April 6, 2001

Mr. Garry L. Randolph
Vice President and Chief Nuclear Officer
Union Electric Company
Post Office Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 - ISSUANCE OF AMENDMENT RE: INSTALLATION OF REPLACEMENT ENGINEERED SAFETY FEATURE TRANSFORMERS (TAC NO. MB1038)

Dear Mr. Randolph:

The Commission has issued the enclosed Amendment No. 143 to Facility Operating License No. NPF-30 for the Callaway Plant, Unit 1. The amendment consists of changes to the Final Safety Analysis Report (FSAR) in response to your application dated January 18, 2001, as supplemented by letter dated February 21, 2001 (ULNRC-04393).

The amendment authorizes changes to the FSAR related to the installation of replacement engineered safety feature (ESF) transformers. The Callaway Plant FSAR will be updated in accordance with the schedule in 10 CFR 50.71(e). The proposed changes support the planned replacement of the ESF transformers with new transformers having active automatic load tap changers (LTCs). There are no changes to the technical specifications.

A copy of the related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA/

Jack N. Donohew, Senior Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosures: 1. Amendment No. 143 to NPF-30
2. Safety Evaluation

cc w/encls: See next page

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UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 143
License No. NPF-30

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Union Electric Company, (UE, the licensee) dated January 18, 2001, as supplemented by letter dated February 21, 2001, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act) and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, by Amendment No. , the license is amended to authorize revision of the Final Safety Analysis Report (FSAR), as set forth in the application for amendment by Union Electric Company dated January 18, 2001, and supplement dated February 21, 2001. Union Electric Company shall update the FSAR to reflect the planned replacement of the engineered safety features transformers with new transformers having active automatic load tap changers.

3. This license amendment is effective as of its date of issuance and shall be implemented in the next periodic update to the FSAR in accordance with 10 CFR 50.71(e). Implementation of the amendment is the incorporation into the FSAR of the changes discussed above, as described in the licensee's application dated January 18, 2001, and supplement dated February 21, 2001, and evaluated in the staff's Safety Evaluation attached to this amendment.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA by L. Raghavan for/

Stephen Dembek, Chief, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Date of Issuance: April 6, 2001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 143 TO FACILITY OPERATING LICENSE NO. NPF-30

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

1.0 INTRODUCTION

By application dated January 18, 2001, as supplemented February 21, 2001, Union Electric Company (the licensee) requested changes to the Final Safety Analysis Report (FSAR) for the Callaway Plant (Callaway). The proposed amendment would support the planned replacement of the engineered safety features (ESF) transformers with new transformers having active automatic load tap changers (LTCs). The licensee evaluated this design change per 10 CFR 50.59 (prior to the rule change issued by the Commission in 1999 [64 FR 53582]) by the licensee and determined that it constituted an unreviewed safety question as defined in 10 CFR 50.59 (a)(2)(i) and (ii). There are no proposed changes to the technical specifications (TSs) for Callaway.

The purpose of the proposed modification is to replace the ESF transformers, which provide power to the plant's 4.16 kV safety buses from the 345 kV offsite transmission network, with new transformers having a automatic load tap changing capability. This change is to ensure continued compliance with 10 CFR Part 50 General Design Criterion (GDC) 17, "Electric Power Systems." Due to an increase in regional power transmission through the area of the Callaway Plant, reliability of offsite power of sufficient voltage is now reduced.

This change would improve voltage of offsite power to Callaway's electrical safety buses. As a result, overall electrical reliability and compliance with the GDC would be improved. However, the new transformers incorporate LTCs in their design and function which could introduce a new equipment malfunction. The licensee stated that because malfunctioning of the LTCs in the automatic mode could cause over-voltage or under-voltage conditions on the safety buses, new conditions are thereby introduced which were not previously considered in the FSAR. Therefore, the licensee concluded that it could not make the proposed change without obtaining staff approval through a license amendment.

In the course of the review, the staff conducted two telephone conferences with the licensee and a number of requests for additional information were identified. The licensee provided the additional information during the conference calls and documented the response information in the supplemental letter dated February 21, 2001. The supplemental letter provided additional clarifying information, did not expand the scope of the application as originally noticed, and did not change the staff's original proposed no significant hazards consideration determination published in the *Federal Register* on February 21, 2001 (66 FR 11063).

