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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Additional Information Regarding the Definition of Core Alterations

Gentlemen:

As discussed in a telephone conversation with the NRC on May 24, 2000, the Staff presented questions regarding the Arkansas Nuclear One – Unit 2 (ANO-2) proposed definition of core alterations, specifically related to the coupling and uncoupling of control element assemblies (CEA) within the reactor vessel. Entergy Operations proposed in its March 8, 2000 letter (2CAN030002) that the technical specification (TS) definition of core alterations be revised to be consistent with NUREG-1432, Revised Standard Technical Specifications (RSTS). In addition, Entergy Operations requested that the coupling and uncoupling of CEAs within the reactor vessel be excluded from being considered a core alteration. Although the NRC concurred with a similar request by the St. Lucie plant in 1984, the NRC Staff believes that each individual TS that would be impacted by this exclusion should be addressed.

Information in the attachment to this letter will retain the originally proposed definition in the March 8, 2000, letter while providing discussion and justification of each applicable TS. Based on the attached information, Entergy Operations believes the previously proposed TS definition of core alterations in its March 8, 2000, letter remains acceptable.

Should further information be required, please contact me.

Very truly yours,

Jimmy D. Vandergrift
Director, Nuclear Safety Assurance

JDV/dbb
Attachment

A001

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ENTERGY OPERATIONS DISCUSSION OF APPLICABLE TECHNICAL SPECIFICATIONS AFFECTED BY THE DEFINITION OF CORE ALTERATIONS

In the Arkansas Nuclear One – Unit 2 (ANO-2) March 8, 2000, letter (2CAN030002), a revised Technical Specification (TS) definition of core alterations was proposed. The proposed definition reads as follows:

> "CORE ALTERATION shall be the movement or manipulation of any fuel, sources, or reactivity control components [excluding coupling/uncoupling of CEAs] within the reactor vessel with the vessel head removed and fuel in the vessel. Suspension of CORE ALTERATION shall not preclude completion of movement of a component to a safe conservative position."

This definition is consistent with NUREG-1432, Revised Standard Technical Specifications (RSTS) for Combustion Engineering plants. However, the proposed definition additionally excludes the coupling and uncoupling of control element assemblies (CEA). Although several of the TSs that will be discussed within this letter are applicable in Modes 5 and 6, only Mode 6 will be addressed since CEA coupling and uncoupling cannot occur in Mode 5. CEA coupling and uncoupling is performed under extremely controlled conditions with the refueling canal flooded (≥ 23 feet above the top of the fuel) with highly borated water and the upper guide structure (UGS) in place. This plant condition precludes the possibility of a fuel handling accident as the fuel remains protected by the UGS. A refueling boron concentration of ≥ 2500 ppm is established prior to entering Mode 6 (entered upon commencing the detensioning of the reactor vessel head), ensuring the reactor is shutdown by a margin of ≥ 5% Δk/k. Should a core offload be required at the beginning of core life (highest fuel worth), the reactor coolant would need to be deborated from 2500 ppm to ~ 661 ppm to achieve criticality (assumes UGS in place and all CEAs fully inserted). Such a deboration would require well over 296,000 gallons of unborated water to be added to the reactor coolant and an approximate refueling canal level change of over 23 feet (overflow to the containment sump would occur at less than four feet). This calculation is conservative since it does not take into account the volume of the reactor coolant or shutdown cooling systems. The significant inventory change would be easily detected. In addition, the amount of positive reactivity necessary to achieve criticality indicates that CEA coupling and uncoupling activities are not readily detectable and may be considered negligible. Therefore, for each of the following TSs, if a significant reduction in shutdown boron concentration is not evident due to the loss of a required component, then CEA coupling and uncoupling activities will have no adverse impact on these limiting conditions for operation.

Individual CEAs are lifted approximately four inches, one at a time, by a manual chain fall in order to perform coupling or uncoupling activities. Measurements are taken during the procedure and independent verification is also required. The insignificant distance of travel and slow movement of the CEA precludes any appreciable amount of positive reactivity from being inserted into the reactor core, especially in light of the heavily borated reactor coolant described above. Therefore, Entergy Operations does not consider this activity to be a core alteration or a positive reactivity addition for the purposes of the TSs. To reduce unnecessary repetition in the discussions that follow, this above information will be considered applicable to each TS assessed below unless otherwise noted.

The following list includes the ANO-2 TSs that may be impacted by the TS definition of core alterations:

3.1.2.1	3.1.2.7	3.9.1	3.9.5
3.1.2.3	Table 3.3-6	3.9.2	3.9.8.1
3.1.2.5	3.8.1.2	3.9.4	6.2.2.e

All of the affected TSs, with the exception of TS 3.9.1 regarding refueling boron concentrations, do not impact core reactivity. Therefore, the following discussions of these specifications will identify whether or not core reactivity is impacted and also indicate that CEA coupling and uncoupling activities are unrelated to the intent of the individual specifications.

