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August 18, 1975

Mr. Dennis 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 E
Control Rod Sequences
NRC Docket No. 50-249

Dear Mr. Ziemann:

As discussed in Dresden Unit 3, Reload No. 3 Licensing Submittal, Supplement C, dated May 21, 1975, and Supplement D, dated June 18, 1975, Commonwealth Edison has a technique for developing rod withdrawal sequences to control rod worth to below the Technical Specification limits. In the June 18, 1975 reload supplement, we committed to using control rod withdrawal sequences developed by General Electric Company pending NRC approval of the Commonwealth Edison technique. Dresden Unit 3, Reload No. 3 Licensing Submittal, Supplement E, provides additional information which members of your staff indicated would allow a complete review of the technique.

After review of this matter, it is our conclusion that use of the control rod withdrawal sequences, developed from the Commonwealth Edison technique, described in Dresden Unit 3, Reload No. 3, Supplement C, dated May 21, 1975, and the attached Supplement E, involves no unreviewed safety consideration and requires no license amendment. The control rod withdrawal sequences, which have been developed from this technique, will be used for Dresden Unit 3, Reload No. 3, Cycle 4.

One (1) signed original and 39 copies of this additional information are provided.

Very truly yours,

J. S. Abel
J. S. Abel
Nuclear Licensing Administrator
Boiling Water Reactors

Attachment

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QUESTION:

1. An "Accident Reactivity Shape Function" curve for the worst in-sequence rod using the CECo techniques. The curve will be developed consistent with Figure 6.3 of NEDO 20694, because the results must be within the GE envelope curve.

RESPONSE:

The General Electric control rod withdrawal sequence can be revised to avoid ganged withdrawal of rod groups 3 and 4 by splitting group 3 into three subgroups. This revised control rod withdrawal sequence is shown in Figures 1 to 5. Utilizing a FLARE type code, a steady-state accident reactivity shape function is presented in Figure 6 for the worst in-sequence control rod for groups 3 or 4 of either sequence. The rod worths were evaluated for Dresden 2 - BOC 4 at a hot standby, zero power, zero voids and xenon free condition. The worst in-sequence rod was a group 3 B rod (C-9) with groups 1, 2 and 3A of the B sequence fully withdrawn. The General Electric technical basis is included in Figure 6 for comparison.

