WOLF CREEK
NUCLEAR OPERATING CORPORATION

March 18, 2019

Stephen L. Smith
Vice President Engineering

ET 19-0002

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

Subject: Docket No. 50-482: License Amendment Request to Revise Technical Specification 3.3.5, "Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation"

To Whom It May Concern:

Pursuant to 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit," Wolf Creek Nuclear Operating Corporation (WCNOC) hereby requests an amendment to Renewed Facility Operating License No. NPF-42 to revise the Technical Specifications (TS) for the Wolf Creek Generating Station (WCGS). The license amendment request (LAR) would revise TS Surveillance Requirement (SR) 3.3.5.3 regarding the degraded voltage and loss of voltage relays Allowable Values, nominal Trip Setpoints, and time delays based on analysis utilizing the guidance in Regulatory Issue Summary (RIS) 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages."

On June 10, 2016, the Nuclear Regulatory Commission (NRC) issued Component Design Bases Inspection Report 05000482/2016007 that included Non-Cited Violation (NCV) 05000482/2016007-01, "Inadequate Degraded Voltage Analyses of Class 1E Systems." The NRC inspection team identified five examples of performance deficiencies in the electrical calculations that contributed to the failure to verify and assure adequate voltages to safety-related equipment during a degraded voltage condition and/or design basis event with offsite power available in accordance with the guidelines in RIS 2011-12, Revision 1. In response to the NCV, WCNOC completed analyses based on the guidance in RIS 2011-12, Revision 1, and Nuclear Energy Institute 15-01, Revision 1, "An Analytical Approach for Establishing Degraded Voltage Relay (DVR) Settings." A review of the current licensing basis calculation of record determined that the existing TS SR 3.3.5.3 Allowable Values, nominal Trip Setpoints, and time delays are acceptable and the Class 1E electrical equipment is OPERABLE. However, WCNOC has determined that the current licensing basis margins do not provide sufficient margin for long term operation and the existing calculation of record does not incorporate the guidance in RIS 2011-12, Revision 1.

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Attachments I through IV provide the Evaluation, Markup of TSs, Retyped TS pages, and proposed TS Bases changes, respectively, in support of this amendment request. Attachment IV is provided for information only. Final TS Bases changes will be implemented pursuant to TS 5.5.14, "Technical Specification (TS) Bases Control Program," at the time the amendment is implemented. The Enclosure provides a drawing of the plant electrical system.

It has been determined that this amendment application does not involve a significant hazard consideration as determined per 10 CFR 50.92, "Issuance of amendment." Pursuant to 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," Section (b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of this amendment.

This amendment application was reviewed by the Plant Safety Review Committee. In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," Section (b)(1), a copy of this amendment application, with Attachments II through IV and the Enclosure, is being provided to the designated Kansas State official.

WCNOC requests approval of this LAR by March 13, 2020. The license amendment, as approved, will be effective upon issuance and will be implemented prior to startup from the next refueling outage or forced outage of sufficient duration from the date of issuance.

There are no regulatory commitments contained in this submittal. If you have any questions concerning this matter, please contact me at (620) 364-4093, or Ron Benham at (620) 364-4204.

Sincerely,

Stephen L. Smith

SLS/rlt

Attachments:	I	Evaluation
	II	Proposed Technical Specification Changes (Mark-up)
	III	Revised Technical Specification Pages
	IV	Proposed TS Bases Changes (for information only)

Enclosure: Drawing KD-7496, "One Line Diagram"

cc: S. A. Morris, (NRC), w/a, w/e
B. K. Singal (NRC), w/a, w/e
K. S. Steves (KDHE), w/a, w/e
N. H. Taylor (NRC), w/a, w/e
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STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Stephen L. Smith, of lawful age, being first duly sworn upon oath says that he is Vice President Engineering of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By____________________
Stephen L. Smith
Vice President Engineering

SUBSCRIBED and sworn to before me this 18th day of March, 2019.

RHONDA L. TIEMEYER
Notary Public, State of Kansas
My Appointment Expires
January 11, 2022

Rhonda L. Tiemeyer
Notary Public

Expiration Date January 11, 2022

EVALUATION OF THE PROPOSED CHANGE

Subject: License Amendment Request to Revise Technical Specification 3.3.5, "Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation"

EVALUATION

1.0 SUMMARY DESCRIPTION

The proposed amendment request would revise Wolf Creek Generating Station (WCGS) Technical Specification (TS) Surveillance Requirement (SR) 3.3.5.3 regarding the degraded voltage (DV) and loss of voltage (LOV) relays Allowable Values (AV), nominal Trip Setpoints, and time delays. The proposed changes are the result of revised analyses in response to Non-Cited Violation (NCV) 05000482/2016007-01 (Reference 6.1), "Inadequate Degraded Voltage Analyses of Class 1E Systems," and are based on the guidance in Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2011-12, Revision 1 (Reference 6.2), "Adequacy of Station Electric Distribution System Voltages," and Nuclear Energy Institute (NEI) 15-01, Revision 1, "An Analytical Approach for Establishing Degraded Voltage Relay (DVR) Settings," (Reference 6.3).

2.0 DETAILED DESCRIPTION

2.1 System Design and Operation

The onsite distribution system is divided into redundant load groups (trains) so that the loss of any one group does not prevent the minimum safety functions from being performed. Each train has connections to its preferred offsite power source and a single diesel generator (DG). Power is supplied to loads at 13.8kV, 4.16kV, 480V, 480/277V, 208/120V, 120 VAC, 250 VDC, and 125 VDC. The Class 1E AC System loads are accordingly separated into two load groups that are powered from separate engineered safety features (ESF) transformers. Each load group has power distributed by a 4.16 kV bus (NB01 or NB02), 480V load centers, and 480V motor control centers (MCCs). Each load group is independently capable of safely bringing the plant to a cold shutdown condition, as the Class 1E electrical power distribution system is designed to satisfy the single-failure criterion. Drawing KD-7496, "One Line Diagram," in the Enclosure provides the onsite Class 1E AC Distribution System and the offsite power system.

The DGs provide a source of emergency power when offsite power is either unavailable or is insufficiently stable to allow safe unit operation. Upon recognition of an LOV or DV on a 4.16kV Class 1E bus, a logic signal is initiated to effect the following on each load group:

a. Shed selected loads
b. Send signal to start the DG
c. Trip 4.16 kV preferred power supply breakers

Two voltage sensing schemes are employed on each 4.16kV Class 1E bus to initiate the required logic signal. One scheme recognizes an LOV, and the other recognizes a degraded voltage. Four potential transformers (PTs) (42000V:120V or 35:1) on each bus provide the necessary input voltages to the protective devices necessary to achieve the above protection.

In order to recognize an LOV, four time delayed undervoltage relays (127-1, 2, 3, 4/DG) are used. The output contacts of these relays are directed to logic circuits that process the four undervoltage input circuits into the 2-out-of-4 logic circuit. This scheme is used on each bus. The LOV logic signal is set below the minimum bus voltage encountered during DG sequential loading. A brief time delay is employed to prevent false trips arising from transient undervoltage (spike) conditions.

In order to recognize a DV, a diverse protection scheme is used. Four PTs provide input to four DV bistables with associated time delays for each 4.16kV Class 1E system bus for detecting a sustained DV condition. The four PTs each provide an analog output signal of 0-120 volts corresponding to 0-4200 volts on the primary. This signal is directed to logic circuits and processors that convert the analog signals into a 2-out-of-4 logic signal, whenever the signal drops below a preset value. This scheme serves only to trip the incoming offsite power circuit breakers when that power source has been determined to be degraded. This design cannot adversely affect the sequential loading of the diesel generators. The DV logic signal is set at the minimum permissible continuous bus voltage. A time delay is provided that prevents damage to or spurious tripping of the permanently connected Class 1E loads by limiting the amount of time they are exposed to a degraded voltage. The final voltage and time setpoints were determined based on an analysis of the auxiliary power distribution system, including the Class 1E buses at all voltage levels. The use of a Safety Injection Signal (SIS) contact in series with the DV logic circuit output contact ensures that the Class 1E buses are separated from the offsite power system whenever an accident occurs and the offsite power system is not able to accept the loads continuously. If an SIS were to occur concurrently with or after the arming of the tripping circuitry, the bus feeder breaker would open, a bus undervoltage would be sensed, and a loss of power signal would be generated. Should the DV condition occur in a non-accident condition (no SIS present), with the current time delay setting applied, an additional 111 second time delay is provided. These time delays are specific to the feeder breakers (2 per bus). If the DV is not alleviated in the overall 119 seconds (nominal delay), the bus feeder breaker is tripped. An alarm is also provided to alert the operator to a DV condition. It is delayed until any motor starting induced voltage transient bus has had sufficient time to clear.

The WCGS 4.16kV DV relaying is depicted in a simplified form in Figure 1 below.

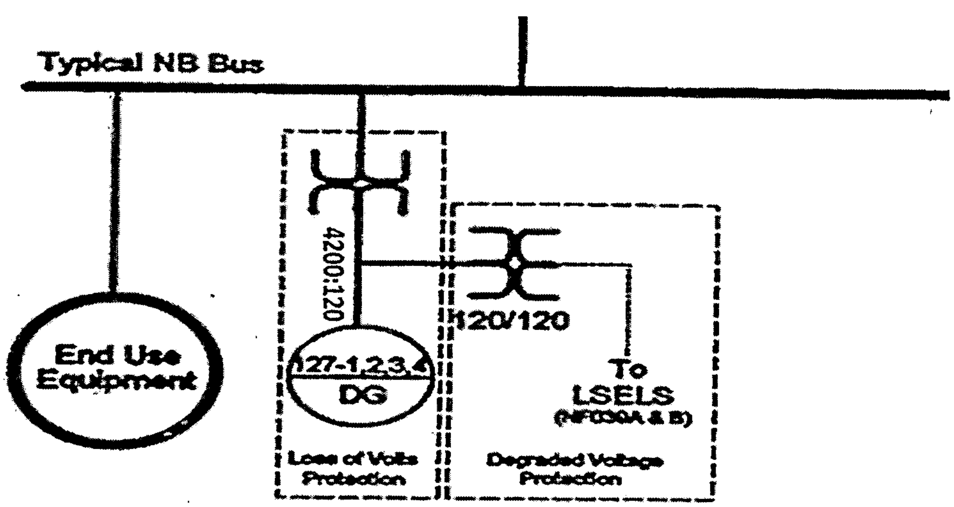

Figure 1

2.2 Description of Proposed Technical Specification Changes

The following specific TS changes are proposed to reflect the revised analysis in Wolf Creek Nuclear Operating Corporation (WCNOC) Calculation XX-E-009-001-CN006, "System NB, NG, PG Under Voltage /Degraded Voltage."

