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FROM: Niagara Mohawk Power Corp. Syracuse, N. Y. 13202 T. J. Brosnan	DATE OF DOC: 4-21-72	DATE REC'D 4-24-72	LTR X	MEMO	RPT	OTHER
TO: Mr. Skovholt	ORIG 1 signed	CC	OTHER	SENT AEC PDR x SENT LOCAL PDR x		
CLASS: U/ PROP INFO	INPUT	NO CYS REC'D 40 cys rec'd	DOCKET NO: 50-220			

DESCRIPTION:
Ltr re our ltr dtd 3-21-72, trans the following:

ENCLOSURES:
Addl info regarding proposed changes to the Tech Specs & Bases for Nine Mile Point Station

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ACKNOWLEDGED

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NIAGARA MOHAWK POWER CORPORATION

NIAGARA MOHAWK

300 ERIE BOULEVARD WEST
SYRACUSE, N.Y. 13202

April 21, 1972

Mr. Donald J. Skovholt
Assistant Director for Reactor Operations
Division of Reactor Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Skovholt:

Re: Docket No. 50-220
License DPR-17

We submit the additional information requested in your letter of March 21, 1972 regarding proposed changes to the Technical Specifications and Bases for the Nine Mile Point Nuclear Station. Since testing of the new relief valve set points requires deinerting and access to the drywell, we plan, subject to your approval, to make these changes and perform the necessary testing during the current station outage.

In addition to data on operational transients, your letter also requested information on the postulated control rod drop accident. A complete reanalysis of this accident will be forthcoming in the very near future from the General Electric Company as a Topical Report generic to boiling water reactors.

Very truly yours,

T. J. Brosnan

T. J. Brosnan
Vice President and Chief Engineer

Enclosures

2218

Question No. 1

You state that improved analytical techniques available at General Electric Company caused you to adopt the proposed revised scram reactivity curve, but no information regarding these techniques was provided. Describe the analytical techniques used previously, the changes being made to the analytical model, and the basis for considering the change an improvement.

Answer No. 1

The improved analytical techniques which caused adoption of a new scram reactivity curve include:

(a) A revised power shaping philosophy has been followed which results in a flatter axial power distribution (lower lineal heat generation rates) particularly at end-of-cycle. The power shaping has been accomplished by management of control rod patterns throughout the operating cycle in accordance with the Haling principle. Although not presently incorporated in fuel at Nine Mile Point, the use of axial shaped gadolinia may also be used in the future to further flatten the power distribution.

(b) A new lattice code[2] for calculation of bundle k_∞'s has replaced the model originally used for Nine Mile Point fuel. The use of the new lattice code[3] as further described herein, also results in a flattening of the axial power distribution.

(c) More detail has been incorporated into the model for calculation of scram reactivity.

The changes described in (b) and (c) have the effect of decreasing the peak axial power and moving the peak away from the bottom of the core as an equilibrium fuel cycle is approached. These effects, in turn, reduce the initial rate of reactivity inserted by a scram because of the increased time interval between the scram iniation and the point where the control blades enter the high power region of the core.

The revised power shaping philosophy is directed toward maintaining a relatively constant power distribution throughout each fuel cycle. Careful management of control rod patterns during power operation in accordance with the Haling principle will result in minimum peaking at the end-of-cycle with all control rods out of core.

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[1]Haling, R. K., "Operating Strategy Maintaining an Optimum Power Distribution Throughout Life", TID-7672, p. 205, (September, 1963)

[2]AEC Docket 50-298, Browns Ferry Station, Safety Analysis Report, Volume I, pp. II-6-2

[3]AEC Docket 50-220, Nine Mile Point Nuclear Station, Final Safety Analysis Report, Volume I, pp. IV-22-24

The newer lattice code results in an improved calculation of k_∞'s. A significant difference in the k_∞ predicted by each lattice model can be seen by examination of the curves in Figure 1-1. The new lattice code predicts higher k_∞'s at high void and lower k_∞'s at lower void conditions relative to the older lattice code. This results in a lower predicted peak power at the bottom of the core which reduces the initial rate of scram reactivity.

