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L-15-117

10 CFR 50.90

ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3
License Amendment Request to Revise Emergency Diesel Generator Minimum Voltage and Frequency Surveillance Requirements

Pursuant to 10 CFR 50.90, FirstEnergy Nuclear Operating Company (FENOC) hereby requests to amend the operating license for the Davis-Besse Nuclear Power Station. The proposed amendment would revise Technical Specification 3.8.1, "AC Sources-Operating" to change certain minimum voltage and frequency acceptance criteria for emergency diesel generator surveillance testing. The changes are necessary to address non-conservatism in the subject technical specification surveillance testing acceptance criteria.

The non-conservative acceptance criteria in Technical Specification 3.8.1 are currently administratively controlled under the provisions of Nuclear Regulatory Commission Administrative Letter (AL) 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety," to assure that plant safety is maintained. This license amendment request is submitted in accordance with the guidance in AL 98-10 as a required license amendment request to resolve a non-conservative technical specification. As such, this is not a "voluntary request from a licensee to change its licensing basis" and should not be subject to "forward fit" considerations.

The enclosure provides an evaluation of the proposed amendment. Attachments to the evaluation provide a copy of the existing technical specification pages and technical specification bases pages marked up to reflect the proposed amendment, re-typed technical specification pages with the proposed amendment incorporated, and information related to emergency diesel generator analyses.

Approval of the proposed license amendment is requested by April of 2016, and the amendment would be implemented within 60 days of approval. There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-315-6810.

I declare under penalty of perjury that the foregoing is true and correct. Executed on April 1st, 2015.

Sincerely,

Raymond A. Lieb

Enclosure:
FENOC Evaluation of the Proposed Amendment

cc: NRC Region III Administrator
NRC Project Manager
NRC Resident Inspector
Executive Director, Ohio Emergency Management Agency,
State of Ohio (NRC Liaison)
Utility Radiological Safety Board

## 1. SUMMARY DESCRIPTION

This FirstEnergy Nuclear Operating Company (FENOC) evaluation supports a request to amend Operating License NPF-3 for the Davis-Besse Nuclear Power Station (hereafter referred to as Davis-Besse). The proposed amendment would revise Operating License NPF-3, Appendix A, Technical Specification 3.8.1, "AC Sources - Operating" by increasing the minimum voltage and frequency acceptance criteria for emergency diesel generator (EDG) testing specified in surveillance requirements 3.8.1.8.a and 3.8.1.14.a, and the minimum steady state voltage specified in surveillance requirements 3.8.1.2, 3.8.1.8.b, 3.8.1.11.c.3, 3.8.1.14.b, and 3.8.1.15.c.3.

The minimum voltage and frequency specified for EDG start testing in surveillance requirements 3.8.1.8.a and 3.8.1.14.a would change from greater than or equal to (≥) 4031 volts (V) to ≥ 4070 V, and from ≥ 58.8 Hertz (Hz) to ≥ 59.5 Hz, respectively. The minimum steady state voltage specified in surveillance requirements 3.8.1.2, 3.8.1.8.b, 3.8.1.11.c.3, 3.8.1.14.b, and 3.8.1.15.c.3 would change from ≥ 3744 V to ≥ 4088 V.

An increased minimum voltage is needed in surveillance requirements 3.8.1.8.a and 3.8.1.14.a to confirm sufficient minimum voltage is achieved to satisfy the EDG output circuit breaker closure permissive. Based in part on there being no frequency requirement for the EDG output circuit breaker closure permissive, the increased minimum frequency value proposed for surveillance requirements 3.8.1.8.a and 3.8.1.14.a was chosen so that the value is consistent with the minimum steady state frequency requirement. The increased minimum steady state voltage proposed for surveillance requirements 3.8.1.2, 3.8.1.8.b, 3.8.1.11.c.3, 3.8.1.14.b, and 3.8.1.15.c.3 would provide assurance that during emergency diesel generator loading, the voltage response recommendations of Safety Guide 9, “Selection of Diesel Generator Set Capacity for Standby Power Supplies,” dated March 10, 1971 (Accession No. ML12305A251), can be satisfied.

## 2. DETAILED DESCRIPTION

During a review of operating experience, FENOC identified a potentially non-conservative technical specification. A subsequent evaluation demonstrated that the minimum voltage limit in surveillance requirements 3.8.1.8.a and 3.8.1.14.a was insufficient to ensure automatic closure of the EDG output circuit breaker. It was also determined that the minimum steady state voltage specified in the EDG surveillance requirements should be increased. These findings are documented in FENOC’s corrective action program. It was also determined that the minimum required frequency for EDG operability in surveillance requirements 3.8.1.8.a and 3.8.1.14.a should be increased to be consistent with the minimum steady state frequency requirement.

The EDG minimum voltage and frequency acceptance criterion achieved in less than or equal to (≤) 10 seconds, as specified in surveillance requirements 3.8.1.8.a and 3.8.1.14.a, would be changed from ≥ 4031 V to ≥ 4070 V and from ≥ 58.8 Hz to ≥ 59.5 Hz, as shown underlined below. No change is proposed to the specified time interval of ≤ 10 seconds.

Subject: License Amendment Request to Revise Emergency Diesel Generator Voltage and Frequency Surveillance Requirements in Technical Specification 3.8.1, "AC Sources – Operating"

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Surveillance Requirement 3.8.1.8.a - Verify each EDG starts from standby condition and achieves:

a. In ≤ 10 seconds, voltage ≥ 4070 V and frequency ≥ 59.5 Hz; and

Surveillance Requirement 3.8.1.14.a - Verify each EDG starts and achieves:

a. In ≤ 10 seconds, voltage ≥ 4070 V and frequency ≥ 59.5 Hz; and

The EDG minimum steady state voltage acceptance criterion, as specified in surveillance requirements 3.8.1.2, 3.8.1.8.b, 3.8.1.11.c.3, 3.8.1.14.b, and 3.8.1.15.c.3, would be changed from ≥ 3744 V to ≥ 4088 V, as shown underlined below. No change is proposed to the specified maximum steady state voltage or steady state frequency values.

Surveillance Requirement 3.8.1.2 - Verify each EDG starts from standby condition and achieves steady state voltage ≥ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz.

Surveillance Requirement 3.8.1.8.b - Verify each EDG starts from standby condition and achieves:

b. Steady state voltage ≥ 4088 V and ≤ 4400 V,
and frequency ≥ 59.5 Hz and ≤ 60.5 Hz.

Surveillance Requirement 3.8.1.11.c.3 - Verify on actual or simulated loss of offsite power signal:

c. EDG auto-starts from standby condition and:

3. Maintains steady-state voltage ≥ 4088 V and ≤ 4400 V;

Surveillance Requirement 3.8.1.14.b - Verify each EDG starts and achieves:

b. Steady state voltage ≥ 4088 V and ≤ 4400 V,
and frequency ≥ 59.5 Hz and ≤ 60.5 Hz.

Surveillance Requirement 3.8.1.15.c.3 - Verify on actual or simulated loss of offsite power signal in conjunction with an actual or simulated SFAS actuation signal:

c. EDG auto-starts from standby condition and:

3. Achieves steady-state voltage ≥ 4088 V and ≤ 4400 V;

The proposed technical specification changes are shown in Attachment A. Attachment A shows deletions with a strike-through and insertions underlined, with a vertical line in the margin showing the area of change. Retyped technical specification pages are provided for information in Attachment B. Proposed Technical Specification Bases changes are shown in Attachment C, for information only.

Updated Safety Analysis Report, Subsection 8.3.1.1.4.1, “Emergency Diesel Generators,” states that two redundant EDG units, one connected to essential 4160 V bus C1 and the other connected to essential 4160 V bus D1, are provided as onsite standby power sources to supply their respective essential buses upon loss of the normal and reserve power sources.

These EDGs are each rated at 2600 kilowatts (kW) continuous, 0.8 assumed power factor, and 900 revolutions per minute (nominal). The 2,000 hour rating of each EDG is 2838 kW. The 30 minute rating of each EDG is 3035 kW. The EDGs are designed to provide alternating current (AC) power at 4160 V on the emergency bus.

The EDG is capable of attaining rated frequency and voltage approximately 10 seconds after the engine start signal is received.

Each of the two emergency diesel generators has the capability to:

- Supply continuously the sum of the loads on the essential 4160 V bus needed to be powered at any one time.
- Start and accelerate to rated speed in the required sequence its dedicated engineered safety features loads. At no time during the loading sequence, will the frequency and voltage decrease to less than 95 percent of nominal (0.95 x 60 Hz = 57 Hz) and 75 percent of nominal (0.75 x 4160 V = 3120 V), respectively, except that during the first step in the required loading sequence there may be a voltage dip below 75 percent of nominal lasting for a few cycles due to the essential unit substation transformer excitation inrush.

## 3. TECHNICAL EVALUATION

### 3.1 Minimum EDG Starting Voltage and Frequency

Accident analyses credit the loading of the EDG, following a postulated loss of offsite power coincident with a loss of coolant accident. The actual EDG start has historically been associated with the safety features actuation system activation. The EDG loading has been included in the delay time associated with each safety system component requiring EDG supplied power following a loss of offsite power. This delay time includes contributions from the EDG start, EDG loading, and component actuation. The delay times assumed in the safety analysis for the engineered safety features equipment include the 10 second EDG start delay and, if applicable, the appropriate load sequencing delay.

Surveillance requirement 3.8.1.8.a demonstrates that the EDG can start from standby conditions and achieve the required voltage and frequency within 10 seconds. Surveillance requirement 3.8.1.14.a demonstrates that the diesel engine can restart from a hot condition (such as subsequent to shutdown from normal surveillances), and achieve the required voltage and frequency within 10 seconds.

The proposed change would modify the EDG minimum voltage and frequency acceptance criteria for surveillance requirements 3.8.1.8.a and 3.8.1.14.a. The existing minimum voltage acceptance criterion of ≥ 4031 V will be increased to a more restrictive minimum voltage of ≥ 4070 V. The minimum acceptable voltage of 4070 V was determined based on the bus voltage required by the EDG output circuit breaker voltage permissive relay circuitry. That is, the voltage required for the EDG output circuit breaker to close.

The existing minimum frequency acceptance criterion in surveillance requirements 3.8.1.8.a and 3.8.1.14.a of ≥ 58.8 Hz will be increased to a more restrictive minimum frequency of ≥ 59.5 Hz. The revised minimum frequency value to be specified in surveillance requirements 3.8.1.8.a and 3.8.1.14.a was chosen so that the value is consistent with the minimum steady state frequency requirement. The minimum steady state output frequency of 59.5 Hz is the minimum EDG frequency value evaluated for plant-specific accident analyses, and is demonstrated by the EDG transient analysis to satisfy Safety Guide 9 transient frequency criteria.

In summary, the proposed higher EDG minimum starting voltage and frequency acceptance criteria demonstrate operability of the EDG by confirming adequate voltage and frequency is achieved in ≤ 10 seconds. The surveillance requirements demonstrate that the EDG starts and achieves the necessary voltage for the EDG output circuit breaker to close and a frequency consistent with the minimum steady state frequency requirement.

### 3.2 Steady State Voltage and Frequency

Surveillance requirements 3.8.1.2 and 3.8.1.8 help to ensure the availability of the standby electrical power supply to mitigate design basis accidents and transients, and to maintain the unit in a safe shutdown condition. For the purposes of Surveillance requirements 3.8.1.2 and 3.8.1.8 testing, the EDGs are started from standby conditions. Surveillance requirement 3.8.1.11 demonstrates the as designed operation of the standby power sources during loss of the offsite source. Surveillance requirement 3.8.1.14 demonstrates that the diesel engine can restart from a hot condition, such as subsequent to shutdown from normal surveillances, and achieve the required voltage and frequency within 10 seconds. Surveillance requirement 3.8.1.15 demonstrates the EDG operation during a loss of offsite power actuation test signal in conjunction with a safety features actuation system actuation signal. For this test, the EDG loading logic includes both the load sequencer and the individual time delay relays for the makeup pumps.

The existing EDG minimum steady state voltage acceptance criteria in surveillance requirements 3.8.1.2, 3.8.1.8.b, 3.8.1.11.c.3, 3.8.1.14.b, and 3.8.1.15.c.3 would be increased to a more restrictive minimum voltage of ≥ 4088 V. The more restrictive minimum steady state voltage provides assurance that during EDG loading, the voltage response recommendations of Safety Guide 9 can be satisfied.

No changes are proposed to the maximum steady state voltage or minimum and maximum steady state frequency values specified in surveillance requirements 3.8.1.2, 3.8.1.8.b, 3.8.1.11.c.3, 3.8.1.14.b, and 3.8.1.15.c.3.

In summary, the proposed higher EDG minimum steady state voltage and current minimum steady state frequency acceptance criteria demonstrate operability of the EDG by confirming adequate steady state voltage and frequency is achieved. The surveillance requirements demonstrate that during the loading transient, the EDG achieves the minimum steady state voltage and frequency necessary to provide

assurance that the voltage and frequency response recommendations of Safety Guide 9 can be satisfied.

### 3.3 AC Power System Analysis

The AC Power System Analysis evaluates the Davis-Besse AC power system when powered from the offsite power system via the start-up transformer(s) or via the unit auxiliary transformer. The analysis provides safety-related motor terminal voltages during steady state loading and motor starting conditions. Available system loading and bus operating voltages are also calculated. The analysis includes various plant operating conditions and system configurations for both normal and accident conditions. This analysis and its associated inputs provide the basis for equipment operating characteristics. Section 3.0, “Acceptance Criteria,” of the AC Power System Analysis (Attachment D) summarizes the acceptable operating limits for plant equipment (except motor operated valves) that are energized via the AC power system. The analysis also determines the maximum steady state loading for the EDGs.

Attachment 3, tables 1A, 1B, and 1C of the AC Power System Analysis, provide the minimum and maximum voltage requirements of equipment powered from each bus (bus voltage acceptance criteria). Minimum motor control center voltage results, minimum and maximum bus voltage results for certain load flow analyses, transient minimum bus voltage results for motor starting analyses, and maximum transformer voltage results are shown in Attachment 3 tables 2 through 10. Voltage analysis results and bus voltage acceptance criteria are presented in tables 3 through 9. Tables in Attachment 3 of the analysis are provided here as Attachment E. The impact of voltage variation on motor operated valve performance is discussed below.

### 3.4 EDG Frequency and Voltage

Regulatory Position C.4 of Safety Guide 9 indicates that at no time during the loading sequence should the frequency decrease to less than 95 percent of nominal [57 Hz]. This regulatory position also indicates that frequency should be restored to within 2 percent of nominal (98 percent of 60 Hz or 58.8 Hz) in less than 40 percent of each load sequence time interval. There is no frequency requirement associated with the EDG output circuit breaker closure permissive. As such, the revised Technical Specification surveillance requirements 3.8.1.8.a and 3.8.1.14.a minimum frequency acceptance criterion of 59.5 Hz was chosen to ensure Safety Guide 9 criteria will be met and to align the starting frequency requirement with the steady state frequency requirement. Surveillance requirements in 3.8.1.8.b and 3.8.1.14.b are used to demonstrate that the EDG can achieve the specified steady state voltage and frequency. A transient analysis computer model was used to analyze the voltage and frequency response of the Davis-Besse EDGs to the load sequence associated with the design basis loss of coolant accident with loss of offsite power. The transient frequency and voltage response is evaluated while the EDG frequency operates at its minimum and maximum steady state frequency setpoints (59.5 Hz and 60.5 Hz) and the EDG voltage setpoint is at its minimum allowable voltage (4088 V) to satisfy the Safety Guide 9 regulatory position regarding voltage and frequency response. The analysis showed that Davis-Besse EDGs are capable of starting their dedicated engineered safety features loads in the

required sequence while meeting the minimum voltage and frequency recommendations of Safety Guide 9 for the loading sequence and each load sequence time interval.

Regulatory Position C.4 of Safety Guide 9 also indicates that voltage should be restored to within 10 percent of nominal in less than 40 percent of each load sequence time interval. Davis-Besse Technical Specification surveillance requirements currently require that the EDG achieve a minimum steady state voltage of at least 3744 V (within 10 percent of the nominal 4160 V). However, an EDG steady state voltage of 3744 V cannot be demonstrated to provide adequate voltage for starting safety-related equipment during EDG design basis event sequencing. The EDG transient response calculation shows that with a minimum voltage setpoint of 4088 V, the EDG voltage can recover to within the Safety Guide 9 design criteria of 10 percent of nominal within 40 percent of each load sequence time interval. The calculation also shows that a steady state voltage of 3744 V is sufficient to continuously operate essential equipment after a design basis event.

The AC Power System Analysis, the EDG transient analysis, and their associated inputs demonstrate that the EDG loading is within the capabilities of the EDG when pumps are running at their maximum postulated loading conditions and the EDG is operating at its minimum and maximum steady state frequency and minimum voltage limits.

The frequency and voltage variation within the limits of Safety Guide 9 criteria have been evaluated for their impact on EDG load performance (excluding motor operated valves, which are addressed separately as described below). The AC Power System Analysis determines the maximum EDG load per sequence step and accounts for loading scenarios where pumps may be operating at run-out conditions. The analysis addresses the impact of voltage variation while the postulated loads operate between 4200 V and 4250 V. The voltage variation is based on the EDG voltage regulator settings. The EDG loading analyses are performed with the voltage regulator at its maximum setting (4250 V). The analysis also addresses the impact of frequency variation on EDG loading while individual loads operate at 61.2 Hz. In the analysis, this frequency is the maximum expected recovery frequency during transient loading of the EDG.

Under-frequency and under-voltage in the AC system due to variability in the EDG start and load conditions could lead to increased motor operated valve stroke times. The frequency and voltage variation within the limits of Safety Guide 9 criteria have been evaluated for their impact on motor operated valve performance. Based on Reliance Electric Action Guide, Table A, (Attachment F) the voltage variation has a minimal impact on motor speed, so a penalty was not applied. The Davis-Besse inservice test program document, provided in Attachment G, accounts for the impact of frequency variation on stroke time for the listed motor operated valves. The title of the document is “ISTB3, Pump and Valve Basis Document, Volume III, Stroke Time Basis.”

An EDG transient loading analysis based on equipment operability limits was also performed. This analysis shows that the minimum EDG voltage setpoint (3850 V)

required to maintain adequate starting and steady state voltage is lower than the voltage values proposed for Technical Specification surveillance requirements. That is, 3850 V is lower than the EDG output breaker closure permissive voltage (4070 V) and lower than the minimum voltage setpoint (4088 V) required to satisfy Safety Guide 9 criteria. In determining the minimum EDG terminal voltage required to maintain adequate starting and steady state voltage, the EDG transient loading analysis considered a conservative system frequency of 61.2 Hz, as this would result in higher motor load and a lower EDG terminal voltage. The use of the 61.2 Hz system frequency bounds the steady state frequency value of 60.5 Hz. The allowable EDG steady state frequency required for individual components shall be maintained within 0.5 Hz of 60 Hz in accordance with the Davis-Besse Technical Specifications.

The maximum steady state EDG output voltage of 4400 V specified in Davis-Besse Technical Specifications is equal to the maximum steady state operating voltage specified for 4000 V rated motors. This ensures that for a lightly loaded distribution system, the voltage at the terminals of 4000 V motors is no more than the maximum rated operating voltages. Evaluation of the maximum EDG steady state loading at the maximum voltage setpoint of 4400 V and the maximum frequency setpoint of 61.2 HZ shows that loading results are bound by the EDG steady state loading limits. Operating the EDG at the maximum steady state output voltage of 4400 V in conjunction with a large-load rejection transient results in transient voltages less than or equal to the EDG overvoltage alarm setpoint. The EDG overvoltage alarm setpoint (4550 V) is set to bound the maximum circuit breaker ratings and the maximum voltage ratings for the essential buses. The large-load rejection transient evaluation inputs and methodology are discussed in Attachment H, “Operability Limits for EDG Voltage and Frequency During Transient Loading.”

Davis-Besse does not have a Technical Specification surveillance requirement for EDG full load reject testing, and the EDG is not routinely subjected to a full-load rejection transient. However, analysis shows that the transient results in voltages less than the EDG maximum test voltage (9320 V) and voltage recovers to the EDG setpoint of 4400 V within 60 seconds.

### 3.5 Degraded Voltage and Loss of Voltage Relays

Relays with time delays are provided on each 4160 V essential bus for the purpose of detecting a sustained under-voltage condition (degraded voltage condition). The degraded voltage relay pickup setpoint and time delays are set to ensure the offsite source supplies sufficient voltage to safety-related equipment so that they perform their function in the event of a design basis event. The degraded voltage dropout, pickup, and time delay setpoints ensure the busses are not inappropriately disconnected from the offsite source. The degraded voltage relays automatically initiate disconnection of the offsite power source whenever the voltage setpoint and time delay have been exceeded.

Relays with time delays are provided on each 4160 V essential bus for the purpose of detecting a loss of voltage condition. Disconnecting the offsite power source causes the loss of voltage relays to actuate. The loss of voltage relays automatically initiate

disconnection of the offsite power source, load shed the bus, and start the diesel generator whenever the voltage setpoint and time delay have been exceeded.

The analytical limit for the degraded voltage relay dropout/trip setpoint is 3700 V. Post-accident loads are required to have adequate voltage for continuous operation while the essential (safeguards) 4160 V buses operate just above the degraded voltage relay analytical limit dropout setpoint. Once actuated, in the event of a loss of offsite power, the degraded voltage relays do not have to be manually reset to sequentially load the EDGs.

## 4. REGULATORY EVALUATION

FirstEnergy Nuclear Operating Company proposes to amend Davis-Besse Nuclear Power Station Operating License NPF-3, Appendix A, Technical Specification 3.8.1, “AC Sources – Operating." The proposed amendment would revised certain emergency diesel generator (EDG) surveillance test acceptance criteria by increasing the minimum voltage and frequency to be achieved in less than or equal to 10 seconds, and increasing the minimum steady state voltage to be achieved.

The proposed surveillance requirement changes would address non-conservative minimum voltage acceptance criteria for EDG starting and steady state operation, which were identified during a review of operating experience and subsequent evaluation. The revised surveillance requirements help to ensure the availability of the standby electrical power supply to mitigate design basis accidents and transients, and to maintain the unit in a safe shutdown condition.

The change to the minimum voltage acceptance criterion for EDG starting confirms sufficient minimum voltage to satisfy the EDG output circuit breaker closure permissive. The minimum frequency acceptance criterion for EDG starting was chosen so that the value is consistent with the minimum steady state frequency requirement. The minimum steady state output frequency of 59.5 Hz is the minimum EDG frequency value evaluated for plant-specific accident analyses, and is demonstrated by the EDG transient analysis to satisfy Safety Guide 9 transient frequency criteria. The more restrictive minimum steady state output voltage acceptance criterion ensures that during EDG loading, the voltage response criteria of Safety Guide 9 are satisfied.

### 4.1 Significant Hazards Consideration

FirstEnergy Nuclear Operating Company 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 amendment would provide more restrictive acceptance criteria for certain EDG technical specification surveillance tests. The proposed acceptance criteria changes would help to ensure the EDGs are capable of carrying the electrical loading assumed in the safety analyses that take credit for the operation of the EDGs, would not affect the capability of other structures, systems, and components to perform their design function, and would not increase the likelihood of a malfunction.

Therefore, the proposed amendment 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 changes would provide more restrictive acceptance criteria to be applied to existing technical specification surveillance tests that demonstrate the capability of the facility EDGs to perform their design function. The proposed acceptance criteria changes would not create any new failure mechanisms, malfunctions, or accident initiators not considered in the design and licensing bases.

   Therefore, the possibility of a new or different kind of accident from any previously evaluated has not been created.

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

   Response: No.

   The proposed EDG surveillance requirement changes involve increased minimum voltage and frequency test acceptance criteria. The conduct of surveillance tests on safety related plant equipment is a means of assuring that the equipment is capable of maintaining the margin of safety established in the safety analyses for the facility. The proposed amendment does not affect EDG performance as described in the design basis analyses, including the capability for the EDG to attain and maintain required voltage and frequency for accepting and supporting plant safety loads should an EDG start signal be received. The proposed amendment does not introduce changes to limits established in the accident analysis.

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

Based on the above, FirstEnergy Nuclear Operating Company concludes that the proposed amendment does not involve a significant hazards consideration under the

standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

## 4.2 Applicable Regulatory Requirements/Criteria

Changes described in the license amendment request comply with the following regulations and continue to meet the intent of the applicable General Design Criteria.

10 CFR Part 50.36, “Technical specifications,” requires in paragraph 50.36(c)(2)(ii)(C) *Criterion 3* that a technical specification limiting condition for operation be established for a structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. The alternating current electrical power sources (AC Sources - Operating) limiting condition for operation (LCO 3.8.1) satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

10 CFR Part 50.36, “Technical specifications,” requires in paragraph 50.36(c)(3) that technical specifications include surveillance requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met. The technical specifications will continue to include surveillance requirements relating to emergency diesel generator testing to assure the components are maintained, facility operation will be within safety limits, and the limiting conditions for emergency diesel generator operation will be met.

10 CFR 50, Appendix A, General Design Criterion (GDC) 17, “Electric power systems,” ensures an onsite electric power system is provided to permit functioning of structures, systems, and components important to safety. As required by GDC 17, the design of the alternating current electrical power system provides independence and redundancy to ensure an available source of power to the engineered safety features systems.

Safety Guide 9, “Selection of Diesel Generator Set Capacity For Standby Power Supplies,” describes an acceptable basis for the selection of diesel generator sets of sufficient capacity and margin to implement General Design Criterion 17. The system electrical design as described in Updated Safety Analysis Report Subsection 8.3.1.1.4.1, “Emergency Diesel Generators,” incorporates the provisions of this safety guide.

GDC 18, “Inspection and testing of electric power systems,” ensures electric power systems important to safety are designed to permit appropriate periodic inspection and testing of important areas and features. The alternating current electrical systems are designed to permit testing and inspection of the operability and functional performance of the components of the system as well as the operability of the system as a whole. Essential and safety-related systems are provided with complete redundancy to permit testing of one system while the redundant system is performing the same function. This ensures no interruption of station operation.

The existing EDG transient analysis demonstrates that the EDGs are capable of starting their dedicated engineered safety features loads in the required sequence. The applicable technical specification surveillances will continue to verify the capability of the EDG to start and accelerate to the required speed and voltage within 10 seconds. Maintenance and monitoring of the EDG will be maintained in accordance with the Maintenance Rule (10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants") and the Mitigating System Performance Index Process.

### 4.3 Conclusions

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. ENVIRONMENTAL CONSIDERATION

The proposed amendment 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 amendment 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 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 environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

**Attachment A**

**Proposed Technical Specification Changes (Mark-up)**

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The following is a list of the affected pages.

| |
|---|
| 3.8.1-5 |
| 3.8.1-6 |
| 3.8.1-9 |
| 3.8.1-11 |
| 3.8.1-12 |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.1 | Verify correct breaker alignment and indicated power availability for each offsite circuit. | 7 days |
| SR 3.8.1.2 | ----------NOTES----------<br>1. All EDG starts may be preceded by an engine prelube period and followed by a warmup period prior to loading.<br><br>2. A modified EDG start involving idling and/or gradual acceleration to synchronous speed may be used for this SR as recommended by the manufacturer. When modified start procedures are not used, the time, voltage, and frequency tolerances of SR 3.8.1.8 must be met.<br>----------<br><br>Verify each EDG starts from standby conditions and achieves steady state voltage ≥ ~~3744~~ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz. | 31 days |
| SR 3.8.1.3 | ----------NOTES----------<br>1. EDG loadings may include gradual loading as recommended by the manufacturer.<br><br>2. Momentary transients outside the load range do not invalidate this test.<br><br>3. This Surveillance shall be conducted on only one EDG at a time.<br><br>4. This SR shall be preceded by and immediately follow, without shutdown, a successful performance of SR 3.8.1.2 or SR 3.8.1.8.<br>----------<br><br>Verify each EDG is synchronized and loaded and operates for ≥ 60 minutes at a load ≥ 2340 kW and ≤ 2600 kW. | 31 days |
| SR 3.8.1.4 | Verify each day tank contains ≥ 4000 gal of fuel oil. | 31 days |

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.5 | Check for and remove accumulated water from each day tank. | 31 days |
| SR 3.8.1.6 | Verify interval between each sequenced load block is within ± 10% of design interval for each emergency load sequencer and each emergency time delay relay. | 31 days |
| SR 3.8.1.7 | Verify the fuel oil transfer system operates to transfer fuel oil from fuel oil storage tank to the day tank. | 92 days |
| SR 3.8.1.8 | ----------NOTE----------<br>All EDG starts may be preceded by an engine prelube period.<br>----------<br><br>Verify each EDG starts from standby condition and achieves:<br><br>a. In ≤ 10 seconds, voltage ≥ ~~4031~~ 4070 V and frequency ≥ ~~58.8~~ 59.5 Hz; and<br><br>b. Steady state voltage ≥ ~~3744~~ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz. | 184 days |

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.11 | ----------NOTES----------<br>1. All EDG starts may be preceded by an engine prelube period.<br><br>2. This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR.<br>---------- | |
| | Verify on an actual or simulated loss of offsite power signal:<br><br>a. De-energization of essential buses;<br><br>b. Load shedding from essential buses; and<br><br>c. EDG auto-starts from standby condition and:<br><br>1. Energizes permanently connected loads in ≤ 10 seconds;<br><br>2. Energizes auto-connected shutdown loads through individual time delay relays;<br><br>3. Maintains steady-state voltage ≥ ~~3744~~ 4088 V and ≤ 4400 V;<br><br>4. Maintains steady-state frequency ≥ 59.5 Hz and ≤ 60.5 Hz; and<br><br>5. Supplies permanently connected and auto-connected shutdown loads for ≥ 5 minutes. | 24 months |

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.14 | ----------NOTES----------<br>1. This Surveillance shall be performed within 5 minutes of shutting down the EDG after the EDG has operated ≥ 1 hour loaded ≥ 2340 kW and ≤ 2600 kW.<br><br>Momentary transients outside of load range do not invalidate this test.<br><br>2. All EDG starts may be preceded by an engine prelube period.<br>----------<br><br>Verify each EDG starts and achieves:<br><br>a. In ≤ 10 seconds, voltage ≥ ~~4031~~ 4070 V and frequency ≥ ~~58.8~~ 59.5 Hz; and<br><br>b. Steady state voltage ≥ ~~3744~~ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz. | 24 months |

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.15 | ----------NOTES----------<br>1. All EDG starts may be preceded by an engine prelube period.<br><br>2. This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR.<br>----------<br><br>Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated SFAS actuation signal:<br><br>a. De-energization of essential buses;<br><br>b. Load shedding from essential buses;<br><br>c. EDG auto-starts from standby condition and:<br><br>1. Energizes permanently connected loads in ≤ 10 seconds;<br><br>2. Energizes auto-connected emergency loads through load sequencer and individual time delay relays;<br><br>3. Achieves steady-state voltage ≥ ~~3744~~ 4088 V and ≤ 4400 V;<br><br>4. Achieves steady-state frequency ≥ 59.5 Hz and ≤ 60.5 Hz; and<br><br>5. Supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes. | 24 months |

**Attachment B**

**Proposed Technical Specification Changes (Retyped)**

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The following is a list of the affected pages.

| |
|---|
| 3.8.1-5 |
| 3.8.1-6 |
| 3.8.1-9 |
| 3.8.1-11 |
| 3.8.1-12 |

Retyped page provided for information only.

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.1 | Verify correct breaker alignment and indicated power availability for each offsite circuit. | 7 days |
| SR 3.8.1.2 | ----------NOTES----------<br>1. All EDG starts may be preceded by an engine prelube period and followed by a warmup period prior to loading.<br><br>2. A modified EDG start involving idling and/or gradual acceleration to synchronous speed may be used for this SR as recommended by the manufacturer. When modified start procedures are not used, the time, voltage, and frequency tolerances of SR 3.8.1.8 must be met.<br>----------<br><br>Verify each EDG starts from standby conditions and achieves steady state voltage ≥ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz. | 31 days |
| SR 3.8.1.3 | ----------NOTES----------<br>1. EDG loadings may include gradual loading as recommended by the manufacturer.<br><br>2. Momentary transients outside the load range do not invalidate this test.<br><br>3. This Surveillance shall be conducted on only one EDG at a time.<br><br>4. This SR shall be preceded by and immediately follow, without shutdown, a successful performance of SR 3.8.1.2 or SR 3.8.1.8.<br>----------<br><br>Verify each EDG is synchronized and loaded and operates for ≥ 60 minutes at a load ≥ 2340 kW and ≤ 2600 kW. | 31 days |
| SR 3.8.1.4 | Verify each day tank contains ≥ 4000 gal of fuel oil. | 31 days |

Retyped page provided for information only.

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.5 | Check for and remove accumulated water from each day tank. | 31 days |
| SR 3.8.1.6 | Verify interval between each sequenced load block is within ± 10% of design interval for each emergency load sequencer and each emergency time delay relay. | 31 days |
| SR 3.8.1.7 | Verify the fuel oil transfer system operates to transfer fuel oil from fuel oil storage tank to the day tank. | 92 days |
| SR 3.8.1.8 | ----------NOTE----------<br>All EDG starts may be preceded by an engine prelube period.<br>----------<br><br>Verify each EDG starts from standby condition and achieves:<br><br>a. In ≤ 10 seconds, voltage ≥ 4070 V and frequency ≥ 59.5 Hz; and<br><br>b. Steady state voltage ≥ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz. | 184 days |

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.11 | ----------NOTES----------<br>1. All EDG starts may be preceded by an engine prelube period.<br><br>2. This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR.<br>----------<br><br>Verify on an actual or simulated loss of offsite power signal:<br><br>a. De-energization of essential buses;<br><br>b. Load shedding from essential buses; and<br><br>c. EDG auto-starts from standby condition and:<br><br>1. Energizes permanently connected loads in ≤ 10 seconds;<br><br>2. Energizes auto-connected shutdown loads through individual time delay relays;<br><br>3. Maintains steady-state voltage ≥ 4088 V and ≤ 4400 V;<br><br>4. Maintains steady-state frequency ≥ 59.5 Hz and ≤ 60.5 Hz; and<br><br>5. Supplies permanently connected and auto-connected shutdown loads for ≥ 5 minutes. | 24 months |

Retyped page provided for information only.

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.14 | ----------NOTES----------<br>1. This Surveillance shall be performed within 5 minutes of shutting down the EDG after the EDG has operated ≥ 1 hour loaded ≥ 2340 kW and ≤ 2600 kW.<br><br>Momentary transients outside of load range do not invalidate this test.<br><br>2. All EDG starts may be preceded by an engine prelube period.<br>----------<br><br>Verify each EDG starts and achieves:<br><br>a. In ≤ 10 seconds, voltage ≥ 4070 V and frequency ≥ 59.5 Hz; and<br><br>b. Steady state voltage ≥ 4088 V and ≤ 4400 V, and frequency ≥ 59.5 Hz and ≤ 60.5 Hz. | 24 months |

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.8.1.15 | ----------NOTES----------<br>1. All EDG starts may be preceded by an engine prelube period.<br><br>2. This Surveillance shall not normally be performed in MODE 1, 2, 3, or 4. However, portions of the Surveillance may be performed to reestablish OPERABILITY provided an assessment determines the safety of the plant is maintained or enhanced. Credit may be taken for unplanned events that satisfy this SR.<br>---------- | |
| | Verify on an actual or simulated loss of offsite power signal in conjunction with an actual or simulated SFAS actuation signal:<br><br>a. De-energization of essential buses;<br><br>b. Load shedding from essential buses;<br><br>c. EDG auto-starts from standby condition and:<br><br>1. Energizes permanently connected loads in ≤ 10 seconds;<br><br>2. Energizes auto-connected emergency loads through load sequencer and individual time delay relays;<br><br>3. Achieves steady-state voltage ≥ 4088 V and ≤ 4400 V;<br><br>4. Achieves steady-state frequency ≥ 59.5 Hz and ≤ 60.5 Hz; and<br><br>5. Supplies permanently connected and auto-connected emergency loads for ≥ 5 minutes. | 24 months |

**Attachment C**

**Proposed Technical Specification Bases Changes (Mark-up)**

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The following is a list of the affected pages.

| |
|---|
| B 3.8.1-4 |
| B 3.8.1-12 |
| B 3.8.1-13 |
| B 3.8.1-14 |
| B 3.8.1-19 |
| B 3.8.1-23 |
| B 3.8.2-3 |

BASES

LCO (continued)

through a single 345 - 13.8 kV startup transformer and a single 13.8 - 4.16 kV tie transformer. Thus, if both essential buses are being powered in this manner, both offsite circuits are inoperable. In addition, while not covered by this Specification, requirements for the switchyard are provided in Technical Requirements Manual 8.8.1.

In addition, in MODES 3 and 4, in lieu of one of the 345 - 13.8 kV startup transformers, one main transformer and one unit auxiliary transformer with the generator links removed (i.e., a backfeed alignment) may be used.

Each EDG must be capable of starting, accelerating to ~~rated~~the required speed and voltage as specified in the Technical Specifications, and connecting to its respective essential bus on detection of bus undervoltage. This will be accomplished within 10 seconds. Each EDG must also be capable of accepting required loads within the assumed times, and continue to operate until offsite power can be restored to the essential buses. These capabilities are required to be met from a variety of initial conditions, such as EDG in standby with the engine hot and EDG in standby with the engine at ambient conditions. Additional EDG capabilities must be demonstrated to meet required Surveillances, e.g., capability of the EDG to reject the single largest load. In addition, day tank fuel oil level and fuel oil transfer system requirements must be met for each EDG.

Proper sequencing of loads (which include all required individual time delay relays), including tripping of non-essential loads, is a required function for EDG OPERABILITY.

In addition, two load sequencers per train must be OPERABLE.

The AC sources in one train must be separate and independent (to the extent possible) of the AC sources in the other train. For the EDGs, separation and independence are complete.

For the offsite AC sources, separation and independence are to the extent practical. An offsite circuit may be connected to more than one essential bus, with fast-transfer capability to the other circuit OPERABLE, and not violate separation criteria. An offsite circuit that is not connected to an essential bus is required to have OPERABLE fast-transfer interlock mechanisms to one essential bus to support OPERABILITY of that circuit. The reserve source selector switches are used to ensure this capability is available. Therefore, if both reserve source selector switches are selected to the same offsite circuit (i.e., the same startup transformer), the non-selected offsite circuit is inoperable.

BASES

ACTIONS

G.1 (continued)

With one or more trains with one load sequencer inoperable, the 1 hour Completion Time provides a period of time to remove the inoperable module from the SFAS cabinet. As noted, since each train is independent from the other train, separate Condition entry is allowed for inoperable load sequencers in each train.

H.1

With one or more trains with two load sequencers inoperable, the EDG cannot be loaded in the proper sequence and therefore, cannot meet its safety function. Therefore, the EDG must be immediately declared inoperable. As noted, since each train is independent from the other train, separate Condition entry is allowed for inoperable load sequencers in each train.

I.1

Condition I corresponds to a level of degradation in which all redundancy in the AC electrical power supplies has been lost. At this severely degraded level, any further losses in the AC electrical power system will cause a loss of function. Therefore, no additional time is justified for continued operation. The unit is required by LCO 3.0.3 to commence a controlled shutdown.

SURVEILLANCE REQUIREMENTS

The AC sources are designed to permit inspection and testing of all important areas and features, especially those that have a standby function, in accordance with UFSAR, Section 8 (Ref. 9). Periodic component tests are supplemented by extensive functional tests during refueling outages (under simulated accident conditions). The SRs for demonstrating the OPERABILITY of the EDGs are consistent with the recommendations of Regulatory Guide 1.9 (Ref. 3) and Regulatory Guide 1.137 (Ref. 10).

Text to be inserted here is provided after page B 3.8.1-13.

~~Where the SRs discussed herein specify voltage and frequency tolerances, the following is applicable. The minimum steady state output voltage of 3744 V is 90% of the nominal 4160 V output voltage, and is consistent with Safety Guide 9 (Ref. 11). The specified maximum steady state output voltage of 4400 V is equal to the maximum operating voltage specified for 4000 V motors. It ensures that for a lightly loaded distribution system, the voltage at the terminals of 4000 V motors is no more than the~~

BASES

SURVEILLANCE REQUIREMENTS (continued)

~~maximum rated operating voltages. The specified steady state minimum and maximum frequencies of the EDG are 59.5 Hz and 60.5 Hz, respectively. These values are based on plant-specific analysis values.~~

SR 3.8.1.1

This SR ensures proper circuit continuity for the offsite AC electrical power supply to the onsite distribution network and availability of offsite AC electrical power. The breaker alignment verifies that each breaker is in its correct position to ensure that distribution buses and loads are connected to their preferred power source, and that appropriate independence of offsite circuits is maintained. The 7 day Frequency is adequate since breaker position is not likely to change without the operator being aware of it and because its status is displayed in the control room.

SR 3.8.1.2 and SR 3.8.1.8

These SRs help to ensure the availability of the standby electrical power supply to mitigate DBAs and transients and to maintain the unit in a safe shutdown condition.

To minimize the wear on moving parts that do not get lubricated when the engine is not running, these SRs are modified by a Note (Note 1 for SR 3.8.1.2 and the Note for SR 3.8.1.8) to indicate that all EDG starts for these Surveillances may be preceded by an engine prelube period and followed by a warmup period prior to loading.

For the purposes of SR 3.8.1.2 and SR 3.8.1.8 testing, the EDGs are started from standby conditions. Standby conditions for an EDG means that the diesel engine coolant and oil are being continuously circulated and temperature is being maintained consistent with manufacturer recommendations.

In order to reduce stress and wear on diesel engines, some manufacturers recommend a modified start in which the starting speed of EDGs is limited, warmup is limited to this lower speed, and the EDGs are gradually accelerated to synchronous speed prior to loading. This is the intent of Note 2, which is only applicable when such modified start procedures are recommended by the manufacturer.

SR 3.8.1.8 requires that, at a 184 day Frequency, the EDG starts from standby conditions and achieves required voltage and frequency within 10 seconds. The 10 second start requirement supports the assumptions

Text To Be Inserted Starting On Page B 3.8.1-12

Where the SRs discussed herein specify voltage and frequency tolerances, the following is applicable. The minimum starting output voltage of 4070 V is based on the minimum voltage value required to close the EDG output circuit breaker. The minimum steady state output voltage of 4088 V is the minimum EDG voltage setpoint value evaluated in the EDG transient analysis, which demonstrates Safety Guide 9 (Ref. 11) transient voltage criteria are satisfied. The maximum steady state output voltage of 4400 V is equal to the maximum operating voltage specified for 4000 V motors. It ensures that for a lightly loaded distribution system, the voltage at the terminals of 4000 V motors is no more than the maximum rated operating voltage. The minimum starting frequency value was chosen to be consistent with the minimum steady state frequency requirements. The minimum steady state output frequency of 59.5 Hz is the minimum EDG frequency value evaluated for plant-specific accident analyses, and is demonstrated by the EDG transient analysis to satisfy Safety Guide 9 (Ref. 11) transient frequency criteria. The maximum steady state output frequency of 60.5 Hz supports plant-specific analyses values.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.1.2 and SR 3.8.1.8 (continued)

of the design basis LOCA analysis in the UFSAR, Section 15 (Ref. 5). ~~The minimum voltage limit is based on the voltage required for EDG breaker closure and the minimum frequency limit is based on the recommendations in Safety Guide 9 (Ref. 11).~~

The 10 second start requirement is not applicable to SR 3.8.1.2 (see Note 2) when a modified start procedure as described above is used. If a modified start is not used, the 10 second start requirement of SR 3.8.1.8 applies.

Since SR 3.8.1.8 requires a 10 second start, it is more restrictive than SR 3.8.1.2, and it may be performed in lieu of SR 3.8.1.2.

In addition to the SR requirements, the time for the EDG to reach steady state operation, unless the modified EDG start method is employed, is monitored to identify degradation of governor and voltage regulator performance.

The 31 day Frequency for SR 3.8.1.2 is consistent with Regulatory Guide 1.9 (Ref. 3). The 184 day Frequency for SR 3.8.1.8 is a reduction in cold testing consistent with Generic Letter 84-15 (Ref. 7). These Frequencies provide adequate assurance of EDG OPERABILITY, while minimizing degradation resulting from testing.

SR 3.8.1.3

Consistent with Regulatory Guide 1.9 (Ref. 3), this Surveillance verifies that the EDGs are capable of synchronizing with the offsite electrical system and accepting loads 90% to 100% of the continuous rating of the EDG. A run time of 60 minutes ensures the engine temperatures are stabilized, while minimizing the time that the EDG is connected to the offsite source.

Although no power factor requirements are established by this SR, the EDG is normally operated at a lagging power factor between 0.8 and 0.95. The 0.8 value is the design rating of the machine, while the 0.95 is an administrative limitation. The load band is provided to avoid routine overloading of the EDG. Routine overloading may result in more frequent teardown inspections being required in order to maintain EDG reliability.

The 31 day Frequency for this Surveillance is consistent with Regulatory Guide 1.9 (Ref. 3).

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.1.10 (continued)

design basis conditions as possible. When synchronized with offsite power, testing should be performed within the power factor limit. This power factor is representative of the actual inductive loading an EDG would see under design basis accident conditions. The power factor limit is ≤ 0.84 for EDG 1 and ≤ 0.84 for EDG 2. Under certain conditions, however, Note 2 allows the Surveillance to be conducted outside the power factor limit. These conditions occur when grid voltage is high, and the additional field excitation needed to get the power factor to within the limit results in voltages on the essential buses that are too high. Under these conditions, the power factor should be maintained as close as practicable to the limit while still maintaining acceptable voltage limits on the essential buses. In other circumstances, the grid voltage may be such that the EDG excitation levels needed to obtain a power factor within limit may not cause unacceptable voltages on the essential buses, but the excitation levels are in excess of those recommended for the EDG. In such cases, the power factor shall be maintained as close as practicable to the power factor limit without exceeding the EDG excitation limits.

SR 3.8.1.11

Consistent with Regulatory Guide 1.9 (Ref. 3), paragraph C.2.2.4, this Surveillance demonstrates the ~~as designed operation~~ operability of the standby power sources during loss of the offsite source. This test verifies all actions encountered from the loss of offsite power, including shedding of the non-essential loads and energization of the essential buses and respective loads from the EDG. It further demonstrates the capability of the EDG to automatically achieve the required voltage and frequency within the specified time.

The EDG auto-start time of 10 seconds is derived from requirements of the accident analysis to respond to a design basis large break LOCA. The Surveillance should be continued for a minimum of 5 minutes in order to demonstrate that all starting transients have decayed and stability has been achieved.

The requirement to verify the connection and power supply of permanent and auto-connected loads is intended to satisfactorily show the relationship of these loads to the EDG loading logic (i.e., the individual time delay relays for the component cooling water, service water, and makeup pumps). In certain circumstances, some of these loads can not actually be connected or loaded without undue hardship or potential for undesired operation. In lieu of actual demonstration of connection and loading of loads, testing that adequately shows the capability of the EDG

BASES

SURVEILLANCE REQUIREMENTS

SR 3.8.1.13 (continued)

rating (part b), the power factor limit is ≤ 0.84 for EDG 1 and ≤ 0.84 for EDG 2. Under certain conditions, however, Note 3 allows the Surveillance to be conducted outside the power factor limit. These conditions occur when grid voltage is high, and the additional field excitation needed to get the power factor to within the limit results in voltages on the essential buses that are too high. Under these conditions, the power factor should be maintained as close as practicable to the limit while still maintaining acceptable voltage limits on the essential buses. In other circumstances, the grid voltage may be such that the EDG excitation levels needed to obtain a power factor within limit may not cause unacceptable voltages on the essential buses, but the excitation levels are in excess of those recommended for the EDG. In such cases, the power factor shall be maintained as close as practicable to the power factor limit without exceeding the EDG excitation limits.

SR 3.8.1.14

This Surveillance demonstrates that the diesel engine can restart from a hot condition, such as subsequent to shutdown from normal Surveillances, and achieve the required voltage and frequency within 10 seconds. The 10 second time is derived from the requirements of the accident analysis to respond to a design basis large break LOCA. ~~The minimum voltage limit is based on the voltage required for EDG breaker closure and the minimum frequency limit is based on the recommendations in Safety Guide 9 (Ref. 11).~~

The 24 month Frequency is based on engineering judgment and is intended to be consistent with the expected fuel cycle lengths. Operating experience has shown that these components usually pass the SR when performed at the 24 month Frequency. Therefore, the Frequency is acceptable from a reliability standpoint.

This SR is modified by two Notes. Note 1 ensures that the test is performed with the diesel sufficiently hot. The load band is provided to avoid routine overloading of the EDG. Routine overloads may result in more frequent teardown inspections, in accordance with vendor recommendations, in order to maintain EDG OPERABILITY. The requirement that the diesel has operated for at least 1 hour at approximately full load conditions prior to performance of this Surveillance is based on achieving hot, stabilized conditions. Momentary transients due to changing bus loads do not invalidate this test. Note 2 allows all EDG starts to be preceded by an engine prelube period to minimize wear and tear on the diesel during testing.

BASES

LCO (continued)

The EDG must be capable of starting, accelerating to ~~rated~~the required speed and voltage as specified in the Technical Specifications, and connecting to its respective essential bus on detection of bus undervoltage (loss of voltage or degraded voltage). This sequence must be accomplished within 10 seconds. The EDG must be capable of accepting required shutdown loads (shutdown loads are started through individual time delay relays), and must continue to operate until offsite power can be restored to the essential buses. These capabilities are required to be met from a variety of initial conditions such as EDG in standby with the engine hot and EDG in standby at ambient conditions.

Proper sequencing of loads, including tripping of non-essential loads, is a required function for EDG OPERABILITY.

It is acceptable for trains to be cross tied during shutdown conditions, allowing a single offsite power circuit to supply all required trains.

APPLICABILITY

The AC sources required to be OPERABLE in MODES 5 and 6 and during movement of irradiated fuel assemblies provide assurance that:

a. Systems to provide adequate coolant inventory makeup are available for the irradiated fuel assemblies;

b. Systems needed to mitigate a fuel handling accident are available;

c. Systems necessary to mitigate the effects of events that can lead to core damage during shutdown are available; and

d. Instrumentation and control capability is available for monitoring and maintaining the unit in a cold shutdown condition or refueling condition.

The AC power requirements for MODES 1, 2, 3, and 4 are covered in LCO 3.8.1.

ACTIONS

LCO 3.0.3 is not applicable while in MODE 5 or 6. However, since irradiated fuel assembly movement can occur in MODE 1, 2, 3, or 4, the ACTIONS have been modified by a Note stating that LCO 3.0.3 is not applicable. If moving irradiated fuel assemblies while in MODE 5 or 6, LCO 3.0.3 would not specify any action. If moving irradiated fuel assemblies while in MODE 1, 2, 3, or 4, the fuel movement is independent of reactor operations. Entering LCO 3.0.3, while in MODE 1, 2, 3, or 4 would require the unit to be shutdown unnecessarily

**Attachment D**

**AC Power System Analysis,**
**Section 3, Acceptance Criteria**

(12 pages follow)

The abbreviations and acronyms listed below are used in the AC Power System Analysis, Calculation No. C-EE-015.03-008 pages provided in Attachment D.

| | |
|---|---|
| A | ampere |
| Amps | amperes |
| ANSI | American National Standards Institute |
| ARTS | anticipatory reactor trip system |
| Att. | Attachment |
| CR | condition report |
| DIN | document index [reference] number |
| dc | direct current |
| DVR | degraded voltage relay |
| EDG | emergency diesel generator |
| e.g. | for example |
| ETAP | Electrical Transient Analysis Program |
| FLA | full load amperes |
| hp | horsepower |
| ID | identification |
| i.e. | that is |
| kV | kilo-volt |
| kVA | kilo-volt-ampere |
| kW | kilo-watt |
| LOCA | loss of coolant accident |
| LOOP | loss of offsite power |
| MCC | motor control center |
| MOV | motor operated valve |
| SFRCS | steam and feedwater rupture control system |
| V | volt |
| Vdc | volts direct current |
| % | percent |
| + | plus |
| - | minus |
| ± | plus or minus |
| +/- | plus or minus |
| = | equals |

# 3.0 ACCEPTANCE CRITERIA

Acceptance criteria for MOV terminal voltages are not within the scope of this calculation.

## 3.1 Bus Voltages

Attachment 4E contains safe operating limit voltage ranges for 345kV switchyard, 13.8kV switchgear A and B, 4.16kV switchgear C1 and D1, and 480V switchgear E1 and F1. The safe operating limit voltage ranges are more limiting than the bus voltage acceptance criteria listed in this section. The voltage ranges shown in Attachment 4E provide the proper voltages necessary to satisfy technical specification surveillance requirements in accordance with procedures DB-SC-03023 (DIN 24), DB-SC-03041 (DIN 25), and DB-SC-03042 (DIN 26). Note: The voltages provided for 4.16kV switchgear C1 and D1 in procedure DB-SC-03023 are approximate voltages only; i.e., they are only used to determine proper offsite power lineup to C1 and D1 and therefore are not required to be within the proper voltage range listed in Attachment 4E.

### 3.1.1 Continuous Maximum Voltages

Buses shall have continuous voltages less than the voltages shown in the following table:

| Bus Nominal Voltage | Bus Maximum Voltage | Reference |
|---|---|---|
| 13.8 kV | 15.0 kV | Specification E-005Q (DIN 245) |
| 4.16 kV | 4.76 kV | Specification E-005Q (DIN 245) |
| 480 V | 600 V | VMAN E-007-142 (DIN 244) |

Table 1C of Attachment 3 provides the overall maximum bus voltages which includes maximum voltage requirements of equipment powered from each bus.

### 3.1.2 Minimum Voltages

The minimum voltage requirement for buses is based on the minimum voltage requirement of equipment powered from that bus, which includes motors, contactors, relays, loads that support the dc system, hydramotors, radiation monitors, and SFRCS Logic Channels. The voltage requirements for the individual loads are discussed in more detail in their applicable sections below. Table 1A of Attachment 3 determines the overall minimum continuous bus voltage for select buses based on the minimum voltage requirement of the loads and control circuits powered from that bus. Table 1B of Attachment 3 determines the overall minimum bus voltage during motor starting transients.

Further discussion of the minimum required voltage for MCCs YE2 and YF2 is provided below.

#### 3.1.2.1 Motor Control Centers YE2 and YF2

According to the minimum required voltages in Attachment 24, the minimum required steady state voltage for MCC YE2 and MCC YF2 is 209.0 V (87.08% of 240 V) and 208.3 V (86.78% of 240 V), based on relay pickup voltage requirements. The minimum required ride through voltage for MCCs YE2 and YF2 is 148.8 V (62% of 240 V) based on the voltage at SFRCS Logic Channels 3 and 4 to prevent relay drop-out and inadvertent actuation of ARTS. The bases for these steady state and transient voltage requirements are discussed in more detail below.

- **SFRCS Logic Channels 3 and 4 Steady State Voltages**
  SFRCS Logic Channels 3 and 4 are fed from MCC YE2 and MCC YF2, respectively. Calculation C-EE-017-01-008 (DIN 372) establishes a minimum voltage at MCCs YE2 and YF2 of 222.6 V (92.75% of 240 V) and 223.2 V (93.00% of 240 V), respectively. Calculation C-EE-017-01-008 performs a voltage drop analysis from the SFRCS cabinet to the corresponding MCC starting with the SFRCS system design specification minimum voltage of 108 V (90% of 120 V) per Specification E-030AQ (DIN 620). Based on the SFRCS cabinet voltage drop calculation, there is at most a 3% voltage drop from the 240 V MCC (either YE2 or YF2) to the corresponding SFRCS cabinet.

  CR 03-01242 (DIN 619) analyzes the minimum voltage requirements for the SFRCS cabinets fed from MCCs YE2 and YF2. The analysis determined that the relays in the cabinets have a pickup voltage of approximately 81% of rated voltage. Applying a 3% voltage drop from the SFRCS cabinet to the corresponding MCC, a relay pickup voltage of 81% would result in a minimum required voltage at MCCs YE2 and YF2 of approximately 84%. This is below the minimum required steady state voltage for MCCs YE2 and YF2 based on MOV contactor pickup and is therefore not the bounding steady state acceptance criterion.

- **SFRCS Logic Channels 3 and 4 Transient Voltage Dips**
  CR 03-01242 (DIN 619) also determined that 59% was a conservative upper bound for the maximum dropout voltage of the relays in the SFCRS cabinets that are fed from MCCs YE2 and YF2. The purpose for this analysis was to ensure that an inadvertent ARTS actuation (which occurs if relays in SFRCS channels 3 or 4 drop out) does not occur during degraded voltage conditions.

  Applying a 3% voltage drop from the SFCRS cabinet to the corresponding MCC, a dropout voltage of 59% results in a minimum required holding voltage at MCCs YE2 and YF2 of 62% of rated voltage. This value is above the required bus holding voltages of 58.52% and 58.51% for MCC YE2 and MCC YF2, respectively, per Attachment 24. Therefore, the minimum required ride-through voltage for both MCCs YE2 and YF2 during motor starting transients is 148.8 V (62% of 240 V). This will ensure SFRCS Logic Channels 3 and 4 remain energized, and prevent an inadvertent ARTS actuation.

## 3.2 Transformers

### 3.2.1 Maximum Loading

Transformer output kVA shall not exceed the maximum transformer kVA rating per ANSI Standard C57.12.00 (DIN 421). The rated transformer kVA is the continuous output that the transformer can deliver at rated secondary voltage and frequency without exceeding the temperature-rise limitations. Transformer operations at a load greater than rated kVA could result in reduction of equipment life.

### 3.2.2 Maximum Voltages

The voltage on the transformer low voltage winding shall not exceed 105% of the nominal winding rated voltage at full load, nor 110% at no load (DIN 421).

## 3.3 Induction Motors

### 3.3.1 Continuous Running Voltages

Motor terminal continuous running voltage shall be within ±10% of the motor rated voltage per Davis Besse Design Criteria Manual Part III.D Section 4.5 (DIN 4). An exception to this is the running voltage for essential fan motors (see discussion in Section 3.3.1.1 below).

#### 3.3.1.1 Essential Fan Motors 10 hp or Smaller

The acceptance criteria established for the minimum terminal voltage of essential fan motors 10 hp or smaller is 90% of nominal 460 V (or 414 V) with the following exception: during design basis accident loading conditions with off-site voltage degraded below 98.3% of 345 kV, it is acceptable for essential fan motors 10 hp or smaller to be less than 90% of nominal provide: (1) the voltage remains above 87% of nominal 460 V (or 400.2 V), (2) the motor has a service factor of at least 1.15, (3) operation at reduced voltage would not cause the motor's thermal overload (if installed) to trip, and (4) the motor continues to operate above rated speed at reduced voltage. This exception is based on the following justification:

1. Motor starting analyses demonstrate that there is sufficient voltage for these fans to start and run (within the acceptance criteria from their design specifications) following a design basis accident coincident with off-site power degraded to 98.3% of 345 kV. This capability is demonstrated by the accident block loading ST1 analysis case series. Per Attachment 4C, the 2003 summer voltage assessment shows that the probability of the off-site power voltage being lower than 98.3% of 345 kV is less than 1 day in 1000 years. The assessment of the system for the summer 2005 conditions indicates an overall probability of experiencing off-site power voltage below 98.3% of 345 kV is 1 day in 900,000 years. Combined with the chance of occurrence of a design basis accident, the likelihood that the essential fan motors would be required to operate under these plant conditions is very small. Addationally, voltages for assments performed in 2010, 2011,

2012 and 2013 all show higher minimum voltages than assments performed in 2001, 2003 and 2005, see section 1.11.1.1 for details. Therefore, loss of equipment life caused by long term operation of the essential fan motors outside of the voltage design specifications is not a concern.

2. The actual current draw for the essential fan motors is expected to be less than the modeled current draw. Seven essential fan motors that are 10 hp or smaller and whose terminal voltage was less than 90% of nominal in the degraded voltage analytical limit analysis (ST4 case series) have been tested in-situ. The "WinVis" motor test data was obtained via procedure DB-PF-05064 (DIN 29), and has been included as Attachment 9 Item No. 30. The following table summarizes the results of the most recent test data provided for each motor:

| Motor ID | Full Load Amps (From Att. 18) | Measured Current (A) | Measured Voltage (V) | Measured Current at 460V (A) | Margin to FLA (A) | Margin to FLA (%) |
|---|---|---|---|---|---|---|
| MC21-1 | 7.10 | 5.82 | 471.44 | 5.96 | 1.14 | 16% |
| MC31-1 | 10.80 | 7.91 | 477.47 | 8.21 | 2.59 | 24% |
| MC31-2 | 11.80 | 9.49 | 472.78 | 9.75 | 2.05 | 17% |
| MC31-4 | 11.80 | 9.06 | 468.58 | 9.23 | 2.57 | 22% |
| MC31-5 | 11.80 | 10.06 | 477.43 | 10.44 | 1.36 | 12% |
| MS61-2 | 10.80 | 6.17 | 484.02 | 6.49 | 4.31 | 40% |
| MC73-2 | 10.10 | 7.80 | 480.95 | 8.16 | 1.94 | 19% |
| MC75-1 | 9.90 | 7.85 | 473.42 | 8.08 | 1.82 | 18% |

The measured current was converted to 460V in order to provide a direct comparison with the full load amps rating of the motor, which is specified at 460V. To convert the current eto a different voltage, the fans were modeled as constant power devices, which is standard industry practice for steady state induction motors. This gives the following conversion:

$$I_{460V} = I_{Measured} \times (V_{Measured} / 460V)$$

Where:

$I_{460V}$ = Measured current at 460V (Amps)

$I_{Measured}$ = Meaured current (Amps)

$V_{Measured}$ = Measured voltage corresponding to measured current (Volts)

The results show that there is significant margin between the actual running current measured and the rated full load current modeled in ETAP for these seven motors. Each motor has greater than 10% margin between measured and modeled current.

3. A service factor of 1.15 means the induction motor can be operated continuously at 115% of its nameplate rating, which corresponds to 115% rated full load amps at nominal voltage. Since induction motors act like constant power devices during continuous operations, an induction motor operating at 100% rated load and 87% rated voltage would be operating at approximately 115% (=100%/87%) of its nameplate full load amps. Since a service factor of 1.15 is part of the acceptance criteria for these fan motors, operating the fan motor at 87% rated terminal voltage would not cause the motor to have a running current above design specification. Therefore, the additional thermal heating caused by the higher current draw at 87% rated voltage is determined to be acceptable.