- TS 3.3.5, "Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation"

  SR 3.3.5.3a. is revised as follows:

  Loss of voltage Allowable Value is revised from ≥ 82.5V to ≥ 90.0V and the associated time delay is revised from 1.0 +0.2, -0.5 seconds to ≥ 0.9 sec. and ≤ 1.15 sec.

  Loss of voltage nominal Trip Setpoint is revised from 83V to 91.28V.

  SR 3.3.5.3b. is revised as follows:

  Degraded voltage Allowable Value is revised from ≥ 105.9V to ≥ 107.5V and the associated time delay is revised from 119 ± 11.6 sec. to ≥ 7.4 sec. and ≤ 8.5 sec.

  Degraded voltage nominal Trip Setpoint is revised from 106.9V to 108.46V and the associated time delay is revised from 119 sec. to 8 sec.

The current TS value of 119 seconds encompasses both the DV time delay with an SIS present (8 seconds) and without an SIS present (111 seconds). The proposed change revises the TSs to provide only the time delay associated with a SIS present.

2.3 Reason for the Proposed Changes

RIS 2011-12, Revision 1, provided guidelines associated with the DV protection for nuclear power plant Class 1E electrical safety buses and expectations for voltage calculations for the plant offsite/station electric power system design. The RIS also clarifies voltage studies necessary for 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. GDC 17 requires that Class 1E loads perform their respective safety function when powered from the preferred offsite power supply or the onsite power supply independently. Also, a DV condition on the Class 1E buses (when powered by offsite power) should not prevent any Class 1E load from becoming unavailable such that it cannot be automatically transferred successfully to the onsite supply. This inability to transfer the Class 1E loads is likely to occur if the voltage on the Class 1E buses degrades to the extent that may challenge the individuals load's protective devices trip in such a manner preventing automatic re-sequencing to the onsite supply.

Subsequent to the issuance of the RIS, NEI published NEI 15-01, Revision 1. NEI 15-01 provides one analytical approach that establishes the settings for the DV protection scheme in order to demonstrate the design basis of safety-related equipment (running and starting voltage requirements) is in accordance with NRC regulatory guidance. NEI 15-01 provides guidelines for determining the minimum required grid voltage to ensure the OPERABILITY of the safety-related equipment in the plant. It is essential to ensure that the designed DV scheme for the

Class 1E loads remain connected to an OPERABLE offsite power supply for postulated design basis accidents and anticipated operational occurrences. It is worth noting that the DV relay scheme is not intended to ensure OPERABILITY of the offsite supply, but rather to ensure that the safety-related loads have adequate voltage to perform their intended safety function when connected to offsite power.

On June 10, 2016, the NRC issued Component Design Bases Inspection Report 05000482/2016007, that included NCV 05000482/2016007-01, "Inadequate Degraded Voltage Analyses of Class 1E Systems." The inspection report indicated that in 2011, the NRC issued RIS 2011-12 to clarify voltage studies necessary for determining the proper settings for DV relays. RIS 2011-12 provided the NRC staff's position for the licensee's transmission network/offsite power system design to meet the requirements of GDC 17. The NRC inspection team identified five examples of performance deficiencies in the electrical calculations that contributed to the failure to verify and assure adequate voltages to safety-related equipment during a DV condition and/or design basis event with offsite power available in accordance with the guidelines in RIS 2011-12.

The NCV states, in part:

> Enforcement. The team identified a Green, non-cited violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," which states, in part, "design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program." Contrary to the above, the licensee failed to provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program. Specifically, prior to April 28, 2016, the licensee failed to verify the adequacy of the design of the Class 1E electrical equipment, because it failed to perform adequate analyses demonstrating 1) that the degraded voltage relay setpoints specified in technical specifications would ensure adequate voltage to safety-related equipment, 2) adequate voltage would be available to the safety-related loads during transient voltage conditions caused by load sequencing, and 3) that the degraded voltage relay-associated time delays provide timely separation from offsite power and transfer to the emergency diesel generator to ensure that the Class 1E safety-related loads can achieve their safety function without protective device tripping. In response to these issues, the licensee performed preliminary analyses to demonstrate that the Class 1E electrical equipment would function at degraded voltages and was operable.

In response to the NCV, WCNOC completed analyses based on the guidance in RIS 2011-12, Revision 1, and NEI 15-01, Revision 1, to demonstrate the adequacy of the WCGS electrical system. A review of the current licensing basis calculation of record determined that the existing TS SR 3.3.5.3 AV, nominal Trip Setpoints, and time delays are acceptable and that the Class 1E electrical equipment is OPERABLE. However, WCNOC has determined that current licensing basis margins do not provide sufficient margin for long term operation and the existing calculation of record does not incorporate the guidance in RIS 2011-12, Revision 1.

3.0 TECHNICAL EVALUATION

WCNOC has performed analyses to demonstrate the adequacy of the WCGS electrical distribution system performance in accordance with the guidance provided in RIS 2011-12, Revision 1, and NEI 15-01, Revision 1. These analyses include evaluation of load performances during steady-state conditions as well as transient (motor starting) conditions. The analyses will also establish that during a sustained DV condition, the undervoltage protection scheme settings are such that no required safety-related loads will stall or trip and lock-out, and thereby be unable to be reconnect to the onsite power supply when required. The analyses are documented in calculation XX-E-009-001-CN006, "System NB, NG, PG Under Voltage /Degraded Voltage." The following sections below summarize the details of this calculation.

3.1 Degraded Voltage Analysis

NEI 15-01 identifies five analyses needed to demonstrate adequate DV relay protection[1]:

1. Establish DV Relay Dropout Setting
2. Confirm Adequacy of DV Relay Dropout Setting for Motor Starting
3. Establish DV Relay Time Delay (with accident signal)
4. Confirm Reset of DV Relay with Minimum Required Grid Voltage
5. Confirm LOV Relay Setpoint Prevents Motor Stalling

The above five analyses form the basis that establish/confirm a proper setting for the undervoltage protection scheme and ultimately ensure that the Class 1E buses and safety-related components are anticipated to perform its intended function under any grid voltage conditions.

3.1.1 Establish DV Relay Dropout Setting

In this analysis, a minimum steady-state voltage at the DV relay monitored bus is determined. This is to ensure operating (running) voltages are adequate for the Class 1E loads required to support postulated design basis accidents and anticipated operational occurrences. This analysis uses the minimum operating voltage for the required loads as acceptance criteria and is consistent with the methodology of IEEE Standard 741-1997, Annex A (Reference 6.4).

This steady-state analysis was carried out by simply connecting a fixed voltage source to the DV relay monitored bus. Using steady-state load flow analysis, the fixed voltage source will be set as low as possible while maintaining the operating (running) voltages of the required Class 1E loads to be within their design requirements. This establishes the lower analytical limit for the DV relay dropout setting. The worst system loading condition (that is, highest loading on the Class 1E distribution system) will be used to envelop the postulated accident and operating scenarios that manifests the most severe voltage drop.

[1] DV relay protection refers to the sense, command, and execute features with their associated interconnections. This protection is provided to minimize Class 1E equipment damage and to ensure independence of the offsite and on-site power sources required by GDC-17 during any interruption of electrical service resulting in a degraded voltage. This includes mechanical or electrical failures or other unacceptable conditions.

The steps needed to establish the DV relay dropout setting included the following:

1. A load flow analysis at the DV relay safety limit, which is lower than the analytical limit, with margin was performed to verify the following:

   a. The operating (running) voltages of the required Class 1E loads meet design requirements.

   b. Class 1E MCC voltage ≥ 423.2V (92% of 460V) to ensure proper control circuit voltage for the 460V loads.

For this analysis a fixed voltage source is connected to the DV relay monitored bus. The fixed voltage source at each Class 1E 4.16 kV NB bus was adjusted as required to establish the DV relay dropout setting safety limit, so that the operating (running) voltages of required Class 1E loads were within their design limits.

Acceptance Criteria:

Running or operating terminal voltage for loads: ≥ 90% rated voltage

Class 1E MCC Voltages: ≥ 423.2V (92% of 460V)

Results:

The results of the load flow analysis at a NB01 and NB02 bus voltage of 3756.8V are as follows:

1. The Class 1E 4.16 kV and 480V motors loads have adequate voltage for operating.

2. The following equipment have running terminal voltages slightly less than the rated voltage (< 90% of rated):

   a. Inverter NN011 - 89.11%
   b. Inverter NN012 - 89.91%
   c. Inverter NN013 - 89.87%
   d. Inverter NN014 - 89.26%

   The NN Inverters have steady state terminal voltages which are slightly below the acceptance criteria of greater than or equal to 90% rated voltage. This is acceptable because the NN inverters are not OPERABLE unless they are powered from a Class 1E 125 VDC battery bus. The AC feed is an alternate source of power and makes the inverters inoperable.

3. Class 1E MCC voltages ≥ 423.2V (92% of 460V).

3.1.2 Confirm Adequacy of DV Relay Dropout Setting for Motor Starting

In this analysis, it is demonstrated that the Class 1E motors required for postulated design basis accidents or anticipated operational occurrences are capable of being started individually when the voltage at the DV relay monitored bus is at the DV relay dropout setting (lower analytical limit). Therefore, motors will be started individually to evaluate motor starting and whether it could cause the bus voltage to drop below the DV relay dropout setting resulting into a DV relay actuation and disconnecting the motor from the offsite power supply. This analysis provides the approach to determine a bounding technique that demonstrates equipment capability at the DV relay dropout setting.

This analytical approach determines bounding transient scenarios caused by motor starting events, where the voltage never dips below the DV relay dropout setting, or where it dips below and then recovers above the DV relay dropout setting within the time delay. The analysis using motor starting analysis is performed at a fixed voltage source set to the lower analytical limit for the DV relay dropout setting. The worst system loading condition (that is, highest loading on the Class 1E distribution system) is used to envelop the postulated accident and operating scenarios that manifests the most severe voltage drop. According to NEI 15-01, the motor starting analysis can either be a dynamic simulation that demonstrates each motor can be successfully started within its required time period or a static "snapshot" load flow analysis that demonstrates the calculated starting voltage at locked rotor conditions is within design requirements. This analysis performs the dynamic simulation.

The steps needed to verify the adequacy of the DV relay dropout setting for motor starting included the following:

1. The fixed voltage sources were set at a voltage of 3756.8V on the Class 1E 4.16 kV NB buses, which is the lower analytical limit.
2. To evaluate the motor starting voltages, each motor was modeled in Electrical Power System Analysis Software (ETAP). The motor load was turned off and then restarted in order to obtain the equipment terminal voltages.

Acceptance Criteria:

Starting terminal voltage: ≥ minimum starting voltage

Results:

At a NB01 and NB02 bus voltage of 3756.8V, the Class 1E 4.16 kV and 480V loads have adequate starting voltage.