The basic refinements in the analytical techniques for evaluation of the scram reactivity curve characteristics referred to in (c) above include the following changes:

(a) An increase in the number of prompt neutron groups from 1.5 to 3.

(b) An increase in the number of axial nodes.

(c) Replacement of the time constant previously used to relate heat flux to voids with a transient thermal hydraulic model similar to that used in blowdown transient analyses.

(d) Adding the ability to represent cross-section data based on typical exposure and void history.

(e) An improved finite difference representation of the one-dimensional time dependent few group neutron diffusion equations.

Question No. 2

Describe the data and measurements obtained at Nine Mile Point from reactor operations and tests that support use of the new analytical techniques.

Answer No. 2

The management of control rod patterns at Nine Mile Point has enabled the core to develop and maintain an axial power distribution and, therefore, an exposure distribution, consistent with the objective of minimizing power peaking throughout each operating cycle. Figure 2-1 compares the exposure distribution calculated from Nine Mile Point reactor operation as of January, 1972, with the "target" exposure distribution derived from the Haling principle. The "target" exposure distribution has been computed for an all rods out condition prior to removal of control curtains, it does not represent the equilibrium end-of-cycle condition.

Confirmation of the new lattice code is evidenced by the ability of this code, in conjunction with a gobal 3-D simulator[1] to predict power distributions and rod inventory. Figure 2-2 compares the normalized predicted rod inventory to actual rod inventory during the operating period just prior to the current station shutdown.

In addition, comparisons of predicted and observed data have been made for various other reactors[1],[2] which are also applicable to the Nine Mile Point reactor in demonstrating the general adequacy of the basic computer model employed for these calculations.

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[1]Crowther, R. L. and et. al., "Three Dimensional BWR Simulation" (TID-4500), Proceedings of Conference on Effective Use of Computers in Nuclear Industry, Knoxville, Tennessee, April 21 - 23, 1969.

[2]Fuller, E. D., "Physics of Operating Boiling Water Reactors," Nuclear Applications and Technology, Volume 19, pp. 622 - 633, (November, 1970).

Question No. 3

The effect of partial refuelings on the scram reactivity curve has not been presented. Please define the relationship of the present core loading with the scram reactivity curve and describe the effect on the scram reactivity from approaching an equilibrium fuel loading, including the expected operational control rod patterns.

Answer No. 3

The scram reactivity curve used in the analysis presented in our letter of February 28, 1972, was a conservative estimate of an end condition for a fuel cycle approximating the equilibrium fuel loading.

Additional calculations have been made of a conservative scram reactivity curve typical of the period immediately following removal of control curtains. These results are shown in Figure 3-1 along with curves used in previous analyses. All of these scram reactivity curves are conservatively based on a scram time of 5 seconds for 90 percent insertion; a condition which does not exist at this station. Figure 3-1 indicates there will be a gradual reduction in the initial scram reactivity insertion rate as the core approaches an equilibrium condition. Figure 3-2 shows an axial control rod position and the resultant relative axial power distribution which is typical of expected reactor performance following the curtain removal.

Other axial control rod fractions have been examined which result in a scram reactivity insertion rate close to that corresponding to beginning of life. These patterns result in high axial power peaking which is not consistent with current desires to limit total peaking factors, and, therefore, heat flux to those required to achieve optimum fuel performance.

Question No. 4

Your analyses supporting the proposed changes do not include consideration of the control rod drop accident. The change in slope of the scram reactivity curve would indicate an increased rate of reactivity insertion in the event of a control rod drop accident. Provide a complete reanalysis of this accident, including consideration of the validity of the assumed maximum reactivity worth of the control rod involved in the drop accident. Your attention is directed to a letter dated March 8, 1972, to Mr. A. P. Bray of the General Electric Company from Mr. R. S. Boyd, Division of Reactor Licensing. A copy of this letter is enclosed for your convenience.

Answer No. 4

Reanalysis of the control rod drop accident as outlined in Mr. Roger S. Boyd's March 8, 1972, letter to Mr. P. A. Bray is now being prepared by General Electric and will be submitted to the Commission as a Topical Report in the very near future.

