Evaluation of the Proposed Change

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DESCRIPTION AND ASSESSMENT OF THE PROPOSED CHANGE

1. SUMMARY DESCRIPTION

This enclosure provides an evaluation of the proposed Technical Specification (TS) change. A regulatory evaluation (including the Significant Hazards Consideration Determination Analysis) and environmental evaluation are provided in Sections 4 and 5 of this Enclosure. Attachment 1 provides marked-up TS pages, Attachment 2 provides the retyped (clean) TS pages, and Attachment 3 provides marked-up TS Bases pages. The marked-up TS Bases pages are provided for information only.

Ameren Missouri (Union Electric Company) is proposing to amend Operating License NPF-30 for Callaway Plant, Unit 1. The proposed amendment would revise the emergency diesel generator (EDG or DG) frequency range for TS 3.8.1, "AC Sources – Operating," as specified in a number of the Surveillance Requirements (SRs). Specifically, the proposed changes reflect incorporation of Technical Specification Task Force (TSTF) traveler TSTF-163, Revision 2, "Minimum vs. Steady State Voltage and Frequency" (Reference 1), as well as changes to the steady state DG operating frequency range consistent with the methodology specified in WCAP-17308-NP-A, “Treatment of Diesel Generator (DG) Technical Specification Frequency and Voltage Tolerances” (Reference 2). The proposed amendment does not change the allowable DG voltage operating range.

The license amendment request is required to correct a non-conservative TS. The proposed TS SR changes establish DG surveillance testing limits to support the required performance ranges for the affected safety related equipment. This change is necessary based on the discovery that some safety related pumps could not be demonstrated to perform as specified in the design basis over the full range of DG frequency allowed by the Technical Specifications without more detailed analysis. Conservative plant operations are currently administratively controlled in accordance with NEI 15-03, Revision 0, “Licensee Actions to Address Nonconservative Technical Specifications” (Reference 3).

2.0 DETAILED DESCRIPTION

2.1 <u>System Design and Operation</u>

The onsite standby power source for each of the two 4.16 kV Engineered Safety Feature (ESF) buses at the Callaway Plant is a dedicated DG. Accordingly, DGs A and B (component ID NE01 and NE02) are dedicated to ESF buses A and B (component IDs NB01 and NB02), respectively. A DG starts automatically on a safety injection (SI) signal or on an ESF bus degraded voltage or undervoltage signal. After the DG has started, it will automatically tie to its respective bus after offsite power is tripped as a consequence of ESF bus undervoltage or degraded voltage, independent of or coincident with an SI signal. The DGs will also start and operate in the standby mode without tying to the ESF bus on an SI signal alone. Following the loss of offsite power, in response to the undervoltage signal, a sequencer strips non-permanent loads from the ESF bus. When the DG is tied to the ESF bus, the associated loads are then sequentially connected to the ESF bus by an automatic load sequencer. The sequencing logic controls the permissive and starting signals to motor breakers to prevent overloading the DG by automatic load application.

This configuration assures that the independent emergency diesel generator can supply the Class 1E loads required to safely shutdown the unit following a design basis accident. Each diesel generator is designed to attain rated voltage and frequency and to accept load within 12 seconds after receipt of a start signal. The characteristics of the generator exciter and voltage regulator provide satisfactory starting and acceleration of sequenced loads and ensure rapid voltage and frequency recovery when starting large motors. The voltage and frequency recovery characteristics meet or exceed the requirements of Regulatory Guide (RG) 1.9, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants," Revision 3 (Reference 11).

Each diesel generator is rated at 6201 kW for continuous operation. Additional ratings are 6,635 kW for 2,000 hours, 6,821 kW for 7 days, and 7,441 kW for 30 minutes. The generator 2-hour rating is equal to the 7-day rating. Refer to the Final Safety Analysis Report (FSAR) Standard Plant (SP) Section 8.3.1.1.2 for additional details on the Class 1E alternating current (AC) system (Reference 12).

2.2 Current Technical Specification Requirements

Pertinent portions of the current Surveillance Requirements (SR) of TS 3.8.1 (as they currently appear in Appendix A of the Callaway Operating License) are presented below:

SR 3.8.1.2 Verify each DG starts from standby conditions and achieves steady state voltage $\geq$ 3740 V and $\leq$ 4320 V, and frequency $\geq$ 58.8 Hz and $\leq$ 61.2 Hz.

SR 3.8.1.7 Verify each DG starts from standby condition and achieves in $\leq$ 12 seconds, voltage $\geq$ 3740 V and $\leq$ 4320 V, and frequency $\geq$ 58.8 Hz and $\leq$ 61.2 Hz.

SR 3.8.1.11 Verify on an actual or simulated loss of offsite power signal:

...

c. DG auto-starts from standby condition and:

...

4. maintains steady state frequency $\geq$ 58.8 Hz and $\leq$ 61.2 Hz, and

…

SR 3.8.1.12 Verify on an actual or simulated safety injection signal each DG auto-starts from standby condition and:

a. In ≤ 12 seconds after auto-start and during tests, achieves voltage ≥ 3740 V and ≤ 4320 V;

b. In ≤ 12 seconds after auto-start and during tests, achieves frequency ≥ 58.8 Hz and ≤ 61.2 Hz;

...

SR 3.8.1.15 Verify each DG starts and achieves, in ≤ 12 seconds, voltage ≥ 3740, and ≤ 4320 V and frequency ≥ 58.8 Hz and ≤ 61.2 Hz,

SR 3.8.1.19 Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated Safety Injection signal:

….

c. DG auto-starts from standby condition and:

…

4. achieves steady state frequency ≥ 58.8 Hz and ≤ 61.2 Hz, and

…

SR 3.8.1.20 Verify when started simultaneously from standby condition, each DG achieves in ≤ 12 seconds, voltage ≥ 3740 V and ≤ 4320 V, and frequency ≥ 58.8 Hz and ≤ 61.2 Hz.

