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May 21, 1975

Regulatory File Cy

Mr. D. L. Ziemann, Chief
Operating Reactors - Branch 2
Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Station Unit 3
Reload No. 3 Licensing Submittal
Supplement C
NRC Docket No. 50-249

Dear Mr. Ziemann:

Attached is the subject supplement which provides the additional information requested in your letter dated May 12, 1975.

One (1) signed original and 39 copies are submitted for your use.

Very truly yours,

J. S. Abel
Nuclear Licensing Administrator
Boiling Water Reactors

Attachment

5702

Dresden Unit 3 - Reload No. 3 Licensing Submittal
Supplement C
Response to Letter from D. L. Ziemann dated May 12, 1975

Question 1

The accident reactivity characteristics for the rod drop accident shown in Figure 6-2 of NEDO-20694 imply segment rod withdrawals. This corresponds to a changing philosophy in the rod withdrawals previously established for Dresden Unit 3. Provide a thorough explanation and discussion of rod withdrawal sequences and patterns if different than previously reported to the NRC.

Response 1:

The rod drop accident analysis for Dresden Unit 3 cycle 4 was performed by applying the concept of incremental group withdrawal to bank intermediate withdrawal positions to limit the reactivity addition resulting from any possible rod drop to $\leq$ 1.3% ΔK.

The control rods in the core were assigned to either sequence A or sequence B, each sequence consisting of about 1/2 the control rods in the core. Each of these sequences were further broken down into four groups of rods, each group of rods being about 1/8 of the control rods in the core. Rod withdrawal sequences were then defined so that the groups 1 through 4 rods would be pulled in this order to arrive at a "checker board" rod pattern. The rod groups and basic withdrawal scheme does not differ from that used in the past. However, in order to insure that no possible rod drop can result in >1.3% ΔK reactivity addition, banked intermediate rod positions were defined as necessary so that the worth of an entire group of rods is $\leq$ 1.3% ΔK from one banked position to the next. In the case of Dresden Unit 3 cycle 4 calculations revealed that the reactor can not be made more than 1.3% ΔK supercritical at any exposure in the cycle with any moderator conditions in either sequence with only groups 1 and 2 withdrawn. Thus, no banked intermediate rod positions were defined for groups 1 and 2. The group 3 rods, however, were worth more than 1.3% ΔK and two intermediate rod positions (six notches and ten notches) were defined to limit the worth of the entire group of rods from one banked position to the next to $\leq$ 1.3% ΔK.

Response 1 (cont'd)

The group 4 rods were also worth more than 1.3% ΔK and one intermediate banked rod position was defined for group 4 (8 notches).

With the banked rod positions defined above, all the possible single rod drops for both cold and hot standby conditions were analyzed to find the cases which resulted in the greatest reactivity addition in the hot standby condition and in the cold condition. The rod drop which resulted in the maximum reactivity addition in the cold condition was found to occur at the BOC with groups 1 and 2 withdrawn in sequence B when control rod 26, 31 is dropped to the first banked position (the position of its drive). The resulting worth curve is shown in Figure 6-2 of NEDO-20694. The rod drop which results in the greatest reactivity addition with hot standby conditions was found to occur when groups 1 and 2 in sequence B are fully withdrawn and group 3 is at the second intermediate banked rod position with the exception of rod 26, 31 which is assumed to be detached from its drive and to fall from fully inserted to fully withdrawn. The resulting worth curve is shown in Figure 6-3 of NEDO-20694.

Withdrawal by banks does provide a valid technique for limiting rod worths; however, the process requires additional time for reactor startup. For this reason, Commonwealth Edison undertook a somewhat more extensive analyses of rod worth to allow reactor startup using only full rod withdrawal sequences through the fourth rod group, i.e., black and white rod pattern. The technique used for these analyses is summarized below. From these analyses, rod withdrawal sequences have been developed using full rods and smaller subgroups which minimizes the rod drop accident worth to a maximum of 0.013 ΔK supercritical.