4. For essential fan motors operating below 90% of rated 460V, an evaluation was performed to ensure the increase in current draw due to operating at reduced voltage would not cause the motor's thermal overload to trip (see Section 5.8.2.1).

5. For essential fan motors operating below 90% of rated 460V, an evaluation was performed to ensure the motors operate above rated speed at reduced terminal voltage (see computation Section 4.4 and results Section 5.8.2.1).

### 3.3.2 Ride Through Voltages

The minimum ride through terminal voltage for safety-related 4 kV and 460 V motors during starting transients is 65% of nominal per specifications 7749-E-37 (DIN 247) and EA-002 (DIN 430), respectively. This criterion ensures safety-related motors will not stall during momentary voltage dips.

### 3.3.3 Starting Voltages

#### 3.3.3.1 Safety Related Motors

The minimum starting terminal voltage for Safety Related motors shall be 70% of motor rated voltage per Davis Besse Design Criteria Manual Part III.D Section 4.5 (DIN 4).

#### 3.3.3.2 Non-Safety Related Motors

The minimum starting terminal voltage for Non-Safety Related motors shall be 80% of motor rated voltage per Davis Besse Design Criteria Manual Part III.D Section 4.5 (DIN 4).

## 3.4 Non-Motor Loads

### 3.4.1 Battery Chargers

#### 3.4.1.1 Continuous Running Voltages

Battery Chargers DBC2PN, DBC1PN, DBC1N, DBC1P, DBC2N, and DBC2P shall have a steady state terminal voltage between -18% to +10% of rated 480 V (393.6 to 528 V) (DIN 431).

#### 3.4.1.2 Ride Through Voltages

There is no acceptance criterion for the ride-through voltage of the battery chargers during a motor starting transient. When a battery charger dips below its minimum required voltage, the corresponding station battery may be required to assume the burden of the dc system. The longest dip from a motor starting transient is at most 15.5 seconds (from starting a Reactor Coolant Pump). This means that the station battery would have to carry the dc system burden for at most 15.5 seconds at any one time during a motor starting transient. A 15.5 second load on a station battery is a negligible amount of Amp-hours discharged from the battery (much less than one Amp-hour removed). In addition, dc system calculation C-EE-002.01-010 (DIN 281) shows each battery can support design basis accident loading on the dc system for up to one hour and takes no credit for alternate ac power sources.

### 3.4.2 Constant Voltage Transformers

#### 3.4.2.1 Continuous Running Voltages

Constant Voltage (Ferroresonant Isolomiter) Transformers XY1, XY2, XY3, and XY4 shall have a steady state terminal voltage between -15% to +10% of rated 480 V (408 to 528 V) (DIN 232). The constant voltage transformers are operating at no load under all scenarios analyzed (see discussion in Attachment 5). Therefore, the minimum voltage requirement is based on continuous operation of the transformers within design specifications, and is not based on providing adequate voltage to downstream equipment.

#### 3.4.2.2 Ride Through Voltages

There is no acceptance criterion for the ride-through voltage of the constant voltage transformers since there are no downstream components that would be affected by a momentary dip in the output voltage of the transformers.

### 3.4.3 Regulated Rectifiers

#### 3.4.3.1 Continuous Running Voltages

Regulated Rectifiers YRF1, YRF2, YFR3, and YRF4 shall have a steady state terminal voltage between ±10% of rated voltage 480 V (432 to 528 V), except under the specific plant conditions discussed below. A terminal voltage of ±10% of rated 480 V is the design specification and ensures the regulated rectifiers can supply 144 Vdc to the dc system per Specification 12501-E-854Q (DIN 432), which is above the normal dc system voltage. An output voltage of 140 Vdc bounds the nominal battery charger float voltage of 132 Vdc per Section 8.3.2.1.2 of the USAR (DIN 1) and a battery charger equalizing voltage of 142 Vdc per battery charger specification E-20Q (DIN 246).

- **Exception to Steady State Voltage Requirement for Regulated Rectifiers**

Following a design basis accident with off-site power degraded below 98.3% of 345 kV, the regulated rectifiers shall have a minimum steady state terminal voltage of -15% of rated 480 V (or 408 V). At -15% of rated voltage, the regulated rectifiers will supply approximately 136.6 Vdc to the dc system (DIN 444). This is above the 132 Vdc nominal dc system supply voltage expected during operations with the battery on a float with the battery charger. However, during conditions with the battery charger in equalize mode, the dc system voltage may be above a regulated rectifier output of 136.6 Vdc. In this case, the dc system may be required to provide steady-state voltage to the essential inverters in lieu of the regulated rectifiers. This is acceptable for reasons discussed below:

1. Since the battery chargers would be available to supply power to the essential inverters, a drop in regulated rectifier dc output voltage below the dc system voltage would result in a transfer of load from the regulated rectifier to the corresponding battery charger. Therefore, operation of the regulated rectifiers at a dc output voltage below dc system voltage is not a concern regarding the operability of the essential inverters. Instead, it is an undesirable condition based on continuous operation of the regulated rectifiers outside of design specification 12501-E-854Q (DIN 432).

2. Per Attachment 4C, the 2003 summer voltage assessment shows that the probability of the offsite power voltage being lower than 98.3% of 345 kV is less than 1 day in 1000 years. The assessment of the system for the summer 2005 conditions indicates an overall probability of experiencing off-site power voltage below 98.3% of 345 kV is 1 day in 900,000 years. Combining this probability with the likelihood of a design basis accident and a battery charger in equalize mode results in a much lower probability from three independent plant conditions that are extremely unlikely to occur simultaneously. In addition, if this combination of events were to occur, the specific set of plant conditions is likely to be of short duration while the plant restores ac system voltage (e.g., by operating the EDGs) or returns dc system voltages to normal (e.g., by placing the battery charger in float mode instead of equalize mode).

#### 3.4.3.2 Ride Through Voltages

There is no acceptance criterion for the ride-through voltage of the regulated rectifiers during a motor starting transient. The dc output voltage from regulated rectifiers YRF1, YRF2, YFR3, and YRF4 is auctioneered with the dc voltage supplied via the station battery (or battery charger) to provide power to essential inverters YV1, YV2, YV3 and YV4, respectively. The longest dip from a motor starting transient is at most 15.5 seconds (from starting a Reactor Coolant Pump). This means that the station battery would have to carry the burden of inverters YV1, YV2, YV3, and YV4 for at most 15.5 seconds at any one time during a motor starting transient. A 15.5 second load on a station battery is a negligible amount of Amp-hours discharged from the battery (much less than one Amp-hour). Moreover, the dc system calculation C-EE-002.01-010 (DIN 281) shows the battery can support design basis accident loading on the dc system for up to one hour, and does not take credit for the regulated rectifiers.

### 3.4.4 Radiation Monitors

Per PIN 30 to Revision 5 of this calculation (DIN 793), Revision 1 of C-EE-006.01-032 will establish the minimum steady state voltages at the following MCCs due to requirements of the radiation monitors:

| MCC | Motor for Electrotechnical Unit | $V_{NEEDED}$ at MCC [Volts] | $V_{ADJUSTED, PU}$ at MCC |
|---|---|---|---|
| E16B | DB-C3841 | 416.6 | 0.868 |
| F16B | DB-C3743 | 417.6 | 0.870 |
| E16A | DB-C5306 | 414.2 | 0.863 |
| F16A | DB-C5308 | 413.3 | 0.861 |

### 3.4.5 Hydramotors

#### 3.4.5.1 Continuous Running Voltages

The hydramotors which are modeled explicitly in ETAP have an acceptable operating voltage down to 85% of rated voltage during steady-state running conditions at the terminals of the hydramotors (DIN 373).

For hydramotors fed from 240V MCCs YE2 and YF2 or 480V-120V transformers YE1 and YF1 (which are not modeled explicitly in ETAP), the hydramotor steady-state terminal voltage is considered acceptable if the MCC or transformer supply-side voltage do not fall below the minimum required voltage specified in the following table (per DIN 373):

| MCC / Transformer | Rated Voltage | Minimum Required Voltage | Percent Rated Voltage |
|---|---|---|---|
| YE2 | 240 V | 201.6 V | 84.0 % |
| YF2 | 240 V | 197.8 V | 82.4 % |
| YE1 | 480 V | 394.0 V | 82.1 % |
| YF1 | 480 V | 391.6 V | 81.6 % |

#### 3.4.5.2 Starting Voltages

The minimum starting terminal voltage for safety related hydramotors is 70% of rated voltage per Davis Besse Design Criteria Manual Part III.D Section 4.5 (DIN 4).

#### 3.4.5.3 Ride Through Voltages

Safety-related hydramotors 460 V and below motors shall not stall during momentary voltage dips provided that their terminal voltage is greater than 65% of rated voltage (DIN 430).

### 3.5 Motor/Load Contactors

Attachment 24 provides a list of minimum required MCC voltages based on control circuit pickup and holding voltage requirements per correspondence letter DBE 07-00145 (DIN 626) and Table 5-1 of NSS-03-00060 (DIN 399). The acceptance criteria for control circuit pickup and holding voltage requirements are based on the specific type of analysis being performed (i.e., load flow or motor starting) and are defined in Sections 3.5.1 and 3.5.2 below.

When evaluating contactor pickup and dropout voltage limits, the following loads were not considered limiting per CR No. 03-05010 (DIN 429):

- MP0411 on bus E11C MCC, Primary Water Transfer Pump - This pump has been spared and is therefore not modeled in ETAP.
- X39D1 on bus E11C MCC, Containment Lighting Transformer - This load serves no safety function.
- MC56-1 on bus E11B MCC, Containment Recirculation Fan 1 - The only safety function is Electrical Circuit Integrity (no short-circuits allowed), not an operational function.
- MC56-2 on bus F11A MCC, Containment Recirculation Fan 2 - This load serves no safety function.

### 3.5.1 Control Circuit Pickup Voltage

For steady-state load flow analyses, MCC bus voltages must remain above the bus required pickup voltage listed in Attachment 24. For motor starting analyses, the minimum MCC voltage before the accident load block starts (case series ST1, ST4, ST5) or before the reactor coolant pump/condensate pump motor starts (case series ST2 and ST3) must remain above the bus required pickup voltage listed in Attachment 24. Therefore, the bus required pickup voltage from Attachment 24 is used as the MCC voltage acceptance criteria in Table 1A of Attachment 3.

### 3.5.2 Control Circuit Holding Voltage

For motor starting analyses, the MCC bus voltages must remain above the bus required hold voltage listed in Attachment 24 at all times during the motor starting event. This ensures MCC contactors that have picked up do not drop out during voltage transients. Therefore, the bus required hold voltage from Attachment 24 is used as the MCC voltage acceptance criteria in Table 1B of Attachment 3.

## 3.6 Degraded Voltage Relays

C-EE-004.01-049 (DIN 308) establishes the Analytical Limits, Allowable Values and Set points for the upper and lower ranges of the Degraded Voltage Relays in support of LAR 03-0014 (DIN 469) and is used as input for this calculation.

### 3.6.1 Analytical Limit Pickup (Reset)

The voltage at 4.16 kV Switchgear C1 and D1 must remain above the Analytical Limit for Degraded Voltage Relay Pickup (reset) setting of 3786 V (91.01% of 4.16 kV) during steady-state operating conditions (LF1 through LF6 and LF12 series load flow analyses). The Analytical Limit for Degraded Voltage Relay Pickup (reset), as provided in Calculation C-EE-004.01-049 (DIN 308), is used as acceptance criteria for the minimum allowable voltage at 4.16 kV Switchgear C1and D1 during steady state conditions, as opposed to the setpoint for relay dropout (3734 +/- 7 V) because, in the event of a motor start, use of the relay dropout setpoint may cause the bus voltage to drop below the dropout trip setpoint and never recover to above the Analytical Limit for Degraded Voltage Relay reset (reference DIN 470). Use of the Analytical Limit for Degraded Voltage Relay reset in this analysis will ensure that the bus voltage will recover above the Allowable Value for Degraded Voltage Relay Pickup (3771 V).

In addition, for motor starting transients which reduce the voltage at 4.16 kV Switchgear C1 or D1 voltage below the DVR dropout (trip) setpoint, the bus voltage must recover to higher than the Analytical Limit for Degraded Voltage Relay reset within the DVR Dropout Time Delay setting Lower Analytical Limit of 6.4 seconds (DIN 308). This criterion ensures that premature transfer to the Diesel generators during SFAS load sequencing or any other short duration voltage transients (i.e. bus transfers etc.) does not occur. To meet this acceptance

criterion, the 4.16 kV Switchgear C1 and D1 voltages must be at or above the Analytical Limit for Degraded Voltage Relay reset (3786 V) at modeling event T=1 for motor starting analysis cases ST1 and ST5. The T=1 time step represents the longest 4 kV motor acceleration time at reduced voltage (see discussion in Section 1.2.4.1), which is less than 6.4 seconds (as seen in Attachment 13).

### 3.6.2 Analytical Limit Dropout (Trip)

The Analytical Limit for Degraded Voltage Relay Dropout (trip) is 3700V (88.942% of 4.16kV). When the voltage at 4.16 kV Switchgear C1 and D1 is set at the Analytical Limit for Degraded Voltage Relay Dropout value of 3700 V in ETAP Analysis cases ST4a4, ST4a5, and ST4b, motor terminal voltages shall be equal or greater than 90% of the motor nameplate ratings at modeling event T=5 (steady-state).

### 3.6.3 Degraded Voltage Relay Bypass

During a reactor coolant pump or circulating water pump start, voltages at 4.16 kV essential Switchgear C1 or D1 may drop below the DVR trip setpoint. Reactor coolant pumps may take up to 15.5 seconds to start at 80% voltage (see Attachment 13), which is greater than the 6.4 second time delay of the degraded voltage relay reset. In order to block a low voltage trip of 4.16 kV essential Switchgear C1 or D1, a pushbutton bypass allows the degraded voltage relays to be bypassed for up to one minute during a Reactor Coolant Pump or Circulating Water Pump motor start (DIN 1, Section 8.3.1.1.3).

In the Large Motor Starting Transient analysis series (ST2 and ST3), the effects of starting a 13.2 kV reactor coolant pump (which bounds the starting of a circulating water pump) and a 4 kV condensate pump are examined. Based on the discussion in the preceding paragraph, the operator is expected to bypass the DVR during a reactor coolant pump start. In addition, the condensate pumps can start within 3.5 seconds at 80% voltage (see Attachment 13), and would be finished accelerating prior to the expiration of the DVR time delay. Therefore, the DVR acceptance criteria for motor starting analysis series ST2 and ST3 is that bus voltages must recover to above the DVR reset of 3786 V at the end of each motor starting transient.

## 3.7 Emergency Diesel Generators

See Section 1.11.2.1 for a complete list of the EDG load ratings. The effects of EDG cold start derating are evaluated in the EDG Transient Analysis calculation and therefore are not included in this calculation.

### 3.7.1 Design Basis Accident Loading

The emergency diesel generator continuous loading shall not exceed 2730 kW following a loss of offsite power with or without a design basis accident. This requirement is based on DIN 435, which states the loading on the EDGs should not exceed the smaller of the 2000-hr

rating (2838 kW) or 90% of the 30-minute rating (2731.5 kW) of the diesel-generator set. In addition, an endurance run is performed on the EDGs every 24 months per Technical Specification SR 3.8.1.13.a (DIN 2), during which the EDG is loaded to between 2730 kW and 2860 kW for the first 2 hours of the test. Ensuring the EDG loading does not exceed the minimum endurance test load value of 2730 kW guarantees the test load bounds the maximum expected load on the EDG following a loss of offsite power with or without a design basis accident.

### 3.7.2 Appendix R Loading

Per Report MPR-2559 (DIN 434) for Appendix R fire scenarios, the EDG load could exceed the 2000-hour rating since there are required loads that are not auto-connected. However, the potential maintenance impact on the EDGs would need to be considered. Therefore, for the purposes of this calculation, the EDG loading in the Appendix R scenario should not exceed the EDG 2000-hour rating (2838 kW).

### 3.7.3 Automatic EDG Loading

Per Addendum 02 to C-NSA-016.04-006 Revision 1 (DIN 784) load during automatic EDG sequencing shall not excced 2600kW during a LOOP or LOOP/LOCA scenarios.

## Attachment E

## AC Power System Analysis, Attachment 3, Bus Voltage Acceptance Criteria and Summary Result Tables

(35 pages follow)

The abbreviations and acronyms listed below are used in the AC Power System Analysis, Calculation No. C-EE-015.03-008 pages provided in Attachment E.

| | |
|---|---|
| CVT | constant voltage transformer |
| DVR | degraded voltage relay |
| ETAP | Electrical Transient Analysis Program |
| kV | kilo-volt |
| Max | maximum |
| MCC | motor control center |
| Min | minimum |
| MOV | motor operated valve |
| Nom | nominal |
| SFRCS | steam and feedwater rupture control system |
| T | time |
| V | volt |
| % | percent |

# BUS VOLTAGE ACCEPTANCE CRITERIA AND SUMMARY RESULT TABLES


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**Table 1A. Minimum Continuous Bus Voltage Acceptance Criteria (%V)**

| Bus | Nominal Bus Voltage | Continuous Motor Running Voltage (rated Volt*) | DVR Reset Analytical Limit | Contactor Required Pickup Voltage (480V) | Battery Chargers (Rated 480V) | CVT (Rated 480V) | Regulated Rectifier (Rated 480V**) | SFRCS Logic | Hydra motors | Radiation Monitors (Rated 480V) | Minimum Required Continuous Bus Voltage |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 13800 | 86.090 | | | | | | | | | 86.090 |
| B | 13800 | 86.090 | | | | | | | | | 86.090 |
| C1 | 4160 | 86.540 | 91.010 | | | | | | | | 91.010 |
| CD | 4160 | 86.540 | | | | | | | | | 86.540 |
| D1 | 4160 | 86.540 | 91.010 | | | | | | | | 91.010 |
| E1 | 480 | 86.250 | | | | | | | | | 86.250 |
| E11A | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| E11B | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| E11C | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| E11D | 480 | 86.250 | | 86.770 | 82.000 | | | | | | 86.770 |
| E11E | 480 | 86.250 | | 87.100 | | | | | 85.000 | | 87.100 |
| E12A | 480 | 86.250 | | 87.100 | 82.000 | | 90.000 | | 85.000 | | 90.000 |
| E12B | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| E12C | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| E12D | 480 | 86.250 | | 78.520 | | | | | | | 86.250 |
| E12E | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| E12F | 480 | 86.250 | | 78.150 | | | | | | | 86.250 |
| E14 | 480 | 86.250 | | 78.150 | | | | | | | 86.250 |
| E15 | 480 | 86.250 | | 78.150 | | | | | | | 86.250 |
| E16A | 480 | 86.250 | | | | 85.000 | | | | 89.8 | 89.800 |
| E16B | 480 | 86.250 | | 78.150 | | | | | | 90.3 | 90.300 |
| EF12C | 480 | 86.250 | | 82.170 | | | | | | | 86.250 |
| EF12D | 480 | 86.250 | | | | | | | | | 86.250 |
| F1 | 480 | 86.250 | | | | | | | | | 86.250 |
| F11A | 480 | 86.250 | | 87.100 | | | | | 85.000 | | 87.100 |
| F11B | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| F11C | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| F11D | 480 | 86.250 | | 87.100 | 82.000 | | | | | | 87.100 |
| F11E | 480 | 86.250 | | 86.230 | | | | | | | 86.250 |
| F12A | 480 | 86.250 | | 87.100 | 82.000 | | 90.000 | | 85.000 | | 90.000 |
| F12B | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| F12C | 480 | 86.250 | | 87.100 | | | | | | | 87.100 |
| F12D | 480 | 86.250 | | 78.150 | | | | | | | 86.250 |
| F13 | 480 | 86.250 | | | | | | | | | 86.250 |
| F14 | 480 | 86.250 | | 78.150 | | | | | | | 86.250 |
| F15 | 480 | 86.250 | | 78.150 | | | | | | | 86.250 |
| F16A | 480 | 86.250 | | 78.150 | | 85.000 | | | | 89.7 | 89.700 |
| F16B | 480 | 86.250 | | | | | | | | 90.5 | 90.500 |
| EF15 | 480 | 86.250 | | | | | | | | | 86.250 |
| XYE2 | 480 | 86.250 | | | | | | | | | 86.250 |
| YE1 | 120 | | | 73.780 | | | | | 82.100 | | 82.100 |
| YE2 | 240 | 86.250 | | 87.080 | | | | 84.000 | 84.000 | | 87.080 |
| YF1 | 120 | | | 73.380 | | | | | 81.600 | | 81.600 |
| YF2 | 240 | 86.250 | | 86.780 | | | | 84.000 | 82.400 | | 86.780 |

* See Motor Ratings Below
1) 13.2kV rated motors are connected to 13.8kV Bus
2) 4.0kV rated motors are connected to 4.16kV Bus
3) 460V rated motors are connected to 480V Bus
4) 230V rated motors are connected to 240V Bus
** Regulated Rectifiers continuous minimum voltage is 85% for scenario ST4

**Table 1B. Minimum Starting/Ride Through Bus Voltage Acceptance Criteria (%V)**

| Bus | Nominal Bus Voltage | Motor Starting Voltage (rated Volt*) | Contactor Required Holding Voltage (480V) | SFRCS Logic | Hydramotors (Not Modeled in ETAP) | Hydramotors (Modeled in ETAP) | Minimum Required Starting Bus Voltage |
|---|---|---|---|---|---|---|---|
| A | 13800 | 76.530 | | | | | 76.530 |
| B | 13800 | 76.530 | | | | | 76.530 |
| C1 | 4160 | 67.310 | | | | | 67.310 |
| CD | 4160 | 67.310 | | | | | 67.310 |
| D1 | 4160 | 67.310 | | | | | 67.310 |
| E1 | 480 | 67.090 | | | | | 67.090 |
| E11A | 480 | 67.090 | 60.200 | | | | 67.090 |
| E11B | 480 | 67.090 | 59.070 | | | | 67.090 |
| E11C | 480 | 67.090 | 60.350 | | | | 67.090 |
| E11D | 480 | 67.090 | 58.880 | | | | 67.090 |
| E11E | 480 | 67.090 | 58.660 | | | 67.090 | 67.090 |
| E12A | 480 | 67.090 | 60.740 | | | 67.090 | 67.090 |
| E12B | 480 | 67.090 | 60.310 | | | | 67.090 |
| E12C | 480 | 67.090 | 58.500 | | | | 67.090 |
| E12D | 480 | 67.090 | 57.150 | | | | 67.090 |
| E12E | 480 | 67.090 | 58.610 | | | | 67.090 |
| E12F | 480 | 67.090 | 59.040 | | | | 67.090 |
| E14 | 480 | 67.090 | 58.330 | | | | 67.090 |
| E15 | 480 | 67.090 | 58.330 | | | | 67.090 |
| E16A | 480 | 67.090 | | | | | 67.090 |
| E16B | 480 | 67.090 | 58.850 | | | | 67.090 |
| EF12C | 480 | 67.090 | 58.560 | | | | 67.090 |
| EF12D | 480 | 67.090 | | | | | 67.090 |
| F1 | 480 | 67.090 | | | | | 67.090 |
| F11A | 480 | 67.090 | 60.370 | | | 67.090 | 67.090 |
| F11B | 480 | 67.090 | 60.320 | | | | 67.090 |
| F11C | 480 | 67.090 | 60.740 | | | | 67.090 |
| F11D | 480 | 67.090 | 58.640 | | | | 67.090 |
| F11E | 480 | 67.090 | 58.520 | | | | 67.090 |
| F12A | 480 | 67.090 | 59.760 | | | 67.090 | 67.090 |
| F12B | 480 | 67.090 | 58.810 | | | | 67.090 |
| F12C | 480 | 67.090 | 60.220 | | | | 67.090 |
| F12D | 480 | 67.090 | 58.790 | | | | 67.090 |
| F13 | 480 | 67.090 | | | | | 67.090 |
| F14 | 480 | 67.090 | 58.330 | | | | 67.090 |
| F15 | 480 | 67.090 | 59.020 | | | | 67.090 |
| F16A | 480 | 67.090 | 59.150 | | | | 67.090 |
| F16B | 480 | 67.090 | | | | | 67.090 |
| EF15 | 480 | 67.090 | | | | | 67.090 |
| XYE2 | 480 | 67.090 | | | | | 67.090 |
| YE1 | 120 | | 60.100 | | 65.000 | | 65.000 |
| YE2 | 240 | 67.090 | 58.520 | 62.000 | 65.000 | 67.090 | 67.090 |
| YF1 | 120 | | 60.080 | | 65.000 | | 65.000 |
| YF2 | 240 | 67.090 | 58.510 | 62.000 | 65.000 | 67.090 | 67.090 |

* See Motor Ratings Below
1) 13.2kV rated motors are connected to 13.8kV Bus
2) 4.0kV rated motors are connected to 4.16kV Bus
3) 460V rated motors are connected to 480V Bus
4) 230V rated motors are connected to 240V Bus

**Table 1C. Maximum Continuous Bus Voltage Acceptance Criteria (%V)**

| Bus | Nominal Bus Voltage | Maximum Bus Voltages | Motor Starting Voltage (rated Volt*) | Battery Chargers (Rated 480V) | CVT (Rated 480V) | Regulated Rectifier (Rated 480V) | SFRCS Logic | Maximum Continuous Bus Voltage |
|---|---|---|---|---|---|---|---|---|
| A | 13800 | 108.690 | 105.210 | | | | | 105.210 |
| B | 13800 | 108.690 | 105.210 | | | | | 105.210 |
| C1 | 4160 | 114.420 | 105.760 | | | | | 105.760 |
| CD | 4160 | 114.420 | 105.760 | | | | | 105.760 |
| D1 | 4160 | 114.420 | 105.760 | | | | | 105.760 |
| E1 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E11A | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E11B | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E11C | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E11D | 480 | 125.000 | 105.410 | 110.000 | | | | 105.410 |
| E11E | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E12A | 480 | 125.000 | 105.410 | 110.000 | | 110.000 | | 105.410 |
| E12B | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E12C | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E12D | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E12E | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E12F | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E14 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E15 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| E16A | 480 | 125.000 | 105.410 | | 110.000 | | | 105.410 |
| E16B | 480 | 125.000 | 105.410 | | | | | 105.410 |
| EF12C | 480 | 125.000 | 105.410 | | | | | 105.410 |
| EF12D | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F1 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F11A | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F11B | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F11C | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F11D | 480 | 125.000 | 105.410 | 110.000 | | | | 105.410 |
| F11E | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F12A | 480 | 125.000 | 105.410 | 110.000 | | 110.000 | | 105.410 |
| F12B | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F12C | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F12D | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F13 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F14 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F15 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| F16A | 480 | 125.000 | 105.410 | | 110.000 | | | 105.410 |
| F16B | 480 | 125.000 | 105.410 | | | | | 105.410 |
| EF15 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| XYE2 | 480 | 125.000 | 105.410 | | | | | 105.410 |
| YE2 | 240 | | | | | | 105.410 | 105.410 |
| YF2 | 240 | | | | | | 105.410 | 105.410 |

* See Motor Ratings Below
1) 13.2kV rated motors are connected to 13.8kV Bus
2) 4.0kV rated motors are connected to 4.16kV Bus
3) 460V rated motors are connected to 480V Bus
4) 230V rated motors are connected to 240V Bus

**Table 2. Minimum MCC Voltages**
**(Input to MOV Voltage Drop Calculations)**

| MCC | Nominal Voltage | ST1k | | ST1k1 | | ST1k2 | | ST4a4 | | ST4a5 | | ST4b | | **Minimum MCC Voltage** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Volts | %Rating | Volts | %Rating | Volts | %Rating | Volts | %Rating | Volts | %Rating | Volts | %Rating | |
| | | T=1 | | T=1 | | T=1 | | T=0 | | T=0 | | T=0 | | |
| E11A | 480 | **410.428** | 85.506% | 411.381 | 85.704% | 421.400 | 87.792% | 413.960 | 86.242% | | | | | 410.428 |
| E11B (2) | 480 | **409.986** | 85.414% | 410.940 | 85.613% | 420.852 | 87.678% | 413.433 | 86.132% | | | | | 409.986 |
| E11C(1) | 480 | **408.582** | 85.121% | 409.532 | 85.319% | 421.200 | 87.750% | 413.916 | 86.233% | | | | | 408.582 |
| E11D | 480 | **410.390** | 85.498% | 411.381 | 85.704% | 421.275 | 87.766% | 412.433 | 85.924% | | | | | 410.390 |
| E11E | 480 | **406.877** | 84.766% | 407.823 | 84.963% | 421.103 | 87.730% | 413.895 | 86.228% | | | | | 406.877 |
| E12A | 480 | 418.198 | 87.125% | 419.139 | 87.321% | 424.082 | 88.350% | **416.869** | 86.848% | | | | | 416.869 |
| E12B | 480 | **414.761** | 86.409% | 415.695 | 86.603% | 421.180 | 87.746% | 416.049 | 86.677% | | | | | 414.761 |
| E12C | 480 | 415.538 | 86.570% | 416.482 | 86.767% | 421.447 | 87.801% | **414.638** | 86.383% | | | | | 414.638 |
| E12D | 480 | 415.409 | 86.544% | 416.354 | 86.740% | 421.320 | 87.775% | **414.510** | 86.356% | | | | | 414.510 |
| E12E | 480 | 416.672 | 86.807% | 417.610 | 87.002% | 423.257 | 88.179% | **414.945** | 86.447% | | | | | 414.945 |
| E12F | 480 | **414.076** | 86.266% | 415.012 | 86.461% | 420.506 | 87.605% | 415.949 | 86.656% | | | | | 414.076 |
| E14 | 480 | **416.695** | 86.811% | 417.631 | 87.006% | 422.529 | 88.027% | 416.968 | 86.868% | | | | | 416.695 |
| E15 | 480 | 418.932 | 87.278% | 419.873 | 87.474% | 424.798 | 88.500% | **417.518** | 86.983% | | | | | 417.518 |
| E16A | 480 | 418.338 | 87.154% | 419.278 | 87.350% | 424.198 | 88.375% | **416.833** | 86.840% | | | | | 416.833 |
| E16B | 480 | 418.264 | 87.138% | 419.204 | 87.334% | 424.123 | 88.359% | **416.118** | 86.691% | | | | | 416.118 |
| E22A | 480 | 423.796 | 88.291% | 424.131 | 88.361% | 424.529 | 88.444% | | | | | **406.190** | 84.623% | 406.190 |
| EF12C | 480 | 415.344 | 86.530% | 416.289 | 86.727% | 421.256 | 87.762% | **414.445** | 86.343% | | | | | 414.445 |
| EF12D | 480 | 418.198 | 87.125% | 419.139 | 87.321% | 424.082 | 88.350% | **416.869** | 86.848% | | | | | 416.869 |
| F11A (2) | 480 | 417.203 | 86.917% | 417.479 | 86.975% | 427.368 | 89.035% | **413.887** | 86.226% | | | | | 413.887 |
| F11B | 480 | 416.678 | 86.808% | 416.953 | 86.865% | 426.842 | 88.925% | **413.887** | 86.226% | | | | | 413.887 |
| F11C | 480 | 416.658 | 86.804% | 416.893 | 86.853% | 426.809 | 88.919% | **411.437** | 85.716% | | | | | 411.437 |
| F11D(1) | 480 | **409.524** | 85.318% | 409.795 | 85.374% | 427.235 | 89.007% | 413.621 | 86.171% | | | | | 409.524 |
| F11E | 480 | 416.898 | 86.854% | 417.174 | 86.911% | 427.055 | 88.970% | **412.363** | 85.909% | | | | | 412.363 |
| F11F | 480 | 416.740 | 86.821% | 417.015 | 86.878% | 426.893 | 88.936% | **412.206** | 85.876% | | | | | 412.206 |
| F12A | 480 | 422.051 | 87.927% | 422.347 | 87.989% | 428.726 | 89.318% | **416.702** | 86.813% | | | | | 416.702 |
| F12B | 480 | 419.003 | 87.292% | 419.297 | 87.354% | 426.182 | 88.788% | **415.950** | 86.656% | | | | | 415.950 |
| F12C | 480 | 420.106 | 87.522% | 420.402 | 87.584% | 426.796 | 88.916% | **415.217** | 86.504% | | | | | 415.217 |
| F12D | 480 | 419.691 | 87.436% | 419.988 | 87.498% | 426.388 | 88.831% | **414.797** | 86.416% | | | | | 414.797 |
| F14 | 480 | 420.360 | 87.575% | 420.654 | 87.636% | 426.917 | 88.941% | **416.702** | 86.813% | | | | | 416.702 |
| F15 | 480 | 423.025 | 88.130% | 423.321 | 88.192% | 429.624 | 89.505% | **417.353** | 86.949% | | | | | 417.353 |
| F16A | 480 | 422.906 | 88.105% | 423.202 | 88.167% | 429.503 | 89.480% | **417.189** | 86.914% | | | | | 417.189 |
| F16B | 480 | 422.835 | 88.091% | 423.131 | 88.152% | 429.431 | 89.465% | **417.119** | 86.900% | | | | | 417.119 |
| F21A | 480 | 430.302 | 89.646% | 430.641 | 89.717% | 431.049 | 89.802% | | | | | **414.078** | 86.266% | 414.078 |
| YE2 | 240 | **205.705** | 85.710% | 206.186 | 85.911% | 211.181 | 87.992% | 211.517 | 88.132% | | | | | 205.705 |
| YF2 | 240 | **210.377** | 87.657% | 210.517 | 87.715% | 215.519 | 89.800% | 211.865 | 88.277% | | | | | 210.377 |
| E11C for MV612 (1) | | 408.582 | 85.121% | 409.532 | 85.319% | 421.200 | 87.750% | | | **405.001** | 84.375% | | | 405.001 |
| F11D for MV601 (1) | | 409.524 | 85.318% | 409.795 | 85.374% | 427.235 | 89.007% | | | **401.966** | 83.743% | | | 401.966 |
| E11B for MVDH120 (2) | | 448.566 | 93.451% | 448.566 | 93.451% | 443.547 | 92.406% | **419.952** | 87.490% | | | | | 419.952 |
| F11A for MVDH110 (2) | | 452.931 | 94.361% | 452.931 | 94.361% | 447.876 | 93.308% | **420.581** | 87.621% | | | | | 420.581 |

Note 1: MV601 and MV612 are running in study case ST4a5 and are not running in study case ST4a4. Therefore, the steady state voltages for MCC E11C and MCC F11D to be used for MV612 and MV601, respectively, include a comparison between the most limiting ST1 case and case ST4a5. For all other MOVs fed from MCC E11C and MCC F11D, the MCC voltage comparison is between the most limiting ST1 case and case ST4a4.

Note 2: MVDH120 (fed from MCC E11B) and MVDH110 (fed from MCC F11A) are manually operated valves. Therefore, the steady-state voltages for MCC E11B and MCC F11A to be used for MVDH120 and MVDH110, respectively, correspond to model event T=4 in the above cases.

**Table 3. Scenarios LF1-LF4: Mode 1-4 Non-Accident Maximum Loading Minimum and Maximum Bus Voltages (Sheet 1 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| A 13.8KV SWGR | 13.8 | 86.090 | 94.149 | LF2d | 105.210 | 99.356 | LF2c |
| A MP2-1 | 13.8 | 86.090 | 94.107 | LF2d | 105.210 | 99.316 | LF2c |
| A MP2-3 | 13.8 | 86.090 | 94.114 | LF2d | 105.210 | 99.322 | LF2c |
| A MP36-1 | 13.8 | 86.090 | 94.106 | LF2d | 105.210 | 99.315 | LF2c |
| A MP36-4 | 13.8 | 86.090 | 94.128 | LF2d | 105.210 | 99.336 | LF2c |
| B 13.8KV SWGR | 13.8 | 86.090 | 94.146 | LF2d | 105.210 | 99.441 | LF2b |
| B MP2-2 | 13.8 | 86.090 | 94.092 | LF2d | 105.210 | 99.390 | LF2b |
| B MP2-4 | 13.8 | 86.090 | 94.099 | LF2d | 105.210 | 99.397 | LF2b |
| B MP36-2 | 13.8 | 86.090 | 94.097 | LF2d | 105.210 | 99.395 | LF2b |
| B MP36-3 | 13.8 | 86.090 | 94.127 | LF2d | 105.210 | 99.423 | LF2b |
| BF81 MCC | 0.48 | 86.250 | 94.602 | LF2d | 105.410 | 99.469 | LF2a |
| BF81 DBCSBOP | 0.48 | 82.000 | 94.521 | LF2d | 110.000 | 99.384 | LF2a |
| C1 4160 SWGR | 4.16 | 91.010 | 94.760 | LF2d | 105.760 | 99.341 | LF3b |
| C1 MP3-1 | 4.16 | 86.540 | 94.587 | LF2d | 105.760 | 99.176 | LF3b |
| C1 MP37-1A | 4.16 | 86.540 | 94.674 | LF2d | 105.760 | 99.259 | LF3b |
| C1 MP42-1 | 4.16 | 86.540 | 94.760 | LF2d | 105.760 | 99.341 | LF3b |
| C1 MP43-1 | 4.16 | 86.540 | 94.760 | LF2d | 105.760 | 99.341 | LF3b |
| C1 MP58-1 | 4.16 | 86.540 | 94.760 | LF2d | 105.760 | 99.341 | LF3b |
| C2 4160 SWGR | 4.16 | 86.540 | 94.765 | LF2d | 105.760 | 99.345 | LF3b |
| D1 4160 SWGR | 4.16 | 91.010 | 95.335 | LF2d | 105.760 | 100.221 | LF2a |
| D1 MP3-2 | 4.16 | 86.540 | 95.128 | LF2d | 105.760 | 100.024 | LF2a |
| D1 MP37-2A | 4.16 | 86.540 | 95.335 | LF2d | 105.760 | 100.221 | LF2a |
| D1 MP42-2 | 4.16 | 86.540 | 95.335 | LF2d | 105.760 | 100.221 | LF2a |
| D1 MP43-2 | 4.16 | 86.540 | 95.276 | LF2d | 105.760 | 100.165 | LF2a |
| D1 MP58-2 | 4.16 | 86.540 | 95.335 | LF2d | 105.760 | 100.221 | LF2a |
| D2 4160 SWGR | 4.16 | 86.540 | 95.338 | LF2d | 105.760 | 100.224 | LF2a |
| D3 4160 SWGR | 4.16 | 86.540 | 95.330 | LF2d | 105.760 | 100.217 | LF2a |
| E1 480V SWGR | 0.48 | 86.250 | 94.786 | LF2d | 105.410 | 100.033 | LF3b |
| E1 MP56-1 | 0.48 | 86.250 | 94.786 | LF2d | 105.410 | 100.033 | LF3b |
| E11A MCC | 0.48 | 87.100 | 94.644 | LF2d | 105.410 | 99.925 | LF3b |
| E11A MC62-1 | 0.48 | 86.250 | 94.644 | LF2d | 105.410 | 99.925 | LF3b |
| E11A MP89-1A | 0.48 | 86.250 | 94.644 | LF2d | 105.410 | 99.925 | LF3b |
| E11A MP89-1B | 0.48 | 86.250 | 94.644 | LF2d | 105.410 | 99.925 | LF3b |
| E11A MP89-3A | 0.48 | 86.250 | 94.644 | LF2d | 105.410 | 99.925 | LF3b |
| E11A MP89-3B | 0.48 | 86.250 | 94.644 | LF2d | 105.410 | 99.925 | LF3b |
| E11B MCC | 0.48 | 87.100 | 94.617 | LF2d | 105.410 | 99.899 | LF3b |
| E11B MC56-1 | 0.48 | 86.250 | 94.105 | LF2d | 105.410 | 99.415 | LF3b |
| E11C MCC | 0.48 | 87.100 | 94.636 | LF2d | 105.410 | 99.925 | LF3b |
| E11C MC75-1 | 0.48 | 86.250 | 92.599 | LF2d | 105.410 | 99.925 | LF3b |
| E11D MCC | 0.48 | 86.770 | 94.637 | LF2d | 105.410 | 99.918 | LF3b |
| E11D DBC1PN | 0.48 | 82.000 | 94.637 | LF2d | 110.000 | 99.918 | LF3b |
| E11D MP37-1B | 0.48 | 86.250 | 94.306 | LF2d | 105.410 | 99.605 | LF3b |
| E11D MRE5327 | 0.48 | 86.250 | 94.637 | LF2d | 105.410 | 99.918 | LF3b |
| E11E MCC | 0.48 | 87.100 | 94.636 | LF2d | 105.410 | 99.925 | LF3b |
| E11E MV49060 | 0.48 | 85.000 | 94.636 | LF2d | 105.410 | 99.925 | LF3b |
| E12A MCC | 0.48 | 90.000 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |

**Table 3. Scenarios LF1-LF4: Mode 1-4 Non-Accident Maximum Loading Minimum and Maximum Bus Voltages (Sheet 2 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| E12A DBC1N | 0.48 | 82.000 | 94.623 | LF2d | 110.000 | 99.888 | LF3b |
| E12A DBC1P | 0.48 | 82.000 | 94.631 | LF2d | 110.000 | 99.895 | LF3b |
| E12A MC21-1 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12A MC30-1 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12A MC71-1 | 0.48 | 86.250 | 94.497 | LF2d | 105.410 | 99.955 | LF3b |
| E12A MC73-1 | 0.48 | 86.250 | 94.008 | LF2d | 105.410 | 99.955 | LF3b |
| E12A MS3311 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12A MS61-1 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12A MV5597 | 0.48 | 85.000 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12A YRF1 | 0.48 | 90.000 | 94.547 | LF2d | 110.000 | 99.803 | LF3b |
| E12A YRF3 | 0.48 | 90.000 | 94.463 | LF2d | 110.000 | 99.715 | LF3b |
| E12B MCC | 0.48 | 87.100 | 94.537 | LF2d | 105.410 | 99.880 | LF3b |
| E12B MC25-1 | 0.48 | 86.250 | 93.484 | LF2d | 105.410 | 99.880 | LF3b |
| E12B MC25-2 | 0.48 | 86.250 | 93.750 | LF2d | 105.410 | 99.880 | LF3b |
| E12B MC78-1 | 0.48 | 86.250 | 94.076 | LF2d | 105.410 | 99.880 | LF3b |
| E12B MP147-1 | 0.48 | 86.250 | 94.244 | LF2d | 105.410 | 99.604 | LF3b |
| E12B MP147-3 | 0.48 | 86.250 | 94.453 | LF2d | 105.410 | 99.801 | LF3b |
| E12B YE1 | 0.48 | 82.100 | 94.537 | LF2d | 105.410 | 99.880 | LF3b |
| E12C MCC | 0.48 | 87.100 | 94.266 | LF2d | 105.410 | 99.799 | LF3b |
| E12C MC99-1 | 0.48 | 86.250 | 93.254 | LF2d | 105.410 | 99.799 | LF3b |
| E12C MC99-2 | 0.48 | 86.250 | 93.670 | LF2d | 105.410 | 99.799 | LF3b |
| E12C MF15-1 | 0.48 | 86.250 | 94.037 | LF2d | 105.410 | 99.583 | LF3b |
| E12D MCC | 0.48 | 86.250 | 94.241 | LF2d | 105.410 | 99.776 | LF3b |
| E12E MCC | 0.48 | 87.100 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12E MC31-4 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12E MC31-5 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12E MP197-1 | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| E12F MCC | 0.48 | 86.250 | 94.426 | LF2d | 105.410 | 99.776 | LF3b |
| E12F MC25-5 | 0.48 | 86.250 | 94.426 | LF2d | 105.410 | 99.776 | LF3b |
| E12F MP195-1 | 0.48 | 86.250 | 94.426 | LF2d | 105.410 | 99.776 | LF3b |
| E14 MCC | 0.48 | 86.250 | 94.529 | LF2d | 105.410 | 99.790 | LF3b |
| E14 MC1-1 | 0.48 | 86.250 | 93.420 | LF2d | 105.410 | 98.741 | LF3b |
| E14 MC1-1LS | 0.48 | 86.250 | | | 105.410 | | |
| E15 MCC | 0.48 | 86.250 | 94.786 | LF2d | 105.410 | 100.033 | LF3b |
| E16A MCC | 0.48 | 89.800 | 94.655 | LF2d | 105.410 | 99.991 | LF3b |
| E16A MP274-1 | 0.48 | 86.250 | 94.352 | LF2d | 105.410 | 99.671 | LF3b |
| E16A XY1 | 0.48 | 85.000 | 94.606 | LF2d | 110.000 | 99.940 | LF3b |
| E16A XY3 | 0.48 | 85.000 | 94.586 | LF2d | 110.000 | 99.918 | LF3b |
| E16B MCC | 0.48 | 90.300 | 94.638 | LF2d | 105.410 | 99.973 | LF3b |
| E16B MP273-1 | 0.48 | 86.250 | 94.471 | LF2d | 105.410 | 99.796 | LF3b |
| E2 480V SWGR | 0.48 | | 89.291 | LF2d | | 94.432 | LF2c |
| E21A MCC | 0.48 | | 88.707 | LF2d | | 93.831 | LF2c |
| E21B MCC | 0.48 | | 88.677 | LF2d | | 93.799 | LF2c |
| E21C MCC | 0.48 | | 88.183 | LF2d | | 93.289 | LF2c |
| E21D MCC | 0.48 | | 88.707 | LF2d | | 93.831 | LF2c |
| E22A MCC | 0.48 | | 88.404 | LF2d | | 93.524 | LF2c |

**Table 3. Scenarios LF1-LF4: Mode 1-4 Non-Accident Maximum Loading Minimum and Maximum Bus Voltages (Sheet 3 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| E22B MCC | 0.48 | | 88.391 | LF2d | | 93.510 | LF2c |
| E23A MCC | 0.48 | | 88.767 | LF2d | | 93.910 | LF2c |
| E23B MCC | 0.48 | | 88.275 | LF2d | | 93.410 | LF2c |
| E3 480V SWGR | 0.48 | | 90.986 | LF2d | | 96.191 | LF2c |
| E31A MCC | 0.48 | | 89.294 | LF2d | | 94.508 | LF2c |
| E31B MCC | 0.48 | | 89.206 | LF2d | | 94.424 | LF2c |
| E32A MCC | 0.48 | | 90.883 | LF2d | | 96.087 | LF2c |
| E32B MCC | 0.48 | | 90.387 | LF2d | | 95.594 | LF2c |
| E33A MCC | 0.48 | | 90.354 | LF2d | | 95.578 | LF2c |
| E33B MCC | 0.48 | | 90.354 | LF2d | | 95.578 | LF2c |
| E4 480V SWGR | 0.48 | | 91.290 | LF2d | | 96.498 | LF2c |
| E41A MCC | 0.48 | | 90.948 | LF2d | | 96.146 | LF2c |
| E41B MCC | 0.48 | | 90.658 | LF2d | | 95.855 | LF2c |
| E42 MCC | 0.48 | | 92.335 | LF2d | | 96.839 | LF3b |
| E43 MCC | 0.48 | | 91.290 | LF2d | | 96.498 | LF2c |
| E6 480V SWGR | 0.48 | | 94.062 | LF2d | | 99.264 | LF2c |
| E61 MCC | 0.48 | | 93.941 | LF2d | | 99.136 | LF2c |
| E62 MCC | 0.48 | | 94.062 | LF2d | | 99.264 | LF2c |
| E63 MCC | 0.48 | | 94.062 | LF2d | | 99.264 | LF2c |
| EF12C MCC | 0.48 | 86.250 | 94.229 | LF2d | 105.410 | 99.765 | LF3b |
| EF12C MF15-3 | 0.48 | 86.250 | 94.229 | LF2d | 105.410 | 99.765 | LF3b |
| EF12D MCC | 0.48 | 86.250 | 94.691 | LF2d | 105.410 | 99.955 | LF3b |
| EF41 AE4 | 0.48 | | 91.290 | LF2d | | 96.498 | LF2c |
| EF41 BF4 | 0.48 | | 92.974 | LF2d | | 98.237 | LF2b |
| F1 480V SWGR | 0.48 | 86.250 | 95.664 | LF2d | 105.410 | 100.931 | LF3b |
| F1 MP56-2 | 0.48 | 86.250 | 95.664 | LF2d | 105.410 | 100.931 | LF3b |
| F11A MCC | 0.48 | 87.100 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11A MC21-2 | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11A MC62-2 | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11A MC75-2 | 0.48 | 86.250 | 94.397 | LF2d | 105.410 | 100.859 | LF3b |
| F11A MRE5328 | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11A MS3321 | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11A MV4907 | 0.48 | 85.000 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11B MCC | 0.48 | 87.100 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11C MCC | 0.48 | 87.100 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11C MP37-2B | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11C MP37-2D | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11D MCC | 0.48 | 87.100 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11D DBC2PN | 0.48 | 82.000 | 95.571 | LF2d | 110.000 | 100.859 | LF3b |
| F11D MC31-3 | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11D MP89-2A | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11D MP89-2B | 0.48 | 86.250 | 95.571 | LF2d | 105.410 | 100.859 | LF3b |
| F11E MCC | 0.48 | 86.250 | 95.502 | LF2d | 105.410 | 100.785 | LF3b |
| F11E MC31-1 | 0.48 | 86.250 | 95.502 | LF2d | 105.410 | 100.785 | LF3b |
| F11E MC31-2 | 0.48 | 86.250 | 95.502 | LF2d | 105.410 | 100.785 | LF3b |
| F11F MCC | 0.48 | 86.250 | 95.465 | LF2d | 105.410 | 100.747 | LF3b |

**Table 3. Scenarios LF1-LF4: Mode 1-4 Non-Accident Maximum Loading Minimum and Maximum Bus Voltages (Sheet 4 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| F12A MCC | 0.48 | 90.000 | 95.549 | LF2d | 105.410 | 100.841 | LF3b |
| F12A DBC2N | 0.48 | 82.000 | 95.452 | LF2d | 110.000 | 100.744 | LF3b |
| F12A DBC2P | 0.48 | 82.000 | 95.452 | LF2d | 110.000 | 100.744 | LF3b |
| F12A MC133 | 0.48 | 86.250 | 94.410 | LF2d | 105.410 | 100.841 | LF3b |
| F12A MC30-2 | 0.48 | 86.250 | 95.549 | LF2d | 105.410 | 100.841 | LF3b |
| F12A MC73-2 | 0.48 | 86.250 | 93.289 | LF2d | 105.410 | 100.841 | LF3b |
| F12A MP195-2 | 0.48 | 86.250 | 95.549 | LF2d | 105.410 | 100.841 | LF3b |
| F12A MP198-1 | 0.48 | 86.250 | 95.549 | LF2d | 105.410 | 100.841 | LF3b |
| F12A MS61-2 | 0.48 | 86.250 | 95.549 | LF2d | 105.410 | 100.841 | LF3b |
| F12A MV5598 | 0.48 | 85.000 | 95.549 | LF2d | 105.410 | 100.841 | LF3b |
| F12A YRF2 | 0.48 | 90.000 | 95.380 | LF2d | 110.000 | 100.663 | LF3b |
| F12A YRF4 | 0.48 | 90.000 | 95.307 | LF2d | 110.000 | 100.586 | LF3b |
| F12B MCC | 0.48 | 87.100 | 95.417 | LF2d | 105.410 | 100.785 | LF3b |
| F12B MC25-3 | 0.48 | 86.250 | 94.785 | LF2d | 105.410 | 100.785 | LF3b |
| F12B MC25-4 | 0.48 | 86.250 | 94.490 | LF2d | 105.410 | 100.785 | LF3b |
| F12B MC78-2 | 0.48 | 86.250 | 95.129 | LF2d | 105.410 | 100.785 | LF3b |
| F12B MP147-2 | 0.48 | 86.250 | 95.113 | LF2d | 105.410 | 100.498 | LF3b |
| F12B MP147-4 | 0.48 | 86.250 | 95.322 | LF2d | 105.410 | 100.696 | LF3b |
| F12B YF1 | 0.48 | 81.600 | 95.380 | LF2d | 105.410 | 100.750 | LF3b |
| F12C MCC | 0.48 | 87.100 | 95.268 | LF2d | 105.410 | 100.828 | LF3b |
| F12C MF15-2 | 0.48 | 87.100 | 95.061 | LF2d | 105.410 | 100.632 | LF3b |
| F12D MCC | 0.48 | 86.250 | 95.189 | LF2d | 105.410 | 100.828 | LF3b |
| F12D MC99-3 | 0.48 | 86.250 | 94.497 | LF2d | 105.410 | 100.828 | LF3b |
| F12D MC99-4 | 0.48 | 86.250 | 94.356 | LF2d | 105.410 | 100.828 | LF3b |
| F13 MCC | 0.48 | 86.250 | 94.874 | LF2d | 105.410 | 99.738 | LF2a |
| F14 MCC | 0.48 | 86.250 | 95.362 | LF2d | 105.410 | 100.646 | LF3b |
| F14 MC1-2 | 0.48 | 86.250 | 94.192 | LF2d | 105.410 | 99.539 | LF3b |
| F14 MC1-2LS | 0.48 | 86.250 | | | 105.410 | | |
| F15 MCC | 0.48 | 86.250 | 95.664 | LF2d | 105.410 | 100.931 | LF3b |
| F16A MCC | 0.48 | 89.700 | 95.637 | LF2d | 105.410 | 100.903 | LF3b |
| F16A MC25-6 | 0.48 | 86.250 | 95.637 | LF2d | 105.410 | 100.903 | LF3b |
| F16A MP274-3 | 0.48 | 86.250 | 95.393 | LF2d | 105.410 | 100.645 | LF3b |
| F16A XY2 | 0.48 | 85.000 | 95.624 | LF2d | 110.000 | 100.890 | LF3b |
| F16A XY4 | 0.48 | 85.000 | 95.606 | LF2d | 110.000 | 100.870 | LF3b |
| F16B MCC | 0.48 | 90.500 | 95.621 | LF2d | 105.410 | 100.886 | LF3b |
| F16B MP273-4 | 0.48 | 86.250 | 95.085 | LF2d | 105.410 | 100.321 | LF3b |
| F2 480V SWGR | 0.48 | | 90.094 | LF2d | | 95.401 | LF2b |
| F21A MCC | 0.48 | | 89.804 | LF2d | | 95.102 | LF2b |
| F21B MCC | 0.48 | | 89.703 | LF2d | | 94.995 | LF2b |
| F21C MCC | 0.48 | | 89.801 | LF2d | | 95.099 | LF2b |
| F22 MCC | 0.48 | | 88.730 | LF2d | | 94.108 | LF2b |
| F23A MCC | 0.48 | | 89.503 | LF2d | | 94.824 | LF2b |
| F23B MCC | 0.48 | | 88.623 | LF2d | | 93.965 | LF2b |
| F3 480V SWGR | 0.48 | | 90.920 | LF2d | | 96.131 | LF2b |
| F31A MCC | 0.48 | | 90.370 | LF2d | | 95.557 | LF2b |
| F31B MCC | 0.48 | | 89.286 | LF2d | | 94.509 | LF3b |

**Table 3. Scenarios LF1-LF4: Mode 1-4 Non-Accident Maximum Loading Minimum and Maximum Bus Voltages (Sheet 5 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| F32A MCC | 0.48 | | 90.693 | LF2d | | 95.910 | LF2b |
| F32B MCC | 0.48 | | 90.190 | LF2d | | 95.435 | LF2b |
| F33A MCC | 0.48 | | 90.378 | LF2d | | 95.571 | LF2b |
| F33B MCC | 0.48 | | 90.313 | LF2d | | 95.507 | LF2b |
| F4 480V SWGR | 0.48 | | 92.974 | LF2d | | 98.237 | LF2b |
| F41A MCC | 0.48 | | 92.604 | LF2d | | 97.857 | LF2b |
| F41B MCC | 0.48 | | 92.585 | LF2d | | 97.840 | LF2b |
| F4A LOAD CTR | 0.48 | | 93.759 | LF2d | | 99.032 | LF2b |
| F6 480V SWGR | 0.48 | | 94.089 | LF2d | | 99.381 | LF2b |
| F61 MCC | 0.48 | | 94.089 | LF2d | | 99.381 | LF2b |
| F62 MCC | 0.48 | | 94.017 | LF2d | | 99.305 | LF2b |
| F63 MCC | 0.48 | | 94.089 | LF2d | | 99.381 | LF2b |
| F7 480V SWGR | 0.48 | | 95.001 | LF2d | | 99.872 | LF2a |
| F71 MCC | 0.48 | | 94.966 | LF2d | | 99.836 | LF2a |
| M22A MCC | 0.48 | | 90.920 | LF2d | | 96.131 | LF2b |
| YE2 MCC | 0.24 | 87.080 | 97.043 | LF2d | 105.410 | 102.461 | LF3b |
| YE2 MV5443C | 0.24 | 85.000 | 97.043 | LF2d | 105.410 | 102.461 | LF3b |
| YF2 MCC | 0.24 | 86.780 | 98.022 | LF2d | 105.410 | 103.445 | LF3b |
| YF2 MV5444C | 0.24 | 85.000 | 98.022 | LF2d | 105.410 | 103.445 | LF3b |

**Table 4. Scenario LF5: Mode 5 and 6 Non-Accident Light Loading Minimum and Maximum Bus Voltages (Sheet 1 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| A 13.8KV SWGR | 13.8 | 86.090 | 102.571 | LF5c1 | 105.210 | **105.358** | LF5c |
| A MP2-1 | 13.8 | 86.090 | 102.571 | LF5c1 | 105.210 | **105.358** | LF5c |
| A MP2-3 | 13.8 | 86.090 | 102.571 | LF5c1 | 105.210 | **105.358** | LF5c |
| A MP36-1 | 13.8 | 86.090 | 102.571 | LF5c1 | 105.210 | **105.358** | LF5c |
| A MP36-4 | 13.8 | 86.090 | 102.571 | LF5c1 | 105.210 | **105.358** | LF5c |
| B 13.8KV SWGR | 13.8 | 86.090 | 102.632 | LF5c1 | 105.210 | **105.417** | LF5c |
| B MP2-2 | 13.8 | 86.090 | 102.632 | LF5c1 | 105.210 | **105.417** | LF5c |
| B MP2-4 | 13.8 | 86.090 | 102.632 | LF5c1 | 105.210 | **105.417** | LF5c |
| B MP36-2 | 13.8 | 86.090 | 102.632 | LF5c1 | 105.210 | **105.417** | LF5c |
| B MP36-3 | 13.8 | 86.090 | 102.632 | LF5c1 | 105.210 | **105.417** | LF5c |
| BF81 MCC | 0.48 | 86.250 | 104.014 | LF5c1 | 105.410 | **106.857** | LF5c |
| BF81 DBCSBOP | 0.48 | 82.000 | 103.925 | LF5c1 | 110.000 | 106.766 | LF5c |
| C1 4160 SWGR | 4.16 | 91.010 | 104.421 | LF5c1 | 105.760 | **107.283** | LF5c |
| C1 MP3-1 | 4.16 | 86.540 | 104.263 | LF5c1 | 105.760 | **107.129** | LF5c |
| C1 MP37-1A | 4.16 | 86.540 | 104.421 | LF5c1 | 105.760 | **107.283** | LF5c |
| C1 MP42-1 | 4.16 | 86.540 | 104.368 | LF5c1 | 105.760 | **107.231** | LF5c |
| C1 MP43-1 | 4.16 | 86.540 | 104.368 | LF5c1 | 105.760 | **107.232** | LF5c |
| C1 MP58-1 | 4.16 | 86.540 | 104.421 | LF5c1 | 105.760 | **107.283** | LF5c |
| C2 4160 SWGR | 4.16 | 86.540 | 104.424 | LF5c1 | 105.760 | **107.286** | LF5c |
| D1 4160 SWGR | 4.16 | 91.010 | 104.673 | LF5c1 | 105.760 | **107.531** | LF5c |
| D1 MP3-2 | 4.16 | 86.540 | 104.485 | LF5c1 | 105.760 | **107.348** | LF5c |
| D1 MP37-2A | 4.16 | 86.540 | 104.673 | LF5c1 | 105.760 | **107.531** | LF5c |
| D1 MP42-2 | 4.16 | 86.540 | 104.673 | LF5c1 | 105.760 | **107.531** | LF5c |
| D1 MP43-2 | 4.16 | 86.540 | 104.673 | LF5c1 | 105.760 | **107.531** | LF5c |
| D1 MP58-2 | 4.16 | 86.540 | 104.673 | LF5c1 | 105.760 | **107.531** | LF5c |
| D2 4160 SWGR | 4.16 | 86.540 | 104.675 | LF5c1 | 105.760 | **107.533** | LF5c |
| D3 4160 SWGR | 4.16 | 86.540 | 104.668 | LF5c1 | 105.760 | **107.526** | LF5c |
| E1 480V SWGR | 0.48 | 86.250 | 103.607 | LF5c1 | 105.410 | **109.165** | LF5a |
| E1 MP56-1 | 0.48 | 86.250 | 103.607 | LF5c1 | 105.410 | **109.165** | LF5a |
| E11A MCC | 0.48 | 87.100 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11A MC62-1 | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11A MP89-1A | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11A MP89-1B | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11A MP89-3A | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11A MP89-3B | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11B MCC | 0.48 | 87.100 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11B MC56-1 | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11C MCC | 0.48 | 87.100 | 103.279 | LF5c1 | 105.410 | **108.820** | LF5a |
| E11C MC75-1 | 0.48 | 86.250 | 103.279 | LF5c1 | 105.410 | **108.820** | LF5a |
| E11D MCC | 0.48 | 86.770 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11D DBC1PN | 0.48 | 82.000 | 103.354 | LF5c1 | 110.000 | 108.898 | LF5a |
| E11D MP37-1B | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |
| E11D MRE5327 | 0.48 | 86.250 | 103.354 | LF5c1 | 105.410 | **108.898** | LF5a |

