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1CAN030906

March 19, 2009

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Deviation from EPRI Guideline – Steam Generator Chemistry Specification
Arkansas Nuclear One, Unit 1
Docket No. 50-313
License No. DPR-51

REFERENCES:
1. NEI 03-08, Guideline for the Management of Materials Issues, April 2007 Addenda, Materials Initiative Guidance, Addendum E, Rev. 3
2. EPRI Report 1008224, Pressurized Water Reactor Secondary Water Chemistry Guidelines, Rev. 6
3. Entergy letter dated January 28, 2009, Deviation from EPRI Guideline – Steam Generator Chemistry Specification (1CAN010904)

Dear Sir or Madam:

In accordance with NEI 03-08 (Reference 1), Entergy Operations, Inc. (Entergy) is informing the NRC of a deviation from the EPRI Steam Generator Management Project (SGMP) (Reference 2) relating to Steam Generator (SG) chemistry for Arkansas Nuclear One, Unit 1 (ANO-1). Addendum E of NEI 03-08 states:

> *Utilities shall notify the NRC of any approved deviations from Mandatory and Needed guideline elements. This notification is for information; NRC approval or other actions are not expected. The notification shall summarize:*
>
> - *the guidance being deviated from,*
> - *the justification for the deviation, and*
> - *any actions undertaken in lieu of the guidance.*

Guidance Deviated From

During startup from a forced outage on February 6 and 8, 2009, Entergy deviated from "needed" guideline elements as a result of secondary water chemistry guidelines being exceeded. In all cases, the parameter guideline exceeded was the concentration of sodium. The conditions and actions for these deviations are very similar to the conditions and actions

described in Reference 3. The deviation, justification for the deviations, and actions taken in lieu of the guidance document are also very similar to those described in Reference 3.

Justification for Deviation

The sodium concentration deviations prevented thermal cycling of the ANO-1 Enhanced Once-Through Steam Generator (EOTSG). Thermal cycles of the relatively new (replaced in 2005) EOTSGs has been shown to be detrimental to the tube support plate tie rods. A detailed justification for the deviations is included in the attachments to this submittal.

The ANO-1 EOTSGs have experienced tie rod bowing upon cooldown. The cause of this bowing is frictional resistance between the tube support plates and the inner shroud. As the component cools off, the tube support plate(s) lock to the shroud. Due to the difference in material properties, the carbon steel shroud/shell compresses more than the stainless steel support plates and rods. This causes a downward force to be placed on the tie rods resulting in bowing of the rods. Stress to the component in the form of fatigue was viewed as a more severe issue than the short term affects of high caustic conditions with A690 thermally treated material. This condition related to the ANO-1 EOTSGs was presented to the NRC in a meeting in Rockville, Maryland, on August 27, 2008 (reference NRC meeting notes provided in NRC letter dated December 1, 2008).

Actions Undertaken in lieu of Guidance Document

The Moisture Separator Reheater (MSR) drain paths to the Main Condenser were opened during the periods of deviations. In addition, the periods in which the individual deviations were permitted were strictly controlled and limited. Details of compensatory measures and administrative controls are included in the attachments to this submittal.

Note that the attached justifications are internal Entergy documents and were not written in a manner requesting NRC approval. As stated above, these justifications are for informational purposes only.

This letter does not include any new commitments.

If you have any questions or require additional information, please contact me.

Sincerely,

DBB/rwc

Attachments:

1. Technical Justification for Deviation While at Power on February 6, 2009
2. Technical Justification for Deviation While in Mode 3 on February 6, 2009
3. Technical Justification for Deviation While in Mode 3 on February 7, 2009

cc: Mr. Elmo E. Collins
Regional Administrator
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Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
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U. S. Nuclear Regulatory Commission
Attn: Mr. Alan B. Wang
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Attn: Allen Hiser
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Attachment 1 to

1CAN030906

Technical Justification for Deviation
While at Power on February 6, 2009

Technical Justification for Deviation
While at Power on February 6, 2009

The "EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines – Revision 6", identify all steam generator (SG) control parameters as 'shall' requirements. All control parameters (including all associated action level values, hold values, and monitoring frequencies) require appropriate justification for exceptions when those exceptions are less restrictive or less conservative than those contained in the guidelines. The justification must be appropriately approved and documented.