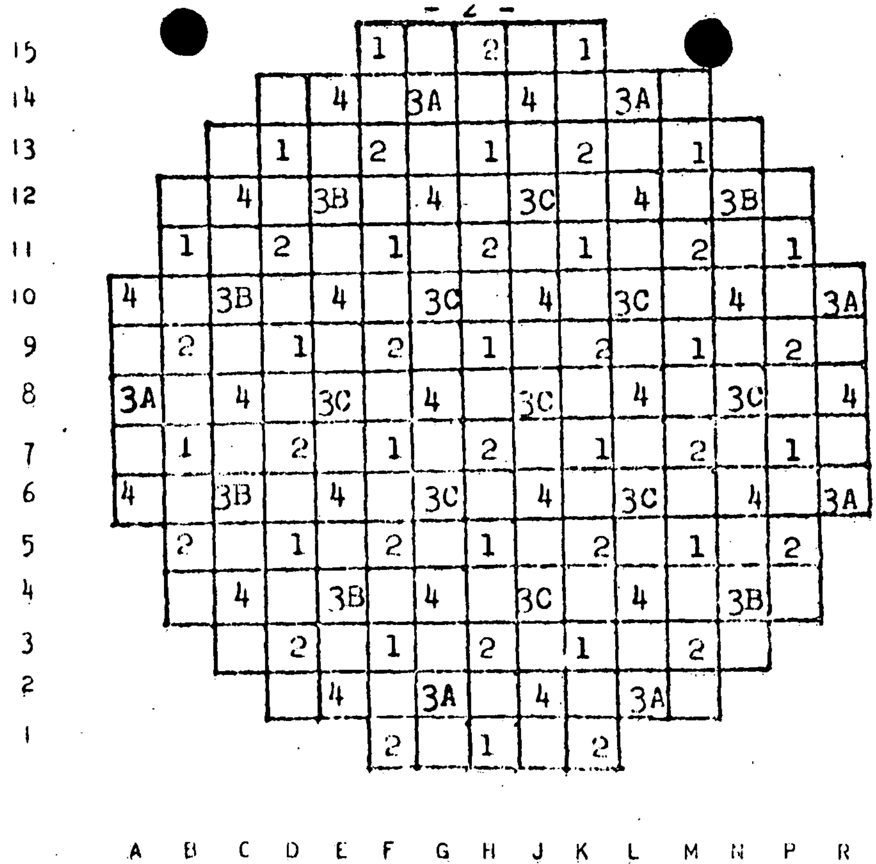

Figure 1. Rod Sequence A to 50% Rod Density - 800 MWe Reactors

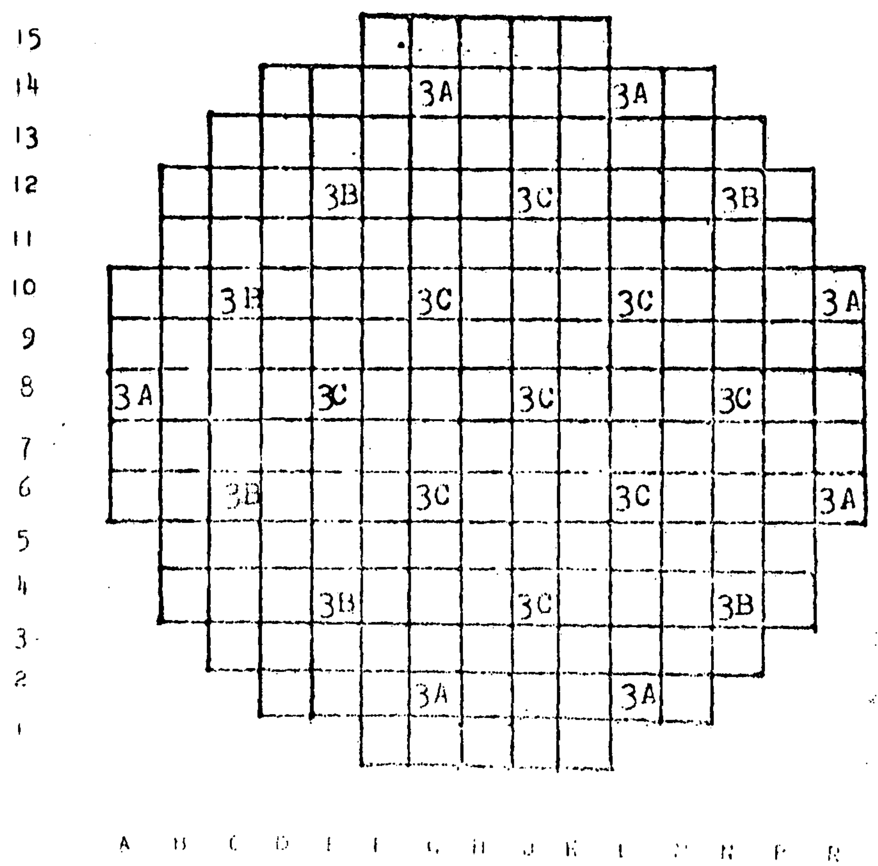

Figure 2. Rod Sequence A - Group 3 - 800 MWe Reactors

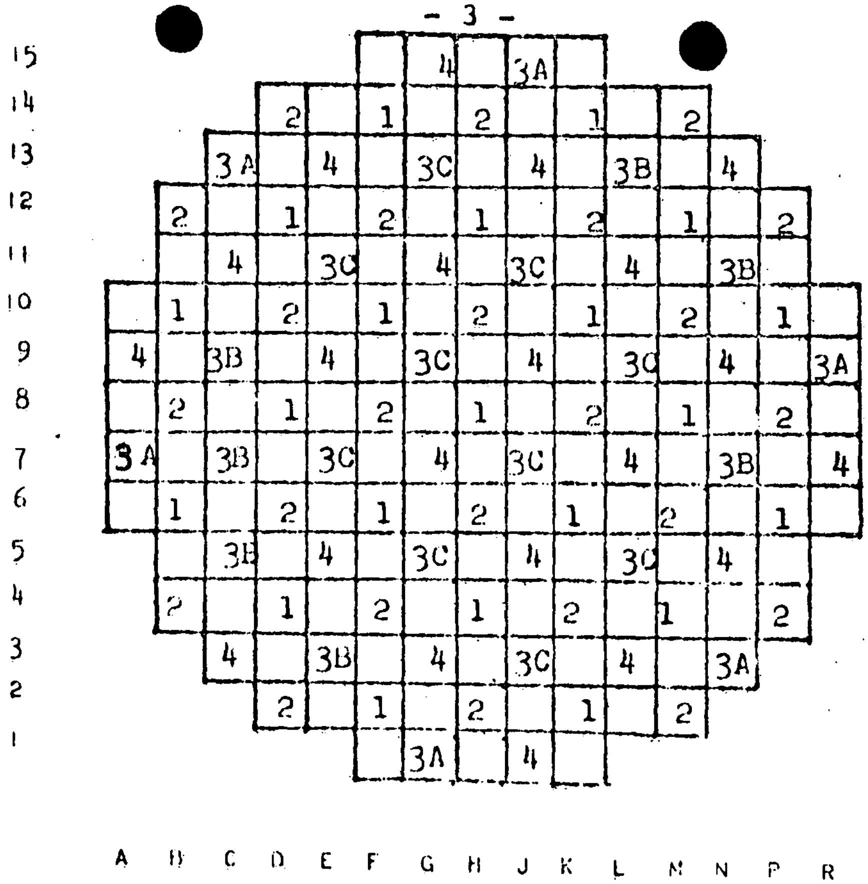

Figure 3. Rod Sequence B to 50% Rod Density - 800 MWe Reactors

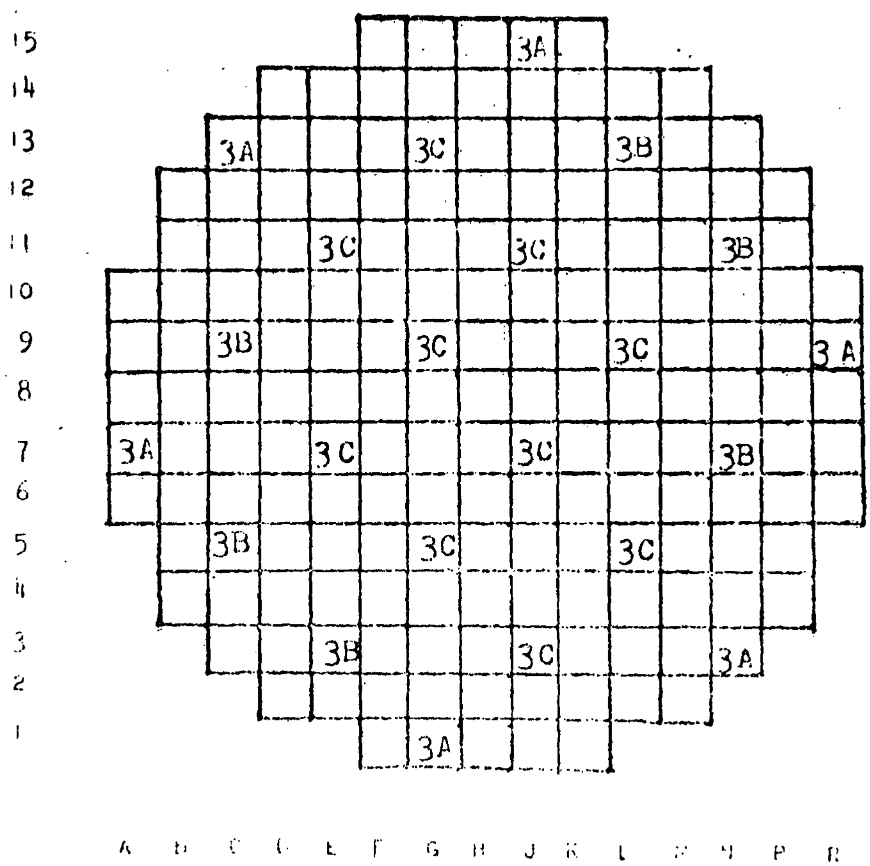

Figure 4. Rod Sequence B Group 3 - 800 Mwe Reactors

FIGURE 5

DRESDEN UNIT 2

RECOMMENDED WITHDRAWAL PATTERN

	SEQUENCE A				SEQUENCE B			
No.	Group 3A	Group 3B	Group 3C	Group 4	Group 3A	Group 3B	Group 3C	Group 4
1	L14	C10	J12	J14	C13	L13	E11	N13
2	R10	E12	L10	L12	J15	N11	G13	R07
3	R06	N12	N08	N10	R09	N07	J11	N05
4	L02	N04	L06	R08	N03	E03	L09	L03
5	G02	E04	J04	N06	G01	C05	L05	J01
6	A08	C06	G06	L04	A07	C09	J03	C03
7	G14		E08	J02			G05	A09
8			G10	E02			E07	C11
9			J08	C04			G09	E13
10				A06			J07	G15
11				A10				J13
12				C12				L11
13				E14				N09
14				G12				L07
15				J10				J05
16				L08				G03
17				J06				E05
18				G04				C07
19				E06				E09
20				C08				G11
21				E10				J09
22				G08				G07

