycle 5. A similar evaluation performed for Cycle 4 was supplied in Reference 1.

II. LOADING PATTERN AND NUCLEAR MODELING

The Cycle 5 core loading contains 48 Region G feed assemblies, 45 Region F once-burnt assemblies, 60 Region E twice-burnt assemblies, 25 Region D thrice-burnt assemblies, 1 Region D once-burnt assembly from Cycle 2, and 14 Region A assemblies from Cycle 1 (see Figure 1).

In the 22 modified assemblies these stainless steel replacement rods are explicitly modelled in Westinghouse's two-dimensional, two-group diffusion theory code TURTLE. These explicit models are used to obtain radial peaking factors for the entire Cycle 5 design. As in previous cycles with SS rods modelled, nuclear design is done with the normal reload design methodology and procedures.

III. EFFECTS OF STAINLESS STEEL RODS

Background

In both Cycle 3 and Cycle 4, two Region E assemblies (E05 and E15) contained three SS rods each. Previous evaluations of these six SS rods showed in both Cycle 3 and Cycle 4 that: (1) the impact of power peaking was small and local, (2) the assembly average power was reduced (causing approximately 50 MWD/MTU burnup reduction), (3) the core loading pattern search was not more difficult, (4) design models are capable of accounting for the SS rod effects, and (5) normal fuel management schemes are definitely possible.

Baffle jetting damage in Cycle 4 has resulted in the requirement for an additional 76 SS rods in Cycle 5. These 76 SS rods are positioned symmetrically in the four core quadrants with each quadrant receiving the same number of rods.

Evaluation Method

To observe the effects of SS rods on power distribution for the Trojan Cycle 5 design, two distinct design models were created. The first of these represents the as-designed Cycle 5 loading with the 76 new SS replacement rods explicity modelled in their correct locations, as shown in Figure 2. The second model represents the very same as-designed Cycle 5 loading, but with fuel rods substituted for the 76 SS replacement rods in fresh fuel.

Results

For both of the aforementioned models, the peak rod power and assembly average power were recorded for assemblies which fall into one of these categories:

- SS rod bearing fresh assemblies
- Assemblies adjacent to SS rod bearing fresh assembly
- Lead power assemblies

The compilation of these assembly power results are presented in Table 2. Note that the presence of SS rods in the feed fuel for Cycle 5 has a negligible effect on the radial power distribution of the lead power assemblies in the core. Peaking is slightly depressed in those assemblies which contain SS rods, as well as in adjacent assemblies. The overall effect of using SS replacement rods in Trojan Cycle 5 is to lower the power on the core periphery by a small amount. There is no effect on quadrant tilt, as the SS rods are placed symmetrically in the core.

The additional 2 x 8 grids in the 8 corner injection baffle assemblies add little extra parasitic neutron absorption, are positioned in areas of low neutron importance, low rod powers, and high neutron leakage. The incremental local power distribution perturbation of these mini-grids is estimated to be very small.

IV. CONCLUSIONS

The use of SS rods has been accommodated in the nuclear design of Trojan Cycle 5 with appropriate modelling. The effect of using SS rods is to produce small, and not necessarily adverse, changes in radial peaking factors. Mini-grids at the 8 corner injection locations have a negligible effect.

Furthermore, previous studies (Reference 2) indicate that SS rod bearing assemblies can be moved to the interior of the core in subsequent cycles, with acceptable consequences to radial peaking factors.

V. REFERENCES

1. PGE to NRC (Withers to Clark) letter dated February 5, 1981 (LCA 70).

2. PGE to NRC (Withers to Clark) letter dated June 18, 1982.

TABLE 1

Trojan Cycle 5
Stainless Steel Rod Location Summary

No. of Assemblies	Assembly Identification	Cycle 5 Core Location,	Number of SS Rods Per Assembly	Comment
8	G03, G36, G10, G41, G37, G23, G35, G12	L-1, E-1, R-5 A-5, R-11, A-11, L-15, E-15	5 with 2 x 8 partial mini-grids	Corner injection baffle joints
12	G02, G45, G30, G01, G33, G40, G42, G47, G06, G21, G11	N-2, M-2, D-2, B-3, P-4, B-4, P-12, B-12, P-13, M-14, D-14, C-14	3	Center injection baffle joint
2	E15, E05	M-8, D-8	3	Center injection baffle joints used in Cycles 3 and 4