There are two conditions relative to SG control parameters that this deviation addresses:

EPRI Revision 6 Guideline Requirements

1. > 250 ppb sodium between 0 – 15% power – be in hot shutdown within 4 hours – clean up by feed and bleed or drain and refill as appropriate

2. > 100 ppb sodium – cannot increase power > 5%

Proposed Deviation:

The plant may be taken to < 15% power with SG sodium concentrations greater than 100 ppb and will not be required to return to hot shutdown unless the sodium concentration exceeds 500 ppb. Since SG blowdown is not available at hot shutdown conditions, routing the moisture separator drains back to the condenser during low power operations will be utilized for cleanup. This will be allowed due to the concern of thermal cycling of the Enhanced Once-Through Steam Generators (EOTSG) tie rods if SG temperature was reduced to allow tubesheet drains to be used for cleanup. If the SG sodium reached 500 ppb then power cannot be escalated and cooldown will be required to clean up the SG impurities.

SG sodium is required to be less than 100 ppb prior to exceeding 15% power.

Justification for Deviation:

Table 6-4 of "EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines – Revision 6" Mode 1, 0 – 15% Power (see Fig. #1) states that if SG sodium exceeds the 250 ppb limit during power escalation, the unit must be in hot shutdown within 4 hours and the impurity cleaned up by feed and bleed or drain and refill as appropriate. The action is required not just during power escalation, but at any time the reactor is critical up to 15% reactor power. The guidelines state on Page 6-10, "Bulk water concentration may be controlled by blowdown from the lower tubesheet drains". The Arkansas Nuclear One, Unit 1 (ANO-1) EOTSGs are configured without SG blowdown at normal operating temperature and pressure. The tubesheet drain valves are closed at approximately 435°F (prior to criticality) which drastically reduces the ability to exchange SG bulk water inventory. These drains are isolated due to thermal and reactor startup dose concerns.

From 0 – 5 % power, the plant is in transient conditions. The Babcock & Wilcox plant will increase in reactor power using auxiliary feed until approximately 5% power when the first main feed pump is placed on line. The water level of the EOTSGs is very small compared to a recirculating generator. The unit has approximately 35˚ of superheat so the boiling zone is within the first 12-15 feet vertically of the generator. As mentioned above, the unit does not have blowdown capability above the temperature at which tubesheet drain lines are isolated to the condenser. Therefore, the only mechanisms to reduce contaminant concentrations are dilution (increasing the water inventory) which is limited due to startup procedures, or by use of the sample line which provides an insignificant volume of water removal (~ 1-2 gallons per minute). Therefore, the only way to increase the exchange of EOTSG inventory is to drop temperature low enough to open the drain lines that connect to the condenser (~435˚ F). This would require not only cooldown but removing a reactor coolant pump from service. In addition, a plant cooldown would thermally cycle the tie rods in “A” EOTSG, which could further bow some of the tie rods.

Contaminants in the bulk water would be essentially blown out the main steam line as feed flow increases and reactor power goes up. Plate-out of the material is possible to some extent but this would be in the area above the water line so the mechanism by which crevices concentrate would not occur since boiling in this area does not happen. The contaminants would then go to the condenser where they would be removed with the full flow polishers.

ANO-1 SGs were replaced in 2005 (1R-19). The replacement SGs are of AREVA design and designated as EOTSGs. The EOTSGs are constructed of Alloy 690 TT tubes that are highly resistant to corrosion degradation. There is also an improvement in boiling stability. There is very little crevice area on the tubesheet to concentrate impurities. These design characteristics improve the overall corrosion resistance of EOTSGs and their associated internals.

The corrosion risk to elevated sodium levels in the EOTSG at low power is considered minimal. A greater concern is the alternative of thermally cycling the tie rods and the plant as a whole for the purpose of establishing blowdown flow for cleanup. This decision is consistent with the EPRI guidelines when taking into account the overall safe operation of the unit.

This deviation is only applicable for 36 hours from criticality. Once this time period has expired and Unit 1 has not escalated in power, then the unit should be cooled down and SG drains opened for cleanup of sodium to less than 100 ppb.

This deviation is documented under Condition Report C-2009-00215.

Attachment 2 to

1CAN030906

Technical Justification for Deviation
While in Mode 3 on February 6, 2009

Technical Justification for Deviation
While in Mode 3 on February 6, 2009

The "EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines – Revision 6", identify all steam generator (SG) control parameters as 'shall' requirements. All control parameters (including all associated action level values, hold values, and monitoring frequencies) require appropriate justification for exceptions when those exceptions are less restrictive or less conservative than those contained in the guidelines. The justification must be appropriately approved and documented.