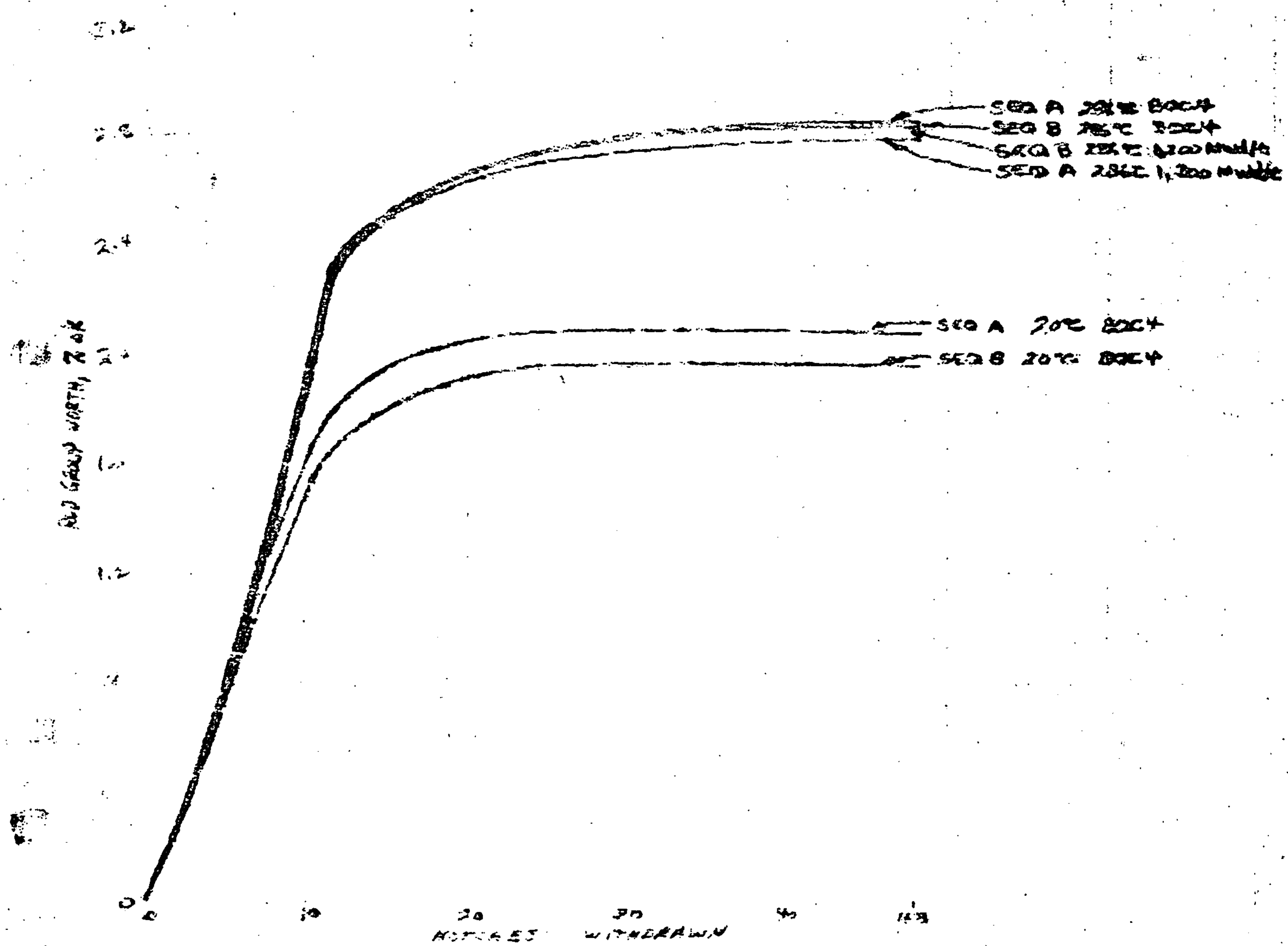
SUMMARY OF TECHNIQUE

The maximum worth rod in group 3 and 4 is determined for as-loaded core. If any rod within the group is $\geq$1.3% ΔK, that group is subdivided until the maximum worth rod within the subgroup is < 1.3% ΔK. These subgroups are programmed into the RWM. The analysis is done at hot 0 void conditions.

Attached are two figures based on calculations which have been performed with the Dresden Unit 3 cycle 4 design reference loading pattern which demonstrates that the worth of the group 3 and group 4 rods are greater at 0 voids, 286^{o}C conditions than at 20^{o}C conditions. These group worth calculations were performed for both sequence A and sequence B at several cycle exposures as noted in the figures.