2.3 Reason for the Proposed Change

The proposed amendment is necessary based on the discovery that some safety related components could not be demonstrated to perform as specified in the design basis over the full range of DG frequencies allowed by the TSs without more detailed analysis. Subsequent Ameren Missouri evaluations utilizing the methodologies approved in WCAP-17308 determined that a more conservative operating range for DG frequency should be specified. The proposed amendment would revise the applicable TS SRs to reflect a more restrictive steady state frequency operating range. The more restrictive steady state frequency operating range assures that safety related equipment can perform its specified safety functions consistent with design basis assumptions.

This LAR is required to resolve a non-conservative TS and is not a voluntary request. Therefore, this request is not subject to 'forward fit' considerations as described in the letter from S. Burns (NRC) to E. Ginsberg (NEI), dated July 14, 2010 (ML101960180).

Upon discovery, the nonconservative TS condition was entered into the Callaway corrective action program for resolution. Administrative controls were established in accordance with NEI 15-03, "Licensee Actions to Address Nonconservative Technical Specifications," (Reference 3) and Regulatory Guide (RG) 1.239, "Licensee Actions to Address Nonconservative Technical Specifications" (Reference 13). These controls ensure that equipment powered from the Class 1E buses can perform its specified safety functions under design basis conditions.

Since the steady state frequency operating range for the DGs is changed per this LAR, it is appropriate to also make the changes prescribed per TSTF-163, Revision 2. TSTF-163 prescribes a generic change which is now reflected in NUREG-1431, "Standard Technical Specifications Westinghouse Plants," Revision 5.0 (Reference 14) to modify the SRs for DG fast starts (i.e., "in [10] seconds") to require achieving a minimum voltage and frequency and then a steady state voltage and frequency within a specified range. Currently, the Callaway TS SRs for these "fast starts" require achieving the minimum voltage and frequency range within 12 seconds. As stated in TSTF-163, "The intent of the [10] second start tests is to confirm the ability of the DG to reach the minimum conditions to accept load." A new range for the acceptable steady state frequency is proposed consistent with the TSTF (and as established in accordance with the methodology of WCAP-17308), which is only applicable to steady state operation. The adoption of the TSTF does not alter Callaway's commitment to RG 1.9, Revision 3, and its endorsement of IEEE Standard 387-1984. The SRs for verifying the attainment of a minimum voltage and frequency when starting the emergency diesel generator are unaffected and will still meet those limits established by guidance given in RG 1.9. Similarly, the DG characteristics for voltage recovery during large motor loading are also unaffected and will still meet the limits established by guidance in RG 1.9.

2.4 Description of the Proposed Change

The changes to be made to the TS 3.8.1 SRs are as proposed below. Deleted text is shown using the strikeout feature. Inserted text is underlined. The revised frequency values are highlighted in **bold**. Changes reflecting the incorporation of TSTF-163 are shown in italics. The changes are also depicted in the TS marked-up pages provided in Attachment 1 to this Enclosure.

SR 3.8.1.2 Verify each DG starts from standby conditions and achieves steady state voltage ≥ 3740 V and ≤ 4320 V, and frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz.

SR 3.8.1.7 Verify each DG starts from standby condition and achieves: ~~*in ≤ 12 seconds*~~,

a. *In ≤ 12 seconds, voltage ≥ 3740 V and frequency ≥ 58.8 Hz, and*

b. *Steady state* voltage ≥ 3740 V and ≤ 4320 V, and frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz.

SR 3.8.1.11 Verify on an actual or simulated loss of offsite power signal:

...

c. DG auto-starts from standby condition and:

...

4. maintains steady state frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz, and

…

SR 3.8.1.12 Verify on an actual or simulated safety injection signal each DG auto-starts from standby condition and:

a. In ≤ 12 seconds after auto-start and during tests, achieves voltage ≥ 3740 V and ~~*≤ 4320 V*~~ *frequency ≥ 58.8 Hz,*

b. ~~*In ≤ 12 seconds after auto-start and during tests, achieves*~~ *Achieves steady state voltage ≥ 3740 V and ≤ 4320 V and* frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz;

...

SR 3.8.1.15 Verify each DG starts and achieves:~~*, in ≤ 12 seconds,*~~

a. *In ≤ 12 seconds, voltage ≥ 3740 V and frequency ≥ 58.8 Hz, and*

b. *Steady state* voltage ≥ 3740, and ≤ 4320 V and frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz,

SR 3.8.1.19 Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated Safety Injection signal:

….

c. DG auto-starts from standby condition and:

…

4. achieves steady state frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz, and

…

SR 3.8.1.20 Verify when started simultaneously from standby condition each DG achieves: ~~*in ≤ 12 seconds*~~,

a. *In ≤ 12 seconds, voltage ≥ 3740 V and frequency ≥ 58.8 Hz, and*

b. *Steady state* voltage ≥ 3740 V and ≤ 4320 V, and frequency ≥ ~~58.8~~ **59.7** Hz and ≤ ~~61.2~~ **60.3** Hz.

3.0 TECHNICAL EVALUATION

The performance of required accident mitigation equipment is dependent on the DG voltage and frequency when the DG is suppling its associated Class 1E electrical bus. The current analyses generally assume that the steady-state DG voltage is 4160 V and the steady-state DG frequency is 60 Hz. However, equipment powered from the DGs is allowed to be subject to voltage and frequency variations up to the limits specified in the TS SRs. The current TS 3.8.1 allows a steady state voltage range of 3740 V to 4320 V and a steady state frequency range of 58.8 Hz to 61.2 Hz. These allowed steady-state ranges represent tolerances for voltage of +3.85%/-10% around a nominal 4160 V and for frequency of ±2% around a nominal 60 Hz. The proposed revised DG frequency ranges have been analyzed assuming a steady state voltage range of 3740 V to 4320 V and a frequency range of 60 Hz ± 0.3 Hz.

