**Reliability Standards issued by North American Electric Reliability Corporation Ltd. (NERC) and corresponding provisions in CEA/CERC Regulations**

| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 1 | BAL-001-1/ BAL-001-2 | Real Power Balancing Control Performance | To maintain Interconnection steady-state frequency within defined limits by balancing real power demand and supply in real-time. To control Interconnection frequency within defined limits | Chapter 5 of the Indian Electricity Grid Code (IEGC) | Provisions need to be more stringent by mandating that control areas balance resources and introducing the concept of Area Control Error (ACE) |
| 2 | BAL-001-TRE-1 | Primary Frequency Response | To maintain Interconnection steady-state frequency within defined limits | IEGC Section 5.2 (f): All thermal generating units of 200 MW and above and all hydro units of 10 MW and above, which are synchronized with the grid, irrespective of their ownership, shall have their governors in operation at all times | ----do------- |
| 3 | BAL-002-1/ BAL-002-1a | Disturbance Control Performance | The purpose of the Disturbance Control Standard (DCS) is to ensure the Balancing Authority is able to utilize its Contingency Reserve to balance resources and demand and return Interconnection frequency within defined limits following a Reportable Disturbance. Because generator failures are far more common than significant losses of load and because Contingency Reserve activation does not typically apply to the loss of load, the application of DCS is limited to the loss of supply and does not apply to the loss of load | No mandatory provision for reserves to be maintained by each control area. | Needs to be added. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 4 | BAL-002-WECC-2 | Contingency Reserve | To specify the quantity and types of Contingency Reserve required to ensure reliability under normal and abnormal conditions. | No mandatory provision for reserves to be maintained by each control area. | Needs to be added. |
| 5 | BAL-003-0.1b/ BAL-003-1 | Frequency Response and Bias | This standard provides a consistent method for calculating the Frequency Bias component of ACE. To require sufficient Frequency Response from the Balancing Authority (BA) to maintain Interconnection Frequency within predefined bounds by arresting frequency deviations and supporting frequency until the frequency is restored to its scheduled value. To provide consistent methods for measuring Frequency Response and determining the Frequency Bias Setting. | No explicit provision for ACE and frequency bias in any of the CEA/CERC Regulations. Order dated 3rd May 2013 issued by CERC prescribes the method for calculating the Frequency Response Characteristic (FRC). | Needs to be added. |
| 6 | BAL-004-0/ BAL-004-WECC-02 | Time Error Correction | The purpose of this standard is to ensure that Time Error Corrections are conducted in a manner that does not adversely affect the reliability of the Interconnection.To maintain Interconnection frequency and to ensure that Time Error Corrections and Primary Inadvertent Interchange (PII) payback are effectively conducted in a manner that does not adversely affect the reliability of the Interconnection. | None | Can be debated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 7 | BAL-005-0.2b | Automatic Generation Control | This standard establishes requirements for Balancing Authority Automatic Generation Control (AGC) necessary to calculate Area Control Error (ACE) and to routinely deploy the Regulating Reserve. The standard also ensures that all facilities and load electrically synchronized to the Interconnection are included within the metered boundary of Balancing Area so that balancing of resources and demand can be achieved | None | Needs to be added. |
| 8 | BAL-006-2 | Inadvertent Interchange | This standard defines a process for monitoring Balancing Authorities to ensure that, over the long term, Balancing Authority Areas do not excessively depend on other Balancing authority Areas in the Interconnection for meeting their demand or Interchange obligations. | Yes, CERC (Deviation Settlement Mechanism) Regulations, 2014 exists but it needs to be made more stringent. | Suitable amendment in DSM Regulations required. |
| 9 | BAL-502-RFC-02 | Planning Resource Adequacy Analysis, Assessment and Documentation | To establish common criteria, based on “one day in ten year” loss of Load expectation principles, for the analysis, assessment and documentation of Resource Adequacy for Load in the Reliability *First* Corporation (RFC) region | No specific mention in any of the CEA/CERC Regulations. | Needs to be added. |
