Radiation Center | Oregon State University | Corvallis, Oregon 97331 (503) 754-2341

June 19, 1979

U.S. Nuclear Regulatory Commission
Region V
Office of Inspection and Enforcement
1990 N California Blvd.
Walnut Creek Plaza, Suite 202
Walnut Creek, CA 94596

Reference: Docket No. 50-243, License No. R-106

Gentlemen:

On June 7, 1979, the shutdown margin of our TRIGA reactor was $0.48, nine cents less than our Technical Specifications (Part 3.2) limitation of $0.57. This was reported to your office by telephone on June 8, 1979, as required by our Technical Specifications (Part 6.7.a). This written report, required by Part 6.7.b of our Technical Specifications, provides more details of this occurrence.

Incident

On June 7, 1979, during a core configuration change to accommodate an experimental request, our shutdown margin (with the most reactive rod out) dropped to $0.48, nine cents less than the Technical Specification limit of $0.57.

Corrective Action

As soon as the situation was discovered, two fuel elements were moved and the shutdown margin went up to $0.74. These two fuel elements were moved on June 7, 1979. Thus, the situation was corrected physically the same day.

This incident was discussed at a Reactor Operations Committee (ROC) meeting held on June 11, 1979. The ROC, upon review of Oregon State TRIGA Reactor Operating Procedures (OSTROP) No. 11 (Fuel Handling Procedures), decided that more guidance should be provided in this OSTROP regarding core excess and shutdown margins during core configuration changes. The ROC directed that the reactor staff write such revisions to OSTROP No. 11 and submit them to the ROC for review and approval. Such revisions to OSTROP No. 11 hopefully will prevent such a situation from arising again.

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Background Details

The core, prior to these changes, was quite symmetrical (see Fig. 1). An experimenter wanted the core skewed toward beamport #4 (the upper left quadrant on Fig. 1) to enhance the flux for his experiment. This change was discussed and approved by the ROC on March 6, 1979.

The first change (see Fig. 2) was performed with three fuel elements left out of the core (i.e., the core in Fig. 2 has three less fuel elements than the original core in Fig. 1). This was done to be conservative, as it was hard to estimate how much the rod worths and core excess would change in this new configuration. As expected, the worths of the regulating and safe rods went down and the worths of the shim and transient rods went up. The total rod worth went down ($10.64 vs. $11.45) in going from Fig. 1 to Fig. 2, and the core excess went down, due to the poorer core geometry and the loss of three fuel elements.

The worth of the fuel element in position G-12 was then measured and found to be worth $0.31. This number was very consistent with previous measurements of fuel element worth. If the three remaining fuel elements were added to the G-ring in positions G-9, G-10, and G-11, we estimated that this would increase the core excess by about 3(31¢) = $0.93. If the rod worths did not change at all, the shutdown margin should be $1.58 - $0.93 = $0.65, still within the Technical Specifications limits. Furthermore, we estimated that the transient rod worth would increase by this fuel addition, and the worths of the other three rods would be basically unchanged. If this were the case, it would increase our shutdown margin even more.

Thus, we decided to add the remaining three fuel elements to the G-ring (see Fig. 3). After the rods were calibrated in this configuration, we discovered that the core excess had increased by $1.11, rather than the $0.93 as predicted, and the shutdown margin was now only $0.48.

Two fuel elements were then moved (from G-9 to F-28 and from G-17 to F-19), and the final core configuration (see Fig. 4) has an acceptable shutdown margin of $0.74.

If there is any further information you desire regarding this occurrence, please let us know.