2.0 BACKGROUND

The offsite power system for Callaway Plant consists of two independent and redundant sources. One preferred circuit at the switchyard supplies power to a three-winding startup transformer. The startup transformer feeds the two medium voltage buses and a 13.8/4.16kV ESF transformer. The second preferred circuit is connected to the second ESF transformer. Each ESF transformer normally supplies its associated medium voltage 4.16kV class 1E bus. Class 1E ac system loads are separated into two load groups which are powered from two separate ESF transformers or two independent diesel generators (one per load group). Each load group distributes power by a 4.16kV bus, 480V load centers and 480V motor control centers. Capacitor banks are installed at the output of the existing ESF transformers to boost system voltage when it degrades close to limits in the TSs.

The licensee explained that on August 12, 1999, with the plant in Mode 3 (Hot Standby), the switchyard voltage supplied from the grid was observed to decrease below the minimum operability limit established in station procedures and the TS action statements for inoperability of both offsite sources of power. Both offsite power sources were inoperable for approximately 12 hours. During investigations to establish the cause for this unanticipated switchyard voltage, engineering reviews determined that large amounts of power were being transported across the grid on the day in question. This rate of power transmission was far in excess of typical levels. According to the licensee, the deregulated wholesale power market contributes to conditions where higher grid power flows are likely to occur-as in this case. With grid loading above previously analyzed values, offsite voltage to Callaway was reduced to a level outside of its design basis.

3.0 EVALUATION

The proposed modification is to replace the existing ESF transformers that provide offsite power to both 4.16kV safety buses from the 345kV transmission network. The new transformers will include an automatic load tap changing feature. Due to changes in the nature of electric power transmission in the vicinity of Callaway, a wider range of grid voltages are expected in the future. This modification will equip the preferred power sources with the ability to provide acceptable voltages to the safety-related electrical distribution system given this wider range of voltages.

3.1 Staff Evaluation

The new transformers and the associated automatic LTCs, when combined with the previously installed six-mega volt amp reactive (VAR)-sized (i.e., 6-MVAR-sized) capacitor banks, will help assure that the required minimum safe operating voltage is available at the class 1E buses under a wider range of grid voltage. This equipment is adding voltage regulation capability to the offsite power sources. The LTC voltage control system is coordinated with the existing capacitor bank voltage control system; however, they are separate control systems. Each component functions without the other. The transformer voltage control system is coordinated with its associated capacitor bank voltage control point to assure the capacitor bank steps are off during times that the safety bus is near its nominal 4.16 kV level. Both systems are also coordinated with the safety bus degraded voltage protection to allow the LTCs and capacitors to

attempt to correct safety bus voltage prior to separating the safety buses from offsite power on a degraded voltage signal.

The licensee states that the new transformers meet the electrical design requirements of the original transformers. The LTC transformers do not share any common electrical circuits or control circuits and cannot be paralleled even if the safety buses are cross connected. The LTCs are capable of automatically varying the voltage at the respective safety bus by plus or minus 16 percent (1 percent per step with 32 steps), the equivalent of approximately plus or minus 665 V at the 4160 V level. The load tap changer range will be limited by a gear driven limit switch to a 6 percent buck and a 4 percent boost to limit the voltage extremes created by the transformers. The tap changer can also be operated in a manual mode, locally at the affected transformer, using the local control panel. Additionally, the tap changers can be manipulated using a hand crank without the control system, provided that the affected transformer is de-energized.

The licensee has calculated the required minimum voltages in the Callaway switchyard associated with the new transformers and existing capacitor banks. These minimum switchyard voltages are necessary to provide adequate plant safety bus voltages and have been determined for a variety of ESF transformer, LTC, and capacitor bank lineups and availabilities. The minimum voltages are monitored by the transmission system control area operator, and the transmission grid load flow analysis is periodically reviewed prior to each peak loading season to ensure the potential impact on maintaining those voltages as a result of any significant changes are evaluated.