| 10 | BAL-STD-002-0 | Operating Reserves | Regional Reliability Standard to address the Operating Reserve requirements | 5% spinning reserve is mentioned in the National Electricity Policy. | Needs to be added. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 11 | CIP-002-3/ CIP-002-5.1 | Cyber Security | NERC Standards CIP-002-3 through CIP-009-3 provide a cyber security framework for the identification and protection of Critical Cyber Assets to support reliable operation of the Bulk Electric System.To identify and categorize BES Cyber Systems and their associated BES Cyber Assets for the application of cyber security requirements commensurate with the adverse impact that loss, compromise, or misuse of those BES Cyber Systems could have on the reliable operation of the BES. Identification and categorization of BES Cyber Systems support appropriate protection against compromises that could lead to misoperation or instability in the BES. | IEGC Section 4.6.5: All utilities shall have in place, a cyber security framework to identify the critical cyber assets and protect them so as to support reliable operation of the grid. | Implementation and compliance monitoring to be added. |
| 12 | CIP-014-1 | Physical Security | To identify and protect Transmission stations and Transmission substations, and their associated primary control centers, that if rendered inoperable or damaged as a result of a physical attack could result in widespread instability, uncontrolled separation, or Cascading within an Interconnection. | No specific mention in any of the CEA/CERC Regulations. | Needs to be added. |
| 13 | COM-001-1.1 | Telecommunications | Each Reliability Coordinator, Transmission Operator and Balancing Authority needs adequate and reliable telecommunications facilities internally and with others for the exchange of Interconnection and operating information necessary to maintain reliability. | No specific mention in any of the CEA/CERC Regulations. The Commission had mentioned the need for a separate Regulation on communication. | Needs to be added. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 14 | COM-001-2 | Communications | To establish Interpersonal Communication capabilities necessary to maintain reliability. To ensure Balancing Authorities, Transmission Operators, and Generator Operators have adequate communications and that these communications capabilities are staffed and available for addressing a real-time emergency condition. To ensure communications by operating personnel are effective. | IEGC Section 5.2 (q): Each User, STU, RLDC, NLDC and CTU shall provide and maintain adequate and reliable communication facility internally and with other Users/STUs /RLDC/SLDC to ensure exchange of data/information necessary to maintain reliability and security of the grid. Wherever possible, redundancy and alternate path shall be maintained for communication along important routes,<br>e.g., SLDC to RLDC to NLDC. | Provisions for effective communication to be added. |
| 15 | COM-001-2/ COM-002-4 | Communication and Coordination | To establish Interpersonal Communication capabilities necessary to maintain reliability. To ensure Balancing Authorities, Transmission Operators, and Generator Operators have adequate communications and that these communications capabilities are staffed and available for addressing a real-time emergency condition. To ensure communications by operating personnel are effective.To improve communications for the issuance of Operating Instructions with predefined communications protocols to reduce the possibility of miscommunication that could lead to action or inaction harmful to the reliability of the Bulk Electric System (BES). | No provisions on predefined communication protocols; however RLDCs could include the same in their Operating Procedure which they have to prepare as per Chapter 5 of the IEGC. | Provisions for effective communication to be added. |
| 16 | EOP-001-2.1b | Emergency Operations Planning | Each Transmission Operator and Balancing Authority needs to develop, maintain, and implement a set of plans to mitigate operating emergencies. These plans need to be coordinated with other Transmission Operators and Balancing Authorities, and the Reliability Coordinator. | No provisions on predefined communication protocols; however RLDCs could include the same in their Operating Procedure which they have to prepare as per Chapter 5 of the IEGC. | Provisions for contingency plans to be added. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 17 | EOP-002-3.1 | Capacity and Energy Emergencies | To ensure Reliability Coordinators and Balancing Authorities are prepared for capacity and energy emergencies | No specific mention or definition of capacity and energy emergency. | Capacity and Energy Emergency to be defined. |
| 18 | EOP-003-2 | Load Shedding Plans | A Balancing Authority and Transmission Operator operating with insufficient generation or transmission capacity must have the capability and authority to shed load rather than risk an uncontrolled failure of the interconnection | IEGC section 5.4.2 has stipulations on demand disconnection | Implementation and compliance monitoring to be added. |