There is one condition relative to SG control parameters that this deviation addresses:

EPRI Revision 6 Guideline Requirements (Table 6-4 and associated footnote d)

1. > 250 ppb sodium between 0 – 15% power – be in hot shutdown within 4 hours – clean up by feed and bleed or drain and refill as appropriate

Proposed Deviation:

The plant may be taken to Mode 1 with SG sodium concentrations greater than 100 ppb and will not be required to return to hot shutdown unless the sodium concentration exceeds 500 ppb. Since SG blowdown is not available at hot shutdown conditions, routing the moisture separator drains back to the condenser during low power operations will be utilized for cleanup. This will be allowed due to the concern of thermal cycling of the Enhanced Once-Through Steam Generator (EOTSG) tie rods if SG temperature was reduced to allow tubesheet drains to be used for cleanup. If the SG sodium reaches 500 ppb then power cannot be escalated and cooldown will be required to clean up the SG impurities.

Justification for Deviation:

Table 6-4 of "EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines – Revision 6" Mode 1, 0 – 15% Power (see Fig. #1) states that if SG sodium exceeds the 250 ppb limit during power escalation, the unit must be in hot shutdown within 4 hours and the impurity cleaned up by feed and bleed or drain and refill as appropriate. The action is required not just during power escalation, but at any time the reactor is critical up to 15% reactor power. The guidelines state on Page 6-10, "Bulk water concentration may be controlled by blowdown from the lower tubesheet drains". The Arkansas Nuclear One, Unit 1 (ANO-1) EOTSGs are configured without SG blowdown at normal operating temperature and pressure. The tubesheet drain valves are closed at approximately 435°F (prior to criticality) which drastically reduces the ability to exchange SG bulk water inventory. These drains are isolated due to thermal and reactor startup dose concerns.

From 0 – 5 % power, the plant is in transient conditions. The Babcock & Wilcox plant will increase in reactor power using auxiliary feed until approximately 5% power when the first main feed pump is placed on line. The water level of the OTSGs is very small compared to a recirculating generator. The unit has approximately 35° of superheat so the boiling zone is within the first 12-15 feet vertically of the generator. As mentioned above, the unit does not

have blowdown capability above the temperature at which tubesheet drain lines are isolated to the condenser. Therefore, the only mechanisms to reduce contaminant concentrations are dilution (increasing the water inventory) which is limited due to startup procedures, or by use of the sample line which provides an insignificant volume of water removal (~ 1-2 gallons per minute). Therefore, the only way to increase the exchange of EOTSG inventory is to drop temperature low enough to open the drain lines that connect to the condenser (~435˚ F). This would require not only cooldown but removing a reactor coolant pump from service. In addition, a plant cooldown would thermally cycle the tie rods in "A" EOTSG, which could further bow some of the tie rods.

Contaminants in the bulk water would be essentially blown out the main steam line as feed flow increases and reactor power goes up. Plate-out of the material is possible to some extent but this would be in the area above the water line so the mechanism by which crevices concentrate would not occur since boiling in this area does not happen. The contaminants would then go to the condenser where they would be removed with the full flow polishers.

ANO-1 SGs were replaced in 2005 (1R-19). The replacement SGs are of AREVA design and designated as EOTSGs. The EOTSGs are constructed of Alloy 690 TT tubes that are highly resistant to corrosion degradation. There is also an improvement in boiling stability. There is very little crevice area on the tubesheet to concentrate impurities. These design characteristics improve the overall corrosion resistance of EOTSGs and their associated internals.

The corrosion risk to elevated sodium levels in the EOTSG at low power is considered minimal. A greater concern is the alternative of thermally cycling the tie rods and the plant as a whole for the purpose of establishing blowdown flow for cleanup. This decision is consistent with the EPRI guidelines when taking into account the overall safe operation of the unit.

This deviation is only applicable for 36 hours from criticality. Once this time period has expired and Unit 1 has not escalated in power, then the unit should be cooled down and SG drains opened for cleanup of sodium to less than 100 ppb.

The turbine will be unaffected because the 100 ppb limit before exceeding 5% power is retained. Also SG sodium is always much lower when the turbine is placed on line at approximately 12% power.

This deviation is documented under Condition Report 1-2009-00239.