Sincerely,

C. H. Wang
Reactor Administrator
Director, Radiation Center

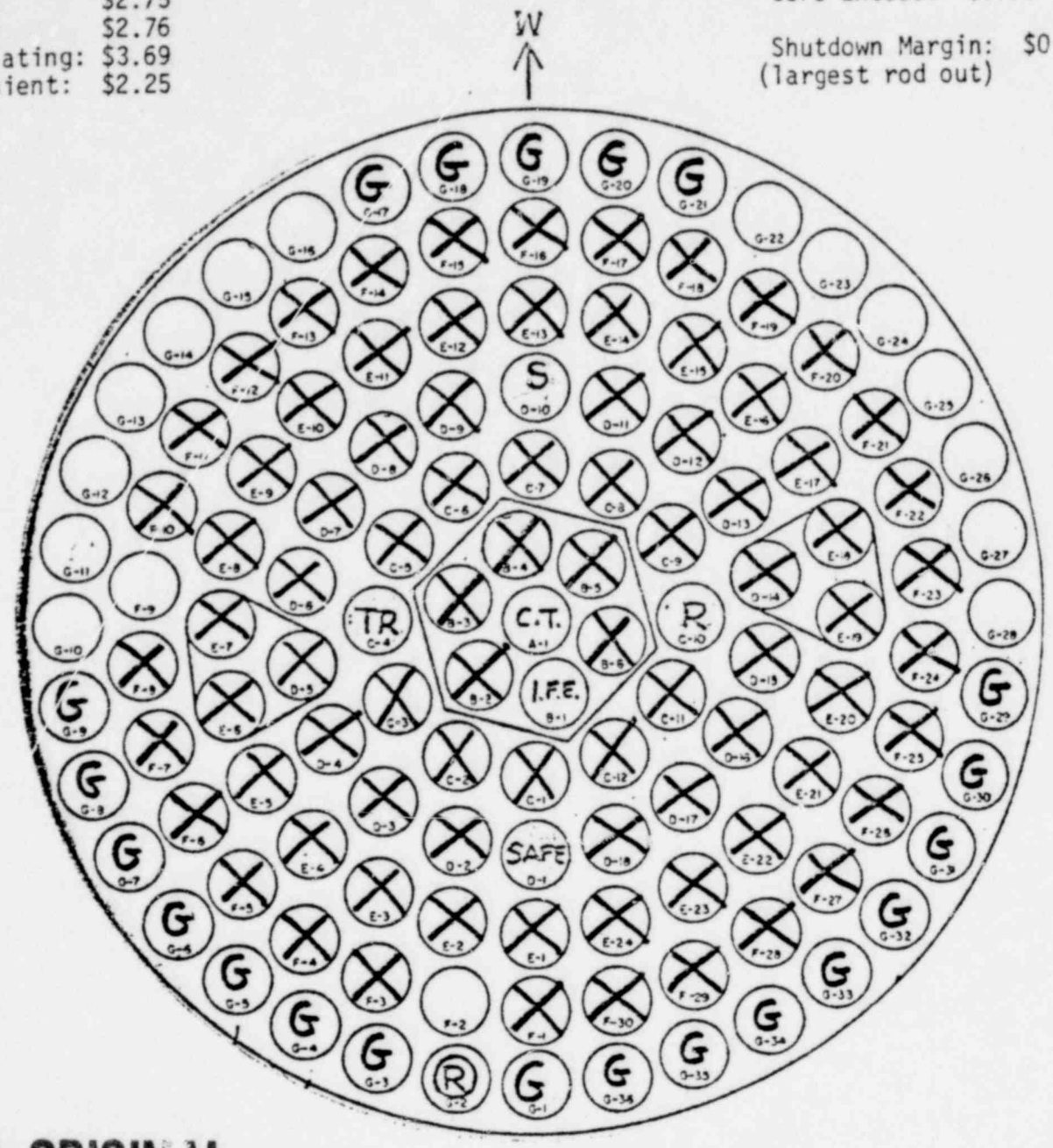
CHW/rk
Enclosures
cc-USNRC Office of Inspection & Enforcement, Washington DC
Oregon Department of Energy
J. C. Ringle, Assistant Reactor Administrator, OSU
T. V. Anderson, Reactor Supervisor, OSU
A. G. Johnson, Health Physicist, OSU

Fig. 1. Core Before Configuration Change

Safe: $2.75
Shim: $2.76
Regulating: $3.69
Transient: $2.25

Core Excess: $6.90

Shutdown Margin: $0.86
(largest rod out)