TS 3.1.2.1 Boration System Flowpaths – Shutdown

This specification requires at least one boration flow path to be operable in Modes 5 and 6. With no boration flow path operable, the specification directs the suspension of core alterations or positive reactivity additions. The loss of the required boration flow path will not result in a change to the shutdown boron concentration or core reactivity. In addition, the coupling or uncoupling of CEAs will not result in the need to borate the reactor coolant or refueling canal. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling upon loss of the boration flow paths.

TS 3.1.2.3 Charging Pumps – Shutdown

This specification requires that the charging pump in the operable boration flow path be operable in Modes 5 and 6. With the required charging pump inoperable (if any), the specification directs the suspension of core alterations or positive reactivity additions. The loss of the required charging pump will not result in a change to the shutdown boron concentration or core reactivity. In addition, the coupling or uncoupling of CEAs will not result in the need to borate the reactor coolant or refueling canal. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling upon loss of the required charging pump.

TS 3.1.2.5 Boric Acid Makeup Pumps – Shutdown

This specification requires that the boric acid makeup pump in the operable boration flow path be operable in Modes 5 and 6. With the required boric acid makeup pump inoperable (if any), the specification directs the suspension of core alterations or positive reactivity additions. T he loss of the required boric acid makeup pump will not result in a change to the shutdown boron concentration or core reactivity. In addition, the coupling or uncoupling of CEAs will not result

in the need to borate the reactor coolant or refueling canal. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling upon loss of the required boric acid makeup pump.

TS 3.1.2.7 Borated Water Sources – Shutdown

This specification requires that a boric acid makeup tank or the refueling water tank (RWT) supporting the operable boration flow path be operable in Modes 5 and 6. With the required boric acid makeup tank or RWT inoperable, the specification directs the suspension of core alterations or positive reactivity additions. The loss of the required borated water source will not result in a change to the shutdown boron concentration or core reactivity. In addition, the coupling or uncoupling of CEAs will not result in the need to borate the reactor coolant or refueling canal. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling upon loss of the required boric acid makeup tank or RWT.

TS Table 3.3-6 Radiation Monitoring Instrumentation – Containment Purge and Exhaust

This specification requires that the ventilation flow path for the containment purge and exhaust system be capable of automatic isolation upon receipt of a high radiation signal in Modes 5 and 6. For the purposes of this supplement, Action 16 requires suspension of core alterations or the securing of the containment purge system should the radiation monitor be unable to perform the isolation function. The purpose of this specification as it applies to Mode 6 conditions is to aid in mitigating the consequences of an offsite release in the event of a fuel handling accident. However, the loss of this function will not result in a change to the shutdown boron concentration or core reactivity. Since the UGS remains in place during the performance of CEA coupling and uncoupling activities, the probability of a fuel handling accident is precluded during this time period. Therefore, the coupling and uncoupling of CEAs will not result in an offsite dose consequence for which the containment purge system or core alterations would need to be secured. In addition, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling upon loss of the required containment purge system radiation monitor.

TS 3.8.1.2 Electrical Power Systems – Shutdown

This specification requires at least one offsite power source and one emergency diesel generator (EDG) to be operable in Modes 5 and 6. With less than the above operable, the specification directs the suspension of core alterations or positive reactivity additions. The loss of the required electrical power sources will not result in a change to the shutdown boron concentration or core reactivity. The coupling or uncoupling of CEAs does not require an alternating current (AC)

power source. Although it is likely that this activity would be temporarily suspended if both of the above power sources were physically lost, such cessation would be a matter of inconvenience due to the loss of some area lighting and not as a result of any reactor core safety issue. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling solely due to the loss of one or both of the required AC power sources.

TS 3.9.1 Refueling Operations – Boron Concentration

This specification requires that the boron concentration of the refueling canal be ≥ 2500 ppm or that a K-effective (K_{eff}) of ≤ 0.95 be maintained in Mode 6. If neither of this conditions can be met, the specification requires the suspension of core alterations or positive reactivity additions. This specification ensures sufficient shutdown margin (SDM) is available to support fuel shuffling activities without the possibility of unexpected criticality. CEA coupling or uncoupling will not cause any appreciable reduction in SDM. Because it is more simplistic to describe reactivity effects in terms of boron concentration versus K_{eff}, the following discussion will use concentration of boron to describe such effects, with the understanding that a similar effect occurs to the value of K_{eff}. The 2500 ppm TS limit accounts for 50 ppm of uncertainty (1% Δk/k uncertainty included in the K_{eff} value). Under flood-up conditions, with a refueling canal boron concentration at the minimum value of 2500 ppm, well over 8000 gallons (~ 7.5" increase in refueling canal level) of unborated water would need to be added to reduce the overall boron concentration by 50 ppm. This calculation is conservative since it does not take into account the volume of the reactor coolant or shutdown cooling systems. As discussed previously, over 296,000 gallons of unborated water would be required to approach criticality from a 2500 ppm, flooded-up condition. Neutron flux monitoring, refueling canal level, interconnected tank level observations, flow rate indications, and the significant amount of unborated water that is required to changed refueling boron concentration provide operators ample time and opportunity to detect and mitigate dilution events well before significant reductions in SDM would occur. Although it is likely that the CEA coupling and uncoupling activities would be suspended should an unexpected reduction in SDM occur, such suspension would be a matter of prudence and not due to any significant reactor or personnel safety issue that would result from the CEA movement itself. The coupling and uncoupling of CEAs will not result in the consequences of a dilution event escalating. In addition, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary to suspend CEA coupling or uncoupling solely due to a reduction the required SDM during Mode 6 conditions.

