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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One – Unit 2
Docket No. 50-368, License No. NPF-6
Request for Additional Information Relating to the Elimination of Movement of Control Element Assembly #43 from Surveillance Requirement 4.1.3.1.2 for the Remainder of Cycle 15

Gentlemen:

By letter dated August 23, 2001 (2CAN080110), Entergy Operations, Inc. (Entergy) proposed a change to the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TS) to eliminate movement of Control Element Assembly (CEA) #43 as required by Surveillance Requirement (SR) 4.1.3.1.2 for the remainder of the current fuel cycle. On August 27, 2001, Entergy and members of your Staff held a follow-up call to discuss specific questions regarding the reactivity effects associated with the proposed change. Please find Entergy's response in Attachment 1.

No new commitments are contained in this response.

I declare under penalty of perjury that the foregoing is true and correct. Executed on September 25, 2001.

Very truly yours,

Glenn R. Ashley
Manager, Licensing

GRA/dm
Attachments

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Response to NRC RAI on Eliminating Movement of CEA #43 for Remainder of Cycle 15

Question 1:

If CEA #43 is assumed to remain fully withdrawn when a reactor trip occurs, is Shutdown Margin maintained?

Response:

The Technical Specification (TS) definition of Shutdown Margin (SDM) is:

> Shutdown Margin shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming all control element assemblies are fully inserted except for the single assembly of highest reactivity worth which is assumed to be fully withdrawn.

TSs 3.1.1.1 (Modes 1 through 4) and 3.1.1.2 (Mode 5) specify that SDM shall be greater than or equal to that specified in the Core Operating Limits Report (COLR). The SDM operating limit, which is included in the COLR for Cycle 15 is 5.0 % Δk/k in Modes 1 through 5.

If a reactivity balance was performed for the Cycle 15 core with a known stuck CEA (i.e., a pair of stuck CEAs) in the current operating conditions (~250 EFPD), the TS required SDM would not be met. The SDM is 4.385 % Δk/k with the worst case two stuck CEAs. However, there is conservatism built into the calculation of the SDM. The following discussion is provided to demonstrate some of that conservatism. It should be noted that the following discussion does not reflect the response of the operator in the control room. Emergency operating procedures require emergency boration of the RCS at a minimum rate of 40 gpm with 2500 ppmB if one or more CEAs fail to fully insert into the core. Reactivity control is of primary importance in accident mitigation.

The only term in the SDM calculation that would change due to the proposed situation is the worth of the CEAs that do insert to the core. The worth of the fuel, boron, xenon and net samarium is 2.282% Δk/k. At 250 EFPD, the worth of the "worst stuck pair" of CEAs (the combination of the highest worth CEA with another CEA whose total reactivity impact is the greatest) is 3.419 % Δk/k. The total pattern worth of all the CEAs is 10.086 % Δk/k. Therefore, the SDM assuming the "worst stuck pair" would be 4.385 % Δk/k.

CEA #43 is not the single CEA of highest reactivity worth in the Cycle 15 core, nor does it make up part of the "worst stuck pair". If CEA #43 plus one more rod were assumed stuck out, then the worst possible resulting pair would be worth 2.880 % Δk/k. Substituting this value for the worth of the worst stuck pair discussed previously, the resulting SDM would be 4.924 % Δk/k.

The reactor physics methods used to establish the guidelines for the development of the reactivity balance calculation are contained in Topical Report ENEAD-01-P-A, Revision 0,

"*Qualification of Reactor Physics Methods for Application to Pressurized Water Reactor of the Entergy System*." The guidance calls for the addition of - 0.155 % Δk/k as margin. For conservatism, Entergy has applied a multiplication factor of 1/1.05 to the total CEA pattern worth instead of subtracting 0.155 % Δk/k. If the 5% conservatism is removed from the Total Pattern Worth and then 0.155 % Δk/k is subtracted from the raw Total Pattern Worth as called for in the Topical Report's 95/95 Reliability Factor, then the total pattern worth would be 10.435 % Δk/k. This results in an "extra margin" of 0.349 % Δk/k in the pattern worth. If this is accounted for when the worst possible pair including CEA # 43 is stuck out, then SDM would be 5.273 % Δk/k, which would satisfy the COLR requirement.

Furthermore, between 250 and 500 EFPD (end of cycle), the additional margin in the worst stuck pair that includes CEA #43 versus the two used in the reactivity balance calculation will increase from 0.539 to 0.826 % Δk/k and the margin in the Total Pattern Worth will increase from 0.349 to 0.389 % Δk/k. Therefore, it can be shown analytically that SDM in excess of the COLR limit will be present at all times for the remaining portion of Cycle 15 if CEA #43 fails to insert into the core.

Question 2:

What is your past experience with mechanical binding of CEAs?

ANO-2 has not experienced any mechanical binding. There are two documented instances of individual CEAs failing to insert fully when dropped. In each case, the CEA that failed to fully insert dropped to approximately 11 inches withdrawn. The cause in each case was attributed to debris in the fuel assembly, not mechanical binding of the drive mechanism.