3.1.3 Establish DV Relay Time Delay (with accident signal)

In this analysis, it is demonstrated that the Class 1E loads required for postulated design basis accidents (including control equipment) will successfully auto-transfer to the onsite power supply if the DV relay monitored bus experiences DV conditions. Therefore, an upper analytical limit of the DV relay time delay will be used to ensure accident analyses (core cooling) requirements are not exceeded. This analysis shows that coordination exists between the DV relay time delay and any protective devices that are capable of preventing transfer to the onsite supply (such as overcurrent devices that could trip and require a manual reset).

Essentially, protective devices coordination analysis is performed in this section. The analysis assesses the overcurrent protective devices of Class 1E motors that auto-start upon receipt of an accident signal and ensures that it will not prevent transfer (automatic restart) to the onsite supply and will not trip if the DV occurs at the initiation of the motor start. The analysis ensures that protective devices must not trip for a duration equal to the upper analytical limit of the DV relay time delay plus the additional time needed to accelerate the motor on the onsite power supply (at rated starting current). Protective devices that are not subject to heating such as overcurrent relays and solid-state trip units do not require an evaluation for the motor start on the onsite power supply.

This analysis is also applicable to protective devices associated with Class 1E non-motor loads (such as battery chargers) to ensure they will not lock-out during the DV time delay period. Control power circuits fed from Class 1E AC MCCs are evaluated for the Class 1E accident-initiated motors to ensure that their control circuit fuses will not melt if the starter does not have sufficient voltage to pick-up during the DV time delay period.

The steps needed to evaluate the performance of the overcurrent devices for the Class 1E loads required for postulated design basis accidents consist of the following:

1. For the Class 1E 4000V motors that are started during a design basis accident, the motor starting current was compared against the coordination plot for these motors to verify the overcurrent relay would not trip in 9.5 seconds. To ensure that the overcurrent relay does not trip during a concurrent loss of coolant accident (LOCA) and DV condition, WCNOC Calculation H-08-005-CN009, "System NB, Relay Setting," determined that acceptance criteria for the relay trip time of ≥ 9.5 seconds. The recommended setting for the DV relay timer of ≥ 7.4 seconds and ≤ 8.5 seconds bounds the 9.5 seconds criteria.

2. The Class 1E 460V motors that are powered from the 480V load centers are protected by GE or Square D SST trip units. For these motors a Time-Current Characteristic (TCC) curve was created in the ETAP model using the GE SST trip unit settings from drawings E-11NG01, "Single Line Meter & Relay Diagram for NG01 & NG03," and E-11NG02, "Single Line Meter & Relay Diagram for NG02 & NG04." The motor starting current that correlates to its starting voltage was calculated. This motor starting current was then compared against the TCC curve to verify the GE SST trip unit would not trip in 8.5 seconds. Since the ETAP model curve for the SST includes tolerance, the fastest operating trip time from the TCC curve was used for this evaluation.

3. The Class 1E 460V motors that are powered from the 480V MCCs are protected by Molded Case Circuit Breakers (MCCBs). Most MCCBs have only a magnetic or instantaneous setting. The MCCB magnetic and thermal settings were reviewed to verify that the MCCB did not trip.

4. The Class 1E 460V motors that are powered from the 480V MCCs are protected by thermal overload (TOL) relays. Since the TOL relay heaters are subjected to heating when subjected to a current, the TOL relay heater size must be capable of withstanding the total heating that occurs during the 8.5-second DV condition and the subsequent

restart from the DG without tripping. To evaluate the performance of the TOL during the 8.5-second concurrent LOCA and DV condition, the motor starting current that correlates to its starting voltage was calculated, and this motor starting current was then compared against the TCC curves for the TOLs to obtain the trip time. The fastest operating trip time from the TCC curve was used for this evaluation. If the TOL did not trip during the 8.5-second DV condition, the TOL performance of the TOL relay heater was then evaluated during the subsequent start from the DG.

The evaluation, which was based on NEI 15-01 methodology, showed that the overcurrent devices met the acceptance criteria except for 20 TOLs. For these 20 TOLs an enhanced overcurrent evaluation was performed. The NEI 15-01 methodology conservatively assumes the motors continue to draw starting current until the DV relay times out (8.5 seconds). The enhanced TOL evaluation determines the motor starting voltage at the LOV relay lower analytical limit, which is the lowest DV that can occur without tripping the LOV relays. If the motor terminal voltage is high enough to start the motor, the resultant motor starting current and acceleration time is then calculated. After the motor reaches rated speed, the running current is determined. Thus, during the concurrent DV condition and LOCA, the TOL is evaluated for motor starting current only during the acceleration period and for running current for the remainder of the 8.5 second DV condition.

Acceptance Criteria:

Overcurrent Relay Trip Time during DV condition	≥ 9.5 seconds
GE SST Trip Unit Trip Time	> 8.5 seconds
MCCB Magnetic Setting	> Motor Locked Rotor Amperes (LRA)
MCCB Thermal Setting Trip Time	> 8.5 seconds
TOL Trip Time during DV condition	> 8.5 seconds
TOL Trip Time for DG start:	> motor acceleration time at rated voltage

Results:

1. The overcurrent relays for the 4000V motors do not trip during the concurrent DV condition and LOCA.

2. The SST trip units for the 460V motors powered from the 480V load centers do not trip during the concurrent DV condition and LOCA.

3. The MCCBs do not trip during the concurrent DV condition and LOCA.

4. The TOL relay heaters for the 460V motors do not trip during the concurrent DV condition and LOCA and the subsequent restart from the DG.

3.1.4 Confirm Reset of DV Relay with Minimum Required Grid Voltage

The purpose of this analysis is to verify that the required accident-initiated Class 1E motors will start and accelerate within required time periods at the minimum required grid voltage (or available minimum OPERABLE grid). This analysis ensures the capability of offsite power to mitigate the plant design basis accidents by demonstrating availability of adequate starting voltage to Class 1E motors that auto-start in response to an accident signal when powered at minimum voltage and capacity (minimum OPERABLE grid). For the DV relay settings, this analysis confirms that the minimum required grid voltage will be adequate to reset the DV relay prior to the automatic disconnection from offsite power. The lower analytical limit of the DV relay time delay (7.4 seconds) is used for this analysis. The results of the analysis show that the DV relay monitored bus voltage recovers above 3864V for the scenarios studied at the lowest switchyard voltage of 98% of the 345 kV rated voltage. Also, the longest recovery voltage time is less than 4 seconds and is acceptable since the lower analytical trip time is 7.4 seconds.

Acceptance Criteria:

The lowest DV relay monitored buses (NB01 and NB02) must recover to the DV relay reset voltage of 3864V (92.88% of rated bus voltage) within 7.4 seconds. The maximum reset voltage for the DV relay is 3864V.

The starting voltage for the Class 1E motors remain above minimum starting voltage.

The running or operating voltages are ≥ 90% rated following the completion of the load sequence operation.

Results:

1. The voltages at the DV relay monitored buses NB01 and NB02 recover above the DV relay reset voltage of 3864V in less than 4 seconds.

2. Starting voltages remain above minimum.

3. Running or operating voltages following the completion of the load sequence operation are ≥ 90% rated.

3.1.5 Confirm Loss of Voltage Relay Setpoint Prevents Motor Stalling

An LOV relay acts as an integral part of the overall DV protection scheme. The function of this relay is to limit the magnitude and duration of an undervoltage condition on the Class 1E buses. In an LOV relay, the voltage and time delay settings are typically selected to prevent nuisance trips during anticipated voltage transients (large motor starts, accident-initiated load sequencing, transmission system transients, lightning strikes, etc.).

In this analysis, the LOV relay dropout setting (lower analytical limit) is selected to ensure stalling of Class 1E motors is prevented during the postulated design basis accidents and anticipated operational transients.

A steady-state load flow analysis is carried out using a fixed voltage source to the LOV relay monitored bus. This analysis is used to set the LOV relay dropout setting (lower analytical limit).

The load flow analysis voltages of the required Class 1E motors are reviewed to confirm that the voltages are higher than their respective stall voltage. The worst system loading condition (that is, highest loading on the Class 1E distribution system) is used to envelop all postulated accident and operating scenarios that manifest the most severe voltage drop.

Acceptance Criteria:

Running terminal voltage for motors: > Stall Voltage

Class 1E MCC Voltages: ≥ 345V (75% of 460V)

Results:

At an LOV relay lower analytical limit of 3150.4V at the NB buses, the Class 1E motors that are running for plant design basis accidents will not stall, and the Class 1E MCC voltages exceed 345V.

3.2 Degraded Voltage and Loss of Voltage Relay Settings

The primary purpose of this section is to determine the voltage and time delay setpoints for the DV and LOV relays associated with the Class 1E 4.16 kV buses NB01 and NB02.

The methodology of calculation XX-E-009-001-CN006 is based on the guidance from Draft Regulatory Guide DG-1141 (Reference 6.5), ISA-RP67.04.02-2010 (Reference 6.6), and WCNOC Design Guide DG-J-001 (Reference 6.7). The following steps determine the DV and LOV relay dropout and reset voltage setpoints for NB01 and NB02 buses. The DV and LOV relays dropout and reset voltage settings are established to ensure the TS and Safety Limit voltages are protected.

Figure 2 illustrates the setpoint dropout and pickup diagram and the relationship between the Analytical Limit/Safety Limit, TS SR 3.3.5.3 AV, Dropout Minimum Allowable As-Found Value, nominal dropout Trip Setpoint ($NTSP_{DO}$), and the TS nominal Trip Setpoint (Actual Trip Setpoint (ATSP)) for both the DV relay dropout setpoints and relay pickup setpoint.

