Union Electric
Callaway Plant

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May 17, 1999

U.S. Nuclear Regulatory Commission
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Gentlemen:

ULNRC-04034
TAC No. MA 3954

AmerenUE

CALLAWAY PLANT
UNION ELECTRIC COMPANY
DOCKET NUMBER 50-483
REVISION TO TECHNICAL SPECIFICATION 3/4.4
REACTOR COOLANT SYSTEM

References:
1) ULNRC-3358 dated April 12, 1996
2) ULNRC-3910 dated October 27, 1998
3) ULNRC-3920 dated November 13, 1998
4) ULNRC-3948 dated January 11, 1999
5) ULNRC-3955 dated January 29, 1999
6) ULNRC-3970 dated February 25, 1999
7) NRC letter dated April 6, 1999, Record of March 18, 1999 Telecon
8) ULNRC-4004 dated April 7, 1999
9) ULNRC-4005 dated April 7, 1999

Reference 1 transmitted an amendment request to revise Callaway Technical Specifications to use Electrosleeves to repair steam generator tubes. Reference 2 transmitted a modified request limited to two operating cycles to address NDE issues. References 3 through 9 modified the request based on Staff input.

In February, 1999, NRC contacted AmerenUE personnel concerning evaluation of Electrosleeve material at high temperature severe accident conditions. Evaluation of Electrosleeves at high temperature severe accident conditions was not anticipated by AmerenUE, since it is beyond the licensing and design basis for Callaway Plant.

A number of telephone conversations and one meeting (April 22, 1999) have taken place on this issue. AmerenUE has informally provided risk evaluation information to address the concerns raised by the staff. This letter is a formal transmittal of AmerenUE's risk evaluation summary and provides a listing of other documents which have been previously provided to support the evaluation. Since the referenced amendment request was based on demonstrating that the Electrosleeve steam generator tube repair method met currently approved staff positions and the Callaway Licensing Basis, the risk evaluation was not prepared based on the guidance provided in NRC Regulatory Guide 1.174, *An Approach for Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes to the Licensing Basis*.

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AmerenUE offers the following items for NRC consideration of the requested amendment:

1) This repair method meets all regulatory requirements based on approved Staff positions. (This fact was stated by the Staff in the April 22, 1999 meeting between AmerenUE and NRC.)

2) A risk evaluation performed by AmerenUE, specific to the Callaway Plant, shows scenarios, under which induced steam generator tube ruptures are postulated to potentially occur, to have an estimated core damage frequency (CDF) of approximately 1.70E-6 yr^{-1}.

3) The delta LERF (Large Early Release Frequency), for this repair method, would be less than 1E-6 yr^{-1}, since the above CDF would be multiplied by the conditional incremental probability of induced tube rupture of Electrosleeved tubes (as compared to non-repaired tubes).

4) Based on evaluations performed by AmerenUE specific to the Callaway design using the MAAP (Modular Accident Analysis Program) Code, the steam generator hot leg tube temperatures do not reach the temperature at which Electrosleeve tube samples failed in testing.

5) The testing associated with Electrosleeve samples is significantly more conservative than what would exist in actual plant conditions. The process of manufacturing a flaw using EDM (Electro Disintegration Machining) produces a flaw that is more susceptible to failure than flaws which develop in tubes in actual steam generator conditions. Framatome Technologies, Inc. (FTI) has recently tested two Electrosleeves with flaws machined to more closely simulate plant flaws, and have obtained results which show failure at 699°C and 689°C.

AmerenUE believes Electrosleeves represent a steam generator tube repair method superior to any other tube repair method available to date. Based on the attached information and the referenced letters, we request that the Staff issue the license amendment requested in References 2 through 9. Please respond to this request by May 21, 1999. If you determine that the License Amendment cannot be approved as requested, please identify the basis for that determination by May 21, 1999.

Sincerely,

Garry L. Randolph

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DS/ACP/jdg

Attachments:
1) List of PRA-Related transmittals to NRC on Electrosleeves
2) Issues Related Quantification of LERF Due to Installation of Electrosleeves

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ATTACHMENT 1

List of PRA-Related Transmittals to NRC on Electrosleeve

- ✓ 3/18/99 – A preliminary AmerenUE probabilistic model was faxed to NRC to support a telecon that same day.