Attachment 3 to

1CAN030906

Technical Justification for Deviation
While in Mode 3 on February 7, 2009

Technical Justification for Deviation
While in Mode 3 on February 7, 2009

The "EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines – Revision 6", identify all steam generator (SG) control parameters as 'shall' requirements. All control parameters (including all associated action level values, hold values, and monitoring frequencies) require appropriate justification for exceptions when those exceptions are less restrictive or less conservative than those contained in the guidelines. The justification must be appropriately approved and documented.

There are two conditions relative to SG control parameters that this deviation addresses:

EPRI Revision 6 Guideline Requirements

1. > 250 ppb sodium between 0 – 15% power – be in hot shutdown within 4 hours – clean up by feed and bleed or drain and refill as appropriate

2. > 100 ppb sodium – cannot increase power > 5%

Proposed Deviation:

The plant may be taken to < 15% power with SG sodium concentrations greater than 100 ppb and will not be required to return to hot shutdown unless the sodium concentration exceeds 500 ppb. Since SG blowdown is not available at hot shutdown conditions, routing the moisture separator drains back to the condenser during low power operations will be utilized for cleanup. This will be allowed due to the concern of thermal cycling of the Enhanced Once-Through Steam Generator (EOTSG) tie rods if SG temperature was reduced to allow tubesheet drains to be used for cleanup. If the SG sodium reached 500 ppb then power cannot be escalated and cooldown will be required to clean up the SG impurities.

Justification for Deviation:

Table 6-4 of "EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines – Revision 6" Mode 1, 0 – 15% Power (see Fig. #1) states that if SG sodium exceeds the 250 ppb limit during power escalation, the unit must be in hot shutdown within 4 hours and the impurity cleaned up by feed and bleed or drain and refill as appropriate. The action is required not just during power escalation, but at any time the reactor is critical up to 15% reactor power. The guidelines state on Page 6-10, "Bulk water concentration may be controlled by blowdown from the lower tubesheet drains". The Arkansas Nuclear One, Unit 1 (ANO-1) EOTSGs are configured without SG blowdown at normal operating temperature and pressure. The tubesheet drain valves are closed at approximately 435°F (prior to criticality) which drastically reduces the ability to exchange SG bulk water inventory. These drains are isolated due to thermal and reactor startup dose concerns.

From 0 – 5 % power, the plant is in transient conditions. The Babcock & Wilcox plant will increase in reactor power using auxiliary feed until approximately 5% power when the first main feed pump is placed on line. The water level of the OTSG is very small compared to a

recirculating generator. The unit has approximately 35˚ of superheat so the boiling zone is within the first 12-15 feet vertically of the generator. As mentioned above, the unit does not have blowdown capability above the temperature at which tubesheet drain lines are isolated to the condenser. Therefore, the only mechanisms to reduce contaminant concentrations are dilution (increasing the water inventory) which is limited due to startup procedures, or by use of the sample line which provides an insignificant volume of water removal (~ 1-2 gallons per minute). Therefore, the only way to increase the exchange of EOTSG inventory is to drop temperature low enough to open the drain lines that connect to the condenser (~435˚ F). This would require not only cooldown but removing a reactor coolant pump from service. In addition, a plant cooldown would thermally cycle the tie rods in "A" EOTSG, which could further bow some of the tie rods.

Contaminants in the bulk water would be essentially blown out the main steam line as feed flow increases and reactor power goes up. Plate-out of the material is possible to some extent but this would be in the area above the water line so the mechanism by which crevices concentrate would not occur since boiling in this area does not happen. The contaminants would then go to the condenser where they would be removed with the full flow polishers.

ANO-1 SGs were replaced in 2005 (1R-19). The replacement SGs are of AREVA design and designated as EOTSGs. The EOTSGs are constructed of Alloy 690 TT tubes that are highly resistant to corrosion degradation. There is also an improvement in boiling stability. There is very little crevice area on the tubesheet to concentrate impurities. These design characteristics improve the overall corrosion resistance of EOTSGs and their associated internals.

The corrosion risk to elevated sodium levels in the EOTSG at low power is considered minimal. A greater concern is the alternative of thermally cycling the tie rods and the plant as a whole for the purpose of establishing blowdown flow for cleanup. This decision is consistent with the EPRI guidelines when taking into account the overall safe operation of the unit.

This deviation is only applicable for 36 hours from criticality. Once this time period has expired and Unit 1 has not escalated in power, then the unit should be cooled down and SG drains opened for cleanup of sodium to less than 100 ppb.

This deviation is documented under Condition Report-ANO1-2009-00257.