The transmission system control area operator, AmerenUE Energy Supply Operations (ESO), monitors and models the available system grid voltage, including Callaway's switchyard voltage. In addition to the seasonal grid load flow analysis, ESO utilizes an online computer model to predict in near real time, voltages that would exist at the Callaway switchyard for various transmission system contingencies, including the loss of Callaway generation (plant trip). The contingency computer model incorporates a watch guard alarm that alerts ESO to contingency Callaway switchyard voltages below a set level. For normal operation (both LTCs and capacitor banks are operable and both ESF transformers in service), the Callaway watch guard alarm is set to approximately 333 kV to provide a 3 kV margin above the minimum switchyard voltage requirement. The 3 kV margin allows time for ESO to contact the Callaway control room and to take actions to restore the minimum grid voltage before it drops below the Callaway operational requirement. With portions of the LTCs, capacitor banks, or ESF transformers inoperable, the required minimum Callaway switchyard voltages are higher. When these equipment outages occur, the Callaway control room will notify ESO to reset the Callaway watch guard alarm to 3 kV above the new required minimum value.

The licensee has stated that a single source lineup (one ESF transformer feeding both safety divisions) with capacitor banks out-of-service, automatic LTC taps fixed, and two ESF transformers in service will not be considered an operable line-up. This is because such a lineup, without the use of the capacitor banks, results in a corresponding switchyard voltage requirement that is too high to be met by the transmission system for most of the year. Only a dual source lineup (each ESF transformer feeding only one safety division) will be used in this situation.

The licensee has indicated that equipment problems or inoperabilities associated with the new ESF transformers, LTCs, or existing capacitor banks will be annunciated in the Callaway control room. A general "XNB01(02) Transformer/Voltage Control Trouble" annunciator window is provided. Computer points and local annunciators further identify problems alarmed by this common annunciator. A second main control board annunciator is provided to indicate a voltage control system freeze. This indicates that the automatic control systems are disabled and prevented from stepping on capacitor banks or changing LTC steps. This is normally used to prevent unwanted control system interaction when testing the emergency diesel generators.

As indicated in the introduction to this evaluation, malfunctioning of the LTCs in the automatic mode could cause over-voltage or under-voltage conditions on the safety buses. In this regard, the licensee has evaluated the potential failures of an LTC and its control system as follows:

- Case 1 - Failure Mechanisms that Cause the Transformer Tap Changer to Fail and Raise the Affected Safety Bus Voltage Unexpectedly: In this case it is anticipated that the transformer tap changer goes to full or partial boost. The bus voltage then goes high. When the voltage reaches a high enough value the voltage at load centers goes high and the condition alarms in the control room. The capacitor banks will not interact. The gear driven limit switch prevents movement of the tap to greater than 4 percent boost.

- Case 2 - Failure Mechanisms that Cause the Transformer Tap Changer to Fail and Lower the Safety Bus Voltage Unexpectedly: In this case, the expected result is that the transformer tap changer goes to full or partial buck and the bus voltage decreases. The capacitor banks will step on to raise voltage dependent on the magnitude of the voltage drop. If the voltage were to go low enough, alarms would energize in the control room. If the low voltage actuates the class 1E degraded voltage circuits after the appropriate time interval (8 seconds during a loss-of-coolant accident (LOCA) or 119 seconds during a non-LOCA) the affected safety bus(es) are shed from the offsite power system and are loaded onto the associated emergency diesel generator. A gear driven limit switch prevents movement of the tap to less than 6 percent buck.

- Case 3 - Failure Mechanisms that Cause the Tap Changer to Fail to Move: In this case the LTC self-test alarm is annunciated through the transformer trouble alarm in the control room. The voltage on the affected safety bus may go high or low depending on grid voltage changes. If the affected voltage goes high enough, the corresponding load center will alarm on high voltage in the control room as well. If the safety bus voltage goes low enough, the capacitor banks will step on. If the voltage is still too low, the condition will alarm in the control room and after the appropriate time interval (8 seconds during a LOCA and 119 seconds during a non-LOCA) class 1E circuits shed the safety buses from the offsite power system and load onto the associated emergency diesel generators.

- Case 4 - Failure Mechanisms that Cause the High Side And/ or Low Side Breaker(s) to Isolate the Transformer from the Applicable Safety Bus: In this case, the protective relays for the affected ESF transformer trips the applicable 13.8kV transformer feeder and/ or low side breaker(s) or class 1E voltage relays actuate causing a transfer of the

applicable safety bus(es) to the associated emergency diesel generator. The capacitor bank is isolated along with the transformer.