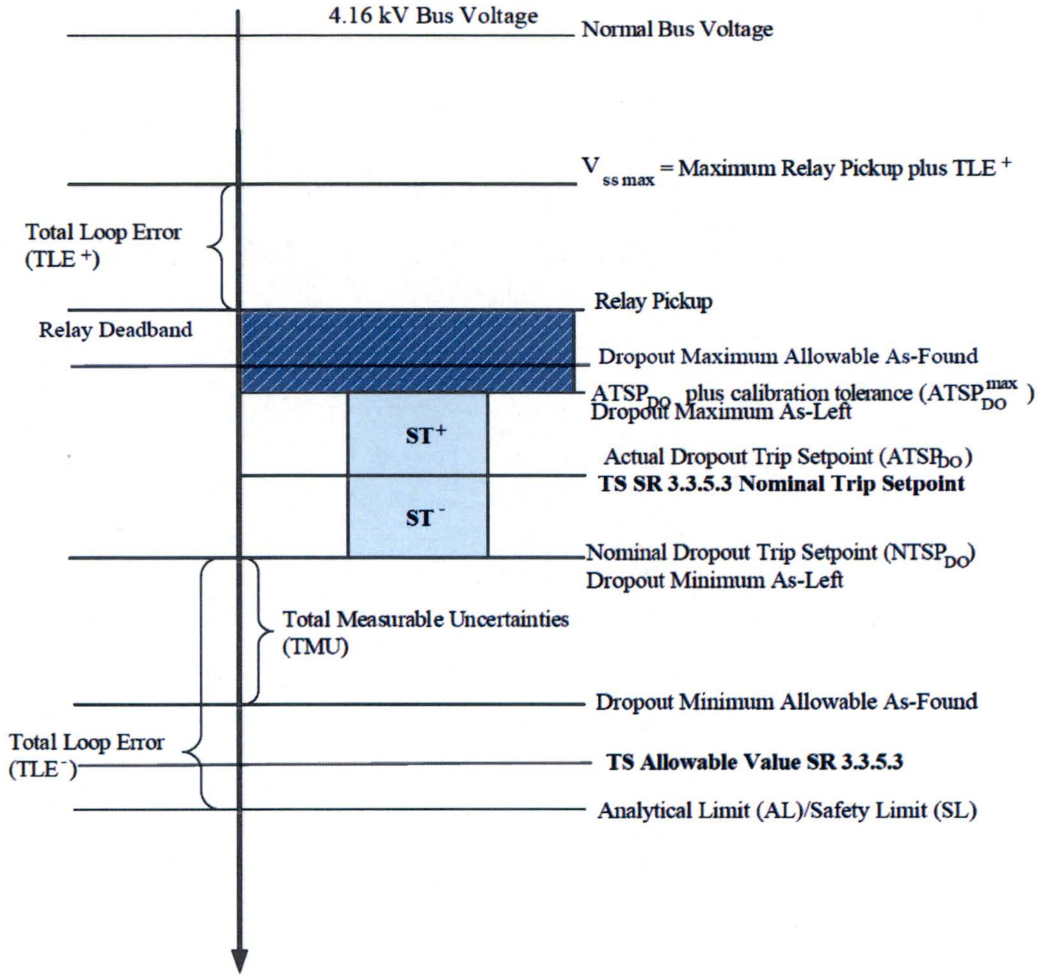

Figure 2: Dropout and Pickup Setpoint Diagram

3.2.1 Degraded Voltage Relay Settings

The DV relay dropout setpoint (for Relays NF039A & NF039B) is established to ensure that the Class 1E 4.16 kV NB01 and NB02 buses are separated from offsite power prior to unsatisfactory operation of equipment (e.g., damage) or trip on overcurrent, which would prevent the equipment from being resequenced onto the DGs. Additionally, the DV relays pickup at a fixed reset voltage that ensures there is a minimum differential between the dropout and pickup to reduce the probability of the buses separating from the preferred offsite power source during short-term undervoltage transients (e.g., motor starting) that recover to a voltage above the relay pickup voltage.

The following steps determine the DV relay dropout and reset voltage setpoints for NB01 and NB02 buses. The DV relays dropout and reset voltage settings are established to ensure the TS and Safety Limit voltages are protected.

There is no additional uncertainty for humidity, radiation or seismic effect for the DV relays. The setting tolerance (ST) in percent of setting is determined by the below equation. The DV relay or LOV relay setting tolerance is established to allow an acceptable setpoint range for technicians to set the relays. The setting tolerance is determined to be equal to or greater than the square root sum of the square (SRSS) of accuracy of the DV relays and the maintenance and test equipment (M&TE) accuracy. This ensures that the setting tolerance is large enough to allow the trip setpoints to be easily adjusted between the limits. When the drift is determined by statistical analysis of as-found/as-left calibration data, the drift is substituted for the relay accuracy. As-found/as-left calibration data was statistically analyzed to establish the drift error on the DV and LOV relays. This statistical analysis provides a 95% probability at a 95% confidence level (95/95) drift value for the relays based on a monthly surveillance interval. This setting tolerance is applied to both the dropout and pickup setting of the DV relays and drop out setting of the LOV relays.

$$ST = \pm\sqrt{a^2 + m^2}$$

a: repeatability accuracy at constant temperature and control voltage of the DV relays or drift is determined through statistical analysis. The bistable can be set using the drift through statistical analysis and is determined to be ±0.1228% of relay setting.

m: M&TE error for equipment used to calibrate the relays (0.4426% of relay setting)

$$ST = \pm\sqrt{0.1228^2 + 0.4426^2} = \pm 0.4594\%$$

The total loop error (TLE) includes relay uncertainties (except the PT ratio correction) and is determined in accordance with the requirements of Reference 6.7. The setpoint methodology at WCNOC utilizes a combination of the straight sum and SRSS plus algebraic approaches. The error effects are evaluated based on known behavior and are characterized as independent, dependent, random or non-random. The random elements of uncertainty are combined by SRSS, and any non-random uncertainties (commonly known as a bias) are added algebraically (straight sum) to the SRSS result according to sign. The uncertainty equation for each instrument is based on the characteristics of each applicable element of uncertainty. The TLE is calculated based on the following equation to determine the largest positive (TLE^+) and largest negative TLE (TLE^-) for the DV relays.

$$TLE = \pm[d^2 + p^2 + t_n^2]^{1/2}$$

Where:

d: Total measurable uncertainty through statistical analysis = ±0.1228%

p: There is no independent power supply effect on the uncertainty from other variables

t_n: Temperature effect uncertainty. ±0.139% for voltage transducer and ±0.213% for 6N229 Bistable

$$TLE = \pm[0.1228^2 + 0^2 + 0.139^2 + 0.213^2]^{1/2} = \pm 0.2825\%$$

The total measurable uncertainty (TMU) is determined similarly to TLE but is limited to those errors that are included in the portion of the loop that is measured during the calibration of the instruments/relays. However, since a statistical analysis of the as-left and as-found data was performed, the TMU was not calculated. The TMU will be equal to the drift (d) in percent of setting.

$TMU = \pm 0.1228\%$

A TS SR 3.3.5.3 DV AV of 107.5V (at 120V base and 3773.8 V on the 4.16 kV side) is chosen for the DV relay settings and its acceptability is demonstrated in calculation XX-E-009-001-CN006. The TS AV is referenced at the relay voltage and has no adjustment for PT error versus the actual setting on the relay, which has the PT error applied. The TS AV was determined by iteration by performing multiple computer runs with different values until the results yielded an acceptable value (i.e., required loads had voltages within their allowable operating range at their terminals).

The Dropout Minimum Allowable As-Found Value AV accounting for PT error is calculated as follows:

$$AV = \frac{107.5}{PT^-} = \frac{107.5}{0.997} = 107.82V$$

The DV relays sense a voltage between 0 – 120V; therefore, it is necessary to have a PT to convert a high voltage signal to a low voltage signal. Because a PT has a fixed turns ratio (35:1), the PT error is limited to the correction applied to the turns ratio as a result of the secondary side burden. This error is a bias, because the burden shifts the PT output in only one direction for a given burden. The error of the PT will be expressed as PT^- for the largest error in the negative direction. For operation 90% to 110% of rated voltage, the transformer correction factor limit is ±0.3%.

$$PT^- = 1.0 - 0.003 = 0.997$$

The AV is the calculated minimum as-found setting that protects the AL from being exceeded by accounting for the unmeasurable uncertainties in the relay loop (at a 95% confidence level). The AV or Dropout Minimum Allowable As-Found Value (107.82V) is the calculated minimum as-found setting that protects the AL from being exceeded by accounting for the unmeasurable uncertainties in the relay loop (at a 95% confidence level).

The DV dropout nominal trip setpoint ($NTSP_{DO}$) is the calculated minimum as-left setting that protects the AL from being exceeded by accounting for instrument uncertainties in the relay loop (at a 95% confidence level). The $NTSP_{DO}$ is determined based on the TMU as follows:

$$NTSP_{DO} = \frac{AV}{1 - TMU} = \frac{107.82}{1 - 0.001228} = 107.96V$$

The $NTSP_{DO}$ needs to be greater than the AL with TLE^- accounted for. The DV AL is established based on the Safety Limit and TLE.

$$AL = NTSP_{DO}(1 - TLE^-) = 107.96(1 - 0.002825) = 107.66V$$

The DV Safety Limit is set equal to the AL of 107.66V. The DV Safety Limit is determined for NB01 and NB02 buses using the Allowable Value. The safety-related equipment in the 4.16kV and 480 V systems must have sufficient voltage to perform their design basis function during a Design Basis Event (e.g., LOCA). Similarly, at the Safety Limit, the transient dip in voltages due to motor starting must not impact the motor acceleration and actuation of the DV relay due to voltage recovery. The Safety Limit is established on a base voltage relative to the 4.16 kV system.

The DV TS nominal Trip Setpoint ($ATSP_{DO}$) is the ideal field setting in the calibration procedure. The DV TS nominal Trip Setpoint is calculated as follows:

$$ATSP_{DO} = NTSP_{DO} + ST * NTSP_{DO} = 107.96(1+0.004594) = 108.46V$$

The maximum actuation of the DV relay dropout (dropout max allowable as-left) is determined by as follows:

$$ATSP_{DO}^{max} = ATSP_{DO}(1 + ST) = 108.46(1 + 0.004594) = 108.96V$$

The DV maximum pickup actual trip setpoint ($ATSP_{PU}^{max}$) is calculated as follows:

$$ATSP_{PU}^{max} = ATSP_{DO}^{max} + 0.75 = 108.96+0.75 = 109.71V$$

The bistable has an adjustable hysteresis in the analog comparator to eliminate chatter at the output due to low level electrical noise as the analog input approaches the comparison threshold. Based on operating experience, a 0.5% of bistable span is used for the hysteresis setpoint setting. At this setting, the hysteresis is 0.75V.

The DV relay dropout maximum as-found value (AF_{DO}^{max}) is determined as follows:

$$AF_{DO}^{max} = ATSP_{DO}^{max}(1 + TMU) = 108.96(1 + 0.001228) = 109.1V$$

The maximum 4.16 kV system reset (pickup) voltage $V_{ss\,Max}$ is calculated as follows (where N is the nominal turns ratio on the potential transformers):

$$V_{ss\,Max} = [ATSP_{PU}^{MAX}(1 + TLE^{+}) + Maximum\ Cable\ Voltage\ Drop] * (N * PT^{+})$$

$$V_{ss\,Max} = [109.71(1 + 0.002825) + 0.035] * (35 * 1.003) = 3864\ Vac$$

Results

TS AV is ≥ 107.5V (3773.8 V on the 4.16 kV side).

TS nominal Trip Setpoint is 108.46V.

Analytical Limit/Safety Limit is 107.66V (3756.8 V on the 4.16 kV side).

The voltage element settings for NB01 and NB02 bus DVR relays are tabulated below. Values are presented in volts on the relay base, with the voltage on the 4.16 kV bus base for selected values.

