ADDENDUM TO

FUEL DENSIFICATION - INDIAN POINT NUCLEAR GENERATING

STATION UNIT NO. 2

March 22, 1973

Addendum to "Fuel Densification - Indian Point Nuclear Generating Station Unit No. 2" (January, 1973)

The changes indicated below have been made to the subject report.

1. Change to Region 1 Fuel Assemblies

Section 3.1.1.1 of the Fuel Densification Report for Indian Point Unit 2 states that 9 of the 65 Region 1 assemblies have been designed for two cycles of operation by use of the shorter plate-type bottom nozzle. During fuel refabrication, an additional 5 Region 1 assemblies were modified and now use this same plate-type bottom nozzle. Thus, Region 1 now contains 14 assemblies designed for two cycles of operation.

2. Change in Total Heat Flux Peaking Factor F_Q, vs Axial Offset

Since the issuance of the Indian Point Unit No. 2 Fuel Densification Report, the F_Q vs. axial offset correlation, which was presented in Figure 4.2, has been re-evaluated on a basis consistent with Attachment 3 of Westinghouse letter NS-SL-524 to D. Knuth from R. Salvatori, dated January 2, 1973. The methods employed for the results presented below are the same as in the original IPP 2 analysis, but with more control rod maneuvers and resultant transients considered. The same margins for uncertainty and manufacturing tolerances are included as in the previous analysis. As in the previous analysis, the axial power peaking factor and a horizontal peaking factor, F_{xy}, at the plane of the peak local power no lower than 1.44 were also incorporated. This new correlation is shown in the revised Figure 4.2 and necessitates the following changes in operating procedures to assure conformity to the assumptions of the revised analyses.

a. The control rod insertion limits must be revised as indicated below in the revision for Section 7.0. This is due to the fact that unacceptable values of F_Q result from some transients considered with control rods at their previous full power insertion limit.

b. The change in the shape of the F_Q envelope necessitates a modification to the reactor trip settings. This has also been incorporated in a change for Section 7.

The re-evaluation indicates that a total peaking factor, F_Q, of 2.70 is still maintained by reference only to the ex-core detector axial offset.

3. Changes to the Technical Specification

Changes to the Technical Specifications are contained on the revised pages 7-2, 7-3, 7-4 and 7-6 and the revised Figures 3.10-1 and 3.10-2.

1. For $(q_t - q_b)$ within the range between ΔI_1 and ΔI_2 given in the table below, $f(\Delta I) = 0$ (where q_t and q_b are percent power in the top and bottom halves of the core respectively, and $q_t + q_b$ is total core power in percent of rated power.)

2. For each percent that $(q_t - q_b)$ is less than ΔI_1, the Delta-T trip set point shall be automatically reduced by 4.5% of its value at rated power. For each percent that $(q_t - q_b)$ is greater than ΔI_2, the Delta-T trip set point shall be automatically reduced by 2% of its value at rated power.

ΔI_1 and ΔI_2 are linear functions of the gain K_4. The proper limits on ΔI_1 and ΔI_2 shall be obtained from the following table which gives the allowable values corresponding to the actual value of K_4.

K_4	ΔI_1	ΔI_2
$\leq$ 1.01	$\geq$ -16.0	$\leq$ +16
1.04	$\geq$ -15.33	$\leq$ +14.5
1.07	$\geq$ -14.66	$\leq$ +13
1.10	$\geq$ -14.0	$\leq$ +11.5
1.13	$\geq$ -13.33	$\leq$ +10
1.16	$\geq$ -12.66	$\leq$ +8.5
1.19	$\geq$ -12	$\leq$ +7

Basis for Revision:

The $f(\Delta I)$ function in overpower and overtemperature protection system setpoints have been revised to include effects of fuel densification on core safety limits. The revised setpoints as given above will ensure that the safety limit of centerline fuel melt will not be reached and DNBR of 1.30 will not be violated.

Section 3.10 CONTROL ROD AND POWER DISTRIBUTION LIMITS

Specification:

The referenced portion of the previous specification is noted in parenthesis.

(3.10.1) Control Rod Insertion Limits

(3.10.1.5) The part length rods shall not be more than 70% inserted.