- ✓ 3/24/99 – Following another telecon on AmerenUEs PRA arguments, we faxed the updated Callaway Level 1 event trees, with core damage sequence frequencies printed thereon, to NRC.

- ✓ 3/25/99 – We overnighted hard copies of the following documents to NRC:

  - ✓ Updated Callaway Level 1 event trees, with sequence frequencies.
  - ✓ Severe accident management guideline SAG-1, Rev. 0.
  - ✓ The OCL file (T1TC.OCL) that takes sequence T(1)S06 (LOSP-initiated loss of RCP seal cooling), and generates the resultant core damage sequence cutsets.
  - ✓ AmerenUE calculation BB-97, Rev. 0, which determines the probabilities of core uncovery, given a loss of RCP seal cooling under various scenarios.

- ✓ Prior to the 4/22/99 meeting, between AmerenUE, FTI and NRC, AmerenUE provided a white paper documenting our PRA assessment of the induced SGTR issue related to the Electrosleeve amendment.
- ✓ 4/27/99 – A white paper entitled "Issues Related to Quantification of ΔLERF Due to Installation of Electrosleeves" was transmitted to NRC. (This document is provided as Attachment 2.) **This transmittal / document should be considered AmerenUEs PRA justification for approval of the Electrosleeve license amendment, as it was developed based upon a more complete understanding of NRCs LERF concerns, and represents our refined position with respect to ΔLERF due to installation of Electrosleeves.**

ATTACHMENT 2

AmerenUE

Callaway Plant

ELECTROSLEEVE LICENSE AMENDMENT

Issues Related to Quantification of ΔLERF Due to Installation of Electrosleeves

April, 1999

ATTACHMENT 2

ELECTROSLEEVE LICENSE AMENDMENT

Issues Related to Quantification of ΔLERF Due to Installation of Electrosleeves

1) Approximately 25% (1.63E-6 yr^{-1}) of the total CDF (6.61E-6 yr^{-1}) of the candidate sequences for induced SGTR are non-station blackout core damage sequences. These sequences could be mitigated by injection of firewater into one (1) steam generator, pursuant to FR-H.1. Core damage would be precluded if firewater were successfully injected into a steam generator. This success path is not credited in the CDF estimate noted above. Using an estimated probability of 0.13 for failure to inject firewater into a steam generator, the non-SBO contribution is reduced to 2.12E-7 yr^{-1}.

2) The highest frequency (2.75E-6 yr^{-1}) SBO core damage sequence, which could contribute to the frequency of induced SGTR, is T(1S)S26. This is a station blackout, followed by failure of the turbine-driven auxiliary feed pump, and failure to recover AC power within 1 hour. In actuality, core damage will begin at approximately 2 hours. The 1-hour timeframe was chosen, for CDF quantification, to provide approximately 1 hour for the operators to start and align mitigating systems, such as ECCS, to prevent core damage. For quantification of the potential for induced SGTR, use of the full 2-hour timeframe is more appropriate. At 2 hours, core uncovery begins. However, the SGs (secondary side) are still pressurized. If AC power is recovered within 2 hours, operators can inject into the RCS with the ECCS, and begin a controlled injection with the motor-driven auxiliary feed water pumps into the SGs.

   NUREG-1032 is used in the Callaway PRA to determine probabilities of AC power recovery following station blackout. The probability of failure to recover AC power within 1 hour, used in the quantification of CDF for T(1S)S26, is 0.389. The probability for failure to recover within 2 hours is 0.222. If the 2-hour timeframe is credited, the frequency of T(1S)S26 is reduced from 2.75E-6 yr^{-1} to 1.57E-6 yr^{-1}.

   Removing three additional conservatisms that exist in the calculation can credibly reduce the 1.57E-6 yr^{-1} value further. These three conservatisms are:

   a) The diesel-generator (DGN) fault trees model a direct dependency of the DGNs on diesel building HVAC. However, AmerenUE has previously determined that this dependency does not actually exist, unless the outside ambient temperature is greater than 65°F. Using data in the Callaway FSAR Site Addendum, the probability that the outside ambient temperature is greater than 65°F is, conservatively, 0.583.