Setting	Value (Calculated Settings) (at 4kV)
Vss max (Reset)	3864.0V
$ATSP_{PU}^{max}$ (Relay Pickup)	109.71V
Dropout Max As-Found	109.1V
$ATSP_{DO}^{max}$ Dropout Max Allowable As-Left	108.96V
$ATSP_{DO}$ **TS nominal Trip Setpoint**	108.46V
$NTSP_{DO}$ Dropout Min As-Left	107.96V
Dropout Min As-Found	107.82V
TS Allowable Value	107.5V(1) 3773.8V(2)
Analytical Limit/Safety Limit	3756.8V

(1) The voltage at the relay with PT error excluded.
(2) The TS AV voltage at the 4.16 kV bus with PT error included.

3.2.2 Loss of Voltage Relay Setting

The LOV relaying scheme is set to detect a complete LOV on the bus. Once an LOV is detected, the feeder breaker is tripped nearly instantaneously (after a short time delay to avoid spurious actuations) and the loads transferred to the associated onsite DGs.

The LOV relay dropout setpoint is established to ensure that the Class 1E 4.16 kV NB01 and NB02 buses are separated from offsite power due to a LOV of the preferred source of power (that is the grid). The LOV relay dropout settings are calculated to a 95% probability at a 95% confidence level (95/95). The tolerances for the instrument loop components must be considered in order to determine the LOV relay setpoints.

Figure 2 is applicable for the LOV relay as well. The relay pickup (or reset) setting is not critical for LOV function and is therefore not carried out similar to the DV relay settings. Also, as the voltage is collapsing toward the LOV relay setting, it is unlikely that the bus will recover to its pickup setting. The following steps determine the LOV relay dropout and reset voltage setpoints for the NB01 and NB02 buses. There is no additional uncertainty for humidity, radiation or seismic effect for the LOV relays.

The setting tolerance (ST) in percent of setting is specified below.

$$ST = \pm\sqrt{0.4534^2 + 0.4612^2} = \pm 0.6468\%$$

The TLE is calculated to determine the largest positive TLE^+ and largest negative TLE^- for the LOV relays.

$$TLE = \pm[0.4534^2 + 0^2 + 0^2]^{1/2} = \pm 0.4534\%$$

The TMU is calculated based on the performance of a statistical analysis of the as-left and as-found data. The TMU is equal to the drift (d) in percent of setting.

$$TMU = \pm 0.4534\%$$

A TS SR 3.3.5.3 Loss of Voltage AV of 90.0V (at 120V base) is chosen for the LOV Relay settings and its acceptability is demonstrated in calculation XX-E-009.

The dropout minimum allowable as-found value AV accounting for PT error is calculated as follows:

$$AV = \frac{90}{PT^-} = \frac{90}{0.997} = 90.28V$$

The $NTSP_{DO}$ (dropout min as-left) is calculated as follows:

$$NTSP_{DO} = \frac{AV}{1 - TMU} = \frac{90.28}{1 - 0.004534} = 90.69V$$

The Analytical Limit (AL) is calculated as follows. The Safety Limit (SL) is set equal to the Analytical Limit.

$$AL = NTSP_{DO}(1 - TLE^-) = 90.69(1 - 0.004534) = 90.28\text{V}$$

The LOV TS nominal Trip Setpoint ($ATSP_{DO}$) is calculated as follows:

$$ATSP_{DO} = NTSP_{DO}\ (1+ST) = 90.69\ (1+0.006468) = 91.28\text{V}$$

The maximum actuation of the LOV relay dropout (dropout max allowable as-left) is calculated as follows:

$$ATSP_{DO}^{max} = ATSP_{DO}(1 + ST) = 91.28\ (1 + 0.006468) = 91.88V$$

The LOV relay dropout maximum as-found value (dropout max as-found (AF_{DO}^{max})) is calculated as follows:

$$AF_{DO}^{max} = ATSP_{DO}^{max}(1 + TMU) = 91.88(1 + 0.004534) = 92.3V$$

The LOV relay dropout minimum as-found value (dropout min as-found (AF_{DO}^{min})) is calculated using the following equation.

$$AF_{DO}^{min} = NTSP_{DO}(1 - TMU) = 90.7\ (1 - 0.004534) = 90.28V$$

The maximum reset voltage ($V_{max\ reset}$) is calculated from the AF_{DO}^{max} voltage and PU/DO ratio (relay pickup to dropout voltage ratio (in % of ATSP)). The PU is 110% of the dropout voltage for the LOV relay.

$$V_{max\ reset} = AF_{DO}^{max}\left(1+\frac{PU/DO}{100}\right) = 92.3\left(1+\frac{10}{100}\right) = 101.53V$$

This translates to 101.53 x 35 x 1.003 = 3564.3V at the 4.16kV buses when PT error is considered.

Results

TS AV is ≥ 90.0V (3159.5V on the 4.16kV side).

TS nominal Trip Setpoint is 91.28V.

Analytical Limit/Safety Limit is 90.28V (90.28 x 35 x 0.997 = 3150.4Vac on the 4.16kV side).

The voltage element settings for the NB01 and NB02 bus LOV relays are tabulated below.

Setting	Value (Calculated Settings) (at 4kV)
Vss max (Reset)	3864.0V
$ATSP_{PU}^{max}$ (Relay Pickup)	109.71V
Dropout Max As-Found	109.1V
$ATSP_{DO}^{max}$ Dropout Max Allowable As-Left	108.96V
$ATSP_{DO}$ **TS nominal Trip Setpoint**	108.46V
$NTSP_{DO}$ Dropout Min As-Left	107.96V
Dropout Min As-Found	107.82V
TS Allowable Value	107.5V(1) 3773.8V(2)
Analytical Limit/Safety Limit	3756.8V

(1) The voltage at the relay with PT error excluded.
(2) The TS AV voltage at the 4.16 kV bus with PT error included

3.3 Time Delay Relays

The time delays are intended to trip the NB01 and NB02 breaker as a result of DV conditions from the offsite power. Depending on the design of DV and LOV protection schemes, appropriate time delays are set to trip the offsite power in the event the DV condition does not recover to an acceptable level for performance of the safety-related equipment. The design is intended to minimize undesirable operation of the onsite power sources (DGs) and separation of the offsite power supply. Thus, the use of coincident logic (e.g., LOCA, Non-LOCA, Reactor Coolant Pump (RCP) start) and appropriate time delays is incorporated to ride through the DV transient conditions and are distinguished as follows:

- a time delay with an SIS referred to as DV relay time delay.
- a time delay without an SIS referred to as non-accident time delay.
- a time delay for enabling the start of RCP motor.
- a time delay for enabling the LOV relay to override the system transients.

The time delay with an SIS is established to ensure the offsite power to the NB buses is tripped and subsequently transferred to onsite power in the event a DV persists following a LOCA. The objective of the DV relay time delay is to ensure that the delay is adequate to overcome the starting of accident loads without tripping itself from the offsite power during the sustained DV condition of the offsite power. The non-accident time delay is provided to ensure that the normally running safety-related equipment are not damaged or tripped as a result of sustained system DV condition without the safety injection signal. Additionally, another time delay is incorporated to enable RCP motor start since the starting time of this motor is significantly longer than all other motors in the system.

Also, an intentional time delay is introduced in LOV relay actuation. This delay ensures that sufficient time is allowed (internal to Load Shedder Emergency Load Sequencer (LSELS)) prior to tripping the bus feeder breakers spuriously as a result of a disturbance (such as fault) or transient in the offsite power system.

The time delay relays that are addressed in calculation XX-E-009-001-CN006 include:

a. DV Relay Time Delay with SIS. (Relay ID NF039A/B (TDE2)

b. DV Relay Time Delay without SIS (or Non-Accident Time Delay). (Relay ID 62TDENB03-04)

c. RCP Start Time Delay. (Relay ID 62TDENB05-08)

d. LOV Relay Time Delay. (Relay ID NF039A/B TDE1)

As the DV Relay Time Delay without SIS and RCP Start Time Delay relay setpoints are not included in the TSs, no discussion is provided on the determination of these relay setpoints.

NF039A/B (TDE-2): The first time delay internal to the LSELS cabinet is chosen such that when the large motors start and the auxiliary system experiences voltage dips, the system will not falsely arm the DV circuitry.

NF039A/B (TDE-1): This time delay is an intentional delay to allow the system transients to subside before spuriously tripping the Class 1E 4.16 kV buses.

Degraded Voltage Time Delay

This section establishes the time delay setpoints for the DV relay in the event that an SIS is present in the system. The objective of this relay is to ensure that no safety-related equipment will trip during this time delay due to resulting overcurrent during a LOCA before the system is transferred to the onsite power system or the recovery of the offsite power system. The overcurrent tripping time is established as follows.

a. Review the startup characteristics of motors (including motor-operated valves (MOVs)).

b. Review protective device characteristics for safety-related equipment and bus feeder breakers including device setpoints and time current curves.

c. Review 480V safety-related motors (including MOVs) protective devices tripping times. The Class 1E MOVs have their TOLs bypassed, and therefore do not have this protection.

d. Review the block start sequence times.

WCNOC Calculation XX-E-006, Revision 8, "AC System Analysis," has performed a review of the auto sequenced safety-related motor starting times and determined that it is less than 5 seconds. This basis is used to set the block starting of loads (that is load sequencing) at an interval of 5 seconds. Based on the review of calculation XX-E-006, it is concluded that the auto sequenced safety-related motors can be started within 5 seconds. This forms the basis for establishing the minimum time allowed to set the DV relay to 5 seconds. The maximum starting time is determined based on the review of safety analysis that allows the time delay to transfer the safeguard loads to the onsite power. The maximum time delay will also review the thermal rating of the valve motors since their TOLs are bypassed.

The maximum time delay is determined based on the safety analysis discussed in the WCNOC Updated Safety Analysis Report (USAR). The safety analysis included a 12 second time delay in the case that offsite power is not available to allow the start of onsite power (i.e., DGs) and to load the necessary SI equipment to mitigate the LOCA event. However, the other limiting scenario is dictated by the limiting thermal capabilities of the motors used in valves since the protection associated with valve motors are bypassed. Therefore, the thermal characteristics of valve motors were reviewed. The MOVs are designed with a thermal withstand capability of 10 seconds under a locked rotor condition. Further review of motor performance curves reveals that most motors exceed the thermal rating greater than 10 seconds. Therefore, based on the limiting thermal rating of 10 seconds, the DV relay is determined to be set at less than 10 seconds. For MOV's, per WCNOC Calculation XX-E-004, "AC MOV Terminal Voltage," a limitation of 9.5 seconds is imposed to assure the MOV motor thermal rating is not exceeded.

A review of protective devices in WCNOC Calculation H-08-005-CN009 was performed. The concern is during concurrent LOCA and DV conditions, the protective devices may lockout and prevent Class 1E motors from starting when transferred to the onsite emergency power supplies. The protective devices should be set such that they do not lockout and prevent operation of motors after transfer from offsite to onsite power. Based on calculation WCNOC H-08-005-CN009, the protective relay settings were set such that the protective relays do not trip for at least 9.5 seconds, considering starting current drawn at the lowest starting voltage of the motor. This approach is considered conservative since the motors are capable of starting at their lowest starting voltage which is considerably less than the DV relay drop out voltage, thus, motors will attain their normal running current prior to 9.5 seconds.