TS 3.9.2 Refueling Operations – Instrumentation

This specification requires two source range neutron flux monitors to be operable in Mode 6. If only one of these indicators is operable, the TS requires the suspension of core alterations or positive reactivity additions. With both indicators inoperable, the boron concentration of the reactor coolant must be determined once per 12 hours. This specification aids in ensuring that

changes in reactivity due to fuel shuffling activities or dilution events are readily detected. The loss of this instrumentation will not result in a change to the shutdown boron concentration or core reactivity. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Likewise, the minor movement of these individual CEAs does not effect a change in reactivity that could be detected by the neutron flux monitors. As is the case above concerning reductions in SDM, it is likely that CEA coupling or uncoupling activities will be suspended if both source range channels are inoperable. However, such suspension would not be the result of any adverse effect that the CEA coupling or uncoupling activity would have on core reactivity, but more likely due to having lost an early warning indicator of core reactivity changes that could be used to warn others of degrading conditions. Therefore, it is not necessary for the TSs to require the suspension of CEA coupling or uncoupling solely due to the loss of the required neutron flux monitors in Mode 6.

TS 3.9.4 Refueling Operations – Containment Building Penetrations

This specification requires that core alterations be suspended if containment closure is not met. In addition, this specification is applicable only during the movement of fuel within the containment building or when other core alterations are taking place. The loss of containment closure will not result in a change to the shutdown boron concentration or core reactivity. The applicability and requirement for containment closure is to protect against offsite dose consequences in the event of a fuel handling accident. As discussed previously, CEA coupling and uncoupling is performed with the UGS in place, precluding a fuel handling accident from being initiated. Since a fuel handling accident is prevented with the UGS in place, it is not necessary to establish containment closure to support CEA coupling and uncoupling activities. Therefore, suspending CEA coupling and uncoupling activities during periods when containment closure cannot be established is not necessary.

TS 3.9.5 Refueling Operations – Communications

This specification requires that direct communications be maintained between the control room and refueling personnel during core alterations. Likewise, if communications are lost, core alterations must be suspended. The loss of required communications will not result in a change to the shutdown boron concentration or core reactivity. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. In addition, other communication means are utilized to alert personnel of degrading conditions or for the need of a containment evacuation (paging systems, evacuation alarms, etc). Therefore, it is not necessary to maintain constant communication between the control room and refueling personnel during CEA coupling or uncoupling activities.

TS 3.9.8.1 Refueling Operations – Shutdown Cooling and Coolant Circulation

This specification requires one shutdown cooling (SDC) loop to be in operation in Mode 6. With no SDC loop in operation, the TS action prevents an increase in decay heat load or the reduction of boron concentration in the reactor coolant. The loss of SDC or coolant circulation will not result in a change to the shutdown boron concentration or core reactivity. CEA coupling and uncoupling activities do not result in an increase in decay load or a reduction in soluble boron concentration within the reactor coolant. In addition, the specification allows the securing of the SDC loop once every 8 hours while normal core alterations continue. Since CEA coupling and uncoupling activities are unrelated to the requirement for SDC loop operability, suspension of CEA coupling and uncoupling activities are not necessary when no SDC loop is in service.

TS 6.2.2.e Administrative Controls – Unit Staff

This specification requires that core alterations be supervised by a licensed senior reactor operator (SRO) or SRO limited to fuel handling. The purpose of this specification is to ensure an individual highly trained in reactor theory and plant systems oversees all reactivity manipulations. The absence of an SRO will not result in a change to the shutdown boron concentration or core reactivity. As discussed previously, the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity. Therefore, it is not necessary for CEA coupling or uncoupling activities to be directly supervised by a SRO.

Conclusion

The above discussions conclude that the ANO-2 proposed definition of core alteration is acceptable. The definition is proposed such that the standards of NUREG-1432 are applied while excluding CEA coupling or uncoupling activities as part of core alterations. Since the coupling and uncoupling of CEAs is not considered a positive reactivity manipulation due to its small, unappreciable affect on core reactivity, excluding this activity from the proposed definition is acceptable.