The Station's Technical Specifications (3.1.1b(3)) require that a prescribed control rod withdrawal sequence be adhered to during plant startups in order to limit maximum rod worth. Specifically, when the rod worth minimizer is not operable, a second licensed operator or qualified technical station employee shall verify that the operator at the reactor console is following the prescribed rod withdrawal sequence.

FIGURE 1-

NINE MILE POINT

K∞ (HOT) VERSUS PERCENT IN CHANNEL VOIDS

INITIAL FUEL-UNCONTROLLED CURTAINS-ZERO EXPOSURE

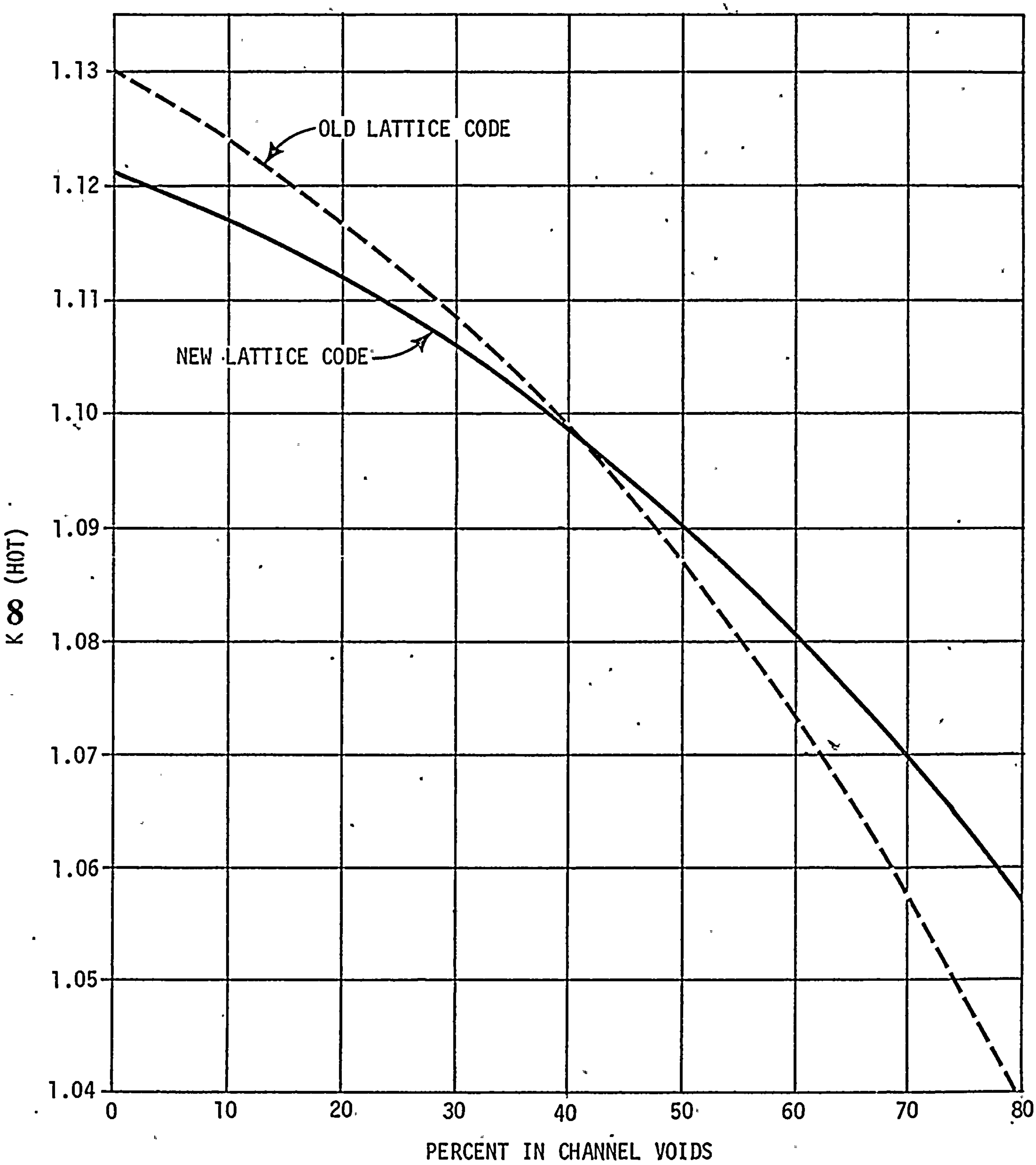

FIGURE 2-1

NINE MILE POINT REACTOR

AXIAL EXPOSURE DISTRIBUTION

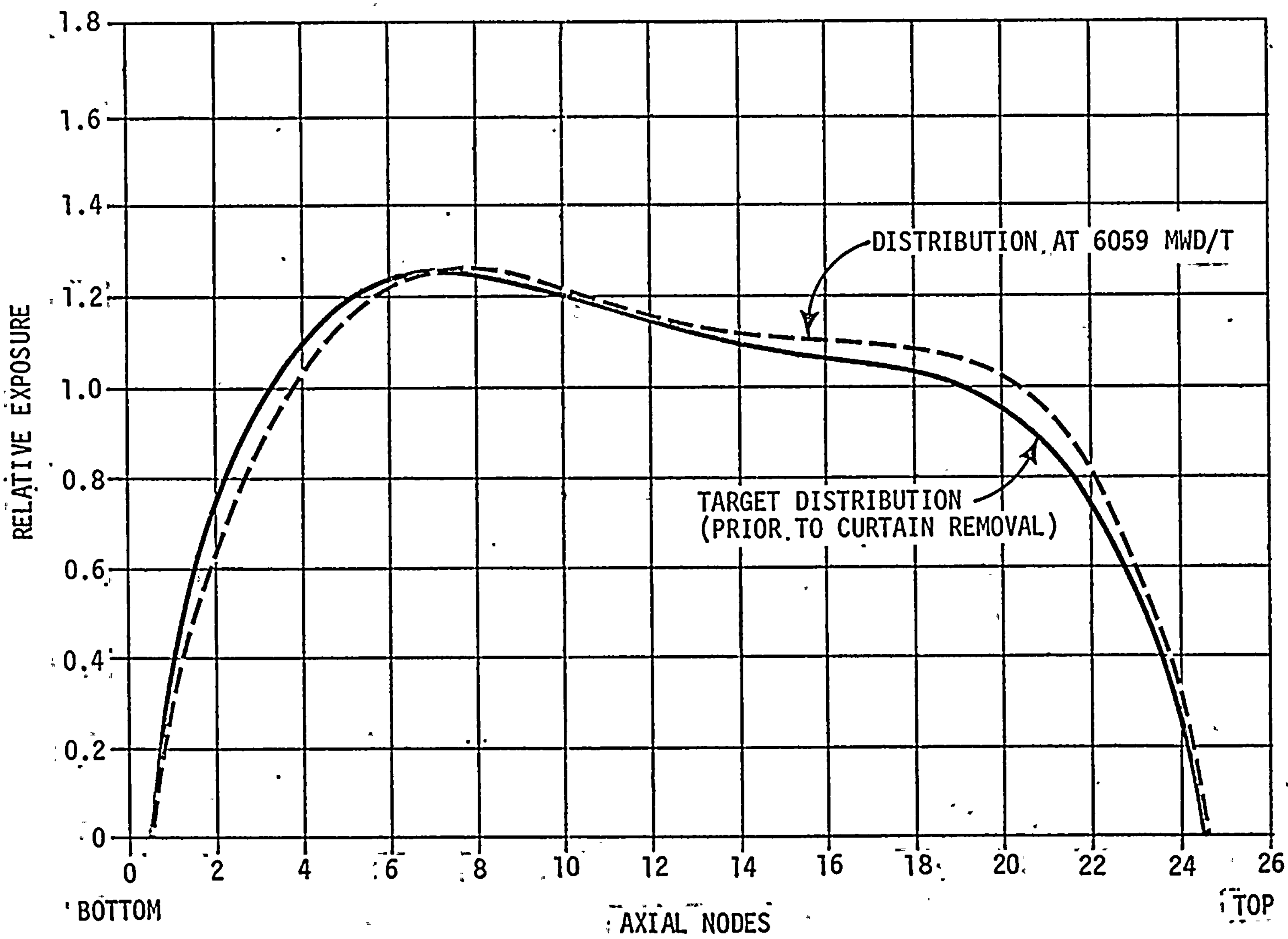

FIGURE 2-2

NINE MILE POINT

ROD INVENTORY VS. EXPOSURE

SEQUENCE A-3