Calculations

The DV nominal Trip Setpoint time delay is established at 8.0 seconds. The TS time delay was determined by iteration by performing multiple ETAP software runs with different values until the results yielded an acceptable value.

Drift: +0.47/-0.53 seconds (A drift calculation provides 95/95 drift values for the DV relays and LOV relays for a monthly surveillance interval.

Drift is comprised of TMU and TLE. Uncertainties are included in the drift data. Therefore, no other uncertainties exist to include in the drift data.

The setting tolerance is determined as follows:

$$ST = \pm\sqrt{a^2 + m^2}$$

a = 0.01 seconds
m = 0.01 seconds

$$ST = \pm\ (0.01^2 + 0.01^2)^{1/2} = 0.0142 \text{ seconds}$$

The Minimum Actual Trip Setpoint ($ATSP_{min}$) time delay for the DV relay is determined to establish a positive and negative range for the calibration of the relays for the technicians setting/calibrating the relay. The setting for the $ATSP_{min}$ is obtained by subtracting the setting tolerance (ST^-) from the ATSP (TS nominal Trip Setpoint). This setting is also the maximum As-Left

$$ATSP_{min} = ATSP - ST^- = 8.0\text{-}0.0142 = 7.99 \text{ seconds}$$

The Nominal Trip Setpoint time delay for the DV relay is determined to ensure that the DV relay trips prior to the analytical limit AL_{max} is reached. Therefore, the time available between the Nominal Trip Setpoint and AL_{max} accounts for all the uncertainties associated with the DV time delay relay. This uncertainty is called the Total Loop Error (TLE^+) for the DV time delay relay.

$$NTSP = ATSP + ST^+ = 8.0 + 0.0142 = 8.02 \text{ seconds}$$

Analytical limits (maximum and minimum) for the DV time delay relays is the TS SR 3.3.5.3b time delay Allowable Value. The maximum analytical limit AL_{max} is required to protect the SL, that is, the maximum allowable DV relay time delay that include a margin. The AL_{max} is determined by:

$$AL_{max} = SL - Margin = NTSP + TLE^{+}$$

$$AL_{max} = 8.02+0.47 = 8.49 \text{ seconds or } 8.5 \text{ seconds}$$

The minimum analytical limit AL_{min} is established to ensure that the time delay is long enough to ride through the starting of any safety-related load during a LOCA without tripping from the offsite power source during the DV condition. The AL_{min} is determined to be less than 5 seconds. The AL_{min} is also calculated as follows:

$AL_{min} = ATSP_{min} - TLE^{-}$ (TLE^{-} is the negative drift, that is, 0.53 seconds)

$AL_{min} = 7.99\text{-}0.53 = 7.46$ seconds (is greater than 5 seconds, and therefore has acceptable margin)

The maximum allowable delay time is established to be less than 10 seconds. This time delay ensures that during an accident coincident with degraded voltage, the time delay relays allow the safety-related buses to separate from offsite power before any protective device trips enabling safeguards equipment to sequence automatically onto the onsite power system (i.e., DGs). The maximum allowable time delay is considered the SL to protect safety-related equipment. The SL time delay is established to be 10 seconds.

Results

Description	Value
TS SR 3.3.5.3b. nominal Trip Setpoint	8.0 sec
Maximum As-Left Value	8.5 sec
Minimum As-Left Value	7.4 sec
TS SR 3.3.5.3b Allowable Value	≥ 7.4 sec. and ≤ 8.5 sec.

The above settings are well within the SL of 10 seconds.

Loss of Voltage Time Delay

This section establishes the time delay setpoints for the LOV relay in the event that NB bus voltage falls below the dropout setting of the relay. The LOV relay is an instantaneous undervoltage relay. An intentional time delay is introduced to delay the LOV relay actuation to ensure that sufficient time is allowed (internal to LSELS) prior to tripping the bus feeder breakers spuriously as a result of a disturbance or transient in the offsite power system.

The minimum time delay limit for the relay is calculated such that it prevents spurious operation during momentary voltage transients caused by offsite power disturbances (such as three phase faults, or other disturbances in the offsite power system). Since the bus transient voltage is not expected to last longer than the calculated 0.85 seconds as a result of offsite power system faults, a time delay setting of 1.0 second is expected to ensure that no spurious trip of the feeder breaker occurs.

The maximum time delay for the LOV relay is limited to the 1.2 second time used in the accident analysis response time for starting the DGs during a Loss of Offsite Power Event.

Calculations

The TS LOV nominal Trip Setpoint time delay is established at 1.0 second. It should be noted that this is not a change from the existing TS SR 3.3.5.3a LOV nominal Trip Setpoint.

Drift: +0.09 seconds

Drift is comprised of TMU and TLE. Uncertainties are included in the drift data. Therefore, no other uncertainties exist to include in the drift data.

The setting tolerance is determined as follows:

$$ST = \pm\sqrt{a^2 + m^2}$$

a=0.01 seconds
m=0.01 seconds

$ST = \pm\ (0.01^2 + 0.01^2)^{1/2} = 0.0142$ seconds

The Minimum Actual Trip Setpoint ($ATSP_{min}$) is calculated as follows:

$ATSP_{min} = ATSP - ST^- = 1.0 - 0.0142 = 0.99$ seconds

Nominal Trip Setpoint (NTSP) time delay for the LOV relay is calculated as follows:

$NTSP = ATSP + ST^+ = 1.0 + 0.0142 = 1.02$ seconds

Analytical Limits (maximum as-left and minimum as-left) for the LOV time delay relays is the TS SR 3.3.5.3b time delay Allowable Value. These values are calculated as follows:

$AL_{max} = SL - Margin = NTSP + TLE^+$

$AL_{max} = 1.02 + 0.09 = 1.11$ seconds (conservatively considered to be 1.15 seconds)

$AL_{min} = ATSP_{min} - TLE^-$ (TLE^- is the negative drift, that is, 0.09 seconds)

$AL_{min} = 0.99 - 0.09 = 0.90$ seconds (is greater than .85 seconds, therefore it has acceptable margin)

Results

Description	Value
TS SR 3.3.5.3a. nominal Trip Setpoint	1.0 sec
Maximum As-Left Value	1.15 sec
Minimum As-Left Value	0.9 sec
TS SR 3.3.5.3b Allowable Value	≥ 0.9 sec. and ≤ 1.15 sec.

The above settings are well within the allowable minimum SL of 0.85 seconds and the 1.2 seconds accident analysis limit.

4.0 REGULATORY EVALUATION

This section addresses the standards of 10 CFR 50.92 as well as the applicable regulatory requirements and acceptance criteria.

4.1 Applicable Regulatory Requirements/Criteria

The proposed change has been evaluated to determine whether the applicable regulations and requirements, noted below, continue to be met.

Section 182a of the Atomic Energy Act requires applicants for nuclear power plant operating licenses to include Technical Specifications (TSs) as part of the license. The TSs ensures the operational capability of structures, systems, and components that are required to protect the health and safety of the public. The U.S. Nuclear Regulatory Commission's requirements related to the content of the TSs are contained in Section 50.36 of Title 10 of the *Code of Federal Regulations* (10 CFR 50.36) which requires that the TSs include items in the following specific categories: (1) safety limits, limiting safety systems settings, and limiting control settings; (2) limiting conditions for operation; (3) surveillance requirements per 10 CFR 50.36(c)(3); (4) design features; and (5) administrative controls.

General Design Criterion 17, "Electric power systems," states that provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 8, "Electric Power," Appendix 8-A, Branch Technical Position (BTP) PSB-1, "Adequacy of Station Electric Distribution System Voltages," Revision 0 (July 1981), states, in part, as follows:

> The technical specifications shall include limiting conditions for operations, surveillance requirements, trip setpoints with minimum and maximum limits, and allowable values for

the second-level voltage protection sensors and associated time delay devices.

Based on the review of the above requirements, WCNOC has determined that the proposed change does not require any exemptions or relief from regulatory requirements, other than revising the TS as described, and does not affect conformance with any of the above noted regulatory requirements or criteria.

4.2 Precedent

No identical precedent was identified.

4.3 No Significant Hazards Consideration Determination

The proposed amendment request would revise Wolf Creek Generating Station (WCGS) Technical Specification (TS) Surveillance Requirement (SR) 3.3.5.3 regarding the degraded voltage (DV) and loss of voltage (LOV) relays Allowable Values (AV), nominal Trip Setpoints, and time delays. The proposed changes are the result of revised analyses in response to Non-Cited Violation (NCV) 05000482/2016007-01, "Inadequate Degraded Voltage Analyses of Class 1E Systems," and are based on the information in Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages," and Nuclear Energy Institute (NEI) 15-01, Revision 1, "An Analytical Approach for Establishing Degraded Voltage Relay (DVR) Settings."

The following specific TS changes are proposed to reflect the revised analysis in WCNOC Calculation XX-E-009-001-CN006, "System NB, NG, PG Under Voltage /Degraded Voltage."

- TS 3.3.5, "Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation"

SR 3.3.5.3a. is revised as follows:

Loss of voltage Allowable Value is revised from ≥ 82.5V to ≥ 90.0V and the associated time delay is revised from 1.0 +0.2, -0.5 seconds to ≥ 0.9 sec. and ≤ 1.15 sec.

Loss of voltage nominal Trip Setpoint is revised from 83V to 91.28V.

SR 3.3.5.3b. is revised as follows:

Degraded voltage Allowable Value is revised from ≥ 105.9V to ≥ 107.5V and the associated time delay is revised from 119 ± 11.6 sec. to ≥ 7.4 sec. and ≤ 8.5 sec.

Degraded voltage nominal Trip Setpoint is revised from 106.9V to 108.46V and the associated time delay is revised from 119 sec. to 8 sec.

Wolf Creek Nuclear Operating Corporation (WCNOC) 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 amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No

   The proposed change to the LOV and DV Functions allows the protection scheme to function as originally designed. This change will involve alteration of the nominal Trip Setpoints in the field and will also be reflected in revisions to the surveillance procedures. The proposed change does not affect the probability or consequences of any accident. Analysis was conducted and demonstrates that the proposed changes will allow the normally operating safety-related motors to not be damaged in the event of sustained degraded bus voltage during the time delay period prior to initiation of the first level LOV trip function. Therefore, these safety-related loads will be available to perform their design basis function should a loss-of-coolant accident (LOCA) occur concurrent with a loss-of-offsite power (LOOP) following the DV condition.