**Table 4. Scenario LF5: Mode 5 and 6 Non-Accident Light Loading Minimum and Maximum Bus Voltages (Sheet 2 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| E11E MCC | 0.48 | 87.100 | 103.279 | LF5c1 | 105.410 | **108.820** | LF5a |
| E11E MV49060 | 0.48 | 85.000 | 103.279 | LF5c1 | 105.410 | **108.820** | LF5a |
| E12A MCC | 0.48 | 90.000 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A DBC1N | 0.48 | 82.000 | 103.565 | LF5c1 | 110.000 | 109.122 | LF5a |
| E12A DBC1P | 0.48 | 82.000 | 103.566 | LF5c1 | 110.000 | 109.124 | LF5a |
| E12A MC21-1 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A MC30-1 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A MC71-1 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A MC73-1 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A MS3311 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A MS61-1 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A MV5597 | 0.48 | 85.000 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12A YRF1 | 0.48 | 90.000 | 103.420 | LF5c1 | 110.000 | 108.969 | LF5a |
| E12A YRF3 | 0.48 | 90.000 | 103.328 | LF5c1 | 110.000 | 108.872 | LF5a |
| E12B MCC | 0.48 | 87.100 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12B MC25-1 | 0.48 | 86.250 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12B MC25-2 | 0.48 | 86.250 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12B MC78-1 | 0.48 | 86.250 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12B MP147-1 | 0.48 | 86.250 | 103.255 | LF5c1 | 105.410 | **108.823** | LF5a |
| E12B MP147-3 | 0.48 | 86.250 | 103.446 | LF5c1 | 105.410 | **109.004** | LF5a |
| E12B YE1 | 0.48 | 82.100 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12C MCC | 0.48 | 87.100 | 103.427 | LF5c1 | 105.410 | **108.992** | LF5a |
| E12C MC99-1 | 0.48 | 86.250 | 103.427 | LF5c1 | 105.410 | **108.992** | LF5a |
| E12C MC99-2 | 0.48 | 86.250 | 103.427 | LF5c1 | 105.410 | **108.992** | LF5a |
| E12C MF15-1 | 0.48 | 86.250 | 103.219 | LF5c1 | 105.410 | **108.795** | LF5a |
| E12D MCC | 0.48 | 86.250 | 103.405 | LF5c1 | 105.410 | **108.971** | LF5a |
| E12E MCC | 0.48 | 87.100 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12E MC31-4 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12E MC31-5 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12E MP197-1 | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| E12F MCC | 0.48 | 86.250 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12F MC25-5 | 0.48 | 86.250 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E12F MP195-1 | 0.48 | 86.250 | 103.522 | LF5c1 | 105.410 | **109.077** | LF5a |
| E14 MCC | 0.48 | 86.250 | 103.607 | LF5c1 | 105.410 | **109.165** | LF5a |
| E14 MC1-1 | 0.48 | 86.250 | 103.607 | LF5c1 | 105.410 | **109.165** | LF5a |
| E14 MC1-1LS | 0.48 | 86.250 | | | 105.410 | | |
| E15 MCC | 0.48 | 86.250 | 103.607 | LF5c1 | 105.410 | **109.165** | LF5a |
| E16A MCC | 0.48 | 89.800 | 103.563 | LF5c1 | 105.410 | **109.119** | LF5a |
| E16A MP274-1 | 0.48 | 86.250 | 103.232 | LF5c1 | 105.410 | **108.770** | LF5a |
| E16A XY1 | 0.48 | 85.000 | 103.510 | LF5c1 | 110.000 | 109.063 | LF5a |
| E16A XY3 | 0.48 | 85.000 | 103.488 | LF5c1 | 110.000 | 109.040 | LF5a |
| E16B MCC | 0.48 | 90.300 | 103.545 | LF5c1 | 105.410 | **109.100** | LF5a |
| E16B MP273-1 | 0.48 | 86.250 | 103.362 | LF5c1 | 105.410 | **108.907** | LF5a |

**Table 4. Scenario LF5: Mode 5 and 6 Non-Accident Light Loading Minimum and Maximum Bus Voltages (Sheet 3 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| E2 480V SWGR | 0.48 | | 98.505 | LF5c1 | | 101.254 | LF5c |
| E21A MCC | 0.48 | | 97.848 | LF5c1 | | 100.583 | LF5c |
| E21B MCC | 0.48 | | 97.815 | LF5c1 | | 100.549 | LF5c |
| E21C MCC | 0.48 | | 97.347 | LF5c1 | | 100.068 | LF5c |
| E21D MCC | 0.48 | | 97.825 | LF5c1 | | 100.559 | LF5c |
| E22A MCC | 0.48 | | 97.100 | LF5c1 | | 99.818 | LF5c |
| E22B MCC | 0.48 | | 97.092 | LF5c1 | | 99.809 | LF5c |
| E23A MCC | 0.48 | | 98.121 | LF5c1 | | 100.873 | LF5c |
| E23B MCC | 0.48 | | 97.782 | LF5c1 | | 100.529 | LF5c |
| E3 480V SWGR | 0.48 | | 101.205 | LF5c1 | | 103.959 | LF5c |
| E31A MCC | 0.48 | | 100.992 | LF5c1 | | 103.740 | LF5c |
| E31B MCC | 0.48 | | 100.992 | LF5c1 | | 103.740 | LF5c |
| E32A MCC | 0.48 | | 101.135 | LF5c1 | | 103.887 | LF5c |
| E32B MCC | 0.48 | | 101.135 | LF5c1 | | 103.887 | LF5c |
| E33A MCC | 0.48 | | 100.658 | LF5c1 | | 103.403 | LF5c |
| E33B MCC | 0.48 | | 100.619 | LF5c1 | | 103.362 | LF5c |
| E4 480V SWGR | 0.48 | | 99.825 | LF5c1 | | 102.607 | LF5c |
| E41A MCC | 0.48 | | 99.536 | LF5c1 | | 102.314 | LF5c |
| E41B MCC | 0.48 | | 99.289 | LF5c1 | | 102.064 | LF5c |
| E42 MCC | 0.48 | | 101.831 | LF5c1 | | 104.643 | LF5c |
| E43 MCC | 0.48 | | 99.825 | LF5c1 | | 102.607 | LF5c |
| E6 480V SWGR | 0.48 | | 102.571 | LF5c1 | | 105.358 | LF5c |
| E61 MCC | 0.48 | | 102.571 | LF5c1 | | 105.358 | LF5c |
| E62 MCC | 0.48 | | 102.571 | LF5c1 | | 105.358 | LF5c |
| E63 MCC | 0.48 | | 102.571 | LF5c1 | | 105.358 | LF5c |
| EF12C MCC | 0.48 | 86.250 | 103.393 | LF5c1 | 105.410 | **108.961** | LF5a |
| EF12C MF15-3 | 0.48 | 86.250 | 103.393 | LF5c1 | 105.410 | **108.961** | LF5a |
| EF12D MCC | 0.48 | 86.250 | 103.577 | LF5c1 | 105.410 | **109.134** | LF5a |
| EF41 AE4 | 0.48 | | 99.825 | LF5c1 | | 102.607 | LF5c |
| EF41 BF4 | 0.48 | | 100.836 | LF5c1 | | 103.613 | LF5c |
| F1 480V SWGR | 0.48 | 86.250 | 103.681 | LF5c1 | 105.410 | **109.223** | LF5a |
| F1 MP56-2 | 0.48 | 86.250 | 103.681 | LF5c1 | 105.410 | **109.223** | LF5a |
| F11A MCC | 0.48 | 87.100 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11A MC21-2 | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11A MC62-2 | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11A MC75-2 | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11A MRE5328 | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11A MS3321 | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11A MV4907 | 0.48 | 85.000 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11B MCC | 0.48 | 87.100 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11C MCC | 0.48 | 87.100 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11C MP37-2B | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11C MP37-2D | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |

**Table 4. Scenario LF5: Mode 5 and 6 Non-Accident Light Loading Minimum and Maximum Bus Voltages (Sheet 4 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| F11D MCC | 0.48 | 87.100 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11D DBC2PN | 0.48 | 82.000 | 103.383 | LF5c1 | 110.000 | 108.908 | LF5a |
| F11D MC31-3 | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11D MP89-2A | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11D MP89-2B | 0.48 | 86.250 | 103.383 | LF5c1 | 105.410 | **108.908** | LF5a |
| F11E MCC | 0.48 | 86.250 | 103.307 | LF5c1 | 105.410 | **108.829** | LF5a |
| F11E MC31-1 | 0.48 | 86.250 | 103.307 | LF5c1 | 105.410 | **108.829** | LF5a |
| F11E MC31-2 | 0.48 | 86.250 | 103.307 | LF5c1 | 105.410 | **108.829** | LF5a |
| F11F MCC | 0.48 | 86.250 | 103.268 | LF5c1 | 105.410 | **108.787** | LF5a |
| F12A MCC | 0.48 | 90.000 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A DBC2N | 0.48 | 82.000 | 103.634 | LF5c1 | 110.000 | 109.174 | LF5a |
| F12A DBC2P | 0.48 | 82.000 | 103.634 | LF5c1 | 110.000 | 109.174 | LF5a |
| F12A MC133 | 0.48 | 86.250 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A MC30-2 | 0.48 | 86.250 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A MC73-2 | 0.48 | 86.250 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A MP195-2 | 0.48 | 86.250 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A MP198-1 | 0.48 | 86.250 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A MS61-2 | 0.48 | 86.250 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A MV5598 | 0.48 | 85.000 | 103.651 | LF5c1 | 105.410 | **109.192** | LF5a |
| F12A YRF2 | 0.48 | 90.000 | 103.468 | LF5c1 | 110.000 | 108.999 | LF5a |
| F12A YRF4 | 0.48 | 90.000 | 103.389 | LF5c1 | 110.000 | 108.916 | LF5a |
| F12B MCC | 0.48 | 87.100 | 103.603 | LF5c1 | 105.410 | **109.142** | LF5a |
| F12B MC25-3 | 0.48 | 86.250 | 103.603 | LF5c1 | 105.410 | **109.142** | LF5a |
| F12B MC25-4 | 0.48 | 86.250 | 103.603 | LF5c1 | 105.410 | **109.142** | LF5a |
| F12B MC78-2 | 0.48 | 86.250 | 103.603 | LF5c1 | 105.410 | **109.142** | LF5a |
| F12B MP147-2 | 0.48 | 86.250 | 103.324 | LF5c1 | 105.410 | **108.877** | LF5a |
| F12B MP147-4 | 0.48 | 86.250 | 103.516 | LF5c1 | 105.410 | **109.060** | LF5a |
| F12B YF1 | 0.48 | 81.600 | 103.569 | LF5c1 | 105.410 | **109.110** | LF5a |
| F12C MCC | 0.48 | 87.100 | 103.638 | LF5c1 | 105.410 | **109.180** | LF5a |
| F12C MF15-2 | 0.48 | 87.100 | 103.448 | LF5c1 | 105.410 | **108.999** | LF5a |
| F12D MCC | 0.48 | 86.250 | 103.638 | LF5c1 | 105.410 | **109.180** | LF5a |
| F12D MC99-3 | 0.48 | 86.250 | 103.638 | LF5c1 | 105.410 | **109.180** | LF5a |
| F12D MC99-4 | 0.48 | 86.250 | 103.638 | LF5c1 | 105.410 | **109.180** | LF5a |
| F13 MCC | 0.48 | 86.250 | 104.170 | LF5c1 | 105.410 | **107.016** | LF5c |
| F14 MCC | 0.48 | 86.250 | 103.681 | LF5c1 | 105.410 | **109.223** | LF5a |
| F14 MC1-2 | 0.48 | 86.250 | 103.681 | LF5c1 | 105.410 | **109.223** | LF5a |
| F14 MC1-2LS | 0.48 | 86.250 | | | 105.410 | | |
| F15 MCC | 0.48 | 86.250 | 103.681 | LF5c1 | 105.410 | **109.223** | LF5a |
| F16A MCC | 0.48 | 89.700 | 103.652 | LF5c1 | 105.410 | **109.192** | LF5a |
| F16A MC25-6 | 0.48 | 86.250 | 103.652 | LF5c1 | 105.410 | **109.192** | LF5a |
| F16A MP274-3 | 0.48 | 86.250 | 103.388 | LF5c1 | 105.410 | **108.913** | LF5a |
| F16A XY2 | 0.48 | 85.000 | 103.639 | LF5c1 | 110.000 | 109.178 | LF5a |
| F16A XY4 | 0.48 | 85.000 | 103.619 | LF5c1 | 110.000 | 109.157 | LF5a |

**Table 4. Scenario LF5: Mode 5 and 6 Non-Accident Light Loading Minimum and Maximum Bus Voltages (Sheet 5 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| F16B MCC | 0.48 | 90.500 | 103.635 | LF5c1 | 105.410 | **109.174** | LF5a |
| F16B MP273-4 | 0.48 | 86.250 | 103.055 | LF5c1 | 105.410 | **108.562** | LF5a |
| F2 480V SWGR | 0.48 | | 98.787 | LF5c1 | | 101.557 | LF5c |
| F21A MCC | 0.48 | | 98.121 | LF5c1 | | 100.878 | LF5c |
| F21B MCC | 0.48 | | 98.011 | LF5c1 | | 100.765 | LF5c |
| F21C MCC | 0.48 | | 98.109 | LF5c1 | | 100.866 | LF5c |
| F22 MCC | 0.48 | | 97.221 | LF5c1 | | 99.996 | LF5c |
| F23A MCC | 0.48 | | 98.314 | LF5c1 | | 101.088 | LF5c |
| F23B MCC | 0.48 | | 97.764 | LF5c1 | | 100.544 | LF5c |
| F3 480V SWGR | 0.48 | | 99.579 | LF5c1 | | 102.294 | LF5c |
| F31A MCC | 0.48 | | 99.030 | LF5c1 | | 101.730 | LF5c |
| F31B MCC | 0.48 | | 98.170 | LF5c1 | | 100.846 | LF5c |
| F32A MCC | 0.48 | | 99.470 | LF5c1 | | 102.183 | LF5c |
| F32B MCC | 0.48 | | 99.383 | LF5c1 | | 102.094 | LF5c |
| F33A MCC | 0.48 | | 99.062 | LF5c1 | | 101.765 | LF5c |
| F33B MCC | 0.48 | | 99.062 | LF5c1 | | 101.765 | LF5c |
| F4 480V SWGR | 0.48 | | 100.836 | LF5c1 | | 103.613 | LF5c |
| F41A MCC | 0.48 | | 100.258 | LF5c1 | | 103.033 | LF5c |
| F41B MCC | 0.48 | | 100.203 | LF5c1 | | 102.976 | LF5c |
| F4A LOAD CTR | 0.48 | | 102.620 | LF5c1 | | 105.406 | LF5c |
| F6 480V SWGR | 0.48 | | 102.632 | LF5c1 | | 105.417 | LF5c |
| F61 MCC | 0.48 | | 102.632 | LF5c1 | | 105.417 | LF5c |
| F62 MCC | 0.48 | | 102.632 | LF5c1 | | 105.417 | LF5c |
| F63 MCC | 0.48 | | 102.632 | LF5c1 | | 105.417 | LF5c |
| F7 480V SWGR | 0.48 | | 104.310 | LF5c1 | | 107.159 | LF5c |
| F71 MCC | 0.48 | | 104.272 | LF5c1 | | 107.120 | LF5c |
| M22A MCC | 0.48 | | 99.579 | LF5c1 | | 102.294 | LF5c |
| YE2 MCC | 0.24 | 87.080 | 106.004 | LF5c1 | 105.410 | **111.690** | LF5a |
| YE2 MV5443C | 0.24 | 85.000 | 106.004 | LF5c1 | 105.410 | **111.690** | LF5a |
| YF2 MCC | 0.24 | 86.780 | 106.034 | LF5c1 | 105.410 | **111.701** | LF5a |
| YF2 MV5444C | 0.24 | 85.000 | 106.034 | LF5c1 | 105.410 | **111.701** | LF5a |

**Table 5. Scenario ST1: Mode 1 Design Basis Accident**
**Transient Minimum Bus Voltages (Sheet 1 of 4)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| A 13.8KV SWGR | 13.8 | 86.090 | 76.530 | 93.802 | ST1k | 89.100 | ST1k2 | 92.707 | ST1k | 93.014 | ST1k | 93.184 | ST1k2 | 93.215 | ST1k2 |
| A MP2-1 | 13.8 | 86.090 | 76.530 | 93.760 | ST1k | 89.056 | ST1k2 | 92.664 | ST1k | 92.971 | ST1k | 93.141 | ST1k2 | 93.173 | ST1k2 |
| A MP2-3 | 13.8 | 86.090 | 76.530 | 93.767 | ST1k | 89.063 | ST1k2 | 92.671 | ST1k | 92.978 | ST1k | 93.148 | ST1k2 | 93.180 | ST1k2 |
| A MP36-1 | 13.8 | 86.090 | 76.530 | 93.759 | ST1k | 89.055 | ST1k2 | 92.663 | ST1k | 92.970 | ST1k | 93.140 | ST1k2 | 93.172 | ST1k2 |
| A MP36-4 | 13.8 | 86.090 | 76.530 | 93.782 | ST1k | 89.079 | ST1k2 | 92.686 | ST1k | 92.993 | ST1k | 93.163 | ST1k2 | 93.195 | ST1k2 |
| B 13.8KV SWGR | 13.8 | 86.090 | 76.530 | 93.799 | ST1k | 89.098 | ST1k2 | 92.704 | ST1k | 93.011 | ST1k | 93.181 | ST1k2 | 93.213 | ST1k2 |
| B MP2-2 | 13.8 | 86.090 | 76.530 | 93.745 | ST1k | 89.041 | ST1k2 | 92.649 | ST1k | 92.956 | ST1k | 93.127 | ST1k2 | 93.158 | ST1k2 |
| B MP2-4 | 13.8 | 86.090 | 76.530 | 93.752 | ST1k | 89.048 | ST1k2 | 92.657 | ST1k | 92.963 | ST1k | 93.134 | ST1k2 | 93.165 | ST1k2 |
| B MP36-2 | 13.8 | 86.090 | 76.530 | 93.750 | ST1k | 89.046 | ST1k2 | 92.654 | ST1k | 92.961 | ST1k | 93.132 | ST1k2 | 93.163 | ST1k2 |
| B MP36-3 | 13.8 | 86.090 | 76.530 | 93.780 | ST1k | 89.078 | ST1k2 | 92.685 | ST1k | 92.992 | ST1k | 93.162 | ST1k2 | 93.193 | ST1k2 |
| BF81 MCC | 0.48 | 86.250 | 76.670 | 94.305 | ST1k | 82.957 | ST1g | 92.182 | ST1g | 92.905 | ST1k | 93.229 | ST1k2 | 93.285 | ST1k2 |
| BF81 DBCSBOP | 0.48 | 82.000 | | 94.224 | ST1k | 82.886 | ST1g | 92.103 | ST1g | 92.825 | ST1k | 93.150 | ST1k2 | 93.205 | ST1k2 |
| C1 4160 SWGR | 4.16 | 91.010 | 67.310 | 94.466 | ST1k | 83.534 | ST1g | 92.379 | ST1k | 92.939 | ST1k | 93.262 | ST1k2 | 93.324 | ST1k2 |
| C1 MP3-1 | 4.16 | 86.540 | 67.310 | 94.292 | ST1k | 83.337 | ST1g | 92.201 | ST1k | 92.762 | ST1k | 93.085 | ST1k2 | 93.148 | ST1k2 |
| C1 MP37-1A | 4.16 | 86.540 | 76.930 | 94.379 | ST1k | 83.436 | ST1g | 92.291 | ST1k | 92.851 | ST1k | 93.175 | ST1k2 | 93.237 | ST1k2 |
| C1 MP42-1 | 4.16 | 86.540 | 67.310 | 94.466 | ST1k | 83.297 | ST1g | 92.310 | ST1k | 92.870 | ST1k | 93.194 | ST1k2 | 93.256 | ST1k2 |
| C1 MP43-1 | 4.16 | 86.540 | 67.310 | 94.466 | ST1k | 83.348 | ST1g | 92.320 | ST1k | 92.880 | ST1k | 93.203 | ST1k2 | 93.265 | ST1k2 |
| C1 MP58-1 | 4.16 | 86.540 | 67.310 | 94.466 | ST1k | 83.117 | ST1g | 92.231 | ST1k | 92.792 | ST1k | 93.115 | ST1k2 | 93.177 | ST1k2 |
| C2 4160 SWGR | 4.16 | 86.540 | 76.930 | 94.470 | ST1k | 83.566 | ST1g | 92.391 | ST1k | 92.949 | ST1k | 93.271 | ST1k2 | 93.333 | ST1k2 |
| D1 4160 SWGR | 4.16 | 91.010 | 67.310 | 95.037 | ST1k | 83.659 | ST1g | 92.914 | ST1g | 93.628 | ST1k | 93.954 | ST1k2 | 94.010 | ST1k2 |
| D1 MP3-2 | 4.16 | 86.540 | 67.310 | 94.829 | ST1k | 83.423 | ST1g | 92.702 | ST1g | 93.417 | ST1k | 93.745 | ST1k2 | 93.801 | ST1k2 |
| D1 MP37-2A | 4.16 | 86.540 | 76.930 | 95.104 | ST1k1 | 86.937 | ST1k1 | 93.144 | ST1k1 | 93.699 | ST1k1 | 94.121 | ST1k1 | 94.250 | ST1k1 |
| D1 MP42-2 | 4.16 | 86.540 | 67.310 | 95.037 | ST1k | 83.503 | ST1g | 92.861 | ST1g | 93.575 | ST1k | 93.902 | ST1k2 | 93.958 | ST1k2 |
| D1 MP43-2 | 4.16 | 86.540 | 67.310 | 94.978 | ST1k | 83.592 | ST1g | 92.854 | ST1g | 93.568 | ST1k | 93.895 | ST1k2 | 93.951 | ST1k2 |
| D1 MP58-2 | 4.16 | 86.540 | 67.310 | 95.037 | ST1k | 83.415 | ST1g | 92.826 | ST1g | 93.540 | ST1k | 93.867 | ST1k2 | 93.923 | ST1k2 |
| D2 4160 SWGR | 4.16 | 86.540 | 76.930 | 95.040 | ST1k | 83.653 | ST1g | 92.909 | ST1g | 93.635 | ST1k | 93.960 | ST1k2 | 94.016 | ST1k2 |
| D3 4160 SWGR | 4.16 | 86.540 | 76.930 | 95.032 | ST1k | 83.646 | ST1g | 92.902 | ST1g | 93.627 | ST1k | 93.953 | ST1k2 | 94.009 | ST1k2 |
| E1 480V SWGR | 0.48 | 86.250 | 67.090 | 95.219 | ST1k | 76.304 | ST1k2 | 87.278 | ST1k | 90.385 | ST1k | 92.262 | ST1k2 | 92.648 | ST1k2 |
| E1 MP56-1 | 0.48 | 86.250 | 67.090 | 95.219 | ST1k2 | 71.063 | ST1k2 | 87.062 | ST1k2 | 90.268 | ST1k2 | 90.886 | ST1k2 | 91.277 | ST1k2 |
| E11A MCC | 0.48 | 87.100 | 67.090 | 95.027 | ST1k | 75.631 | ST1k2 | 85.506 | ST1k | 88.571 | ST1k | 91.840 | ST1k2 | 92.448 | ST1k2 |
| E11A MC62-1 | 0.48 | 86.250 | 67.090 | 95.027 | ST1k | 75.631 | ST1k2 | 85.506 | ST1k | 88.571 | ST1k | 91.840 | ST1k2 | 92.448 | ST1k2 |
| E11A MP89-1A | 0.48 | 86.250 | 67.090 | 95.027 | ST1k | 75.631 | ST1k2 | 85.506 | ST1k | 88.571 | ST1k | 91.840 | ST1k2 | 92.448 | ST1k2 |
| E11A MP89-1B | 0.48 | 86.250 | 67.090 | 95.027 | ST1k | 75.631 | ST1k2 | 85.506 | ST1k | 88.571 | ST1k | 91.840 | ST1k2 | 92.448 | ST1k2 |
| E11A MP89-3A | 0.48 | 86.250 | 67.090 | 95.027 | ST1k | 75.631 | ST1k2 | 85.506 | ST1k | 88.571 | ST1k | 91.840 | ST1k2 | 92.448 | ST1k2 |
| E11A MP89-3B | 0.48 | 86.250 | 67.090 | 95.027 | ST1k | 75.631 | ST1k2 | 85.506 | ST1k | 88.571 | ST1k | 91.840 | ST1k2 | 92.448 | ST1k2 |
| E11B MCC | 0.48 | 87.100 | 67.090 | 94.986 | ST1k | 75.519 | ST1k2 | 85.414 | ST1k | 88.480 | ST1k | 91.766 | ST1k2 | 92.406 | ST1k2 |
| E11B MC56-1 | 0.48 | 86.250 | 67.090 | 94.140 | ST1k | 74.449 | ST1k2 | 84.471 | ST1k | 87.571 | ST1k | 90.891 | ST1k2 | 91.536 | ST1k2 |
| E11C MCC | 0.48 | 87.100 | 67.090 | 95.019 | ST1k | 75.593 | ST1k2 | 85.121 | ST1k | 88.175 | ST1k | 91.817 | ST1k2 | 92.440 | ST1k2 |
| E11C MC75-1 | 0.48 | 86.250 | 67.090 | 92.991 | ST1k | 73.000 | ST1k2 | 82.841 | ST1k | 85.979 | ST1k | 89.713 | ST1k2 | 90.351 | ST1k2 |
| E11D MCC | 0.48 | 86.770 | 67.090 | 95.020 | ST1k | 75.606 | ST1k2 | 85.498 | ST1k | 88.564 | ST1k | 91.824 | ST1k2 | 92.441 | ST1k2 |
| E11D DBC1PN | 0.48 | 82.000 | | 95.020 | ST1k | 75.606 | ST1k2 | 85.498 | ST1k | 88.564 | ST1k | 91.824 | ST1k2 | 92.441 | ST1k2 |
| E11D MP37-1B | 0.48 | 86.250 | 67.090 | 94.690 | ST1k | 75.191 | ST1k2 | 85.131 | ST1k | 88.210 | ST1k | 91.483 | ST1k2 | 92.102 | ST1k2 |
| E11D MRE5327 | 0.48 | 86.250 | 67.090 | 95.020 | ST1k | 75.606 | ST1k2 | 85.498 | ST1k | 88.564 | ST1k | 91.824 | ST1k2 | 92.441 | ST1k2 |
| E11E MCC | 0.48 | 87.100 | 67.090 | 95.019 | ST1k | 75.575 | ST1k2 | 84.766 | ST1k | 87.823 | ST1k | 91.813 | ST1k2 | 92.436 | ST1k2 |
| E11E MV49060 | 0.48 | 85.000 | 67.090 | 95.019 | ST1k | **66.884** | ST1k2 | 75.018 | ST1k | 85.739 | ST1k | 89.828 | ST1k2 | 90.465 | ST1k2 |
| E12A MCC | 0.48 | 90.000 | 67.090 | 95.124 | ST1k | 76.158 | ST1k2 | 87.125 | ST1k | 90.275 | ST1k | 92.155 | ST1k2 | 92.544 | ST1k2 |
| E12A DBC1N | 0.48 | 82.000 | | 95.057 | ST1k | 76.088 | ST1k2 | 87.057 | ST1k | 90.208 | ST1k | 92.087 | ST1k2 | 92.476 | ST1k2 |
| E12A DBC1P | 0.48 | 82.000 | | 95.064 | ST1k | 76.095 | ST1k2 | 87.064 | ST1k | 90.215 | ST1k | 92.095 | ST1k2 | 92.483 | ST1k2 |
| E12A MC21-1 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 76.158 | ST1k2 | 87.125 | ST1k | 90.275 | ST1k | 92.155 | ST1k2 | 92.544 | ST1k2 |
| E12A MC30-1 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 75.477 | ST1k2 | 86.346 | ST1k | 90.275 | ST1k | 91.933 | ST1k2 | 92.322 | ST1k2 |
| E12A MC71-1 | 0.48 | 86.250 | 67.090 | 94.931 | ST1k | 75.916 | ST1k2 | 86.914 | ST1k | 90.072 | ST1k | 91.956 | ST1k2 | 92.345 | ST1k2 |
| E12A MC73-1 | 0.48 | 86.250 | 67.090 | 94.445 | ST1k | 75.305 | ST1k2 | 86.382 | ST1k | 89.559 | ST1k | 91.453 | ST1k2 | 91.845 | ST1k2 |
| E12A MS3311 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 76.158 | ST1k2 | 87.125 | ST1k | 90.275 | ST1k | 92.155 | ST1k2 | 92.544 | ST1k2 |
| E12A MS61-1 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 76.158 | ST1k2 | 87.125 | ST1k | 90.275 | ST1k | 92.155 | ST1k2 | 92.544 | ST1k2 |
| E12A MV5597 | 0.48 | 85.000 | 67.090 | 95.124 | ST1k | 67.576 | ST1k2 | 77.307 | ST1k | 88.269 | ST1k | 90.223 | ST1k2 | 90.620 | ST1k2 |
| E12A YRF1 | 0.48 | 90.000 | | 94.980 | ST1k | 76.042 | ST1k2 | 86.992 | ST1k | 90.138 | ST1k | 92.015 | ST1k2 | 92.403 | ST1k2 |
| E12A YRF3 | 0.48 | 90.000 | | 94.895 | ST1k | 75.975 | ST1k2 | 86.915 | ST1k | 90.058 | ST1k | 91.934 | ST1k2 | 92.321 | ST1k2 |
| E12B MCC | 0.48 | 87.100 | 67.090 | 95.112 | ST1k | 75.478 | ST1k2 | 86.409 | ST1k | 89.967 | ST1k | 91.976 | ST1k2 | 92.362 | ST1k2 |
| E12B MC25-1 | 0.48 | 86.250 | 67.090 | 95.112 | ST1k | 71.861 | ST1k2 | 82.268 | ST1k | 88.860 | ST1k | 90.893 | ST1k2 | 91.284 | ST1k2 |
| E12B MC25-2 | 0.48 | 86.250 | 67.090 | 95.112 | ST1k | 72.760 | ST1k2 | 83.297 | ST1k | 89.140 | ST1k | 91.167 | ST1k2 | 91.556 | ST1k2 |
| E12B MC78-1 | 0.48 | 86.250 | 67.090 | 94.654 | ST1k | 74.898 | ST1k2 | 85.904 | ST1k | 89.483 | ST1k | 91.503 | ST1k2 | 91.890 | ST1k2 |
| E12B MP147-1 | 0.48 | 86.250 | 67.090 | 94.821 | ST1k | 75.111 | ST1k2 | 86.088 | ST1k | 89.660 | ST1k | 91.675 | ST1k2 | 92.063 | ST1k2 |
| E12B MP147-3 | 0.48 | 86.250 | 67.090 | 95.029 | ST1k | 75.373 | ST1k2 | 86.317 | ST1k | 89.879 | ST1k | 91.890 | ST1k2 | 92.276 | ST1k2 |
| E12B YE1 | 0.48 | 82.100 | | 95.075 | ST1k | 75.432 | ST1k2 | 86.368 | ST1k | 89.929 | ST1k | 91.938 | ST1k2 | 92.324 | ST1k2 |
| E12C MCC | 0.48 | 87.100 | 67.090 | 94.701 | ST1k | 75.546 | ST1k2 | 86.570 | ST1k | 89.734 | ST1k | 91.679 | ST1k2 | 92.108 | ST1k2 |
| E12C MC99-1 | 0.48 | 86.250 | 67.090 | 93.694 | ST1k | 74.273 | ST1k2 | 85.465 | ST1k | 88.670 | ST1k | 90.638 | ST1k2 | 91.072 | ST1k2 |

**Table 5. Scenario ST1: Mode 1 Design Basis Accident**
**Transient Minimum Bus Voltages (Sheet 2 of 4)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| E12C MC99-2 | 0.48 | 86.250 | 67.090 | 94.108 | ST1k | 74.798 | ST1k2 | 85.920 | ST1k | 89.108 | ST1k | 91.066 | ST1k2 | 91.498 | ST1k2 |
| E12C MF15-1 | 0.48 | 86.250 | 67.090 | 94.473 | ST1k | 75.260 | ST1k2 | 86.321 | ST1k | 89.494 | ST1k | 91.444 | ST1k2 | 91.874 | ST1k2 |
| E12D MCC | 0.48 | 86.250 | 67.090 | 94.677 | ST1k | 75.515 | ST1k2 | 86.544 | ST1k | 89.709 | ST1k | 91.654 | ST1k2 | 92.083 | ST1k2 |
| E12E MCC | 0.48 | 87.100 | 67.090 | 95.124 | ST1k | 76.010 | ST1k2 | 86.807 | ST1k | 90.097 | ST1k | 92.131 | ST1k2 | 92.520 | ST1k2 |
| E12E MC31-4 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 76.010 | ST1k2 | 86.807 | ST1k | 90.097 | ST1k | 92.131 | ST1k2 | 92.520 | ST1k2 |
| E12E MC31-5 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 76.010 | ST1k2 | 86.807 | ST1k | 90.097 | ST1k | 92.131 | ST1k2 | 92.520 | ST1k2 |
| E12E MP197-1 | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 73.385 | ST1k2 | 83.809 | ST1k | 89.700 | ST1k | 91.744 | ST1k2 | 92.134 | ST1k2 |
| E12F MCC | 0.48 | 86.250 | 67.090 | 95.093 | ST1k | 75.090 | ST1k2 | 86.266 | ST1k | 89.830 | ST1k | 91.843 | ST1k2 | 92.229 | ST1k2 |
| E12F MC25-5 | 0.48 | 86.250 | 67.090 | 95.093 | ST1k | 75.090 | ST1k2 | 86.266 | ST1k | 89.830 | ST1k | 91.843 | ST1k2 | 92.229 | ST1k2 |
| E12F MP195-1 | 0.48 | 86.250 | 67.090 | 94.539 | ST1k | 74.385 | ST1k2 | 85.654 | ST1k | 89.243 | ST1k | 91.268 | ST1k2 | 91.657 | ST1k2 |
| E14 MCC | 0.48 | 86.250 | 67.090 | 95.219 | ST1k | 75.897 | ST1k2 | 86.811 | ST1k | 90.275 | ST1k | 92.154 | ST1k2 | 92.540 | ST1k2 |
| E14 MC1-1 | 0.48 | 86.250 | 67.090 | 95.219 | ST1k | 75.897 | ST1k2 | 86.811 | ST1k | 90.275 | ST1k | 92.154 | ST1k2 | 92.540 | ST1k2 |
| E14 MC1-1LS | 0.48 | 86.250 | 67.090 | 95.219 | ST1k | 74.022 | ST1k2 | 84.667 | ST1k | 89.762 | ST1k | 91.652 | ST1k2 | 92.040 | ST1k2 |
| E15 MCC | 0.48 | 86.250 | 67.090 | 95.219 | ST1k | 76.304 | ST1k2 | 87.278 | ST1k | 90.385 | ST1k | 92.262 | ST1k2 | 92.648 | ST1k2 |
| E16A MCC | 0.48 | 89.800 | 67.090 | 95.088 | ST1k | 76.191 | ST1k2 | 87.154 | ST1k | 90.258 | ST1k | 92.134 | ST1k2 | 92.519 | ST1k2 |
| E16A MP274-1 | 0.48 | 86.250 | 67.090 | 94.784 | ST1k | 75.947 | ST1k2 | 86.875 | ST1k | 89.970 | ST1k | 91.839 | ST1k2 | 92.223 | ST1k2 |
| E16A XY1 | 0.48 | 85.000 | | 95.039 | ST1k | 76.152 | ST1k2 | 87.109 | ST1k | 90.212 | ST1k | 92.086 | ST1k2 | 92.471 | ST1k2 |
| E16A XY3 | 0.48 | 85.000 | | 95.019 | ST1k | 76.135 | ST1k2 | 87.091 | ST1k | 90.193 | ST1k | 92.067 | ST1k2 | 92.452 | ST1k2 |
| E16B MCC | 0.48 | 90.300 | 67.090 | 95.071 | ST1k | 76.177 | ST1k2 | 87.138 | ST1k | 90.242 | ST1k | 92.117 | ST1k2 | 92.502 | ST1k2 |
| E16B MP273-1 | 0.48 | 86.250 | 67.090 | 94.903 | ST1k | 76.042 | ST1k2 | 86.984 | ST1k | 90.082 | ST1k | 91.954 | ST1k2 | 92.338 | ST1k2 |
| E2 480V SWGR | 0.48 | | | 90.266 | ST1k | 85.592 | ST1k2 | 89.178 | ST1k | 89.483 | ST1k | 89.651 | ST1k2 | 89.683 | ST1k2 |
| E21A MCC | 0.48 | | | 89.678 | ST1k | 85.019 | ST1k2 | 88.594 | ST1k | 88.897 | ST1k | 89.066 | ST1k2 | 89.097 | ST1k2 |
| E21B MCC | 0.48 | | | 89.647 | ST1k | 84.990 | ST1k2 | 88.564 | ST1k | 88.867 | ST1k | 89.035 | ST1k2 | 89.067 | ST1k2 |
| E21C MCC | 0.48 | | | 89.151 | ST1k | 84.507 | ST1k2 | 88.070 | ST1k | 88.373 | ST1k | 88.540 | ST1k2 | 88.572 | ST1k2 |
| E21D MCC | 0.48 | | | 89.678 | ST1k | 85.019 | ST1k2 | 88.594 | ST1k | 88.897 | ST1k | 89.066 | ST1k2 | 89.097 | ST1k2 |
| E22A MCC | 0.48 | | | 89.374 | ST1k | 84.718 | ST1k2 | 88.291 | ST1k | 88.594 | ST1k | 88.763 | ST1k2 | 88.794 | ST1k2 |
| E22B MCC | 0.48 | | | 89.361 | ST1k | 84.705 | ST1k2 | 88.278 | ST1k | 88.581 | ST1k | 88.750 | ST1k2 | 88.781 | ST1k2 |
| E23A MCC | 0.48 | | | 89.833 | ST1k | 85.160 | ST1k2 | 88.746 | ST1k | 89.050 | ST1k | 89.219 | ST1k2 | 89.251 | ST1k2 |
| E23B MCC | 0.48 | | | 89.339 | ST1k | 84.673 | ST1k2 | 88.253 | ST1k | 88.558 | ST1k | 88.726 | ST1k2 | 88.758 | ST1k2 |
| E3 480V SWGR | 0.48 | | | 90.639 | ST1k | 85.705 | ST1k | 89.025 | ST1k | 89.792 | ST1k | 90.015 | ST1k | 90.051 | ST1k2 |
| E31A MCC | 0.48 | | | 88.946 | ST1k | 83.998 | ST1k | 87.328 | ST1k | 88.098 | ST1k | 88.321 | ST1k | 88.357 | ST1k2 |
| E31B MCC | 0.48 | | | 88.857 | ST1k | 83.904 | ST1k | 87.238 | ST1k | 88.008 | ST1k | 88.232 | ST1k | 88.268 | ST1k2 |
| E32A MCC | 0.48 | | | 90.536 | ST1k | 85.551 | ST1k | 88.868 | ST1k | 89.683 | ST1k | 89.906 | ST1k | 89.949 | ST1k2 |
| E32B MCC | 0.48 | | | 90.040 | ST1k | 85.049 | ST1k | 88.370 | ST1k | 89.186 | ST1k | 89.409 | ST1k | 89.452 | ST1k2 |
| E33A MCC | 0.48 | | | 90.005 | ST1k | 85.051 | ST1k | 88.385 | ST1k | 89.156 | ST1k | 89.380 | ST1k | 89.416 | ST1k2 |
| E33B MCC | 0.48 | | | 90.005 | ST1k | 85.051 | ST1k | 88.385 | ST1k | 89.156 | ST1k | 89.380 | ST1k | 89.416 | ST1k2 |
| E4 480V SWGR | 0.48 | | | 91.732 | ST1k | 87.002 | ST1k2 | 90.631 | ST1k | 90.939 | ST1k | 91.110 | ST1k2 | 91.142 | ST1k2 |
| E41A MCC | 0.48 | | | 91.389 | ST1k | 86.668 | ST1k2 | 90.290 | ST1k | 90.598 | ST1k | 90.768 | ST1k2 | 90.800 | ST1k2 |
| E41B MCC | 0.48 | | | 91.099 | ST1k | 86.377 | ST1k2 | 90.000 | ST1k | 90.308 | ST1k | 90.478 | ST1k2 | 90.510 | ST1k2 |
| E42 MCC | 0.48 | | | 92.045 | ST1k | 81.314 | ST1g | 90.000 | ST1k | 90.549 | ST1k | 90.866 | ST1k2 | 90.927 | ST1k2 |
| E43 MCC | 0.48 | | | 91.732 | ST1k | 87.002 | ST1k2 | 90.631 | ST1k | 90.939 | ST1k | 91.110 | ST1k2 | 91.142 | ST1k2 |
| E6 480V SWGR | 0.48 | | | 93.802 | ST1k | 89.100 | ST1k2 | 92.707 | ST1k | 93.014 | ST1k | 93.184 | ST1k2 | 93.215 | ST1k2 |
| E61 MCC | 0.48 | | | 93.802 | ST1k | 89.100 | ST1k2 | 92.707 | ST1k | 93.014 | ST1k | 93.184 | ST1k2 | 93.215 | ST1k2 |
| E62 MCC | 0.48 | | | 93.802 | ST1k | 89.100 | ST1k2 | 92.707 | ST1k | 93.014 | ST1k | 93.184 | ST1k2 | 93.215 | ST1k2 |
| E63 MCC | 0.48 | | | 93.802 | ST1k | 89.100 | ST1k2 | 92.707 | ST1k | 93.014 | ST1k | 93.184 | ST1k2 | 93.215 | ST1k2 |
| EF12C MCC | 0.48 | 86.250 | 67.090 | 94.664 | ST1k | 75.499 | ST1k2 | 86.530 | ST1k | 89.696 | ST1k | 91.641 | ST1k2 | 92.071 | ST1k2 |
| EF12C MF15-3 | 0.48 | 86.250 | 67.090 | 94.664 | ST1k | 75.499 | ST1k2 | 86.530 | ST1k | 89.696 | ST1k | 91.641 | ST1k2 | 92.071 | ST1k2 |
| EF12D MCC | 0.48 | 86.250 | 67.090 | 95.124 | ST1k | 76.158 | ST1k2 | 87.125 | ST1k | 90.275 | ST1k | 92.155 | ST1k2 | 92.544 | ST1k2 |
| EF41 AE4 | 0.48 | | | 91.732 | ST1k | 87.002 | ST1k2 | 90.631 | ST1k | 90.939 | ST1k | 91.110 | ST1k2 | 91.142 | ST1k2 |
| EF41 BF4 | 0.48 | | | 92.629 | ST1k | 87.954 | ST1k2 | 91.540 | ST1k | 91.845 | ST1k | 92.014 | ST1k2 | 92.046 | ST1k2 |
| F1 480V SWGR | 0.48 | 86.250 | 67.090 | 96.052 | ST1k | 77.838 | ST1k2 | 87.978 | ST1g | 91.235 | ST1k | 93.184 | ST1k2 | 93.505 | ST1k2 |
| F1 MP56-2 | 0.48 | 86.250 | 67.090 | 96.052 | ST1k2 | 73.005 | ST1k2 | 88.165 | ST1k2 | 91.374 | ST1k2 | 91.899 | ST1k2 | 92.224 | ST1k2 |
| F11A MCC | 0.48 | 87.100 | 67.090 | 95.913 | ST1k | 77.391 | ST1k2 | 86.767 | ST1g | 89.994 | ST1k | 92.868 | ST1k2 | 93.308 | ST1k2 |
| F11A MC21-2 | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 77.391 | ST1k2 | 86.767 | ST1g | 89.994 | ST1k | 92.868 | ST1k2 | 93.308 | ST1k2 |
| F11A MC62-2 | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 77.391 | ST1k2 | 86.767 | ST1g | 89.994 | ST1k | 92.868 | ST1k2 | 93.308 | ST1k2 |
| F11A MC75-2 | 0.48 | 86.250 | 67.090 | 94.743 | ST1k | 75.928 | ST1k2 | 85.469 | ST1g | 88.744 | ST1k | 91.658 | ST1k2 | 92.104 | ST1k2 |
| F11A MRE5328 | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 77.391 | ST1k2 | 86.767 | ST1g | 89.994 | ST1k | 92.868 | ST1k2 | 93.308 | ST1k2 |
| F11A MS3321 | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 77.391 | ST1k2 | 86.767 | ST1g | 89.994 | ST1k | 92.868 | ST1k2 | 93.308 | ST1k2 |
| F11A MV4907 | 0.48 | 85.000 | 67.090 | 95.913 | ST1k | 68.603 | ST1k2 | 76.914 | ST1g | 87.999 | ST1k | 90.935 | ST1k2 | 91.384 | ST1k2 |
| F11B MCC | 0.48 | 87.100 | 67.090 | 95.913 | ST1k | 77.296 | ST1k2 | 86.657 | ST1g | 89.880 | ST1k | 92.819 | ST1k2 | 93.308 | ST1k2 |
| F11C MCC | 0.48 | 87.100 | 67.090 | 95.913 | ST1k | 77.290 | ST1k2 | 86.653 | ST1g | 89.876 | ST1k | 92.810 | ST1k2 | 93.308 | ST1k2 |
| F11C MP37-2B | 0.48 | 86.250 | 67.090 | 95.648 | ST1k1 | 80.281 | ST1k1 | 86.504 | ST1k1 | 89.591 | ST1k1 | 93.011 | ST1k1 | 94.095 | ST1k1 |
| F11C MP37-2D | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 77.290 | ST1k2 | 86.653 | ST1g | 89.876 | ST1k | 92.810 | ST1k2 | 93.308 | ST1k2 |
| F11D MCC | 0.48 | 87.100 | 67.090 | 95.913 | ST1k | 76.227 | ST1g | 85.170 | ST1g | 88.337 | ST1k | 92.859 | ST1k2 | 93.308 | ST1k2 |
| F11D DBC2PN | 0.48 | 82.000 | | 95.913 | ST1k | 76.227 | ST1g | 85.170 | ST1g | 88.337 | ST1k | 92.859 | ST1k2 | 93.308 | ST1k2 |
| F11D MC31-3 | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 76.227 | ST1g | 85.170 | ST1g | 88.337 | ST1k | 92.859 | ST1k2 | 93.308 | ST1k2 |

**Table 5. Scenario ST1: Mode 1 Design Basis Accident**
**Transient Minimum Bus Voltages (Sheet 3 of 4)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| F11D MP89-2A | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 76.227 | ST1g | 85.170 | ST1g | 88.337 | ST1k | 92.859 | ST1k2 | 93.308 | ST1k2 |
| F11D MP89-2B | 0.48 | 86.250 | 67.090 | 95.913 | ST1k | 76.227 | ST1g | 85.170 | ST1g | 88.337 | ST1k | 92.859 | ST1k2 | 93.308 | ST1k2 |
| F11E MCC | 0.48 | 86.250 | 67.090 | 95.843 | ST1k | 77.334 | ST1k2 | 86.703 | ST1g | 89.928 | ST1k | 92.800 | ST1k2 | 93.239 | ST1k2 |
| F11E MC31-1 | 0.48 | 86.250 | 67.090 | 95.843 | ST1k | 77.334 | ST1k2 | 86.703 | ST1g | 89.928 | ST1k | 92.800 | ST1k2 | 93.239 | ST1k2 |
| F11E MC31-2 | 0.48 | 86.250 | 67.090 | 95.843 | ST1k | 77.334 | ST1k2 | 86.703 | ST1g | 89.928 | ST1k | 92.800 | ST1k2 | 93.239 | ST1k2 |
| F11F MCC | 0.48 | 86.250 | 67.090 | 95.807 | ST1k | 77.305 | ST1k2 | 86.670 | ST1g | 89.894 | ST1k | 92.765 | ST1k2 | 93.204 | ST1k2 |
| F12A MCC | 0.48 | 90.000 | 67.090 | 95.936 | ST1k | 77.655 | ST1k2 | 87.775 | ST1g | 91.090 | ST1k | 93.053 | ST1k2 | 93.378 | ST1k2 |
| F12A DBC2N | 0.48 | 82.000 | | 95.839 | ST1k | 77.556 | ST1k2 | 87.677 | ST1g | 90.993 | ST1k | 92.956 | ST1k2 | 93.281 | ST1k2 |
| F12A DBC2P | 0.48 | 82.000 | | 95.839 | ST1k | 77.556 | ST1k2 | 87.677 | ST1g | 90.993 | ST1k | 92.956 | ST1k2 | 93.281 | ST1k2 |
| F12A MC133 | 0.48 | 86.250 | 67.090 | 94.802 | ST1k | 76.244 | ST1k2 | 86.532 | ST1g | 89.894 | ST1k | 91.883 | ST1k2 | 92.212 | ST1k2 |
| F12A MC30-2 | 0.48 | 86.250 | 67.090 | 95.936 | ST1k | 76.502 | ST1k2 | 86.471 | ST1g | 91.090 | ST1k | 92.672 | ST1k2 | 92.999 | ST1k2 |
| F12A MC73-2 | 0.48 | 86.250 | 67.090 | 93.686 | ST1k | 74.831 | ST1k2 | 85.301 | ST1g | 88.712 | ST1k | 90.729 | ST1k2 | 91.063 | ST1k2 |
| F12A MP195-2 | 0.48 | 86.250 | 67.090 | 95.418 | ST1k | 77.013 | ST1k2 | 87.208 | ST1g | 90.544 | ST1k | 92.519 | ST1k2 | 92.846 | ST1k2 |
| F12A MP198-1 | 0.48 | 86.250 | 67.090 | 95.936 | ST1k | 73.220 | ST1k2 | 82.762 | ST1g | 90.427 | ST1k | 92.405 | ST1k2 | 92.732 | ST1k2 |
| F12A MS61-2 | 0.48 | 86.250 | 67.090 | 95.936 | ST1k | 77.655 | ST1k2 | 87.775 | ST1g | 91.090 | ST1k | 93.053 | ST1k2 | 93.378 | ST1k2 |
| F12A MV5598 | 0.48 | 85.000 | 67.090 | 95.936 | ST1k | 71.005 | ST1k2 | 80.258 | ST1g | 89.645 | ST1k | 91.647 | ST1k2 | 91.977 | ST1k2 |
| F12A YRF2 | 0.48 | 90.000 | | 95.766 | ST1k | 77.518 | ST1k2 | 87.620 | ST1g | 90.928 | ST1k | 92.888 | ST1k2 | 93.213 | ST1k2 |
| F12A YRF4 | 0.48 | 90.000 | | 95.693 | ST1k | 77.459 | ST1k2 | 87.553 | ST1g | 90.859 | ST1k | 92.818 | ST1k2 | 93.142 | ST1k2 |
| F12B MCC | 0.48 | 87.100 | 67.090 | 95.967 | ST1k | 76.995 | ST1k2 | 87.141 | ST1g | 90.832 | ST1k | 92.919 | ST1k2 | 93.241 | ST1k2 |
| F12B MC25-3 | 0.48 | 86.250 | 67.090 | 95.967 | ST1k | 74.744 | ST1k2 | 84.593 | ST1g | 90.169 | ST1k | 92.271 | ST1k2 | 92.595 | ST1k2 |
| F12B MC25-4 | 0.48 | 86.250 | 67.090 | 95.967 | ST1k | 74.166 | ST1k2 | 83.939 | ST1g | 89.858 | ST1k | 91.967 | ST1k2 | 92.292 | ST1k2 |
| F12B MC78-2 | 0.48 | 86.250 | 67.090 | 95.681 | ST1k | 76.637 | ST1k2 | 86.826 | ST1g | 90.530 | ST1k | 92.624 | ST1k2 | 92.946 | ST1k2 |
| F12B MP147-2 | 0.48 | 86.250 | 67.090 | 95.666 | ST1k | 76.618 | ST1k2 | 86.808 | ST1g | 90.513 | ST1k | 92.607 | ST1k2 | 92.930 | ST1k2 |
| F12B MP147-4 | 0.48 | 86.250 | 67.090 | 95.874 | ST1k | 76.878 | ST1k2 | 87.038 | ST1g | 90.733 | ST1k | 92.823 | ST1k2 | 93.144 | ST1k2 |
| F12B YF1 | 0.48 | 81.600 | | 95.931 | ST1k | 76.950 | ST1k2 | 87.101 | ST1g | 90.794 | ST1k | 92.882 | ST1k2 | 93.203 | ST1k2 |
| F12C MCC | 0.48 | 87.100 | 67.090 | 95.657 | ST1k | 77.220 | ST1k2 | 87.369 | ST1g | 90.692 | ST1k | 92.722 | ST1k2 | 93.091 | ST1k2 |
| F12C MF15-2 | 0.48 | 87.100 | 67.090 | 95.450 | ST1k | 76.964 | ST1k2 | 87.143 | ST1g | 90.474 | ST1k | 92.509 | ST1k2 | 92.879 | ST1k2 |
| F12D MCC | 0.48 | 86.250 | 67.090 | 95.578 | ST1k | 77.122 | ST1k2 | 87.283 | ST1g | 90.609 | ST1k | 92.641 | ST1k2 | 93.010 | ST1k2 |
| F12D MC99-3 | 0.48 | 86.250 | 67.090 | 94.888 | ST1k | 76.263 | ST1k2 | 86.526 | ST1g | 89.881 | ST1k | 91.929 | ST1k2 | 92.301 | ST1k2 |
| F12D MC99-4 | 0.48 | 86.250 | 67.090 | 94.748 | ST1k | 76.087 | ST1k2 | 86.372 | ST1g | 89.733 | ST1k | 91.784 | ST1k2 | 92.157 | ST1k2 |
| F13 MCC | 0.48 | 86.250 | 67.090 | 94.577 | ST1k | 83.241 | ST1g | 92.456 | ST1g | 93.178 | ST1k | 93.502 | ST1k2 | 93.558 | ST1k2 |
| F14 MCC | 0.48 | 86.250 | 67.090 | 96.052 | ST1k | 77.348 | ST1k2 | 87.424 | ST1g | 91.106 | ST1k | 93.058 | ST1k2 | 93.379 | ST1k2 |
| F14 MC1-2 | 0.48 | 86.250 | 67.090 | 96.052 | ST1k | 77.348 | ST1k2 | 87.424 | ST1g | 91.106 | ST1k | 93.058 | ST1k2 | 93.379 | ST1k2 |
| F14 MC1-2LS | 0.48 | 86.250 | 67.090 | 96.052 | ST1k | 75.210 | ST1k2 | 85.007 | ST1g | 90.536 | ST1k | 92.500 | ST1k2 | 92.824 | ST1k2 |
| F15 MCC | 0.48 | 86.250 | 67.090 | 96.052 | ST1k | 77.838 | ST1k2 | 87.978 | ST1g | 91.235 | ST1k | 93.184 | ST1k2 | 93.505 | ST1k2 |
| F16A MCC | 0.48 | 89.700 | 67.090 | 96.025 | ST1k | 77.816 | ST1k2 | 87.953 | ST1g | 91.209 | ST1k | 93.158 | ST1k2 | 93.479 | ST1k2 |
| F16A MC25-6 | 0.48 | 86.250 | 67.090 | 96.025 | ST1k | 77.816 | ST1k2 | 87.953 | ST1g | 91.209 | ST1k | 93.158 | ST1k2 | 93.479 | ST1k2 |
| F16A MP274-3 | 0.48 | 86.250 | 67.090 | 95.780 | ST1k | 77.618 | ST1k2 | 87.729 | ST1g | 90.977 | ST1k | 92.920 | ST1k2 | 93.240 | ST1k2 |
| F16A XY2 | 0.48 | 85.000 | | 96.012 | ST1k | 77.806 | ST1k2 | 87.942 | ST1g | 91.197 | ST1k | 93.146 | ST1k2 | 93.467 | ST1k2 |
| F16A XY4 | 0.48 | 85.000 | | 95.994 | ST1k | 77.791 | ST1k2 | 87.925 | ST1g | 91.180 | ST1k | 93.128 | ST1k2 | 93.449 | ST1k2 |
| F16B MCC | 0.48 | 90.500 | 67.090 | 96.009 | ST1k | 77.803 | ST1k2 | 87.938 | ST1g | 91.194 | ST1k | 93.142 | ST1k2 | 93.463 | ST1k2 |
| F16B MP273-4 | 0.48 | 86.250 | 67.090 | 95.471 | ST1k | 77.368 | ST1k2 | 87.446 | ST1g | 90.684 | ST1k | 92.621 | ST1k2 | 92.940 | ST1k2 |
| F2 480V SWGR | 0.48 | | | 91.040 | ST1k | 86.294 | ST1k2 | 89.936 | ST1k | 90.245 | ST1k | 90.417 | ST1k2 | 90.449 | ST1k2 |
| F21A MCC | 0.48 | | | 90.749 | ST1k | 86.011 | ST1k2 | 89.646 | ST1k | 89.955 | ST1k | 90.127 | ST1k2 | 90.158 | ST1k2 |
| F21B MCC | 0.48 | | | 90.647 | ST1k | 85.914 | ST1k2 | 89.546 | ST1k | 89.854 | ST1k | 90.025 | ST1k2 | 90.057 | ST1k2 |
| F21C MCC | 0.48 | | | 90.746 | ST1k | 86.008 | ST1k2 | 89.644 | ST1k | 89.953 | ST1k | 90.124 | ST1k2 | 90.156 | ST1k2 |
| F22 MCC | 0.48 | | | 90.253 | ST1k | 85.470 | ST1k2 | 89.140 | ST1k | 89.452 | ST1k | 89.625 | ST1k2 | 89.657 | ST1k2 |
| F23A MCC | 0.48 | | | 90.452 | ST1k | 85.692 | ST1k2 | 89.344 | ST1k | 89.655 | ST1k | 89.827 | ST1k2 | 89.859 | ST1k2 |
| F23B MCC | 0.48 | | | 89.576 | ST1k | 84.794 | ST1k2 | 88.464 | ST1k | 88.776 | ST1k | 88.948 | ST1k2 | 88.981 | ST1k2 |
| F3 480V SWGR | 0.48 | | | 90.578 | ST1k | 85.730 | ST1k | 88.994 | ST1k | 89.746 | ST1k | 89.965 | ST1k | 90.001 | ST1k2 |
| F31A MCC | 0.48 | | | 90.030 | ST1k | 85.205 | ST1k | 88.454 | ST1k | 89.202 | ST1k | 89.420 | ST1k | 89.455 | ST1k2 |
| F31B MCC | 0.48 | | | 88.949 | ST1k | 84.170 | ST1k | 87.388 | ST1k | 88.129 | ST1k | 88.345 | ST1k | 88.380 | ST1k2 |
| F32A MCC | 0.48 | | | 90.351 | ST1k | 85.352 | ST1k | 88.614 | ST1k | 89.499 | ST1k | 89.718 | ST1k | 89.772 | ST1k2 |
| F32B MCC | 0.48 | | | 89.846 | ST1k | 84.817 | ST1k | 88.100 | ST1k | 88.989 | ST1k | 89.210 | ST1k | 89.264 | ST1k2 |
| F33A MCC | 0.48 | | | 90.038 | ST1k | 85.207 | ST1k | 88.459 | ST1k | 89.208 | ST1k | 89.427 | ST1k | 89.462 | ST1k2 |
| F33B MCC | 0.48 | | | 89.972 | ST1k | 85.139 | ST1k | 88.393 | ST1k | 89.142 | ST1k | 89.361 | ST1k | 89.396 | ST1k2 |
| F4 480V SWGR | 0.48 | | | 92.629 | ST1k | 87.954 | ST1k2 | 91.540 | ST1k | 91.845 | ST1k | 92.014 | ST1k2 | 92.046 | ST1k2 |
| F41A MCC | 0.48 | | | 92.259 | ST1k | 87.593 | ST1k2 | 91.173 | ST1k | 91.477 | ST1k | 91.646 | ST1k2 | 91.677 | ST1k2 |
| F41B MCC | 0.48 | | | 92.241 | ST1k | 87.573 | ST1k2 | 91.154 | ST1k | 91.458 | ST1k | 91.627 | ST1k2 | 91.659 | ST1k2 |
| F4A LOAD CTR | 0.48 | | | 93.413 | ST1k | 88.731 | ST1k2 | 92.322 | ST1k | 92.628 | ST1k | 92.797 | ST1k2 | 92.829 | ST1k2 |
| F6 480V SWGR | 0.48 | | | 93.799 | ST1k | 89.098 | ST1k2 | 92.704 | ST1k | 93.011 | ST1k | 93.181 | ST1k2 | 93.213 | ST1k2 |
| F61 MCC | 0.48 | | | 93.799 | ST1k | 89.098 | ST1k2 | 92.704 | ST1k | 93.011 | ST1k | 93.181 | ST1k2 | 93.213 | ST1k2 |
| F62 MCC | 0.48 | | | 93.799 | ST1k | 89.098 | ST1k2 | 92.704 | ST1k | 93.011 | ST1k | 93.181 | ST1k2 | 93.213 | ST1k2 |
| F63 MCC | 0.48 | | | 93.799 | ST1k | 89.098 | ST1k2 | 92.704 | ST1k | 93.011 | ST1k | 93.181 | ST1k2 | 93.213 | ST1k2 |
| F7 480V SWGR | 0.48 | | | 94.704 | ST1k | 83.352 | ST1g | 92.580 | ST1g | 93.303 | ST1k | 93.628 | ST1k2 | 93.684 | ST1k2 |
| F71 MCC | 0.48 | | | 94.669 | ST1k | 83.321 | ST1g | 92.545 | ST1g | 93.269 | ST1k | 93.593 | ST1k2 | 93.649 | ST1k2 |

**Table 5. Scenario ST1: Mode 1 Design Basis Accident**
**Transient Minimum Bus Voltages (Sheet 4 of 4)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| M22A MCC | 0.48 | | | 90.578 | ST1k | 85.730 | ST1k | 88.994 | ST1k | 89.746 | ST1k | 89.965 | ST1k | 90.001 | ST1k2 |
| YE2 MCC | 0.24 | 87.080 | 65.000 | 97.251 | ST1k | 75.734 | ST1k2 | 85.710 | ST1k | 88.889 | ST1k | 93.105 | ST1k2 | 94.581 | ST1k2 |
| YE2 MV5443C | 0.24 | 85.000 | 67.090 | 97.251 | ST1k | 74.834 | ST1k2 | 84.691 | ST1k | 88.701 | ST1k | 92.925 | ST1k2 | 94.405 | ST1k2 |
| YF2 MCC | 0.24 | 86.780 | 65.000 | 98.242 | ST1k | 78.016 | ST1k2 | 87.505 | ST1g | 90.840 | ST1k | 94.456 | ST1k2 | 95.552 | ST1k2 |
| YF2 MV5444C | 0.24 | 85.000 | 67.090 | 98.242 | ST1k | 77.167 | ST1k2 | 86.552 | ST1g | 90.672 | ST1k | 94.294 | ST1k2 | 95.392 | ST1k2 |