(3.10.2) Power Distribution Limits and Misaligned Control Rod

(3.10.2.1) (Change 50% to 75%)

(3.10.2.2-b) The hot channel factors shall be determined and maximum allowable power shall be reduced one percent for each percent the hot channel factors exceed the design values of:

$F_Q^N \leq 2.62 \, [1 + 0.2(1-P)]$ in the indicated flux difference range of +7 to -12 percent

$F_{\Delta H}^N \leq 1.65 \, [1 + 0.2(1-P)]$

where P is the fraction of full power at which the core is operating.

For every percent outside of the indicated flux difference range +7 to -12 percent, the allowed F_Q^N may be increased above 2.62 by 2 percent in the positive range and by 4.5 percent in the negative range.

The measured values, with due allowance for measurement error, must be corrected by including a penalty as shown on Figure 3.10-4 (at the approximate core location) to account for fuel densification effects before comparison with the limiting values above.

(3.10.2.6) Except during physics tests, the following power distribution restrictions must be maintained:

3. The control bank insertion limits are not violated.

4. Axial power distribution guide lines, which are given in terms of flux difference control, are observed. Flux difference refers to the difference in signals between the top and bottom halves of two-section excore neutron detectors. The flux difference is a measure of the axial offset which is defined as the difference in power between the top and bottom halves of the core. Calculation of core average axial peaking factors have been correlated with axial offset. The correlation shows that an F_Q^N of 2.62 and allowed DNB shapes, including the effects of fuel densification, are not exceeded if the axial offset is maintained between -15 and +10 percent.

For operation at the fraction, P, of full power the design limits are met, provided,

$F_Q^N \leq 2.62 \, [1 + 0.2 \, (1-P)]$ in the indicated flux difference range range of +7 to -12 percent.

and

$F_{\Delta H}^N \leq 1.65 \, [1 + .2 \, (1-P)]$

For every percent outside of the indicated flux difference range +7 to -12 percent, the allowed F_Q^N may be increased above 2.62 by 2 percent in the positive range and by 4.5 percent in the negative range.

The permitted relaxation of F_Q^N and $F_{\Delta H}^N$ allows radial power shape changes with rod insertion to the insertion limits. The allowed increase in F_Q^N for large flux differences is consistent with power shapes assumed in setting the overpower and overtemperature ΔT setpoints. It has been determined that provided the above conditions 1 through 4 are observed, these hot channel factors limits are met.

For normal operation and anticipated transients the core is protected from exceeding 21.1 KW/ft locally, and from going below a minimum DNBR of 1.30, by automatic protection on power, flux difference, pressure and temperature. Only condition 1 through 3, above, are mandatory since the flux difference is an explicit input to the protection system.

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a. At rated power, the indicated axial flux difference must be maintained within +7 percent and -12 percent.

b. If, at rated power, the indicated axial flux difference exceeds the permissible range defined above for a period of more than eight hours, the situation shall be corrected or the reactor power shall be reduced 2 percent for each percent the flux difference exceeds the permissible positive range and reduced 4.5% for each percent in the negative range.

c. For every 2 percent below full power, the permissible flux difference range is extended by 1 percent in the positive range and 0.44 percent in the negative range.

Basis for Revision:

Part length rod insertion has been limited to eliminate certain adverse power shapes.

Two criteria have been chosen as a design basis for fuel performance related to fission gas release, pellet temperature and cladding mechanical properties. First the peak value of linear power density must not exceed 21.1 kw/ft. Second, the minimum DNBR in the core must not be less than 1.30 in normal operation or in short term transients.

In addition to the above, the initial steady state conditions for the peak linear power for a loss of coolant accident must not exceed the values assumed in the accident evaluation. This limit is required in order for the maximum clad temperature to remain below that established by the Interim Policy Statement for LOCA. To aid in specifying the limits on power distribution the following hot channel factors are defined.

F_Q, Heat Flux Hot Channel Factor, is defined as the maximum local heat flux on the surface of a fuel rod divided by the average fuel rod heat flux, allowing for manufacturing tolerances on fuel pellets and rods.