The proposed frequency tolerance is more restrictive with respect to the current TS SR range for DG frequency. Since the DGs were designed to operate within the current frequency tolerance, limiting the tolerance to a tighter band is considered acceptable for DG operation. The DG frequency range was reduced to minimize the impact of frequency variation on the operation of connected loads. The DG voltage regulator has demonstrated its capability to maintain steady state voltage within the existing tolerance. Similarly, DG governor has demonstrated its capability to maintain DG speed within the narrower tolerance as demonstrated during operation. Design analyses and supporting manufacturer design tolerances also support the capability of the DG governor to maintain speed within the SR limits. Furthermore, review of surveillance test data over the past three years provides assurance that the revised voltage and frequency limits will be achievable.

Callaway was initially licensed to RG 1.108 and RG 1.9, Revision 2 regarding the original design and testing of the emergency diesel generators. RG 1.9, Revision 2 was essentially an endorsement of IEEE Standard 387-1977 with a number of provisions specified in the Regulatory Position section of the RG.

For ongoing testing of the DGs, Callaway conforms to the TSs and with exceptions (as described in the TS 3.8.1 Bases) to the test recommendations of RG 1.9, Revision 3. The SR frequencies are controlled under the Surveillance Frequency Control Program (SFCP) described in TS 5.5.18. Revision 3 of RG 1.9 integrates the pertinent guidance previously addressed in Revisions 1 and 2 of RG 1.9 and the guidance of Revision 1 of RG 1.108. RG 1.9, Revision 3 endorses IEEE Standard 387-1984 with respect to design, qualification and periodic testing of diesel generator units, subject to the supplemental design considerations specified in Section C.1 and the diesel generator testing provisions specified in Section C.2 of the RG.

In conformance with the original design criteria, the continuous rating of each diesel generator is greater than the sum of the conservatively estimated loads needed to be supplied following any design basis event. Load requirements are noted in Callaway site specific calculations. The short-term or transient response requirements for each DG conform to the requirements of RG 1.9 Revision 3 as described in FSAR SP Section 8.1.4.3. The voltage/frequency values/ranges corresponding to those requirements are the values currently specified in the Callaway TS SRs.

Topical Report WCAP-17308-NP-A is approved for determining the impact of DG steady state frequency and voltage variations on the performance of pumps, valves, and fans/blowers, chillers, coolers, and miscellaneous electrical loads and mechanical equipment, particularly with regards to the Emergency Core Cooling System (ECCS). Voltage and frequency operating range requirements allow for variations in motor speeds, which consequently allow for variations in equipment performance. Ameren Missouri analyzed the allowable steady state variations in voltage and frequency proposed for the affected TS SRs (as listed in Section 2.4 of this LAR) following the methods provided by WCAP-17308, including the utilization of Callaway-specific inputs, to demonstrate the capability of equipment to meet its specified safety function. The SRs being revised are consistent with those addressed by WCAP-17308.

The TSTF-163 related changes to Callaway TS SRs 3.8.1.7, 3.8.1.12, 3.8.1.15, and 3.8.1.20 preserve the requirement to achieve a minimum voltage and frequency within 12 seconds. This confirms the ability of the DG to reach the conditions necessary to accept load. The minimum values for voltage and frequency are unchanged and remain acceptable since these SRs do not require the DG to be loaded at 12 seconds. As such, this change does not have any impact on the safety related loads. The proposed change does not involve any departures (other than Callaway-specific values) from TSTF-163. The approach taken to evaluate the effects of the proposed voltage/frequency limits/range are described in each equipment evaluation below.

3.1 Pump Evaluation

In WCAP-17308-NP-A Section 2.1, it is noted that the total pump head uncertainty is calculated at discrete flow rates as a function of the combined uncertainties for frequency, voltage, and various other measurements including flow and pressure. Therefore, flow variability due to measurement uncertainties and the effects of frequency and voltage on pump speed must be statistically factored into the pump head uncertainty. For the simultaneous underfrequency and undervoltage condition, the decrease in pump flow rates must be evaluated to ensure ECCS acceptance criteria can continue to be met. For the simultaneous overfrequency and overvoltage condition, the increase in pump flow rates must be evaluated to ensure Net Positive Suction Head (NPSH) requirements continue to be met and that MOV operation is acceptable.

A plant specific analysis was performed to evaluate the pumps required to mitigate design basis accidents (Reference 15). The analysis assessed the DGs operating at the proposed SR steady state undervoltage and underfrequency values. The following pumps were evaluated:

- Essential Service Water (ESW) Pumps (PEF01A/B)
- Component Cooling Water (CCW) Pumps (PEG01A/B)
- Motor-Driven Auxiliary Feedwater Pumps (MDAFWPs) (PAL01A/B)
- Residual Heat Removal (RHR) Pumps (PEJ01A/B)
- Containment Spray (CS) Pumps (PEN01A/B)
- Fuel Oil Transfer Pumps (PJE01A/B)
- High Head Safety Injection (SI) Pumps (aka Centrifugal Charging Pumps) (PBG05A/B)
- Intermediate Head SI Pumps (aka Safety Injection Pumps) (PEM01A/B)

The analysis evaluated the performance of the Callaway pumps to generate revised minimum and maximum test curves that account for the effects of steady state DG voltage and frequency variations, as well as evaluating flow and pressure measurement uncertainties. Adjustments were applied to the existing pump curves of record using the Callaway-specific DG and instrument uncertainties. In systems with variable resistance, throttle valve settings were checked or reset to within prescribed limits to meet the required minimum design basis accident flow rates, ensure that pumps do not exceed runout flow, and ensure that flow balance tolerances between branch lines are met.

The analysis results are to be used to adjust the Inservice Testing (IST) surveillance test acceptance criteria, as applicable, to ensure that design basis safety analysis limits of equipment loaded on the DG will be met at the extremes of the allowed steady state DG voltage and frequency variations, including flow and pressure measurement uncertainties. These adjustments will be implemented upon approval of the requested license amendment.

