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10 CFR 50.90

1CAN012002

January 24, 2020

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

Subject: License Amendment Request
Revise Loss of Voltage Relay Allowable Values

Arkansas Nuclear One, Unit 1
NRC Docket No. 50-313
Renewed Facility Operating License No. DPR-51

As required by 10 CFR 50.90, Entergy Operations, Inc. (Entergy) is submitting a request for an amendment to the Technical Specifications (TSs) for Arkansas Nuclear One, Unit 1 (ANO-1).

Entergy is currently developing modifications to the site undervoltage schemes. Undervoltage protection is designed to protect important in-plant equipment from damage during degraded voltage conditions. The modifications are intended to address, in part, information contained in Regulatory Issue Summary (RIS) 2011-12, "Adequacy of Station Electric Distribution System Voltages," Revision 1 (ML113050583).

The modifications being developed, in part, include replacing the current inverse time loss of voltage relays installed on the vital 4160 volt switchgear A3 and A4 with definite time relays. In addition, the actuation setpoints for these relays are being revised. As a result, Entergy is proposing a change to the current loss of voltage allowable values contained in TS 3.3.8, "Diesel Generator (DG) Loss of Power Start (LOPS)."

The enclosure provides a description and assessment of the proposed changes. In addition, the enclosure concludes that the proposed amendment does not involve a significant hazards consideration. Attachment 1 of the enclosure provides the existing TS pages marked to show the proposed changes. Attachment 2 of the enclosure provides a markup of the current TS Bases pages associated with this change, for information only. Attachment 3 of the enclosure provides revised (clean) TS pages.

No new regulatory commitments are included in this amendment request.

Approval of the proposed amendment is requested by February 26, 2021. Once approved, the amendment shall be implemented prior to startup from refueling outage 1R29 (spring 2021), coincident with the necessary plant modifications to be performed in 1R29 to address RIS 2011-12.

In accordance with 10 CFR 50.91, Entergy is notifying the State of Arkansas of this amendment request by transmitting a copy of this letter and enclosure to the designated State Official.

If there are any questions or if additional information is needed, please contact Tim Arnold, Manager, Regulatory Assurance, Arkansas Nuclear One, at 479-858-7826.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on January 24, 2020.

Respectfully,

ORIGINAL SIGNED BY RON GASTON

Ron Gaston

RWG/dbb

Enclosure: Evaluation of the Proposed Change

Attachments to Enclosure:

1. Technical Specification Page Markup
2. Technical Specification Bases Page Markups
3. Retyped Technical Specification Page

cc: NRC Region IV Regional Administrator

NRC Senior Resident Inspector – Arkansas Nuclear One

NRC Project Manager – Arkansas Nuclear One

Designated Arkansas State Official

Enclosure to

1CAN012002

Evaluation of Proposed Change

EVALUATION OF THE PROPOSED CHANGE

1.0 SUMMARY DESCRIPTION

The proposed amendment would modify the Arkansas Nuclear One, Unit 1 (ANO-1) Renewed Operating License DPR-51Technical Specification (TS) 3.3.8, "Diesel Generator (DG) Loss of Power Start (LOPS)." Specifically, the proposed amendment modifies the loss of voltage (LOV) relay allowable values stated in Surveillance Requirement (SR) 3.3.8.2.b. The requested change does not involve a significant hazards consideration.

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

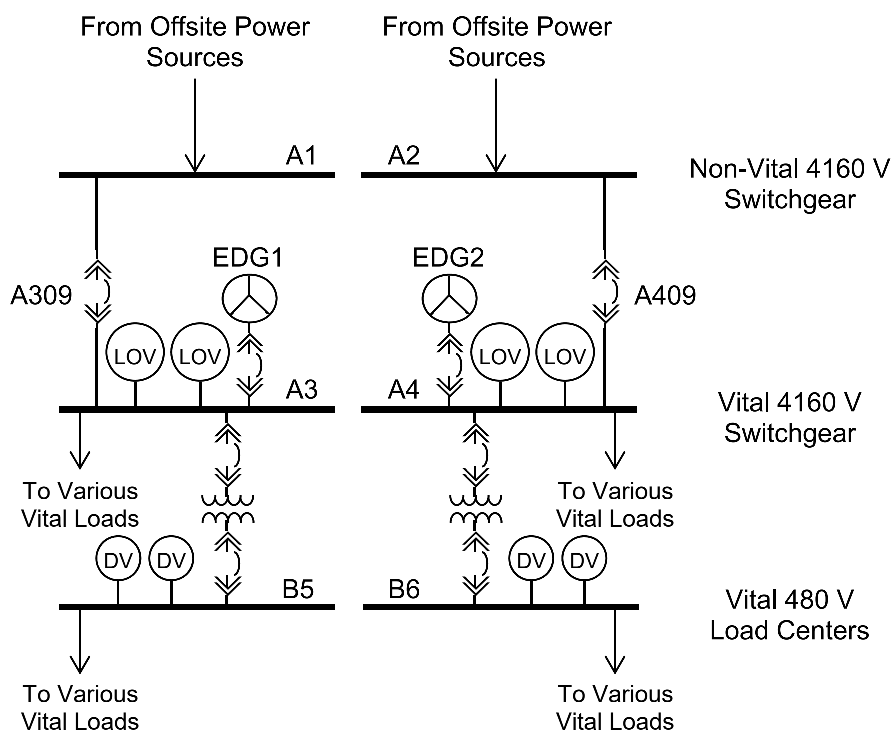
The ANO-1 Emergency Diesel Generators (EDGs) provide a source of emergency power when offsite power is either unavailable or is insufficiently stable to ensure proper operation of safety related loads. Undervoltage protection devices generate a LOPS of the EDGs in the event a loss of voltage or degraded voltage condition occurs on select ANO-1 switchgear or load centers. There are two LOPS functions for each 4160 volt (V) vital switchgear (A3 and A4).