b) Test and maintenance unavailability point estimates used in the updated Callaway PRA are based on data from the IPE (1/87 – 5/90) and Cycles 7, 8 and 9 (11/93 – 5/98). A review of this data shows that trains of equipment were out of service for test/maintenance less time in Cycles 7, 8 and 9 than during the IPE data collection period. Accordingly, more representative test/maintenance point estimates, for the diesel-generators, turbine-driven auxiliary feed water pump and essential service water pumps, can be derived using the Cycles 7, 8 and 9 data only.

c) A review of cutsets for sequence T(1S)S26 reveals cutsets with both the turbine-driven auxiliary feed water pump and a diesel-generator in test/ maintenance. In fact, the plant configuration risk matrix (contained in plant procedures), developed pursuant to (a)(3) of the Maintenance Rule, identifies simultaneous outages of the turbine-driven auxiliary feed water pump and a diesel-generator as being undesirable from a plant risk perspective. Accordingly, concurrent planned outages of this equipment would not be undertaken.

Factoring the above three conservatisms into the frequency calculation for T(1S)S26 further reduces the frequency, from 1.57E-6 yr^{-1} to 9.58E-7 yr^{-1}.

In addition to the above discussion, MAAP runs for this sequence show that the steam generator tubes will not reach the requisite temperature for induced SGTR. (Refer to item 5, below.)

3) The second highest frequency SBO CD sequence, under evaluation for induced SGTR potential, is T(1S)S10. This sequence is a SBO, successful operation of the turbine-driven auxiliary feed water pump, successful cooldown and depressurization, but AC power is not restored within 12 hours. The CDF for this sequence is 1.93E-6 yr^{-1}.

MAAP runs for Callaway show that, given this sequence, the time at which core uncovery begins is actually 20.7 hours. The failure to recover probability for 12 hours is 4.44E-3 (based on NUREG-1032). NUREG-1032 only provides data for times up to 16 hours. If 16 hours is used as a surrogate for the actual 20.7 hour timeframe, the failure to recover AC power probability is $<$ 1.22E-3. Therefore, the frequency for this sequence can be reduced to $<$ 5.31E-7 yr^{-1}.

Also, per item 5, below, MAAP runs show that the SG tubes will not reach the temperatures required for induced SGTR.

4) The RCP seal LOCA model, used in the Callaway PRA for sequences in which seal injection and cooling is lost, assigns a 90% probability to a leakage rate of 21.4 gpm per RCP. This leakage rate is insufficient in most scenarios to depressurize the RCS and thereby prevent induced SGTR from occurring. However, larger postulated RCP seal leakage rates would depressurize the RCS such that induced SGTR would not occur. It is important to note that Callaway CDFs are calculated assuming either (1) a 21.4 gpm per RCP LOCA or (2) a 90% probability of a seal LOCA of this size.

5) The discussion of increases in ΔLERF for the purposes of the Electrosleeve amendment should be limited to proposed scenarios where the steam generator tube temperatures fall between the failure temperature of an Alloy-600 tube (~1400°F with no tube degradation) and the failure temperature of an Electrosleeved tube (~1100°F with a 2 inch axial flaw). At temperatures above 1400°F, no increase in ΔLERF occurs since any tube (including the original Alloy-600 tube) is predicted to fail. At temperatures below 1100°F, no increase in ΔLERF occurs since no tubes are predicted to fail. This narrow temperature band limits the scenarios which would lead to an increase in ΔLERF.

   The MAAP code was used to estimate the steam generator tube temperatures for the sequences identified in items 2 and 3 above. Figure 1 provides the steam generator hot leg tube temperatures for sequence T(1S)S26. Figure 2 provides the steam generator hot leg tube temperatures for sequence T(1S)S10. Both figures show that the steam generator tube temperatures remain below 1100°F, and thus result in no increase in ΔLERF.

Conclusions

Based on analysis of issues related to quantification of ΔLERF due to installation of Electrosleeves, the following conclusions are drawn.

The frequency of Callaway core damage sequences that may precede induced SGTR is very small (approximately 1.70E-6 yr^{-1}). In addition, this frequency would have to be multiplied by the conditional incremental probability of induced tube rupture of Electrosleeved tubes. MAAP runs for Callaway show that, for the dominant relevant two station blackout core damage sequences, the steam generator tubes would not reach the required temperature for induced rupture of either the Electrosleeved tubes, or Alloy-600 tubes. Therefore, the conditional probability of induced tube rupture can be taken to be zero.