**Table 6. Scenarios ST2 and ST3 Large Motor Starting Transient Minimum Bus VOltages (Sheet 1 of 3)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | | T=5 | | T=6 | | T=7 | | T=8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| A 13.8KV SWGR | 13.8 | 86.090 | 76.530 | 93.275 | ST2h | 94.359 | ST2h | 82.546 | ST2h | 93.500 | ST2h | 90.880 | ST2h | 94.364 | ST2h | 82.606 | ST2h | 93.511 | ST2h | 90.873 | ST2h |
| A MP2-1 | 13.8 | 86.090 | 76.530 | 93.233 | ST2h | 94.317 | ST2h | 82.498 | ST2h | 93.458 | ST2h | 90.837 | ST2h | 94.322 | ST2h | 82.558 | ST2h | 93.469 | ST2h | 90.830 | ST2h |
| A MP2-3 | 13.8 | 86.090 | 76.530 | 93.239 | ST2h | 94.324 | ST2h | 82.506 | ST2h | 93.465 | ST2h | 90.844 | ST2h | 94.329 | ST2h | 82.566 | ST2h | 93.476 | ST2h | 90.836 | ST2h |
| A MP36-1 | 13.8 | 86.090 | 76.530 | 93.232 | ST2h | 94.359 | ST2h | 82.320 | ST2h | 93.458 | ST2h | 90.836 | ST2h | 94.322 | ST2h | 82.558 | ST2h | 93.469 | ST2h | 90.829 | ST2h |
| A MP36-4 | 13.8 | 86.090 | 76.530 | 93.254 | ST2h | 94.339 | ST2h | 82.523 | ST2h | 93.480 | ST2h | 90.859 | ST2h | 94.344 | ST2h | 82.583 | ST2h | 93.491 | ST2h | 90.852 | ST2h |
| B 13.8KV SWGR | 13.8 | 86.090 | 76.530 | 93.272 | ST2h | 94.350 | ST2h | 82.604 | ST2h | 93.498 | ST2h | 90.860 | ST2h | 94.368 | ST2h | 82.530 | ST2h | 93.507 | ST2h | 90.884 | ST2h |
| B MP2-2 | 13.8 | 86.090 | 76.530 | 93.217 | ST2h | 94.296 | ST2h | 82.543 | ST2h | 93.444 | ST2h | 90.805 | ST2h | 94.315 | ST2h | 82.468 | ST2h | 93.452 | ST2h | 90.828 | ST2h |
| B MP2-4 | 13.8 | 86.090 | 76.530 | 93.224 | ST2h | 94.303 | ST2h | 82.551 | ST2h | 93.451 | ST2h | 90.812 | ST2h | 94.321 | ST2h | 82.476 | ST2h | 93.459 | ST2h | 90.835 | ST2h |
| B MP36-2 | 13.8 | 86.090 | 76.530 | 93.222 | ST2h | 94.301 | ST2h | 82.548 | ST2h | 93.449 | ST2h | 90.809 | ST2h | 94.319 | ST2h | 82.474 | ST2h | 93.457 | ST2h | 90.833 | ST2h |
| B MP36-3 | 13.8 | 86.090 | 76.530 | 93.252 | ST2h | 94.331 | ST2h | 82.582 | ST2h | 93.479 | ST2h | 90.841 | ST2h | 94.368 | ST2h | 82.428 | ST2h | 93.487 | ST2h | 90.864 | ST2h |
| BF81 MCC | 0.48 | 86.250 | 76.670 | 93.274 | ST2h | 93.709 | ST2g | 82.193 | ST2h | 93.850 | ST2h | 86.301 | ST2h | 93.659 | ST2f | 82.116 | ST2h | 93.517 | ST2h | 86.579 | ST2f |
| BF81 DBCSBOP | 0.48 | 82.000 | | 93.194 | ST2h | 93.629 | ST2g | 82.123 | ST2h | 93.770 | ST2h | 86.227 | ST2h | 93.579 | ST2f | 82.045 | ST2h | 93.437 | ST2h | 86.505 | ST2f |
| C1 4160 SWGR | 4.16 | 91.010 | 67.310 | 93.483 | ST2h | 94.446 | ST2g | 82.241 | ST2h | 93.719 | ST2h | 87.237 | ST2f | 94.348 | ST2f | 82.305 | ST2h | 94.088 | ST2h | 86.479 | ST2h |
| C1 MP3-1 | 4.16 | 86.540 | 67.310 | 93.308 | ST2h | 94.272 | ST2g | 82.041 | ST2h | 93.543 | ST2h | 87.049 | ST2f | 94.173 | ST2f | 82.105 | ST2h | 93.913 | ST2h | 86.289 | ST2h |
| C1 MP37-1A | 4.16 | 86.540 | 76.930 | 93.483 | ST2h | 94.446 | ST2g | 82.241 | ST2h | 93.719 | ST2h | 87.237 | ST2f | 94.348 | ST2f | 82.305 | ST2h | 94.088 | ST2h | 86.479 | ST2h |
| C1 MP42-1 | 4.16 | 86.540 | 67.310 | 93.415 | ST2h | 94.379 | ST2g | 82.164 | ST2h | 93.651 | ST2h | 87.164 | ST2f | 94.280 | ST2f | 82.227 | ST2h | 94.020 | ST2h | 86.405 | ST2h |
| C1 MP43-1 | 4.16 | 86.540 | 67.310 | 93.425 | ST2h | 94.389 | ST2g | 82.175 | ST2h | 93.661 | ST2h | 87.175 | ST2f | 94.290 | ST2f | 82.238 | ST2h | 94.030 | ST2h | 86.416 | ST2h |
| C1 MP58-1 | 4.16 | 86.540 | 67.310 | 93.337 | ST2h | 94.302 | ST2g | 82.075 | ST2h | 93.573 | ST2h | 87.081 | ST2f | 94.203 | ST2f | 82.139 | ST2h | 93.942 | ST2h | 86.321 | ST2h |
| C2 4160 SWGR | 4.16 | 86.540 | 76.930 | 93.492 | ST2h | 94.434 | ST2g | 82.250 | ST2h | 93.727 | ST2h | 87.246 | ST2f | 94.356 | ST2f | 82.314 | ST2h | 94.096 | ST2h | 86.487 | ST2h |
| D1 4160 SWGR | 4.16 | 91.010 | 67.310 | 93.999 | ST2h | 94.436 | ST2g | 82.880 | ST2h | 94.578 | ST2h | 87.001 | ST2h | 94.397 | ST2f | 82.802 | ST2h | 94.243 | ST2h | 87.292 | ST2f |
| D1 MP3-2 | 4.16 | 86.540 | 67.310 | 93.789 | ST2h | 94.228 | ST2g | 82.642 | ST2h | 94.369 | ST2h | 86.774 | ST2h | 94.188 | ST2f | 82.564 | ST2h | 94.034 | ST2h | 87.067 | ST2f |
| D1 MP37-2A | 4.16 | 86.540 | 76.930 | 93.999 | ST2h | 94.436 | ST2g | 82.880 | ST2h | 94.578 | ST2h | 87.001 | ST2h | 94.397 | ST2f | 82.802 | ST2h | 94.243 | ST2h | 87.292 | ST2f |
| D1 MP42-2 | 4.16 | 86.540 | 67.310 | 93.946 | ST2h | 94.384 | ST2g | 82.820 | ST2h | 94.525 | ST2h | 86.944 | ST2h | 94.345 | ST2f | 82.742 | ST2h | 94.191 | ST2h | 87.236 | ST2f |
| D1 MP43-2 | 4.16 | 86.540 | 67.310 | 93.940 | ST2h | 94.377 | ST2g | 82.813 | ST2h | 94.519 | ST2h | 86.937 | ST2h | 94.338 | ST2f | 82.735 | ST2h | 94.184 | ST2h | 87.229 | ST2f |
| D1 MP58-2 | 4.16 | 86.540 | 67.310 | 93.911 | ST2h | 94.349 | ST2g | 82.781 | ST2h | 94.491 | ST2h | 86.906 | ST2h | 94.310 | ST2f | 82.703 | ST2h | 94.156 | ST2h | 87.198 | ST2f |
| D2 4160 SWGR | 4.16 | 86.540 | 76.930 | 94.005 | ST2h | 94.442 | ST2g | 82.887 | ST2h | 94.584 | ST2h | 87.007 | ST2h | 94.391 | ST2f | 82.809 | ST2h | 94.249 | ST2h | 87.286 | ST2f |
| D3 4160 SWGR | 4.16 | 86.540 | 76.930 | 93.998 | ST2h | 94.435 | ST2g | 82.880 | ST2h | 94.576 | ST2h | 87.000 | ST2h | 94.384 | ST2f | 82.802 | ST2h | 94.242 | ST2h | 87.279 | ST2f |
| E1 480V SWGR | 0.48 | 86.250 | 67.090 | 92.572 | ST2h | 93.581 | ST2g | 80.737 | ST2h | 92.819 | ST2h | 86.011 | ST2f | 93.478 | ST2f | 80.804 | ST2h | 93.205 | ST2h | 85.212 | ST2h |
| E1 MP56-1 | 0.48 | 86.250 | 67.090 | 91.282 | ST2h | 92.305 | ST2g | 79.250 | ST2h | 91.532 | ST2h | 84.619 | ST2f | 92.200 | ST2f | 79.318 | ST2h | 91.924 | ST2h | 83.807 | ST2h |
| E11A MCC | 0.48 | 87.100 | 67.090 | 92.308 | ST2h | 93.320 | ST2g | 80.433 | ST2h | 92.556 | ST2h | 85.727 | ST2f | 93.216 | ST2f | 80.500 | ST2h | 92.943 | ST2h | 84.925 | ST2h |
| E11A MC62-1 | 0.48 | 86.250 | 67.090 | 92.308 | ST2h | 93.320 | ST2g | 80.433 | ST2h | 92.556 | ST2h | 85.727 | ST2f | 93.216 | ST2f | 80.500 | ST2h | 92.943 | ST2h | 84.925 | ST2h |
| E11A MP89-1A | 0.48 | 86.250 | 67.090 | 91.675 | ST2h | 92.693 | ST2g | 79.704 | ST2h | 91.924 | ST2h | 85.043 | ST2f | 92.589 | ST2f | 79.772 | ST2h | 92.314 | ST2h | 84.235 | ST2h |
| E11A MP89-1B | 0.48 | 86.250 | 67.090 | 92.308 | ST2h | 93.320 | ST2g | 80.433 | ST2h | 92.556 | ST2h | 85.727 | ST2f | 93.216 | ST2f | 80.500 | ST2h | 92.943 | ST2h | 84.925 | ST2h |
| E11A MP89-3A | 0.48 | 86.250 | 67.090 | 91.171 | ST2h | 92.195 | ST2g | 79.121 | ST2h | 91.421 | ST2h | 84.499 | ST2f | 92.090 | ST2f | 79.189 | ST2h | 91.813 | ST2h | 83.685 | ST2h |
| E11A MP89-3B | 0.48 | 86.250 | 67.090 | 92.308 | ST2h | 93.320 | ST2g | 80.433 | ST2h | 92.556 | ST2h | 85.727 | ST2f | 93.216 | ST2f | 80.500 | ST2h | 92.943 | ST2h | 84.925 | ST2h |
| E11B MCC | 0.48 | 87.100 | 67.090 | 92.266 | ST2h | 93.277 | ST2g | 80.384 | ST2h | 92.513 | ST2h | 85.680 | ST2f | 93.174 | ST2f | 80.451 | ST2h | 92.901 | ST2h | 84.878 | ST2h |
| E11B MC56-1 | 0.48 | 86.250 | 67.090 | 91.394 | ST2h | 92.416 | ST2g | 79.380 | ST2h | 91.644 | ST2h | 84.741 | ST2f | 92.311 | ST2f | 79.448 | ST2h | 92.035 | ST2h | 83.930 | ST2h |
| E11C MCC | 0.48 | 87.100 | 67.090 | 92.300 | ST2h | 93.311 | ST2g | 80.423 | ST2h | 92.547 | ST2h | 85.717 | ST2f | 93.208 | ST2f | 80.490 | ST2h | 92.935 | ST2h | 84.916 | ST2h |
| E11C MC75-1 | 0.48 | 86.250 | 67.090 | 90.208 | ST2h | 91.244 | ST2g | 77.999 | ST2h | 90.461 | ST2h | 83.454 | ST2f | 91.138 | ST2f | 78.069 | ST2h | 90.858 | ST2h | 82.630 | ST2h |
| E11D MCC | 0.48 | 86.770 | 67.090 | 92.280 | ST2h | 93.292 | ST2g | 80.401 | ST2h | 92.528 | ST2h | 85.697 | ST2f | 93.189 | ST2f | 80.468 | ST2h | 92.915 | ST2h | 84.895 | ST2h |
| E11D DBC1PN | 0.48 | 82.000 | | 92.280 | ST2h | 93.292 | ST2g | 80.401 | ST2h | 92.528 | ST2h | 85.697 | ST2f | 93.189 | ST2f | 80.468 | ST2h | 92.915 | ST2h | 84.895 | ST2h |
| E11D MP37-1B | 0.48 | 86.250 | 67.090 | 92.280 | ST2h | 93.292 | ST2g | 80.401 | ST2h | 92.528 | ST2h | 85.697 | ST2f | 93.189 | ST2f | 80.468 | ST2h | 92.915 | ST2h | 84.895 | ST2h |
| E11D MRE5327 | 0.48 | 86.250 | 67.090 | 91.977 | ST2h | 92.992 | ST2g | 80.052 | ST2h | 92.225 | ST2h | 85.370 | ST2f | 92.888 | ST2f | 80.120 | ST2h | 92.614 | ST2h | 84.565 | ST2h |
| E11E MCC | 0.48 | 87.100 | 67.090 | 92.296 | ST2h | 93.307 | ST2g | 80.418 | ST2h | 92.543 | ST2h | 85.713 | ST2f | 93.204 | ST2f | 80.486 | ST2h | 92.931 | ST2h | 84.911 | ST2h |
| E11E MV49060 | 0.48 | 85.000 | 67.090 | 90.322 | ST2h | 91.356 | ST2g | 78.133 | ST2h | 90.575 | ST2h | 83.578 | ST2f | 91.250 | ST2f | 78.202 | ST2h | 90.971 | ST2h | 82.755 | ST2h |
| E12A MCC | 0.48 | 90.000 | 67.090 | 92.441 | ST2h | 93.450 | ST2g | 80.596 | ST2h | 92.688 | ST2h | 85.875 | ST2f | 93.347 | ST2f | 80.663 | ST2h | 93.074 | ST2h | 85.076 | ST2h |
| E12A DBC1N | 0.48 | 82.000 | | 92.373 | ST2h | 93.382 | ST2g | 80.527 | ST2h | 92.620 | ST2h | 85.807 | ST2f | 93.279 | ST2f | 80.594 | ST2h | 93.007 | ST2h | 85.008 | ST2h |
| E12A DBC1P | 0.48 | 82.000 | | 92.381 | ST2h | 93.390 | ST2g | 80.535 | ST2h | 92.627 | ST2h | 85.815 | ST2f | 93.287 | ST2f | 80.602 | ST2h | 93.014 | ST2h | 85.015 | ST2h |
| E12A MC21-1 | 0.48 | 86.250 | 67.090 | 90.835 | ST2h | 91.862 | ST2g | 78.742 | ST2h | 91.086 | ST2h | 84.141 | ST2f | 91.757 | ST2f | 78.810 | ST2h | 91.479 | ST2h | 83.324 | ST2h |
| E12A MC30-1 | 0.48 | 86.250 | 67.090 | 92.219 | ST2h | 93.231 | ST2g | 80.342 | ST2h | 92.467 | ST2h | 85.637 | ST2f | 93.127 | ST2f | 80.409 | ST2h | 92.854 | ST2h | 84.835 | ST2h |
| E12A MC71-1 | 0.48 | 86.250 | 67.090 | 92.242 | ST2h | 93.254 | ST2g | 80.368 | ST2h | 92.490 | ST2h | 85.662 | ST2f | 93.150 | ST2f | 80.436 | ST2h | 92.877 | ST2h | 84.860 | ST2h |
| E12A MC73-1 | 0.48 | 86.250 | 67.090 | 91.742 | ST2h | 92.758 | ST2g | 79.792 | ST2h | 91.990 | ST2h | 85.121 | ST2f | 92.654 | ST2f | 79.859 | ST2h | 92.380 | ST2h | 84.315 | ST2h |
| E12A MS3311 | 0.48 | 86.250 | 67.090 | 91.209 | ST2h | 92.232 | ST2g | 79.176 | ST2h | 91.459 | ST2h | 84.546 | ST2f | 92.127 | ST2f | 79.244 | ST2h | 91.851 | ST2h | 83.733 | ST2h |
| E12A MS61-1 | 0.48 | 86.250 | 67.090 | 90.011 | ST2h | 91.048 | ST2g | 77.777 | ST2h | 90.264 | ST2h | 83.245 | ST2f | 90.942 | ST2f | 77.847 | ST2h | 90.662 | ST2h | 82.418 | ST2h |
| E12A MV5597 | 0.48 | 85.000 | 67.090 | 90.515 | ST2h | 91.546 | ST2g | 78.369 | ST2h | 90.767 | ST2h | 83.794 | ST2f | 91.441 | ST2f | 78.438 | ST2h | 91.162 | ST2h | 82.973 | ST2h |
| E12A YRF1 | 0.48 | 90.000 | | 92.301 | ST2h | 93.308 | ST2g | 80.474 | ST2h | 92.547 | ST2h | 85.745 | ST2f | 93.205 | ST2f | 80.541 | ST2h | 92.933 | ST2h | 84.947 | ST2h |
| E12A YRF3 | 0.48 | 90.000 | | 92.219 | ST2h | 93.225 | ST2g | 80.403 | ST2h | 92.465 | ST2h | 85.669 | ST2f | 93.122 | ST2f | 80.469 | ST2h | 92.850 | ST2h | 84.871 | ST2h |
| E12B MCC | 0.48 | 87.100 | 67.090 | 92.398 | ST2h | 93.408 | ST2g | 80.544 | ST2h | 92.645 | ST2h | 85.828 | ST2f | 93.305 | ST2f | 80.611 | ST2h | 93.032 | ST2h | 85.028 | ST2h |
| E12B MC25-1 | 0.48 | 86.250 | 67.090 | 91.321 | ST2h | 92.342 | ST2g | 79.303 | ST2h | 91.570 | ST2h | 84.665 | ST2f | 92.238 | ST2f | 79.371 | ST2h | 91.962 | ST2h | 83.854 | ST2h |
| E12B MC25-2 | 0.48 | 86.250 | 67.090 | 91.593 | ST2h | 92.611 | ST2g | 79.617 | ST2h | 91.842 | ST2h | 84.959 | ST2f | 92.507 | ST2f | 79.685 | ST2h | 92.232 | ST2h | 84.151 | ST2h |
| E12B MC78-1 | 0.48 | 86.250 | 67.090 | 91.927 | ST2h | 92.942 | ST2g | 80.002 | ST2h | 92.175 | ST2h | 85.320 | ST2f | 92.838 | ST2f | 80.069 | ST2h | 92.564 | ST2h | 84.514 | ST2h |
| E12B MP147-1 | 0.48 | 86.250 | 67.090 | 92.099 | ST2h | 93.112 | ST2g | 80.200 | ST2h | 92.347 | ST2h | 85.505 | ST2f | 93.008 | ST2f | 80.268 | ST2h | 92.735 | ST2h | 84.702 | ST2h |
| E12B MP147-3 | 0.48 | 86.250 | 67.090 | 92.313 | ST2h | 93.323 | ST2g | 80.446 | ST2h | 92.560 | ST2h | 85.736 | ST2f | 93.220 | ST2f | 80.513 | ST2h | 92.947 | ST2h | 84.934 | ST2h |
| E12B YE1 | 0.48 | 82.100 | | 92.361 | ST2h | 93.371 | ST2g | 80.501 | ST2h | 92.608 | ST2h | 85.787 | ST2f | 93.267 | ST2f | 80.568 | ST2h | 92.994 | ST2h | 84.987 | ST2h |
| E12C MCC | 0.48 | 87.100 | 67.090 | 92.005 | ST2h | 93.019 | ST2g | 80.094 | ST2h | 92.253 | ST2h | 85.405 | ST2f | 92.915 | ST2f | 80.162 | ST2h | 92.641 | ST2h | 84.601 | ST2h |
| E12C MC99-1 | 0.48 | 86.250 | 67.090 | 90.968 | ST2h | 91.993 | ST2g | 78.897 | ST2h | 91.218 | ST2h | 84.285 | ST2f | 91.888 | ST2f | 78.965 | ST2h | 91.611 | ST2h | 83.470 | ST2h |
| E12C MC99-2 | 0.48 | 86.250 | 67.090 | 91.394 | ST2h | 92.415 | ST2g | 79.391 | ST2h | 91.644 | ST2h | 84.746 | ST2f | 92.311 | ST2f | 79.459 | ST2h | 92.035 | ST2h | 83.936 | ST2h |
| E12C MF15-1 | 0.48 | 86.250 | 67.090 | 91.771 | ST2h | 92.787 | ST2g | 79.825 | ST2h | 92.019 | ST2h | 85.153 | ST2f | 92.683 | ST2f | 79.892 | ST2h | 92.409 | ST2h | 84.346 | ST2h |
| E12D MCC | 0.48 | 86.250 | 67.090 | 91.980 | ST2h | 92.994 | ST2g | 80.065 | ST2h | 92.228 | ST2h | 85.378 | ST2f | 92.890 | ST2f | 80.133 | ST2h | 92.616 | ST2h | 84.574 | ST2h |
| E12E MCC | 0.48 | 87.100 | 67.090 | 92.065 | ST2h | 93.079 | ST2g | 80.163 | ST2h | 92.313 | ST2h | 85.470 | ST2f | 92.975 | ST2f | 80.230 | ST2h | 92.701 | ST2h | 84.666 | ST2h |
| E12E MC31-4 | 0.48 | 86.250 | 67.090 | 90.390 | ST2h | 91.423 | ST2g | 78.225 | ST2h | 90.643 | ST2h | 83.659 | ST2f | 91.317 | ST2f | 78.294 | ST2h | 91.038 | ST2h | 82.837 | ST2h |
| E12E MC31-5 | 0.48 | 86.250 | 67.090 | 90.859 | ST2h | 91.886 | ST2g | 78.770 | ST2h | 91.110 | ST2h | 84.167 | ST2f | 91.781 | ST2f | 78.839 | ST2h | 91.503 | ST2h | 83.351 | ST2h |
| E12E MP197-1 | 0.48 | 86.250 | 67.090 | 91.677 | ST2h | 92.695 | ST2g | 79.716 | ST2h | 91.926 | ST2h | 85.052 | ST2f | 92.591 | ST2f | 79.784 | ST2h | 92.316 | ST2h | 84.244 | ST2h |
| E12F MCC | 0.48 | 86.250 | 67.090 | 92.379 | ST2h | 93.389 | ST2g | 80.522 | ST2h | 92.626 | ST2h | 85.807 | ST2f | 93.286 | ST2f | 80.589 | ST2h | 93.013 | ST2h | 85.007 | ST2h |
| E12F MC25-5 | 0.48 | 86.250 | 67.090 | 92.379 | ST2h | 93.389 | ST2g | 80.522 | ST2h | 92.626 | ST2h | 85.807 | ST2f | 93.286 | ST2f | 80.589 | ST2h | 93.013 | ST2h | 85.007 | ST2h |
| E12F MP195-1 | 0.48 | 86.250 | 67.090 | 91.808 | ST2h | 92.824 | ST2g | 79.865 | ST2h | 92.056 | ST2h | 85.191 | ST2f | 92.720 | ST2f | 79.933 | ST2h | 92.445 | ST2h | 84.385 | ST2h |
| E14 MCC | 0.48 | 86.250 | 67.090 | 92.465 | ST2h | 93.474 | ST2g | 80.613 | ST2h | 92.712 | ST2h | 85.896 | ST2f | 93.371 | ST2f | 80.680 | ST2h | 93.098 | ST2h | 85.095 | ST2h |
| E14 MC1-1 | 0.48 | 86.250 | 67.090 | 93.420 | ST3c | 94.554 | ST3c | 81.732 | ST3c | 93.650 | ST3c | 88.212 | ST3b | 94.559 | ST3c | 81.799 | ST3c | 94.028 | ST3c | 86.022 | ST3c |
| E14 MC1-1LS | 0.48 | 86.250 | 67.090 | 91.965 | ST2h | 92.980 | ST2g | 80.038 | ST2h | 92.213 | ST2h | 85.356 | ST2f | 92.876 | ST2f | 80.106 | ST2h | 92.602 | ST2h | 84.551 | ST2h |
| E15 MCC | 0.48 | 86.250 | 67.090 | 92.572 | ST2h | 93.581 | ST2g | 80.737 | ST2h | 92.819 | ST2h | 86.011 | ST2f | 93.478 | ST2f | 80.804 | ST2h | 93.205 | ST2h | 85.212 | ST2h |
| E16A MCC | 0.48 | 89.800 | 67.090 | 92.443 | ST2h | 93.451 | ST2g | 80.619 | ST2h | 92.690 | ST2h | 85.889 | ST2f | 93.348 | ST2f | 80.686 | ST2h | 93.076 | ST2h | 85.091 | ST2h |
| E16A MP274-1 | 0.48 | 86.250 | 67.090 | 92.148 | ST2h | 93.152 | ST2g | 80.362 | ST2h | 92.394 | ST2h | 85.614 | ST2f | 93.050 | ST2f | 80.428 | ST2h | 92.778 | ST2h | 84.819 | ST2h |
| E16A XY1 | 0.48 | 85.000 | | 92.396 | ST2h | 93.403 | ST2g | 80.578 | ST2h | 92.642 | ST2h | 85.845 | ST2f | 93.300 | ST2f | 80.645 | ST2h | 93.028 | ST2h | 85.047 | ST2h |
| E16A XY3 | 0.48 | 85.000 | | 92.377 | ST2h | 93.383 | ST2g | 80.561 | ST2h | 92.623 | ST2h | 85.827 | ST2f | 93.280 | ST2f | 80.628 | ST2h | 93.008 | ST2h | 85.029 | ST2h |
| E16B MCC | 0.48 | 90.300 | 67.090 | 92.427 | ST2h | 93.434 | ST2g | 80.605 | ST2h | 92.673 | ST2h | 85.874 | ST2f | 93.331 | ST2f | 80.672 | ST2h | 93.059 | ST2h | 85.076 | ST2h |
| E16B MP273-1 | 0.48 | 86.250 | 67.090 | 92.264 | ST2h | 93.269 | ST2g | 80.462 | ST2h | 92.509 | ST2h | 85.722 | ST2f | 93.166 | ST2f | 80.529 | ST2h | 92.894 | ST2h | 84.925 | ST2h |
| E2 480V SWGR | 0.48 | | | 89.291 | ST3c | 90.317 | ST3c | 78.758 | ST3c | 89.499 | ST3c | 86.947 | ST3c | 90.322 | ST3c | 78.818 | ST3c | 89.510 | ST3c | 86.940 | ST3c |
| E21A MCC | 0.48 | | | 88.707 | ST3c | 89.730 | ST3c | 78.204 | ST3c | 88.914 | ST3c | 86.370 | ST3c | 89.734 | ST3c | 78.264 | ST3c | 88.925 | ST3c | 86.363 | ST3c |
| E21B MCC | 0.48 | | | 88.677 | ST3c | 89.699 | ST3c | 78.177 | ST3c | 88.884 | ST3c | 86.340 | ST3c | 89.704 | ST3c | 78.237 | ST3c | 88.895 | ST3c | 86.334 | ST3c |
| E21C MCC | 0.48 | | | 88.183 | ST3c | 89.202 | ST3c | 77.714 | ST3c | 88.389 | ST3c | 85.854 | ST3c | 89.207 | ST3c | 77.773 | ST3c | 88.400 | ST3c | 85.847 | ST3c |
| E21D MCC | 0.48 | | | 88.707 | ST3c | 89.730 | ST3c | 78.204 | ST3c | 88.914 | ST3c | 86.370 | ST3c | 89.734 | ST3c | 78.264 | ST3c | 88.925 | ST3c | 86.363 | ST3c |
| E22A MCC | 0.48 | | | 88.404 | ST3c | 89.426 | ST3c | 77.906 | ST3c | 88.611 | ST3c | 86.068 | ST3c | 89.430 | ST3c | 77.966 | ST3c | 88.622 | ST3c | 86.062 | ST3c |
| E22B MCC | 0.48 | | | 88.391 | ST3c | 89.413 | ST3c | 77.894 | ST3c | 88.598 | ST3c | 86.056 | ST3c | 89.417 | ST3c | 77.954 | ST3c | 88.609 | ST3c | 86.049 | ST3c |

**Table 6. Scenarios ST2 and ST3 Large Motor Starting Transient Minimum Bus VOltages (Sheet 2 of 3)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | | T=5 | | T=6 | | T=7 | | T=8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| E23A MCC | 0.48 | | | 88.767 | ST3c | 89.794 | ST3c | 78.221 | ST3c | 88.975 | ST3c | 86.421 | ST3c | 89.798 | ST3c | 78.281 | ST3c | 88.986 | ST3c | 86.414 | ST3c |
| E23B MCC | 0.48 | | | 88.275 | ST3c | 89.300 | ST3c | 77.741 | ST3c | 88.483 | ST3c | 85.932 | ST3c | 89.305 | ST3c | 77.801 | ST3c | 88.493 | ST3c | 85.925 | ST3c |
| E3 480V SWGR | 0.48 | | | 90.111 | ST2h | 91.196 | ST2h | 79.342 | ST2h | 90.337 | ST2h | 87.713 | ST2h | 91.201 | ST2h | 79.402 | ST2h | 90.348 | ST2h | 87.705 | ST2h |
| E31A MCC | 0.48 | | | 88.417 | ST2h | 89.505 | ST2h | 77.605 | ST2h | 88.643 | ST2h | 86.012 | ST2h | 89.510 | ST2h | 77.666 | ST2h | 88.654 | ST2h | 86.005 | ST2h |
| E31B MCC | 0.48 | | | 88.328 | ST2h | 89.417 | ST2h | 77.503 | ST2h | 88.554 | ST2h | 85.920 | ST2h | 89.422 | ST2h | 77.564 | ST2h | 88.565 | ST2h | 85.913 | ST2h |
| E32A MCC | 0.48 | | | 90.009 | ST2h | 91.094 | ST2h | 79.241 | ST2h | 90.234 | ST2h | 87.611 | ST2h | 91.099 | ST2h | 79.302 | ST2h | 90.245 | ST2h | 87.604 | ST2h |
| E32B MCC | 0.48 | | | 89.512 | ST2h | 90.598 | ST2h | 78.729 | ST2h | 89.738 | ST2h | 87.111 | ST2h | 90.603 | ST2h | 78.790 | ST2h | 89.748 | ST2h | 87.104 | ST2h |
| E33A MCC | 0.48 | | | 89.476 | ST2h | 90.565 | ST2h | 78.655 | ST2h | 89.702 | ST2h | 87.067 | ST2h | 90.570 | ST2h | 78.716 | ST2h | 89.713 | ST2h | 87.060 | ST2h |
| E33B MCC | 0.48 | | | 89.476 | ST2h | 90.565 | ST2h | 78.655 | ST2h | 89.702 | ST2h | 87.067 | ST2h | 90.570 | ST2h | 78.716 | ST2h | 89.713 | ST2h | 87.060 | ST2h |
| E4 480V SWGR | 0.48 | | | 91.202 | ST2h | 92.292 | ST2h | 80.393 | ST2h | 91.428 | ST2h | 88.793 | ST2h | 92.297 | ST2h | 80.454 | ST2h | 91.439 | ST2h | 88.786 | ST2h |
| E41A MCC | 0.48 | | | 90.860 | ST2h | 91.948 | ST2h | 80.070 | ST2h | 91.086 | ST2h | 88.456 | ST2h | 91.953 | ST2h | 80.131 | ST2h | 91.097 | ST2h | 88.449 | ST2h |
| E41B MCC | 0.48 | | | 90.570 | ST2h | 91.658 | ST2h | 79.778 | ST2h | 90.796 | ST2h | 88.166 | ST2h | 91.663 | ST2h | 79.838 | ST2h | 90.807 | ST2h | 88.158 | ST2h |
| E42 MCC | 0.48 | | | 91.083 | ST2h | 92.010 | ST2g | 80.018 | ST2h | 91.314 | ST2h | 84.937 | ST2f | 91.933 | ST2f | 80.081 | ST2h | 91.677 | ST2h | 84.191 | ST2h |
| E43 MCC | 0.48 | | | 91.202 | ST2h | 92.292 | ST2h | 80.393 | ST2h | 91.428 | ST2h | 88.793 | ST2h | 92.297 | ST2h | 80.454 | ST2h | 91.439 | ST2h | 88.786 | ST2h |
| E6 480V SWGR | 0.48 | | | 93.275 | ST2h | 94.359 | ST2h | 82.546 | ST2h | 93.500 | ST2h | 90.880 | ST2h | 94.364 | ST2h | 82.606 | ST2h | 93.511 | ST2h | 90.873 | ST2h |
| E61 MCC | 0.48 | | | 93.275 | ST2h | 94.359 | ST2h | 82.546 | ST2h | 93.500 | ST2h | 90.880 | ST2h | 94.364 | ST2h | 82.606 | ST2h | 93.511 | ST2h | 90.873 | ST2h |
| E62 MCC | 0.48 | | | 93.275 | ST2h | 94.359 | ST2h | 82.546 | ST2h | 93.500 | ST2h | 90.880 | ST2h | 94.364 | ST2h | 82.606 | ST2h | 93.511 | ST2h | 90.873 | ST2h |
| E63 MCC | 0.48 | | | 93.275 | ST2h | 94.359 | ST2h | 82.546 | ST2h | 93.500 | ST2h | 90.880 | ST2h | 94.364 | ST2h | 82.606 | ST2h | 93.511 | ST2h | 90.873 | ST2h |
| EF12C MCC | 0.48 | 86.250 | 67.090 | 91.967 | ST2h | 92.982 | ST2g | 80.051 | ST2h | 92.215 | ST2h | 85.364 | ST2f | 92.878 | ST2f | 80.118 | ST2h | 92.604 | ST2h | 84.560 | ST2h |
| EF12C MF15-3 | 0.48 | 86.250 | 67.090 | 91.967 | ST2h | 92.982 | ST2g | 80.051 | ST2h | 92.215 | ST2h | 85.364 | ST2f | 92.878 | ST2f | 80.118 | ST2h | 92.604 | ST2h | 84.560 | ST2h |
| EF12D MCC | 0.48 | 86.250 | 67.090 | 92.441 | ST2h | 93.450 | ST2g | 80.596 | ST2h | 92.688 | ST2h | 85.875 | ST2f | 93.347 | ST2f | 80.663 | ST2h | 93.074 | ST2h | 85.076 | ST2h |
| EF41 AE4 | 0.48 | | | 91.202 | ST2h | 92.292 | ST2h | 80.393 | ST2h | 91.428 | ST2h | 88.793 | ST2h | 92.297 | ST2h | 80.454 | ST2h | 91.439 | ST2h | 88.786 | ST2h |
| EF41 BF4 | 0.48 | | | 92.104 | ST2h | 93.176 | ST2h | 81.494 | ST2h | 92.330 | ST2h | 89.707 | ST2h | 93.195 | ST2h | 81.420 | ST2h | 92.338 | ST2h | 89.730 | ST2h |
| F1 480V SWGR | 0.48 | 86.250 | 67.090 | 93.259 | ST2h | 93.717 | ST2g | 81.569 | ST2h | 93.865 | ST2h | 85.915 | ST2h | 93.676 | ST2f | 81.487 | ST2h | 93.515 | ST2h | 86.222 | ST2f |
| F1 MP56-2 | 0.48 | 86.250 | 67.090 | 92.051 | ST2h | 92.514 | ST2g | 80.181 | ST2h | 92.664 | ST2h | 84.600 | ST2h | 92.473 | ST2f | 80.097 | ST2h | 92.310 | ST2h | 84.911 | ST2f |
| F11A MCC | 0.48 | 87.100 | 67.090 | 92.928 | ST2h | 93.387 | ST2g | 81.208 | ST2h | 93.536 | ST2h | 85.566 | ST2h | 93.346 | ST2f | 81.125 | ST2h | 93.185 | ST2h | 85.874 | ST2f |
| F11A MC21-2 | 0.48 | 86.250 | 67.090 | 92.256 | ST2h | 92.718 | ST2g | 80.436 | ST2h | 92.868 | ST2h | 84.835 | ST2h | 92.677 | ST2f | 80.353 | ST2h | 92.514 | ST2h | 85.145 | ST2f |
| F11A MC62-2 | 0.48 | 86.250 | 67.090 | 92.928 | ST2h | 93.387 | ST2g | 81.208 | ST2h | 93.536 | ST2h | 85.566 | ST2h | 93.346 | ST2f | 81.125 | ST2h | 93.185 | ST2h | 85.874 | ST2f |
| F11A MC75-2 | 0.48 | 86.250 | 67.090 | 91.719 | ST2h | 92.184 | ST2g | 79.817 | ST2h | 92.335 | ST2h | 84.249 | ST2h | 92.143 | ST2f | 79.733 | ST2h | 91.979 | ST2h | 84.562 | ST2f |
| F11A MRE5328 | 0.48 | 86.250 | 67.090 | 92.686 | ST2h | 93.146 | ST2g | 80.930 | ST2h | 93.295 | ST2h | 85.303 | ST2h | 93.105 | ST2f | 80.847 | ST2h | 92.943 | ST2h | 85.611 | ST2f |
| F11A MS3321 | 0.48 | 86.250 | 67.090 | 92.185 | ST2h | 92.648 | ST2g | 80.355 | ST2h | 92.798 | ST2h | 84.758 | ST2h | 92.607 | ST2f | 80.271 | ST2h | 92.444 | ST2h | 85.068 | ST2f |
| F11A MV4907 | 0.48 | 85.000 | 67.090 | 90.997 | ST2h | 91.465 | ST2g | 78.979 | ST2h | 91.617 | ST2h | 83.458 | ST2h | 91.424 | ST2f | 78.893 | ST2h | 91.258 | ST2h | 83.774 | ST2f |
| F11B MCC | 0.48 | 87.100 | 67.090 | 92.928 | ST2h | 93.387 | ST2g | 81.208 | ST2h | 93.536 | ST2h | 85.566 | ST2h | 93.346 | ST2f | 81.125 | ST2h | 93.185 | ST2h | 85.874 | ST2f |
| F11C MCC | 0.48 | 87.100 | 67.090 | 92.910 | ST2h | 93.369 | ST2g | 81.186 | ST2h | 93.517 | ST2h | 85.546 | ST2h | 93.328 | ST2f | 81.104 | ST2h | 93.166 | ST2h | 85.853 | ST2f |
| F11C MP37-2B | 0.48 | 86.250 | 67.090 | 92.910 | ST2h | 93.369 | ST2g | 81.186 | ST2h | 93.517 | ST2h | 85.546 | ST2h | 93.328 | ST2f | 81.104 | ST2h | 93.166 | ST2h | 85.853 | ST2f |
| F11C MP37-2D | 0.48 | 86.250 | 67.090 | 92.470 | ST2h | 92.931 | ST2g | 80.683 | ST2h | 93.080 | ST2h | 85.068 | ST2h | 92.890 | ST2f | 80.599 | ST2h | 92.728 | ST2h | 85.377 | ST2f |
| F11D MCC | 0.48 | 87.100 | 67.090 | 92.877 | ST2h | 93.336 | ST2g | 81.149 | ST2h | 93.485 | ST2h | 85.510 | ST2h | 93.295 | ST2f | 81.066 | ST2h | 93.134 | ST2h | 85.818 | ST2f |
| F11D DBC2PN | 0.48 | 82.000 | | 92.877 | ST2h | 93.336 | ST2g | 81.149 | ST2h | 93.485 | ST2h | 85.510 | ST2h | 93.295 | ST2f | 81.066 | ST2h | 93.134 | ST2h | 85.818 | ST2f |
| F11D MC31-3 | 0.48 | 86.250 | 67.090 | 92.535 | ST2h | 92.996 | ST2g | 80.757 | ST2h | 93.145 | ST2h | 85.139 | ST2h | 92.955 | ST2f | 80.674 | ST2h | 92.793 | ST2h | 85.448 | ST2f |
| F11D MP89-2A | 0.48 | 86.250 | 67.090 | 92.119 | ST2h | 92.582 | ST2g | 80.279 | ST2h | 92.732 | ST2h | 84.686 | ST2h | 92.541 | ST2f | 80.195 | ST2h | 92.378 | ST2h | 84.997 | ST2f |
| F11D MP89-2B | 0.48 | 86.250 | 67.090 | 92.877 | ST2h | 93.336 | ST2g | 81.149 | ST2h | 93.485 | ST2h | 85.510 | ST2h | 93.295 | ST2f | 81.066 | ST2h | 93.134 | ST2h | 85.818 | ST2f |
| F11E MCC | 0.48 | 86.250 | 67.090 | 92.626 | ST2h | 93.085 | ST2g | 80.877 | ST2h | 93.234 | ST2h | 85.247 | ST2h | 93.044 | ST2f | 80.794 | ST2h | 92.882 | ST2h | 85.555 | ST2f |
| F11E MC31-1 | 0.48 | 86.250 | 67.090 | 90.582 | ST2h | 91.053 | ST2g | 78.517 | ST2h | 91.205 | ST2h | 83.016 | ST2h | 91.011 | ST2f | 78.431 | ST2h | 90.845 | ST2h | 83.333 | ST2f |
| F11E MC31-2 | 0.48 | 86.250 | 67.090 | 89.665 | ST2h | 90.141 | ST2g | 77.443 | ST2h | 90.294 | ST2h | 82.007 | ST2h | 90.098 | ST2f | 77.356 | ST2h | 89.931 | ST2h | 82.328 | ST2f |
| F11F MCC | 0.48 | 86.250 | 67.090 | 92.590 | ST2h | 93.050 | ST2g | 80.846 | ST2h | 93.199 | ST2h | 85.215 | ST2h | 93.009 | ST2f | 80.763 | ST2h | 92.847 | ST2h | 85.523 | ST2f |
| F12A MCC | 0.48 | 90.000 | 67.090 | 93.126 | ST2h | 93.584 | ST2g | 81.430 | ST2h | 93.732 | ST2h | 85.779 | ST2h | 93.544 | ST2f | 81.348 | ST2h | 93.382 | ST2h | 86.086 | ST2f |
| F12A DBC2N | 0.48 | 82.000 | | 93.029 | ST2h | 93.488 | ST2g | 81.332 | ST2h | 93.636 | ST2h | 85.681 | ST2h | 93.447 | ST2f | 81.249 | ST2h | 93.285 | ST2h | 85.988 | ST2f |
| F12A DBC2P | 0.48 | 82.000 | | 93.029 | ST2h | 93.488 | ST2g | 81.332 | ST2h | 93.636 | ST2h | 85.681 | ST2h | 93.447 | ST2f | 81.249 | ST2h | 93.285 | ST2h | 85.988 | ST2f |
| F12A MC133 | 0.48 | 86.250 | 67.090 | 91.957 | ST2h | 92.421 | ST2g | 80.087 | ST2h | 92.571 | ST2h | 84.506 | ST2h | 92.380 | ST2f | 80.003 | ST2h | 92.216 | ST2h | 84.817 | ST2f |
| F12A MC30-2 | 0.48 | 86.250 | 67.090 | 92.746 | ST2h | 93.206 | ST2g | 80.995 | ST2h | 93.354 | ST2h | 85.365 | ST2h | 93.165 | ST2f | 80.911 | ST2h | 93.003 | ST2h | 85.674 | ST2f |
| F12A MC73-2 | 0.48 | 86.250 | 67.090 | 90.804 | ST2h | 91.274 | ST2g | 78.748 | ST2h | 91.426 | ST2h | 83.243 | ST2h | 91.232 | ST2f | 78.663 | ST2h | 91.067 | ST2h | 83.560 | ST2f |
| F12A MP195-2 | 0.48 | 86.250 | 67.090 | 92.593 | ST2h | 93.053 | ST2g | 80.819 | ST2h | 93.202 | ST2h | 85.198 | ST2h | 93.012 | ST2f | 80.735 | ST2h | 92.850 | ST2h | 85.507 | ST2f |
| F12A MP198-1 | 0.48 | 86.250 | 67.090 | 92.479 | ST2h | 92.940 | ST2g | 80.687 | ST2h | 93.089 | ST2h | 85.074 | ST2h | 92.899 | ST2f | 80.604 | ST2h | 92.736 | ST2h | 85.383 | ST2f |
| F12A MS61-2 | 0.48 | 86.250 | 67.090 | 91.080 | ST2h | 91.549 | ST2g | 79.069 | ST2h | 91.701 | ST2h | 83.546 | ST2h | 91.507 | ST2f | 78.984 | ST2h | 91.342 | ST2h | 83.861 | ST2f |
| F12A MV5598 | 0.48 | 85.000 | 67.090 | 91.721 | ST2h | 92.187 | ST2g | 79.814 | ST2h | 92.337 | ST2h | 84.248 | ST2h | 92.145 | ST2f | 79.730 | ST2h | 91.981 | ST2h | 84.561 | ST2f |
| F12A YRF2 | 0.48 | 90.000 | | 92.961 | ST2h | 93.419 | ST2g | 81.286 | ST2h | 93.566 | ST2h | 85.627 | ST2h | 93.378 | ST2f | 81.204 | ST2h | 93.217 | ST2h | 85.933 | ST2f |
| F12A YRF4 | 0.48 | 90.000 | | 92.891 | ST2h | 93.348 | ST2g | 81.224 | ST2h | 93.495 | ST2h | 85.562 | ST2h | 93.307 | ST2f | 81.142 | ST2h | 93.146 | ST2h | 85.868 | ST2f |
| F12B MCC | 0.48 | 87.100 | 67.090 | 93.105 | ST2h | 93.564 | ST2g | 81.396 | ST2h | 93.712 | ST2h | 85.750 | ST2h | 93.523 | ST2f | 81.314 | ST2h | 93.361 | ST2h | 86.057 | ST2f |
| F12B MC25-3 | 0.48 | 86.250 | 67.090 | 92.458 | ST2h | 92.920 | ST2g | 80.654 | ST2h | 93.069 | ST2h | 85.046 | ST2h | 92.879 | ST2f | 80.571 | ST2h | 92.716 | ST2h | 85.356 | ST2f |
| F12B MC25-4 | 0.48 | 86.250 | 67.090 | 92.155 | ST2h | 92.618 | ST2g | 80.305 | ST2h | 92.768 | ST2h | 84.716 | ST2h | 92.577 | ST2f | 80.222 | ST2h | 92.414 | ST2h | 85.027 | ST2f |
| F12B MC78-2 | 0.48 | 86.250 | 67.090 | 92.810 | ST2h | 93.270 | ST2g | 81.058 | ST2h | 93.419 | ST2h | 85.429 | ST2h | 93.229 | ST2f | 80.975 | ST2h | 93.067 | ST2h | 85.737 | ST2f |
| F12B MP147-2 | 0.48 | 86.250 | 67.090 | 92.794 | ST2h | 93.254 | ST2g | 81.040 | ST2h | 93.403 | ST2h | 85.412 | ST2h | 93.213 | ST2f | 80.957 | ST2h | 93.051 | ST2h | 85.720 | ST2f |
| F12B MP147-4 | 0.48 | 86.250 | 67.090 | 93.009 | ST2h | 93.468 | ST2g | 81.286 | ST2h | 93.616 | ST2h | 85.645 | ST2h | 93.427 | ST2f | 81.203 | ST2h | 93.265 | ST2h | 85.952 | ST2f |
| F12B YF1 | 0.48 | 81.600 | | 93.068 | ST2h | 93.526 | ST2g | 81.354 | ST2h | 93.675 | ST2h | 85.709 | ST2h | 93.485 | ST2f | 81.271 | ST2h | 93.324 | ST2h | 86.016 | ST2f |
| F12C MCC | 0.48 | 87.100 | 67.090 | 92.838 | ST2h | 93.298 | ST2g | 81.100 | ST2h | 93.446 | ST2h | 85.465 | ST2h | 93.257 | ST2f | 81.017 | ST2h | 93.095 | ST2h | 85.773 | ST2f |
| F12C MF15-2 | 0.48 | 87.100 | 67.090 | 92.626 | ST2h | 93.086 | ST2g | 80.856 | ST2h | 93.235 | ST2h | 85.234 | ST2h | 93.045 | ST2f | 80.773 | ST2h | 92.883 | ST2h | 85.543 | ST2f |
| F12D MCC | 0.48 | 86.250 | 67.090 | 92.757 | ST2h | 93.217 | ST2g | 81.006 | ST2h | 93.366 | ST2h | 85.377 | ST2h | 93.176 | ST2f | 80.923 | ST2h | 93.014 | ST2h | 85.685 | ST2f |
| F12D MC99-3 | 0.48 | 86.250 | 67.090 | 92.046 | ST2h | 92.510 | ST2g | 80.190 | ST2h | 92.659 | ST2h | 84.603 | ST2h | 92.468 | ST2f | 80.106 | ST2h | 92.305 | ST2h | 84.914 | ST2f |
| F12D MC99-4 | 0.48 | 86.250 | 67.090 | 91.902 | ST2h | 92.366 | ST2g | 80.023 | ST2h | 92.516 | ST2h | 84.445 | ST2h | 92.324 | ST2f | 79.939 | ST2h | 92.161 | ST2h | 84.757 | ST2f |
| F13 MCC | 0.48 | 86.250 | 67.090 | 92.557 | ST2h | 92.997 | ST2g | 81.349 | ST2h | 93.140 | ST2h | 85.508 | ST2h | 92.946 | ST2f | 81.270 | ST2h | 92.803 | ST2h | 85.789 | ST2f |
| F14 MCC | 0.48 | 86.250 | 67.090 | 93.133 | ST2h | 93.591 | ST2g | 81.424 | ST2h | 93.740 | ST2h | 85.777 | ST2h | 93.550 | ST2f | 81.342 | ST2h | 93.389 | ST2h | 86.085 | ST2f |
| F14 MC1-2 | 0.48 | 86.250 | 67.090 | 94.192 | ST3c | 95.315 | ST3c | 82.629 | ST3c | 94.773 | ST3c | 86.792 | ST3c | 95.334 | ST3c | 82.544 | ST3c | 94.431 | ST3c | 88.417 | ST3b |
| F14 MC1-2LS | 0.48 | 86.250 | 67.090 | 92.576 | ST2h | 93.037 | ST2g | 80.786 | ST2h | 93.186 | ST2h | 85.172 | ST2h | 92.996 | ST2f | 80.702 | ST2h | 92.833 | ST2h | 85.481 | ST2f |
| F15 MCC | 0.48 | 86.250 | 67.090 | 93.259 | ST2h | 93.717 | ST2g | 81.569 | ST2h | 93.865 | ST2h | 85.915 | ST2h | 93.676 | ST2f | 81.487 | ST2h | 93.515 | ST2h | 86.222 | ST2f |
| F16A MCC | 0.48 | 89.700 | 67.090 | 93.233 | ST2h | 93.691 | ST2g | 81.546 | ST2h | 93.838 | ST2h | 85.891 | ST2h | 93.650 | ST2f | 81.464 | ST2h | 93.488 | ST2h | 86.197 | ST2f |
| F16A MC25-6 | 0.48 | 86.250 | 67.090 | 93.233 | ST2h | 93.691 | ST2g | 81.546 | ST2h | 93.838 | ST2h | 85.891 | ST2h | 93.650 | ST2f | 81.464 | ST2h | 93.488 | ST2h | 86.197 | ST2f |
| F16A MP274-3 | 0.48 | 86.250 | 67.090 | 92.995 | ST2h | 93.452 | ST2g | 81.338 | ST2h | 93.599 | ST2h | 85.671 | ST2h | 93.411 | ST2f | 81.256 | ST2h | 93.250 | ST2h | 85.977 | ST2f |
| F16A XY2 | 0.48 | 85.000 | | 93.221 | ST2h | 93.678 | ST2g | 81.536 | ST2h | 93.826 | ST2h | 85.879 | ST2h | 93.637 | ST2f | 81.453 | ST2h | 93.476 | ST2h | 86.186 | ST2f |
| F16A XY4 | 0.48 | 85.000 | | 93.203 | ST2h | 93.660 | ST2g | 81.520 | ST2h | 93.808 | ST2h | 85.863 | ST2h | 93.620 | ST2f | 81.438 | ST2h | 93.458 | ST2h | 86.170 | ST2f |
| F16B MCC | 0.48 | 90.500 | 67.090 | 93.217 | ST2h | 93.675 | ST2g | 81.533 | ST2h | 93.823 | ST2h | 85.876 | ST2h | 93.634 | ST2f | 81.450 | ST2h | 93.473 | ST2h | 86.183 | ST2f |
| F16B MP273-4 | 0.48 | 86.250 | 67.090 | 92.695 | ST2h | 93.150 | ST2g | 81.076 | ST2h | 93.297 | ST2h | 85.395 | ST2h | 93.110 | ST2f | 80.994 | ST2h | 92.949 | ST2h | 85.700 | ST2f |
| F2 480V SWGR | 0.48 | | | 90.094 | ST3c | 91.130 | ST3c | 79.452 | ST3c | 90.306 | ST3c | 87.695 | ST3c | 91.147 | ST3c | 79.374 | ST3c | 90.315 | ST3c | 87.720 | ST3c |
| F21A MCC | 0.48 | | | 89.804 | ST3c | 90.838 | ST3c | 79.179 | ST3c | 90.016 | ST3c | 87.410 | ST3c | 90.856 | ST3c | 79.102 | ST3c | 90.024 | ST3c | 87.434 | ST3c |
| F21B MCC | 0.48 | | | 89.703 | ST3c | 90.736 | ST3c | 79.091 | ST3c | 89.915 | ST3c | 87.312 | ST3c | 90.754 | ST3c | 79.013 | ST3c | 89.923 | ST3c | 87.336 | ST3c |
| F21C MCC | 0.48 | | | 89.801 | ST3c | 90.835 | ST3c | 79.177 | ST3c | 90.013 | ST3c | 87.407 | ST3c | 90.853 | ST3c | 79.099 | ST3c | 90.022 | ST3c | 87.432 | ST3c |
| F22 MCC | 0.48 | | | 88.730 | ST3c | 89.780 | ST3c | 77.916 | ST3c | 88.945 | ST3c | 86.297 | ST3c | 89.798 | ST3c | 77.837 | ST3c | 88.954 | ST3c | 86.322 | ST3c |
| F23A MCC | 0.48 | | | 89.503 | ST3c | 90.541 | ST3c | 78.824 | ST3c | 89.716 | ST3c | 87.097 | ST3c | 90.559 | ST3c | 78.746 | ST3c | 89.724 | ST3c | 87.122 | ST3c |
| F23B MCC | 0.48 | | | 88.623 | ST3c | 89.666 | ST3c | 77.887 | ST3c | 88.837 | ST3c | 86.207 | ST3c | 89.684 | ST3c | 77.809 | ST3c | 88.845 | ST3c | 86.231 | ST3c |
| F3 480V SWGR | 0.48 | | | 90.059 | ST2h | 91.120 | ST2h | 79.537 | ST2h | 90.282 | ST2h | 87.683 | ST2h | 91.139 | ST2h | 79.463 | ST2h | 90.290 | ST2h | 87.706 | ST2h |
| F31A MCC | 0.48 | | | 89.513 | ST2h | 90.570 | ST2h | 79.041 | ST2h | 89.735 | ST2h | 87.149 | ST2h | 90.588 | ST2h | 78.967 | ST2h | 89.743 | ST2h | 87.172 | ST2h |
| F31B MCC | 0.48 | | | 88.437 | ST2h | 89.484 | ST2h | 78.061 | ST2h | 88.657 | ST2h | 86.095 | ST2h | 89.502 | ST2h | 77.989 | ST2h | 88.665 | ST2h | 86.118 | ST2h |
| F32A MCC | 0.48 | | | 89.830 | ST2h | 90.894 | ST2h | 79.293 | ST2h | 90.054 | ST2h | 87.452 | ST2h | 90.912 | ST2h | 79.219 | ST2h | 90.062 | ST2h | 87.475 | ST2h |
| F32B MCC | 0.48 | | | 89.323 | ST2h | 90.392 | ST2h | 78.717 | ST2h | 89.547 | ST2h | 86.930 | ST2h | 90.410 | ST2h | 78.643 | ST2h | 89.556 | ST2h | 86.953 | ST2h |

**Table 6. Scenarios ST2 and ST3 Large Motor Starting**
**Transient Minimum Bus VOltages (Sheet 3 of 3)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | | T=5 | | T=6 | | T=7 | | T=8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| F33A MCC | 0.48 | | | 89.520 | ST2h | 90.578 | ST2h | 79.034 | ST2h | 89.742 | ST2h | 87.153 | ST2h | 90.596 | ST2h | 78.960 | ST2h | 89.750 | ST2h | 87.176 | ST2h |
| F33B MCC | 0.48 | | | 89.454 | ST2h | 90.512 | ST2h | 78.963 | ST2h | 89.677 | ST2h | 87.086 | ST2h | 90.530 | ST2h | 78.890 | ST2h | 89.685 | ST2h | 87.109 | ST2h |
| F4 480V SWGR | 0.48 | | | 92.104 | ST2h | 93.176 | ST2h | 81.494 | ST2h | 92.330 | ST2h | 89.707 | ST2h | 93.195 | ST2h | 81.420 | ST2h | 92.338 | ST2h | 89.730 | ST2h |
| F41A MCC | 0.48 | | | 91.736 | ST2h | 92.806 | ST2h | 81.143 | ST2h | 91.961 | ST2h | 89.342 | ST2h | 92.824 | ST2h | 81.068 | ST2h | 91.969 | ST2h | 89.366 | ST2h |
| F41B MCC | 0.48 | | | 91.717 | ST2h | 92.787 | ST2h | 81.122 | ST2h | 91.942 | ST2h | 89.323 | ST2h | 92.806 | ST2h | 81.047 | ST2h | 91.950 | ST2h | 89.346 | ST2h |
| F4A LOAD CTR | 0.48 | | | 92.888 | ST2h | 93.961 | ST2h | 82.264 | ST2h | 93.113 | ST2h | 90.486 | ST2h | 93.980 | ST2h | 82.189 | ST2h | 93.122 | ST2h | 90.509 | ST2h |
| F6 480V SWGR | 0.48 | | | 93.272 | ST2h | 94.350 | ST2h | 82.604 | ST2h | 93.498 | ST2h | 90.860 | ST2h | 94.368 | ST2h | 82.530 | ST2h | 93.507 | ST2h | 90.884 | ST2h |
| F61 MCC | 0.48 | | | 93.272 | ST2h | 94.350 | ST2h | 82.604 | ST2h | 93.498 | ST2h | 90.860 | ST2h | 94.368 | ST2h | 82.530 | ST2h | 93.507 | ST2h | 90.884 | ST2h |
| F62 MCC | 0.48 | | | 93.272 | ST2h | 94.350 | ST2h | 82.604 | ST2h | 93.498 | ST2h | 90.860 | ST2h | 94.368 | ST2h | 82.530 | ST2h | 93.507 | ST2h | 90.884 | ST2h |
| F63 MCC | 0.48 | | | 93.272 | ST2h | 94.350 | ST2h | 82.604 | ST2h | 93.498 | ST2h | 90.860 | ST2h | 94.368 | ST2h | 82.530 | ST2h | 93.507 | ST2h | 90.884 | ST2h |
| F7 480V SWGR | 0.48 | | | 92.897 | ST2h | 93.337 | ST2g | 81.704 | ST2h | 93.479 | ST2h | 85.856 | ST2h | 93.286 | ST2f | 81.625 | ST2h | 93.142 | ST2h | 86.137 | ST2f |
| F71 MCC | 0.48 | | | 92.863 | ST2h | 93.302 | ST2g | 81.673 | ST2h | 93.444 | ST2h | 85.824 | ST2h | 93.251 | ST2f | 81.594 | ST2h | 93.108 | ST2h | 86.105 | ST2f |
| M22A MCC | 0.48 | | | 90.059 | ST2h | 91.120 | ST2h | 79.537 | ST2h | 90.282 | ST2h | 87.683 | ST2h | 91.139 | ST2h | 79.463 | ST2h | 90.290 | ST2h | 87.706 | ST2h |
| YE2 MCC | 0.24 | 87.080 | 65.000 | 94.437 | ST2h | 95.477 | ST2g | 82.222 | ST2h | 94.691 | ST2h | 87.668 | ST2f | 95.371 | ST2f | 82.291 | ST2h | 95.090 | ST2h | 86.844 | ST2h |
| YE2 MV5443C | 0.24 | 85.000 | 67.090 | 94.260 | ST2h | 95.302 | ST2g | 82.019 | ST2h | 94.515 | ST2h | 87.478 | ST2f | 95.196 | ST2f | 82.088 | ST2h | 94.914 | ST2h | 86.651 | ST2h |
| YF2 MCC | 0.24 | 86.780 | 65.000 | 95.162 | ST2h | 95.634 | ST2g | 83.120 | ST2h | 95.786 | ST2h | 87.598 | ST2h | 95.592 | ST2f | 83.035 | ST2h | 95.426 | ST2h | 87.915 | ST2f |
| YF2 MV5444C | 0.24 | 85.000 | 67.090 | 95.002 | ST2h | 95.474 | ST2g | 82.936 | ST2h | 95.627 | ST2h | 87.424 | ST2h | 95.432 | ST2f | 82.851 | ST2h | 95.266 | ST2h | 87.741 | ST2f |