Two LOV relays with inverse voltage time characteristics are provided on each 4160 V Class 1E switchgear for the purpose of detecting a loss of bus voltage (indicative of degraded offsite power conditions). The existing relay allowable values are based on a maximum setting, which is below the lowest allowed motor terminal momentary voltage of 75% of the motor voltage rating of 4000 V. The TS allowable values are adjusted to include channel uncertainties and calibration tolerances within plant procedures such that actual in-plant relay settings are conservative to the allowable values stated in the TSs. Upon loss of power to either of these relays, in approximately 1.0 second, load shedding of the applicable vital buses occurs and the associated EDG receives a start signal. Separation of the safety related buses from offsite power is delayed approximately 2.0 seconds to allow an automatic transfer to an available offsite power transformer. The safety related alternating current (AC) electrical train is separated from its offsite power source only if this transfer is unsuccessful.

In addition to the above, two instantaneous (definite time) degraded voltage (DV) relays are provided on each safety related 480 V load center with a coincident 2 out of 2 trip logic for the purpose of detecting a sustained undervoltage condition. The existing relay allowable values on the 480 V bus are based on long term motor voltage requirements plus the maximum feeder voltage drop allowance resulting in a nominal setting of 92% of the motor rated voltage of 460 V. The TS allowable values are adjusted to include channel uncertainties and calibration tolerances within plant procedures such that actual in-plant relay settings are conservative to the allowable values stated in the TSs. Upon voltage degradation to 92% of 460 V and after a delay of approximately 8 seconds, both DV relays must operate to separate the associated safety related 4160 V bus from offsite power, and start and connect the associated EDG to the vital bus. The relays are delayed approximately 8.0 seconds to prevent spurious operation of the relays when large motors start on the safety related 4160 V and 480 V buses. The EDG LOPS is further described in the ANO-1 Safety Analysis Report (SAR), Section 8.3.1.

The selection of the allowable values is such that adequate protection is provided when all sensor and processing time delays are taken into account. Emergency power is established within the maximum time delay assumed for each event analyzed in the accident analysis in which a loss of offsite power is assumed, including the maximum 15-second start time of the EDG. The accident analyses also accounts for the EDG load sequencing delay times of safety injection system component actuations, based on the loss of offsite power, assuming a coincident loss of coolant accident (LOCA).

A simplified drawing of the undervoltage protection scheme is included below.



As discussed previously, either LOV relay on a given bus will start the respective EDG, shed loads, and after an approximate 2.0-second time delay, will open A309 or A409 (respective to the affected bus).

Both DV relays on a given bus must drop out to perform similar actions, but only after a time delay of 8.0 ±1.0 seconds.

2.2 Current TS Requirements

SR 3.3.8.2.b currently requires verification of the loss of voltage relay setting and time delay to be within the following limits:

Loss of voltage ≥ 1600 V and ≤ 3000 V with a time delay of ≥ 0.30 seconds and ≤ 0.98 seconds.

2.3 Reason for the Proposed Change

Entergy Operations, Inc. (Entergy) is currently developing modifications to the site undervoltage schemes. Undervoltage protection is designed to protect important in-plant equipment from damage during degraded voltage conditions. The modifications are intended to address, in part, information contained in Regulatory Issue Summary (RIS) 2011-12, "Adequacy of Station Electric Distribution System Voltages," Revision 1 (Reference 1), namely the following statement in the Summary of Issues section, first bullet, "Degraded Voltage Relaying Design Calculations:"

> *The time delay chosen should be optimized to ensure that permanently connected Class 1E loads are not damaged under sustained degraded voltage conditions (such as a sustained degraded voltage below the DVR voltage setting(s) for the duration of the time delay setting).*

The plant modifications include replacement of the inverse time LOV relays installed on the ANO-1 vital 4160 V switchgear A3 and A4 with definite time LOV relays. In addition, the ANO-1 undervoltage protection scheme has been re-evaluated as a whole. The relay replacement in conjunction with addressing the aforementioned potential for sustained undervoltage conditions requires a revision to the allowable values currently stated in SR 3.3.8.2.b. A detailed discussion of the overall scope of the undervoltage protection modifications is included in Section 3.0 of this letter.

2.4 Description of the Proposed Change

The LOV relay setting and time delay limits described in SR 3.3.8.2.b are proposed to be modified as follows:

> Loss of voltage ≥ 3251.5~~1600~~ V and ≤ 3349.5~~3000~~ V with a time delay of ≥ 2.0~~0.30~~ seconds and ≤ 2.6~~0.98~~ seconds.

No change is proposed to the existing DV relay TS voltage and time delay allowable values.