In addition to the analyses for the pumps, the effects of operation at the minimum DG voltage and frequency were evaluated for any necessary adjustments to the post-LOCA flow balance heat loads on the ESW and CCW systems (Reference 15).

3.2 DG Loading and Fuel Consumption

In WCAP-17308-NP-A Section 3.2, it is noted that a calculated change in diesel generator loading due to steady-state variation in frequency requires a commensurate evaluation of the impact on fuel oil consumption and stored fuel requirements as a result of the change in loading.

At Callaway, the Fuel Oil Transfer Pumps, are used to provide makeup to the DG fuel oil day tanks. FSAR SP Section 9.5.4.2.2.b indicates the capacity of each transfer pump is approximately twice the consumption rate of the diesel engine at its continuous rating. Since the maximum EDG consumption rate is approximately 7.7 gpm, these pumps have significant margin for degradation and can easily accommodate the EDG uncertainty. The effect on NPSH required during overvoltage and overfrequency is also negligible. It is therefore concluded that the impact of the revised frequency range for the DG on the Diesel Fuel Oil Transfer Pumps (DFOTPs) is negligible.

The increase in DG loading due to DG voltage and frequency variation is used as input into the existing diesel fuel consumption and storage tank capacity calculation to verify that the increase in fuel oil consumption remains bounded. If variations in both voltage and frequency occur simultaneously, the effects were superimposed. The maximum impact on DG loading is observed when both the voltage and frequency are at the upper TS limits of 4320 V and 60.3 Hz. For this condition, it was determined that the steady state loading on the DG does not exceed the continuous rating of the DG. The reduction in the maximum allowable frequency band from 60 +1.2 Hz to 60 +0.3 Hz will reduce the operating load on the DGs from 6147 kW to 5952 kW, as evaluated per Reference 16. This demonstrates that the continuous rating of Callaway's DGs of 6201 kW is not exceeded due to the maximum allowable voltage and frequency variations proposed.

WCAP-17308-NP-A Section 3.2 addresses impact on diesel generator fuel consumption calculations. It simply notes that the calculated change in the DG loading due to steady state variation in frequency also requires a commensurate evaluation of the impact on fuel oil consumption and stored fuel requirements as a result of the change in loading. The Callaway DG fuel oil storage tank 7-day volume is based on the DG continuous rating of 8600 brake horsepower (bhp). The generator output power at this engine rating is 6201 kW. As described above, calculations show that the loading at the maximum allowable frequency of 60.3 Hz is below the 6201-kW generator rating, and thus, the existing design bases fuel oil requirements are not adversely impacted. By extension, the fuel oil storage requirements of TS 3.8.3, "Diesel Fuel Oil, Lube Oil, and Starting Air," are not adversely impacted.

3.3 Motor Overload Protection

The protective relaying or overload settings for breakers and overload relays could be impacted by operation at higher frequency and low voltage, potentially resulting in spurious breaker openings (i.e., trips). This potential condition has been evaluated. Given that the allowable operating range for DG voltage is unchanged and that the allowable operating range for the DG frequency is being reduced, it was determined that no plausible operational impact exists.

Protective relaying for the 4 kV motors is established for safety related motors such that overload alarms are received at 115% of the full load amperage and the breaker trips are set to 175% of full load amperage. Calculations demonstrated that the overcurrent alarms and trips will not occur, assuming a high operating frequency of 60.3 Hz and a concurrent low operating voltage of 3740 VAC.

The effect of the proposed changes on overcurrent protection for direct drive fans has been calculated. For those fans with ductwork that require the performance of flow balances, calculations assumed the worst-case bhp in the band assuming operation of ±10% airflow and a degraded voltage that bounds the allowable DG lower voltage. For fans with no ductwork, the operating point bhp was modified to the horsepower for higher speed from 60.3 Hz EDG operation. These calculations demonstrate that there is margin from the thermal overload trip point.

The effect of the proposed changes on overcurrent protection for belt driven fans has also been evaluated. The existing calculation assumes operation of ±10% airflow and a degraded voltage that bounds the allowable DG lower voltage. The ±10% airflow assumes the worst case loading within the band. Using a ±9% airflow assumption instead still allows for flow balance tolerances and uncertainties in the settings established by maintenance personnel and allows a ±1% uncertainty for the DG frequency and voltage band. These calculations demonstrated that there is margin from the thermal overload trip point.

Lastly, the spent fuel pool (SFP) cooling pump motor protection was evaluated for proper operation during EDG low voltage and high frequency operation. The evaluation documented in Reference 16 demonstrates that the motor overload protection has margin to this worst-case DG operation condition. In addition, a qualitative assessment of the SFP cooling capabilities concluded that the system has more than adequate cooling capability given the very conservative assumptions for decay heat generation by the fuel in the SFP and component cooling water system heat removal.

3.4 Motor Operated Valve (MOV) Performance

In WCAP-17308-NP-A Section 4, it is noted that the impact of frequency and voltage variation on motor-operated valves (MOVs) would be similar to the impact on other inductive motors such as pump motors. A higher than nominal frequency would increase the speed of the motor, whereas a lower frequency would slow the motor speed. All rotating machinery powered by the DG output would be affected by a change in frequency in a similar manner (but specific to each motor).

Since the MOVs are powered by the 480-VAC system, the DG bus frequency translates directly through the step-down transformer. That is, if 59 Hz power is provided in the primary (high voltage) side of the transformer, then 59 Hz power at the secondary side (low voltage) transformer terminals will result. It can be noted that a change in frequency affects the reactance of a transformer, and as a result, the output voltage on the secondary side is affected as well. For this analysis, it was determined that any change in transformer reactance and secondary side voltage is negligible. DG output frequency will carry through the step-down transformer to the motor control centers (MCCs) and to the MOVs. WCAP 17308-NP-A Section 4.1 documents that there would be no adverse impact on MOV stroke times due to the small frequency variation allowed by the proposed TS change.