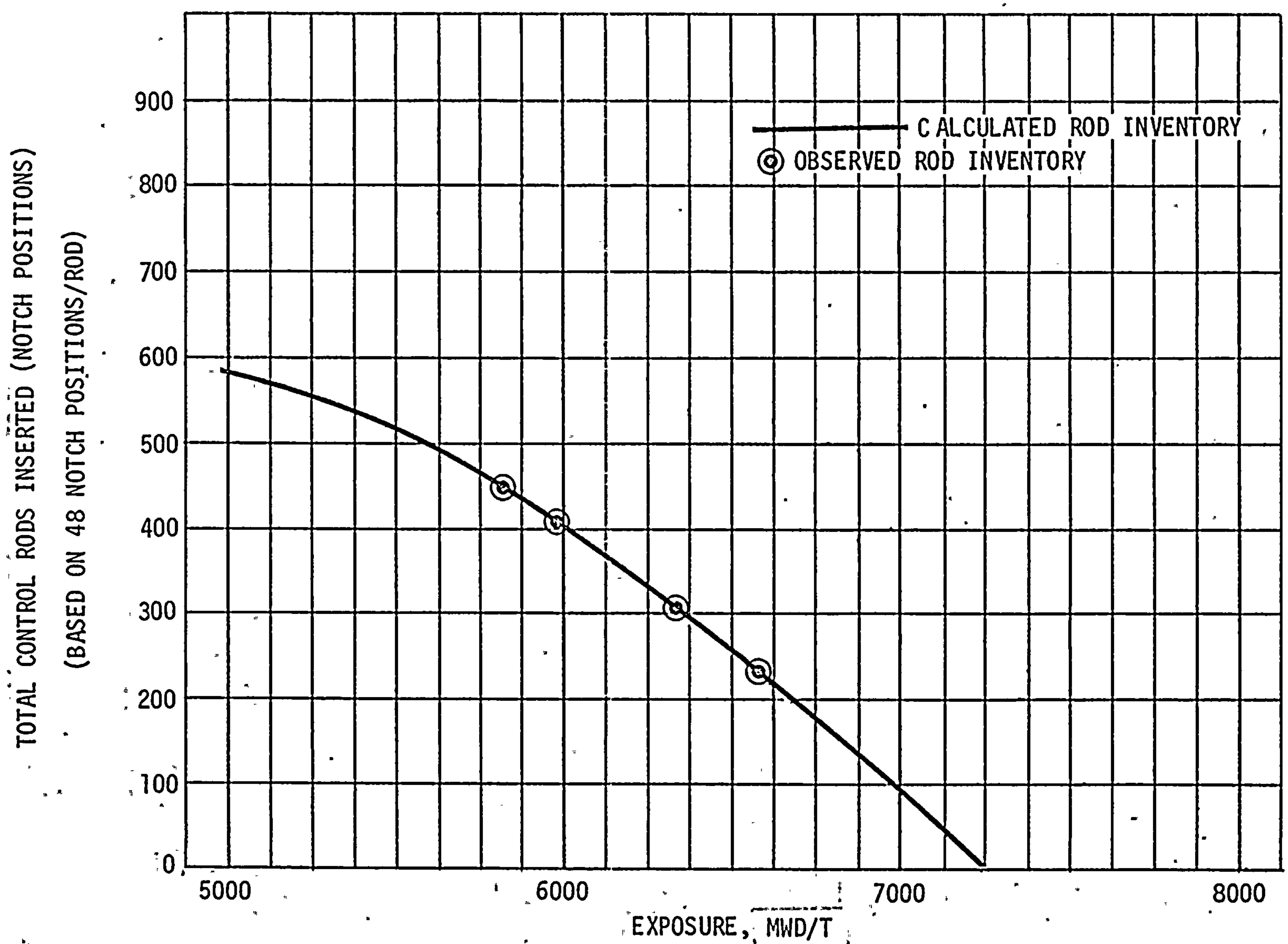

FIGURE 3-1

NINE MILE POINT

SCRAM REACTIVITY CURVES

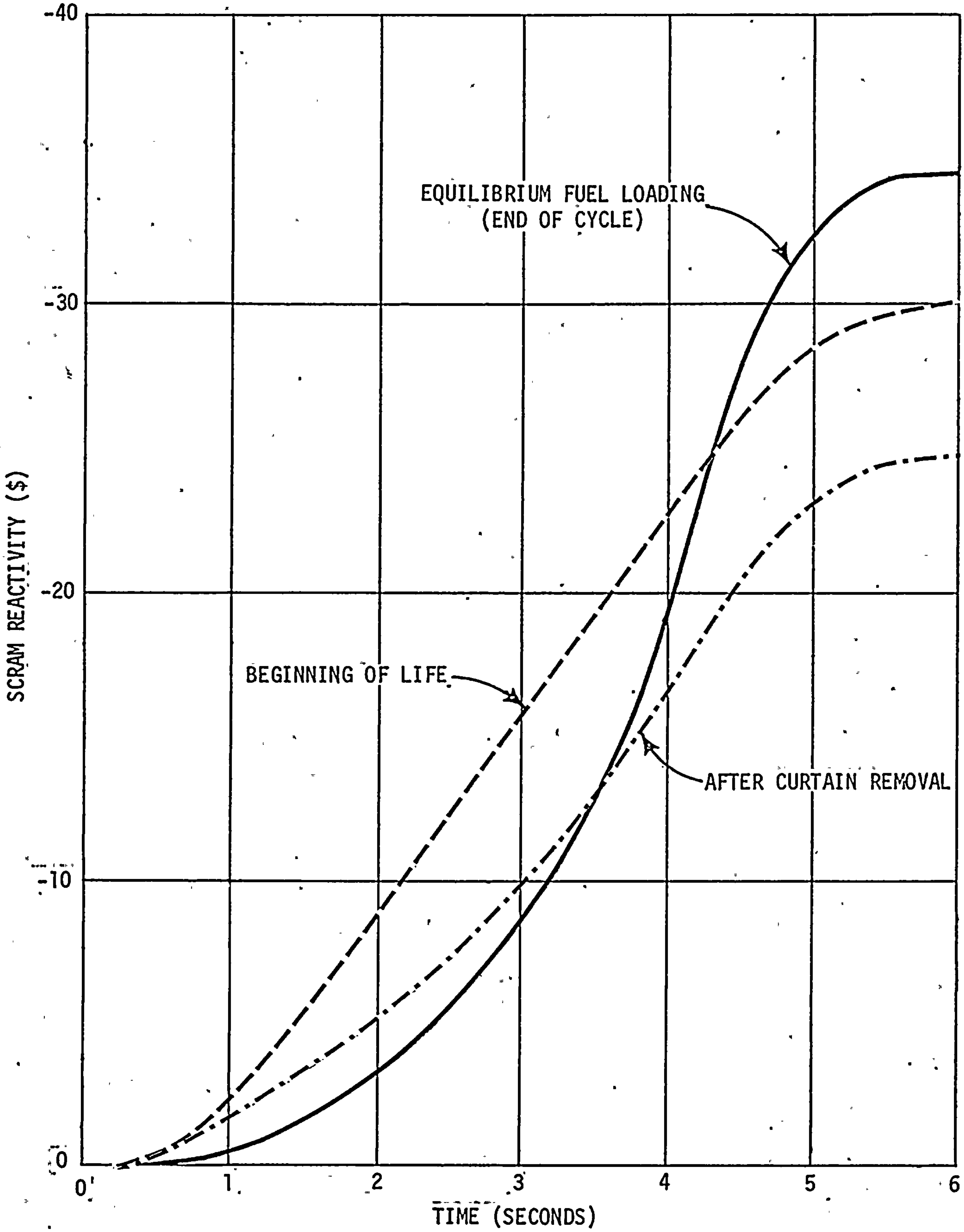

FIGURE 3

NINE MILE POINT

TYPICAL CONTROL FRACTION AND RELATIVE POWER VERSUS AXIAL POSITION

(AFTER CURTAIN REMOVAL)