3.0 TECHNICAL EVALUATION

ANO-1 Design/Licensing Bases

RIS 2011-12 (Reference 1) was issued to clarify the NRC staff's technical position on existing regulatory requirements specifically related to voltage studies necessary for the DV relay (second level undervoltage protection) setting bases and transmission network/offsite/station electric power system design bases for meeting the regulatory requirements specified in General Design Criteria (GDC) 17 to 10 CFR Part 50, Appendix A. For nuclear power plants that were licensed before GDC 17 applied, the RIS stated that the site-specific SAR provided the applicable design criteria.

ANO-1 was not licensed to the 10 CFR 50, Appendix A, GDC. ANO-1 was originally designed to comply with the 70 "Proposed General Design Criteria for Nuclear Power Plant Construction Permits," published in July 1967. However, the ANO-1 SAR provides a comparison with the Atomic Energy Commission (AEC) GDC published as Appendix A to 10 CFR 50 in 1971. The

applicable AEC GDC were compared to the 10 CFR 50, Appendix A, GDC as discussed in Section 1.4 of the ANO-1 SAR. With respect to meeting the intent of GDC 17 and with respect to undervoltage protection, this SAR section states, in part:

> *Unavailability of both offsite power sources will be sensed by the safeguards bus A3 under-voltage relay which in turn will open the tie breaker between buses A1 and A3 and set the conditions for emergency diesel breaker 152-308 to close after attaining preset voltage level.*

This SAR GDC-related excerpt only discusses the existence of the LOV relays since additional protection was not installed at ANO-1 until after the Millstone Station degraded voltage event which occurred in July 1976. Following the Millstone event, the aforementioned DV relays (second level of protection) were installed and SAR Section 8.3.1.5 revised to discuss the plant modifications incorporated in light of the Millstone event.

During a Component Design Basis Inspection (CDBI) in late 2016, the NRC identified a potential concern with the ability of ANO-1 safety-related components to ride through a sustained degraded voltage condition equivalent to the time delay associated with the installed DV relays (total of 9 seconds). This concern was based on previous NRC positions related to this condition. Subsequently, ANO was issued a green non-cited violation of 10 CFR 50, Appendix B, Criterion III, "Design Control". RIS 2011-12 (Reference 1) states the following with respect to the DV protective devices:

> *The allowable time duration of a degraded voltage condition at all distribution system levels shall not result in failure of safety-related systems or components.*

The intent of the above statement is to ensure degraded offsite power sources are divorced from safety-related equipment before the equipment would be damaged by prolonged operation outside the acceptable voltage range. ANO-1 SAR Section 8.3.1.5 contains the same statement illustrated above. This SAR section also discusses how ANO-1 meets the intent of this statement (emphasis added):

> *Under the conditions <u>identified by the system analysis</u>, the safety related equipment will function satisfactorily.*

Of key importance is that meeting the intent of the above RIS excerpt is based on the assumptions of the ANO-1 system analysis. ANO-1 degraded voltage protection is based on the assumption that the offsite power grid voltage is at the "minimum expected value" as opposed to a transient voltage that is not supported by grid analysis. This assumption is consistent with Generic Letter (GL) 79-36, "Adequacy of Station Electric Distribution Systems Voltages," which states, in part:

> *The voltage at the terminals of each safety load should be calculated based on the above listed consideration and assumptions and based on the assumption that the grid voltage is at the "minimum expected value". The "minimum expected value" should be selected based on the least of the following:*
>
> *a. The minimum steady-state voltage experience at the connection to the offsite circuit.*
>
> *b. The minimum voltage expected at the connection to the offsite circuit due to contingency plans which may result in reduced voltage from this grid.*
>
> *c. The minimum predicted voltage from grid stability analysis. (e.g., load flow studies).*

ANO-1 submitted information to the NRC in letter dated August 23, 1978 (Reference 2) detailing plant modifications and controls addressing the 1976 Millstone event. The NRC accepted the ANO-1 response in letter dated December 17, 1979 (Reference 3), including the studies performed to determine the settings for undervoltage protection devices. The ANO-1 letter, in part, provided the following information:

> *The most severe condition investigated was the outage of the 500/161/22 kV autotransformer at the ANO Switchyard and a coincidental, but not simultaneous, outage of the hydro unit at the Dardanelle Dam. For this case the voltage level was 150 kV or 93% at the ANO Switchyard 161 kV bus. However, this condition is unlikely since it requires the outage of three generating units and the 500/161 kV autotransformer at the summer system peak.*

The most recent offsite power grid study (completed in 2017) supports the assumption that sustained voltage degradation below the DV relay setpoint is not credible for the ANO-1 unit. ANO is committed to perform an offsite power grid study relative to the two ANO units every 3 years. The recent study is similar, but more conservative, to the 1979 study, in that the voltage for the worst expected outage condition on the 161 KV system assumed the loss of the ANO autotransformer, the ANO generators (both units), and the loss of the local Dardanelle and Morrilton hydro units. The 500 KV system evaluation is similar, but also assumed a loss of two of the three incoming 500 KV lines to the ANO switchyard. In addition, a LOCA was assumed to occur during peak summer load conditions. In summary, the grid study concluded that all offsite power sources were capable of supplying accident loads while avoiding separation from offsite power due to potential drop out of the LOV and DV relays. In addition, any relay that may drop out during subsequent load sequencing would reset before timing out; therefore, offsite power remains available to supply in-house loads in all cases.