POOR ORIGINAL

G — GRAPHITE ELEMENT

FUEL ELEMENT

IFE — INSTRUMENTED FUEL ELEMENT

EMPTY

CT — CENTRAL THIMBLE

TR — TRANSIENT ROD

S — SHIM ROD

R — REGULATING ROD

SAFE — SAFETY ROD

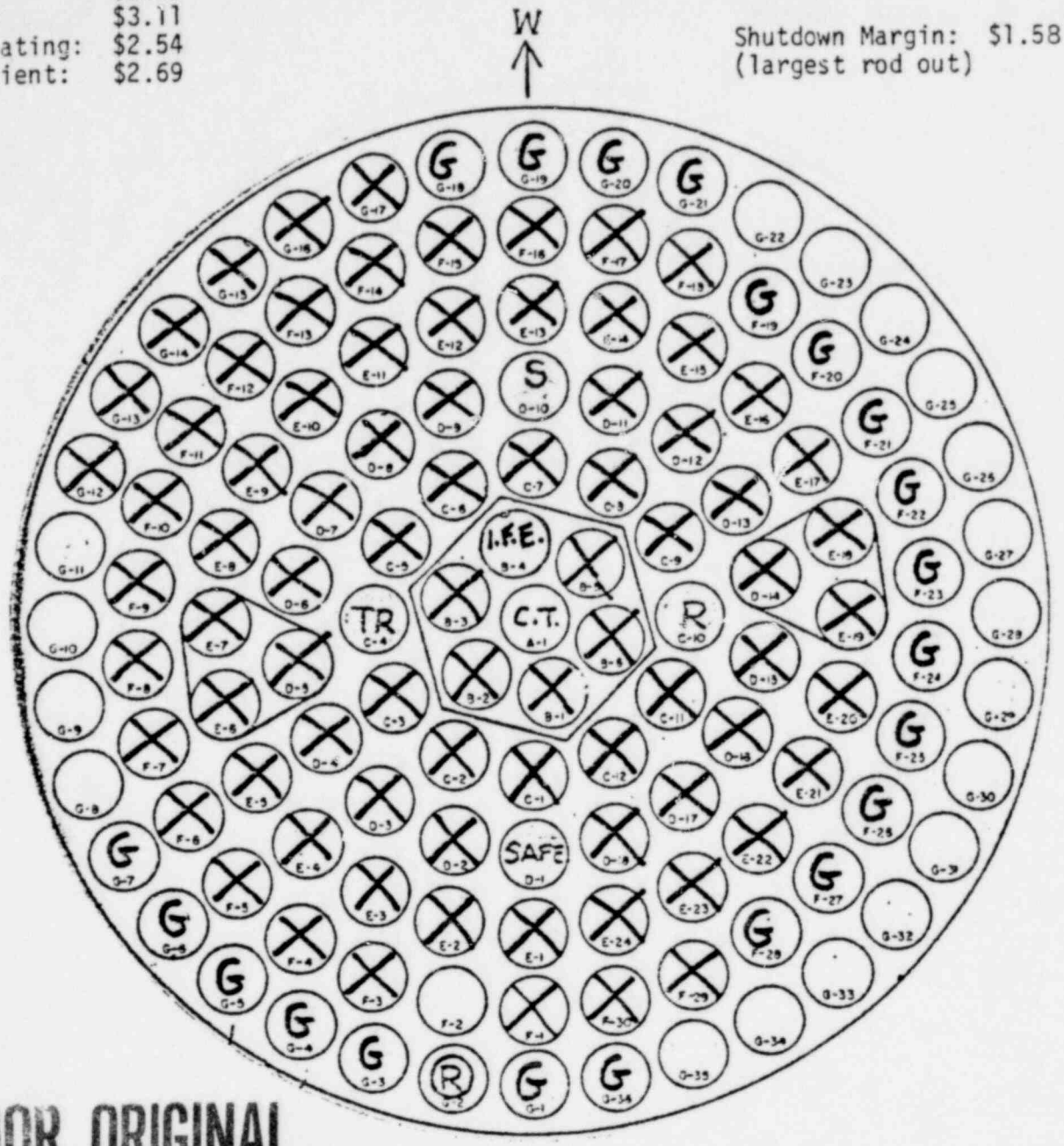
R — RABBIT FACILITY

Fig. 2. Core After Change #1

Safe: $2.30
Shim: $3.11
Regulating: $2.54
Transient: $2.69

Core Excess: $5.95

Shutdown Margin: $1.58
(largest rod out)