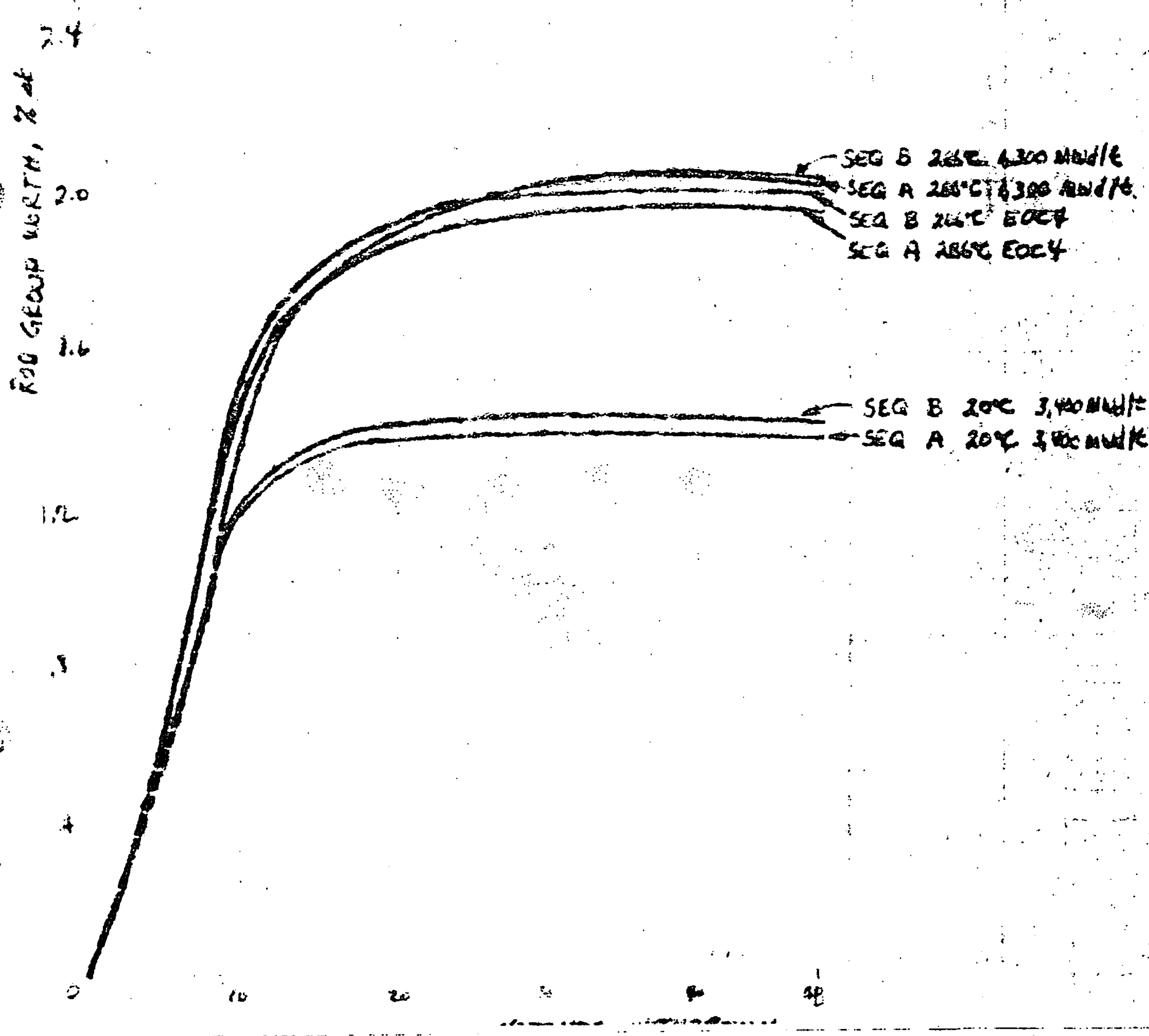
DRESDEN 3 CYCLE 4

WORTH OF THE GROUP 3 RODS



DRESDEN 3, CYCLE 4

WORTH OF THE GROUP 4 RODS



Question 2:

Figure 2-1 of NEDO-20694 shows that the two rows and columns of fuel that intersect at the center of the reactor will consist of only initial core fuel. Discuss the effect of possible neutronic uncoupling of the core into possible quarter core "criticals" by use of the loading patterns for this reload and the previous two reloads. What is the average reactivity of these two rows and columns of fuel compared to the reloaded core average reactivity both controlled and unconcontrolled?

Response 2:

The loading pattern was designed so that the reactivity distribution of the core is relatively flat at BOC. Note the calculation shown in Table 2-1 below. Figure 2-1 in NEDO-20694 gives the false impression that the axes of the core are much lower in reactivity than the rest of the core because of the absence of any reload fuel. However, it should be noted that the fresh reload fuel, because of the Gd poisoning, has a reactivity not much different from that of the initial core fuel. Although the exposed reload fuel has a significantly higher reactivity than the initial fuel, this effect is balanced by selecting initial fuel bundles of relatively low exposure to load along the axes and bundles of higher exposure to load near the exposed reload fuel. Although the reactivity of the axes will decrease with cycle exposure more rapidly than the average reactivity of the core, the difference in reactivity will never be greater than about 2.5% ΔK.

Because of the abundance of nuclear instrumentation scattered throughout the core, there is no possibility of any significant power change in any position of the core being undetectable.

TABLE 2-1

Core Average K Cold at BOC	controlled	0.948
	uncontrolled	1.108
Average K. of Axes Cold at BOC	controlled	0.949
	uncontrolled	1.103