The LOV and DV relay allowable values were revised at various times from 1979 through 1999 via approved changes to the ANO-1 TSs. As discussed previously, RIS 2011-12 (Reference 1) stated that, for nuclear power plants that were licensed before GDC 17 applied, the site-specific SAR provides the applicable design criteria. Based on the historical ANO-1 design and analysis assumptions associated with undervoltage protection (including changes following the 1976 Millstone event), the offsite power grid studies performed consistent with the intent of GL 79-36 indicating that the minimum grid voltage for ANO remains sufficient to prevent separation from offsite power at peak conditions during a LOCA, and because ANO-1 was not licensed as a GDC plant, Entergy has concluded that the existing ANO-1 undervoltage protection scheme meets regulatory requirements as previously approved by the NRC. Note that the ANO-1 licensing basis assumes a large break LOCA with concurrent loss of offsite power, and does not assume a sustained undervoltage below the LOV relay setpoint, which is supported by the aforementioned grid study. Likewise, the small break LOCA analysis does not assume a sustained undervoltage below the LOV relay setpoint, consistent with the grid study results. Nevertheless, Entergy is currently pursuing modification of the ANO-1 undervoltage protection system to voluntarily address the aforementioned NRC concerns related to a sustained undervoltage condition.

In order to address the NRC concern of a sustained undervoltage holding between the DV relay setting and the LOV setting, Entergy has re-evaluated the ANO-1 undervoltage protection scheme as a whole. Modifications are planned to include overload and overcurrent relay adjustments for some safety-related motors, replacing the existing inverse time LOV relays with definite time relays, and installing two additional DV relays (heretofore referred to as Motor Start

Protection or MSP relays) on each of the vital 480 V load centers (B5 and B6) to specifically address a sustained undervoltage condition. The new design is discussed in detail below. Because the current ANO-1 design and licensing basis does not assume a sustained undervoltage condition as described above, Entergy does not intend to include the new additional DV relays within the TSs. The relays will be controlled and tested, however, consistent with requirements for Class 1E devices.

Undervoltage Protection Scheme Evaluation

Re-evaluation of the ANO-1 undervoltage protective scheme has been performed to verify that the design of protective devices for loads required at the beginning of a LOCA are adequate to prevent tripping of these devices under degraded voltage conditions prior to transferring to the onsite source. Unlike existing evaluations and analysis, this re-evaluation assumed the potential presence of a sustained undervoltage condition (voltage below the DV relay setpoint but at or above the LOV relay setpoint). The evaluation included the following:

1. Determination that Class 1E motors will have adequate voltage to start when the bus voltage is at the minimum analytical limit of the LOV relays for 4000 V motors, and the DV relays or new additional MSP relays for 460 V motors. The evaluation verified that the subject motors will not stall if bus voltages are at or above the dropout setting of the relays. The maximum time a motor could be in a stalled condition for voltages below the dropout was based on the time delay of these relays.

2. Determination that the protective devices, including control equipment, for the Class 1E loads do not trip and lock-out for a duration equal to the maximum analytical limit of the time delay of the LOV relays, DV relays, or MSP relays plus the additional time needed to accelerate a given motor on the onsite power supply if a degraded voltage occurs at the initiation of a motor start that prevents the motor from starting. This was analyzed for accident conditions (i.e. with an Engineered Safeguards (ES) signal present). For running motors, a degraded voltage condition below the minimum analytical limit of the LOV relays was verified to not result in tripping of a protective device on a Class 1E load prior to the loads transferring to the onsite source, with or without an ES signal present. The LOV relays were evaluated to ensure running motors would not stall for voltages at or above the LOV dropout setting.

3. Determination of adequate starting voltage for those Class 1E motors that auto-start in response to an ES signal when powered by the preferred (offsite) power supply at minimum voltage and capacity (minimum operable grid) and determination that the minimum required grid voltage can reset the LOV, DV, and MSP relays prior to the automatic disconnection of offsite power.

4. Determination of whether Class 1E motors would stall, assuming a bus voltage at the minimum analytical limit of the LOV relays.

The protective device evaluation for 4160 V motors assumed a maximum 2.6 seconds LOV relay time delay with the addition of acceleration time of the motor on the onsite source. The protective device evaluation for 480 V load center loads assumed the maximum 3.7-second MSP relay time delay with the addition of acceleration time of the motor when aligned to the onsite source.

The protective device evaluation for 480 V motor control center (MCC) motors other than motor operated valves (MOVs) assumed the maximum 2.6-second LOV relay time delay plus a 2.5-second time delay (±10%) following LOV relay time-out before the 480 V load center bus is de-energized (for a total of 5.35 seconds) with the addition of acceleration time of the motor on the onsite source. Note that the above 2.5-second time delay is slightly increased from the current 2-second time delay to provide sufficient opportunity for transfer to an available offsite power source. This additional delay time and exposure to degraded voltage conditions does not result in the loss of any required plant equipment.

The protective device evaluation for 480 V MCC MOVs assumed a maximum 3.7-second MSP relay time delay with the addition of acceleration time of the motor on the onsite source, with the exception of Sluice Gates SG-2, SG-6, and SG-7, which assumed the maximum 9-second DV relay time delay with the addition of acceleration time of the motor on the onsite source. 480 V MCC non-motor loads as well as 120 V MCC control circuits were evaluated to ensure protective devices would not trip during sustained degraded voltage events.