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TABLE 2

ASSEMBLYWISE PEAK AND AVERAGE POWERS FOR TROJAN CYCLE 5

CYCLE BU=0 MWD/MTU, FULL POWER, RCCA'S OUT OF CORE

Assembly Location*	As-Designed Loading With 76 SS Rods in Feed Fuel		As-Designed Loading With 3.20 w/o Fuel Rods Replacing SS Rods	
	Assembly Average Power	Assembly Peak Power	Assembly Average Power	Assembly Peak Power
"Lead" Power Assemblies				
5,4	1.252	1.344	1.252	1.344
4,5	1.249	1.341	1.249	1.342
7,2	1.186	1.343	1.184	1.341
2,7	1.177	1.334	1.176	1.333
SS Rod Bearing Assemblies				
5,7	1.000	1.232	1.103	1.249
7,5	.933	1.223	1.007	1.240
7,6	.734	1.104	.749	1.124
8,4	.717	1.075	.720	1.091
4,8	.715	1.078	.718	1.088
Adjacent to SS Rod Bearing Assemblies				
6,6	1.160	1.284	1.179	1.301
7,4	1.127	1.248	1.139	1.256
4,7	1.125	1.240	1.138	1.249
6,5	.886	.948	.895	.952
5,6	.888	.938	.897	.948

* X,Y Location coordinates corresponding to Figure 2.