**Table 7. Scenarios LF6 and LF12: Post-Accident Loading with Degraded Offsite Power Minimum and Maximum Bus Voltages (Sheet 1 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| A 13.8KV SWGR | 13.8 | 86.090 | 93.184 | LF6g | 105.210 | 97.635 | LF6j |
| A MP2-1 | 13.8 | 86.090 | 93.142 | LF6g | 105.210 | 97.594 | LF6j |
| A MP2-3 | 13.8 | 86.090 | 93.149 | LF6g | 105.210 | 97.601 | LF6j |
| A MP36-1 | 13.8 | 86.090 | 93.141 | LF6g | 105.210 | 97.593 | LF6j |
| A MP36-4 | 13.8 | 86.090 | 93.164 | LF6g | 105.210 | 97.615 | LF6j |
| B 13.8KV SWGR | 13.8 | 86.090 | 93.182 | LF6g | 105.210 | 97.690 | LF6i |
| B MP2-2 | 13.8 | 86.090 | 93.127 | LF6g | 105.210 | 97.638 | LF6i |
| B MP2-4 | 13.8 | 86.090 | 93.134 | LF6g | 105.210 | 97.645 | LF6i |
| B MP36-2 | 13.8 | 86.090 | 93.132 | LF6g | 105.210 | 97.642 | LF6i |
| B MP36-3 | 13.8 | 86.090 | 93.162 | LF6g | 105.210 | 97.671 | LF6i |
| BF81 MCC | 0.48 | 86.250 | 93.191 | LF6g | 105.410 | 97.047 | LF6a |
| BF81 DBCSBOP | 0.48 | 82.000 | 93.112 | LF6g | 110.000 | 96.964 | LF6a |
| C1 4160 SWGR | 4.16 | 91.010 | 93.228 | LF6g | 105.760 | 96.956 | LF12a |
| C1 MP3-1 | 4.16 | 86.540 | 93.052 | LF6g | 105.760 | 96.786 | LF12a |
| C1 MP37-1A | 4.16 | 86.540 | 93.141 | LF6g | 105.760 | 96.956 | LF12a |
| C1 MP42-1 | 4.16 | 86.540 | 93.160 | LF6g | 105.760 | 96.890 | LF12a |
| C1 MP43-1 | 4.16 | 86.540 | 93.170 | LF6g | 105.760 | 96.899 | LF12a |
| C1 MP58-1 | 4.16 | 86.540 | 93.082 | LF6g | 105.760 | 96.815 | LF12a |
| C2 4160 SWGR | 4.16 | 86.540 | 93.238 | LF6g | 105.760 | 96.963 | LF12a |
| D1 4160 SWGR | 4.16 | 91.010 | 93.916 | LF6g | 105.760 | 97.786 | LF6a |
| D1 MP3-2 | 4.16 | 86.540 | 93.706 | LF6g | 105.760 | 97.585 | LF6a |
| D1 MP37-2A | 4.16 | 86.540 | 93.916 | LF6g | 105.760 | 97.786 | LF6a |
| D1 MP42-2 | 4.16 | 86.540 | 93.863 | LF6g | 105.760 | 97.736 | LF6a |
| D1 MP43-2 | 4.16 | 86.540 | 93.857 | LF6g | 105.760 | 97.729 | LF6a |
| D1 MP58-2 | 4.16 | 86.540 | 93.828 | LF6g | 105.760 | 97.702 | LF6a |
| D2 4160 SWGR | 4.16 | 86.540 | 93.922 | LF6g | 105.760 | 97.793 | LF6a |
| D3 4160 SWGR | 4.16 | 86.540 | 93.915 | LF6g | 105.760 | 97.785 | LF6a |
| E1 480V SWGR | 0.48 | 86.250 | 91.867 | LF6g | 105.410 | 96.206 | LF12a |
| E1 MP56-1 | 0.48 | 86.250 | 90.566 | LF6g | 105.410 | 94.966 | LF12a |
| E11A MCC | 0.48 | 87.100 | 91.242 | LF6g | 105.410 | 95.953 | LF12a |
| E11A MC62-1 | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 95.953 | LF12a |
| E11A MP89-1A | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 95.343 | LF12a |
| E11A MP89-1B | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 95.953 | LF12a |
| E11A MP89-3A | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 94.859 | LF12a |
| E11A MP89-3B | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 95.953 | LF12a |
| E11B MCC | 0.48 | 87.100 | 91.168 | LF6g | 105.410 | 95.911 | LF12a |
| E11B MC56-1 | 0.48 | 86.250 | 90.286 | LF6g | 105.410 | 95.074 | LF12a |
| E11C MCC | 0.48 | 87.100 | 91.159 | LF6g | 105.410 | 95.944 | LF12a |
| E11C MC75-1 | 0.48 | 86.250 | 89.039 | LF6g | 105.410 | 93.937 | LF12a |
| E11D MCC | 0.48 | 86.770 | 91.226 | LF6g | 105.410 | 95.926 | LF12a |
| E11D DBC1PN | 0.48 | 82.000 | 91.226 | LF6g | 110.000 | 95.926 | LF12a |
| E11D MP37-1B | 0.48 | 86.250 | 90.882 | LF6g | 105.410 | 95.926 | LF12a |
| E11D MRE5327 | 0.48 | 86.250 | 91.226 | LF6g | 105.410 | 95.634 | LF12a |
| E11E MCC | 0.48 | 87.100 | 91.069 | LF6g | 105.410 | 95.940 | LF12a |
| E11E MV49060 | 0.48 | 85.000 | 89.067 | LF6g | 105.410 | 94.045 | LF12a |
| E12A MCC | 0.48 | 90.000 | 91.758 | LF6g | 105.410 | 96.077 | LF12a |

**Table 7. Scenarios LF6 and LF12: Post-Accident Loading with Degraded Offsite Power Minimum and Maximum Bus Voltages (Sheet 2 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| E12A DBC1N | 0.48 | 82.000 | 91.690 | LF6g | 110.000 | 96.009 | LF12a |
| E12A DBC1P | 0.48 | 82.000 | 91.697 | LF6g | 110.000 | 96.017 | LF12a |
| E12A MC21-1 | 0.48 | 86.250 | 91.758 | LF6g | 105.410 | 95.366 | LF6a |
| E12A MC30-1 | 0.48 | 86.250 | 91.535 | LF6g | 105.410 | 95.864 | LF12a |
| E12A MC71-1 | 0.48 | 86.250 | 91.558 | LF6g | 105.410 | 95.886 | LF12a |
| E12A MC73-1 | 0.48 | 86.250 | 91.053 | LF6g | 105.410 | 95.405 | LF12a |
| E12A MS3311 | 0.48 | 86.250 | 91.758 | LF6g | 105.410 | 95.366 | LF6a |
| E12A MS61-1 | 0.48 | 86.250 | 91.758 | LF6g | 105.410 | 95.366 | LF6a |
| E12A MV5597 | 0.48 | 85.000 | 89.817 | LF6g | 105.410 | 94.228 | LF12a |
| E12A YRF1 | 0.48 | 90.000 | 91.618 | LF6g | 110.000 | 95.931 | LF12a |
| E12A YRF3 | 0.48 | 90.000 | 91.537 | LF6g | 110.000 | 95.846 | LF12a |
| E12B MCC | 0.48 | 87.100 | 91.553 | LF6g | 105.410 | 96.037 | LF12a |
| E12B MC25-1 | 0.48 | 86.250 | 90.465 | LF6g | 105.410 | 95.001 | LF12a |
| E12B MC25-2 | 0.48 | 86.250 | 90.740 | LF6g | 105.410 | 95.262 | LF12a |
| E12B MC78-1 | 0.48 | 86.250 | 91.077 | LF6g | 105.410 | 95.583 | LF12a |
| E12B MP147-1 | 0.48 | 86.250 | 91.251 | LF6g | 105.410 | 95.749 | LF12a |
| E12B MP147-3 | 0.48 | 86.250 | 91.466 | LF6g | 105.410 | 95.954 | LF12a |
| E12B YE1 | 0.48 | 82.100 | 91.515 | LF6g | 105.410 | 96.000 | LF12a |
| E12C MCC | 0.48 | 87.100 | 91.280 | LF6g | 105.410 | 95.658 | LF12a |
| E12C MC99-1 | 0.48 | 86.250 | 90.234 | LF6g | 105.410 | 94.661 | LF12a |
| E12C MC99-2 | 0.48 | 86.250 | 90.664 | LF6g | 105.410 | 95.071 | LF12a |
| E12C MF15-1 | 0.48 | 86.250 | 91.044 | LF6g | 105.410 | 95.433 | LF12a |
| E12D MCC | 0.48 | 86.250 | 91.255 | LF6g | 105.410 | 95.634 | LF12a |
| E12E MCC | 0.48 | 87.100 | 91.667 | LF6g | 105.410 | 95.716 | LF12a |
| E12E MC31-4 | 0.48 | 86.250 | 91.667 | LF6g | 105.410 | 95.274 | LF6a |
| E12E MC31-5 | 0.48 | 86.250 | 91.667 | LF6g | 105.410 | 95.274 | LF6a |
| E12E MP197-1 | 0.48 | 86.250 | 91.277 | LF6g | 105.410 | 95.343 | LF12a |
| E12F MCC | 0.48 | 86.250 | 91.418 | LF6g | 105.410 | 96.018 | LF12a |
| E12F MC25-5 | 0.48 | 86.250 | 91.418 | LF6g | 105.410 | 96.018 | LF12a |
| E12F MP195-1 | 0.48 | 86.250 | 90.841 | LF6g | 105.410 | 95.469 | LF12a |
| E14 MCC | 0.48 | 86.250 | 91.759 | LF6g | 105.410 | 96.103 | LF12a |
| E14 MC1-1 | 0.48 | 86.250 | | | 105.410 | | |
| E14 MC1-1LS | 0.48 | 86.250 | 91.254 | LF6g | 105.410 | 95.622 | LF12a |
| E15 MCC | 0.48 | 86.250 | 91.867 | LF6g | 105.410 | 96.206 | LF12a |
| E16A MCC | 0.48 | 89.800 | 91.739 | LF6g | 105.410 | 96.074 | LF12a |
| E16A MP274-1 | 0.48 | 86.250 | 91.446 | LF6g | 105.410 | 95.767 | LF12a |
| E16A XY1 | 0.48 | 85.000 | 91.692 | LF6g | 110.000 | 96.025 | LF12a |
| E16A XY3 | 0.48 | 85.000 | 91.672 | LF6g | 110.000 | 96.004 | LF12a |
| E16B MCC | 0.48 | 90.300 | 91.722 | LF6g | 105.410 | 96.057 | LF12a |
| E16B MP273-1 | 0.48 | 86.250 | 91.560 | LF6g | 105.410 | 95.887 | LF12a |
| E2 480V SWGR | 0.48 | | 89.652 | LF6g | | 94.069 | LF6j |
| E21A MCC | 0.48 | | 89.066 | LF6g | | 93.470 | LF6j |
| E21B MCC | 0.48 | | 89.036 | LF6g | | 93.438 | LF6j |
| E21C MCC | 0.48 | | 88.541 | LF6g | | 92.929 | LF6j |
| E21D MCC | 0.48 | | 89.066 | LF6g | | 93.470 | LF6j |
| E22A MCC | 0.48 | | 88.763 | LF6g | | 93.163 | LF6j |

**Table 7. Scenarios LF6 and LF12: Post-Accident Loading with Degraded Offsite Power Minimum and Maximum Bus Voltages (Sheet 3 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| E22B MCC | 0.48 | | 88.750 | LF6g | | 93.150 | LF6j |
| E23A MCC | 0.48 | | 89.220 | LF6g | | 93.635 | LF6j |
| E23B MCC | 0.48 | | 88.727 | LF6g | | 93.136 | LF6j |
| E3 480V SWGR | 0.48 | | 89.963 | LF6g | | 94.417 | LF6j |
| E31A MCC | 0.48 | | 88.269 | LF6g | | 92.732 | LF6j |
| E31B MCC | 0.48 | | 88.180 | LF6g | | 92.647 | LF6j |
| E32A MCC | 0.48 | | 89.854 | LF6g | | 94.307 | LF6j |
| E32B MCC | 0.48 | | 89.357 | LF6g | | 93.814 | LF6j |
| E33A MCC | 0.48 | | 89.327 | LF6g | | 93.798 | LF6j |
| E33B MCC | 0.48 | | 89.327 | LF6g | | 93.798 | LF6j |
| E4 480V SWGR | 0.48 | | 91.111 | LF6g | | 95.582 | LF6j |
| E41A MCC | 0.48 | | 90.769 | LF6g | | 95.232 | LF6j |
| E41B MCC | 0.48 | | 90.479 | LF6g | | 94.941 | LF6j |
| E42 MCC | 0.48 | | 90.833 | LF6g | | 94.497 | LF12a |
| E43 MCC | 0.48 | | 91.111 | LF6g | | 95.582 | LF6j |
| E6 480V SWGR | 0.48 | | 93.184 | LF6g | | 97.635 | LF6j |
| E61 MCC | 0.48 | | 93.184 | LF6g | | 97.635 | LF6j |
| E62 MCC | 0.48 | | 93.184 | LF6g | | 97.635 | LF6j |
| E63 MCC | 0.48 | | 93.184 | LF6g | | 97.635 | LF6j |
| EF12C MCC | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 95.622 | LF12a |
| EF12C MF15-3 | 0.48 | 86.250 | 91.242 | LF6g | 105.410 | 95.622 | LF12a |
| EF12D MCC | 0.48 | 86.250 | 91.758 | LF6g | 105.410 | 96.077 | LF12a |
| EF41 AE4 | 0.48 | | 91.111 | LF6g | | 95.582 | LF6j |
| EF41 BF4 | 0.48 | | 92.015 | LF6g | | 96.496 | LF6i |
| F1 480V SWGR | 0.48 | 86.250 | 92.725 | LF6g | 105.410 | 97.213 | LF12a |
| F1 MP56-2 | 0.48 | 86.250 | 91.509 | LF6g | 105.410 | 96.055 | LF12a |
| F11A MCC | 0.48 | 87.100 | 92.253 | LF6g | 105.410 | 96.891 | LF12a |
| F11A MC21-2 | 0.48 | 86.250 | 92.253 | LF6g | 105.410 | 96.251 | LF6a |
| F11A MC62-2 | 0.48 | 86.250 | 92.253 | LF6g | 105.410 | 96.891 | LF12a |
| F11A MC75-2 | 0.48 | 86.250 | 91.035 | LF6g | 105.410 | 95.732 | LF12a |
| F11A MRE5328 | 0.48 | 86.250 | 92.253 | LF6g | 105.410 | 96.658 | LF12a |
| F11A MS3321 | 0.48 | 86.250 | 92.253 | LF6g | 105.410 | 96.251 | LF6a |
| F11A MV4907 | 0.48 | 85.000 | 90.307 | LF6g | 105.410 | 95.042 | LF12a |
| F11B MCC | 0.48 | 87.100 | 92.192 | LF6g | 105.410 | 96.891 | LF12a |
| F11C MCC | 0.48 | 87.100 | 92.188 | LF6g | 105.410 | 96.873 | LF12a |
| F11C MP37-2B | 0.48 | 86.250 | 91.859 | LF6g | 105.410 | 96.873 | LF12a |
| F11C MP37-2D | 0.48 | 86.250 | 92.188 | LF6g | 105.410 | 96.451 | LF12a |
| F11D MCC | 0.48 | 87.100 | 91.972 | LF6g | 105.410 | 96.841 | LF12a |
| F11D DBC2PN | 0.48 | 82.000 | 91.972 | LF6g | 110.000 | 96.841 | LF12a |
| F11D MC31-3 | 0.48 | 86.250 | 91.972 | LF6g | 105.410 | 96.514 | LF12a |
| F11D MP89-2A | 0.48 | 86.250 | 91.972 | LF6g | 105.410 | 96.115 | LF12a |
| F11D MP89-2B | 0.48 | 86.250 | 91.972 | LF6g | 105.410 | 96.841 | LF12a |
| F11E MCC | 0.48 | 86.250 | 92.186 | LF6g | 105.410 | 96.595 | LF12a |
| F11E MC31-1 | 0.48 | 86.250 | 92.186 | LF6g | 105.410 | 96.180 | LF6a |
| F11E MC31-2 | 0.48 | 86.250 | 92.186 | LF6g | 105.410 | 96.180 | LF6a |
| F11F MCC | 0.48 | 86.250 | 92.151 | LF6g | 105.410 | 96.558 | LF12a |

**Table 7. Scenarios LF6 and LF12: Post-Accident Loading with Degraded Offsite Power Minimum and Maximum Bus Voltages (Sheet 4 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| F12A MCC | 0.48 | 90.000 | 92.590 | LF6g | 105.410 | 97.082 | LF12a |
| F12A DBC2N | 0.48 | 82.000 | 92.493 | LF6g | 110.000 | 96.985 | LF12a |
| F12A DBC2P | 0.48 | 82.000 | 92.493 | LF6g | 110.000 | 96.985 | LF12a |
| F12A MC133 | 0.48 | 86.250 | 91.414 | LF6g | 105.410 | 95.961 | LF12a |
| F12A MC30-2 | 0.48 | 86.250 | 92.207 | LF6g | 105.410 | 96.717 | LF12a |
| F12A MC73-2 | 0.48 | 86.250 | 90.254 | LF6g | 105.410 | 94.860 | LF12a |
| F12A MP195-2 | 0.48 | 86.250 | 92.053 | LF6g | 105.410 | 96.570 | LF12a |
| F12A MP198-1 | 0.48 | 86.250 | 91.938 | LF6g | 105.410 | 96.461 | LF12a |
| F12A MS61-2 | 0.48 | 86.250 | 92.590 | LF6g | 105.410 | 96.597 | LF6a |
| F12A MV5598 | 0.48 | 85.000 | 91.177 | LF6g | 105.410 | 95.736 | LF12a |
| F12A YRF2 | 0.48 | 90.000 | 92.426 | LF6g | 110.000 | 96.910 | LF12a |
| F12A YRF4 | 0.48 | 90.000 | 92.356 | LF6g | 110.000 | 96.836 | LF12a |
| F12B MCC | 0.48 | 87.100 | 92.429 | LF6g | 105.410 | 97.064 | LF12a |
| F12B MC25-3 | 0.48 | 86.250 | 91.777 | LF6g | 105.410 | 96.444 | LF12a |
| F12B MC25-4 | 0.48 | 86.250 | 91.472 | LF6g | 105.410 | 96.154 | LF12a |
| F12B MC78-2 | 0.48 | 86.250 | 92.132 | LF6g | 105.410 | 96.781 | LF12a |
| F12B MP147-2 | 0.48 | 86.250 | 92.115 | LF6g | 105.410 | 96.766 | LF12a |
| F12B MP147-4 | 0.48 | 86.250 | 92.332 | LF6g | 105.410 | 96.972 | LF12a |
| F12B YF1 | 0.48 | 81.600 | 92.391 | LF6g | 105.410 | 97.028 | LF12a |
| F12C MCC | 0.48 | 87.100 | 92.258 | LF6g | 105.410 | 96.806 | LF12a |
| F12C MF15-2 | 0.48 | 87.100 | 92.044 | LF6g | 105.410 | 96.602 | LF12a |
| F12D MCC | 0.48 | 86.250 | 92.176 | LF6g | 105.410 | 96.728 | LF12a |
| F12D MC99-3 | 0.48 | 86.250 | 91.461 | LF6g | 105.410 | 96.047 | LF12a |
| F12D MC99-4 | 0.48 | 86.250 | 91.315 | LF6g | 105.410 | 95.909 | LF12a |
| F13 MCC | 0.48 | 86.250 | 93.465 | LF6g | 105.410 | 97.318 | LF6a |
| F14 MCC | 0.48 | 86.250 | 92.598 | LF6g | 105.410 | 97.092 | LF12a |
| F14 MC1-2 | 0.48 | 86.250 | | | 105.410 | | |
| F14 MC1-2LS | 0.48 | 86.250 | 92.038 | LF6g | 105.410 | 96.558 | LF12a |
| F15 MCC | 0.48 | 86.250 | 92.725 | LF6g | 105.410 | 97.213 | LF12a |
| F16A MCC | 0.48 | 89.700 | 92.699 | LF6g | 105.410 | 97.186 | LF12a |
| F16A MC25-6 | 0.48 | 86.250 | 92.699 | LF6g | 105.410 | 97.186 | LF12a |
| F16A MP274-3 | 0.48 | 86.250 | 92.462 | LF6g | 105.410 | 96.938 | LF12a |
| F16A XY2 | 0.48 | 85.000 | 92.687 | LF6g | 110.000 | 97.173 | LF12a |
| F16A XY4 | 0.48 | 85.000 | 92.669 | LF6g | 110.000 | 97.154 | LF12a |
| F16B MCC | 0.48 | 90.500 | 92.683 | LF6g | 105.410 | 97.169 | LF12a |
| F16B MP273-4 | 0.48 | 86.250 | 92.164 | LF6g | 105.410 | 96.625 | LF12a |
| F2 480V SWGR | 0.48 | | 90.417 | LF6g | | 94.960 | LF6i |
| F21A MCC | 0.48 | | 90.127 | LF6g | | 94.662 | LF6i |
| F21B MCC | 0.48 | | 90.026 | LF6g | | 94.555 | LF6i |
| F21C MCC | 0.48 | | 90.125 | LF6g | | 94.659 | LF6i |
| F22 MCC | 0.48 | | 89.625 | LF6g | | 94.200 | LF6i |
| F23A MCC | 0.48 | | 89.827 | LF6g | | 94.382 | LF6i |
| F23B MCC | 0.48 | | 88.949 | LF6g | | 93.521 | LF6i |
| F3 480V SWGR | 0.48 | | 89.914 | LF6g | | 94.355 | LF6i |
| F31A MCC | 0.48 | | 89.369 | LF6g | | 93.789 | LF6i |
| F31B MCC | 0.48 | | 88.294 | LF6g | | 92.672 | LF6i |

**Table 7. Scenarios LF6 and LF12: Post-Accident Loading with Degraded Offsite Power Minimum and Maximum Bus Voltages (Sheet 5 of 5)**

| ID From | NomkV | Acceptance Criteria for Min %kV | Minimum %kV | Case with Minimum | Acceptance Criteria for Max %kV | Maximum %kV | Case with Maximum |
|---|---|---|---|---|---|---|---|
| F32A MCC | 0.48 | | 89.667 | LF6g | | 94.114 | LF6i |
| F32B MCC | 0.48 | | 89.158 | LF6g | | 93.630 | LF6i |
| F33A MCC | 0.48 | | 89.376 | LF6g | | 93.801 | LF6i |
| F33B MCC | 0.48 | | 89.310 | LF6g | | 93.736 | LF6i |
| F4 480V SWGR | 0.48 | | 92.015 | LF6g | | 96.496 | LF6i |
| F41A MCC | 0.48 | | 91.646 | LF6g | | 96.120 | LF6i |
| F41B MCC | 0.48 | | 91.628 | LF6g | | 96.102 | LF6i |
| F4A LOAD CTR | 0.48 | | 92.798 | LF6g | | 97.288 | LF6i |
| F6 480V SWGR | 0.48 | | 93.182 | LF6g | | 97.690 | LF6i |
| F61 MCC | 0.48 | | 93.182 | LF6g | | 97.690 | LF6i |
| F62 MCC | 0.48 | | 93.182 | LF6g | | 97.690 | LF6i |
| F63 MCC | 0.48 | | 93.182 | LF6g | | 97.690 | LF6i |
| F7 480V SWGR | 0.48 | | 93.590 | LF6g | | 97.448 | LF6a |
| F71 MCC | 0.48 | | 93.555 | LF6g | | 97.412 | LF6a |
| M22A MCC | 0.48 | | 89.914 | LF6g | | 94.355 | LF6i |
| YE2 MCC | 0.24 | 87.080 | 92.495 | LF6g | 105.410 | 98.184 | LF12a |
| YE2 MV5443C | 0.24 | 85.000 | 92.314 | LF6g | 105.410 | 98.014 | LF12a |
| YF2 MCC | 0.24 | 86.780 | 93.829 | LF6g | 105.410 | 99.232 | LF12a |
| YF2 MV5444C | 0.24 | 85.000 | 93.666 | LF6g | 105.410 | 99.078 | LF12a |

**Table 8. Scenario ST4 Post-Accident Loading at DVR Trip Setpoint Analytical Limit Minimum Bus Voltages (Sheet 1 of 4)**

| IDFrom | Acceptance Criteria for Min %kV (Continuous | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| A 13.8KV SWGR | 86.090 | 76.530 | 89.286 | ST4b | 89.149 | ST4b | 89.260 | ST4b | 89.285 | ST4b |
| A MP2-1 | 86.090 | 76.530 | 89.242 | ST4b | 89.105 | ST4b | 89.216 | ST4b | 89.241 | ST4b |
| A MP2-3 | 86.090 | 76.530 | 89.249 | ST4b | 89.112 | ST4b | 89.223 | ST4b | 89.248 | ST4b |
| A MP36-1 | 86.090 | 76.530 | 89.241 | ST4b | 89.104 | ST4b | 89.215 | ST4b | 89.240 | ST4b |
| A MP36-4 | 86.090 | 76.530 | 89.265 | ST4b | 89.127 | ST4b | 89.238 | ST4b | 89.263 | ST4b |
| B 13.8KV SWGR | 86.090 | 76.530 | 89.625 | ST4b | 89.487 | ST4b | 89.598 | ST4b | 89.624 | ST4b |
| B MP2-2 | 86.090 | 76.530 | 89.569 | ST4b | 89.431 | ST4b | 89.542 | ST4b | 89.568 | ST4b |
| B MP2-4 | 86.090 | 76.530 | 89.576 | ST4b | 89.438 | ST4b | 89.549 | ST4b | 89.575 | ST4b |
| B MP36-2 | 86.090 | 76.530 | 89.574 | ST4b | 89.436 | ST4b | 89.547 | ST4b | 89.573 | ST4b |
| B MP36-3 | 86.090 | 76.530 | 89.605 | ST4b | 89.467 | ST4b | 89.578 | ST4b | 89.604 | ST4b |
| BF81 MCC | 86.250 | 76.670 | 89.493 | ST4b | 89.112 | ST4b | 89.419 | ST4b | 89.492 | ST4b |
| BF81 DBCSBOP | 82.000 | | 89.417 | ST4b | 89.036 | ST4b | 89.343 | ST4b | 89.416 | ST4b |
| C1 4160 SWGR | | 67.310 | 88.950 | ST4a4 | 88.933 | ST4b | 88.950 | ST4a4 | 88.950 | ST4a4 |
| C1 MP3-1 | 86.540 | 67.310 | 88.765 | ST4a4 | 88.748 | ST4b | 88.765 | ST4a4 | 88.765 | ST4a4 |
| C1 MP37-1A | 86.540 | 76.930 | 88.950 | ST4a4 | 88.933 | ST4b | 88.950 | ST4a4 | 88.950 | ST4a4 |
| C1 MP42-1 | 86.540 | 67.310 | 88.879 | ST4a4 | 88.861 | ST4b | 88.879 | ST4a4 | 88.879 | ST4a4 |
| C1 MP43-1 | 86.540 | 67.310 | 88.889 | ST4a4 | 88.872 | ST4b | 88.889 | ST4a4 | 88.889 | ST4a4 |
| C1 MP58-1 | 86.540 | 67.310 | 88.797 | ST4a4 | 88.779 | ST4b | 88.797 | ST4a4 | 88.797 | ST4a4 |
| C2 4160 SWGR | 86.540 | 76.930 | 89.321 | ST4b | 88.943 | ST4b | 89.250 | ST4b | 89.320 | ST4b |
| D1 4160 SWGR | | 67.310 | 88.950 | ST4a4 | 88.950 | ST4a4 | 88.950 | ST4a4 | 88.950 | ST4a4 |
| D1 MP3-2 | 86.540 | 67.310 | 88.728 | ST4a4 | 88.728 | ST4a4 | 88.728 | ST4a4 | 88.728 | ST4a4 |
| D1 MP37-2A | 86.540 | 76.930 | 88.950 | ST4a4 | 88.950 | ST4a4 | 88.950 | ST4a4 | 88.950 | ST4a4 |
| D1 MP42-2 | 86.540 | 67.310 | 88.894 | ST4a4 | 88.894 | ST4a4 | 88.894 | ST4a4 | 88.894 | ST4a4 |
| D1 MP43-2 | 86.540 | 67.310 | 88.887 | ST4a4 | 88.887 | ST4a4 | 88.887 | ST4a4 | 88.887 | ST4a4 |
| D1 MP58-2 | 86.540 | 67.310 | 88.857 | ST4a4 | 88.857 | ST4a4 | 88.857 | ST4a4 | 88.857 | ST4a4 |
| D2 4160 SWGR | 86.540 | 76.930 | 90.211 | ST4b | 89.828 | ST4b | 90.137 | ST4b | 90.210 | ST4b |
| D3 4160 SWGR | 86.540 | 76.930 | 90.204 | ST4b | 89.821 | ST4b | 90.130 | ST4b | 90.202 | ST4b |
| E1 480V SWGR | 86.250 | 67.090 | 87.814 | ST4a4 | 85.252 | ST4b | 87.503 | ST4a5 | 87.814 | ST4a4 |
| E1 MP56-1 | 86.250 | 67.090 | 86.451 | ST4a4 | 83.847 | ST4b | 86.136 | ST4a5 | 86.451 | ST4a4 |
| E11A MCC | 87.100 | 67.090 | 87.535 | ST4a4 | 83.459 | ST4b | 87.048 | ST4a5 | 87.535 | ST4a4 |
| E11A MC62-1 | 86.250 | 67.090 | 87.535 | ST4a4 | 83.459 | ST4b | 87.049 | ST4a5 | 87.535 | ST4a4 |
| E11A MP89-1A | 86.250 | 67.090 | 86.866 | ST4a4 | 82.757 | ST4b | 86.376 | ST4a5 | 86.866 | ST4a4 |
| E11A MP89-1B | 86.250 | 67.090 | 87.535 | ST4a4 | 83.459 | ST4b | 87.048 | ST4a5 | 87.535 | ST4a4 |
| E11A MP89-3A | 86.250 | 67.090 | 86.333 | ST4a4 | 82.196 | ST4b | 85.840 | ST4a5 | 86.333 | ST4a4 |
| E11A MP89-3B | 86.250 | 67.090 | 87.535 | ST4a4 | 83.459 | ST4b | 87.048 | ST4a5 | 87.535 | ST4a4 |
| E11B MCC | 87.100 | 67.090 | 87.490 | ST4a4 | 83.349 | ST4b | 87.003 | ST4a5 | 87.490 | ST4a4 |
| E11B MC56-1 | 86.250 | 67.090 | 86.570 | ST4a4 | 82.383 | ST4b | 86.078 | ST4a5 | 86.570 | ST4a4 |
| E11C MCC | 87.100 | 67.090 | 87.526 | ST4a4 | 83.138 | ST4b | 86.988 | ST4a5 | 87.526 | ST4a4 |
| E11C MC75-1 | 86.250 | 67.090 | **85.313** | ST4a4 | 80.800 | ST4b | 84.760 | ST4a5 | 85.313 | ST4a4 |
| E11D MCC | 86.770 | 67.090 | 87.506 | ST4a4 | 83.149 | ST4b | 87.012 | ST4b | 87.506 | ST4a4 |
| E11D DBC1PN | 82.000 | | 87.506 | ST4a4 | 83.149 | ST4b | 87.012 | ST4b | 87.506 | ST4a4 |
| E11D MP37-1B | 86.250 | 67.090 | 87.506 | ST4a4 | 83.149 | ST4b | 87.012 | ST4b | 87.506 | ST4a4 |
| E11D MRE5327 | 86.250 | 67.090 | 87.186 | ST4a4 | 82.812 | ST4b | 86.690 | ST4b | 87.186 | ST4a4 |
| E11E MCC | 87.100 | 67.090 | 87.522 | ST4a4 | 83.134 | ST4b | 86.984 | ST4a5 | 87.522 | ST4a4 |
| E11E MV49060 | 85.000 | 67.090 | 85.434 | ST4a4 | 80.928 | ST4b | 84.882 | ST4a5 | 85.434 | ST4a4 |
| E12A MCC | 87.100 | 67.090 | 87.679 | ST4a4 | 85.116 | ST4b | 87.369 | ST4a5 | 87.679 | ST4a4 |
| E12A DBC1N | 82.000 | | 87.611 | ST4a4 | 85.048 | ST4b | 87.301 | ST4a5 | 87.611 | ST4a4 |
| E12A DBC1P | 82.000 | | 87.619 | ST4a4 | 85.055 | ST4b | 87.308 | ST4a5 | 87.619 | ST4a4 |
| E12A MC21-1 | 86.250 | 67.090 | **85.982** | ST4a4 | 83.365 | ST4b | 85.665 | ST4a5 | 85.982 | ST4a4 |
| E12A MC30-1 | 86.250 | 67.090 | 87.446 | ST4a4 | 84.875 | ST4b | 87.134 | ST4a5 | 87.446 | ST4a4 |
| E12A MC71-1 | 86.250 | 67.090 | 87.470 | ST4a4 | 84.900 | ST4b | 87.158 | ST4a5 | 87.470 | ST4a4 |

**Table 8. Scenario ST4 Post-Accident Loading at DVR Trip Setpoint Analytical Limit Minimum Bus Voltages (Sheet 2 of 4)**

| IDFrom | Acceptance Criteria for Min %kV (Continuous | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| E12A MC73-1 | 86.250 | 67.090 | 86.941 | ST4a4 | 84.355 | ST4b | 86.628 | ST4a5 | 86.941 | ST4a4 |
| E12A MS3311 | 86.250 | 67.090 | 86.378 | ST4a4 | 83.774 | ST4b | 86.063 | ST4a5 | 86.378 | ST4a4 |
| E12A MS61-1 | 86.250 | 67.090 | **85.107** | ST4a4 | 82.460 | ST4b | 84.786 | ST4a5 | 85.107 | ST4a4 |
| E12A MV5597 | 85.000 | 67.090 | 85.643 | ST4a4 | 83.014 | ST4b | 85.325 | ST4a5 | 85.643 | ST4a4 |
| E12A YRF1 | 85.000 | | 87.546 | ST4a4 | 84.987 | ST4b | 87.236 | ST4a5 | 87.546 | ST4a4 |
| E12A YRF3 | 85.000 | | 87.469 | ST4a4 | 84.911 | ST4b | 87.159 | ST4a5 | 87.469 | ST4a4 |
| E12B MCC | 87.100 | 67.090 | 87.633 | ST4a4 | 84.946 | ST4b | 87.322 | ST4a5 | 87.633 | ST4a4 |
| E12B MC25-1 | 86.250 | 67.090 | 86.495 | ST4a4 | 83.771 | ST4b | 86.180 | ST4a5 | 86.495 | ST4a4 |
| E12B MC25-2 | 86.250 | 67.090 | 86.783 | ST4a4 | 84.068 | ST4b | 86.469 | ST4a5 | 86.783 | ST4a4 |
| E12B MC78-1 | 86.250 | 67.090 | 87.135 | ST4a4 | 84.432 | ST4b | 86.823 | ST4a5 | 87.135 | ST4a4 |
| E12B MP147-1 | 86.250 | 67.090 | 87.317 | ST4a4 | 84.620 | ST4b | 87.005 | ST4a5 | 87.317 | ST4a4 |
| E12B MP147-3 | 86.250 | 67.090 | 87.543 | ST4a4 | 84.853 | ST4b | 87.231 | ST4a5 | 87.543 | ST4a4 |
| E12B YE1 | 82.100 | | 87.593 | ST4a4 | 84.905 | ST4b | 87.282 | ST4a5 | 87.593 | ST4a4 |
| E12C MCC | 87.100 | 67.090 | 87.219 | ST4a4 | 84.641 | ST4b | 86.907 | ST4a5 | 87.219 | ST4a4 |
| E12C MC99-1 | 86.250 | 67.090 | **86.123** | ST4a4 | 83.511 | ST4b | 85.806 | ST4a5 | 86.123 | ST4a4 |
| E12C MC99-2 | 86.250 | 67.090 | 86.574 | ST4a4 | 83.976 | ST4b | 86.259 | ST4a5 | 86.574 | ST4a4 |
| E12C MF15-1 | 86.250 | 67.090 | 86.972 | ST4a4 | 84.387 | ST4b | 86.658 | ST4a5 | 86.972 | ST4a4 |
| E12D MCC | 86.250 | 67.090 | 87.193 | ST4a4 | 84.614 | ST4b | 86.880 | ST4a5 | 87.193 | ST4a4 |
| E12E MCC | 87.100 | 67.090 | 87.282 | ST4a4 | 84.707 | ST4b | 86.970 | ST4a5 | 87.282 | ST4a4 |
| E12E MC31-4 | 86.250 | 67.090 | **85.511** | ST4a4 | 82.879 | ST4b | 85.192 | ST4a5 | 85.511 | ST4a4 |
| E12E MC31-5 | 86.250 | 67.090 | **86.008** | ST4a4 | 83.392 | ST4b | 85.691 | ST4a5 | 86.008 | ST4a4 |
| E12E MP197-1 | 86.250 | 67.090 | 86.873 | ST4a4 | 84.284 | ST4b | 86.559 | ST4a5 | 86.873 | ST4a4 |
| E12F MCC | 86.250 | 67.090 | 87.613 | ST4a4 | 84.925 | ST4b | 87.302 | ST4a5 | 87.613 | ST4a4 |
| E12F MC25-5 | 86.250 | 67.090 | 87.613 | ST4a4 | 84.925 | ST4b | 87.302 | ST4a5 | 87.613 | ST4a4 |
| E12F MP195-1 | 86.250 | 67.090 | 87.010 | ST4a4 | 84.303 | ST4b | 86.697 | ST4a5 | 87.010 | ST4a4 |
| E14 MCC | 86.250 | 67.090 | 87.700 | ST4a4 | 85.136 | ST4b | 87.390 | ST4a5 | 87.700 | ST4a4 |
| E14 MC1-1 | 86.250 | 67.090 | | | | | | | | |
| E14 MC1-1LS | 86.250 | 67.090 | 87.173 | ST4a4 | 84.591 | ST4b | 86.860 | ST4a5 | 87.173 | ST4a4 |
| E15 MCC | 86.250 | 67.090 | 87.814 | ST4a4 | 85.252 | ST4b | 87.503 | ST4a5 | 87.814 | ST4a4 |
| E16A MCC | 89.800 | 67.090 | **87.689** | ST4a4 | 85.112 | ST4b | 87.379 | ST4a5 | 87.689 | ST4a4 |
| E16A MP274-1 | 86.250 | 67.090 | 87.409 | ST4a4 | 84.840 | ST4b | 87.100 | ST4a5 | 87.409 | ST4a4 |
| E16A XY1 | 85.000 | | 87.645 | ST4a4 | 85.068 | ST4b | 87.335 | ST4a5 | 87.645 | ST4a4 |
| E16A XY3 | 85.000 | | 87.626 | ST4a4 | 85.050 | ST4b | 87.316 | ST4a5 | 87.626 | ST4a4 |
| E16B MCC | 90.300 | 67.090 | **87.674** | ST4a4 | 84.966 | ST4b | 87.364 | ST4a5 | 87.674 | ST4a4 |
| E16B MP273-1 | 86.250 | 67.090 | 87.519 | ST4a4 | 84.815 | ST4b | 87.209 | ST4a5 | 87.519 | ST4a4 |
| E2 480V SWGR | | | 85.777 | ST4b | 85.573 | ST4b | 85.725 | ST4b | 85.750 | ST4b |
| E21A MCC | | | 85.203 | ST4b | 84.999 | ST4b | 85.151 | ST4b | 85.176 | ST4b |
| E21B MCC | | | 85.174 | ST4b | 84.970 | ST4b | 85.122 | ST4b | 85.147 | ST4b |
| E21C MCC | | | 84.690 | ST4b | 84.488 | ST4b | 84.639 | ST4b | 84.663 | ST4b |
| E21D MCC | | | 85.203 | ST4b | 84.999 | ST4b | 85.151 | ST4b | 85.176 | ST4b |
| E22A MCC | | | 84.902 | ST4b | 84.623 | ST4b | 84.831 | ST4b | 84.856 | ST4b |
| E22B MCC | | | 84.889 | ST4b | 84.611 | ST4b | 84.818 | ST4b | 84.843 | ST4b |
| E23A MCC | | | 85.345 | ST4b | 85.141 | ST4b | 85.293 | ST4b | 85.318 | ST4b |
| E23B MCC | | | 84.857 | ST4b | 84.654 | ST4b | 84.805 | ST4b | 84.830 | ST4b |
| E3 480V SWGR | | | 86.114 | ST4b | 85.977 | ST4b | 86.088 | ST4b | 86.113 | ST4b |
| E31A MCC | | | 84.409 | ST4b | 84.271 | ST4b | 84.382 | ST4b | 84.408 | ST4b |
| E31B MCC | | | 84.315 | ST4b | 84.177 | ST4b | 84.289 | ST4b | 84.314 | ST4b |
| E32A MCC | | | 86.013 | ST4b | 85.876 | ST4b | 85.987 | ST4b | 86.012 | ST4b |
| E32B MCC | | | 85.512 | ST4b | 85.374 | ST4b | 85.485 | ST4b | 85.510 | ST4b |
| E33A MCC | | | 85.462 | ST4b | 85.324 | ST4b | 85.436 | ST4b | 85.461 | ST4b |
| E33B MCC | | | 85.462 | ST4b | 85.324 | ST4b | 85.436 | ST4b | 85.461 | ST4b |

**Table 8. Scenario ST4 Post-Accident Loading at DVR Trip Setpoint Analytical Limit Minimum Bus Voltages (Sheet 3 of 4)**

| IDFrom | Acceptance Criteria for Min %kV (Continuous | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| E4 480V SWGR | | | 87.189 | ST4b | 87.051 | ST4b | 87.162 | ST4b | 87.187 | ST4b |
| E41A MCC | | | 86.854 | ST4b | 86.716 | ST4b | 86.828 | ST4b | 86.853 | ST4b |
| E41B MCC | | | 86.564 | ST4b | 86.426 | ST4b | 86.537 | ST4b | 86.563 | ST4b |
| E42 MCC | | | 86.980 | ST4b | 86.608 | ST4b | 86.910 | ST4b | 86.979 | ST4b |
| E43 MCC | | | 87.189 | ST4b | 87.051 | ST4b | 87.162 | ST4b | 87.187 | ST4b |
| E6 480V SWGR | | | 89.286 | ST4b | 89.149 | ST4b | 89.260 | ST4b | 89.285 | ST4b |
| E61 MCC | | | 89.286 | ST4b | 89.149 | ST4b | 89.260 | ST4b | 89.285 | ST4b |
| E62 MCC | | | 89.286 | ST4b | 89.149 | ST4b | 89.260 | ST4b | 89.285 | ST4b |
| E63 MCC | | | 89.286 | ST4b | 89.149 | ST4b | 89.260 | ST4b | 89.285 | ST4b |
| EF12C MCC | 86.250 | 67.090 | 87.179 | ST4a4 | 84.600 | ST4b | 86.867 | ST4a5 | 87.179 | ST4a4 |
| EF12C MF15-3 | 86.250 | 67.090 | 87.179 | ST4a4 | 84.600 | ST4b | 86.867 | ST4a5 | 87.179 | ST4a4 |
| EF12D MCC | 86.250 | 67.090 | 87.679 | ST4a4 | 85.116 | ST4b | 87.369 | ST4a5 | 87.679 | ST4a4 |
| EF41 AE4 | | | 87.189 | ST4b | 87.051 | ST4b | 87.162 | ST4b | 87.187 | ST4b |
| EF41 BF4 | | | 88.479 | ST4b | 88.342 | ST4b | 88.452 | ST4b | 88.478 | ST4b |
| F1 480V SWGR | 86.250 | 67.090 | 87.964 | ST4a4 | 86.270 | ST4b | 87.660 | ST4a5 | 87.964 | ST4a4 |
| F1 MP56-2 | 86.250 | 67.090 | 86.681 | ST4a4 | 84.960 | ST4b | 86.372 | ST4a5 | 86.681 | ST4a4 |
| F11A MCC | 87.100 | 67.090 | 87.621 | ST4a4 | 84.890 | ST4b | 87.202 | ST4a5 | 87.621 | ST4a4 |
| F11A MC21-2 | 86.250 | 67.090 | 86.907 | ST4a4 | 84.152 | ST4b | 86.485 | ST4a5 | 86.907 | ST4a4 |
| F11A MC62-2 | 86.250 | 67.090 | 87.621 | ST4a4 | 84.890 | ST4b | 87.202 | ST4a5 | 87.621 | ST4a4 |
| F11A MC75-2 | 86.250 | 67.090 | 86.336 | ST4a4 | 83.562 | ST4b | 85.911 | ST4a5 | 86.336 | ST4a4 |
| F11A MRE5328 | 86.250 | 67.090 | 87.364 | ST4a4 | 84.624 | ST4b | 86.944 | ST4a5 | 87.364 | ST4a4 |
| F11A MS3321 | 86.250 | 67.090 | 86.832 | ST4a4 | 84.075 | ST4b | 86.409 | ST4a5 | 86.832 | ST4a4 |
| F11A MV4907 | 85.000 | 67.090 | 85.565 | ST4a4 | 82.764 | ST4b | 85.136 | ST4a5 | 85.565 | ST4a4 |
| F11B MCC | 87.100 | 67.090 | 87.621 | ST4a4 | 84.890 | ST4b | 87.202 | ST4a5 | 87.621 | ST4a4 |
| F11C MCC | 87.100 | 67.090 | 87.601 | ST4a4 | 84.387 | ST4b | 87.182 | ST4a5 | 87.601 | ST4a4 |
| F11C MP37-2B | 86.250 | 67.090 | 87.601 | ST4a4 | 84.387 | ST4b | 87.182 | ST4a5 | 87.601 | ST4a4 |
| F11C MP37-2D | 86.250 | 67.090 | 87.135 | ST4a4 | 83.902 | ST4b | 86.714 | ST4a5 | 87.135 | ST4a4 |
| F11D MCC | 87.100 | 67.090 | 87.567 | ST4a4 | 83.296 | ST4b | 86.889 | ST4a5 | 87.567 | ST4a4 |
| F11D DBC2PN | 82.000 | | 87.567 | ST4a4 | 83.296 | ST4b | 86.889 | ST4a5 | 87.567 | ST4a4 |
| F11D MC31-3 | 86.250 | 67.090 | 87.204 | ST4a4 | 82.915 | ST4b | 86.524 | ST4a5 | 87.204 | ST4a4 |
| F11D MP89-2A | 86.250 | 67.090 | 86.762 | ST4a4 | 82.449 | ST4b | 86.078 | ST4a5 | 86.762 | ST4a4 |
| F11D MP89-2B | 86.250 | 67.090 | 87.567 | ST4a4 | 83.296 | ST4b | 86.889 | ST4a5 | 87.567 | ST4a4 |
| F11E MCC | 86.250 | 67.090 | 87.307 | ST4a4 | 84.569 | ST4b | 86.887 | ST4a5 | 87.307 | ST4a4 |
| F11E MC31-1 | 86.250 | 67.090 | **85.132** | ST4a4 | 82.319 | ST4b | 84.701 | ST4a5 | 85.132 | ST4a4 |
| F11E MC31-2 | 86.250 | 67.090 | **84.150** | ST4a4 | 81.300 | ST4b | 83.714 | ST4a5 | 84.150 | ST4a4 |
| F11F MCC | 86.250 | 67.090 | 87.274 | ST4a4 | 84.537 | ST4b | 86.854 | ST4a5 | 87.274 | ST4a4 |
| F12A MCC | 87.100 | 67.090 | 87.829 | ST4a4 | 86.134 | ST4b | 87.525 | ST4a5 | 87.829 | ST4a4 |
| F12A DBC2N | 82.000 | | 87.732 | ST4a4 | 86.036 | ST4b | 87.427 | ST4a5 | 87.732 | ST4a4 |
| F12A DBC2P | 82.000 | | 87.732 | ST4a4 | 86.036 | ST4b | 87.427 | ST4a5 | 87.732 | ST4a4 |
| F12A MC133 | 86.250 | 67.090 | 86.587 | ST4a4 | 84.866 | ST4b | 86.278 | ST4a5 | 86.587 | ST4a4 |
| F12A MC30-2 | 86.250 | 67.090 | 87.426 | ST4a4 | 85.722 | ST4b | 87.119 | ST4a5 | 87.426 | ST4a4 |
| F12A MC73-2 | 86.250 | 67.090 | **85.357** | ST4a4 | 83.609 | ST4b | 85.043 | ST4a5 | 85.357 | ST4a4 |
| F12A MP195-2 | 86.250 | 67.090 | 87.263 | ST4a4 | 85.556 | ST4b | 86.956 | ST4a5 | 87.263 | ST4a4 |
| F12A MP198-1 | 86.250 | 67.090 | 87.141 | ST4a4 | 85.432 | ST4b | 86.834 | ST4a5 | 87.141 | ST4a4 |
| F12A MS61-2 | 86.250 | 67.090 | **85.652** | ST4a4 | 83.910 | ST4b | 85.339 | ST4a5 | 85.652 | ST4a4 |
| F12A MV5598 | 85.000 | 67.090 | 86.336 | ST4a4 | 84.610 | ST4b | 86.026 | ST4a5 | 86.336 | ST4a4 |
| F12A YRF2 | 85.000 | | 87.674 | ST4a4 | 85.981 | ST4b | 87.370 | ST4a5 | 87.674 | ST4a4 |
| F12A YRF4 | 85.000 | | 87.607 | ST4a4 | 85.916 | ST4b | 87.303 | ST4a5 | 87.607 | ST4a4 |
| F12B MCC | 87.100 | 67.090 | 87.803 | ST4a4 | 85.977 | ST4b | 87.497 | ST4a5 | 87.803 | ST4a4 |
| F12B MC25-3 | 86.250 | 67.090 | 87.116 | ST4a4 | 85.275 | ST4b | 86.808 | ST4a5 | 87.116 | ST4a4 |
| F12B MC25-4 | 86.250 | 67.090 | 86.793 | ST4a4 | 84.946 | ST4b | 86.485 | ST4a5 | 86.793 | ST4a4 |

**Table 8. Scenario ST4 Post-Accident Loading at DVR Trip Setpoint Analytical Limit Minimum Bus Voltages (Sheet 4 of 4)**

| IDFrom | Acceptance Criteria for Min %kV (Continuous | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| F12B MC78-2 | 86.250 | 67.090 | 87.489 | ST4a4 | 85.657 | ST4b | 87.183 | ST4a5 | 87.489 | ST4a4 |
| F12B MP147-2 | 86.250 | 67.090 | 87.472 | ST4a4 | 85.640 | ST4b | 87.166 | ST4a5 | 87.472 | ST4a4 |
| F12B MP147-4 | 86.250 | 67.090 | 87.700 | ST4a4 | 85.872 | ST4b | 87.395 | ST4a5 | 87.700 | ST4a4 |
| F12B YF1 | 81.600 | | 87.763 | ST4a4 | 85.936 | ST4b | 87.458 | ST4a5 | 87.763 | ST4a4 |
| F12C MCC | 87.100 | 67.090 | 87.523 | ST4a4 | 85.822 | ST4b | 87.218 | ST4a5 | 87.523 | ST4a4 |
| F12C MF15-2 | 87.100 | 67.090 | 87.298 | ST4a4 | 85.591 | ST4b | 86.991 | ST4a5 | 87.298 | ST4a4 |
| F12D MCC | 86.250 | 67.090 | 87.437 | ST4a4 | 85.733 | ST4b | 87.131 | ST4a5 | 87.437 | ST4a4 |
| F12D MC99-3 | 86.250 | 67.090 | 86.682 | ST4a4 | 84.963 | ST4b | 86.373 | ST4a5 | 86.682 | ST4a4 |
| F12D MC99-4 | 86.250 | 67.090 | 86.528 | ST4a4 | 84.806 | ST4b | 86.219 | ST4a5 | 86.528 | ST4a4 |
| F13 MCC | 86.250 | 67.090 | 88.737 | ST4b | 88.351 | ST4b | 88.662 | ST4b | 88.735 | ST4b |
| F14 MCC | 86.250 | 67.090 | 87.830 | ST4a4 | 86.133 | ST4b | 87.525 | ST4a5 | 87.830 | ST4a4 |
| F14 MC1-2 | 86.250 | 67.090 | | | | | | | | |
| F14 MC1-2LS | 86.250 | 67.090 | 87.239 | ST4a4 | 85.530 | ST4b | 86.932 | ST4a5 | 87.239 | ST4a4 |
| F15 MCC | 86.250 | 67.090 | 87.964 | ST4a4 | 86.270 | ST4b | 87.660 | ST4a5 | 87.964 | ST4a4 |
| F16A MCC | 89.700 | 67.090 | **87.940** | ST4a4 | 86.235 | ST4b | 87.635 | ST4a5 | 87.940 | ST4a4 |
| F16A MC25-6 | 86.250 | 67.090 | 87.940 | ST4a4 | 86.235 | ST4b | 87.635 | ST4a5 | 87.940 | ST4a4 |
| F16A MP274-3 | 86.250 | 67.090 | 87.715 | ST4a4 | 86.015 | ST4b | 87.412 | ST4a5 | 87.715 | ST4a4 |
| F16A XY2 | 85.000 | | 87.928 | ST4a4 | 86.224 | ST4b | 87.624 | ST4a5 | 87.928 | ST4a4 |
| F16A XY4 | 85.000 | | 87.911 | ST4a4 | 86.208 | ST4b | 87.607 | ST4a5 | 87.911 | ST4a4 |
| F16B MCC | 90.500 | 67.090 | **87.925** | ST4a4 | 86.221 | ST4b | 87.620 | ST4a5 | 87.925 | ST4a4 |
| F16B MP273-4 | 86.250 | 67.090 | 87.433 | ST4a4 | 85.738 | ST4b | 87.130 | ST4a5 | 87.433 | ST4a4 |
| F2 480V SWGR | | | 86.827 | ST4b | 86.614 | ST4b | 86.775 | ST4b | 86.801 | ST4b |
| F21A MCC | | | 86.543 | ST4b | 86.266 | ST4b | 86.475 | ST4b | 86.501 | ST4b |
| F21B MCC | | | 86.445 | ST4b | 86.169 | ST4b | 86.378 | ST4b | 86.404 | ST4b |
| F21C MCC | | | 86.540 | ST4b | 86.264 | ST4b | 86.472 | ST4b | 86.498 | ST4b |
| F22 MCC | | | 86.007 | ST4b | 85.793 | ST4b | 85.955 | ST4b | 85.981 | ST4b |
| F23A MCC | | | 86.226 | ST4b | 86.013 | ST4b | 86.174 | ST4b | 86.201 | ST4b |
| F23B MCC | | | 85.331 | ST4b | 85.117 | ST4b | 85.279 | ST4b | 85.306 | ST4b |
| F3 480V SWGR | | | 86.465 | ST4b | 86.330 | ST4b | 86.439 | ST4b | 86.464 | ST4b |
| F31A MCC | | | 85.937 | ST4b | 85.802 | ST4b | 85.911 | ST4b | 85.936 | ST4b |
| F31B MCC | | | 84.894 | ST4b | 84.760 | ST4b | 84.868 | ST4b | 84.893 | ST4b |
| F32A MCC | | | 86.233 | ST4b | 86.097 | ST4b | 86.206 | ST4b | 86.232 | ST4b |
| F32B MCC | | | 85.703 | ST4b | 85.567 | ST4b | 85.677 | ST4b | 85.702 | ST4b |
| F33A MCC | | | 85.939 | ST4b | 85.804 | ST4b | 85.913 | ST4b | 85.938 | ST4b |
| F33B MCC | | | 85.872 | ST4b | 85.737 | ST4b | 85.846 | ST4b | 85.871 | ST4b |
| F4 480V SWGR | | | 88.479 | ST4b | 88.342 | ST4b | 88.452 | ST4b | 88.478 | ST4b |
| F41A MCC | | | 88.116 | ST4b | 87.979 | ST4b | 88.090 | ST4b | 88.115 | ST4b |
| F41B MCC | | | 88.097 | ST4b | 87.960 | ST4b | 88.070 | ST4b | 88.096 | ST4b |
| F4A LOAD CTR | | | 89.256 | ST4b | 89.119 | ST4b | 89.229 | ST4b | 89.255 | ST4b |
| F6 480V SWGR | | | 89.625 | ST4b | 89.487 | ST4b | 89.598 | ST4b | 89.624 | ST4b |
| F61 MCC | | | 89.625 | ST4b | 89.487 | ST4b | 89.598 | ST4b | 89.624 | ST4b |
| F62 MCC | | | 89.625 | ST4b | 89.487 | ST4b | 89.598 | ST4b | 89.624 | ST4b |
| F63 MCC | | | 89.625 | ST4b | 89.487 | ST4b | 89.598 | ST4b | 89.624 | ST4b |
| F7 480V SWGR | | | 89.080 | ST4b | 88.696 | ST4b | 89.006 | ST4b | 89.079 | ST4b |
| F71 MCC | | | 89.047 | ST4b | 88.663 | ST4b | 88.973 | ST4b | 89.046 | ST4b |
| M22A MCC | | | 86.465 | ST4b | 86.330 | ST4b | 86.439 | ST4b | 86.464 | ST4b |
| YE2 MCC | 87.080 | 65.000 | 89.528 | ST4a4 | 85.271 | ST4b | 89.028 | ST4a5 | 89.528 | ST4a4 |
| YE2 MV5443C | 85.000 | 67.090 | 89.342 | ST4a4 | 85.076 | ST4b | 88.840 | ST4a5 | 89.342 | ST4a4 |
| YF2 MCC | 86.780 | 65.000 | 89.710 | ST4a4 | 86.903 | ST4b | 89.280 | ST4a5 | 89.710 | ST4a4 |
| YF2 MV5444C | 85.000 | 67.090 | 89.540 | ST4a4 | 86.728 | ST4b | 89.108 | ST4a5 | 89.540 | ST4a4 |