Applicable industry operating experience (Dresden, Comanche Peak, Pilgrim) was also considered in the evaluation. The evaluation also determined that the existing accident analyses remained valid given all time delays associated with this event.

Modifications were identified which would be necessary to support the above determinations (discussed later). The re-evaluation, including evaluation of needed modifications, considered the following regulatory and guidance documents, among others:

IEEE Standard 741-2017, "IEEE Standard for Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations" (2007 version considered for motor acceleration times, which states the MOV acceleration times are typically less than one second)

IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations" (single failure criterion)

GDC 2, "Design Bases for Protection Against Natural Phenomena"

GDC 4, "Environmental and Dynamic Effects Design Bases"

GDC 17, "Electric Power Systems"

GDC 18, "Inspection and Testing of Electric Power Systems"

GDC 20, "Protection System Functions"

GDC 21, "Protection System Reliability and Testability"

GDC 22, "Protection System Independence"

NRC Branch Technical Position PSB-1, Rev. 2, July 1981, "Adequacy of Station Electric Distribution System Voltages"

EPRI NP-7484, "Guideline for the Seismic Technical Evaluation of Replacement Items for Nuclear Power Plants"

10 CFR 50.48(c), NFPA 805, 2001, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants"

Motor Overloads and Overload Relays

Given the existing LOV and DV protection, overload heaters for motors (valves, pumps, etc.) powered from the vital 480 V buses would require significant upsizing to accommodate the described sustained undervoltage (voltage below the DV relay setpoint but above the LOV setpoint). The use of overload devices alone to achieve the ride-through requirement for a sustained degraded voltage event is generally unrealistic.

The overall solution for motor protection during the sustained undervoltage event is resolved by the installation of MSP relays (described later). The new relays permit the existing overload protection for the MOVs and small motors to be maintained at or near present settings without compromise to the overload protection schemes.

Re-evaluation of the 4160 V motors concluded that only slight adjustment to overload relays in a few motors are needed to protect equipment during the assumed sustained undervoltage condition, given the proposed change to the LOV TS allowable voltage and time delay values.

MSP Relays

Two MSP relays will be installed on each of the 480 V vital load centers B5 and B6 in parallel with the existing DV relays. Like the existing DV relays, both MSP relays on a given bus must dropout to initiate undervoltage protection. The MSP relays will be set to actuate with a time delay of approximately 3.3 seconds, effectively protecting downstream loads. Following the time delay, a start signal is sent to the respective EDG and the associated vital electrical buses will be separated from offsite power, permitting the EDG to connect to the vital electrical train and power the necessary safety-related loads. This response is equivalent to the current DV relays, but with a shorter time delay. The MSP relays will be set at a slightly lower voltage than the DV relays and will ensure that 480 V motor voltage is maintained above the 80% start voltage. No change is proposed for the existing DV relays or associated TS allowable voltage and time delay values.

Reducing the time delay of the existing DV relays could increase the potential of inadvertent separation from operable offsite power sources. This would be contrary to meeting the intent of RIS 2011-12 (Reference 1) which states:

> *Voltage-time settings for DVRs should be selected so as to avoid inadvertent separation of safety buses from the offsite power system during unit startup, normal operation (including motor starting), and shutdown.*

However, the MSP relays will require an ES enable signal. The ES signal is generated upon a low Reactor Coolant System pressure or high Reactor Building pressure. With no ES signal present, the LOV relay and existing DV relays will continue to provide protection of safety related components. With an ES signal present (maximum bus loading), the MSP relays will function to ensure safety-related loads remain protected from sustained undervoltage conditions. Given the required ES enable and the approximate 3.3-second time delay, inadvertent separation of safety buses from offsite power is effectively avoided while ensuring vital motors remain protected during a sustained undervoltage event with coincident LOCA.

Because the new MSP relays are wired in parallel with the existing DV circuits (same input/output), and function effectively the same (start the EDG and separate loads from offsite power), the same model relay for the MSPs as the existing DV relays is being installed. The MSP relays will monitor bus voltage at all times and actuate when the established voltage setpoint is exceeded; however, unlike the DV relays, the MSP relays can only start the associated EDG when an ES signal is present. Being wired in parallel to the DV relays, the MSPs are also bypassed when the DV relays are bypassed for a short time during a Reactor Coolant Pump start (due to the large current draw of these pumps), consistent with the current design configuration of the DV relays. As is the case for the existing undervoltage protection scheme, the failure of any one undervoltage protection component in one train will not affect the other train.

For comparison with the existing DV relays, the following voltage ranges are provided:

DV 423.2 V (92% of 460 volts) to 436 V (94.8% of 460 volts) with 8.0 ±1 sec. delay[1]

MSP 401.6 V (87.3% of 460 volts) to 413.6 V (89.9% of 460 volts)
with approximate 3.3 sec. delay

[1] Current TS Limits

LOV Relays

The existing LOV relays are General Electric IAV induction-disk inverse-time relays. Relays of the “inverse-time” type are designed to trip faster, the greater the sensed attribute (in this case, voltage) deviates past the given setpoint. To ensure actuation within a defined time for all sustained degraded voltage conditions, these relays are being replaced with new ABB model 27N definite time relays.