Figure 1
CALLAWAY STATION BLACKOUT (CASE1A)
21.4 gpm Seal LOCA per Pump, No Power Recovery, TTRX

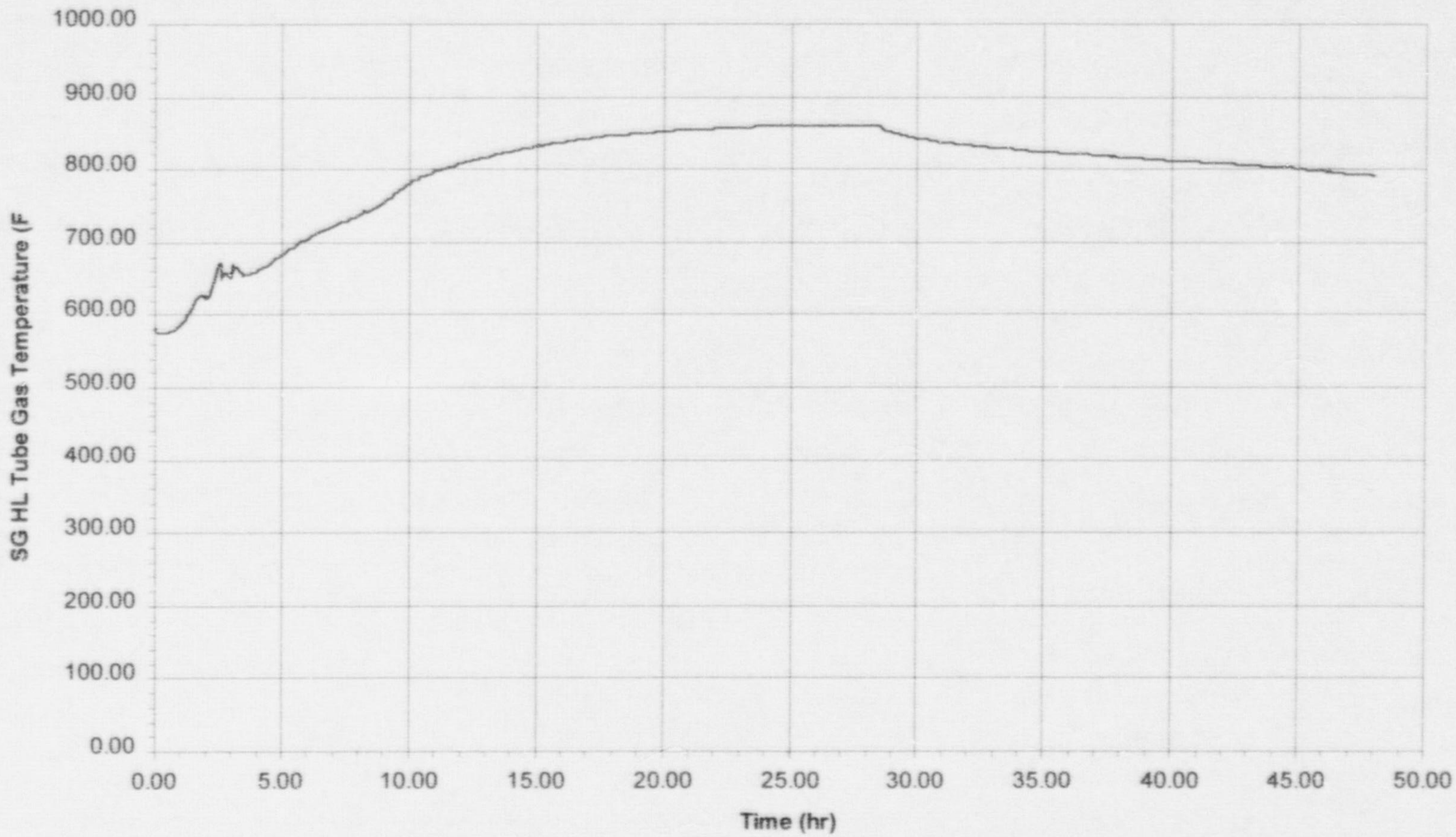

Figure 2
CALLAWAY STATION BLACKOUT (CASE14Ba)
21.4 gpm Seal LOCA per Pump, 8hrs AFW, No Secondary Cooldown, TTRX