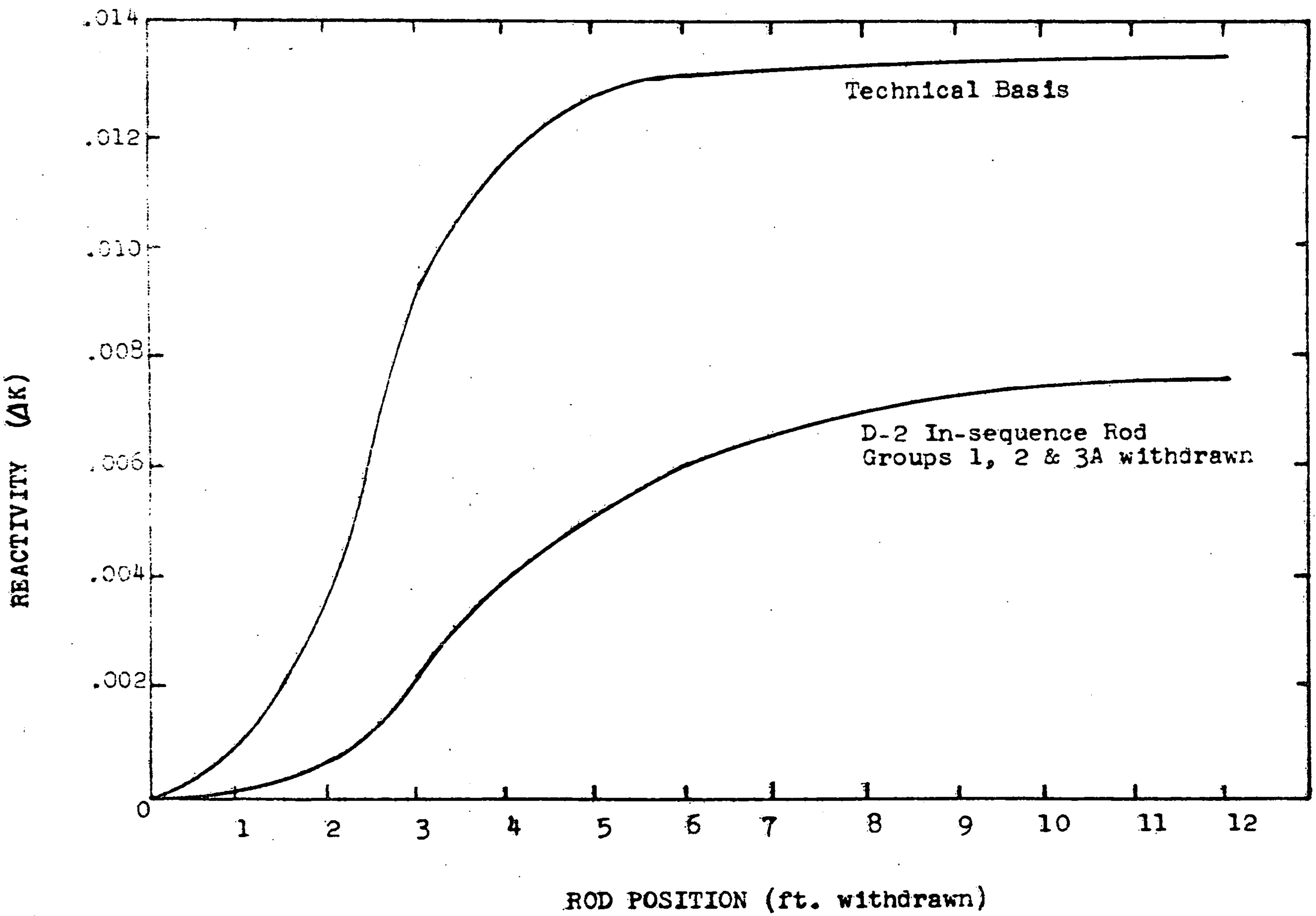

Figure 6. Accident Reactivity Shape Functions at 286°C.

QUESTION:

2. A "Scram Reactivity Function" for the rod drop accident. The function will be developed using CECo techniques but will be comparable to the envelope function of Figure 6-5 of NEDO 20694.

RESPONSE:

A steady state scram reactivity function is presented in Figure 7 assuming control rod C-9 remains in the fully withdrawn position. Design basis scram times are employed.

% Inserted From Fully Withdrawn	Dresden 2 Tech. Spec. Avg. Scram Insertion Time	Design Basis Scram Insertion Time
5	.375 sec.	.475 sec.
20	.900	1.10
50	2.00	2.0
90	3.50	5.0

Linear interpolation was employed between insertion times with time zero equal to deenergization of the scram pilot valve solenoids. Final shutdown is achieved by scramming all but the dropped rod under reactor conditions identical to those for Figure 6. The General Electric technical basis is included in Figure 7 for comparison.