G — GRAPHITE ELEMENT

FUEL ELEMENT

IFE — INSTRUMENTED FUEL ELEMENT

EMPTY

CT — CENTRAL THIMBLE

TR — TRANSIENT ROD

S — SHIM ROD

R — REGULATING ROD

SAFE — SAFETY ROD

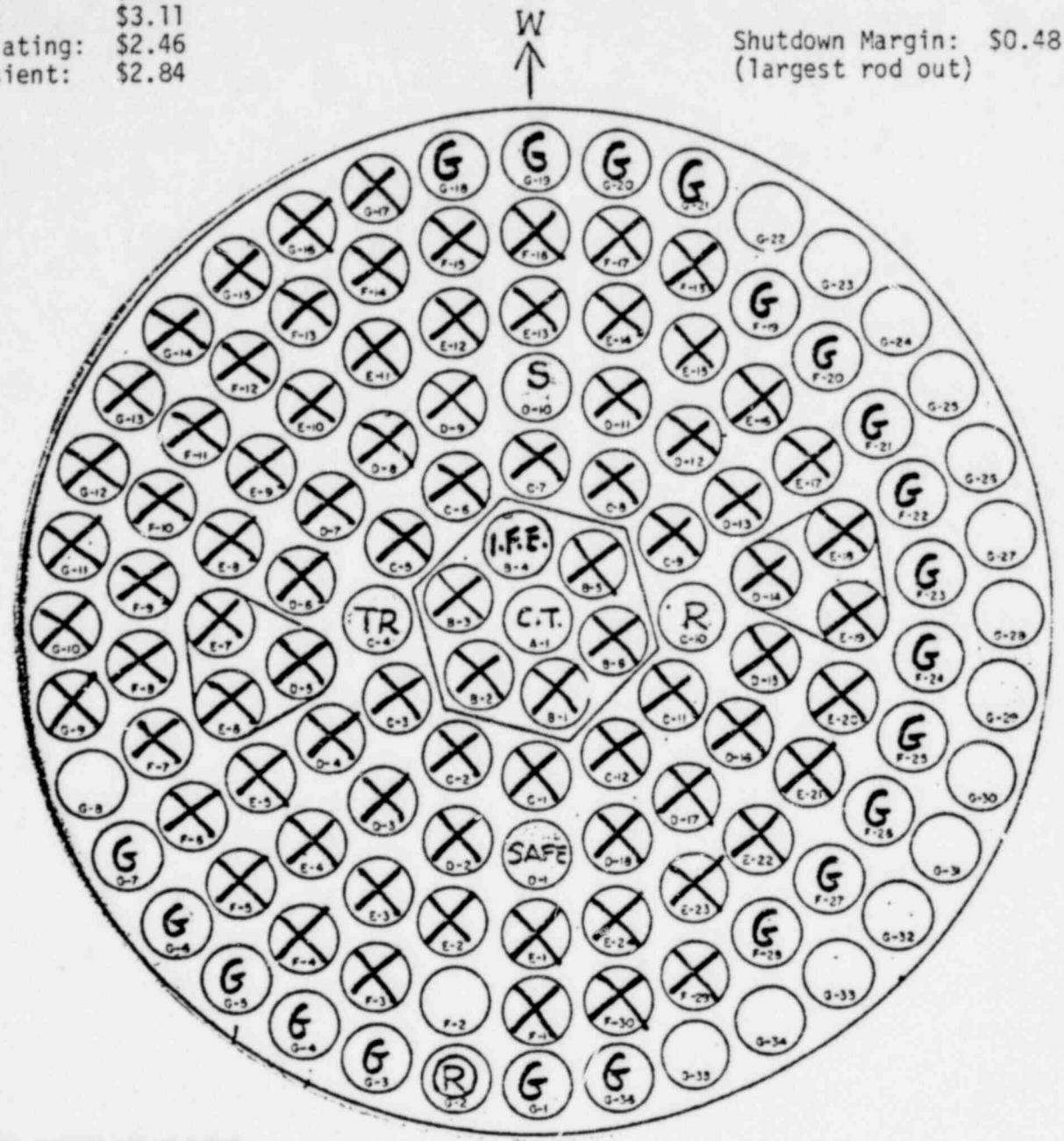
R — RABBIT FACILITY

Fig. 3. Core After Change #2

Safe: $2.24
Shim: $3.11
Regulating: $2.46
Transient: $2.84

Core Excess: $7.06

Shutdown Margin: $0.48
(largest rod out)