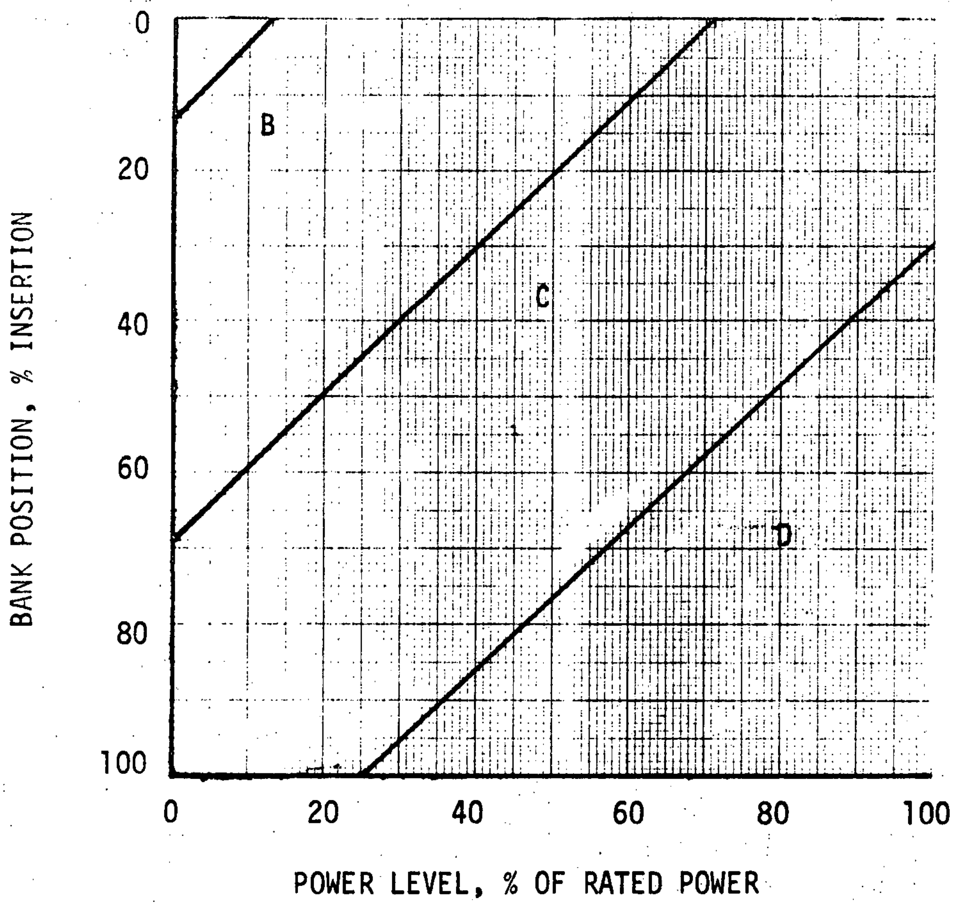

FIGURE 3.10-1 CONTROL BANK INSERTION LIMITS
FOR 4 LOOP OPERATION

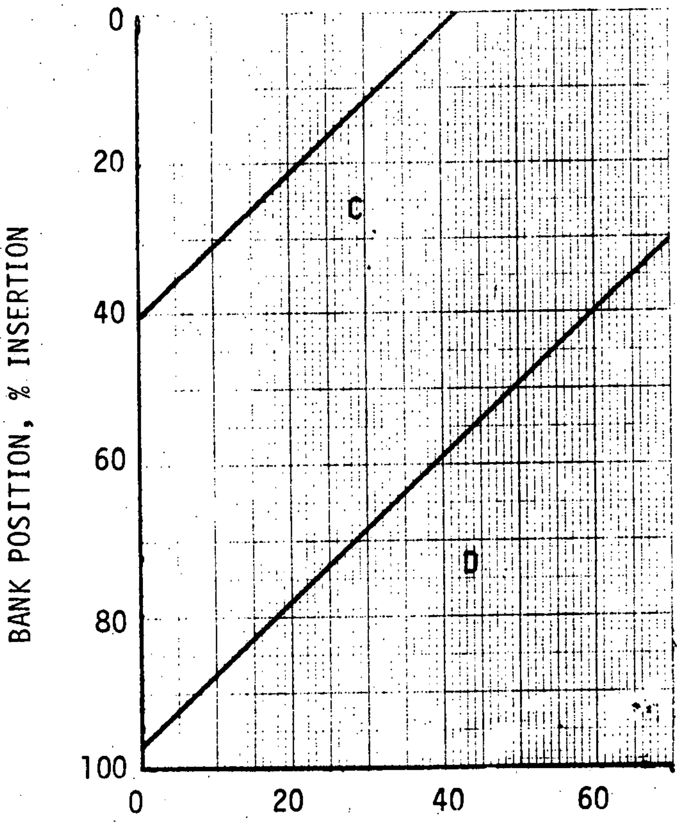