   The proposed changes do not adversely affect accident initiators or precursors, and do not alter the design assumptions, conditions, or configuration or the plant or the manner in which the plant is operated or maintained. The proposed changes ensure that the 4.16kV distribution system remains connected to the offsite power system when adequate offsite voltage is available and motor starting transients are considered. During an actual LOV condition, the LOV time delay will continue to isolate the 4.16kV distribution system from offsite power before the diesel generator (DG) is ready to assume the emergency loads, which is the limiting time basis for mitigating system responses to the accident.

   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 accident previously evaluated?

   Response: No

   The proposed change involves the DV and LOV relays AV, nominal Trip Setpoints, and time delays to satisfy existing design requirements. The proposed change does not introduce any changes or mechanisms that create the possibility of a new or different kind of accident. The proposed change does not install any new or different type of equipment, and installed equipment is not being operated in a new or different manner. No new effects on existing equipment are created nor are any new malfunctions introduced.

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

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

Response: No

The proposed changes to the DV and LOV relay AVs, nominal Trip Setpoints, and time delays continue to provide margin for the protection of equipment from sustained DV conditions. During an actual LOV condition, the LOV time delays will continue to isolate the 4.16kV distribution system from offsite power before the DG is ready to assume the emergency loads.

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

Based on the above evaluation, WCNOC concludes that the proposed amendment 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 Conclusions

In conclusion, 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.

5.0 ENVIRONMENTAL CONSIDERATION

WCNOC has evaluated the proposed amendment and has determined that the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amount of effluent that may be released offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment 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 environment impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

6.1 Letter from T. R. Farnholtz, USRNC, to WCNOC, "Wolf Creek Generating Station - Component Design Bases Inspection Report 05000482/2016007," June 10, 2016. (ADAMS Accession Number ML16162A105)

6.2 Regulatory Issue Summary (RIS) 2011-12, Revision 1, "Adequacy of Station Electric Distribution System Voltages," December 29, 2011. (ADAMS Accession No. ML113050583)

6.3 Nuclear Energy Institute (NEI) 15-01, Revision 1, "An Analytical Approach for Establishing Degraded Voltage Relay (DVR) Settings," November 2015. (ADAMS Accession No. ML18024A960)

6.4 IEEE Standard 741-1997, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generation."

6.5 NRC Draft Regulatory Guide DG-1141, "Setpoint for Safety-Related Instrumentation."

6.6 ISA-RP67.04.02-2010, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation," December 10, 2010.

6.7 WCNOC Design Guide DG-J-001, Revision 0, "Setpoint and Instrument Uncertainty Analysis Methodology for Wolf Creek Generating Station."

ATTACHMENT II

PROPOSED TECHNICAL SPECIFICATION CHANGES (MARK-UP)

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.3.5.1	Not Used.	
SR 3.3.5.2	------------------------------NOTE------------------------------ Verification of time delays is not required. --- Perform TADOT.	31 days
SR 3.3.5.3	Perform CHANNEL CALIBRATION with nominal Trip Setpoint and Allowable Value as follows: a. Loss of voltage Allowable Value ≥ ~~82.5V~~ 90.0V, 120V bus with a time delay of ~~1.8 + 0.2, -0.5 sec~~ ≥ 0.9 sec. and ≤ 1.15 sec.. Loss of voltage nominal Trip Setpoint ~~83V~~ 91.28V, 120V bus with a time delay of 1.0 sec. b. Degraded voltage Allowable Value ≥ ~~105.9V~~ 107.5V, 120V bus with a time delay of ~~119 ± 11.8 sec~~ ≥ 7.4 sec. and ≤ 8.5 sec.. Degraded voltage nominal Trip Setpoint ~~106.9V~~ 108.46V, 120V bus with a time delay of ~~119~~ 8 sec.	18 months
SR 3.3.5.4	Verify LOP DG Start ESF RESPONSE TIMES are within limits.	18 months on a STAGGERED TEST BASIS

ATTACHMENT III

REVISED TECHNICAL SPECIFICATION PAGES

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.3.5.1	Not Used.	
SR 3.3.5.2	-------------------------------NOTE------------------------------ Verification of time delays is not required. --- Perform TADOT.	 31 days
SR 3.3.5.3	Perform CHANNEL CALIBRATION with nominal Trip Setpoint and Allowable Value as follows: a. Loss of voltage Allowable Value ≥ 90.0V, 120V bus with a time delay of ≥ 0.9 sec. and ≤ 1.15 sec. Loss of voltage nominal Trip Setpoint 91.28V, 120V bus with a time delay of 1.0 sec. b. Degraded voltage Allowable Value ≥ 107.5V, 120V bus with a time delay of ≥ 7.4 and ≤ 8.5 sec. Degraded voltage nominal Trip Setpoint 108.46V, 120V bus with a time delay of 8.0 sec.	18 months
SR 3.3.5.4	Verify LOP DG Start ESF RESPONSE TIMES are within limits.	18 months on a STAGGERED TEST BASIS

ATTACHMENT IV
PROPOSED TS BASES CHANGES
(for information only)

B 3.3 INSTRUMENTATION

B 3.3.5 Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation

BASES

BACKGROUND

The DGs provide a source of emergency power when offsite power is either unavailable or is insufficiently stable to allow safe unit operation. There are two sets of undervoltage/degraded voltage protection circuits, one for each 4.16 kV NB system bus. Each set consists of a loss of voltage and degraded voltage Function. The undervoltage/degraded voltage protection circuits are described in USAR Section 8.3.1.1.3 (Ref. 1).

Upon recognition of a loss of voltage at the 4.16 kV ESF buses, a logic signal generated by load shedder and emergency load sequencer (LSELS) initiates the following:

a) Trip the 4.16 kV preferred normal and alternate bus feeder breakers to remove the deficient power source to protect Class 1E equipment from damage;

b) Shed all loads from the bus except the Class 1E 480 Vac load centers and centrifugal charging pumps to prepare the buses for re-energization by the LSELS; and

c) Generate an LOP DG start signal.

Upon detection of a degraded voltage condition, LSELS initiates a logic signal which serves only to trip the 4.16 kV ESF bus normal and alternate feeder breakers. The undervoltage relays detect an undervoltage condition and the same initiation signals as described above are actuated.

Four instantaneous undervoltage relays with an associated time delay are provided for each 4.16 kV Class 1E NB system bus for detecting a loss of bus voltage. The outputs are combined in a two-out-of-four logic to generate an LOP signal if the voltage is below approximately ~~70~~% for 1 second (nominal delay). The time delay prevents undesirable trips arising from transient undervoltage conditions.

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Four potential transformers provide input to four degraded voltage bistables with associated time delays for each 4.16 kV Class 1E system bus for detecting a sustained degraded voltage condition. Once the bistable has actuated, a timer in the LSELS circuitry provides an 8 second time delay to avoid false actuation on large motor starts other than an

The degraded voltage time delay with a safety injection signal (SIS) present is 8.0 seconds.

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BACKGROUND (continued)

RCP. There are four of these 8-second timers per bus, ~~one for each~~ degraded voltage channel. The bistable ~~outputs are~~ then combined in a two-out-of-four logic to ~~generate a~~ degraded voltage signal if the voltage is below approximately ~~90~~%. Once the two-out-of four logic is satisfied, contacts in the bus feeder breaker trip circuits closed to arm the tripping circuitry. If a ~~safety injection signal (SIS)~~ were to occur concurrently with or after the arming of the tripping circuitry, the bus feeder breaker would open ~~immediately~~, a bus undervoltage would be sensed, and a LOP signal would be generated. Should the degraded voltage condition occur in a non-accident condition (no SIS present), an additional ~~111~~ second time delay is provided. These time delays are specific to the feeder breakers (2 per bus). If the degraded voltage is not alleviated in the overall ~~119~~ seconds (nominal delay), the bus feeder breaker is tripped.

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OPERABILITY of LSELS is addressed in LCO 3.8.1, "AC Sources - Operating," And LCO 3.8.2, "AC Sources - Shutdown."

Trip Setpoints and Allowable Values

The Trip Setpoints used in the relays are based on References 1 and 2. The selection of these Trip Setpoints is such that adequate protection is provided when all sensor and processing time delays are taken into account.

The actual nominal Trip Setpoint entered into the relays is ~~normally~~ still more conservative than that required by the Allowable Value. The Trip Setpoints are the nominal value at which the bistables are set. Any bistable is considered to be properly adjusted when the "as left" value is within the two-sided tolerance band for channel accuracy. If the measured setpoint does not exceed the Allowable Value, the relay is considered OPERABLE.

Setpoints adjusted in accordance with the Allowable Value ensure that the consequences of accidents will be acceptable, provided the unit is operated from within the LCOs at the onset of the accident and that the equipment functions as designed.

Allowable Values and/or nominal Trip Setpoints are specified for each Function in SR 3.3.5.3. Nominal Trip Setpoints are also specified in the unit specific setpoint calculations. The nominal setpoints are selected to ensure that the setpoint measured by the surveillance procedure does not exceed the Allowable Value if the relay is performing as required. If the

BASES

BACKGROUND

Trip Setpoints and Allowable Values (continued)

measured setpoint does not exceed the Allowable Value, the relay is considered OPERABLE. Operation with a Trip Setpoint less conservative than the nominal Trip Setpoint, but within the Allowable Value, is acceptable provided that operation and testing is consistent with the assumptions of the setpoint calculation. Each Allowable Value and/or Trip Setpoint specified is more conservative than the analytical limit assumed in the transient and accident analyses in order to account for instrument uncertainties appropriate to the trip function.

APPLICABLE SAFETY ANALYSES

The LOP DG start instrumentation is required for the Engineered Safety Features (ESF) Systems to function in any accident with a loss of offsite power. Its design basis is that of the ESF Actuation System (ESFAS).

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 ESFAS actuation. The DG loading has been included in the delay time associated with each safety system component requiring DG supplied power following a loss of offsite power. The analyses assume a non-mechanistic DG loading, which does not explicitly account for each individual component of loss of power detection and subsequent actions.

The required channels of LOP DG start instrumentation, in conjunction with the ESF systems powered from the DGs, provide unit protection in the event of any of the analyzed accidents discussed in Reference 2, in which a loss of offsite power is assumed.

The delay times assumed in the safety analysis for the ESF equipment include the 12 second DG start delay, and the appropriate sequencing delay, if applicable. The response times for ESFAS actuated equipment in Bases Table B 3.3.2-2 include the appropriate DG loading and sequencing delay.

The LOP DG start instrumentation channels satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO for LOP DG start instrumentation requires that four channels per 4.16 kV NB system bus of both the loss of voltage and degraded voltage Functions shall be OPERABLE in MODES 1, 2, 3, and 4 when the LOP DG start instrumentation supports safety systems associated with the ESFAS. In MODES 5 and 6, the four channels must be OPERABLE

BASES

ACTIONS

B.1 (continued)

MODES 1 - 4 and takes into account the low probability of an event requiring an LOP start occurring during this interval. When the associated DG is required to be OPERABLE in MODES 5 and 6, the Completion Time of Required Action C.1 in LCO 3.8.2, "AC Sources - Shutdown," is consistent with the required times for actions requiring prompt action.