LOV relay replacement along with the re-evaluation of the overall ANO-1 undervoltage scheme with consideration of a sustained undervoltage as described previously requires a change to the TS LOV relay voltage and time delay settings (reference Section 2.3 above). The new voltage and time delay allowable values proposed by Entergy are as follows:

LOV ≥ 3251.5 V (81.3% of 4000 volts) to ≤ 3349.5 V (83.7% of 4000 volts)
with a time delay of ≥ 2.0 seconds and ≤ 2.6 seconds.

The revised values accommodate the new definite time relays and allows a maximum voltage drop from the 4160 V switchgear bus to the motor of < 1.3% during starting of the motor. For voltages below the minimum LOV relay allowable value, a 4160 V or 480 V motor may stall and draw locked-rotor current until the bus is de-energized or the protective device trips. For voltages below the minimum DV or MSP relay value, a 480 V motor or MOV may not be able to start and could draw locked rotor current until the bus is de-energized or the protective device trips. Given the new LOV relay allowable voltage and time delay values proposed above, the revised analysis shows that the protective relays for 4160 V motor loads will not trip if the motor is drawing locked-rotor current for a time period equal to the maximum LOV relay time delay plus the acceleration time of the motor on the onsite source (as discussed previously, the MSP or DV relays prevent loss of 480 V motors and MOVs). The LOV relay setting also ensures that 4160 V and 480 V motors will not stall if already running.

Conclusion

Entergy has voluntarily re-evaluated the ANO-1 undervoltage protection scheme and has developed modifications to support an assumption of sustained undervoltage (voltage below the existing DV relay setpoint but above the proposed LOV relay setpoint). Applicable industry standards and NRC regulations/guidelines were applied to the new analysis. Based on the above information, Entergy has concluded that the proposed change meets applicable requirements and enhances nuclear safety.

4.0 REGULATORY EVALUATION

4.1 <u>Applicable Regulatory Requirements/Criteria</u>

Entergy proposes to revise the existing TS allowable voltage and time delay values associated with the ANO-1 LOV relays to accommodate a previous NRC position related to sustained undervoltage conditions. Entergy has performed a re-evaluation of the overall ANO-1 undervoltage protection scheme in order to fully assess impacts of a sustained undervoltage condition at the ANO-1 site.

Applicable AEC GDCs associated with electrical protection systems are listed below.

GDC 2, “Design Bases for Protection Against Natural Phenomena”

GDC 4, “Environmental and Dynamic Effects Design Bases”

GDC 17, “Electric Power Systems”

GDC 18, “Inspection and Testing of Electric Power Systems”

GDC 20, “Protection System Functions”

GDC 21, “Protection System Reliability and Testability”

GDC 22, “Protection System Independence”

Industry standards and NRC guidance documents were also considered with respect to the proposed change including:

NRC Branch Technical Position PSB-1, Rev. 2, July 1981, "Adequacy of Station Electric Distribution System Voltages"

RIS 2011-12, "Adequacy of Station Electric Distribution System Voltages," Revision 1

IEEE Standard 741-2017, "IEEE Standard for Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations" (2007 version considered for motor acceleration times, which states the MOV acceleration times are typically less than one second)

ANO-1 was not licensed to the 10 CFR 50, Appendix A, GDC. ANO-1 was originally designed to comply with the 70 "Proposed General Design Criteria for Nuclear Power Plant Construction Permits," published in July 1967. However, the ANO-1 SAR provides a comparison with the AEC GDC published as Appendix A to 10 CFR 50 in 1971.

In addition to LOV allowable value changes, the assumption of sustained undervoltage also requires modifications or adjustments to the ANO-1 undervoltage protection system. The revised analysis, which includes all planned changes and modifications, conforms to applicable industry standards as described herein and, therefore, the proposed change does not affect compliance with regulations (including the aforementioned GDCs) or guidance and will ensure that the lowest functional capabilities or performance levels of equipment required for safe operation are met.

4.2 Precedent

Because plant designs vary greatly with respect to station undervoltage protection, no specific precedent has been identified that directly correlates to the undervoltage protection modifications being developed for ANO-1, which include replacement of the ANO-1 LOV relays and subsequent revision to the voltage and time delay values that govern relay actuation. However, the Wolf Creek Nuclear Operating Corporation submitted changes associated with RIS 2011-12 on March 18, 2019 (Reference 4).

4.3 No Significant Hazards Consideration Analysis

Entergy Operations, Inc. (Entergy) requests a revision to Arkansas Nuclear One, Unit 1 (ANO-1) allowable values associated with the station loss of voltage protection (LOV) relays. The allowable values are stated in ANO-1 Technical Specification (TS) 3.3.8, "Diesel Generator (DG) Loss of Power Start (LOPS)," specifically within Surveillance Requirement (SR) 3.3.8.2.b. The proposed change is an enhancement to the current offsite power undervoltage protection scheme for the unit and, in part, acts to address the potential for sustained undervoltage conditions at the onset of a loss of coolant accident.

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

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

   Response: No

   The proposed change revises the allowable voltage and time delay values for ANO-1 LOV relays. The change is necessary due to replacement of the existing inverse time LOV relays with definite time relays and to accommodate a recent undervoltage protection scheme reanalysis, which now accounts for a defined sustained undervoltage condition.