In WCAP-17308-NP-A Section 4.2, it is noted that the inertia of a motor-operated valve is associated with the moving parts of the valve assembly and consists of the sum of the inertias of the motor, the gear train, and the stem-disc assembly. The effect of rotational inertia is to do work when the valve closes by creating a force and a displacement. The force is the inertial effect measured during diagnostic testing. As the moving parts move at different speeds, it is customary to calculate an equivalent inertia. The equivalent inertia is the sum of inertias of the moving parts. In MOVs, the inertia effect on load is measured after static tests as the difference in thrust from closed torque switch trip and hard seat. The energy contribution of the components is proportional to the square of the rotational speed of the component, and for a linear system, it is proportional to the square of the velocity. Since linear velocity is proportional to rotational speed, for all the components of the assembly, the energy is a function of the square of the rotational speed. Since frequency is directly proportional to rotational speed, a change in frequency changes the rotational speed proportionately. Thus, a change in frequency will change the energy content taking into account the square of the rotational speed effect.

As documented in the WCAP, the change in the inertia effect may be expressed as:

$$\Delta F_e = \frac{2\Delta f}{f} F_e$$

Where:
ΔFe = change in force component of inertial work done when the valve closes
Δf = change in frequency, Hz
F_e = Static test inertia effect measured during valve testing (same units as ΔF_e)
f = nominal frequency of motor, Hz

The WCAP includes a worked example based upon a frequency change of 0.5 Hz on a 60 Hz motor and determined the affect would be about 1.7% (this is the term $2\Delta f/f$). In Callaway's case, the change in frequency would be 0.3 Hz. The corresponding effect for Callaway using the WCAP methodology would be 1%, which is a smaller effect than the worked example.

The NRC reviewed and evaluated WCAP-17308-NP and issued a Safety Evaluation (SE) (in April 2017) documenting their review, acceptance and any conditions applicable to applying the Westinghouse methodology. (The NRC SE was subsequently incorporated into WCAP-17308-NP-A, as issued in July 2017.) In their review of Section 4.2 of the WCAP, the NRC (in SE section 3.10) states, "As shown in the worked example, the change in inertia effect is very small and will not impact the valve performance in an adverse manner."

Impact of MOV Voltage: Per WCAP-17308-NP-A Section 4.3, and as part of the calculations performed to comply with Generic Letter (GL) 96-05, the MOV calculations are based on worst-case degraded voltage conditions. There would be no change in the calculation results unless the low-end voltage range for the DG voltage regulator is less than the degraded voltage condition analyzed in the MOV calculations. For typical AC motor and actuator applications, voltage variation from 90% to 100% will not affect the output torque outside its operating range if the nominal ratings are used. Given that the allowable TS values for minimum and maximum steady state DG voltage are unchanged, the proposed amendment has no effect on the assumed performance of the MOVs.

Impact of Pump Output Pressure/Differential Pressure (DP) on affected MOV(s): Per WCAP-17308-NP-A Section 4.4, an increase in pump output pressure (and consequently, the differential pressure caused by a higher than nominal frequency) will create a higher DP at the affected MOV. The concern is the resulting reduction in design margin to assure the valve's ability to perform its specified safety function. Design margin is determined by comparing the available torque or thrust of the MOV to the required torque or thrust of the MOV to operate against the associated differential pressure.

The equations and example calculations from the WCAP allowed determination of a revised margin for each valve. The design margins were compared against the values from previous revisions of the calculations, from which a positive margin was verified to be maintained such that the margin classification remained unchanged from that previously determined.

3.5 Fan and Blower Performance

Per WCAP-17308-NP-A Section 5, calculating the change in fan performance due to small diameter changes, speed variations, and density fluctuations is a matter of multiplying by ratios of the target parameter to the initial parameter (raised to some power). These are the fan/blower affinity laws. Both direct driven and belt driven fans would be impacted in the same manner by DG frequency and voltage variations.

For the upper bound of the DG governor control band, the main concern from a higher than nominal frequency value (> 60 Hz) would be the additional power load required from the DG. This additional power requirement is addressed in the diesel loading calculation described in Reference 16. The lower range of the EDG governor control band (for frequencies < 60 Hz) would cause a slight reduction in motor speed (rpm) and a decrease in fan performance exhibited by reduced airflow (cfm) and static pressure (SP) as indicated by the fan/blower affinity laws.

The effect of voltage variation in excess of the nominal voltage rating of the fan/blower motors would cause the current of the motor load circuits to increase or decrease accordingly. The voltage variation of the DG voltage regulator at steady-state operation has been confirmed to be within the allowable operating voltage range for the fan/blower motors to ensure that there would be no adverse impact to the fan/blower motors from the minimum and maximum expected steady-state voltage allowed by the voltage regulator.

Analyses have been performed as described in Reference 16 for the safety related direct drive fans and the safety related belt-driven fans. The analyses show a ± 0.88% maximum change for the fan flow due to the EDG frequency variation for all direct drive fans except for the ESW pump room supply fans. The variation for these fans was a maximum of 1.15% which is elaborated on in Reference 16. The analyses show a maximum change of ± 0.99% for the belt driven fans. The plant flow balance and periodic maintenance procedures have had their tolerance limits changed from the original ± 10% limit to ± 9% to account for the frequency variation. This gives an allowance of 1.0% for the EDG frequency and voltage operating bands with the exception of ESW pump room supply fans. The design minimum and maximum flow variation in the design for filtering, cooling and thermal overload sizing is based on ± 10% design limits. Performance checks and flow balance tests providing operation to ± 9% will ensure the EDG frequency and voltage variation will not cause operation outside of the design limits for fan operation. Performance checks and flow balance tests for the ESW pump room ventilation supply fans will be held to a tighter acceptance criterion.