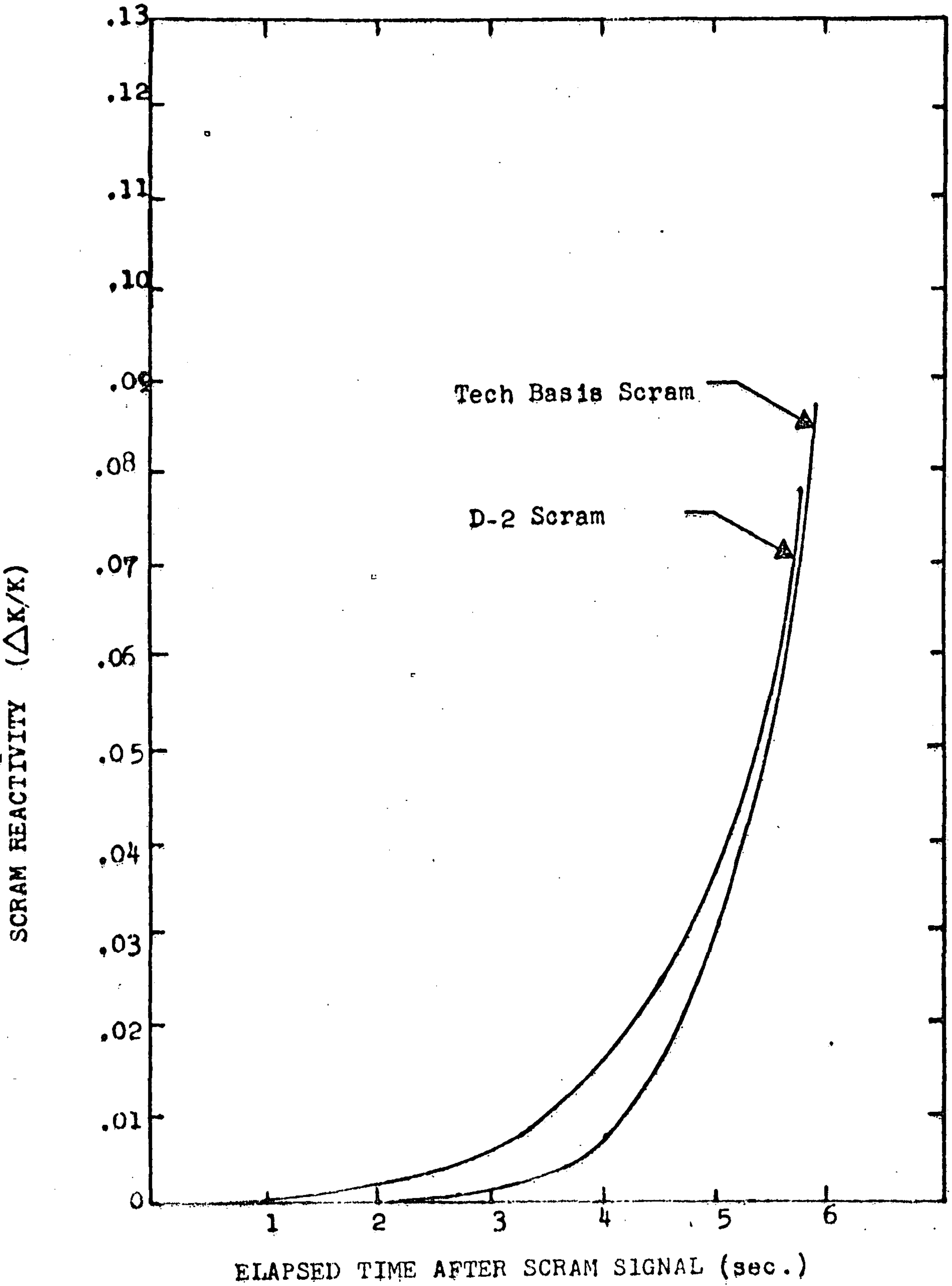

Figure 7. Scram Reactivity Functions at 286 °C

QUESTION:

3. Justify (verify) the CECo. technique for developing rod withdrawal sequences which limit rod worth to less than 1.3% ΔK.

RESPONSE:

To limit the worth of the rod which could be dropped, the Rod Worth Minimizer is used below 10% power. This ensures no movement of an out-of-sequence rod before the 50% rod density configuration is achieved and limits movement of rods to in-sequence segments beyond 50% rod density during startups.

The revised control rod withdrawal sequence is programmed into the Rod Worth Minimizer in such a way that all control rods in group 3A are withdrawn before a control rod in group 3B is selected for withdrawal. For example, a rod in 3B is out-of-sequence until all 3A rods are withdrawn. Rod group worths and individual rod worths were calculated in this manner. Rod and group worths are presented in Table 1 for Dresden 2 BOC4.

The above analysis has previously been performed for Quad-Cities 1 BOC2, and the results compared favorably with G.E. numbers.

Thirty-two 2.30 w/o 7x7 and 124 2.50 w/o 8x8 assemblies were loaded in Dresden 2, Cycle 4. We have followed exposures for the 7x7's and 8x8's for two cycles and one cycle, respectively at Dresden 2 and 3, and our calculations have compared favorably with G.E.'s.

Commonwealth Edison Company has also predicted rod densities for Dresden 2, Cycle 4, which are presented in Figure 8. An actual data point is shown at an exposure of approximately 350 mwd/t into the cycle.