   Accidents related to the undervoltage protection system include a loss of offsite power (LOOP) and a loss of onsite AC (LOAC) power. No new failure modes were identified during the reanalysis of the ANO-1 undervoltage protection scheme and none are introduced by the proposed TS change or supporting plant modifications. The proposed change complies with industry and regulatory standards and acts to protect safety related loads from sustained undervoltage conditions. The changes continue to provide protection against inadvertent separation of site loads from offsite power sources. The proposed change does not increase the potential for a LOOP of LOAC accident.

Many of the associated supplied loads are credited for accident mitigation. The proposed new values ensure that supplied loads will remain available and continue to be protected during various undervoltage conditions.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

   Response: No

   The proposed change revises the allowable voltage and time delay values for ANO-1 LOV relays. The design function of the components involved is not adversely affected. The time response of the existing inverse time LOV relays varies with the amount of voltage degradation. The replacement of the existing inverse time LOV relays with definite time relays ensures mitigating action will be taken within a defined time period, while avoiding unnecessary separations from the offsite power sources. No credible new failure mechanisms, malfunctions, or accident initiators that have not been previously considered in the design and licensing bases are introduced. The current accident analyses remain bounding with consideration of the proposed change.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

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

   Response: No

   The proposed change revises the allowable voltage and time delay values for ANO-1 LOV relays. The proposed change assures sufficient safety margins are maintained, and that the design, operation, surveillance methods, and acceptance criteria specified in applicable codes and standards (or alternatives approved for use by the NRC) will continue to be met as described in the plants' licensing basis. The proposed change does not adversely affect the reliability of the equipment assumed to operate in the accident analysis or existing plant safety margins. Applicable accident analyses in which these time delays are input have been verified to remain bounding. As such, there are no changes being made to safety limits or limiting safety system settings that would adversely affect plant safety as a result of the proposed change. Because the proposed change acts to protect against sustained undervoltage conditions at the ANO-1 site, the proposed change is considered beneficial to the margin of safety.

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

Based on the above, Entergy concludes that the proposed change presents no 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.

4.4 Conclusion

In conclusion, based on the considerations discussed above, (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.

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 significant increase in the amounts of any effluents 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.

5.0 REFERENCES

1. NRC Regulatory Issue Summary 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages," (ML113050583), dated December 29, 2011.

2. Arkansas Power & Light Company (AP&L) letter to U. S. Nuclear Regulatory Commission (NRC), "Onsite Emergency Power System," (1CAN087815) (NRC Reference No. 8004240581), dated August 23, 1978.

3. NRC letter to AP&L, "Safety Evaluation by the Office of Nuclear Regulatory Regulation concerning Proposed Design Modifications in Emergency Power System," (1CNA127919) (NRC Reference No. 8001020341), dated December 17, 1979.

4. Wolf Creek Nuclear Operating Corporation letter to NRC, "*License Amendment Request to Revise Technical Specification 3.3.5, 'Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation,'*" (ML19086A111), dated March 18, 2019.

ATTACHMENTS

1. Technical Specification Page Markup
2. Technical Specification Bases Page Markups
3. Retyped Technical Specification Pages

Enclosure Attachment 1 to

1CAN012002

Technical Specification Page Markup
(1 page)

SURVEILLANCE		FREQUENCY
SR 3.3.8.2	-----------------------------NOTE----------------------------- When DG LOPS instrumentation is placed in an inoperable status solely for performance of this Surveillance, entry into associated Conditions and Required Actions may be delayed up to 4 hours for the loss of voltage Function, provided the one remaining relay monitoring the Function for the bus is OPERABLE. ---	
	Perform CHANNEL CALIBRATION with setpoint Allowable Value as follows: a. Degraded voltage ≥ 423.2 V and ≤ 436.0 V with a time delay of 8 seconds ± 1 second; and b. Loss of voltage ≥ 3251.51600 V and ≤ 3349.53000 V with a time delay of ≥ 2.00.30 seconds and ≤ 2.60.98 seconds.	In accordance with the Surveillance Frequency Control Program

Enclosure Attachment 2 to

1CAN012002

Technical Specification Page Markups
(2 pages)

B 3.3 INSTRUMENTATION

B 3.3.8 Diesel Generator (DG) Loss of Power Start (LOPS)

BASES

BACKGROUND

The DGs provide a source of emergency power when offsite power is either unavailable or is insufficiently stable to allow operation of safety related loads. Undervoltage protection will generate a LOPS in the event a loss of voltage or degraded voltage condition occurs on unit vital buses. There are two LOPS Functions for each 4.16 kV vital bus.

Two loss of voltage (LOV)~~undervoltage~~ relays with definite~~inverse~~ voltage time characteristics are provided on each 4.16 kV Class 1E bus for the purpose of detecting a loss of bus voltage. The LOV relay Allowable Values are based on a maximum setting, which is below the lowest allowed motor terminal momentary voltage of 75% of motor voltage rating of 4000 V. The Allowable Values are adjusted to include channel uncertainties and calibration tolerances within plant procedures such that actual in-plant relay settings are conservative to the Allowable Values. Upon loss of power to either of these relays, in approximately 2.6~~1.0~~ seconds, load shedding and starting of the associated DG are initiated. Isolation of the safety related buses is delayed approximately 2.5~~0~~ seconds to allow an automatic transfer to offsite power. The safety related bus is isolated only if the transfer is unsuccessful.