3.6 Miscellaneous Equipment Powered from the DGs

This analysis also evaluated other pumps, fans, motor operated valves, chillers, air conditioning units and coolers, miscellaneous electrical loads, and miscellaneous mechanical equipment that are powered from the DG for the effects of the over and under frequency and voltage allowed by the TS. Given the broad similarity of component and operating characteristics, such as 480 VAC motors or 110 VAC motors, many components were qualitative dispositioned as falling within the bounds of existing analysis and not adversely affected. The following are specific examples:

3.6.1 Pressurizer Heaters

As identified in the WCAP 17308-NP-A NRC SER, the impact on operation of the pressurizer heaters should be evaluated for low voltage operation to meet TS operability requirements. TS 3.4.9, "Pressurizer," requires that the pressurizer backup heaters have a minimum capacity of 150 kW during MODES 1, 2, and 3. With the DG operating at the minimum voltage of 4160 V – 420 V (3740 VAC), with a conservative LOCA loading versus normal 100% power operation, the normal 692 kW pressurizer backup heaters are calculated to operate at 546.6 kW for PG21 fed heaters and 548.7 kW for PG22 fed heaters (Reference 16). Thus, the operation at the minimum DG voltage will meet TS operating requirements. DG operating frequency will have no discernable effect on pressurizer heater operation.

3.6.2 Battery Chargers

As identified in the WCAP 17308-NP-A NRC SER, the impact of the DG operation on the operation of the battery chargers should be verified. Based on the design principles of the battery chargers, operation at the upper allowable voltage and across the frequency tolerance will have negligible effect on the operation of the battery charger. Operation of the battery chargers at the low voltage tolerance has already been evaluated. The battery chargers are specified and qualified to operate at 460 VAC ± 10%. Electrical bus loading calculations show the lowest DG voltage operation will provide a minimum voltage of 424 VAC at the charger input terminals which is greater than the required minimum 414 VAC specified operating minimum voltage for the chargers. Given the operating principles and design of the battery chargers, there is no postulated mechanism to cause adverse performance of DC loads due to DG voltage or frequency variances. Thus, the battery chargers will continue to perform their specified safety function with the proposed allowable DG voltage and frequency tolerances.

3.6.3 Essential Service Water Discharge Strainer Motors

Each Essential Service Water (ESW) header has a strainer used to capture particulate matter and prevent its transport through the ESW system and introduction into the ESW-supplied components. These strainers have a self-cleaning feature that utilizes electrical motors. The strainer motors were specified to operate at 460 VAC ± 10% (414 to 506 VAC). Per the voltage discussion above, the ESW discharge strainer motors will continue to perform their specified safety function with the proposed allowable DG voltage and frequency tolerances.

3.6.4 Emergency Exhaust Ventilation Filter Heaters

TS 3.7.13, "Emergency Exhaust System (EES)," requires two operable trains of the EES system. This system gathers radioactive gases released into the fuel handling building or into the auxiliary building during analyzed postulated events. The EES filtration beds contain heaters that are used to dry the air passing through the emergency exhaust HEPA filters. A humidity sensor turns these heaters on or off. The heaters are rated for 37 kW at 480 VAC. The power available to the heaters with the DG operating at its minimum voltage of 3740 VAC is greater than the 30 kW required by TS 3.7.13.

3.6.5 Post-LOCA Hydrogen Analyzers

FSAR Section 16.3.3.4, "Accident Monitoring Instrumentation Limiting Condition for Operation," requires certain instrumentation systems to be operable to assess the conditions associated with a post-accident environment. Among other instrumentation channels, this FSAR condition requires two operable channels of the Containment Hydrogen Analyzers (aka post-LOCA Hydrogen Analyzers). Within the analyzers are sample motors rated at 460 VAC and manufactured to NEMA standards. NEMA MG-1 requires each motor to operate with a continuous voltage of rated ± 10% (414 to 506 VAC). Test reports show that the instrumentation panel was tested at a 100 VAC to 135 VAC input and the sample pump was started with a voltage of 75% of 460 VAC. Electrical bus loading calculations show the lowest DG voltage operation will provide a minimum voltage of 426 VAC at the analyzer skid. Thus, the post-accident hydrogen analyzers will continue to perform their specified safety function for the proposed allowable DG voltage and frequency tolerances.

3.6.6 Miscellaneous AC Loads

The adequacy of safety related devices energized from the 120 VAC distribution panels to perform their intended safety related function at degraded voltage is calculated based on voltages lower than the DG minimum steady state voltage. Bus voltage at the maximum steady state DG output voltage is bounded by the maximum 120 VAC bus rating. The effect of DG frequency variance is negligible with respect to the 120 VAC loads, as the loads do not include major rotating equipment (i.e., MOVs, large pumps, or large fans) that are subject to adverse performance based on frequency variances.

3.7 WCAP Limitations and Conditions per NRC SER

Section 4.0, "Limitations and Conditions," of the NRC's Final Safety Evaluation included in Reference 2 identified specific items that the staff expected to be reviewed as part of the resolution of the non-conservative TS values for DG operating voltage and frequency limits. The paraphrased items are presented in the table below. The section of this amendment request that addressed the item is identified to the right of the item.

Additional Consideration	**LAR Section (if applicable)**
Other safety related systems and non-rotating loads such as: - heaters - battery chargers - hydrogen igniters	 - 3.6.4 - 3.6.2 - not applicable
EOP required equipment such as: - pressurizer heaters - room heaters - hydrogen igniters - spent fuel pool cooling - air compressors - discretionary loads	 - 3.6.1 - not applicable - not applicable - 3.3 - not applicable - not applicable
Requirements for pressurizer heaters per NUREG-0737, "Clarification of TMI Action Plan Requirements," Section II.E.3.1 requirements for pressurizer heaters	- 3.6.1

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements / Criteria

The regulatory requirements and/or guidance documents associated with this amendment application include the following:

- Title 10 Code of Federal Regulations (10 CFR) Section 50.36, "Technical Specifications," paragraph (c), "Technical Specifications," requires including items in the following categories: (1) Safety limits, limiting safety system settings, and limiting control settings; (2) Limiting conditions for operation; and (3) Surveillance requirements.