FIGURE 3.10-2 CONTROL BANK INSERTION LIMITS FOR 3 LOOP OPERATION

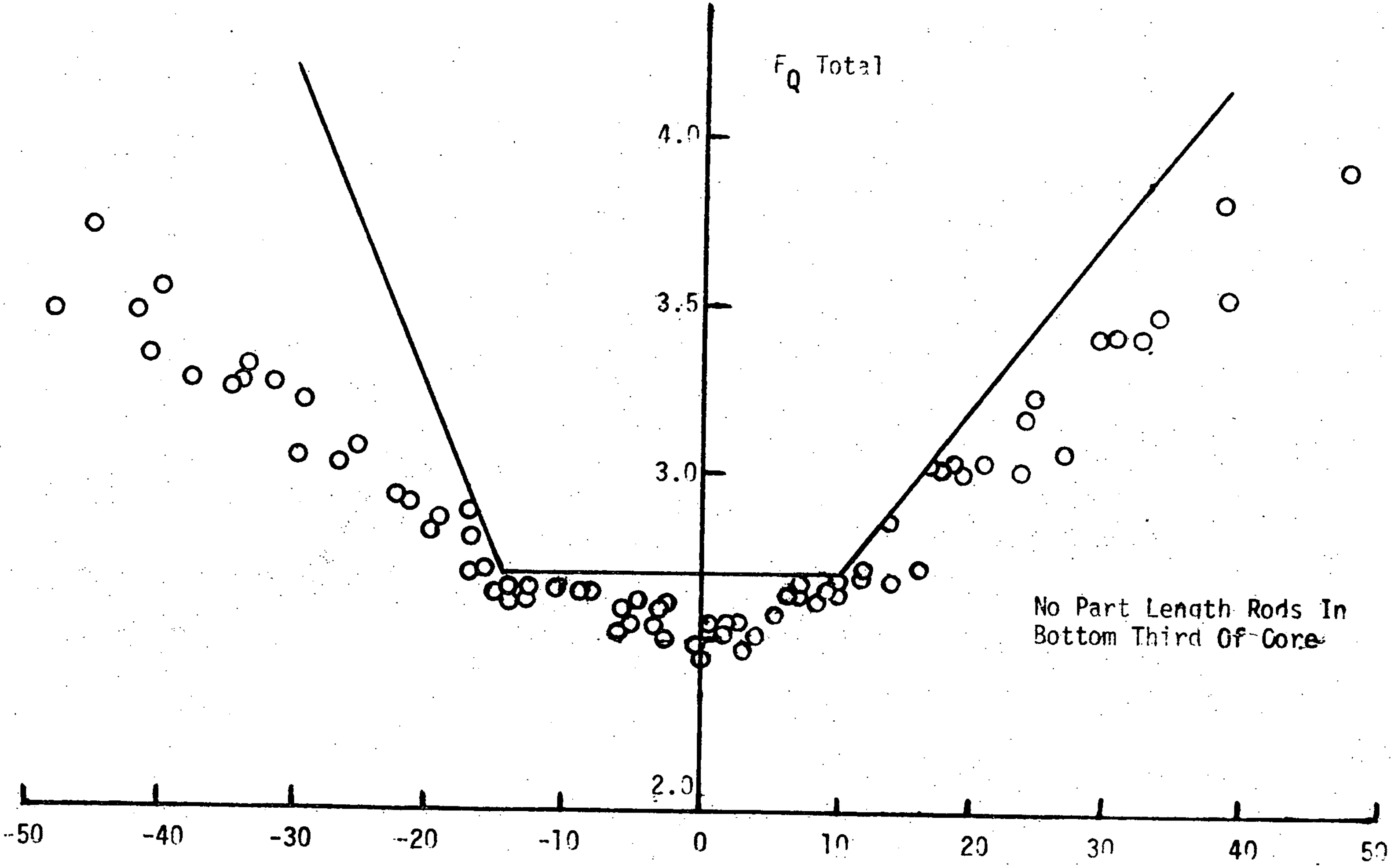

FIGURE 4.2 TOTAL HEAT FLUX PEAKING FACTOR - F_Q VS AXIAL OFFSET

Revised 3-22-73