**Table 9. Scenario ST5: Mode 5 and 6 Design Basis Accident Transient Minimum Bus Voltage (Sheet 1 of 3)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| A 13.8KV SWGR | 13.80 | 86.090 | 76.530 | 94.409 | ST5b | 92.674 | ST5b | 93.793 | ST5b | 94.056 | ST5b | 94.258 | ST5b | 94.323 | ST5b |
| A MP2-1 | 13.80 | 86.090 | 76.530 | 94.367 | ST5b | 92.632 | ST5b | 93.751 | ST5b | 94.014 | ST5b | 94.216 | ST5b | 94.281 | ST5b |
| A MP2-3 | 13.80 | 86.090 | 76.530 | 94.374 | ST5b | 92.638 | ST5b | 93.758 | ST5b | 94.020 | ST5b | 94.223 | ST5b | 94.287 | ST5b |
| A MP36-1 | 13.80 | 86.090 | 76.530 | | | | | | | | | | | | |
| A MP36-4 | 13.80 | 86.090 | 76.530 | 96.863 | ST5a | 95.043 | ST5a | 96.200 | ST5a | 96.489 | ST5a | 96.709 | ST5a | 96.779 | ST5a |
| B 13.8KV SWGR | 13.80 | 86.090 | 76.530 | 94.416 | ST5b | 92.685 | ST5e | 93.803 | ST5b | 94.065 | ST5b | 94.266 | ST5b | 94.330 | ST5b |
| B MP2-2 | 13.80 | 86.090 | 76.530 | 94.362 | ST5b | 92.631 | ST5e | 93.749 | ST5b | 94.011 | ST5b | 94.212 | ST5b | 94.276 | ST5b |
| B MP2-4 | 13.80 | 86.090 | 76.530 | 94.369 | ST5b | 92.638 | ST5e | 93.756 | ST5b | 94.018 | ST5b | 94.219 | ST5b | 94.283 | ST5b |
| B MP36-2 | 13.80 | 86.090 | 76.530 | | | | | | | | | | | | |
| B MP36-3 | 13.80 | 86.090 | 76.530 | 96.870 | ST5a | 95.051 | ST5c | 96.212 | ST5a | 96.499 | ST5a | 96.718 | ST5a | 96.787 | ST5a |
| BF81 MCC | 0.48 | 86.250 | 76.670 | 93.659 | ST5b | 88.550 | ST5b | 91.887 | ST5b | 92.586 | ST5b | 93.170 | ST5b | 93.355 | ST5b |
| BF81 DBCSBOP | 0.48 | 82.000 | | 93.579 | ST5b | 88.474 | ST5b | 91.808 | ST5b | 92.507 | ST5b | 93.091 | ST5b | 93.275 | ST5b |
| C1 4160 SWGR | 4.16 | 91.010 | 67.310 | 94.378 | ST5b | 89.218 | ST5b | 92.585 | ST5b | 93.292 | ST5b | 93.883 | ST5b | 94.069 | ST5b |
| C1 MP3-1 | 4.16 | 86.540 | 67.310 | 94.204 | ST5b | 89.034 | ST5b | 92.408 | ST5b | 93.116 | ST5b | 93.708 | ST5b | 93.895 | ST5b |
| C1 MP37-1A | 4.16 | 86.540 | 76.930 | 94.292 | ST5b | 89.127 | ST5b | 92.498 | ST5b | 93.205 | ST5b | 93.796 | ST5b | 93.983 | ST5b |
| C1 MP42-1 | 4.16 | 86.540 | 67.310 | 94.320 | ST5b | 89.156 | ST5b | 92.526 | ST5b | 93.233 | ST5b | 93.824 | ST5b | 94.011 | ST5b |
| C1 MP43-1 | 4.16 | 86.540 | 67.310 | 94.378 | ST5b | 89.020 | ST5b | 92.527 | ST5b | 93.233 | ST5b | 93.825 | ST5b | 94.011 | ST5b |
| C1 MP58-1 | 4.16 | 86.540 | 67.310 | 94.378 | ST5b | 89.218 | ST5b | 92.585 | ST5b | 93.292 | ST5b | 93.883 | ST5b | 94.069 | ST5b |
| C2 4160 SWGR | 4.16 | 86.540 | 76.930 | 94.383 | ST5b | 89.234 | ST5b | 92.595 | ST5b | 93.300 | ST5b | 93.890 | ST5b | 94.076 | ST5b |
| D1 4160 SWGR | 4.16 | 91.010 | 67.310 | 94.399 | ST5b | 89.271 | ST5b | 92.620 | ST5b | 93.322 | ST5b | 93.909 | ST5b | 94.094 | ST5b |
| D1 MP3-2 | 4.16 | 86.540 | 67.310 | 94.191 | ST5b | 89.051 | ST5b | 92.407 | ST5b | 93.111 | ST5b | 93.699 | ST5b | 93.884 | ST5b |
| D1 MP37-2A | 4.16 | 86.540 | 76.930 | 94.399 | ST5b | 89.271 | ST5b | 92.620 | ST5b | 93.322 | ST5b | 93.909 | ST5b | 94.094 | ST5b |
| D1 MP42-2 | 4.16 | 86.540 | 67.310 | 94.399 | ST5b | 89.105 | ST5b | 92.574 | ST5b | 93.276 | ST5b | 93.863 | ST5b | 94.048 | ST5b |
| D1 MP43-2 | 4.16 | 86.540 | 67.310 | 94.340 | ST5b | 89.209 | ST5b | 92.560 | ST5b | 93.262 | ST5b | 93.849 | ST5b | 94.034 | ST5b |
| D1 MP58-2 | 4.16 | 86.540 | 67.310 | 94.399 | ST5b | 89.271 | ST5b | 92.620 | ST5b | 93.322 | ST5b | 93.909 | ST5b | 94.094 | ST5b |
| D2 4160 SWGR | 4.16 | 86.540 | 76.930 | 94.392 | ST5b | 89.264 | ST5b | 92.613 | ST5b | 93.315 | ST5b | 93.901 | ST5b | 94.087 | ST5b |
| D3 4160 SWGR | 4.16 | 86.540 | 76.930 | 94.385 | ST5b | 89.257 | ST5b | 92.605 | ST5b | 93.307 | ST5b | 93.894 | ST5b | 94.079 | ST5b |
| E1 480V SWGR | 0.48 | 86.250 | 67.090 | 91.966 | ST5b | 81.695 | ST5b | 85.072 | ST5b | 88.139 | ST5b | 90.843 | ST5b | 91.715 | ST5b |
| E1 MP56-1 | 0.48 | 86.250 | 67.090 | 91.966 | ST5b | 81.695 | ST5b | 85.072 | ST5b | 88.139 | ST5b | 90.843 | ST5b | 91.715 | ST5b |
| E11A MCC | 0.48 | 87.100 | 67.090 | 91.735 | ST5b | 79.884 | ST5b | 83.207 | ST5b | 86.231 | ST5b | 90.187 | ST5b | 91.482 | ST5b |
| E11A MC62-1 | 0.48 | 86.250 | 67.090 | 91.735 | ST5b | 79.884 | ST5b | 83.207 | ST5b | 86.231 | ST5b | 90.187 | ST5b | 91.482 | ST5b |
| E11A MP89-1A | 0.48 | 86.250 | 67.090 | 91.735 | ST5b | 79.884 | ST5b | 83.207 | ST5b | 86.231 | ST5b | 90.187 | ST5b | 91.482 | ST5b |
| E11A MP89-1B | 0.48 | 86.250 | 67.090 | 91.735 | ST5b | 79.884 | ST5b | 83.207 | ST5b | 86.231 | ST5b | 90.187 | ST5b | 91.482 | ST5b |
| E11A MP89-3A | 0.48 | 86.250 | 67.090 | 91.735 | ST5b | 79.884 | ST5b | 83.207 | ST5b | 86.231 | ST5b | 90.187 | ST5b | 91.482 | ST5b |
| E11A MP89-3B | 0.48 | 86.250 | 67.090 | 91.735 | ST5b | 79.884 | ST5b | 83.207 | ST5b | 86.231 | ST5b | 90.187 | ST5b | 91.482 | ST5b |
| E11B MCC | 0.48 | 87.100 | 67.090 | 91.705 | ST5b | 79.786 | ST5b | 83.108 | ST5b | 86.131 | ST5b | 90.127 | ST5b | 91.452 | ST5b |
| E11B MC56-1 | 0.48 | 86.250 | 67.090 | 91.177 | ST5b | 79.178 | ST5b | 82.524 | ST5b | 85.569 | ST5b | 89.589 | ST5b | 90.922 | ST5b |
| E11C MCC | 0.48 | 87.100 | 67.090 | 91.727 | ST5b | 79.523 | ST5b | 82.832 | ST5b | 85.844 | ST5b | 90.105 | ST5b | 91.473 | ST5b |
| E11C MC75-1 | 0.48 | 86.250 | 67.090 | 89.622 | ST5b | 77.070 | ST5b | 80.484 | ST5b | 83.584 | ST5b | 87.959 | ST5b | 89.362 | ST5b |
| E11D MCC | 0.48 | 86.770 | 67.090 | 91.623 | ST5b | 79.737 | ST5b | 83.065 | ST5b | 86.093 | ST5b | 90.065 | ST5b | 91.370 | ST5b |
| E11D DBC1PN | 0.48 | 82.000 | | 91.623 | ST5b | 79.737 | ST5b | 83.065 | ST5b | 86.093 | ST5b | 90.065 | ST5b | 91.370 | ST5b |
| E11D MP37-1B | 0.48 | 86.250 | 67.090 | 91.281 | ST5b | 79.344 | ST5b | 82.687 | ST5b | 85.729 | ST5b | 89.717 | ST5b | 91.027 | ST5b |
| E11D MRE5327 | 0.48 | 86.250 | 67.090 | 91.623 | ST5b | 79.737 | ST5b | 83.065 | ST5b | 86.093 | ST5b | 90.065 | ST5b | 91.370 | ST5b |
| E11E MCC | 0.48 | 87.100 | 67.090 | 91.727 | ST5b | 79.191 | ST5b | 82.486 | ST5b | 85.501 | ST5b | 90.016 | ST5b | 91.469 | ST5b |
| E11E MV49060 | 0.48 | 85.000 | 67.090 | 91.727 | ST5b | 70.084 | ST5b | 73.000 | ST5b | 83.357 | ST5b | 87.990 | ST5b | 89.477 | ST5b |
| E12A MCC | 0.48 | 90.000 | 67.090 | 91.870 | ST5b | 81.544 | ST5b | 84.919 | ST5b | 88.021 | ST5b | 90.733 | ST5b | 91.611 | ST5b |
| E12A DBC1N | 0.48 | 82.000 | | 91.803 | ST5b | 81.475 | ST5b | 84.851 | ST5b | 87.953 | ST5b | 90.665 | ST5b | 91.543 | ST5b |
| E12A DBC1P | 0.48 | 82.000 | | 91.810 | ST5b | 81.483 | ST5b | 84.858 | ST5b | 87.960 | ST5b | 90.673 | ST5b | 91.551 | ST5b |
| E12A MC21-1 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 81.544 | ST5b | 84.919 | ST5b | 88.021 | ST5b | 90.733 | ST5b | 91.611 | ST5b |
| E12A MC30-1 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 80.815 | ST5b | 84.160 | ST5b | 87.788 | ST5b | 90.507 | ST5b | 91.387 | ST5b |
| E12A MC71-1 | 0.48 | 86.250 | 67.090 | 91.671 | ST5b | 81.319 | ST5b | 84.703 | ST5b | 87.812 | ST5b | 90.531 | ST5b | 91.411 | ST5b |
| E12A MC73-1 | 0.48 | 86.250 | 67.090 | 91.167 | ST5b | 80.749 | ST5b | 84.157 | ST5b | 87.286 | ST5b | 90.020 | ST5b | 90.905 | ST5b |
| E12A MS3311 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 81.544 | ST5b | 84.919 | ST5b | 88.021 | ST5b | 90.733 | ST5b | 91.611 | ST5b |
| E12A MS61-1 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 81.544 | ST5b | 84.919 | ST5b | 88.021 | ST5b | 90.733 | ST5b | 91.611 | ST5b |
| E12A MV5597 | 0.48 | 85.000 | 67.090 | 91.870 | ST5b | 72.355 | ST5b | 75.350 | ST5b | 85.963 | ST5b | 88.769 | ST5b | 89.667 | ST5b |
| E12A YRF1 | 0.48 | 90.000 | | 91.731 | ST5b | 81.420 | ST5b | 84.790 | ST5b | 87.887 | ST5b | 90.595 | ST5b | 91.472 | ST5b |
| E12A YRF3 | 0.48 | 90.000 | | 91.650 | ST5b | 81.348 | ST5b | 84.715 | ST5b | 87.809 | ST5b | 90.515 | ST5b | 91.391 | ST5b |
| E12B MCC | 0.48 | 87.100 | 67.090 | 91.846 | ST5b | 80.703 | ST5b | 84.219 | ST5b | 87.721 | ST5b | 90.527 | ST5b | 91.429 | ST5b |
| E12B MC25-1 | 0.48 | 86.250 | 67.090 | 91.846 | ST5b | 76.836 | ST5b | 80.184 | ST5b | 86.584 | ST5b | 89.427 | ST5b | 90.339 | ST5b |
| E12B MC25-2 | 0.48 | 86.250 | 67.090 | 91.846 | ST5b | 77.796 | ST5b | 81.186 | ST5b | 86.871 | ST5b | 89.705 | ST5b | 90.614 | ST5b |
| E12B MC78-1 | 0.48 | 86.250 | 67.090 | 91.372 | ST5b | 80.162 | ST5b | 83.701 | ST5b | 87.224 | ST5b | 90.046 | ST5b | 90.952 | ST5b |
| E12B MP147-1 | 0.48 | 86.250 | 67.090 | 91.545 | ST5b | 80.360 | ST5b | 83.890 | ST5b | 87.405 | ST5b | 90.222 | ST5b | 91.126 | ST5b |
| E12B MP147-3 | 0.48 | 86.250 | 67.090 | 91.760 | ST5b | 80.605 | ST5b | 84.125 | ST5b | 87.630 | ST5b | 90.440 | ST5b | 91.342 | ST5b |
| E12B YE1 | 0.48 | 82.100 | | 91.808 | ST5b | 80.660 | ST5b | 84.178 | ST5b | 87.681 | ST5b | 90.489 | ST5b | 91.390 | ST5b |
| E12C MCC | 0.48 | 87.100 | 67.090 | 91.432 | ST5b | 80.963 | ST5b | 84.355 | ST5b | 87.470 | ST5b | 90.251 | ST5b | 91.171 | ST5b |
| E12C MC99-1 | 0.48 | 86.250 | 67.090 | 90.388 | ST5b | 79.778 | ST5b | 83.220 | ST5b | 86.377 | ST5b | 89.192 | ST5b | 90.124 | ST5b |
| E12C MC99-2 | 0.48 | 86.250 | 67.090 | 90.817 | ST5b | 80.267 | ST5b | 83.687 | ST5b | 86.827 | ST5b | 89.628 | ST5b | 90.555 | ST5b |
| E12C MF15-1 | 0.48 | 86.250 | 67.090 | 91.196 | ST5b | 80.696 | ST5b | 84.099 | ST5b | 87.224 | ST5b | 90.012 | ST5b | 90.935 | ST5b |
| E12D MCC | 0.48 | 86.250 | 67.090 | 91.407 | ST5b | 80.934 | ST5b | 84.327 | ST5b | 87.444 | ST5b | 90.225 | ST5b | 91.146 | ST5b |
| E12E MCC | 0.48 | 87.100 | 67.090 | 91.870 | ST5b | 81.247 | ST5b | 84.609 | ST5b | 87.845 | ST5b | 90.643 | ST5b | 91.587 | ST5b |
| E12E MC31-4 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 81.247 | ST5b | 84.609 | ST5b | 87.845 | ST5b | 90.643 | ST5b | 91.587 | ST5b |
| E12E MC31-5 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 81.247 | ST5b | 84.609 | ST5b | 87.845 | ST5b | 90.643 | ST5b | 91.587 | ST5b |
| E12E MP197-1 | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 78.441 | ST5b | 81.688 | ST5b | 87.438 | ST5b | 90.249 | ST5b | 91.197 | ST5b |
| E12F MCC | 0.48 | 86.250 | 67.090 | 91.827 | ST5b | 80.291 | ST5b | 84.072 | ST5b | 87.580 | ST5b | 90.391 | ST5b | 91.294 | ST5b |
| E12F MC25-5 | 0.48 | 86.250 | 67.090 | 91.827 | ST5b | 80.291 | ST5b | 84.072 | ST5b | 87.580 | ST5b | 90.391 | ST5b | 91.294 | ST5b |

**Table 9. Scenario ST5: Mode 5 and 6 Design Basis Accident Transient Minimum Bus Voltage (Sheet 2 of 3)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| E12F MP195-1 | 0.48 | 86.250 | 67.090 | 91.252 | ST5b | 79.633 | ST5b | 83.444 | ST5b | 86.977 | ST5b | 89.807 | ST5b | 90.716 | ST5b |
| E14 MCC | 0.48 | 86.250 | 67.090 | 91.701 | ST5b | 81.259 | ST5b | 84.617 | ST5b | 88.026 | ST5b | 90.733 | ST5b | 91.607 | ST5b |
| E14 MC1-1 | 0.48 | 86.250 | 67.090 | 90.558 | ST5b | 81.259 | ST5b | 84.617 | ST5b | 88.026 | ST5b | 90.733 | ST5b | 91.607 | ST5b |
| E14 MC1-1LS | 0.48 | 86.250 | 67.090 | 91.701 | ST5b | 79.252 | ST5b | 82.527 | ST5b | 87.500 | ST5b | 90.223 | ST5b | 91.102 | ST5b |
| E15 MCC | 0.48 | 86.250 | 67.090 | 91.966 | ST5b | 81.695 | ST5b | 85.072 | ST5b | 88.139 | ST5b | 90.843 | ST5b | 91.715 | ST5b |
| E16A MCC | 0.48 | 89.800 | 67.090 | 91.838 | ST5b | 81.577 | ST5b | 84.950 | ST5b | 88.014 | ST5b | 90.715 | ST5b | 91.587 | ST5b |
| E16A MP274-1 | 0.48 | 86.250 | 67.090 | 91.544 | ST5b | 81.316 | ST5b | 84.678 | ST5b | 87.733 | ST5b | 90.425 | ST5b | 91.295 | ST5b |
| E16A XY1 | 0.48 | 85.000 | | 91.791 | ST5b | 81.535 | ST5b | 84.906 | ST5b | 87.969 | ST5b | 90.669 | ST5b | 91.540 | ST5b |
| E16A XY3 | 0.48 | 85.000 | | 91.771 | ST5b | 81.518 | ST5b | 84.888 | ST5b | 87.950 | ST5b | 90.650 | ST5b | 91.521 | ST5b |
| E16B MCC | 0.48 | 90.300 | 67.090 | 91.822 | ST5b | 81.562 | ST5b | 84.935 | ST5b | 87.998 | ST5b | 90.699 | ST5b | 91.571 | ST5b |
| E16B MP273-1 | 0.48 | 86.250 | 67.090 | 91.659 | ST5b | 81.418 | ST5b | 84.784 | ST5b | 87.843 | ST5b | 90.539 | ST5b | 91.409 | ST5b |
| E2 480V SWGR | 0.48 | | | 90.244 | ST5b | 88.924 | ST5b | 90.032 | ST5b | 90.293 | ST5b | 90.493 | ST5b | 90.557 | ST5b |
| E21A MCC | 0.48 | | | 89.657 | ST5b | 88.340 | ST5b | 89.446 | ST5b | 89.705 | ST5b | 89.905 | ST5b | 89.969 | ST5b |
| E21B MCC | 0.48 | | | 89.626 | ST5b | 88.310 | ST5b | 89.415 | ST5b | 89.674 | ST5b | 89.875 | ST5b | 89.938 | ST5b |
| E21C MCC | 0.48 | | | 89.129 | ST5b | 87.817 | ST5b | 88.919 | ST5b | 89.177 | ST5b | 89.377 | ST5b | 89.440 | ST5b |
| E21D MCC | 0.48 | | | 89.657 | ST5b | 88.340 | ST5b | 89.446 | ST5b | 89.705 | ST5b | 89.905 | ST5b | 89.969 | ST5b |
| E22A MCC | 0.48 | | | 89.100 | ST5b | 87.788 | ST5b | 88.890 | ST5b | 89.148 | ST5b | 89.347 | ST5b | 89.411 | ST5b |
| E22B MCC | 0.48 | | | 89.087 | ST5b | 87.775 | ST5b | 88.877 | ST5b | 89.135 | ST5b | 89.334 | ST5b | 89.398 | ST5b |
| E23A MCC | 0.48 | | | 89.721 | ST5b | 88.492 | ST5b | 89.600 | ST5b | 89.860 | ST5b | 90.061 | ST5b | 90.125 | ST5b |
| E23B MCC | 0.48 | | | 89.227 | ST5b | 88.000 | ST5b | 89.107 | ST5b | 89.366 | ST5b | 89.567 | ST5b | 89.630 | ST5b |
| E3 480V SWGR | 0.48 | | | 90.562 | ST5b | 88.325 | ST5b | 89.431 | ST5b | 90.153 | ST5b | 90.355 | ST5b | 90.419 | ST5b |
| E31A MCC | 0.48 | | | 88.706 | ST5b | 86.467 | ST5b | 87.574 | ST5b | 88.297 | ST5b | 88.499 | ST5b | 88.563 | ST5b |
| E31B MCC | 0.48 | | | 88.617 | ST5b | 86.376 | ST5b | 87.484 | ST5b | 88.208 | ST5b | 88.410 | ST5b | 88.474 | ST5b |
| E32A MCC | 0.48 | | | 90.401 | ST5b | 88.111 | ST5b | 89.216 | ST5b | 89.986 | ST5b | 90.187 | ST5b | 90.251 | ST5b |
| E32B MCC | 0.48 | | | 89.818 | ST5b | 87.529 | ST5b | 88.633 | ST5b | 89.404 | ST5b | 89.605 | ST5b | 89.669 | ST5b |
| E33A MCC | 0.48 | | | 89.928 | ST5b | 87.682 | ST5b | 88.793 | ST5b | 89.518 | ST5b | 89.721 | ST5b | 89.785 | ST5b |
| E33B MCC | 0.48 | | | 89.928 | ST5b | 87.682 | ST5b | 88.793 | ST5b | 89.518 | ST5b | 89.721 | ST5b | 89.785 | ST5b |
| E4 480V SWGR | 0.48 | | | 91.523 | ST5b | 89.786 | ST5b | 90.906 | ST5b | 91.169 | ST5b | 91.372 | ST5b | 91.437 | ST5b |
| E41A MCC | 0.48 | | | 91.176 | ST5b | 89.441 | ST5b | 90.560 | ST5b | 90.823 | ST5b | 91.025 | ST5b | 91.089 | ST5b |
| E41B MCC | 0.48 | | | 90.886 | ST5b | 89.151 | ST5b | 90.270 | ST5b | 90.532 | ST5b | 90.735 | ST5b | 90.799 | ST5b |
| E42 MCC | 0.48 | | | 90.986 | ST5b | 85.974 | ST5b | 89.246 | ST5b | 89.932 | ST5b | 90.506 | ST5b | 90.687 | ST5b |
| E43 MCC | 0.48 | | | 91.523 | ST5b | 89.786 | ST5b | 90.906 | ST5b | 91.169 | ST5b | 91.372 | ST5b | 91.437 | ST5b |
| E6 480V SWGR | 0.48 | | | 93.613 | ST5b | 91.984 | ST5b | 93.094 | ST5b | 93.355 | ST5b | 93.556 | ST5b | 93.620 | ST5b |
| E61 MCC | 0.48 | | | 93.308 | ST5b | 91.802 | ST5b | 92.910 | ST5b | 93.170 | ST5b | 93.371 | ST5b | 93.435 | ST5b |
| E62 MCC | 0.48 | | | 93.613 | ST5b | 91.984 | ST5b | 93.094 | ST5b | 93.355 | ST5b | 93.556 | ST5b | 93.620 | ST5b |
| E63 MCC | 0.48 | | | 93.613 | ST5b | 91.984 | ST5b | 93.094 | ST5b | 93.355 | ST5b | 93.556 | ST5b | 93.620 | ST5b |
| EF12C MCC | 0.48 | 86.250 | 67.090 | 91.394 | ST5b | 80.920 | ST5b | 84.313 | ST5b | 87.431 | ST5b | 90.212 | ST5b | 91.133 | ST5b |
| EF12C MF15-3 | 0.48 | 86.250 | 67.090 | 91.394 | ST5b | 80.920 | ST5b | 84.313 | ST5b | 87.431 | ST5b | 90.212 | ST5b | 91.133 | ST5b |
| EF12D MCC | 0.48 | 86.250 | 67.090 | 91.870 | ST5b | 81.544 | ST5b | 84.919 | ST5b | 88.021 | ST5b | 90.733 | ST5b | 91.611 | ST5b |
| EF41 AE4 | 0.48 | | | 91.523 | ST5b | 89.786 | ST5b | 90.906 | ST5b | 91.169 | ST5b | 91.372 | ST5b | 91.437 | ST5b |
| EF41 BF4 | 0.48 | | | 92.617 | ST5b | 90.888 | ST5e | 92.005 | ST5b | 92.266 | ST5b | 92.468 | ST5b | 92.531 | ST5b |
| F1 480V SWGR | 0.48 | 86.250 | 67.090 | 92.171 | ST5b | 81.900 | ST5b | 85.321 | ST5b | 88.357 | ST5b | 91.071 | ST5b | 91.930 | ST5b |
| F1 MP56-2 | 0.48 | 86.250 | 67.090 | 92.171 | ST5b | 81.900 | ST5b | 85.321 | ST5b | 88.357 | ST5b | 91.071 | ST5b | 91.930 | ST5b |
| F11A MCC | 0.48 | 87.100 | 67.090 | 91.968 | ST5b | 80.686 | ST5b | 84.070 | ST5b | 87.077 | ST5b | 90.600 | ST5b | 91.725 | ST5b |
| F11A MC21-2 | 0.48 | 86.250 | 67.090 | 91.968 | ST5b | 80.686 | ST5b | 84.070 | ST5b | 87.077 | ST5b | 90.600 | ST5b | 91.725 | ST5b |
| F11A MC62-2 | 0.48 | 86.250 | 67.090 | 91.968 | ST5b | 80.686 | ST5b | 84.070 | ST5b | 87.077 | ST5b | 90.600 | ST5b | 91.725 | ST5b |
| F11A MC75-2 | 0.48 | 86.250 | 67.090 | 90.745 | ST5b | 79.286 | ST5b | 82.728 | ST5b | 85.783 | ST5b | 89.359 | ST5b | 90.499 | ST5b |
| F11A MRE5328 | 0.48 | 86.250 | 67.090 | 91.968 | ST5b | 80.686 | ST5b | 84.070 | ST5b | 87.076 | ST5b | 90.600 | ST5b | 91.725 | ST5b |
| F11A MS3321 | 0.48 | 86.250 | 67.090 | 91.968 | ST5b | 80.686 | ST5b | 84.070 | ST5b | 87.076 | ST5b | 90.600 | ST5b | 91.725 | ST5b |
| F11A MV4907 | 0.48 | 85.000 | 67.090 | 91.968 | ST5b | 71.524 | ST5b | 74.523 | ST5b | 85.010 | ST5b | 88.616 | ST5b | 89.766 | ST5b |
| F11B MCC | 0.48 | 87.100 | 67.090 | 91.968 | ST5b | 80.529 | ST5b | 83.906 | ST5b | 86.907 | ST5b | 90.539 | ST5b | 91.725 | ST5b |
| F11C MCC | 0.48 | 87.100 | 67.090 | 91.968 | ST5b | 80.581 | ST5b | 83.960 | ST5b | 86.963 | ST5b | 90.543 | ST5b | 91.725 | ST5b |
| F11C MP37-2B | 0.48 | 86.250 | 67.090 | 91.968 | ST5b | 80.581 | ST5b | 83.960 | ST5b | 86.963 | ST5b | 90.543 | ST5b | 91.725 | ST5b |
| F11C MP37-2D | 0.48 | 86.250 | 67.090 | 91.968 | ST5b | 80.581 | ST5b | 83.960 | ST5b | 86.963 | ST5b | 90.543 | ST5b | 91.725 | ST5b |
| F11D MCC | 0.48 | 87.100 | 67.090 | 91.849 | ST5b | 79.065 | ST5b | 82.392 | ST5b | 85.348 | ST5b | 90.202 | ST5b | 91.606 | ST5b |
| F11D DBC2PN | 0.48 | 82.000 | | 91.849 | ST5b | 79.065 | ST5b | 82.392 | ST5b | 85.348 | ST5b | 90.202 | ST5b | 91.606 | ST5b |
| F11D MC31-3 | 0.48 | 86.250 | 67.090 | 91.849 | ST5b | 79.065 | ST5b | 82.392 | ST5b | 85.348 | ST5b | 90.202 | ST5b | 91.606 | ST5b |
| F11D MP89-2A | 0.48 | 86.250 | 67.090 | 91.849 | ST5b | 79.065 | ST5b | 82.392 | ST5b | 85.348 | ST5b | 90.202 | ST5b | 91.606 | ST5b |
| F11D MP89-2B | 0.48 | 86.250 | 67.090 | 91.849 | ST5b | 79.065 | ST5b | 82.392 | ST5b | 85.348 | ST5b | 90.202 | ST5b | 91.606 | ST5b |
| F11E MCC | 0.48 | 86.250 | 67.090 | 91.900 | ST5b | 80.627 | ST5b | 84.008 | ST5b | 87.013 | ST5b | 90.534 | ST5b | 91.658 | ST5b |
| F11E MC31-1 | 0.48 | 86.250 | 67.090 | 91.900 | ST5b | 80.627 | ST5b | 84.008 | ST5b | 87.013 | ST5b | 90.534 | ST5b | 91.658 | ST5b |
| F11E MC31-2 | 0.48 | 86.250 | 67.090 | 91.900 | ST5b | 80.627 | ST5b | 84.008 | ST5b | 87.013 | ST5b | 90.534 | ST5b | 91.658 | ST5b |
| F11F MCC | 0.48 | 86.250 | 67.090 | 91.865 | ST5b | 80.597 | ST5b | 83.976 | ST5b | 86.980 | ST5b | 90.499 | ST5b | 91.623 | ST5b |
| F12A MCC | 0.48 | 90.000 | 67.090 | 92.055 | ST5b | 81.701 | ST5b | 85.120 | ST5b | 88.202 | ST5b | 90.935 | ST5b | 91.802 | ST5b |
| F12A DBC2N | 0.48 | 82.000 | | 91.958 | ST5b | 81.602 | ST5b | 85.022 | ST5b | 88.104 | ST5b | 90.838 | ST5b | 91.705 | ST5b |
| F12A DBC2P | 0.48 | 82.000 | | 91.958 | ST5b | 81.602 | ST5b | 85.022 | ST5b | 88.104 | ST5b | 90.838 | ST5b | 91.705 | ST5b |
| F12A MC133 | 0.48 | 86.250 | 67.090 | 90.871 | ST5b | 80.362 | ST5b | 83.837 | ST5b | 86.965 | ST5b | 89.737 | ST5b | 90.615 | ST5b |
| F12A MC30-2 | 0.48 | 86.250 | 67.090 | 92.055 | ST5b | 80.487 | ST5b | 83.855 | ST5b | 87.800 | ST5b | 90.546 | ST5b | 91.416 | ST5b |
| F12A MC73-2 | 0.48 | 86.250 | 67.090 | 89.704 | ST5b | 79.028 | ST5b | 82.563 | ST5b | 85.741 | ST5b | 88.553 | ST5b | 89.444 | ST5b |
| F12A MP195-2 | 0.48 | 86.250 | 67.090 | 91.515 | ST5b | 81.091 | ST5b | 84.535 | ST5b | 87.638 | ST5b | 90.389 | ST5b | 91.261 | ST5b |
| F12A MP198-1 | 0.48 | 86.250 | 67.090 | 92.055 | ST5b | 77.034 | ST5b | 80.258 | ST5b | 87.517 | ST5b | 90.272 | ST5b | 91.145 | ST5b |
| F12A MS61-2 | 0.48 | 86.250 | 67.090 | 92.055 | ST5b | 81.701 | ST5b | 85.120 | ST5b | 88.202 | ST5b | 90.935 | ST5b | 91.802 | ST5b |
| F12A MV5598 | 0.48 | 85.000 | 67.090 | 92.055 | ST5b | 74.704 | ST5b | 77.830 | ST5b | 86.708 | ST5b | 89.495 | ST5b | 90.376 | ST5b |
| F12A YRF2 | 0.48 | 90.000 | | 91.892 | ST5b | 81.556 | ST5b | 84.969 | ST5b | 88.046 | ST5b | 90.774 | ST5b | 91.639 | ST5b |
| F12A YRF4 | 0.48 | 90.000 | | 91.822 | ST5b | 81.494 | ST5b | 84.905 | ST5b | 87.979 | ST5b | 90.705 | ST5b | 91.570 | ST5b |

**Table 9. Scenario ST5: Mode 5 and 6 Design Basis Accident Transient Minimum Bus Voltage (Sheet 3 of 3)**

| IDFrom | Nom kV | Acceptance Criteria for Min %kV (Continuous) | Acceptance Criteria for Min %kV (Starting) | T=-1 | | T=0 | | T=1 | | T=2 | | T=3 | | T=4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV | Min %kV | Case with min %kV |
| F12B MCC | 0.48 | 87.100 | 67.090 | 92.074 | ST5b | 80.898 | ST5b | 84.504 | ST5b | 87.954 | ST5b | 90.772 | ST5b | 91.663 | ST5b |
| F12B MC25-3 | 0.48 | 86.250 | 67.090 | 92.074 | ST5b | 78.532 | ST5b | 82.032 | ST5b | 87.268 | ST5b | 90.109 | ST5b | 91.006 | ST5b |
| F12B MC25-4 | 0.48 | 86.250 | 67.090 | 92.074 | ST5b | 77.925 | ST5b | 81.398 | ST5b | 86.947 | ST5b | 89.797 | ST5b | 90.697 | ST5b |
| F12B MC78-2 | 0.48 | 86.250 | 67.090 | 91.776 | ST5b | 80.558 | ST5b | 84.178 | ST5b | 87.641 | ST5b | 90.470 | ST5b | 91.363 | ST5b |
| F12B MP147-2 | 0.48 | 86.250 | 67.090 | 91.759 | ST5b | 80.539 | ST5b | 84.160 | ST5b | 87.625 | ST5b | 90.453 | ST5b | 91.347 | ST5b |
| F12B MP147-4 | 0.48 | 86.250 | 67.090 | 91.976 | ST5b | 80.787 | ST5b | 84.397 | ST5b | 87.852 | ST5b | 90.674 | ST5b | 91.565 | ST5b |
| F12B YF1 | 0.48 | 81.600 | | 92.036 | ST5b | 80.855 | ST5b | 84.462 | ST5b | 87.914 | ST5b | 90.734 | ST5b | 91.625 | ST5b |
| F12C MCC | 0.48 | 87.100 | 67.090 | 91.763 | ST5b | 81.279 | ST5b | 84.707 | ST5b | 87.797 | ST5b | 90.599 | ST5b | 91.510 | ST5b |
| F12C MF15-2 | 0.48 | 87.100 | 67.090 | 91.548 | ST5b | 81.035 | ST5b | 84.474 | ST5b | 87.573 | ST5b | 90.381 | ST5b | 91.294 | ST5b |
| F12D MCC | 0.48 | 86.250 | 67.090 | 91.681 | ST5b | 81.185 | ST5b | 84.618 | ST5b | 87.711 | ST5b | 90.515 | ST5b | 91.427 | ST5b |
| F12D MC99-3 | 0.48 | 86.250 | 67.090 | 90.962 | ST5b | 80.371 | ST5b | 83.837 | ST5b | 86.959 | ST5b | 89.786 | ST5b | 90.706 | ST5b |
| F12D MC99-4 | 0.48 | 86.250 | 67.090 | 90.815 | ST5b | 80.204 | ST5b | 83.678 | ST5b | 86.805 | ST5b | 89.638 | ST5b | 90.559 | ST5b |
| F13 MCC | 0.48 | 86.250 | 67.090 | 93.563 | ST5b | 88.436 | ST5b | 91.785 | ST5b | 92.486 | ST5b | 93.073 | ST5b | 93.258 | ST5b |
| F14 MCC | 0.48 | 86.250 | 67.090 | 91.858 | ST5b | 81.384 | ST5b | 84.783 | ST5b | 88.224 | ST5b | 90.941 | ST5b | 91.802 | ST5b |
| F14 MC1-2 | 0.48 | 86.250 | 67.090 | 90.642 | ST5b | 81.384 | ST5b | 84.783 | ST5b | 88.224 | ST5b | 90.941 | ST5b | 91.802 | ST5b |
| F14 MC1-2LS | 0.48 | 86.250 | 67.090 | 91.858 | ST5b | 79.134 | ST5b | 82.440 | ST5b | 87.635 | ST5b | 90.371 | ST5b | 91.236 | ST5b |
| F15 MCC | 0.48 | 86.250 | 67.090 | 92.171 | ST5b | 81.900 | ST5b | 85.321 | ST5b | 88.357 | ST5b | 91.071 | ST5b | 91.930 | ST5b |
| F16A MCC | 0.48 | 89.700 | 67.090 | 92.145 | ST5b | 81.877 | ST5b | 85.297 | ST5b | 88.333 | ST5b | 91.045 | ST5b | 91.904 | ST5b |
| F16A MC25-6 | 0.48 | 86.250 | 67.090 | 92.145 | ST5b | 81.877 | ST5b | 85.297 | ST5b | 88.333 | ST5b | 91.045 | ST5b | 91.904 | ST5b |
| F16A MP274-3 | 0.48 | 86.250 | 67.090 | 91.910 | ST5b | 81.668 | ST5b | 85.079 | ST5b | 88.107 | ST5b | 90.813 | ST5b | 91.669 | ST5b |
| F16A XY2 | 0.48 | 85.000 | | 92.133 | ST5b | 81.866 | ST5b | 85.286 | ST5b | 88.321 | ST5b | 91.033 | ST5b | 91.892 | ST5b |
| F16A XY4 | 0.48 | 85.000 | | 92.116 | ST5b | 81.851 | ST5b | 85.270 | ST5b | 88.304 | ST5b | 91.016 | ST5b | 91.874 | ST5b |
| F16B MCC | 0.48 | 90.500 | 67.090 | 92.130 | ST5b | 81.863 | ST5b | 85.283 | ST5b | 88.318 | ST5b | 91.030 | ST5b | 91.888 | ST5b |
| F16B MP273-4 | 0.48 | 86.250 | 67.090 | 91.614 | ST5b | 81.405 | ST5b | 84.805 | ST5b | 87.823 | ST5b | 90.520 | ST5b | 91.374 | ST5b |
| F2 480V SWGR | 0.48 | | | 91.065 | ST5b | 89.704 | ST5e | 90.829 | ST5b | 91.092 | ST5b | 91.294 | ST5b | 91.358 | ST5b |
| F21A MCC | 0.48 | | | 90.590 | ST5b | 89.234 | ST5e | 90.355 | ST5b | 90.617 | ST5b | 90.819 | ST5b | 90.883 | ST5b |
| F21B MCC | 0.48 | | | 90.489 | ST5b | 89.134 | ST5e | 90.254 | ST5b | 90.515 | ST5b | 90.717 | ST5b | 90.781 | ST5b |
| F21C MCC | 0.48 | | | 90.588 | ST5b | 89.232 | ST5e | 90.353 | ST5b | 90.614 | ST5b | 90.816 | ST5b | 90.880 | ST5b |
| F22 MCC | 0.48 | | | 89.715 | ST5b | 88.906 | ST5e | 90.039 | ST5b | 90.304 | ST5b | 90.508 | ST5b | 90.573 | ST5b |
| F23A MCC | 0.48 | | | 90.476 | ST5b | 89.111 | ST5e | 90.240 | ST5b | 90.503 | ST5b | 90.706 | ST5b | 90.771 | ST5b |
| F23B MCC | 0.48 | | | 89.601 | ST5b | 88.230 | ST5e | 89.363 | ST5b | 89.628 | ST5b | 89.832 | ST5b | 89.896 | ST5b |
| F3 480V SWGR | 0.48 | | | 90.907 | ST5b | 88.704 | ST5e | 89.796 | ST5b | 90.507 | ST5b | 90.705 | ST5b | 90.768 | ST5b |
| F31A MCC | 0.48 | | | 90.266 | ST5b | 88.075 | ST5e | 89.161 | ST5b | 89.868 | ST5b | 90.065 | ST5b | 90.127 | ST5b |
| F31B MCC | 0.48 | | | 89.183 | ST5b | 87.013 | ST5e | 88.089 | ST5b | 88.789 | ST5b | 88.983 | ST5b | 89.045 | ST5b |
| F32A MCC | 0.48 | | | 90.680 | ST5b | 88.325 | ST5e | 89.416 | ST5b | 90.261 | ST5b | 90.459 | ST5b | 90.522 | ST5b |
| F32B MCC | 0.48 | | | 90.177 | ST5b | 87.808 | ST5e | 88.906 | ST5b | 89.756 | ST5b | 89.955 | ST5b | 90.018 | ST5b |
| F33A MCC | 0.48 | | | 90.321 | ST5b | 88.127 | ST5e | 89.215 | ST5b | 89.922 | ST5b | 90.119 | ST5b | 90.182 | ST5b |
| F33B MCC | 0.48 | | | 90.255 | ST5b | 88.060 | ST5e | 89.149 | ST5b | 89.857 | ST5b | 90.054 | ST5b | 90.116 | ST5b |
| F4 480V SWGR | 0.48 | | | 92.617 | ST5b | 90.888 | ST5e | 92.005 | ST5b | 92.266 | ST5b | 92.468 | ST5b | 92.531 | ST5b |
| F41A MCC | 0.48 | | | 92.038 | ST5b | 90.310 | ST5e | 91.427 | ST5b | 91.688 | ST5b | 91.889 | ST5b | 91.953 | ST5b |
| F41B MCC | 0.48 | | | 92.020 | ST5b | 90.291 | ST5e | 91.408 | ST5b | 91.669 | ST5b | 91.870 | ST5b | 91.934 | ST5b |
| F4A LOAD CTR | 0.48 | | | 94.023 | ST5b | 92.300 | ST5e | 93.413 | ST5b | 93.673 | ST5b | 93.874 | ST5b | 93.937 | ST5b |
| F6 480V SWGR | 0.48 | | | 93.576 | ST5b | 91.921 | ST5e | 93.030 | ST5b | 93.289 | ST5b | 93.489 | ST5b | 93.552 | ST5b |
| F61 MCC | 0.48 | | | 93.372 | ST5b | 91.721 | ST5e | 92.827 | ST5b | 93.086 | ST5b | 93.285 | ST5b | 93.348 | ST5b |
| F62 MCC | 0.48 | | | 93.503 | ST5b | 91.921 | ST5e | 93.030 | ST5b | 93.289 | ST5b | 93.489 | ST5b | 93.552 | ST5b |
| F63 MCC | 0.48 | | | 93.576 | ST5b | 91.921 | ST5e | 93.030 | ST5b | 93.289 | ST5b | 93.489 | ST5b | 93.552 | ST5b |
| F7 480V SWGR | 0.48 | | | 93.768 | ST5b | 88.639 | ST5b | 91.988 | ST5b | 92.690 | ST5b | 93.277 | ST5b | 93.462 | ST5b |
| F71 MCC | 0.48 | | | 93.733 | ST5b | 88.606 | ST5b | 91.954 | ST5b | 92.656 | ST5b | 93.243 | ST5b | 93.428 | ST5b |
| M22A MCC | 0.48 | | | 90.907 | ST5b | 88.704 | ST5e | 89.796 | ST5b | 90.507 | ST5b | 90.705 | ST5b | 90.768 | ST5b |
| YE2 MCC | 0.24 | 87.080 | 65.000 | 93.880 | ST5b | 80.037 | ST5b | 83.386 | ST5b | 86.518 | ST5b | 91.434 | ST5b | 93.601 | ST5b |
| YE2 MV5443C | 0.24 | 85.000 | 67.090 | 93.880 | ST5b | 79.085 | ST5b | 82.394 | ST5b | 86.325 | ST5b | 91.251 | ST5b | 93.422 | ST5b |
| YF2 MCC | 0.24 | 86.780 | 65.000 | 94.190 | ST5b | 81.352 | ST5b | 84.775 | ST5b | 87.885 | ST5b | 92.142 | ST5b | 93.926 | ST5b |
| YF2 MV5444C | 0.24 | 85.000 | 67.090 | 94.190 | ST5b | 80.466 | ST5b | 83.853 | ST5b | 87.711 | ST5b | 91.976 | ST5b | 93.763 | ST5b |

**Table 10. Maximum Transformer Voltages**

| Transformer | Secondary Winding Bus | NomkV | LF5a %kV | LF5b %kV | LF5c %kV | LF5c1 %kV |
|---|---|---|---|---|---|---|
| MAIN TRANSFORMER 1 | MAIN GEN BUS | 25.00 | 0.000 | 0.000 | 98.068 | 98.070 |
| AUX TRANSFORMER 11 | AUX 11 X | 13.80 | 0.000 | 0.000 | 105.367 | 102.580 |
| | AUX 11 Y | 13.80 | 0.000 | 0.000 | 105.420 | 102.635 |
| START-UP 01 | STARTUP 01 | 13.80 | 105.347 | 102.701 | 103.300 | 103.300 |
| START-UP 02 | STARTUP 02 | 13.80 | 105.406 | 102.762 | 103.300 | 103.300 |
| AC | XAC LV | 4.16 | 107.290 | 104.576 | 107.309 | 104.448 |
| BD | XBD LV | 4.16 | 107.526 | 104.816 | 107.550 | 104.692 |
| CE1-1/CE1-2 | E1 480V SWGR | 0.48 | 109.165 | 103.735 | 106.454 | 103.607 |
| DF1-1/DF1-2 | F1 480V SWGR | 0.48 | 109.223 | 103.805 | 106.517 | 103.681 |
| AE2/BE2 | E2 480V SWGR | 0.48 | 101.239 | 98.628 | 101.254 | 98.505 |
| AE3/BE3 | E3 480V SWGR | 0.48 | 103.944 | 101.329 | 103.959 | 101.205 |
| AE4 | AE4 LV | 0.48 | 102.591 | 99.950 | 102.607 | 99.825 |
| AE6 | E6 480V SWGR | 0.48 | 105.342 | 102.696 | 105.358 | 102.571 |
| BF2/AF2 | BF2 LV | 0.48 | 101.538 | 98.908 | 101.557 | 98.787 |
| BF3/AF3 | F3 480V SWGR | 0.48 | 102.274 | 99.697 | 102.294 | 99.579 |
| BF4 | BF4 LV | 0.48 | 103.593 | 100.957 | 103.613 | 100.836 |
| BF6 | F6 480V SWGR | 0.48 | 105.397 | 102.753 | 105.417 | 102.632 |
| XBF4A | F4A LOAD CTR | 0.48 | 105.386 | 102.741 | 105.406 | 102.620 |
| CE5 | XCE5 LV | 0.48 | 105.536 | 102.865 | 105.555 | 102.739 |
| DF5 | XDF5 LV | 0.48 | 105.770 | 103.104 | 105.794 | 102.982 |
| DF6 | XDF6 LV | 0.48 | 107.363 | 104.657 | 107.387 | 104.533 |
| DF7 | F7 480V SWGR | 0.48 | 107.135 | 104.433 | 107.159 | 104.310 |
| DF8 | XDF8 LV | 0.48 | 106.892 | 104.194 | 106.916 | 104.071 |
| X3050 | X3050 LV | 0.48 | 105.238 | 102.574 | 105.256 | 102.449 |
| X3051 | X3051 LV | 0.48 | 106.475 | 103.781 | 106.494 | 103.654 |
| XBY1 | XBY1-LV | 0.48 | 105.912 | 103.224 | 105.931 | 103.097 |
| XYE2A | XYE2A-LV | 0.24 | 111.690 | 106.134 | 108.916 | 106.004 |
| XYF2A | XYF2A-LV | 0.24 | 111.701 | 106.160 | 108.934 | 106.034 |
| XYE2 | YE2 MCC | 0.24 | 111.690 | 106.134 | 108.916 | 106.004 |
| XYF2 | YF2 MCC | 0.24 | 111.701 | 106.160 | 108.934 | 106.034 |

## Attachment F

## Reliance Electric Action Guide, Table A

(1 page follows)

The abbreviations and acronyms listed below are used in Reliance Electric Action Guide, Table A.

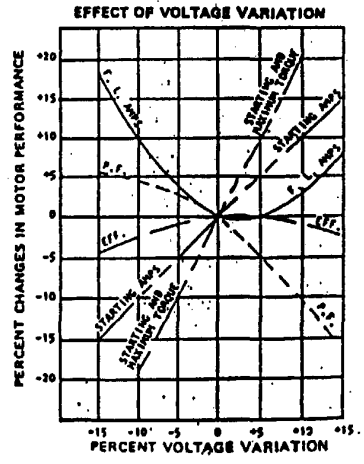
| | |
|---|---|
| AMPS | amperes |
| P. L. AMPS | peak load amperes |
| HP | horsepower |
| EFF. | efficiency |
| P. F. | power factor |
| % | percent |
| °C | degrees centigrade |

TABLE A – GENERAL EFFECT OF VOLTAGE AND FREQUENCY VARIATION ON INDUCTION-MOTOR CHARACTERISTICS

| VARIATION | STARTING & MAX RUNNING TORQUE | SYNCHRONOUS SPEED | % SLIP | FULL-LOAD SPEED | EFFICIENCY | | | POWER FACTOR | | | FULL-LOAD CURRENT | STARTING CURRENT | TEMP RISE, FULL-LOAD | MAX OVERLOAD CAPACITY | MAGNETIC NOISE – NO LOAD IN PARTICULAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Full Load | 3/4 Load | 1/2 Load | Full Load | 3/4 Load | 1/2 Load | | | | | |
| Voltage variation: 120% | Increase 44% | No Change | Decrease 30% | Increase 1.5% | 6-0% Decrease (1-75 HP) 0-.3% Increase (100-200 HP) | Decrease 1/2-2 points | Decrease 7-20 points | Decrease 6-15 points | Decrease 10-30 points | Decrease 16-40 points | Increase 12% | Increase 20% | Increase 5-6°C. | Increase 44% | Noticeable Increase |
| 110% voltage | Increase 21% | No Change | Decrease 17% | Increase 1% | Slight Decrease | Practically no change | Decrease 1-2 points | Decrease 5-10 points | Decrease 5 points | Decrease 5-6 points | Increase 2-4% | Increase 10-12% | Increase 3-4°C. | Increase 21% | Increase Slightly |
| Functions of voltage | $(\text{Voltage})^2$ | Constant | $\frac{1}{(\text{Voltage})^2}$ | (Synchronous speed slip) | | | | | | | | Voltage | | $(\text{Voltage})^2$ | |
| 90% voltage | Decrease 19% | No Change | Increase 23% | Decrease 1-1/2% | Decrease 2 points | Practically no change | Increase 1-2 points | Increase 5 points | Increase 2-3 points | Increase 4-5 points | Increase 10-11% | Decrease 10-12% | Increase 6-7°C. | Decrease 19% | Decrease Slightly |
| Freq. variation: 105% freq. | Decrease 10% | Increase 5% | Practically no change | Increase 5% | Slight Increase | Slight Increase | Slight Increase | Slight Increase | Slight Increase | Slight Increase | Decrease Slightly | Decrease 5-6% | Decrease Slightly | Decrease Slightly | Decrease Slightly |
| Function of frequency | $\frac{1}{(\text{Frequency})^2}$ | Frequency | | (Synchronous speed slip) | | | | | | | | $\frac{1}{\text{frequency}}$ | | | |
| 95% frequency | Increase 11% | Decrease 5% | Practically no change | Decrease 5% | Slight Decrease | Slight Decrease | Slight Decrease | Slight Decrease | Slight Decrease | Slight Decrease | Increase Slightly | Increase 5-6% | Increase Slightly | Increase Slightly | Increase Slightly |
| 1% Unbalance | Slight Decrease | Slight Decrease | | Slight Decrease | 2% Decrease | | | 5-6% Decrease | | | 1-1/2% Increase | Slight Decrease | 2% Increase | | |
| 2% Unbalance | Slight Decrease | Slight Decrease | | Slight Decrease | 8% Decrease | | | 7% Decrease | | | 3% Increase | Slight Decrease | 8% Increase | | |

NOTE: This table shows general effects, which will vary somewhat for specific ratings.

EFFECT OF VOLTAGE VARIATION




RELIANCE ELECTRIC ACNon Gelde

Attachment 9

Calc. No. C-EE-015.03-008
Revision 6

## Attachment G

## ISTB3, Pump and Valve Basis Document, Volume III, Stroke Time Basis

(33 pages follow)

The abbreviations and acronyms listed below are used in the ISTB3, Pump and Valve Basis Document, Volume III, Stroke Time Basis provided in Attachment G.

| | | | |
|---|---|---|---|
| ASME | American Society of Mechanical Engineers | SOV | solenoid operated valve |
| AOV | air operated valve | SRO | senior reactor operator |
| (C) | close | IST | inservice test |
| CIV | containment isolation valve | SFAS | safety features actuation system |
| ECP | engineering change package | SFRCS | steam and feedwater rupture control system |
| ECR | engineering change request | SR | surveillance requirement |
| EDG | emergency diesel generator | TRM | Technical Requirements Manual |
| MOD | modification | USAR | Updated Safety Analysis Report |
| MOV | motor operated valve | WO | work order |
| MWO | maintenance work order | % | percent |
| (O) | open | ≤ | less than or equal to |
| OM | operations and maintenance | > | greater than |
| PCN | procedure change notice | = | equals |
| PORV | power operated relief valve | - | minus |

ISTB3

# Pump and Valve Basis Document

Volume III

Stroke Time Basis

Revision 48

Prepared by: Luke M. Twarek 14 MAY 2014
Date

Reviewed by: Doug Hart Doug Hart 5/14/2014
Date

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Supervisor – Nuclear Engineering Programs Date

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| Section B, Reference Value Information | 6 |
| Section B, Stroke Time Limiting Values | 17 |
| Section C, Stroke Time Limits and Acceptance Criteria | 22 |

Revision 23 incorporated by PCN T-0352.
Revision 24 incorporated by PCN T-0356.
Revision 25 incorporated by PCN T-0357.
Revision 26 incorporated by PCN T-0358.
Revision 27 incorporated by PCN T-0360.
Revision 28 incorporated by PCN T-0363.
Revision 29 incorporated by PCN T-0366.
Revision 30 incorporated by PCN T-0376.
Revision 31 incorporated by PCN T-0377.
Revision 32 incorporated by PCN T-0378.
Revision 33 incorporated by PCN T-0379.
Revision 34 incorporated by PCN T-0381.
Revision 35 incorporated by PCN T-0383.
Revision 36 incorporated by PCN T-0392.
Revision 37 incorporated by PCN T-0395.
Revision 38 incorporated by PCN T-0396.
Revision 39 incorporated by PCN T-0397.
Revision 40 incorporated by PCN T-0404.
Revision 41 incorporated by PCN T-0405.
Revision 42 incorporated by PCNs T-0408 & T-0409.
Revision 43 incorporated by PCN T-0410.
Revision 44 incorporated by PCN T-0411.
Revision 45 incorporated by PCN T-0416.
Revision 46 incorporated by PCN T-0423.
Revision 47 incorporated by PCN T-0429.
Revision 48 incorporated by PCN T-0433.

## GENERAL INFORMATION

This document is divided into three sections. Section A is the narrative portion of this manual. Section B contains reference value information, as well as limiting values. Section C contains the information that is needed to support surveillance testing. Controlled copies of this manual may be obtained from FileNet. Hardcopies of this document are maintained with the Work Support Center SRO, the Control Room, and the Simulator Control Room.

Section C contains a field titled the 'Expected Stroke Time Range'. Under normal circumstances, it is expected that the measured stroke time be within this range. If a value is obtained that is outside of this range, the valve is immediately retested or declared inoperable, as directed by the associated surveillance test. This range appears only for the safety direction of travel for valves included in the IST Program.

This document contains some stroke time information for SFAS actuated ventilation dampers, but is not intended to be a complete list.

The absence of a valve from this document indicates that there is no 'Maximum Allowable Stroke Time' or 'Expected Stroke Time Range'. The absence of a value for a valve listed in this document indicates that no such value exists.

The Reference Value Information section includes some valves that are not in the IST Program and have no stroke time requirements. Some valves and dampers listed in this document are not IST Program components.

All acceptance criteria and stroke time limits are contained in Section C, Stroke Time Limits and Acceptance Criteria.

Some valves may have more than one set of reference values. The Reference Value Information section will indicate those valves, and the Stroke Time Limits and Acceptance Criteria will provide the appropriate values and situations under which each reference value is to be used.

If a valve has a 'Maximum Allowable Stroke Time' limited by other than SFAS, SFRCS, Containment Isolation, or Owner-specified degradation (IST) limits, an explanation will be provided in Section A of this document.

Stroke times will be plotted and trended in the IST computerized tracking program.

The unit of measurement for all stroke time values in this document is seconds.

## STROKE TIME BASIS INFORMATION

The Code of Record for the Fourth Ten Year Interval IST Program is the ASME Code for Operation and Maintenance at Nuclear Power Plants, ASME OM Code-2004 with Addenda through 2006.

Stroke time testing is mandated by the Code in the safety direction of valve travel only. Stroke time testing may also be performed in the non-safety direction for information and trending purposes only.

The Owner must specify 'Maximum Allowable Stroke Time' values for each IST Program power operated valve in the safety direction of valve travel. Calculated acceptance criteria may be rounded off in the conservative direction only. Stroke times shall be measured to at least the nearest second.

Reference values have been established and owner-specified degradation (IST) limits created based upon these values. Limiting stroke time values that must be met to fulfill requirements of the Technical Specifications, SFAS, SFRCS, Containment Isolation, or any other design basis stroke time requirement are included in this document. The 'Maximum Allowable Stroke Time' is defined as the most limiting value among the design basis requirements and the owner-specified degradation limits.

If a stroke time value exceeds the 'Maximum Allowable Stroke Time', then the valve is immediately declared inoperable per TS 5.5.7 and a Condition Report (CR) is written.

The 'Expected Stroke Time Range' and 'Maximum Allowable Stroke Time' apply only in the safety direction of valve travel. If the initial stroke time value is outside of the 'Expected Stroke Time Range', and the 'Maximum Allowable Stroke Time' was not exceeded, then the valve is either declared inoperable, or immediately retested and the following apply:

- If the retest stroke time value is again outside of the 'Expected Stroke Time Range' but does not exceed the 'Maximum Allowable Stroke Time', then the valve remains operable pending an evaluation that must be performed within 96 hours. The CR should state that an evaluation must be performed within 96 hours, or the valve will be declared inoperable per TS 5.5.7.

- If the retest stroke time value is within the 'Expected Stroke Time Range', then the valve remains operable. A CR is initiated to prompt an evaluation of the condition whenever a value is obtained that is outside of the 'Expected Stroke Time Range'. All test data gathered should be included in the CR.

## OWNER SPECIFIED STROKE TIME INFORMATION AND NOTES

1. For motor operated valves, the Owner-specified degradation limit is defined as 1.5 times the reference value.

2. For air-operated valves with a reference value ≤10 seconds, the Owner-specified degradation limit is defined as 3 times the reference value or 10 seconds (whichever is greater). This does not apply to valves that are classified as Rapid Acting Valves. (See Note 10)

3. For solenoid valves with a reference value ≤10 seconds, the Owner-specified degradation limit is defined as 3 times the reference value. This does not apply to valves that are classified as Rapid Acting Valves. (See Note 10)

4. For air-operated valves and solenoid valves with a reference value >10 seconds, the Owner-specified degradation limit is 2 times the reference value.

5. For MS5889A, a maximum value of 42 seconds to open, and for MS5889B a maximum value of 46 seconds to open was assigned. These values are based upon a comparison of valve stroke time to Auxiliary Feed Pump response time, to ensure the Auxiliary Feed Pump response time requirement of 40 seconds is met. Additionally, these valves have a minimum open stroke time of 25 seconds to prevent overspeed trip of the Auxiliary Feed Pump Turbine.

6. For SW1356, SW1357, and SW1358, these valves must travel to at least the 80% open position within 10 seconds per Calculation C-ME-011.06-008. The stroke time matrix conservatively uses a 10 second

time limit for these valves to fully open. These valves have an additional set of reference values. Refer to CR 04-07816.

7. DH7A/DH7B must close within 75 seconds, and DH9A/DH9B must open within 75 seconds as required by SR 3.5.2.8.

8. Since TRM 8.3.11 imposes a 40-second response time requirement on the Auxiliary Feed Pumps, associated auxiliary feedwater system valves have a 40-second limit to achieve their safety positions. Note that MS5889A, MS5889B, SW1382 and SW1383 are exceptions that have specific limits assigned.

9. SW1382 and SW1383 each have a maximum value of 13 seconds due to the Auxiliary Feed Pumps suction piping design change under ECP 08-0571.

10. Certain valves are classified as Rapid Acting Valves. These valves are assigned a 'Maximum Allowable Stroke Time' of 2 seconds and are exempt from the 'Expected Stroke Time Range' requirement of the Code of Record.

11. For SFRCS actuated valves, the maximum allowable SFRCS time is listed in the SFRCS column of Section B. SFRCS actuated component response times are given in TRM Table 8.3.11-1 and include SFRCS sensing time and logic. The SFRCS times listed in this document are calculated by subtracting 1 second from the values listed in the TRM.

12. For Containment Isolation Valves, the maximum allowable containment isolation times are obtained from USAR Table 6.2-23, and are shown in the CIV column of Section B.

13. For IST Program SFAS actuated valves, the maximum allowable SFAS time is listed in the SFAS column of Section B. SFAS actuated component response times are given in Technical Requirements Manual (TRM) Table 8.3.5-1. The TRM values include all of the pieces of the total response time, including SFAS sensing and logic, as well as EDG and sequencer delays. The SFAS times listed in this document is calculated by subtracting all of the pieces affecting total response time from the TRM values, except for the actual valve actuation time. The following equation illustrates this:

    SFAS Time = [TRM Table 8.3.5-1 Time] - [SFAS Sensing & Logic Time] - [EDG Time] – [SFAS Sequencer Time] – [EDG Underfrequency Correction Time]

    [SFAS Sensing & Logic Time] - This is conservatively assumed at 5 seconds, except in cases where limited margin exists. When limited margin exists, the most recent worst case SFAS sensing and logic response times, obtained via DB-SC-03109, DB-SC-03114, or DB-SC-03121 are utilized for the equation in lieu of 5 seconds.

    [EDG Time] - When EDG time is applicable to the component, the value is assumed conservatively at 10 seconds, except in cases where limited margin exists. In these cases, actual EDG time is used.

    [SFAS Sequencer Time] - When SFAS sequencer times are applicable to the component, the value is assumed at nominal sequencer delay time with a tolerance of 1 second.

    [EDG Underfrequency Correction Time] – When EDG time is applicable to the component, this value is determined by the method documented in CA-2012-03071-2 to account for effect of limiting EDG underfrequency on valve stroke times when compared with test times at nominal test frequency.