SURVEILLANCE REQUIREMENTS

SR 3.3.5.1

Not Used.

SR 3.3.5.2

SR 3.3.5.2 is the performance of a TADOT. This test is performed every 31 days. The test checks trip devices that provide actuation signals directly, bypassing the analog process control equipment. For these tests, the relay Trip Setpoints are verified and adjusted as necessary. The SR is modified by a Note that excludes verification of time delays. Testing of the time delay relays is performed as part of the CHANNEL CALIBRATION (SR 3.3.5.3). The Frequency is based on the known reliability of the relays and controls and the multichannel redundancy available, and has been shown to be acceptable through operating experience. If the measured setpoint does not exceed the Allowable Value, the trip device is considered OPERABLE.

SR 3.3.5.3

SR 3.3.5.3 is the performance of a CHANNEL CALIBRATION.

A CHANNEL CALIBRATION is performed every 18 months, or approximately at every refueling. CHANNEL CALIBRATION is a complete check of the instrument loop, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy.

for the degraded voltage Function,

Calculation XX-E-009 (Ref. 3) calculates the undervoltage/degraded voltage setpoints for the NB/NG relays. The calculation also ensures adequate voltage will be present at the end use loads under minimum switchyard voltage and maximum accident loading. Calculation XX-E-009 identifies that the minimum acceptable voltage for the ~~NB01 bus is 3707 V (105.9 V after PT) and for the NB02 bus is 3704 V (105.9 V after PT)~~.

NB01 and NB02 buses is 3756.8V. This provides additional margin below the TS Allowable Value bus voltage of 3773.8V (includes Potential Transformer error) or 107.5V at the relay (excludes Potential Transformer error). For the loss of voltage Function, the minimum acceptable voltage is 3150.4V. This provides additional margin below the TS Allowable Value bus voltage of 3159.5V (includes Potential Transformer error) or 90.0V at the relay (excludes Potential Transformer error).

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.5.3 (continued)

The Frequency of 18 months is based on operating experience and consistency with the typical industry refueling cycle and is justified by the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

SR 3.3.5.4

SR 3.3.5.4 is the performance of the required response time verification every 18 months on a STAGGERED TEST BASIS. This SR ~~measures~~ the total response time of the undervoltage relays, logic circuitry an~~d EDG~~ start time. Response time verification acceptance criteria are:

INITIATING SIGNAL AND FUNCTION	RESPONSE TIME
Loss of Power	
a. 4kV Bus Undervoltage - Loss of Voltage	≤ 14 seconds
b. 4kV Bus Undervoltage - Grid Degraded Voltage	≤ ~~144~~ 78 seconds

(new para.)
The Grid Degraded Voltage Function total response time is without a SIS present.

Each verification shall include at least one train such that both trains are verified at least once per 36 months.

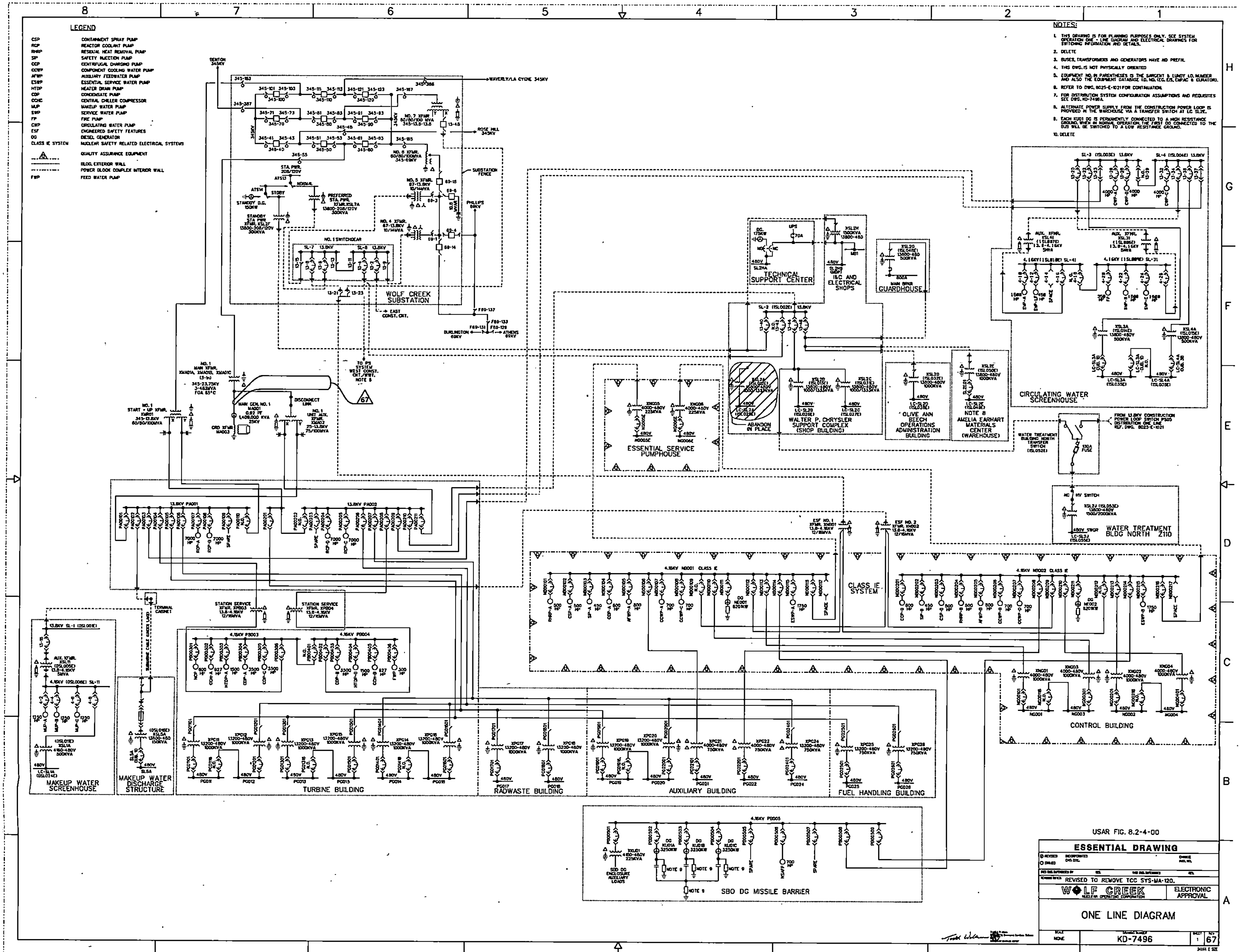
REFERENCES

1. USAR, Section 8.3.
2. USAR, Chapter 15.
3. Calculation XX-E-009, "System NB, NG, PG Undervoltage/Degraded Voltage Relay Setpoints."

Enclosure I

Drawing KD-7496, "One Line Diagram"

(1 page)


LEGEND
CSP CONTAINMENT SPRAY PUMP
RCP REACTOR COOLANT PUMP
RHRP RESIDUAL HEAT REMOVAL PUMP
SIP SAFETY INJECTION PUMP
CCP CENTRIFUGAL CHARGING PUMP
CCWP COMPONENT COOLING WATER PUMP
AFWP AUXILIARY FEEDWATER PUMP
ESWP ESSENTIAL SERVICE WATER PUMP
HTDP HEATER DRAIN PUMP
CDP CONDENSATE PUMP
CCHC CENTRAL CHILLER COMPRESSOR
MUP MAKEUP WATER PUMP
SWP SERVICE WATER PUMP
FP FIRE PUMP
CWP CIRCULATING WATER PUMP
ESF ENGINEERED SAFETY FEATURES
DG DIESEL GENERATOR
CLASS IE SYSTEM NUCLEAR SAFETY RELATED ELECTRICAL SYSTEMS
QUALITY ASSURANCE EQUIPMENT
BLDG. EXTERIOR WALL
POWER BLOCK COMPLEX INTERIOR WALL
FWP FEED WATER PUMP
NOTES:
1. THIS DRAWING IS FOR PLANNING PURPOSES ONLY. SEE SYSTEM OPERATION ONE - LINE DIAGRAM AND ELECTRICAL DRAWINGS FOR SWITCHING INFORMATION AND DETAILS.
2. DELETE
3. BUSES, TRANSFORMERS AND GENERATORS HAVE NO PREFIX
4. THIS DWG. IS NOT PHYSICALLY ORIENTED
5. EQUIPMENT NO. IN PARENTHESES IS THE SARGENT & LUNDY I.D. NUMBER AND ALSO THE EQUIPMENT DATABASE I.D. NO. (EG. EDS, EMPAC & CURATOR).
6. REFER TO DWG. 8025-E-1021 FOR CONTINUATION.
7. FOR DISTRIBUTION SYSTEM CONFIGURATION ASSUMPTIONS AND REQUISITES SEE DWG. KD-7496A.
8. ALTERNATE POWER SUPPLY FROM THE CONSTRUCTION POWER LOOP IS PROVIDED IN THE WAREHOUSE VIA A TRANSFER SWITCH AT LC SL2E.
9. EACH KU01 DG IS PERMANENTLY CONNECTED TO A HIGH RESISTANCE GROUND. WHEN IN NORMAL OPERATION, THE FIRST DG CONNECTED TO THE BUS WILL BE SWITCHED TO A LOW RESISTANCE GROUND.
10. DELETE
WOLF CREEK SUBSTATION
TECHNICAL SUPPORT CENTER
I&C AND ELECTRICAL SHOPS
GUARDHOUSE
CIRCULATING WATER SCREENHOUSE
ESSENTIAL SERVICE PUMPHOUSE
ABANDON IN PLACE
WALTER P. CHRYSLER SUPPORT COMPLEX (SHOP BUILDING)
OLIVE ANN BEECH OPERATIONS ADMINISTRATION BUILDING
AMELIA EARHART MATERIALS CENTER (WAREHOUSE)
WATER TREATMENT BLDG NORTH Z110
CLASS IE SYSTEM
CONTROL BUILDING
MAKEUP WATER SCREENHOUSE
MAKEUP WATER DISCHARGE STRUCTURE
TURBINE BUILDING
RADWASTE BUILDING
AUXILIARY BUILDING
FUEL HANDLING BUILDING
SBO DG MISSILE BARRIER
USAR FIG. 8.2-4-00
ESSENTIAL DRAWING
REVISED TO REMOVE TCC SYS-MA-120.
WOLF CREEK NUCLEAR OPERATING CORPORATION
ELECTRONIC APPROVAL
ONE LINE DIAGRAM
SCALE NONE
KD-7496
SHEET 1
REV 67
34X44 E SIZE