Two definite time degraded voltage (DV)~~undervoltage~~ relays are provided on each safety related 480 V load center bus with a coincident trip logic (2 out of 2) for the purpose of detecting a sustained undervoltage condition. The ~~undervoltage~~ DV relay Allowable Values on the 480 V bus are based on long term motor voltage requirements plus the maximum feeder voltage drop allowance resulting in a nominal setting of 92% of the motor rated voltage of 460 V. The Allowable Values are adjusted to include channel uncertainties and calibration tolerances within plant procedures such that actual in-plant relay settings are conservative to the Allowable Values. Upon voltage degradation to 92% of 460 V and after a delay of approximately 8 seconds, both DV relays must operate to isolate the associated safety related 4.16 kV bus from offsite power, and start and connect the associated DG. The DV relays are delayed approximately 8.0 seconds to prevent spurious operation of the relays when large motors start on the safety related 4.16 kV and 480 V buses. The LOPS is further described in SAR, Section 8.3.1 (Ref. 1).

In addition to the above, two definite time Motor Start Protection (MSP) relays are provided on each safety related 480 V load center bus with a coincident trip logic (2 out of 2) for the purpose of protecting equipment by detecting a sustained undervoltage (voltage below the DV relay setpoint but above the LOV relay setpoint) condition when an Engineered Safeguard Actuation Signal (ESAS) is present. The MSP relay settings are based on motor starting voltage requirements plus the maximum feeder voltage drop allowance resulting in a nominal setting of 88.6% of the motor rated voltage of 460 V. The MSP relays are wired in parallel with and function the same as the DV relays, but have a shorter time delay (approximately 3.3 seconds). Absent an ES signal, the MSP relays will perform no automatic actions. The MSP relays are not included in the TSs because instantaneous voltage drop below the DV relay setpoint which remains above the LOV relay setpoint is not considered credible based on grid studies in the ANO-1 system analysis.

BACKGROUND (continued)

Trip Setpoints

The Allowable Values associated with the TS-required relays ensure automatic system response is initiated as presented in SAR, Section 8.3.1.5.1 (Ref. 1). The selection of these values is such that adequate protection is provided when all sensor and processing time delays are taken into account. A channel is inoperable if its actuation trip setpoint is not within its required Allowable Value or within as-found OPERABILITY limits established in procedures. The as-found OPERABILITY limits contained in the associated plant procedures may be required to account for the method of relay testing, which is performed "on the bench" instead of in the normal installed configuration. To ensure OPERABILITY between calibrations, the as-left setting established in procedures accounts for all other instrument uncertainties such as instrument drift/tolerances and MT&E accuracy.

A complete loss of offsite power will result in an approximately a 2.61- second delay in LOPS actuation. The DG starts and is available to accept loads within a 15 second time interval on actuation by the Engineered Safeguards Actuation System (ESAS) or LOPS. Emergency power is established within the maximum time delay assumed for each event analyzed in the accident analysis in which a loss of offsite power is assumed (Ref. 2).

The DG LOPS protection channels conform to the single failure criteria of IEEE-279-1971 as discussed in Ref. 1.

APPLICABLE SAFETY ANALYSES

The DG LOPS is required for the Engineered Safeguards (ES) to function in any accident which assumes a loss of offsite power.

Accident analyses credit the loading of the DG, based on the loss of offsite power, during a loss of coolant accident (LOCA). The actual DG start has historically been associated with the ESAS actuation. The diesel loading has been included in the assumed delay time associated with each safety system component requiring DG supplied power following a loss of offsite power. The analysis assumes a non-mechanistic DG loading, which does not explicitly account for each individual component of the loss of power detection and subsequent actions. The total assumed actuation time for the limiting systems, high pressure injection, and low pressure injection includes contributions from the DG Start, DG loading, and safety injection system component actuation. The response of the DG to a loss of power must be demonstrated to fall within this analysis response time when including the contributions of all portions of the delay.

The required channels of LOPS, in conjunction with the ES systems powered from the DGs, provide unit protection for the analyzed accidents in which a loss of offsite power is assumed.

The delay times assumed in the safety analysis for the ES equipment include the 15 second DG start delay and, if applicable, the appropriate sequencing delay. The assumed response times for ESAS actuated equipment in LCO 3.3.5, "Engineered Safeguards Actuation System (ESAS) Instrumentation," include the appropriate DG loading and sequencing delay.

Enclosure Attachment 3 to

1CAN012002

Retyped Technical Specification Page
(1 page)

SURVEILLANCE		FREQUENCY
SR 3.3.8.2	------------------------------NOTE------------------------------ When DG LOPS instrumentation is placed in an inoperable status solely for performance of this Surveillance, entry into associated Conditions and Required Actions may be delayed up to 4 hours for the loss of voltage Function, provided the one remaining relay monitoring the Function for the bus is OPERABLE. --- Perform CHANNEL CALIBRATION with setpoint Allowable Value as follows: a. Degraded voltage ≥ 423.2 V and ≤ 436.0 V with a time delay of 8 seconds ± 1 second; and b. Loss of voltage ≥ 3251.5 V and ≤ 3349.5 V with a time delay of ≥ 2.0 seconds and ≤ 2.6 seconds.	In accordance with the Surveillance Frequency Control Program