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| AF599 | 36.489 | 36.561 | DB-PF-09302 | 10/29/2011 | Reference values established following maintenance under Order 200432025. |
| AF608 | 36.606 | 36.757 | DB-PF-09302 | 10/22/2011 | Reference values established following maintenance under Order 200432026. |
| AF3869 | 33.92 | 34.27 | DB-PF-03272 | 11/16/1995 | Reference values established following maintenance under MWO 2-93-0035-18. |
| AF3870 | 19.375 | 19.918 | DB-PF-03272 | 5/29/2012 | Reference values established following valve replacement under Order 200501242. |
| AF3871 | 33.54 | 33.8 | DB-PF-03272 | 10/30/1995 | Reference values established following maintenance under MWO 2-93-0035-19. |
| AF3872 | 26.68 | 27.22 | DB-PF-03163 | 6/28/2000 | Reference values established following maintenance under WO 99-004622-000. |
| AF6451 | 3.59 | 11.3 | DB-SP-03161 | 5/9/1991 | Reference values established based upon 5/9/91 test data. Information only. |
| AF6452 | 4.47 | 10.17 | DB-SP-03152 | 5/16/1991 | Reference values established based upon 5/16/91 test data. Information only. |
| CC1328 | 22.2 | 22.08 | DB-PF-03071 | 11/1/2000 | Reference values established following maintenance under WO 00-000603-000 and review of 11/1/00 test data. |
| CC1338 | 22.25 | 22.51 | DB-PF-03272 | 4/5/2001 | Reference values established following maintenance under WO 00-003421-000. |
| CC1407A | 8.23 | 8.36 | DB-PF-03100 | 5/9/1998 | Reference values established following maintenance under MWO 3-98-0232-01. |
| CC1407B | 9.86 | 9.97 | DB-PF-03272 | 4/19/2000 | Reference values established following maintenance under WO 99-003859-000. |
| CC1411A | 9.87 | 9.88 | DB-PF-03272 | 5/3/1996 | Reference values established following maintenance under MWO 3-96-0222-01. |
| CC1411B | 9.31 | 9.4 | DB-PF-03272 | 5/7/1996 | Reference values established following maintenance under MWO 3-96-0229-01. |
| CC1460 | 3.46 | 4.33 | DB-PF-03071 | 12/26/2005 | Reference values established based following maintenance under Order 200008518. |
| CC1467 | 30.36 | 13.98 | DB-PF-03071 | 3/20/2014 | Reference value established following valve replacement under Order 200597387. |
| CC1469 | 32.52 | 12.29 | DB-PF-03070 | 2/26/2014 | Reference values established following valve replacement under Order 200595028. |
| CC1495 | 14.28 | 24.42 | DB-PF-03071 | 4/21/2014 | Reference values established following valve replacement under Order 200499387. |
| CC1567A | 9.63 | 9.01 | DB-PF-03100 | 4/19/1993 | Reference values established following review of test data obtained on 4/19/93 under DB-PF-03100. |
| CC1567B | 9.07 | 9.22 | DB-PF-03100 | 5/9/1998 | Reference values established following maintenance under MWO 3-98-0231-01. |
| CC2645 | 60.33 | 60.56 | DB-PF-03272 | 3/23/2000 | Reference values established following maintenance under WO 00-000045-000. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| CC2649 | 61.42 | 61.23 | DB-PF-03070 | 2/14/1996 | Reference values established following maintenance under MWO 3-95-0288-01. |
| CC4100 | 12.41 | 12.57 | DB-PF-03272 | 11/2/1994 | Reference values established following maintenance under MWO 1-93-0695-07. |
| CC4200 | 12.26 | 12.31 | DB-PF-03272 | 10/29/1994 | Reference values established following maintenance under MWO 1-93-0695-08. |
| CC4300 | 12.79 | 13.05 | DB-PF-03272 | 11/2/1994 | Reference values established following maintenance under MWO 1-93-0695-09. |
| CC4400 | 13.6 | 13.74 | DB-PF-03272 | 10/29/1994 | Reference values established following maintenance under MWO 1-93-0695-10. |
| CC5095 | 102.77 | 102.86 | DB-PF-03272 | 5/13/1996 | Reference values established following maintenance under MWO 7-94-0326-01. |
| CC5096 | 101.79 | 101.2 | DB-PF-03070 | 3/10/2000 | Reference values established following maintenance under WO 99-006410-002. |
| CC5097 | 57.06 | 57.53 | DB-PF-03272 | 5/13/1996 | Reference values established following maintenance under MWO 1-95-0487-16. |
| CC5098 | 59.4 | 59.36 | DB-PF-03272 | 11/19/1998 | Reference values established following maintenance under MWO 2-97-0076-05. |
| CF1A | 51.84 | 52.44 | DB-PF-03272 | 5/8/2000 | Reference values established following maintenance under WO 99-000403-000. |
| CF1B | 52.2 | 52.7 | DB-PF-03272 | 5/8/2000 | Reference values established following maintenance under WO 99-003753-000. |
| CF2A | 5.8 | 5.79 | DB-PF-03811 | 5/25/1998 | Reference values established following maintenance under MWO 3-98-0321-01 and review of test data obtained on 5/25/98 under DB-PF-03811. |
| CF2B | 6 | 5.6 | DB-PF-03811 | 5/25/1998 | Reference values established following maintenance under MWO 3-98-0322-01 and review of test data obtained on 5/25/98 under DB-PF-03811. |
| CF5A | 5.34 | 5.44 | DB-PF-03272 | 4/24/1996 | Reference values established following maintenance under MWO 3-96-0323-01. |
| CF5B | 5.62 | 5.72 | DB-PF-03272 | 5/4/1998 | Reference values established following maintenance under MWO 3-98-0324-01. |
| CF1541 | 4.14 | 3.56 | DB-PF-05061 | 3/29/2006 | Reference values established following maintenance under Orders 200117189 and 200099359. |
| CF1542 | 6.46 | 6.35 | DB-PF-05061 | 3/30/2006 | Reference values established following maintenance under Orders 200079095 and 200120863. |
| CF1544 | 4.18 | 3.96 | DB-PF-03272 | 3/29/2006 | Reference values established following maintenance under Orders 200099360 and 200117187. |
| CF1545 | 3.49 | 3.24 | DB-PF-03272 | 3/21/2002 | Reference value established following maintenance under WO 00-002974-000. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| CS1530 | 18.793 | 19.02 | DB-PF-09302 | 8/21/2013 | Reference values following implementation of ECP 03-0359 under Order 200389245. |
| CS1531 | 20.741 | 20.838 | DB-PF-03272 | 1/20/2014 | Reference values established following modification under Order 200588933. |
| CV5005 | 33.19 | 6.73 | DB-MI-05023 | 11/14/2003 | Ref values established following maintenance under Order 200001129 & 200006595. |
| CV5006 | 17.59 | 9.64 | DB-PF-03272 | 5/11/1998 | Reference values established following maintenance under MWO 3-98-5316-01. |
| CV5007 | 16.03 | 8.84 | DB-PF-03270 | 6/18/2002 | Reference values established following maintenance under WO 02-003376-000. |
| CV5008 | 7.9 | 8.69 | DB-MI-05023 | 11/16/2003 | Ref values established following maintenance under Order 200001061 & 200006085. |
| CV5010A | 9.93 | 10.03 | DB-PF-03811 | 10/18/1998 | Reference values established following maintenance under MWO 1-98-1161-00. |
| CV5010B | 10.5 | 10.53 | DB-PF-03811 | 3/2/2000 | Reference values established following maintenance under WO 99-002295-000. |
| CV5010C | 9.87 | 9.88 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003685-000. |
| CV5010D | 10.24 | 10.3 | DB-PF-03811 | 3/10/2000 | Reference values established following maintenance under WO 99-002291-000. |
| CV5010E | 10.15 | 10.33 | DB-PF-09302 | 3/10/2010 | Reference values established following maintenance under order 200000681. |
| CV5011A | 11.6 | 11.6 | DB-SP-03272 | 4/14/1990 | Reference values established following maintenance under MWO 3-90-0750-01. |
| CV5011B | 10.84 | 10.81 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003684-000. |
| CV5011C | 10.14 | 10.17 | DB-PF-03811 | 3/2/2000 | Reference values established following maintenance under WO 99-005269-000. |
| CV5011D | 9.94 | 10.15 | DB-PF-03811 | 6/1/2000 | Reference values established following maintenance under WO 99-003683-000. |
| CV5011E | 10.21 | 10.5 | DB-PF-09307 | 6/7/2004 | Reference values established following maintenance under Order 200004259. |
| CV5037 | 48.54 | 48.5 | DB-PF-03272 | 1/19/2000 | Reference values established following maintenance under WO 99-004618-000. |
| CV5038 | 54.05 | 53.96 | DB-PF-03272 | 3/21/2000 | Reference values established following maintenance under WO 99-004837-000. |
| CV5065 | 56.12 | 56.19 | DB-PF-03272 | 1/16/1995 | Reference values established following maintenance under MWO 3-95-0753-01. |
| CV5070 | 10.01 | 10.11 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003696-000 and review of test data obtained on 5/25/00 under DB-PF-03811. |
| CV5071 | 9.62 | 9.63 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003695-000. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| CV5072 | 9.61 | 9.72 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003694-000. |
| CV5073 | 9.9 | 10 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003693-000. |
| CV5074 | 9.77 | 9.87 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003692-000. |
| CV5075 | 9.57 | 9.59 | DB-PF-03272 | 4/11/2000 | Reference values established following maintenance under WO 99-003691-000. |
| CV5076 | 10.27 | 10.37 | DB-PF-03812 | 3/26/1993 | Reference values established following maintenance under MWO 3-93-0782-01. |
| CV5077 | 10.43 | 10.43 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003689-000. |
| CV5078 | 10.07 | 10.09 | DB-PF-03811 | 6/29/1996 | Reference values established following maintenance under MWO 3-96-0780-03 and review of test data obtained on 6/29/96 under DB-PF-03811. |
| CV5079 | 10.43 | 10.42 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003687-000. |
| CV5090 | 56.31 | 56.26 | DB-PF-03272 | 5/26/2000 | Reference values established following maintenanc eunder WO 99-004838-000. |
| DH1A | 9.18 | 9.17 | DB-PF-03272 | 3/28/2011 | Reference values established following maintenance under WO 200450011. |
| DH1B | 9.007 | 8.061 | DB-PF-03272 | 8/7/2010 | Reference values established following maintenance under WO 200426129. |
| DH7A | 66 | 66.3 | DB-SP-03211 | 10/7/1991 | Reference values established following maintenance under MWO 1-91-0974-01. |
| DH7B | 65.94 | 65.81 | DB-PF-03205 | 3/30/2000 | Reference values established following maintenance under WO 99-003027-000 and review of test data obtained on 3/30/00 under DB-PF-03205. |
| DH9A | 63.37 | 63.61 | DB-PF-03272 | 4/30/1998 | Reference values established following maintenance under MWO 3-98-0292-01. |
| DH9B | 65.52 | 64.47 | DB-SP-03208 | 10/14/1994 | Reference values established following maintenance under MWO 1-93-0695-26. |
| DH11 | 55.83 | 56.74 | DB-SP-03130 | 5/13/1996 | Reference values established following maintenance under MWO 1-95-0487-02. |
| DH12 | 59.56 | 59.78 | DB-SP-03130 | 5/13/1996 | Reference values established following maintenance under MWO 2-93-0035-29. |
| DH13A | 6.39 | 7.23 | DB-MI-05023 | 4/2/2006 | Reference values established following maintenance under Order 200104259. |
| DH13B | 7.88 | 11.08 | DB-PF-03205 | 1/13/2008 | Reference values established following maintenance under Order 200067203. |
| DH14A | 5.73 | 6.59 | DB-PF-03206 | 1/16/2008 | Reference values established following maintenance under Order 200067204. |
| DH14B | 5.13 | 6.55 | DB-MI-05023 | 1/13/2008 | Reference values established following maintenance under Order 200067205. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| DH63 | 28.15 | 28.12 | DB-PF-03272 | 10/24/2000 | Reference values established following maintenance under WO 00-001510-000. |
| DH64 | 12.74 | 12.86 | DB-PF-03272 | 9/8/2005 | Reference values established following maintenance under Order 200104259. |
| DH830 | 41.9 | 41.46 | DB-PF-03206 | 7/9/1998 | Reference values established following maintenance under MWO 3-98-0296-01 and review of test data obtained on 7/9/98 under DB-PF-03206. |
| DH831 | 38.71 | 37.63 | DB-PF-03205 | 6/22/2000 | Reference values established following maintenance under WO 99-001209-000 and review of test data obtained on 6/22/00 under DB-PF-03205. |
| DH1517 | 15.5 | 16.22 | DB-PF-03205 | 6/26/2000 | Reference values established following maintenance under WO 99-004337-002. |
| DH1518 | 14.21 | 14.14 | DB-PF-03206 | 6/6/2000 | Reference values established following maintenance under WO 99-004337-006. |
| DH2733 | 111.91 | 112.34 | DB-PF-09302 | 1/12/2008 | Reference values established following maintenance under Order 200091807. |
| DH2734 | 112.48 | 112.06 | DB-PF-03206 | 6/6/2000 | Reference values established following maintenance under WO 98-002735-000 and review of test data obtained on 6/6/00 under DB-PF-03206. |
| DH2735 | 16.47 | 16.39 | DB-PF-03812 | 5/11/1998 | Reference values established following maintenance under MWO 3-98-0301-01 and review of test data obtained on 5/17/98 under DB-PF-03812. |
| DH2736 | 39.75 | 39.8 | DB-PF-03272 | 4/26/2000 | Reference values established following maintenance under WO 99-004337-013. |
| DR2012A | 8.04 | 8.24 | DB-PF-03811 | 6/1/2000 | Reference values established following maintenance under WO 99-003635-000. |
| DR2012B | 8.74 | 8.35 | DB-PF-03811 | 12/17/1999 | Reference values established following maintenance under WO 99-002021-000. |
| DW2643 | 4.81 | 5.9 | DB-PF-05061 | 6/4/2004 | Reference values established following maintenance under Order 200011311. |
| DW6831A | 7.62 | 1.42 | DB-PF-03272 | 6/7/2003 | Open value changed due to Order 200002323. Previous close value retained from DB-PF-03811 on 10/18/98 following WO 99-005780-000. |
| DW6831B | 9.42 | 1.56 | DB-PF-03272 | 6/6/2003 | Open value changed due to WO 02-001457-000. Previous close value retained from DB-PF-03811 on 2/10/94 following MWO 7-93-0477-01. |
| FW601 | 13.2 | 14.1 | DB-PF-03272 | 5/6/1999 | Reference values established following maintenance under WO 99-002535-000. |
| FW612 | 12.09 | 13.11 | DB-PF-03272 | 5/6/2000 | Reference values established following maintenance under WO 99-003729-000. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| HA5439 | 56.21 | 56.24 | DB-PF-03811 | 2/2/2001 | Reference values established following maintenance under WO 00-001511-000 and based upon review of test data obtained on 2/2/01 under DB-PF-03811. |
| HA5440 | 55.15 | 55.03 | DB-PF-03811 | 4/3/1999 | Reference values established following maintenance under WO 98-001409-000 and based upon review of test data obtained on 4/3/99 under DB-PF-03811. |
| HA5441 | 54.89 | 55.05 | DB-PF-03811 | 2/9/2001 | Reference values established following maintenance under WO 00-003582-000 and based upon review of test data obtained on 2/9/01 under DB-PF-03811. |
| HA5442 | 58.4 | 58.36 | DB-PF-03811 | 2/9/2001 | Reference values established following maintenance under WO 00-001512-000 and based upon review of test data obtained on 2/9/01 under DB-PF-03811. |
| HP2A | 8.53 | 8.7 | DB-PF-03272 | 5/1/1998 | Reference values established following maintenance under MWO 3-97-0271-01). |
| HP2B | 9.06 | 9.12 | DB-PF-03206 | 6/6/2000 | Reference values established following maintenance under WO 99-003744-000 and based upon review of test data obtained on 6/6/00 under DB-PF-03206. |
| HP2C | 8.87 | 8.97 | DB-PF-03205 | 5/28/1998 | Reference values established following maintenance under MWO 3-98-0272-01 and based upon review of test data obtained on 5/28/98 under DB-PF-03205. |
| HP2D | 8.82 | 8.34 | DB-PF-03205 | 3/30/2000 | Reference values established following maintenance under WO 99-004365-000 and based upon review of test data obtained on 3/30/00 under DB-PF-03205. |
| HP31 | 28.94 | 27.59 | DB-SP-03219 | 9/7/1995 | Reference values established following maintenance under MWO 7-95-0237-01. |
| HP32 | 28.55 | 28.45 | DB-SP-03218 | 5/1/1995 | Reference values established following maintenance under MWO 3-95-2070-01. |
| IA2011 | 2.58 | 2.42 | DB-PF-03811 | 7/16/2003 | Reference values established following maintenance under Order 200002505. |
| ICS11A | 8 | 4.94 | 99-000913-001 | 5/9/2000 | Reference values established per DB-PF-03440 on 5/9/00 following valve/actuator replacement under MOD 92-0008. |
| ICS11B | 8.75 | 5.72 | DB-PF-03440 | 4/19/2006 | Reference values established following maintenance under Order 200116976. Refer to CR 06-01971. |
| MS100 | | 4.3 | DB-SP-03445 | 5/18/1998 | Reference values established following maintenance under MWO 2-97-0008-01 & 2-98-0013-01. |
| MS100-1 | 4.58 | 19.18 | DB-PF-03811 | 7/20/2006 | Reference values established following maintenance under Order 200117177. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| MS101 | | 4.4 | DB-SP-03444 | 5/12/2000 | Reference values established during 5/12/00 test using a stopwatch. |
| MS101-1 | 4.24 | 19.95 | DB-PF-03811 | 2/23/2008 | Reference values established following maintenance under Order 200237626. |
| MS106 | 17.956 | 18.03 | DB-PF-09302 | 11/8/2011 | Reference values established following maintenance under WO 200432019. |
| MS106A | 29.286 | 29.469 | DB-PF-09302 | 11/9/2011 | Reference values established following maintenance under WO 200432020. |
| MS107 | 28.183 | 28.377 | DB-PF-09302 | 11/7/2011 | Reference values established following maintenance under WO 200432021. |
| MS107A | 26.76 | 26.912 | DB-PF-09302 | 11/8/2011 | Reference values established following maintenance under WO 200432022. |
| MS375 | 4.66 | 7.6 | DB-PF-03811 | 2/23/2002 | Reference values established following maintenance under WO 01-000413-000. |
| MS394 | 6 | 7.48 | DB-PF-03811 | 2/23/2002 | Reference values established following maintenance under WO 01-000425-000. |
| MS603 | 61.24 | 61.55 | DB-PF-03272 | 4/27/2000 | Reference values established following maintenance under WO 99-003962-000. |
| MS611 | 60.19 | 60.52 | DB-PF-03272 | 4/20/1998 | Reference values established following maintenance under MWO 3-98-0256-01. |
| MS5889A | 34.23 | 6.54 | DB-SP-03151 | 6/1/1995 | Reference values established following maintenance under MWO 7-94-0473-02. |
| MS5889B | 36.56 | 5.46 | DB-SP-03166 | 6/25/2010 | Reference values established following maintenance under Order 200421064. |
| MU1A | 9.26 | 9.59 | DB-PF-03272 | 5/10/1999 | Reference values established following maintenance under WO 99-000269-005. |
| MU1B | 9.21 | 9.3 | DB-PF-03272 | 5/9/1996 | Reference values established following maintenance under MWO 2-93-0035-22 & 1-95-0487-05. |
| MU2A | 9.76 | 9.86 | DB-PF-03272 | 5/13/1996 | Reference values established following maintenance under MWO 2-93-0035-20 & 3-96-0184-01. |
| MU2B | 9.63 | 9.79 | DB-PF-03272 | 10/25/1994 | Reference values established following maintenance under MWO 1-92-1078-50. |
| MU3 | 4.12 | 4.88 | DB-PF-03386 | 8/16/2003 | Reference values established following actuator replacement under ECR 03-0111-00 |
| MU38 | 1.16 | 0.7 | DB-PF-03386 | 2/27/2014 | Reference values established following actuator replacement under Order 200595089. |
| MU59A | 15.81 | 15.96 | DB-PF-03272 | 4/30/2000 | Reference values established following maintenance under WO 99-003848-000. |
| MU59B | 15.18 | 15.25 | DB-PF-03272 | 4/30/2000 | Reference values established following maintenance under WO 99-003849-000. |
| MU59C | 14.13 | 14.24 | DB-PF-03272 | 4/27/2000 | Reference values established following maintenance under WO 99-003850-000. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| MU59D | 15.77 | 15.9 | DB-PF-03272 | 4/27/2000 | Reference values established following maintenance under WO 99-003851-000. |
| MU66A | 2.84 | 1.67 | DB-PF-03386 | 3/1/2014 | Reference values established following actuator replacement under Order 200595464. |
| MU66B | 4.15 | 2.95 | DB-PF-05061 | 3/16/2003 | Reference values established following maintenance under WO 03-003956-000 and because of new test methodology. |
| MU66C | 3.46 | 2.67 | DB-PF-05061 | 3/17/2003 | Reference values established following maintenance under WO 03-003957-000 and because of new test methodology. |
| MU66D | 4.01 | 2.94 | DB-PF-05061 | 3/17/2003 | Reference values established following maintenance under WO 02-002306-000 and because of new test methodology. |
| MU3971 | 15.97 | 16.09 | DB-PF-03272 | 5/20/1996 | Reference values established following maintenance under MWO 1-96-0356-00. |
| MU6405 | 15.54 | 15.56 | DB-PF-03272 | 5/28/1996 | Reference values established following maintenance under MWO 1-96-0357-01 |
| MU6420 | 14.03 | 14.11 | DB-PF-03272 | 4/30/1998 | Reference values established following maintenance under MWO 3-96-4640-02. |
| MU6419 | 27.43 | 27.98 | DB-PF-03272 | 4/17/2002 | Reference values established following maintenance under Work Orders 01-005662-000 and 01-002465-000. |
| MU6421 | 14.05 | 13.65 | DB-PF-03811 | 5/25/2000 | Reference values established following maintenance under WO 99-003347-000 and based upon review of test data obtained on 5/25/00 under DB-PF-03811. |
| MU6422 | 13.17 | 13.25 | DB-PF-03272 | 10/18/1994 | Reference values established following maintenance under MWO 1-93-0659-22. |
| NN236 | 3.87 | 2.49 | DB-PF-03272 | 4/5/2006 | Reference values established following maintenance under Order 200117034. |
| RC2 | 6.85 | 6.48 | DB-PF-03272 | 5/10/1999 | Reference values established following maintenance under WO 98-000373-005. |
| RC2A | 0.48 | 0.38 | DB-SP-03366 | 11/18/2011 | Reference values established following maintenance under Order 200353901. |
| RC10 | 11.29 | 11.37 | DB-PF-03272 | 11/7/1994 | Reference values established following maintenance under MWO 2-90-0046-02. |
| RC11 | 17.27 | 17.4 | DB-PF-03272 | 5/18/1996 | Reference values established following maintenance under MWO2-96-0001-01. |
| RC200 | 10.95 | 10.87 | DB-PF-03272 | 10/18/1994 | Reference values established following maintenance under MWO 1-93-0659-24. |
| RC229A | 10 | 2.74 | DB-PF-03811 | 11/24/1994 | Reference values established following maintenance under MWO 3-94-4488-01 and based upon review of test data obtained on 11/24/94 under DB-PF-03811. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| RC229B | 7.21 | 1.56 | DB-PF-03811 | 7/16/2003 | Reference values established following maintenance under Order 200003596. |
| RC232 | 8.86 | 4.83 | DB-SP-03272 | 4/6/1993 | Reference values established following maintenance under MWO 3-93-4486-01. |
| RC239A | 12.94 | 13.03 | DB-PF-03272 | 4/10/2000 | Reference values established following maintenance under WO 99-003809-000. |
| RC240A | 12.08 | 12 | DB-PF-03272 | 4/20/1998 | Reference values established following maintenance under MWO 3-96-0042-01. |
| RC240B | 12.01 | 11.93 | DB-PF-03811 | 12/9/1992 | Reference values established following maintenance under MWO 1-92-1078-27. |
| RC1719A | 4.45 | 2.87 | DB-PF-03811 | 6/29/1996 | Reference values established following maintenance under MWO 3-96-3916-01. |
| RC1719B | 6.41 | 4.15 | DB-PF-03272 | 4/5/2006 | Reference values established following maintenance under Order 200117186. |
| RC1773A | 3.12 | 1.67 | DB-PF-03272 | 3/21/2002 | Reference values established following maintenance under WO 00-003763-000 and WO 01-009132-000. |
| RC1773B | 3.3 | 2 | DB-PF-03272 | 3/13/2002 | Reference values established following maintenance under WO 01-009679-000. |
| RC4608A | 0.94 | 0.61 | DB-SP-03366 | 11/2/1994 | Reference values established following maintenance under MWO 2-86-0175-14. |
| RC4608B | 0.54 | 0.33 | DB-SP-03366 | 11/2/1994 | Reference values established following maintenance under MWO 2-86-0175-14. |
| RC4610A | 0.47 | 0.35 | DB-SP-03366 | 4/13/1993 | Reference values established following maintenance under MWO 2-86-0175-11. |
| RC4610B | 0.24 | 0.24 | DB-SP-03366 | 4/13/1993 | Reference values established following maintenance under MWO 2-86-0175-11. |
| SA2010 | 2.98 | 4.44 | DB-PF-03272 | 4/12/2006 | Reference values established following maintenance under Order 200200915. |
| SP6A | | 5.96 | DB-MI-03232 | 5/6/1999 | Reference values established following maintenance under WO 98-000830-000. |
| SP6B | | 6 | DB-MI-03232 | 5/2/2000 | Reference values established following maintenance under WO 99-004053-000. |
| SP7A | | 3.96 | DB-MI-03233 | 5/6/2000 | Reference values established following maintenance under WO 99-003442-000. |
| SP7B | | 3 | DB-MI-03233 | 5/4/2000 | Reference values established following maintenance under WO 99-003706-000. |
| SS235A | 2.47 | 2.87 | DB-PF-03272 | 3/29/2003 | Reference values established following maintenance under WO 03-001810-000. |
| SS235B | 1.18 | 0.63 | DB-PF-03272 | 3/31/2006 | Reference values established following maintenance under Order 200006644. |
| SS598 | 2.12 | 4.24 | DB-PF-03811 | 7/16/2003 | Reference values established following implementation of ECR 03-0096. Refer to CR 03-00890. |
| SS607 | 2.96 | 2.97 | DB-PF-03272 | 3/31/1999 | Reference values established following maintenance under WO 98-001512-000. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| SW1356 | 5.29 | 6.99 | DB-PF-03020 | 8/23/2013 | Reference values following implementation of ECR 04-0272 under Order 200099230. (Refer to Order 200574209) |
| SW1357 | 3.87 | 8.107 | DB-PF-03027 | 9/12/2013 | Reference values following implementation of ECR 04-0272 under Order 200099231. (Refer to Order 200576869) |
| SW1358 | 4 | 6.26 | DB-PF-03020 | 11/1/2013 | Reference values following implementation of ECR 04-0272 under Order 200099232. (Refer to Order 200582224) |
| SW1366 | 20.1 | 20.1 | DB-PF-03272 | 11/14/1996 | Reference values established following maintenance under MWO3-97-0934-01 |
| SW1367 | 19.24 | 19.26 | DB-PF-03272 | 6/24/1992 | Reference values established following maintenance under MWO 2-88-0109-04. |
| SW1368 | 19.43 | 19.41 | DB-PF-03027 | 5/18/1992 | Reference values established following maintenance under MWO 2-88-0109-03. |
| SW1379 | 29.84 | 29.96 | DB-PF-09302 | 4/2/2006 | Reference values established following maintenance under Order 200007803. |
| SW1380 | 27.89 | 28.05 | DB-PF-09302 | 4/2/2006 | Reference values established following maintenance under Order 200007801. |
| SW1381 | 30.09 | 30.2 | DB-PF-09302 | 4/14/2006 | Reference values established following maintenance under Order 200007816. |
| SW1382 | 10.38 | 10.45 | DB-PF-09302 | 3/8/2010 | Reference values established following maintenance under order 200354089 and ECP 08-0571. |
| SW1383 | 10.22 | 10.26 | DB-PF-09302 | 3/8/2010 | Reference values established following maintenance under order 200354090 and ECP 08-0571. |
| SW1395 | 30.68 | 31.08 | DB-PF-03027 | 5/8/2000 | Reference values established following maintenance under WO 98-000615-000. |
| SW1399 | 30.71 | 30.88 | DB-PF-03020 | 5/4/2000 | Reference values established following maintenance under WO 98-000656-000. |
| SW1424 | 4.78 | 26.23 | DB-PF-05061 | 9/6/2003 | Reference values established following implementation of ECR 03-0299 and Order 200036280. |
| SW1429 | 5.12 | 23.6 | DB-MI-05023 | 9/5/2003 | Reference values established following implementation of ECR 03-0299 and Order 200036281. |
| SW1434 | 4.79 | 25.49 | DB-PF-05061 | 9/10/2003 | Reference values established following implementation of ECR 03-0299. |
| SW2927 | 18.98 | 18.46 | DB-PF-03020 | 12/2/1998 | Reference values established following maintenance under MWO 3-98-0948-01 and based upon review of test data obtained on 12/2/98 under DB-PF-03020. |
| SW2928 | 18.27 | 17.26 | DB-PF-03027 | 5/4/2000 | Reference values established following maintenance under WO 99-005611-000 and based upon review of test data obtained on 5/4/00 under DB-PF-03027. |

## REFERENCE VALUE INFORMATION

| Valve | Reference Value Open | Reference Value Closed | Reference Test Procedure | Reference Test Date | Reference Comments |
|---|---|---|---|---|---|
| SW2929 | 59.35 | 59.55 | DB-PF-03272 | 3/31/2006 | Reference values established following maintenance under Order 200162373. |
| SW2930 | 50.44 | 50.68 | DB-PF-03272 | 3/30/2006 | Reference values established following maintenance under Order 200163414. |
| SW2931 | 56.33 | 56.58 | DB-PF-03272 | 3/31/2006 | Reference values established following maintenance under Order 200163415. |
| SW2932 | 51.41 | 51.49 | DB-PF-03027 | 10/21/1999 | Reference values established following maintenance under WO 99-004180-000. |
| SW5067 | 10.86 | 9.8 | DB-PF-03020 | 1/26/2000 | Reference values established following maintenance under WO 99-001844-000. |
| SW5068 | 19.34 | 18.78 | DB-PF-03027 | 5/4/2000 | Reference values established following maintenance under WO 99-004754-000 and based upon review of test data obtained on 5/4/00 under DB-PF-03027. |

## STROKE TIME LIMITING VALUES

| VALVE | REFERENCE | | TRM | | SFAS | | CIV | SFRCS | FIXED | | IST | | MAX ALLOWABLE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (O) | (C) | (O) | (C) | (O) | (C) | (C) | (C) | (O) | (C) | (O) | (C) | (O) | (C) |
| AF599 | 36.489 | 36.561 | | | | | | | | | 54.73 | 54.84 | 54.73 | 54.84 |
| AF608 | 36.606 | 36.757 | | | | | | | | | 54.9 | 55.13 | 54.9 | 55.13 |
| AF3869 | 33.92 | 34.27 | | | | | | | 40 | 40 | 50.88 | 51.4 | 40 | 40 |
| AF3870 | 19.375 | 19.918 | | | | | | | 40 | 40 | 29.06 | 29.87 | 29.06 | 29.87 |
| AF3871 | 33.54 | 33.8 | | | | | | | 40 | 40 | 50.31 | 50.7 | 40 | 40 |
| AF3872 | 26.68 | 27.22 | | | | | | | 40 | 40 | 40.02 | 40.83 | 40 | 40 |
| CC1328 | 22.2 | 22.08 | | 35 | | 24.5 | | | | | | 33.12 | | 24.5 |
| CC1338 | 22.25 | 22.51 | | 35 | | 24.53 | | | | | | 33.76 | | 24.53 |
| CC1407A | 8.23 | 8.36 | | 30 | | 19.65 | 15 | | | | | 12.54 | | 12.54 |
| CC1407B | 9.86 | 9.97 | | 30 | | 19.8 | 15 | | | | | 14.95 | | 14.95 |
| CC1411A | 9.87 | 9.88 | | 30 | | 19.65 | 15 | | | | | 14.82 | | 14.82 |
| CC1411B | 9.31 | 9.4 | | 30 | | 19.8 | 15 | | | | | 14.1 | | 14.1 |
| CC1460 | 3.46 | 4.33 | | 90 | | 85 | | | | | | 12.99 | | 12.99 |
| CC1467 | 30.36 | 13.98 | | | | | | | | | 60.72 | | 60.72 | |
| CC1469 | 32.52 | 12.29 | | | | | | | | | 65.04 | | 65.04 | |
| CC1495 | 14.28 | 24.42 | | 90 | | 85 | | | | | | 48.84 | | 48.84 |
| CC1567A | 9.63 | 9.01 | | 35 | | 19.36 | 15 | | | | | 13.51 | | 13.51 |
| CC1567B | 9.07 | 9.22 | | 35 | | 19.36 | 15 | | | | | 13.83 | | 13.83 |
| CC2645 | 60.33 | 60.56 | | | | | | | | | | 90.84 | | 90.84 |
| CC2649 | 61.42 | 61.23 | | | | | | | | | | 91.84 | | 91.84 |
| CC4100 | 12.41 | 12.57 | | | | | | | | | | 18.85 | | 18.85 |
| CC4200 | 12.26 | 12.31 | | | | | | | | | | 18.46 | | 18.46 |
| CC4300 | 12.79 | 13.05 | | | | | | | | | | 19.57 | | 19.57 |
| CC4400 | 13.6 | 13.74 | | | | | | | | | | 20.61 | | 20.61 |
| CC5095 | 102.77 | 102.86 | | | | | | | | | | 154.29 | | 154.29 |
| CC5096 | 101.79 | 101.2 | | | | | | | | | | 151.8 | | 151.8 |
| CC5097 | 57.06 | 57.53 | | | | | | | | | | 86.29 | | 86.29 |
| CC5098 | 59.4 | 59.36 | | | | | | | | | | 89.04 | | 89.04 |
| CF1541 | 4.14 | 3.56 | | 15 | | 10 | 10 | | | | | 10.68 | | 10 |
| CF1542 | 6.46 | 6.35 | | 15 | | 10 | 10 | | | | | 19.05 | | 10 |
| CF1544 | 4.18 | 3.96 | | 15 | | 10 | 10 | | | | | 11.88 | | 10 |
| CF1545 | 3.49 | 3.24 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| CS1530 | 18.793 | 19.02 | 80 | | 63.9 | | | | | | 28.18 | 28.53 | 28.18 | 28.53 |
| CS1531 | 20.741 | 20.838 | 80 | | 63.9 | | | | | | 31.11 | 31.25 | 31.11 | 31.25 |
| CV5004 | | | | 75 | | 70 | | | | | | | | 70 |
| CV5005 | 33.19 | 6.73 | | | | | | | | | | 20.19 | | 20.19 |
| CV5006 | 17.59 | 9.64 | | | | | | | | | | 28.92 | | 28.92 |
| CV5007 | 16.03 | 8.84 | | | | | | | | | | 26.52 | | 26.52 |
| CV5008 | 7.9 | 8.69 | | | | | | | | | | 26.07 | | 26.07 |
| CV5009 | | | | 75 | | 70 | | | | | | | | 70 |
| CV5010A | 9.93 | 10.03 | | 30 | | 14.52 | 15 | | | | 14.89 | 15.04 | 14.89 | 14.52 |

## STROKE TIME LIMITING VALUES

| VALVE | REFERENCE | | TRM | | SFAS | | CIV | SFRCS | FIXED | | IST | | MAX ALLOWABLE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (O) | (C) | (O) | (C) | (O) | (C) | (C) | (C) | (O) | (C) | (O) | (C) | (O) | (C) |
| CV5010B | 10.5 | 10.53 | | 30 | | 14.52 | 15 | | | | 15.75 | 15.79 | 15.75 | 14.52 |
| CV5010C | 9.87 | 9.88 | | 30 | | 14.52 | 15 | | | | 14.8 | 14.82 | 14.8 | 14.52 |
| CV5010D | 10.24 | 10.3 | | 30 | | 14.52 | 15 | | | | 15.36 | 15.45 | 15.36 | 14.52 |
| CV5010E | 10.15 | 10.33 | | 30 | | 14.52 | 15 | | | | 15.22 | 15.49 | 15.22 | 14.52 |
| CV5011A | 11.6 | 11.6 | | 30 | | 14.52 | 15 | | | | 17.4 | 17.4 | 17.4 | 14.52 |
| CV5011B | 10.84 | 10.81 | | 30 | | 14.52 | 15 | | | | 16.26 | 16.21 | 16.26 | 14.52 |
| CV5011C | 10.14 | 10.17 | | 30 | | 14.52 | 15 | | | | 15.21 | 15.25 | 15.21 | 14.52 |
| CV5011D | 9.94 | 10.15 | | 30 | | 14.52 | 15 | | | | 14.91 | 15.22 | 14.91 | 14.52 |
| CV5011E | 10.21 | 10.5 | | 30 | | 14.52 | 15 | | | | 15.31 | 15.75 | 15.31 | 14.52 |
| CV5016 | | | | 75 | | 70 | | | | | | | | 70 |
| CV5021 | | | | 75 | | 70 | | | | | | | | 70 |
| CV5024 | | | | 75 | | 60 | | | | | | | | 60 |
| CV5025 | | | | 75 | | 60 | | | | | | | | 60 |
| CV5037 | 48.54 | 48.5 | | 75 | | 58.9 | 60 | | | | 72.81 | 72.75 | 72.81 | 58.9 |
| CV5038 | 54.05 | 53.96 | | 75 | | 58.9 | 60 | | | | 81.07 | 80.94 | 81.07 | 58.9 |
| CV5065 | 56.12 | 56.19 | | 75 | | 58.9 | 60 | | | | 84.18 | 84.28 | 84.18 | 58.9 |
| CV5070 | 10.01 | 10.11 | | 30 | | 14.52 | 15 | | | | | 15.16 | | 14.52 |
| CV5071 | 9.62 | 9.63 | | 30 | | 14.52 | 15 | | | | | 14.44 | | 14.44 |
| CV5072 | 9.61 | 9.72 | | 30 | | 14.52 | 15 | | | | | 14.58 | | 14.52 |
| CV5073 | 9.9 | 10 | | 30 | | 14.52 | 15 | | | | | 15 | | 14.52 |
| CV5074 | 9.77 | 9.87 | | 30 | | 14.52 | 15 | | | | | 14.8 | | 14.52 |
| CV5075 | 9.57 | 9.59 | | 30 | | 14.52 | 15 | | | | | 14.38 | | 14.38 |
| CV5076 | 10.27 | 10.37 | | 30 | | 14.52 | 15 | | | | | 15.55 | | 14.52 |
| CV5077 | 10.43 | 10.43 | | 30 | | 14.52 | 15 | | | | | 15.64 | | 14.52 |
| CV5078 | 10.07 | 10.09 | | 30 | | 14.52 | 15 | | | | | 15.13 | | 14.52 |
| CV5079 | 10.43 | 10.42 | | 30 | | 14.52 | 15 | | | | | 15.63 | | 14.52 |
| CV5090 | 56.31 | 56.26 | | 75 | | 58.9 | 60 | | | | 84.46 | 84.39 | 84.46 | 58.9 |
| DH1A | 9.18 | 9.17 | | | | | | | | | 13.77 | 13.75 | 13.77 | 13.75 |
| DH1B | 9.007 | 8.061 | | | | | | | | | 13.51 | 12.09 | 13.51 | 12.09 |
| DH7A | 66 | 66.3 | | | | | | | | 75 | 99 | 99.45 | 99 | 75 |
| DH7B | 65.94 | 65.81 | | | | | | | | 75 | 98.91 | 98.71 | 98.91 | 75 |
| DH9A | 63.37 | 63.61 | | | | | 71 | | 75 | | 95.05 | 95.41 | 75 | 71 |
| DH9B | 65.52 | 64.47 | | | | | 71 | | 75 | | 98.28 | 96.7 | 75 | 71 |
| DH11 | 55.83 | 56.74 | | | | | | | | | 83.74 | 85.11 | 83.74 | 85.11 |
| DH12 | 59.56 | 59.78 | | | | | | | | | 89.34 | 89.67 | 89.34 | 89.67 |
| DH13A | 6.39 | 7.23 | | | | | | | | | | 21.69 | | 21.69 |
| DH13B | 7.88 | 11.08 | | | | | | | | | | 22.16 | | 22.16 |
| DH14A | 5.73 | 6.59 | | | | | | | | | 17.19 | | 17.19 | |
| DH14B | 5.13 | 6.55 | | | | | | | | | 15.39 | | 15.39 | |
| DH63 | 28.15 | 28.12 | | | | | | | | | 42.22 | 42.18 | 42.22 | 42.18 |
| DH64 | 12.74 | 12.86 | | | | | | | | | 19.11 | 19.29 | 19.11 | 19.29 |

## STROKE TIME LIMITING VALUES

| VALVE | REFERENCE | | TRM | | SFAS | | CIV | SFRCS | FIXED | | IST | | MAX ALLOWABLE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (O) | (C) | (O) | (C) | (O) | (C) | (C) | (C) | (O) | (C) | (O) | (C) | (O) | (C) |
| DH830 | 41.9 | 41.46 | | | | | | | | | | 62.19 | | 62.19 |
| DH831 | 38.71 | 37.63 | | | | | | | | | | 56.44 | | 56.44 |
| DH1517 | 15.5 | 16.22 | | | | | | | | | 23.25 | 24.33 | 23.25 | 24.33 |
| DH1518 | 14.21 | 14.14 | | | | | | | | | 21.31 | 21.21 | 21.31 | 21.21 |
| DH2733 | 111.91 | 112.34 | | | | | | | | | 167.86 | 168.51 | 167.86 | 168.51 |
| DH2734 | 112.48 | 112.06 | | | | | | | | | 168.72 | 168.09 | 168.72 | 168.09 |
| DH2735 | 16.47 | 16.39 | | | | | | | | | 24.7 | 24.58 | 24.7 | 24.58 |
| DH2736 | 39.75 | 39.8 | | | | | | | | | 59.62 | 59.7 | 59.62 | 59.7 |
| DR2012A | 8.04 | 8.24 | | 30 | | 19.25 | 15 | | | | | 12.36 | | 12.36 |
| DR2012B | 8.74 | 8.35 | | 30 | | 19.38 | 15 | | | | | 12.52 | | 12.52 |
| DW2643 | 4.81 | 5.9 | | | | | | | | | | 17.7 | | 17.7 |
| DW6831A | 7.62 | 1.42 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| DW6831B | 9.42 | 1.56 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| FW601 | 13.2 | 14.1 | | 16 | | | | 15 | | | | 21.15 | | 15 |
| FW612 | 12.09 | 13.11 | | 16 | | | | 15 | | | | 19.66 | | 15 |
| HA5439 | 56.21 | 56.24 | | 75 | | 60 | | | | | | | | 60 |
| HA5440 | 55.15 | 55.03 | | 75 | | 60 | | | | | | | | 60 |
| HA5441 | 54.89 | 55.05 | | 75 | | 60 | | | | | | | | 60 |
| HA5442 | 58.4 | 58.36 | | 75 | | 60 | | | | | | | | 60 |
| HA5715A | | | | 75 | | 70 | | | | | | | | 70 |
| HA5715B | | | | 75 | | 70 | | | | | | | | 70 |
| HA5716A | | | | 75 | | 70 | | | | | | | | 70 |
| HA5716B | | | | 75 | | 70 | | | | | | | | 70 |
| HP2A | 8.53 | 8.7 | 30 | | 13.5 | | | | | | 12.79 | 13.05 | 12.79 | 13.05 |
| HP2B | 9.06 | 9.12 | 30 | | 13.45 | | | | | | 13.59 | 13.68 | 13.45 | 13.68 |
| HP2C | 8.87 | 8.97 | 30 | | 13.5 | | | | | | 13.3 | 13.45 | 13.3 | 13.45 |
| HP2D | 8.82 | 8.34 | 30 | | 13.5 | | | | | | 13.23 | 12.51 | 13.23 | 12.51 |
| HP31 | 28.94 | 27.59 | | | | | | | | | | 41.38 | | 41.38 |
| HP32 | 28.55 | 28.45 | | | | | | | | | | 42.67 | | 42.67 |
| IA2011 | 2.58 | 2.42 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| ICS11A | 8 | 4.94 | | | | | | | | | 24 | 14.82 | 24 | 14.82 |
| ICS11B | 8.75 | 5.72 | | | | | | | | | 26.25 | 17.16 | 26.25 | 17.16 |
| MS100 | 0 | 4.3 | | 6 | | | | 5 | | | | 12.9 | | 5 |
| MS100-1 | 4.58 | 19.18 | | | | | | | | | | 38.36 | | 38.36 |
| MS101 | 0 | 4.4 | | 6 | | | | 5 | | | | 13.2 | | 5 |
| MS101-1 | 4.24 | 19.95 | | | | | | | | | | 39.9 | | 39.9 |
| MS106 | 17.956 | 18.03 | | | | | | | 40 | 40 | 26.93 | 27.04 | 26.93 | 27.04 |
| MS106A | 29.286 | 29.469 | | | | | | | 40 | 40 | 43.92 | 44.2 | 40 | 40 |
| MS107 | 28.183 | 28.377 | | | | | | | 40 | 40 | 42.27 | 42.56 | 40 | 40 |
| MS107A | 26.76 | 26.912 | | | | | | | 40 | 40 | 40.14 | 40.36 | 40 | 40 |
| MS375 | 4.66 | 7.6 | | | | | | | | | | 22.8 | | 22.8 |

## STROKE TIME LIMITING VALUES

| VALVE | REFERENCE | | TRM | | SFAS | | CIV | SFRCS | FIXED | | IST | | MAX ALLOWABLE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (O) | (C) | (O) | (C) | (O) | (C) | (C) | (C) | (O) | (C) | (O) | (C) | (O) | (C) |
| MS394 | 6 | 7.48 | | | | | | | | | | 22.44 | | 22.44 |
| MS603 | 61.24 | 61.55 | | | | | | | | | | 92.32 | | 92.32 |
| MS611 | 60.19 | 60.52 | | | | | | | | | | 90.78 | | 90.78 |
| MS5889A | 34.23 | 6.54 | | | | | | | 42 | | 68.46 | | 42 | |
| MS5889B | 36.56 | 5.46 | | | | | | | 46 | | 73.12 | | 46 | |
| MU1A | 9.26 | 9.59 | | | | | | | | | | 14.38 | | 14.38 |
| MU1B | 9.21 | 9.3 | | | | | | | | | | 13.95 | | 13.95 |
| MU2A | 9.76 | 9.86 | | 30 | | 14.52 | 15 | | | | | 14.79 | | 14.52 |
| MU2B | 9.63 | 9.79 | | | | | | | | | | 14.68 | | 14.68 |
| MU3 | 4.12 | 4.88 | | 30 | | 25 | 10 | | | | | 14.64 | | 10 |
| MU38 | 1.16 | 0.7 | | 45 | | 40 | 12 | | | 2 | | | | 2 |
| MU59A | 15.81 | 15.96 | | 45 | | 29.15 | 30 | | | | | 23.94 | | 23.94 |
| MU59B | 15.18 | 15.25 | | 45 | | 29.15 | 30 | | | | | 22.87 | | 22.87 |
| MU59C | 14.13 | 14.24 | | 45 | | 29.15 | 30 | | | | | 21.36 | | 21.36 |
| MU59D | 15.77 | 15.9 | | 45 | | 29.15 | 30 | | | | | 23.85 | | 23.85 |
| MU66A | 2.84 | 1.67 | | 17 | | 12 | 12 | | | | | 10 | | 10 |
| MU66B | 4.15 | 2.95 | | 17 | | 12 | 12 | | | | | 10 | | 10 |
| MU66C | 3.46 | 2.67 | | 17 | | 12 | 12 | | | | | 10 | | 10 |
| MU66D | 4.01 | 2.94 | | 17 | | 12 | 12 | | | | | 10 | | 10 |
| MU3971 | 15.97 | 16.09 | | | | | | | | | | 24.13 | | 24.13 |
| MU6405 | 15.54 | 15.56 | | | | | | | | | | 23.34 | | 23.34 |
| MU6421 | 14.05 | 13.65 | | | | | | | | | | 20.47 | | 20.47 |
| MU6422 | 13.17 | 13.25 | | | | | | | | | | 19.87 | | 19.87 |
| NN236 | 3.87 | 2.49 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| RC2A | 0.48 | 0.38 | | | | | | | 2 | 2 | | | 2 | 2 |
| RC10 | 11.29 | 11.37 | | | | | | | | | | 17.05 | | 17.05 |
| RC11 | 17.27 | 17.4 | | | | | | | | | 25.9 | 26.1 | 25.9 | 26.1 |
| RC200 | 10.95 | 10.87 | | | | | | | | | 16.42 | 16.3 | 16.42 | 16.3 |
| RC229A | 10 | 2.74 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| RC229B | 7.21 | 1.56 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| RC232 | 8.86 | 4.83 | | 15 | | 10 | 10 | | | | | 14.49 | | 10 |
| RC239A | 12.94 | 13.03 | | | | | | | | | 19.41 | 19.54 | 19.41 | 19.54 |
| RC240A | 12.08 | 12 | | 45 | | 29.15 | 30 | | | | 18.12 | 18 | 18.12 | 18 |
| RC240B | 12.01 | 11.93 | | 45 | | 29.15 | 30 | | | | | 17.89 | | 17.89 |
| RC1719A | 4.45 | 2.87 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| RC1719B | 6.41 | 4.15 | | 15 | | 10 | 10 | | | | | 12.45 | | 10 |
| RC1773A | 3.12 | 1.67 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| RC1773B | 3.3 | 2 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| RC4608A | 0.94 | 0.61 | | | | | | | 2 | 2 | | | 2 | 2 |
| RC4608B | 0.54 | 0.33 | | | | | | | 2 | 2 | | | 2 | 2 |
| RC4610A | 0.47 | 0.35 | | | | | | | 2 | 2 | | | 2 | 2 |

## STROKE TIME LIMITING VALUES

| VALVE | REFERENCE | | TRM | | SFAS | | CIV | SFRCS | FIXED | | IST | | MAX ALLOWABLE | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (O) | (C) | (O) | (C) | (O) | (C) | (C) | (C) | (O) | (C) | (O) | (C) | (O) | (C) |
| RC4610B | 0.24 | 0.24 | | | | | | | 2 | 2 | | | 2 | 2 |
| SA2010 | 2.98 | 4.44 | | 15 | | 10 | 10 | | | | | 13.32 | | 10 |
| SP6A | | 5.96 | | 8 | | | | 7 | | | | | | 7 |
| SP6B | | 6 | | 8 | | | | 7 | | | | | | 7 |
| SP7A | | 3.96 | | 13 | | | | 12 | | | | | | 12 |
| SP7B | | 3 | | 13 | | | | 12 | | | | | | 12 |
| SS235A | 2.47 | 2.87 | | 35 | | 30 | 30 | | | | | 10 | | 10 |
| SS235B | 1.18 | 0.63 | | 35 | | 30 | 30 | | | 2 | | | | 2 |
| SS598 | 2.12 | 4.24 | | 15 | | 10 | 10 | | | | | 12.72 | | 10 |
| SS607 | 2.96 | 2.97 | | 15 | | 10 | 10 | | | | | 10 | | 10 |
| SW1356 | 5.29 | 6.99 | | | | | | | 10 | | 15.87 | 20.97 | 10 | 20.97 |
| SW1357 | 3.87 | 8.107 | | | | | | | 10 | | 11.61 | 24.32 | 10 | 24.32 |
| SW1358 | 4 | 6.26 | | | | | | | 10 | | 12 | 18.78 | 10 | 18.78 |
| SW1366 | 20.1 | 20.1 | | | | | | | | | 30.15 | 30.15 | 30.15 | 30.15 |
| SW1367 | 19.24 | 19.26 | | | | | | | | | 28.86 | 28.89 | 28.86 | 28.89 |
| SW1368 | 19.43 | 19.41 | | | | | | | | | 29.14 | 29.11 | 29.14 | 29.11 |
| SW1379 | 29.84 | 29.96 | | | | | | | | | 44.76 | 44.94 | 44.76 | 44.94 |
| SW1380 | 27.89 | 28.05 | | | | | | | | | 41.83 | 42.07 | 41.83 | 42.07 |
| SW1381 | 30.09 | 30.2 | | | | | | | | | 45.13 | 45.3 | 45.13 | 45.3 |
| SW1382 | 10.38 | 10.45 | | | | | | | 13 | | 15.57 | | 13 | |
| SW1383 | 10.22 | 10.26 | | | | | | | 13 | | 15.33 | | 13 | |
| SW1395 | 30.68 | 31.08 | | 45 | | 34.15 | | | | | | 46.62 | | 34.15 |
| SW1399 | 30.71 | 30.88 | | 45 | | 34 | | | | | | 46.32 | | 34 |
| SW1424 | 4.78 | 26.23 | | | | | | | | | 14.34 | | 14.34 | |
| SW1429 | 5.12 | 23.6 | | | | | | | | | 15.36 | | 15.36 | |
| SW1434 | 4.79 | 25.49 | | | | | | | | | 14.37 | | 14.37 | |
| SW2927 | 18.98 | 18.46 | | | | | | | | | 28.47 | | 28.47 | |
| SW2928 | 18.27 | 17.26 | | | | | | | | | 27.4 | | 27.4 | |
| SW2929 | 59.35 | 59.55 | | | | | | | | | 89.02 | 89.32 | 89.02 | 89.32 |
| SW2930 | 50.44 | 50.68 | | | | | | | | | 75.66 | 76.02 | 75.66 | 76.02 |
| SW2931 | 56.33 | 56.58 | | | | | | | | | | 84.87 | | 84.87 |
| SW2932 | 51.41 | 51.49 | | | | | | | | | | 77.23 | | 77.23 |
| SW5067 | 10.86 | 9.8 | | | | | | | | | 16.29 | | 16.29 | |
| SW5068 | 19.34 | 18.78 | | | | | | | | | 29.01 | | 29.01 | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **AF599** | MOV | Open | 36.489 | 31.02 - 41.96 | **54.73** | |
| | | Closed | 36.561 | 31.08 - 42.04 | **54.84** | |
| **AF608** | MOV | Open | 36.606 | 31.12 - 42.09 | **54.9** | |
| | | Closed | 36.757 | 31.25 - 42.27 | **55.13** | |
| **AF3869** | MOV | Open | 33.92 | 28.84 - 39 | **40** | |
| | | Closed | 34.27 | 29.13 - 39.41 | **40** | |
| **AF3870** | MOV | Open | 19.375 | 16.47 - 22.28 | **29.06** | |
| | | Closed | 19.918 | 16.94 - 22.9 | **29.87** | |
| **AF3871** | MOV | Open | 33.54 | 28.51 - 38.57 | **40** | |
| | | Closed | 33.8 | 28.73 - 38.87 | **40** | |
| **AF3872** | MOV | Open | 26.68 | 22.68 - 30.68 | **40** | |
| | | Closed | 27.22 | 23.14 - 31.3 | **40** | |
| **CC1328** | MOV | Open | 22.2 | | | |
| | | Closed | 22.08 | 18.77 - 24.5 | **24.5** | |
| **CC1338** | MOV | Open | 22.25 | | | |
| | | Closed | 22.51 | 19.14 - 24.53 | **24.53** | |
| **CC1407A** | MOV | Open | 8.23 | | | |
| | | Closed | 8.36 | 6.27 - 10.45 | **12.54** | |
| **CC1407B** | MOV | Open | 9.86 | | | |
| | | Closed | 9.97 | 7.48 - 12.46 | **14.95** | |
| **CC1411A** | MOV | Open | 9.87 | | | |
| | | Closed | 9.88 | 7.41 - 12.35 | **14.82** | |
| **CC1411B** | MOV | Open | 9.31 | | | |
| | | Closed | 9.4 | 7.05 - 11.75 | **14.1** | |
| **CC1460** | AOV | Open | 3.46 | | | |
| | | Closed | 4.33 | 2.17 - 6.49 | **12.99** | Fail position closed. |
| **CC1467** | AOV | Open | 30.36 | 22.77 - 37.95 | **60.72** | Fail position open. |
| | | Closed | 13.98 | | | |
| **CC1469** | AOV | Open | 32.52 | 24.39 - 40.65 | **65.04** | Fail position open. |
| | | Closed | 12.29 | | | |
| **CC1495** | AOV | Open | 14.28 | | | |
| | | Closed | 24.42 | 18.32 - 30.52 | **48.84** | Fail position closed. |
| **CC1567A** | MOV | Open | 9.63 | | | |
| | | Closed | 9.01 | 6.76 - 11.26 | **13.51** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **CC1567B** | MOV | Open | 9.07 | | | |
| | | Closed | 9.22 | 6.92 - 11.52 | **13.83** | |
| **CC2645** | MOV | Open | 60.33 | | | |
| | | Closed | 60.56 | 51.48 - 69.64 | **90.84** | |
| **CC2649** | MOV | Open | 61.42 | | | |
| | | Closed | 61.23 | 52.05 - 70.41 | **91.84** | |
| **CC4100** | MOV | Open | 12.41 | | | |
| | | Closed | 12.57 | 10.69 - 14.45 | **18.85** | |
| **CC4200** | MOV | Open | 12.26 | | | |
| | | Closed | 12.31 | 10.47 - 14.15 | **18.46** | |
| **CC4300** | MOV | Open | 12.79 | | | |
| | | Closed | 13.05 | 11.1 - 15 | **19.57** | |
| **CC4400** | MOV | Open | 13.6 | | | |
| | | Closed | 13.74 | 11.68 - 15.8 | **20.61** | |
| **CC5095** | MOV | Open | 102.77 | | | |
| | | Closed | 102.86 | 87.44 - 118.28 | **154.29** | |
| **CC5096** | MOV | Open | 101.79 | | | |
| | | Closed | 101.2 | 86.02 - 116.38 | **151.8** | |
| **CC5097** | MOV | Open | 57.06 | | | |
| | | Closed | 57.53 | 48.91 - 66.15 | **86.29** | |
| **CC5098** | MOV | Open | 59.4 | | | |
| | | Closed | 59.36 | 50.46 - 68.26 | **89.04** | |
| **CF1541** | AOV | Open | 4.14 | | | |
| | | Closed | 3.56 | 1.78 - 5.34 | **10** | Fail position closed. |
| **CF1542** | AOV | Open | 6.46 | | | |
| | | Closed | 6.35 | 3.18 - 9.52 | **10** | Fail position closed. |
| **CF1544** | AOV | Open | 4.18 | | | |
| | | Closed | 3.96 | 1.98 - 5.94 | **10** | Fail position closed. |
| **CF1545** | AOV | Open | 3.49 | | | |
| | | Closed | 3.24 | 1.62 - 4.86 | **10** | Fail position closed. |
| **CS1530** | MOV | Open | 18.793 | 15.98 - 21.61 | **28.18** | |
| | | Closed | 19.02 | 16.17 - 21.87 | **28.53** | |
| **CS1531** | MOV | Open | 20.741 | 17.63 - 23.85 | **31.11** | |
| | | Closed | 20.838 | 17.72 - 23.96 | **31.25** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | | Reference Times | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **CV5004** | AOV | Open | | | | |
| | | Closed | | | **70** | Fail position closed. |
| **CV5005** | AOV | Open | 33.19 | | | |
| | | Closed | 6.73 | 3.37 - 10.09 | **20.19** | Fail position closed. |
| **CV5006** | AOV | Open | 17.59 | | | |
| | | Closed | 9.64 | 4.82 - 14.46 | **28.92** | Fail position closed. |
| **CV5007** | AOV | Open | 16.03 | | | |
| | | Closed | 8.84 | 4.42 - 13.26 | **26.52** | Fail position closed. |
| **CV5008** | AOV | Open | 7.9 | | | |
| | | Closed | 8.69 | 4.35 - 13.03 | **26.07** | Fail position closed. |
| **CV5009** | AOV | Open | | | | |
| | | Closed | | | **70** | Fail position closed. |
| **CV5010A** | MOV | Open | 9.93 | 7.45 - 12.41 | **14.89** | |
| | | Closed | 10.03 | 8.53 - 11.53 | **14.52** | |
| **CV5010B** | MOV | Open | 10.5 | 8.93 - 12.07 | **15.75** | |
| | | Closed | 10.53 | 8.96 - 12.1 | **14.52** | |
| **CV5010C** | MOV | Open | 9.87 | 7.41 - 12.33 | **14.8** | |
| | | Closed | 9.88 | 7.41 - 12.35 | **14.52** | |
| **CV5010D** | MOV | Open | 10.24 | 8.71 - 11.77 | **15.36** | |
| | | Closed | 10.3 | 8.76 - 11.84 | **14.52** | |
| **CV5010E** | MOV | Open | 10.15 | 8.63 - 11.67 | **15.22** | |
| | | Closed | 10.33 | 8.79 - 11.87 | **14.52** | |
| **CV5011A** | MOV | Open | 11.6 | 9.86 - 13.34 | **17.4** | |
| | | Closed | 11.6 | 9.86 - 13.34 | **14.52** | |
| **CV5011B** | MOV | Open | 10.84 | 9.22 - 12.46 | **16.26** | |
| | | Closed | 10.81 | 9.19 - 12.43 | **14.52** | |
| **CV5011C** | MOV | Open | 10.14 | 8.62 - 11.66 | **15.21** | |
| | | Closed | 10.17 | 8.65 - 11.69 | **14.52** | |
| **CV5011D** | MOV | Open | 9.94 | 7.46 - 12.42 | **14.91** | |
| | | Closed | 10.15 | 8.63 - 11.67 | **14.52** | |
| **CV5011E** | MOV | Open | 10.21 | 8.68 - 11.74 | **15.31** | |
| | | Closed | 10.5 | 8.93 - 12.07 | **14.52** | |
| **CV5016** | AOV | Open | | | | |
| | | Closed | | | **70** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | | Reference Times | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **CV5021** | AOV | Open | | | | |
| | | Closed | | | **70** | |
| **CV5024** | MOV | Open | | | | |
| | | Closed | | | **60** | |
| **CV5025** | MOV | Open | | | | |
| | | Closed | | | **60** | |
| **CV5037** | MOV | Open | 48.54 | 41.26 - 55.82 | **72.81** | |
| | | Closed | 48.5 | 41.23 - 55.77 | **58.9** | |
| **CV5038** | MOV | Open | 54.05 | 45.95 - 62.15 | **81.07** | |
| | | Closed | 53.96 | 45.87 - 58.9 | **58.9** | |
| **CV5065** | MOV | Open | 56.12 | 47.71 - 64.53 | **84.18** | |
| | | Closed | 56.19 | 47.77 - 58.9 | **58.9** | |
| **CV5070** | MOV | Open | 10.01 | | | |
| | | Closed | 10.11 | 8.6 - 11.62 | **14.52** | |
| **CV5071** | MOV | Open | 9.62 | | | |
| | | Closed | 9.63 | 7.23 - 12.03 | **14.44** | |
| **CV5072** | MOV | Open | 9.61 | | | |
| | | Closed | 9.72 | 7.29 - 12.15 | **14.52** | |
| **CV5073** | MOV | Open | 9.9 | | | |
| | | Closed | 10 | 7.5 - 12.5 | **14.52** | |
| **CV5074** | MOV | Open | 9.77 | | | |
| | | Closed | 9.87 | 7.41 - 12.33 | **14.52** | |
| **CV5075** | MOV | Open | 9.57 | | | |
| | | Closed | 9.59 | 7.2 - 11.98 | **14.38** | |
| **CV5076** | MOV | Open | 10.27 | | | |
| | | Closed | 10.37 | 8.82 - 11.92 | **14.52** | |
| **CV5077** | MOV | Open | 10.43 | | | |
| | | Closed | 10.43 | 8.87 - 11.99 | **14.52** | |
| **CV5078** | MOV | Open | 10.07 | | | |
| | | Closed | 10.09 | 8.58 - 11.6 | **14.52** | |
| **CV5079** | MOV | Open | 10.43 | | | |
| | | Closed | 10.42 | 8.86 - 11.98 | **14.52** | |
| **CV5090** | MOV | Open | 56.31 | 47.87 - 64.75 | **84.46** | |
| | | Closed | 56.26 | 47.83 - 58.9 | **58.9** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **DH1A** | MOV | Open | 9.18 | 6.89 - 11.47 | **13.77** | |
| | | Closed | 9.17 | 6.88 - 11.46 | **13.75** | |
| **DH1B** | MOV | Open | 9.007 | 6.76 - 11.25 | **13.51** | |
| | | Closed | 8.061 | 6.05 - 10.07 | **12.09** | |
| **DH7A** | MOV | Open | 66 | 56.1 - 75.9 | **99** | |
| | | Closed | 66.3 | 56.36 - 75 | **75** | |
| **DH7B** | MOV | Open | 65.94 | 56.05 - 75.83 | **98.91** | |
| | | Closed | 65.81 | 55.94 - 75 | **75** | |
| **DH9A** | MOV | Open | 63.37 | 53.87 - 72.87 | **75** | |
| | | Closed | 63.61 | 54.07 - 71 | **71** | |
| **DH9B** | MOV | Open | 65.52 | 55.7 - 75 | **75** | |
| | | Closed | 64.47 | 54.8 - 71 | **71** | |
| **DH11** | MOV | Open | 55.83 | 47.46 - 64.2 | **83.74** | |
| | | Closed | 56.74 | 48.23 - 65.25 | **85.11** | |
| **DH12** | MOV | Open | 59.56 | 50.63 - 68.49 | **89.34** | |
| | | Closed | 59.78 | 50.82 - 68.74 | **89.67** | |
| **DH13A** | AOV | Open | 6.39 | | | |
| | | Closed | 7.23 | 3.62 - 10.84 | **21.69** | Fail position closed. |
| **DH13B** | AOV | Open | 7.88 | | | |
| | | Closed | 11.08 | 8.31 - 13.85 | **22.16** | Fail position closed. |
| **DH14A** | AOV | Open | 5.73 | 2.87 - 8.59 | **17.19** | Fail position open. |
| | | Closed | 6.59 | | | |
| **DH14B** | AOV | Open | 5.13 | 2.57 - 7.69 | **15.39** | Fail position open. |
| | | Closed | 6.55 | | | |
| **DH63** | MOV | Open | 28.15 | 23.93 - 32.37 | **42.22** | |
| | | Closed | 28.12 | 23.91 - 32.33 | **42.18** | |
| **DH64** | MOV | Open | 12.74 | 10.83 - 14.65 | **19.11** | |
| | | Closed | 12.86 | 10.94 - 14.78 | **19.29** | |
| **DH830** | MOV | Open | 41.9 | | | |
| | | Closed | 41.46 | 35.25 - 47.67 | **62.19** | |
| **DH831** | MOV | Open | 38.71 | | | |
| | | Closed | 37.63 | 31.99 - 43.27 | **56.44** | |
| **DH1517** | MOV | Open | 15.5 | 13.18 - 17.82 | **23.25** | |
| | | Closed | 16.22 | 13.79 - 18.65 | **24.33** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **DH1518** | MOV | Open | 14.21 | 12.08 - 16.34 | **21.31** | |
| | | Closed | 14.14 | 12.02 - 16.26 | **21.21** | |
| **DH2733** | MOV | Open | 111.91 | 95.13 - 128.69 | **167.86** | |
| | | Closed | 112.34 | 95.49 - 129.19 | **168.51** | |
| **DH2734** | MOV | Open | 112.48 | 95.61 - 129.35 | **168.72** | |
| | | Closed | 112.06 | 95.26 - 128.86 | **168.09** | |
| **DH2735** | MOV | Open | 16.47 | 14 - 18.94 | **24.7** | |
| | | Closed | 16.39 | 13.94 - 18.84 | **24.58** | |
| **DH2736** | MOV | Open | 39.75 | 33.79 - 45.71 | **59.62** | |
| | | Closed | 39.8 | 33.83 - 45.77 | **59.7** | |
| **DR2012A** | MOV | Open | 8.04 | | | |
| | | Closed | 8.24 | 6.18 - 10.3 | **12.36** | |
| **DR2012B** | MOV | Open | 8.74 | | | |
| | | Closed | 8.35 | 6.27 - 10.43 | **12.52** | |
| **DW2643** | AOV | Open | 4.81 | | | |
| | | Closed | 5.9 | 2.95 - 8.85 | **17.7** | Fail position closed. |
| **DW6831A** | AOV | Open | 7.62 | | | |
| | | Closed | 1.42 | 0.71 - 2.13 | **10** | Fail position closed. |
| **DW6831B** | AOV | Open | 9.42 | | | |
| | | Closed | 1.56 | 0.78 - 2.34 | **10** | Fail position closed. |
| **FW601** | MOV | Open | 13.2 | | | |
| | | Closed | 14.1 | 11.99 - 15 | **15** | |
| **FW612** | MOV | Open | 12.09 | | | |
| | | Closed | 13.11 | 11.15 - 15 | **15** | |
| **HA5439** | MOV | Open | 56.21 | | | |
| | | Closed | 56.24 | | **60** | |
| **HA5440** | MOV | Open | 55.15 | | | |
| | | Closed | 55.03 | | **60** | |
| **HA5441** | MOV | Open | 54.89 | | | |
| | | Closed | 55.05 | | **60** | |
| **HA5442** | MOV | Open | 58.4 | | | |
| | | Closed | 58.36 | | **60** | |
| **HA5715A** | AOV | Open | | | | |
| | | Closed | | | **70** | Fail position closed. |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | | Reference Times | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **HA5715B** | AOV | Open | | | | |
| | | Closed | | | **70** | Fail position closed. |
| **HA5716A** | AOV | Open | | | | |
| | | Closed | | | **70** | Fail position closed. |
| **HA5716B** | AOV | Open | | | | |
| | | Closed | | | **70** | Fail position closed. |
| **HP2A** | MOV | Open | 8.53 | 6.4 - 10.66 | **12.79** | |
| | | Closed | 8.7 | 6.53 - 10.87 | **13.05** | |
| **HP2B** | MOV | Open | 9.06 | 6.8 - 11.32 | **13.45** | |
| | | Closed | 9.12 | 6.84 - 11.4 | **13.68** | |
| **HP2C** | MOV | Open | 8.87 | 6.66 - 11.08 | **13.3** | |
| | | Closed | 8.97 | 6.73 - 11.21 | **13.45** | |
| **HP2D** | MOV | Open | 8.82 | 6.62 - 11.02 | **13.23** | |
| | | Closed | 8.34 | 6.26 - 10.42 | **12.51** | |
| **HP31** | MOV | Open | 28.94 | | | |
| | | Closed | 27.59 | 23.46 - 31.72 | **41.38** | |
| **HP32** | MOV | Open | 28.55 | | | |
| | | Closed | 28.45 | 24.19 - 32.71 | **42.67** | |
| **IA2011** | AOV | Open | 2.58 | | | |
| | | Closed | 2.42 | 1.21 - 3.63 | **10** | Fail position closed. |
| **ICS11A** | AOV | Open | 8 | 4 - 12 | **24** | |
| | | Closed | 4.94 | 2.47 - 7.41 | **14.82** | Fail position closed. |
| **ICS11B** | AOV | Open | 8.75 | 4.38 - 13.12 | **26.25** | |
| | | Closed | 5.72 | 2.86 - 8.58 | **17.16** | Fail position closed. |
| **MS100** | AOV | Open | 0 | | | Values valid in Mode 4 |
| | | Closed | 4.3 | 2.15 - 5 | **5** | only. Fail position closed. |
| **MS100-1** | AOV | Open | 4.58 | | | |
| | | Closed | 19.18 | 14.39 - 23.97 | **38.36** | Fail position closed. |
| **MS101** | AOV | Open | 0 | | | Values valid in Mode 4 |
| | | Closed | 4.4 | 2.2 - 5 | **5** | only. Fail position closed. |
| **MS101-1** | AOV | Open | 4.24 | | | |
| | | Closed | 19.95 | 14.97 - 24.93 | **39.9** | Fail position closed. |
| **MS106** | MOV | Open | 17.956 | 15.27 - 20.64 | **26.93** | |
| | | Closed | 18.03 | 15.33 - 20.73 | **27.04** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **MS106A** | MOV | Open | 29.286 | 24.9 - 33.67 | **40** | |
| | | Closed | 29.469 | 25.05 - 33.88 | **40** | |
| **MS107** | MOV | Open | 28.183 | 23.96 - 32.41 | **40** | |
| | | Closed | 28.377 | 24.13 - 32.63 | **40** | |
| **MS107A** | MOV | Open | 26.76 | 22.75 - 30.77 | **40** | |
| | | Closed | 26.912 | 22.88 - 30.94 | **40** | |
| **MS375** | AOV | Open | 4.66 | | | |
| | | Closed | 7.6 | 3.8 - 11.4 | **22.8** | Fail position closed. |
| **MS394** | AOV | Open | 6 | | | |
| | | Closed | 7.48 | 3.74 - 11.22 | **22.44** | Fail position closed. |
| **MS603** | MOV | Open | 61.24 | | | |
| | | Closed | 61.55 | 52.32 - 70.78 | **92.32** | |
| **MS611** | MOV | Open | 60.19 | | | |
| | | Closed | 60.52 | 51.45 - 69.59 | **90.78** | |
| **MS5889A** | AOV | Open | 34.23 | 25.68 - 42 | **42** | Fail position open. |
| | | Closed | 6.54 | | | |
| **MS5889B** | AOV | Open | 36.56 | 27.42 - 45.7 | **46** | Fail position open. |
| | | Closed | 5.46 | | | |
| **MU1A** | MOV | Open | 9.26 | | | |
| | | Closed | 9.59 | 7.2 - 11.98 | **14.38** | |
| **MU1B** | MOV | Open | 9.21 | | | |
| | | Closed | 9.3 | 6.98 - 11.62 | **13.95** | |
| **MU2A** | MOV | Open | 9.76 | | | |
| | | Closed | 9.86 | 7.4 - 12.32 | **14.52** | |
| **MU2B** | MOV | Open | 9.63 | | | |
| | | Closed | 9.79 | 7.35 - 12.23 | **14.68** | |
| **MU3** | AOV | Open | 4.12 | | | |
| | | Closed | 4.88 | 2.44 - 7.32 | **10** | Fail position closed. |
| **MU38** | AOV | Open | 1.16 | | | |
| | | Closed | 0.7 | | **2** | Fail position closed. |
| **MU59A** | MOV | Open | 15.81 | | | |
| | | Closed | 15.96 | 13.57 - 18.35 | **23.94** | |
| **MU59B** | MOV | Open | 15.18 | | | |
| | | Closed | 15.25 | 12.97 - 17.53 | **22.87** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **MU59C** | MOV | Open | 14.13 | | | |
| | | Closed | 14.24 | 12.11 - 16.37 | **21.36** | |
| **MU59D** | MOV | Open | 15.77 | | | |
| | | Closed | 15.9 | 13.52 - 18.28 | **23.85** | |
| **MU66A** | AOV | Open | 2.84 | | | |
| | | Closed | 1.67 | 0.84 - 2.5 | **10** | Fail position closed. |
| **MU66B** | AOV | Open | 4.15 | | | |
| | | Closed | 2.95 | 1.48 - 4.42 | **10** | Fail position closed. |
| **MU66C** | AOV | Open | 3.46 | | | |
| | | Closed | 2.67 | 1.34 - 4 | **10** | Fail position closed. |
| **MU66D** | AOV | Open | 4.01 | | | |
| | | Closed | 2.94 | 1.47 - 4.41 | **10** | Fail position closed. |
| **MU3971** | MOV | Open | 15.97 | | | |
| | | Closed | 16.09 | 13.68 - 18.5 | **24.13** | |
| **MU6405** | MOV | Open | 15.54 | | | |
| | | Closed | 15.56 | 13.23 - 17.89 | **23.34** | |
| **MU6421** | MOV | Open | 14.05 | | | |
| | | Closed | 13.65 | 11.61 - 15.69 | **20.47** | |
| **MU6422** | MOV | Open | 13.17 | | | |
| | | Closed | 13.25 | 11.27 - 15.23 | **19.87** | |
| **NN236** | AOV | Open | 3.87 | | | |
| | | Closed | 2.49 | 1.25 - 3.73 | **10** | Fail position closed. |
| **RC2A** | PORV | Open | 0.48 | | **2** | |
| | | Closed | 0.38 | | **2** | Fail position closed. |
| **RC10** | MOV | Open | 11.29 | | | |
| | | Closed | 11.37 | 9.67 - 13.07 | **17.05** | |
| **RC11** | MOV | Open | 17.27 | 14.68 - 19.86 | **25.9** | |
| | | Closed | 17.4 | 14.79 - 20.01 | **26.1** | |
| **RC200** | MOV | Open | 10.95 | 9.31 - 12.59 | **16.42** | |
| | | Closed | 10.87 | 9.24 - 12.5 | **16.3** | |
| **RC229A** | AOV | Open | 10 | | | |
| | | Closed | 2.74 | 1.37 - 4.11 | **10** | Fail position closed. |
| **RC229B** | AOV | Open | 7.21 | | | |
| | | Closed | 1.56 | 0.78 - 2.34 | **10** | Fail position closed. |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **RC232** | AOV | Open | 8.86 | | | |
| | | Closed | 4.83 | 2.42 - 7.24 | **10** | Fail position closed. |
| **RC239A** | MOV | Open | 12.94 | 11 - 14.88 | **19.41** | |
| | | Closed | 13.03 | 11.08 - 14.98 | **19.54** | |
| **RC240A** | MOV | Open | 12.08 | | **18.12** | |
| | | Closed | 12 | 10.2 - 13.8 | **18** | |
| **RC240B** | MOV | Open | 12.01 | | | |
| | | Closed | 11.93 | 10.15 - 13.71 | **17.89** | |
| **RC1719A** | AOV | Open | 4.45 | | | |
| | | Closed | 2.87 | 1.44 - 4.3 | **10** | Fail position closed. |
| **RC1719B** | AOV | Open | 6.41 | | | |
| | | Closed | 4.15 | 2.08 - 6.22 | **10** | Fail position closed. |
| **RC1773A** | AOV | Open | 3.12 | | | |
| | | Closed | 1.67 | 0.84 - 2.5 | **10** | Fail position closed. |
| **RC1773B** | AOV | Open | 3.3 | | | |
| | | Closed | 2 | 1 - 3 | **10** | Fail position closed. |
| **RC4608A** | SOV | Open | 0.94 | | **2** | |
| | | Closed | 0.61 | | **2** | Fail position closed. |
| **RC4608B** | SOV | Open | 0.54 | | **2** | |
| | | Closed | 0.33 | | **2** | Fail position closed. |
| **RC4610A** | SOV | Open | 0.47 | | **2** | |
| | | Closed | 0.35 | | **2** | Fail position closed. |
| **RC4610B** | SOV | Open | 0.24 | | **2** | |
| | | Closed | 0.24 | | **2** | Fail position closed. |
| **SA2010** | AOV | Open | 2.98 | | | |
| | | Closed | 4.44 | 2.22 - 6.66 | **10** | Fail position closed. |
| **SP6A** | AOV | Open | 0 | | | |
| | | Closed | 5.96 | | **7** | Fail position closed. |
| **SP6B** | AOV | Open | 0 | | | |
| | | Closed | 6 | | **7** | Fail position closed. |
| **SP7A** | AOV | Open | 0 | | | |
| | | Closed | 3.96 | | **12** | Fail position closed. |
| **SP7B** | AOV | Open | 0 | | | |
| | | Closed | 3 | | **12** | Fail position closed. |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **SS235A** | AOV | Open | 2.47 | | | |
| | | Closed | 2.87 | 1.44 - 4.3 | **10** | Fail position closed. |
| **SS235B** | AOV | Open | 1.18 | | | |
| | | Closed | 0.63 | | **2** | Fail position closed. |
| **SS598** | AOV | Open | 2.12 | | | |
| | | Closed | 4.24 | 2.12 - 6.36 | **10** | Fail position closed. |
| **SS607** | AOV | Open | 2.96 | | | |
| | | Closed | 2.97 | 1.49 - 4.45 | **10** | Fail position closed. |
| **SW1356** | AOV | Open | 5.29 | 2.65 - 7.93 | **10** | Fail position open. |
| | | Closed | 6.99 | 3.5 - 10.48 | **20.97** | |
| **SW1357** | AOV | Open | 3.87 | 1.94 - 5.8 | **10** | Fail position open. |
| | | Closed | 8.107 | 4.06 - 12.16 | **24.32** | |
| **SW1358** | AOV | Open | 4 | 2 - 6 | **10** | Fail position open. |
| | | Closed | 6.26 | 3.13 - 9.39 | **18.78** | |
| **SW1366** | MOV | Open | 20.1 | 17.09 - 23.11 | **30.15** | |
| | | Closed | 20.1 | 17.09 - 23.11 | **30.15** | |
| **SW1367** | MOV | Open | 19.24 | 16.36 - 22.12 | **28.86** | |
| | | Closed | 19.26 | 16.38 - 22.14 | **28.89** | |
| **SW1368** | MOV | Open | 19.43 | 16.52 - 22.34 | **29.14** | |
| | | Closed | 19.41 | 16.5 - 22.32 | **29.11** | |
| **SW1379** | MOV | Open | 29.84 | 25.37 - 34.31 | **44.76** | |
| | | Closed | 29.96 | 25.47 - 34.45 | **44.94** | |
| **SW1380** | MOV | Open | 27.89 | 23.71 - 32.07 | **41.83** | |
| | | Closed | 28.05 | 23.85 - 32.25 | **42.07** | |
| **SW1381** | MOV | Open | 30.09 | 25.58 - 34.6 | **45.13** | |
| | | Closed | 30.2 | 25.67 - 34.73 | **45.3** | |
| **SW1382** | MOV | Open | 10.38 | 8.83 - 11.93 | **13** | |
| | | Closed | 10.45 | | | |
| **SW1383** | MOV | Open | 10.22 | 8.69 - 11.75 | **13** | |
| | | Closed | 10.26 | | | |
| **SW1395** | MOV | Open | 30.68 | | | |
| | | Closed | 31.08 | 26.42 - 34.15 | **34.15** | |