  The (1) safety limits, limiting safety system settings, and limiting control settings and (2) limiting conditions for operation are not affected by the proposed amendment. In addition, the proposed changes to the plant specific Technical Specification Surveillance Requirements (SRs), as justified by this license amendment request, will ensure the SRs continue to meet the scope and purpose of the surveillance requirements described by 10 CFR 50.36(c)(3).

- 10 CFR Part 50 Appendix A, General Design Criterion (GDC) 17, "Electric Power Systems," ensures an onsite electric power system is provided to permit functioning of structures, systems, and components important to safety. As required by GDC 17, the design of the on-site emergency AC power system provides independence and redundancy to ensure an available source of power to the engineered safety features systems.

  The proposed TS SR changes help to ensure the DGs and the on-site emergency AC power system remain capable of performing their functions.

- 10 CFR 50, Appendix A, GDC 18, "Inspection and Testing of Electric Power Systems,": *Electric power systems important to safety to be designed to permit appropriate periodic inspection and testing of important areas and features, such as wiring, insulation, connections, and switchboards, to assess the continuity of the systems and the condition of their components. The systems shall be designed with a capability to test periodically*

  (1) the operability and functional performance of the components of the systems, such as onsite power sources, relays, switches, and buses, and

  (2) the operability of the systems, as a whole and under conditions as close to design as practical, the full operation sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power between the nuclear power unit, the offsite power system, and the onsite power system.

  Provisions are made for periodic testing of the important components of the emergency power system. Further provision is made for periodic testing of the DGs to assure their capability to start and to accept loads within design limits. TS SR testing of the DGs and the emergency power system ensures they can perform as required during design basis events. The proposed changes do not affect the designed capabilities for testing the DGs/onsite emergency power system, as they only impact the acceptance criteria for applicable SRs that will continue to be required.

- Regulatory Guide 1.9, "Selection, Design, and Qualification of Emergency Diesel Generator Units Used as Standby (onsite) Onsite Electric Power Systems at Nuclear Power Plants," provides guidance in the selection, design, and qualification of safety related diesel generator units, such that they be selected with sufficient capacity, qualified and maintained for reliability equal to or above the levels selected for a limiting event.

Callaway conforms with Regulatory Guide 1.9 guidance as discussed in FSAR SP Section 8.1.4.3. The proposed changes do not adversely impact the level of conformance with Regulatory Guide 1.9.

In conclusion, based on considerations discussed herein, (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) issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

4.2 Precedent

Although it is not a licensee-submitted amendment request, TSTF-163, Revision 2, has been incorporated into the Standardized Technical Specifications for Westinghouse Plants, NUREG-1431 Volume 2 Revision 5.0 [ADAMS Accession No. ML21259A155]. Approved license amendment requests associated with revising DG Surveillance Requirements to adopt TSTF-163 include the following:

- Pacific Gas and Electric Company submittal on March 28, 2011 [ADAMS Accession No. ML110880202] for Diablo Canyon, which was NRC approved on March 29, 2012 [ADAMS Accession No. ML120790338].
- Southern Nuclear Operating Company submittal on March 20, 2024 [ADAMS Accession No. ML24080A455] for Vogle Units 1 and 2, which was NRC approved on January 16, 2025 [ADAMS Accession No. ML24198A106].

Recently approved license amendment requests associated with revising DG voltage and/or frequency in accordance with the NRC approved methodology in WCAP-17308-NP-A include the following:

- DTE Electric Company submitted on December 16, 2022 [ADAMS Accession No. ML22350A504] for Fermi 2, which was approved on December 8, 2023 [ADAMS Accession No. ML23310A149].
- Exelon Generation submitted on December 15, 2021 [ADAMS Accession No. ML21349B378] for Limerick Units 1 and 2, which was approved on January 3, 2023 [ADAMS Accession No. ML22272A037].
- Duke Energy submittal on August 19, 2020 [ADAMS Accession No. ML20233A258] for Catawba and McGuire, which was NRC approved on June 23, 2021 [ADAMS Accession No. ML21131A026].
- Exelon Generation submittal on June 26, 2020 [ADAMS Accession No. ML20178A467] for Braidwood and Byron, which was NRC approved April 2, 2021 [ADAMS Accession No. ML21060B281].

- Exelon Generation submittal on December 11, 2019 [ADAMS Accession No. ML19346E536] for Calvert Cliffs, which was NRC approved November 9, 2020 [ADAMS Accession No. ML20273A088].
- Southern Nuclear Operating Company submittal on March 20, 2024 [ADAMS Accession No. ML24080A455] for Vogtle Units 1 and 2, which was NRC approved on January 16, 2025 [ADAMS Accession No. ML24198A106].

4.3 No Significant Hazards Consideration Determination

Ameren Missouri is requesting an amendment to the Technical Specifications (TSs) for Callaway Plant Unit 1 to revise the emergency diesel generator (EDG or DG) frequency range specified in applicable Surveillance Requirements under TS 3.8.1, "AC Sources – Operating." Specifically, the proposed changes reflect incorporation of Technical Specification Task Force (TSTF) traveler TSTF-163, Revision 2, "Minimum vs. Steady State Voltage and Frequency" [ADAMS Accession No. ML040500733] as well as changes to the steady state DG operating frequency range consistent with WCAP-17308-NP-A [ADAMS Accession No. ML17215A232] methodology.

Ameren Missouri has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No

The frequency range specified for DG operation is not associated with any accident initiator. The proposed change does not affect the safety limits or limiting safety system settings as required by the plant specific Technical Specifications (TS). The proposed change does not adversely affect the operation of any structures, systems, or components (SSCs) associated with an accident initiator or initiating sequence of events. The initial conditions and operating limits assumed during normal operation, assumed by the accident analysis, and assumed in anticipated operational occurrences would remain unchanged with incorporation of the proposed change. The proposed change does not physically alter the design of the plant. Therefore, the proposed change does not result in any increase in probability of an analyzed accident occurring.