FIGURE 1

TROJAN CYCLE 5 CORE LOADING

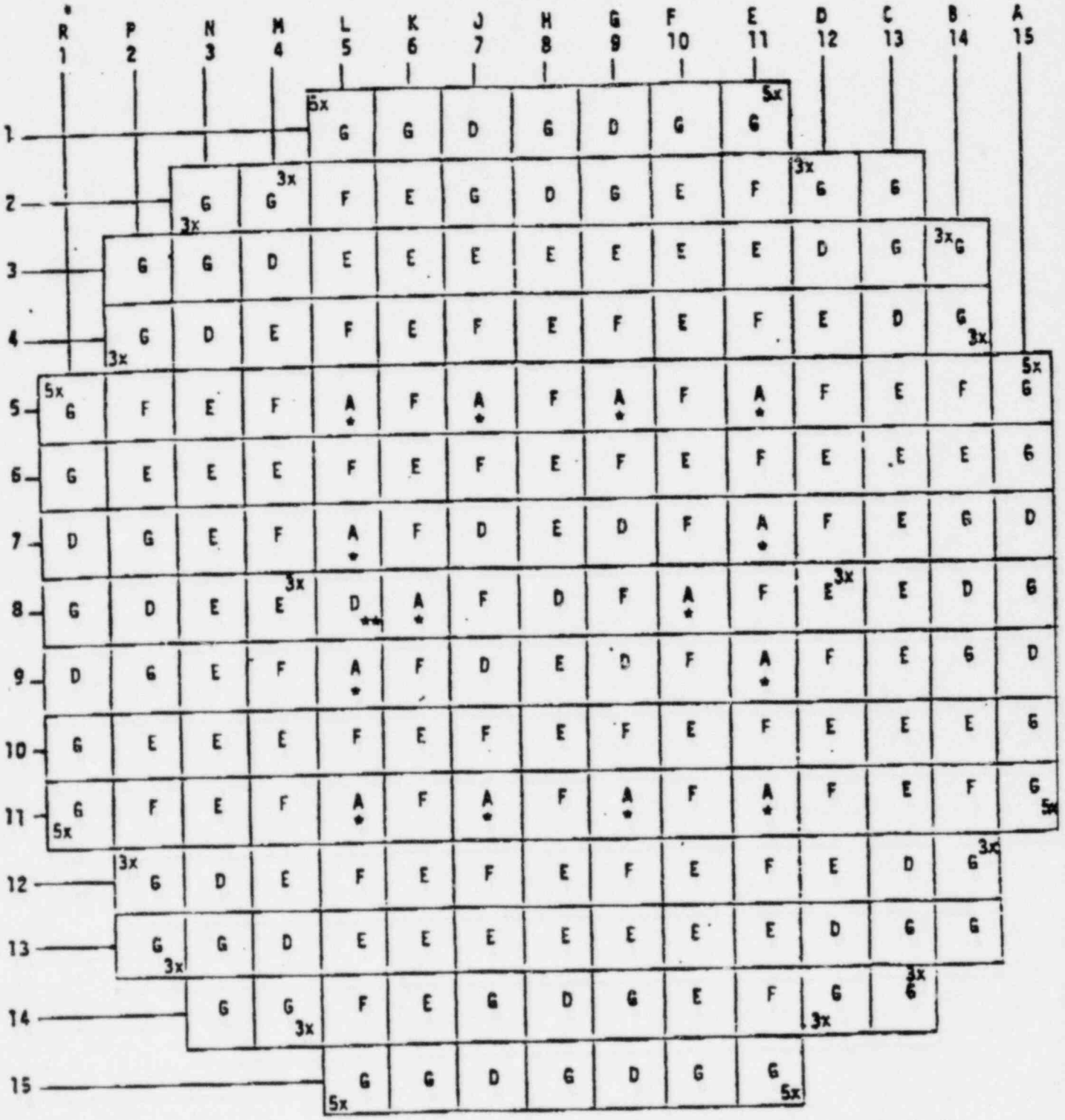
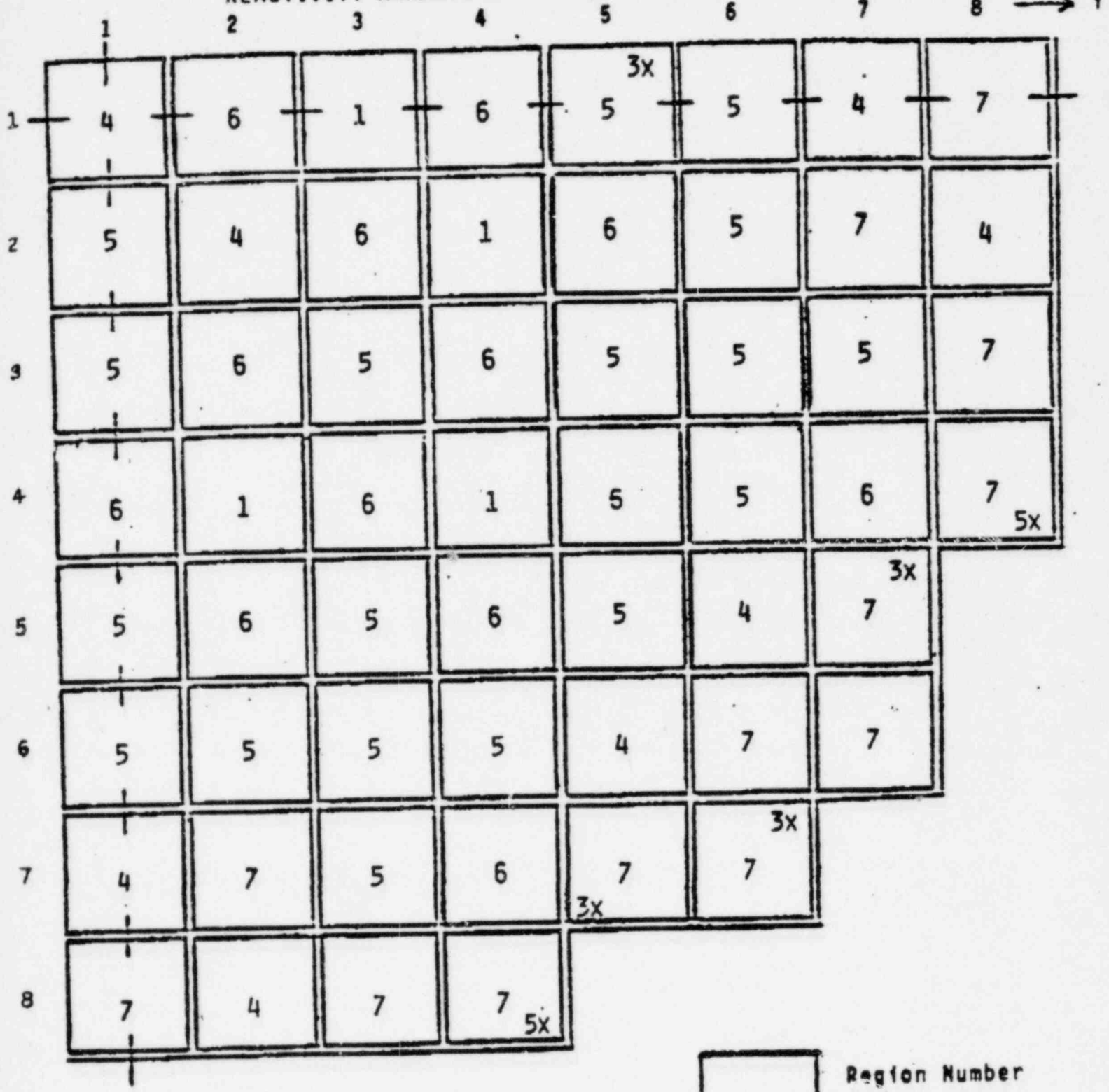


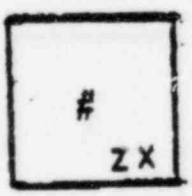
FIGURE 2

POR CYCLE 5

REACTIVITY ARRANGEMENT IN QUARTER CORE SYMMETRY



14	Region 1
26	Region 4
60	Region 5
45	Region 6
48	Region 7



Region Number

Assembly location/ orientation of z stainless steel rods