## STROKE TIME LIMITS AND ACCEPTANCE CRITERIA

| Valve | Type | Reference Times | | Expected Stroke Time Range | Maximum Allowable Stroke Time | Comments |
|---|---|---|---|---|---|---|
| **SW1399** | MOV | Open | 30.71 | | | |
| | | Closed | 30.88 | 26.25 - 34 | **34** | |
| **SW1424** | AOV | Open | 4.78 | 2.39 - 7.17 | **14.34** | Fail position open. |
| | | Closed | 26.23 | | | |
| **SW1429** | AOV | Open | 5.12 | 2.56 - 7.68 | **15.36** | Fail position open. |
| | | Closed | 23.6 | | | |
| **SW1434** | AOV | Open | 4.79 | 2.4 - 7.18 | **14.37** | Fail position open. |
| | | Closed | 25.49 | | | |
| **SW2927** | MOV | Open | 18.98 | 16.14 - 21.82 | **28.47** | |
| | | Closed | 18.46 | | | |
| **SW2928** | MOV | Open | 18.27 | 15.53 - 21.01 | **27.4** | |
| | | Closed | 17.26 | | | |
| **SW2929** | MOV | Open | 59.35 | 50.45 - 68.25 | **89.02** | |
| | | Closed | 59.55 | 50.62 - 68.48 | **89.32** | |
| **SW2930** | MOV | Open | 50.44 | 42.88 - 58 | **75.66** | |
| | | Closed | 50.68 | 43.08 - 58.28 | **76.02** | |
| **SW2931** | MOV | Open | 56.33 | | | |
| | | Closed | 56.58 | 48.1 - 65.06 | **84.87** | |
| **SW2932** | MOV | Open | 51.41 | | | |
| | | Closed | 51.49 | 43.77 - 59.21 | **77.23** | |
| **SW5067** | MOV | Open | 10.86 | 9.24 - 12.48 | **16.29** | |
| | | Closed | 9.8 | | | |
| **SW5068** | MOV | Open | 19.34 | 16.44 - 22.24 | **29.01** | |
| | | Closed | 18.78 | | | |

## Attachment H

## Operability Limits for EDG Voltage and Frequency During Transient Loading

(21 pages follow)

Abbreviations and acronyms used in the evaluation provided in Attachment H are identified in the attachment or presented below.

| | | | |
|---|---|---|---|
| AC | alternating current | rpm | revolutions per minute |
| ANSI | American National Standards Institute | s | seconds |
| ASME | American Society of Mechanical Engineers | Sec. | second |
| DG | diesel generator | Seq. | sequence |
| FENOC | FirstEnergy Nuclear Operating Company | Sh. | sheet |
| HPI | high pressure injection | T | time |
| Hz | hertz | USAR | Updated Safety Analysis Report |
| IEEE | Institute of Electrical and Electronics Engineers | V | volt |
| Int. | interval | Vrms | Voltage root-mean-square |
| Min. Volt. | minimum voltage | e.g. | for example |
| kV | kilo-volt | i.e. | that is |
| kVA | kilo-volt-ampere | = | equals |
| kVAR | kilo-volt-ampere reactive | % | percent |
| kW | kilo-watt | + | plus |
| LOCA | loss of coolant accident | +/- | plus or minus |
| LOOP | loss of offsite power | ΔV | voltage change |
| QA | Quality Assurance | | |

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# CALCULATION TITLE PAGE

| | |
|---|---|
| Client:<br>Davis-Besse (FENOC) | Page 1 of 20<br>(Attachment A - 1 Page) |
| Project:<br>Davis-Besse EDG LAR Engineering Support | Task No.<br>0200-1302-0151 |
| Title:<br>Operability Limits for EDG Voltage and Frequency During Transient Loading | Calculation No.<br>CALC-0200-0151-0001 |

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**QUALITY ASSURANCE DOCUMENT**

This document has been prepared, checked, and reviewed/approved in accordance with the QA requirements of 10CFR50 Appendix B and/or ASME NQA-1, as specified in the MPR Nuclear Quality Assurance Program.

MPR

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# RECORD OF REVISIONS

| Calculation No. | Prepared By | Checked By | Page: 2 |
|---|---|---|---|
| CALC-0200-0151-0001 | Rohit Malik | | |

| Revision | Affected Pages | Description |
|---|---|---|
| 0 | All | Initial Issue |
| 1 | Pages 8 and 9 | Corrected typographical errors on pages 8 and 9. |

***Note:*** *The revision number found on each individual page of the calculation carries the revision level of the calculation in effect at the time that page was last revised.*

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# 1.0 INTRODUCTION

## 1.1 Purpose

The Davis-Besse plant Technical Specifications include periodic Surveillance Requirements (SRs) for the Emergency Diesel Generators (EDGs). Surveillance Requirements SR 3.8.1.2, SR 3.8.1.8 a., SR 3.8.1.8 b., SR 3.8.1.11, SR 3.8.1.14 a., SR 3.8.1.14 b., and SR 3.8.1.15 define performance limits for the EDG voltage and frequency. This calculation documents an EDG transient loading analysis that is based on equipment Operability limits. These limits are not directly tied to the Technical Specification limits or the more stringent design basis limits.

The scope of this calculation does not include evaluating individual component response times with respect to Safety Features Actuation System response time requirements. Steady-state EDG loading is documented in Davis-Besse calculation C-EE-015.03-008, "AC Power System Analysis" (Reference 1).

## 1.2 Background

In May 2012, FirstEnergy Nuclear Operating Company (FENOC) submitted a License Amendment Request (LAR) to the NRC for the Davis-Besse Nuclear Power Station. The purpose of the proposed LAR was to address a non-conservative plant Technical Specification related to the emergency diesel generator (EDG) output breaker closure voltage permissive. Specifically, the LAR proposed to revise plant Technical Specifications 3.8.1 by changing the minimum voltage acceptance criterion for EDG surveillance testing in Surveillance Requirements 3.8.1.8 and 3.8.1.14 from greater than or equal to 4031 V to greater than or equal to 4070 V.

The NRC staff notified FENOC via email on June 21, 2012 that additional information would be necessary to assess the acceptability of FENOC's LAR. Some of the requested information went beyond the scope of the FENOC LAR and was related to topics addressed in the Westinghouse WCAP-17308-NP, Revision 0, "Treatment of Diesel Generator (DG) Technical Specification Frequency and Voltage Tolerances." Consequently, FENOC withdrew the LAR on July 16, 2012.

MPR previously developed a design basis analysis to address the transient frequency and voltage response of the EDGs to design basis LOOP/LOCA, LOOP Only, and Appendix R load sequencing. The analysis is documented in Davis-Besse calculation C-EE-024.01-011 (Reference 2). The purpose of the calculation was to document an analysis of the voltage and frequency response of the Davis-Besse Emergency Diesel Generators (EDGs) during design basis load transients. The load transients addressed by the evaluation include:

- design basis LOOP/LOCA load sequencing,
- design basis LOOP Only load sequencing,
- individual motor starting transients required for Appendix R fire scenarios, and
- design basis LOOP/LOCA load sequencing using a voltage setpoint of 4088 V and frequency setpoints of 59.5 and 60.5 Hz.

As indicated in the limitations section of C-EE-024.01-011, the analysis results are based on a minimum voltage setpoint of 4200 V, which is the lowest voltage setpoint allowed by the EDG operating procedure. Reference 2 also performs an analysis at voltage setpoint of 4088 V to provide the minimum voltage setpoint required to meet the Safety Guide 9 requirements. To provide the additional information requested by the NRC and support a revised LAR, additional analyses are required. Specifically, the following conditions are not analyzed in the calculation C-EE-024.01-011:

- LOOP/LOCA load sequence below 4088 V and 61.2 Hz frequency. Specifically, Technical Specification requirement stating minimum steady state voltage of 3744 V needs to be validated.
- Load reject at 4400 V and 58.8 Hz frequency. The maximum voltage during the transient shall be less than the overvoltage relay setpoint.

### *1.3 Approach*

This calculation uses the MATLAB/Simulink model developed in Reference 2. This calculation does not revise the overall model, input parameters, or validation results. The model was used to perform the LOOP/LOCA studies to determine the voltage and frequency limits required to ensure equipment operability

The EDG transient analysis model was developed in Reference 2 using the MATLAB and Simulink computer programs. MATLAB is a computer program that provides an integrated computing environment that combines numeric computation, advanced graphics and visualization, and a high-level programming language. Simulink is a software program developed using the MATLAB programming language that works within the MATLAB program environment. Simulink provides an interactive, graphical environment for modeling, simulating, and proto-typing dynamic systems.

The following approach was used in Reference 2 to develop the model and perform the analyses and is provided here for reference only:

- Develop the Model Form. MPR developed a library of MATLAB/Simulink component models for modeling EDG response to large motor loads. The library was used to develop a system model that adequately represents the equipment installed at Davis-Besse. The model components consist of the diesel engine, governor, generator, excitation system (including voltage regulator) and the essential bus loads. The major motor loads (i.e. the 4kV motor loads) were modeled in detail and the smaller 480V loads were modeled as a combination of lumped static (i.e., constant impedance) and constant KVA loads.

- Develop the Model Input Parameters. Each component model requires a number of input parameters. The input parameters were determined based on equipment design information, including available factory acceptance test data. There were some parameters that are field adjustable (e.g. governor gain and reset) and some that have significant uncertainty (e.g. the inertia for most of the motor loads). Some of these input parameters were adjusted, or "tuned," based on EDG response data collected by Davis-Besse during surveillance testing of the EDGs.

- Verification of Model Results. The computer model and associated software used for this analysis is classified under the MPR Quality Assurance (QA) Manual as "working-level" software. As such, the requirements for use of this software consist of (a) verification that the program inputs are correct, (b) verification that the program is applicable for the task, (c) verification that the program correctly performs the operations that affects the results, and (d) documentation of the analysis, verification, and results.

  Verification that the program inputs are correct was performed during the check and review process of the associated calculations. Verification that the program is applicable for the task was performed as part of the review of the associated calculations.

  Verification that the EDG system model (i.e. generator, diesel engine, fuel rack, governor and load models) correctly performs the operations that affect the results was performed by comparing model results to a known test case. The known test case was measured data from EDG surveillance tests. The model was used to predict the frequency and voltage response to the surveillance test load steps for EDG1-1 and EDG1-2 and the model results were compared to the actual measured test results.

  Documentation of the verification results are discussed in Reference 2.

## 2.0 INPUTS

The EDG MATLAB/Simulink model was developed in Reference 2 and is directly used here. The inputs for the MATLAB/Simulink model were verified in Reference 2. No new design inputs were required for this calculation.

## 3.0 ACCEPTANCE CRITERIA

The acceptance criteria for this calculation are listed in Table 1 below. Sections 3.1 through 3.4 provide detailed discussion of these acceptance criteria.

**Table 1.** Summary of Acceptance Criteria

| Description | | Value (Note 1) | Section No. |
|---|---|---|---|
| Minimum Allowable Essential 4160 V Bus Voltage | Starting | 67.31 % | Section 3.1 |
| | Steady State | 86.54 % | |
| Worst Case Minimum Allowable Essential 480 V MCC Voltage | Starting | 68.69 % | Section 3.1 |
| | Steady State | 90.60 % | |
| Maximum Steady State 4160 V Bus Voltage | | 105.76% | Section 3.2 |
| Maximum Steady State 480 V Bus and MCC Voltage | | 105.41% | Section 3.2 |
| EDG Maximum Voltage During Transients (For Largest Load Reject Case) | | 109.4% | Section 3.2 |
| EDG Maximum Voltage During Transients (For Full Load Reject Case) | | 224.0% | Section 3.2 |
| EDG Minimum Allowable Frequency (Based on Safety Guide 9) | Steady State | 58.8 Hz | Section 3.3 |
| | Transient | 57 Hz | |
| | Transient Recovery Time (sec.) | 40 % of Load Seq. Time Int. | |
| EDG Maximum Allowable Frequency (Based on Overspeed Trip Setpoint) | | 66.75 Hz | Section 3.4 |

**Note 1**: The percent voltage values are based on bus rating of 4160 V and 480 V.

### 3.1 Minimum Voltage

The minimum bus voltage acceptance criteria is based on the following:

1. Minimum 4160 V essential bus voltage for motor starting and steady state condition.
2. Minimum 480 V essential MCC voltage for motor starting and steady state condition. This also includes minimum voltage required to pickup motor starters.

The minimum 4160 V and 480 V bus voltages during motor starting and steady state conditions are established in the Davis-Besse AC systems analysis calculation C-EE-015.03-008 (Reference 1). Attachment 3 of C-EE-015.03-008 provides these voltages. The minimum steady state and motor starting bus voltages are based on motor rated steady state and starting voltage, 480 V motor starter contactor holding and dropout voltages, and minimum voltages for other 480 V components such as regulated rectifier, radiation monitor, hydra motors, etc.

For the 4160 V essential buses, the minimum steady state and transient voltages are based on minimum continuous motor running and motor starting voltages.

For the 480 V buses and MCCs, the minimum steady state voltage is based on several factors and will depend on the MCC/bus:

a. 480 V bus and MCC minimum continuous motor running voltage
b. Motor starter contactor pickup voltage
c. Battery charger minimum steady state voltage
d. Minimum steady state voltage requirement for constant voltage transformers (CVTs)
e. Minimum steady state voltage requirement for regulated rectifier
f. Minimum steady state voltage requirement for hydra motors

Based on Attachment 3 of Reference 1, the most limiting 480 V MCC minimum bus voltage requirement is 90% (of 480 V) based on the regulated rectifier voltage requirement on MCCs E12A and F12A. For motor starting conditions, the minimum 480 V bus and MCC voltages are based on minimum motor starting voltage and motor starter contactor holding voltage. The minimum voltage for 480 V buses and MCCs during motor starting conditions is 68.69% (of 480 V) (See Table 2).

The EDG MATLAB/Simulink transient calculation (Reference 2) models the Davis-Besse essential 480 V MCCs as a single lumped load. Therefore, the voltage drop for each MCC is not known from the simulation results. Further, the Simulink model also assumes no voltage drop from the 480 V buses to the 480 V MCCs. A voltage drop from the 480 V buses to the MCCs was determined in Section 5.0 (Assumption and Limitations) and was added to the 480 V MCC acceptance criteria.

Table 2 below summarizes the minimum bus voltage acceptance criteria for this calculation:

**Table 2.** Minimum Bus Voltage Acceptance Criteria

| Bus Level | Motor Starting (% Voltage) | Steady State (% Voltage) |
|---|---|---|
| 4160 V Essential Buses | 67.31 | 86.54 |
| 480 V Essential Buses and MCCs (Note 1) | 68.69 | 90.60 |

Notes:

1. The MCC bus voltage acceptance criteria assumes additional voltage drop as documented in Section 5.0.

The voltage acceptance criteria listed in Table 2 are less than the minimum required bus voltage to provide EDG output breaker closure permissive (3990 V +/- 2%). These criteria bound the EDG breaker closure permissive voltage. The EDG output breaker will receive a permissive to close for bus voltage of 3990 V +/-2% (Reference 7). Technical Specification Surveillance Requirement require a minimum bus voltage of 4070 V to close the breaker. This voltage is based on 3990 V + 2% (95.91% + 2%) tolerance from Reference 7.

### *3.2 Maximum Voltage*

The maximum established steady state 4160 V bus voltage is 105.76% and the maximum steady state 480 V bus and MCC voltage is 105.41% (Reference 1, Attachment 3). The steady state voltage for the essential buses shall be less than the limits specified above.

The overvoltage relay setpoint for the EDG output breaker is 4550 V (Reference 4). The overvoltage relay provides alarm in the control room during EDG output overvoltage conditions. Therefore, transient voltage during load rejection shall be less than the EDG output breaker overvoltage alarm setting. Furthermore, per ANSI C37.06 and IEEE C37.20.2 (References 11 and 12, respectively), the maximum rated voltage for 4.16 kV circuit breakers and metal clad switchgears, respectively, is 4.76 kV. Therefore, the maximum voltage acceptance criteria of 4550 V bounds the breaker and bus maximum voltage ratings.

For a full load rejection, the EDG is considered disconnected from the 4160 V essential bus. Therefore, for full load rejection, the maximum allowable EDG voltage rating is considered. Per EDG test report M-180-93-3 (Reference 13), the Davis-Besse EDG was tested at 9320 V for 1 minute. The testing voltage was established per the requirements of ANSI C50.10 (Reference 14) which requires the test voltage to be “1000 V plus twice the rated voltage of the machine.” Therefore, the transient voltage during a full load reject shall be less than 9320 V and recover to the voltage setpoint in less than 1 minute.

### 3.3 Minimum Frequency

This calculation does not explicitly evaluate the response time of individual components. Consequently, for minimum allowable frequency, the acceptance criteria established by Safety Guide 9 are used. Safety Guide 9 requirement states that the frequency shall not fall below 57 Hz (95% of nominal) and should be restored above 58.8 Hz (within 2% of nominal) in less than 40 percent of each load sequence time interval.

### 3.4 Maximum Frequency

For maximum allowable frequency, the acceptance criteria established by Safety Guide 9 for maximum allowable frequency during load transient is used. The Safety Guide 9 requirement for the maximum allowable frequency is stated below:

> "During recovery from transients caused by step load increases or resulting from disconnection of the largest single load, the speed of the diesel generator set should not exceed 75 percent of the difference between nominal speed and the overspeed trip setpoint or 115 percent of nominal, whichever is lower."

The Davis-Besse EDG output breaker overfrequency trip is set at 115% of nominal (60 Hz) (=69 Hz). Therefore, the EDG frequency shall not exceed 75% of the difference between the nominal frequency (60 Hz) and the overspeed setpoint (69 Hz). This frequency is 66.75 Hz.

## 4.0 SUMMARY OF RESULTS

The EDG transient analysis results from Section 7.0 are summarized below:

1. **Minimum Voltage:** The minimum EDG terminal voltage required to maintain adequate motor starting and steady state voltage is 3850 V.

2. **Maximum Voltage:** The maximum EDG steady state voltage required to maintain adequate bus voltage during load loss transients is 4400 V. Operating the EDG at a maximum steady state voltage of 4400 V in conjunction with a largest load rejection transient results in transient voltages less than 4550 V (109.4% of 4160 V), i.e., EDG overvoltage alarm setpoint.

   Furthermore, during full load rejection, the EDG terminal voltage does not exceed the EDG maximum test voltage of 9320 V and recovers to the EDG setpoint of 4400 V within 60 seconds.

3. **Minimum Frequency:** The minimum EDG frequency setpoint required to meet the Safety Guide 9 requirements is 59.17 Hz (887.5 rpm). At this frequency, the EDG frequency recovers to 98% of nominal (58.8 Hz) within 40% of the each load sequence time interval. The frequency does not drop below 95% of nominal. The most limiting

time interval is between the first and the second load step which is 2.5 seconds. Safety Guide 9 recovery time for this load step is 1 second.

4. **Maximum Frequency:** The maximum EDG frequency setpoint of 61.2 Hz satisfies the requirements of maximum allowable EDG frequency transient during large load and full load rejections.

5. **EDG Loading:** The maximum EDG steady state loading at the maximum voltage setpoint of 4400 V and frequency setpoint of 61.2 Hz is 2413 kW and 1610 kVAR, which is less than the EDG steady state loading limit of 2600 kW and 1950 kVAR.

## 5.0 ASSUMPTIONS AND LIMITATIONS

This calculation is not a design basis calculation. The purpose of this calculation is to provide bounding EDG terminal voltage and frequency to support an Operability evaluation.

For further assumptions and limitations, see EDG Transient Response Evaluation calculation C-EE-024.01-011 (Reference 2).

Assumptions associated with MCC voltage acceptance criteria are discussed below.

### MCC Minimum Voltage Acceptance Criteria

The EDG MATLAB/Simulink transient calculation (Reference 2) models the Davis-Besse essential 480 V MCCs as a single lumped load. Therefore, the voltage drop for each MCC is not known from the simulation results. Further, the Simulink model also assumes no voltage drop from the 480 V buses to the 480 V MCCs.

The AC Systems Analysis calculation, C-EE.015-008 (Reference 1), provides the worst case voltage drop from the 480 V E1/F1 buses to the respective essential MCCs. Table 3 below provides the worst case voltage drop from the 480 V buses to the MCCs

**Table 3.** Minimum Bus Voltage Acceptance Criteria
(Reference 1, Attachment 23A and 23B)

| Condition | 480 V Bus | Min. Volt. | Case | MCC | Min. Volt. | Case | ΔV |
|---|---|---|---|---|---|---|---|
| Steady State | E1 | 94.85% | LF4h | E12D | 94.30% | LF4h | 0.55% |
| | F1 | 95.39% | LF4h | F12D | 94.91% | LF4h | 0.48% |
| Motor Starting | E1 | 75.06% | ST1k2 | E12F | 74.00% | ST1k2 | 1.06% |
| | F1 | 76.94% | ST1k2 | F11D | 75.35% | ST1j | 1.59% |

Table 3 shows that the worst case voltage drop to the MCCs during motor starting and steady state conditions are 0.55% and 1.59%, respectively. Therefore, 0.6% and 1.6% have been added to the acceptance criteria for the MCC minimum steady state and starting voltages, respectively.

This is a conservative assumption because it assumes the same voltage drop at all MCCs. This assumption does not require verification.

## 6.0 ANALYSIS CASES AND METHODOLOGY

Case 2 of C-EE-024.01-011 simulates a design basis LOOP/LOCA with 480V MCCs and Component Cooling Water Pump (CCWP) starting at breaker closure and MUP starting at 2.5 seconds after breaker closure. Case 2 assumes a cold generator field. Loading sequence of Case 3 of Reference 2 is similar to Case 2 but assumes a hot generator field. For both cases the voltage and frequency setpoints were 4160 V and 900 rpm, respectively.

The voltage and frequency setpoints for these cases were modified to perform the analysis provided in this calculation. The description of the cases and the underlying methodology is provided in the following sections.

### *6.1 Minimum Voltage Case, Case 3A-V*

The minimum voltage case was performed using loading conditions of Case 3 from Reference 2. The voltage setpoint of 3744 V was used and the value was raised until acceptance criterion 3.1 was met. A system frequency of 61.2 Hz (918 EDG rpm) was used. The motor load increases with increase in frequency. Therefore, using a higher frequency setpoint is more conservative for determining minimum EDG terminal voltage is conservative.

### *6.2 Minimum Frequency Case, Case 3A-F*

The minimum frequency case was performed using the loading conditions and resultant voltage setpoint (3850 V) from Section 6.1 above. An initial frequency setpoint of 58.8 Hz was used (882 rpm). The frequency was increased until the requirements of acceptance criterion 3.3 was met.

### *6.3 Maximum Voltage and Frequency Case, Case 2A-LL and 2A-FL*

The maximum voltage and frequency cases were performed using the loading conditions of Case 2 from Reference 2.

The voltage and frequency setpoints of 4400 V and 61.2 Hz (918 rpm) were used, respectively.

Two loading cases, Case 2A-LL and 2A-FL, were evaluated. Case 2A-LL was performed to simulate the tripping of the largest load (High Pressure Injection pump motor). Case 2A-FL was performed to simulate full load reject.

The voltage plots in Section 7.0 provide the voltage transient after the load rejection. The voltage transients during load addition are not shown.

## 7.0 RESULTS

Sections 7.1 to 7.3 document the predicted EDG voltage and frequency, and MCC bus voltage for the motor starting and load reject cases detailed in Section 6.0. Sections 7.1 to 7.3 include plots of EDG voltage, EDG frequency, and MCC voltage during the transient. Preceding the plots is a summary that compares the minimum and maximum voltage and frequency acceptance criteria established in Section 3.0.

### *7.1 Minimum Voltage Case, Case 3A-V*

The minimum voltage setpoint to meet acceptance criterion 3.1 is 3850 V. Figure 1 and Figure 2 provide the EDG terminal frequency and voltage, and MCC voltage during the transient, respectively. As shown in the figures, the MCC voltage is the most limiting. At a 3850 V setpoint both EDG terminal voltage and the MCC voltage meet acceptance criterion 3.1.

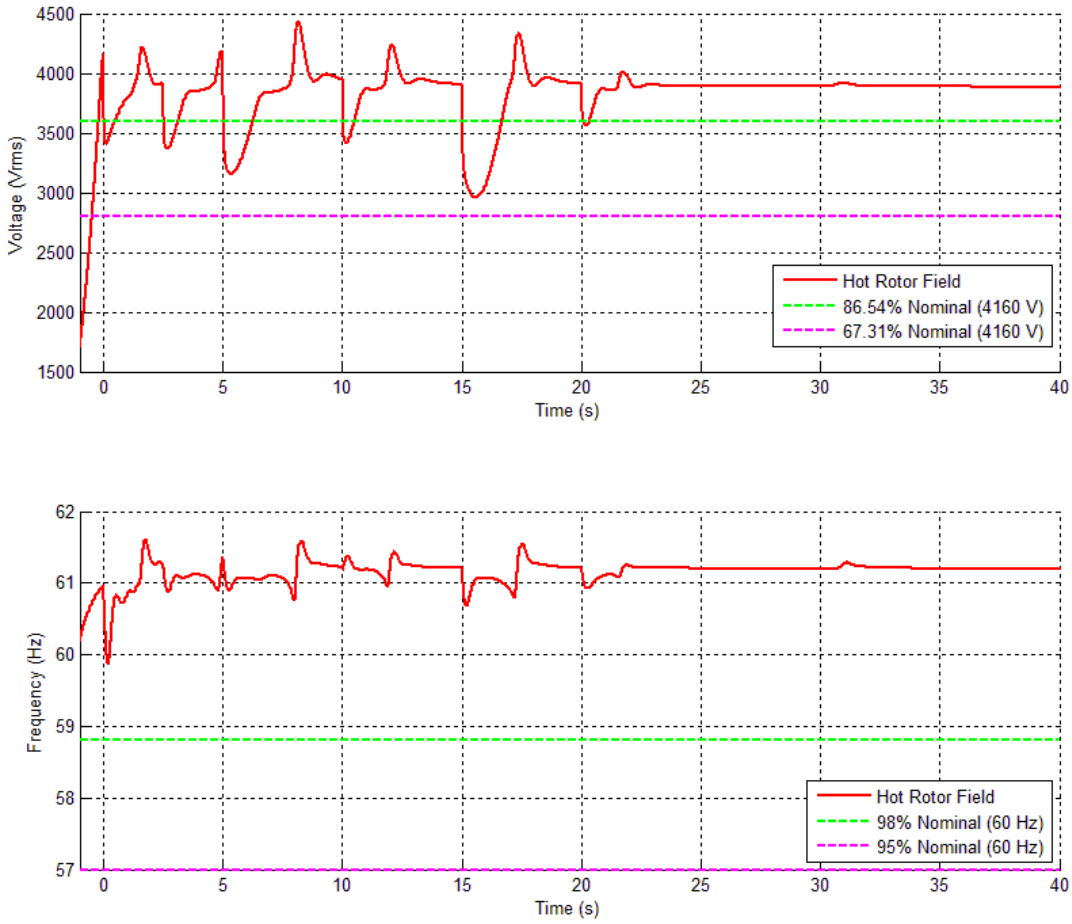


**Figure 1.** Minimum Voltage Analysis Case 3A-V - EDG Terminal Voltage and Frequency
Voltage Setpoint = 3850 V
Frequency Setpoint = 61.2 Hz (918 rpm)

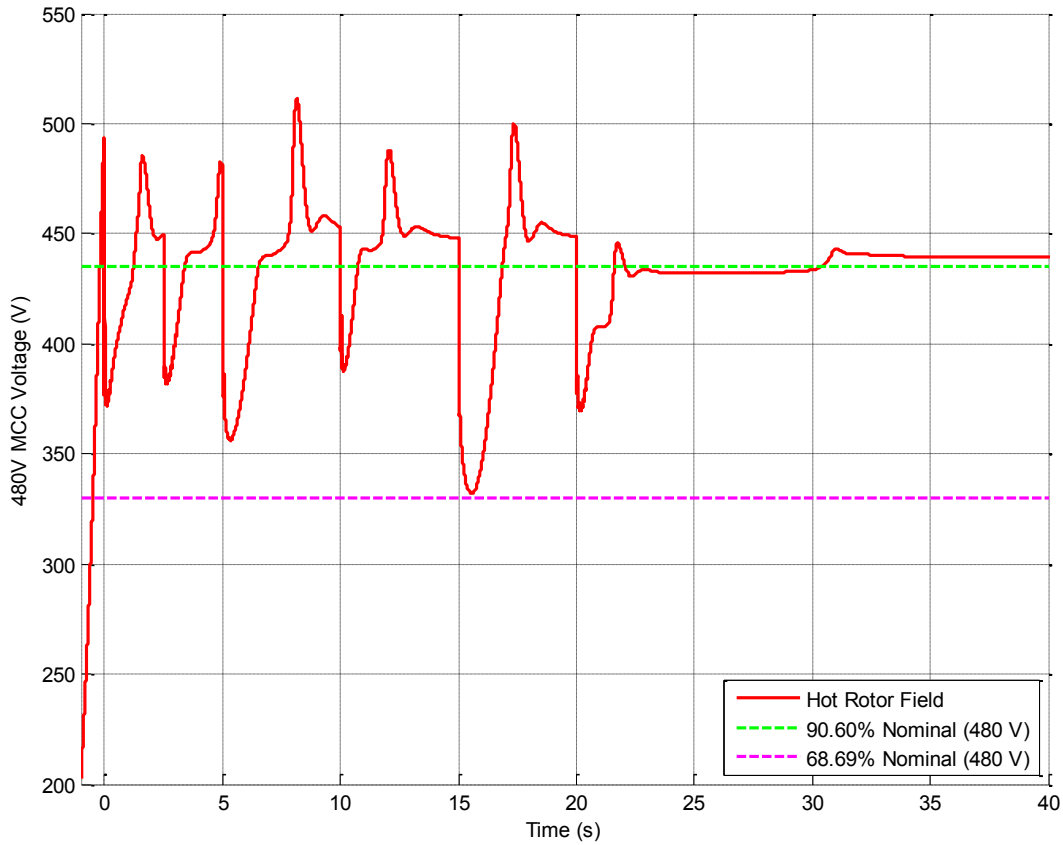


**Figure 2.** Minimum Voltage Analysis Case 3A-V - MCC Voltage

### *7.2 Minimum Frequency Case, Case 3A-F*

The voltage setpoint was fixed at the 3850 V setpoint established in Section 7.1. The minimum frequency was varied to meet the acceptance criterion 3.3. The frequency response in Figure 3 provides the maximum time by which the frequency should recover above 98% of nominal. The acceptance requirement is shown by vertical bars on the figure. The minimum frequency required to meet the acceptance criterion 3.3 is 59.17 Hz (887.5 rpm).

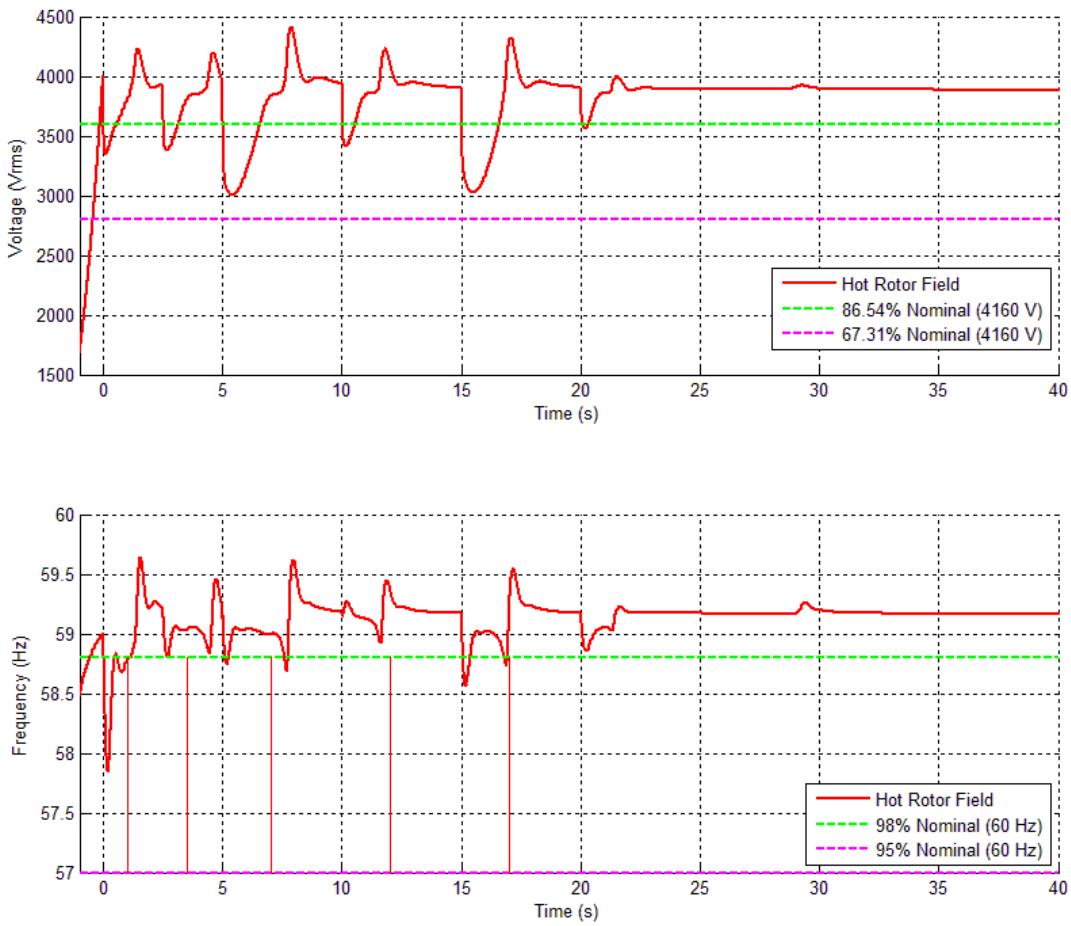


**Figure 3.** Minimum Frequency Analysis Case 3A-F - EDG Terminal Voltage and Frequency Response
Voltage Setpoint = 3850 V
Frequency Setpoint = 59.17 Hz (887.5 rpm)

### *7.3 Maximum Voltage and Frequency*

The maximum voltage and frequency cases were simulated for both large load and full load reject. The cases are discussed in the subsections below. For both cases, prior to the trip of the largest load or the full load, the EDG steady loading will be the same. The EDG steady state loading will be maximum at maximum voltage and frequency. This is because at maximum voltage, resistive loads draw maximum current and at maximum frequency motor loads draw

maximum current. The EDG steady state load during this condition is 2413 kW and 1610 kVAR as shown in Figure 4 below.

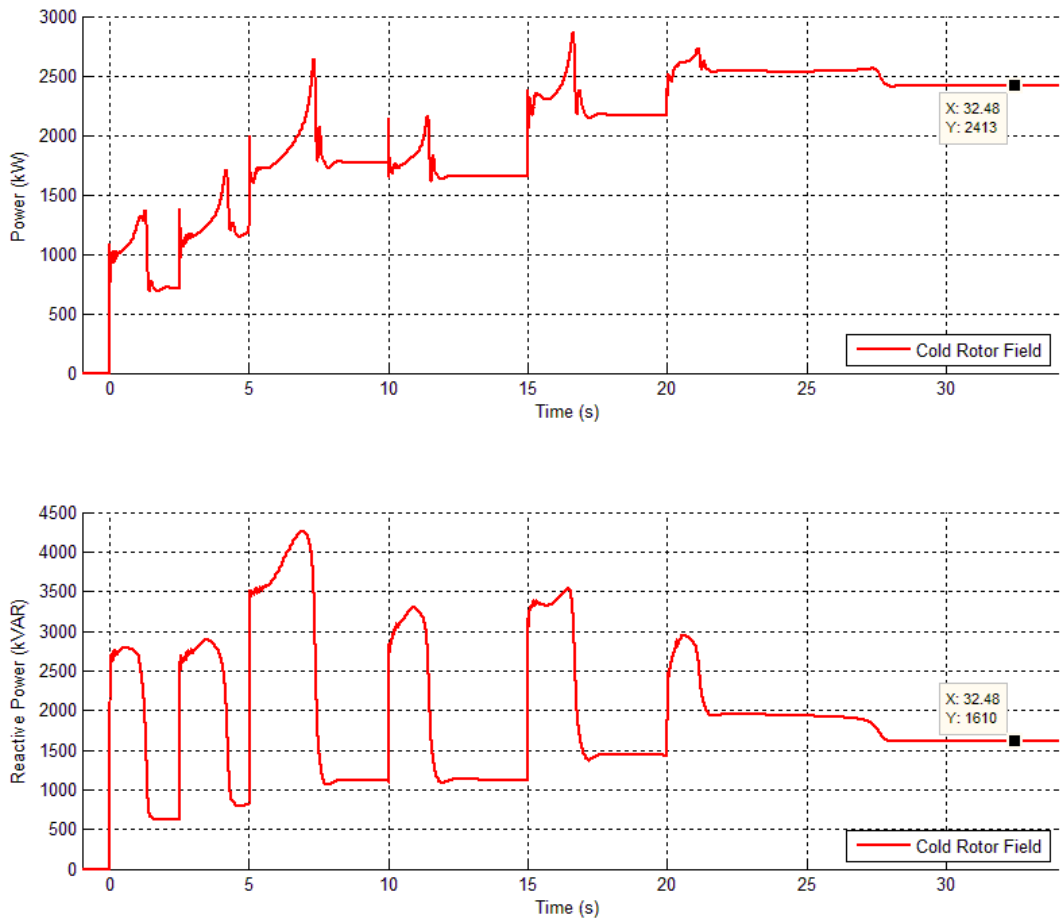


**Figure 4.** Maximum Voltage and Frequency Analysis - EDG Output Real and Reactive Power
Voltage Setpoint = 4400 V
Frequency Setpoint = 61.2 Hz (918 rpm)

### 7.3.1 Large Load Reject, Case 2A-LL

For the large load reject case, the largest essential load (the HPI pump motor) was tripped at T=30s in the simulation time step. The EDG terminal voltage and frequency response are provided in Figure 5. The voltage and frequency response meet the requirements of acceptance criteria 3.2 and 3.4.

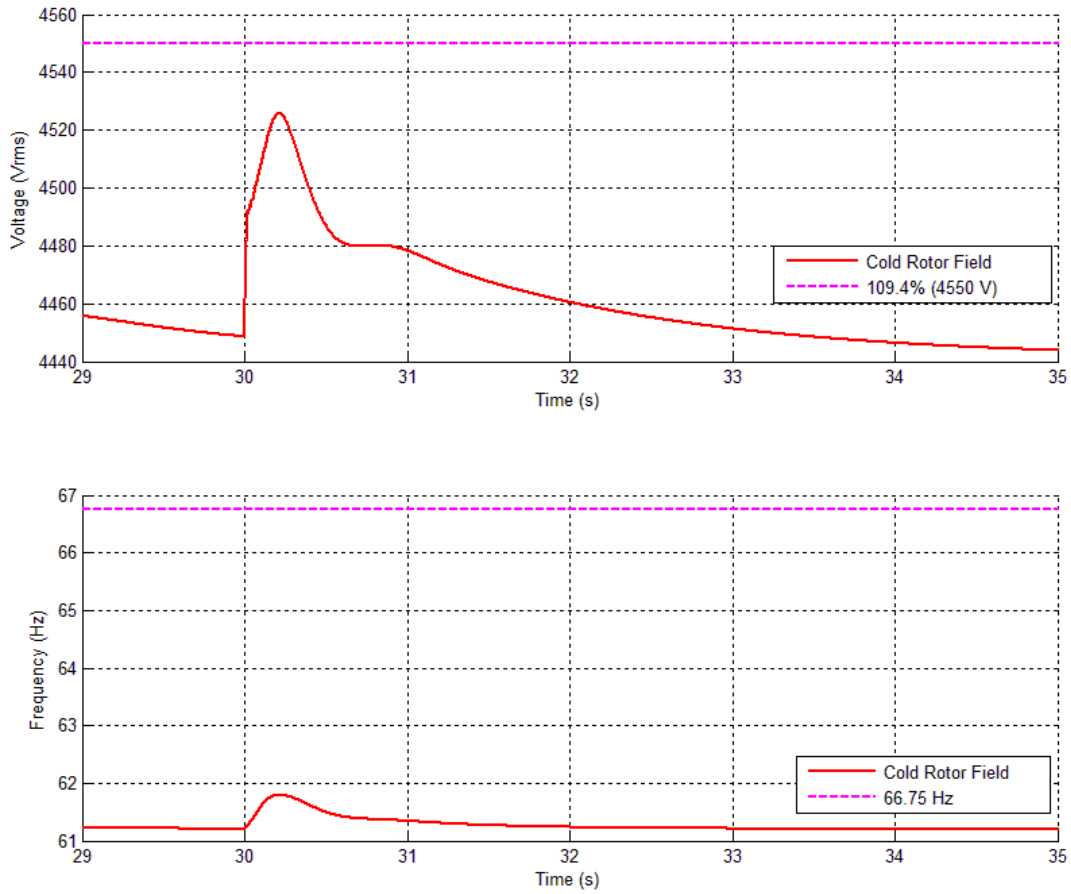


**Figure 5.** Large Load Reject Analysis Case 2A-LL - EDG Terminal Voltage and Frequency
Voltage Setpoint = 4400 V
Frequency Setpoint = 61.2 Hz (918 rpm)

### 7.3.2 Full Load Reject, Case 2A-FL

For the full load reject case, all loads were tripped at T=30s in the simulation time step. The EDG terminal voltage and frequency response are provided in Figure 6. The maximum voltage due to the full load reject transient is 4807 V. The voltage recovers to a steady state voltage of 4450 V within 5 seconds. The voltage response meets the requirements of maximum voltage acceptance criterion 3.2 for full load rejection. The frequency response meets the requirements of acceptance criterion 3.4.

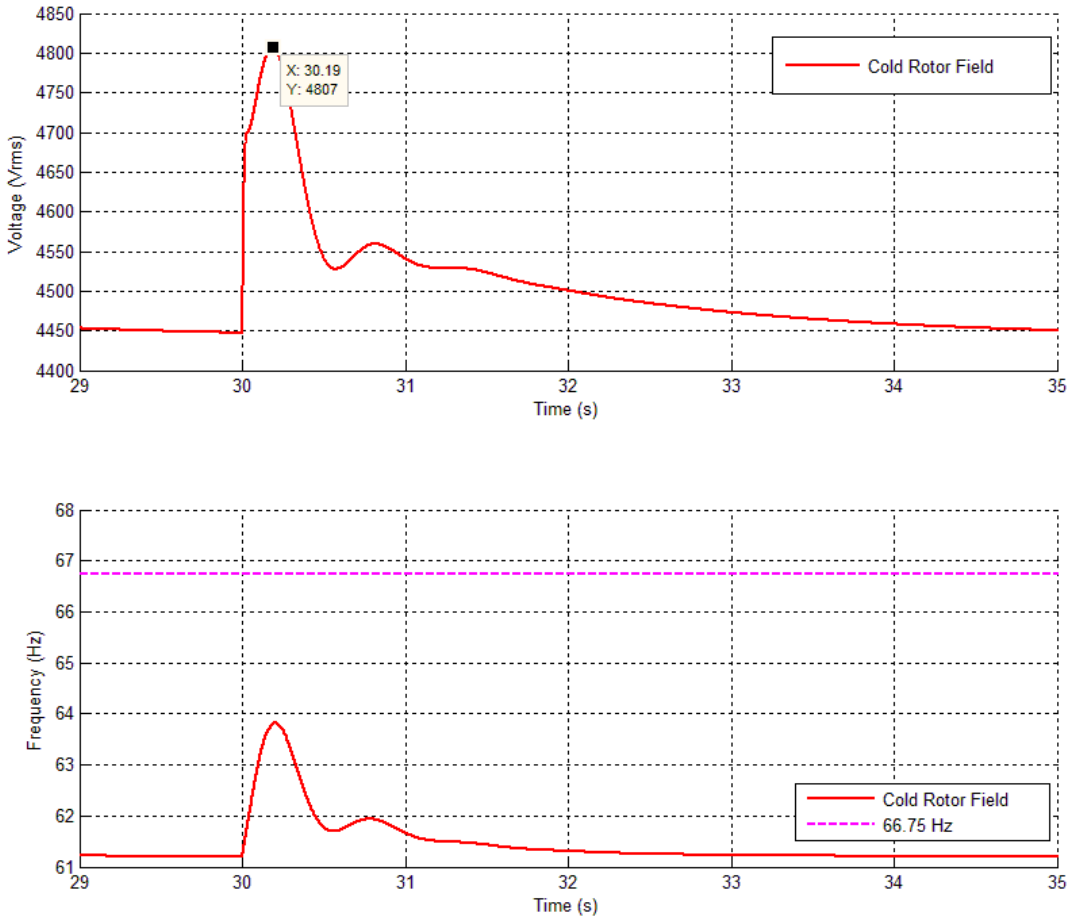


**Figure 6.** Full Load Reject Analysis Case 2A-FL - EDG Terminal Voltage and Frequency
Voltage Setpoint = 4400 V
Frequency Setpoint = 61.2 Hz (918 rpm)

## 8.0 REFERENCES


1. Davis-Besse Calculation C-EE-015.03-008, AC Power System Analysis, Revision 5.
2. Davis-Besse Calculation C-EE-024.01-011, Evaluation of Davis-Besse EDG Transient Response During Design Basis LOOP/LOCA, LOOP Only and Appendix R Loading, Revision 2.
3. Davis-Besse Drawing M-180Q-14, Schematic Diagram of Engine Control, Revision 13.
4. Davis-Besse Relay Setting Manual Volume 1 Tab 02 Sheet 024A, Emergency DG 1 Control and Relay Board, Revision 7.
5. Davis-Besse Drawing E-64B Sh. 1A, Emergency Diesel Generators, Diesel Generator 1-1 Breaker AC101 Control, Revision 13.
6. Davis-Besse Drawing M-180-31 Sh. 2, EDG Excitation System Interconnection Diagram, Revision 23.
7. Davis-Besse Drawing M-180-31 Sh. 3, EDG Excitation System Interconnection Diagram, Revision 23.
8. Davis-Besse USAR, Revision 26.
9. Davis-Besse Technical Specifications, Amendment 279.
10. Davis-Besse Systems Procedure DB-OP-06316, Diesel Generator Operating Procedure, Revision 48.
11. ANSI C37.06-2000, AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities.
12. IEEE Standard C37.20.2-1999, IEEE Standard for Metal Clad Switchgear.
13. Davis-Besse EDG Serial Number 172217211 Data Sheet (M-180-93-3).
14. ANSI C50.10-1977, General Requirements for Synchronous Machines.

# A Timestamps for Simulation Files

**Table A-1.** Timestamps for MATLAB/Simulink Files

| Filename | Timestamp (EDT) | File Size (KB) |
|---|---|---|
| case_3A_F.m | 8/27/2013 11:22 | 4 |
| case_3A_V.m | 8/27/2013 11:22 | 4 |
| case_2A_FL.m | 8/27/2013 11:24 | 4 |
| case_2A_LL.m | 8/27/2013 11:24 | 4 |
| db_edg_rev6.mdl | 11/1/2013 16:56 | 680 |
| design_data_rev6.m | 7/5/2011 17:41 | 16 |