Verifying the ability of each DG to maintain a steady state frequency within the proposed range for the DGs' support function of ensuring proper operation of electrical and mechanical systems credited with accident mitigation does not increase the consequences of an accident. Specifically, by evaluation in accordance with an NRC-approved methodology, it has been determined that safety related equipment supported by either DG will continue to perform as required for or during accident conditions with the DG operating at the more restrictive steady-state frequency operating range proposed for each DG. At the same time, evaluation and operating history shows that the more restrictive, steady-state frequency operating range is still within the design/performance capability of the DG governor/voltage regulator control system for each DG.

The adoption of TSTF-163 does not change the manner in which the EDGs are operated. The TSs, when revised per TSTF-163, will continue to ensure the EDGs perform their function when called upon. Specifically, the TS Surveillance Requirements (SRs) will continue to ensure that minimum frequency and voltage are attained within the required time and that proper steady state voltage and frequency are attained consistent with proper EDG governor and voltage regulator performance. Therefore, the probability and consequences of previously evaluated accidents are not significantly increased.

In addition, the proposed change does not involve a change to any mitigation sequence or the predicted radiological releases due to postulated accident conditions. Thus, the consequences of the accidents previously evaluated are not adversely affected.

Based on the above, it is concluded that this change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No

The proposed change would apply more restrictive acceptance criteria for the steady state DG frequency during DG operation, consistent with the DG design function to support the assumed loads. The currently required minimum values for voltage and frequency for DG loading at 12 seconds would be retained under the proposed change. With the adoption of the proposed change, it has been determined that the DGs and the systems supported by the DGs will continue to provide their required functional capability for mitigation of previously evaluated accidents and anticipated operational occurrences. The proposed change does not change the functions of the related systems, and thus, the change does not introduce a new failure mode, malfunction or sequence of events that could adversely affect safety or safety-related equipment.

Therefore, it is concluded that this change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

Response: No

The margin of safety is established through equipment design, operating parameters, and the setpoints at which automatic actions are initiated. The proposed changes continue to provide the required functional capability of the safety systems for previously evaluated accidents and anticipated operational occurrences. The proposed changes do not change the function of the related systems or significantly affect the margins provided by the systems. No safety analysis or design basis acceptance limit/criterion is challenged or exceeded by the requested changes.

Adoption of TSTF-163 does not impact EDG performance, including the capability for each EDG to attain and maintain required voltage and frequency for accepting and supporting plant safety loads within the required time, as assumed in the plant safety analysis. The proposed change does not involve a significant reduction in a margin of safety since the operability of the EDGs will continue to be required and verified (by SR performance) to ensure the capability of the EDGs to provide emergency power to plant equipment credited for accident mitigation.

Therefore, it is concluded that the proposed change does not involve a significant reduction in a margin of safety.

In consideration of all of the above, Ameren Missouri concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and on that basis, a finding of "no significant hazards consideration" is justified.

4.4 Conclusions

Based on the considerations discussed above, 1) there is a 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. Therefore, it is concluded that the requested amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of “no significant hazards consideration” is justified.

5.0 ENVIRONMENTAL EVALUATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

6.0 REFERENCES

1. Technical Specification Task Force (TSTF) traveler TSTF-163, Revision 2, "Minimum vs. Steady State Voltage and Frequency" [ADAMS Accession No. ML040500733]
2. WCAP-17308-NP-A, "Treatment of Diesel Generator (DG) Technical Specification Frequency and Voltage Tolerances" [ADAMS Accession No. ML17215A232]

3. NEI 15-03, Revision 0, "Licensee Actions to Address Nonconservative Technical Specifications" [ADAMS Accession No. ML15147A655]
4. Pacific Gas and Electric Company submittal on March 28, 2011 [ADAMS Accession No. ML110880202] for Diablo Canyon and NRC approval on March 29, 2012 [ADAMS Accession No. ML120790338]
5. DTE Electric Company submitted on December 16, 2022 [ADAMS Accession No. ML22350A504] for Fermi 2, which was approved on December 8, 2023 [ADAMS Accession No. ML23310A149]
6. Exelon Generation submitted on December 15, 2021 [ADAMS Accession No. ML21349B378] for Limerick Units 1 and 2, and NRC approval on January 3, 2023 [ADAMS Accession No. ML22272A037]
7. Duke Energy submittal on August 19, 2020 [ADAMS Accession No. ML20233A258] for Catawba and McGuire and NRC approval on June 23, 2021 [ADAMS Accession No. ML21131A026]
8. Exelon Generation submittal on June 26, 2020 [ADAMS Accession No. ML20178A467] for Braidwood and Byron and NRC approval April 2, 2021 [ADAMS Accession No. ML21060B281]
9. Exelon Generation submittal on December 11, 2019 [ADAMS Accession No. ML19346E536] for Calvert Cliffs and NRC approval November 9, 2020 [ADAMS Accession No. ML20273A088]
10. Southern Nuclear Company submittal on March 20, 2024, for Vogtle Electric Generating Plant Units 1 and 2 [ADAMS Accession No. ML24080A455] for Vogle, which was NRC approved on January 16, 2025 [ADAMS Accession No. ML24198A106].
11. RG 1.9, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants," Revision 3 dated July 1993 [ADAMS Accession No. ML003739929]
12. Callaway Plant, Unit 1, Final Safety Analysis Report (FSAR) Standard Plant (SP) Section 8.3.1.1.2, "Class 1E AC System"
13. Regulatory Guide 1.239, "Licensee Actions to Address Nonconservative Technical Specifications," Revision 0, dated November 2020 [ADAMS Accession No. ML20294A510]
14. NUREG-1431, "Standard Technical Specifications Westinghouse Plants," Revision 5.0, Volume 1, Specifications [ADAMS Accession No. ML21259A155]
15. Westinghouse Letter LTR-SEE-18-228, Revision 2, "Implementation of WCAP-17308-NP-A for Callaway Safety Related Pumps," dated August 26, 2024.
16. Request for Resolution (RFR) 220278, "Non-conservative Tech Spec on EDG Frequency"