Unit	Cycle	Sequence	Group	Max-Rod	Rod Worth	Group Worth
Dresden 2	4	A	3A	-	-	.54% ΔK
			3B	-	-	1.18
			3C	-	-	1.24
			4	-	-	2.19
		B	3A	-	-	.14
			3B	C-9	.76% ΔK	1.38
			3C	J-11	.17	1.45
			4	J-13	.27	2.21

Table 1. Rod and Group Worths

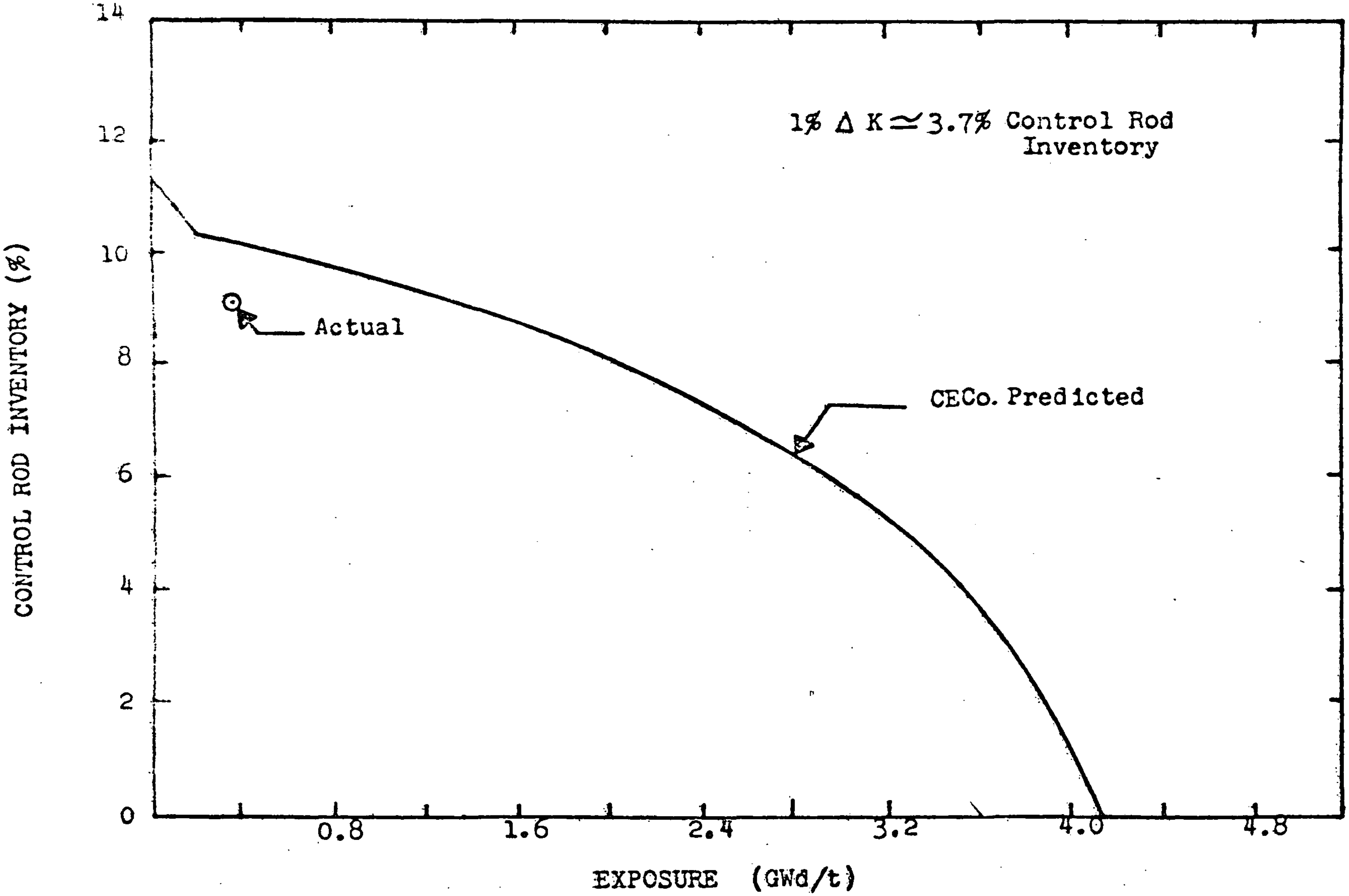

Figure 8. Control Inventory vs. Exposure