Except for the bus overvoltage issues in Cases 1 and 3, the expected system responses identified above are enveloped by the existing accident analysis. The licensee states that although not specifically discussed in the FSAR, limited bus overvoltage is an analyzed and accepted failure mode when within accepted limits. In its submittals, the licensee supports this statement with the following pertinent discussions:

> Over voltage may occur if the voltage controller fails, giving an increase tap signal and the backup control relay fails to block and run back the tap changer. This is not a likely occurrence. A probabilistic risk assessment using manufacturer-provided mean-time-before-failure data for the devices (110 years for the primary controller and 296 years for the back up controller) results in an incremental conditional core damage frequency of 1.5 E-8/yr based on common cause failure of the primary controller and the backup controller. This frequency is three orders of magnitude below the existing core damage frequency. Thus, the design provides over voltage control and protection whose simultaneous failure probability for both the voltage regulator and the backup protection relay to fail is sufficiently low that the over voltage protection will be assumed to exist and provide protection.
>
> This overvoltage protection is not new as the grid, main generator, and emergency diesel generators may also cause high voltages given component failures. These failures however have not been quantified or discussed in the FSAR and have been accepted as is. These hazards would have a low probability of occurrence.
>
> In addition, design features also exist to identify failures and limit failure duration. These are the following features:
>
> - The voltage controller is provided with a self-test alarm that determines the functionality of the device. This will have annunciation to detect the operational failure.
> - The back-up protection relay will identify the controller failure when out-of-control range voltages occur. This is annunciated in the control room.
> - The voltage controller and back-up control relay are fed from separate potential transformers and fuses.
> - The devices separately identify a voltage loss and inhibit voltage raise functions. This condition is identified by annunciation.
> - The devices will have periodic testing to ensure their proper operation.
>
> The licensee has performed an overvoltage study. The results indicate that at worst case conditions (e.g., high grid voltage, LTC controller failure causing uncontrolled

boost, and backup protection relay failure) equipment damage will not occur for several minutes. Load flow analysis performed for loads present during a LOCA indicates that the overvoltage will not occur. This overvoltage study combined with the low probability of occurrence seen in probabilistic analysis further indicate the overvoltage condition is not a credible new accident.

The staff agrees that, given the various features incorporated into the LTC design and the expected reliability of the key features (i.e., primary controllers and backup controllers), the likelihood that an overvoltage will create a safety problem is very low.

In their January 18, 2001, submittal, the licensee summarized the testing to be performed on the automatic LTC transformers. The staff agrees with the licensee that the testing demonstrates continuing compliance with GDC 18, "Inspection and Testing of Electric Power Systems."

3.2 Conclusion

The proposed design will accommodate higher and lower voltages than previously available from the offsite power sources. The new ESF transformers will allow greater regulation of voltage to the electrical safety buses. The various features incorporated into the LTC design, and the expected reliability of the key features, will keep the likelihood of a safety significant overvoltage to an acceptably low level. The licensee has established the minimum voltages necessary in the Callaway switchyard to support adequate voltages at the safety-related plant equipment for combinations of ESF transformer, LTC, and capacitor bank availabilities. The licensee has also shown that sufficient alarms, online contingency computer capability, periodic grid load flow analyses, and administrative controls between Callaway plant staff and ESO exist to maintain adequate switchyard voltages and alert the Callaway operators when the voltage minimums are threatened.

Based on the evaluation above on the new ESF transformers proposed for Callaway, the staff concludes that the proposed modification to replace the two existing ESF transformers with new transformers having automatic LTCs meets GDC 17, and is, therefore, acceptable. The staff has also reviewed the proposed changes to the FSAR and concludes that the proposed changes accurately reflect the proposed change to the new ESF transformers.

4.0 STATE CONSULTATION

In accordance with the Commission’s regulations, the Missouri State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to the installation or use of facility components located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no

significant hazards consideration and there has been no public comment on such finding (66 FR 11063). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributors: J. Lazevnick
D. Holland

Date: April 6, 2001