G — GRAPHITE ELEMENT

FUEL ELEMENT

IFE — INSTRUMENTED FUEL ELEMENT

EMPTY

CT — CENTRAL THIMBLE

TR — TRANSIENT ROD

S — SHIM ROD

R — REGULATING ROD

SAFE — SAFETY ROD

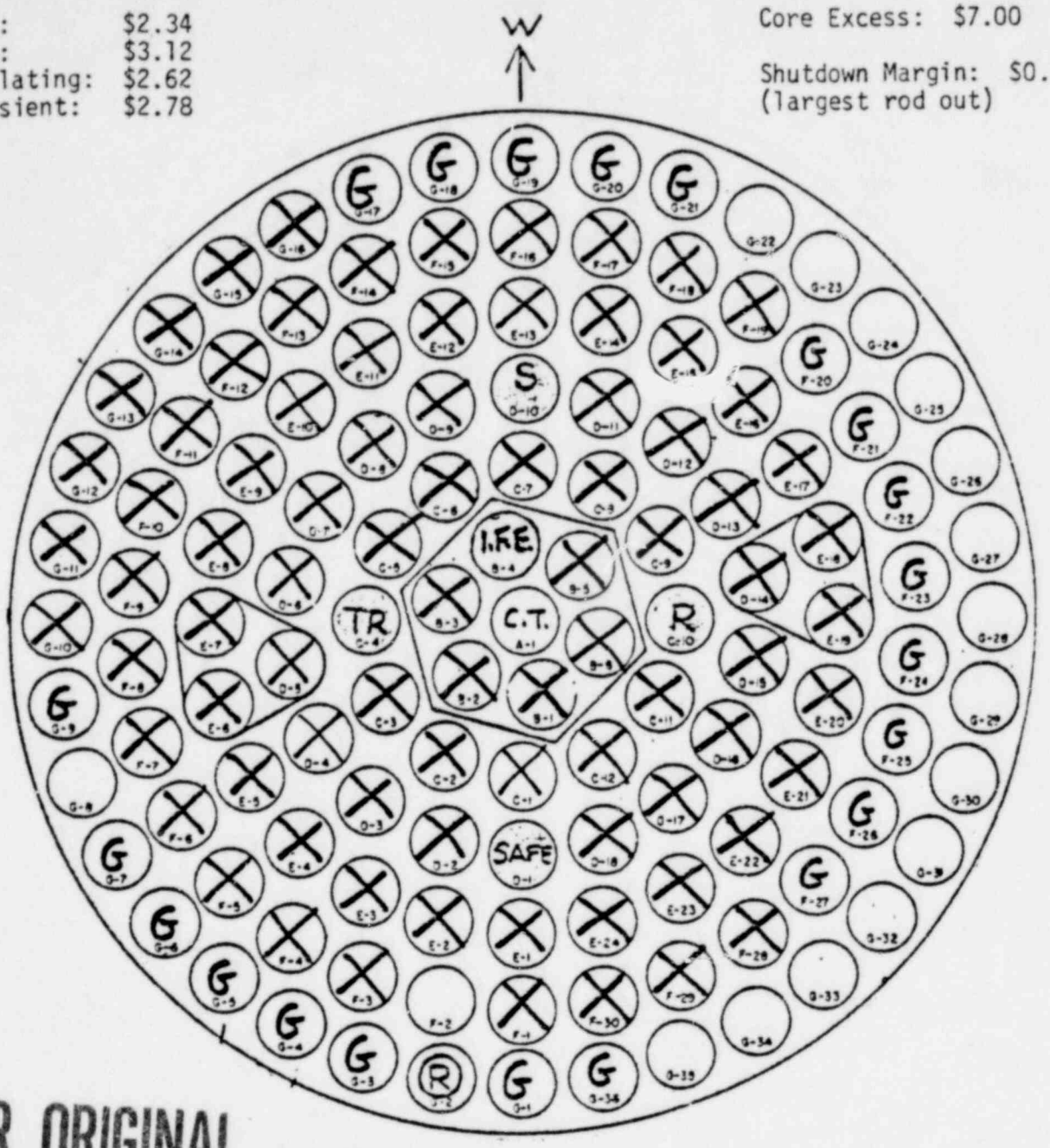
R — RABBIT FACILITY

Fig. 4. Core After Change #3 (Final Core Configuration)

Safe: $2.34
Shim: $3.12
Regulating: $2.62
Transient: $2.78

Core Excess: $7.00

Shutdown Margin: $0.74
(largest rod out)



G — GRAPHITE ELEMENT

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IFE — INSTRUMENTED FUEL ELEMENT

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