| 19 | EOP-004-2 | Event Reporting | To improve the reliability of the Bulk Electric System by requiring the reporting of events by Responsible Entities. | IEGC Section 5.9: This section indicates the procedure by which events are reported and the related information exchange requirements etc. | Implementation and compliance monitoring to be added. |
| 20 | EOP-005-2 | System Restoration from Blackstart Resources | Ensure plans, Facilities, and personnel are prepared to enable System restoration from Blackstart Resources to assure reliability is maintained during restoration and priority is placed on restoring the Interconnection | IEGC Section 5.8: Recovery Procedures | Implementation and compliance monitoring to be added. |
| 21 | EOP-006-2 | System Restoration Coordination | Ensure plans are established and personnel are prepared to enable effective coordination of the System restoration process to ensure reliability is maintained during restoration and priority is placed on restoring the Interconnection. | IEGC Section 5.8: Recovery Procedures | Implementation and compliance monitoring to be added. |
| 22 | EOP-008-1 | Loss of Control Centre Functionality | Ensure continued reliable operations of the Bulk Electric System (BES) in the event that a control center becomes inoperable. | None | Needs to be added. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 23 | EOP-010-1 | Geometric Disturbance Operations | To mitigate the effects of geomagnetic disturbance (GMD) events by implementing Operating Plans, Processes, and Procedures | None | Needs to be added. |
| 24 | FAC-001-1 | Facility Connection Requirements | To avoid adverse impacts on reliability, Transmission Owners and Generator Owners must establish Facility connection and performance requirements. | CEA (Technical Standards for Connnectivity to the Grid), Regulations 2007 specifies the need for a Connection Agreement. | Implementation and compliance monitoring to be added. |
| 25 | FAC-001-2 | Facility Interconnection Requirements | To avoid adverse impacts on the reliability of the Bulk Electric System, Transmission Owners and applicable Generator Owners must document and make Facility interconnection requirements available so that entities seeking to interconnect will have the necessary information. | CEA (Technical Standards for Connnectivity to the Grid), Regulations 2007 specifies the need for a Connection Agreement. | Implementation and compliance monitoring to be added. |
| 26 | FAC-002-1 | Coordination of Plans for New Generation, Transmission and End-User Facilities | To avoid adverse impacts on reliability, Generator Owners and Transmission Owners and electricity end-users must meet facility connection and performance requirements. | CEA (Technical Standards for Connnectivity to the Grid), Regulations 2007 specifies the need for a Connection Agreement. | Implementation and compliance monitoring to be added. |
| 27 | FAC-002-2 | Facility Interconnection Studies | To study the impact of interconnecting new or materially modified Facilities on the Bulk Electric System. | CEA (Technical Standards for Connnectivity to the Grid), Regulations 2007 specifies the need for a Connection Agreement and the need for Interconnection studies. | Implementation and compliance monitoring to be added. |
| 28 | FAC-003-3 | Transmission Vegetation Management | To maintain a reliable electric transmission system by using a defense-indepth strategy to manage vegetation located on transmission rights of way (ROW) and minimize encroachments from vegetation located adjacent to the ROW, thus preventing the risk of those vegetation-related outages that could lead to Cascading. | None | Needs to be added. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 29 | FAC-008-3 | Facility Ratings | To ensure that Facility Ratings used in the reliable planning and operation of the Bulk Electric System (BES) are determined based on technically sound principles. A Facility Rating is essential for the determination of System Operating Limits. | None | Needs to be added. |
| 30 | FAC-010-2.1/ FAC-011-2 | System Operation Limits Methodology for the Operations Horizon | To ensure that System Operating Limits (SOLs) used in the reliable operation of the Bulk Electric System (BES) are determined based on an established methodology or methodologies. | None | Needs to be added. |
| 31 | FAC-013-2 | Assessment of Transfer Capability for the Near-Term Transmission Planning Horizon | To ensure that Planning Coordinators have a methodology for, and perform an annual assessment to identify potential future Transmission System weaknesses and limiting Facilities that could impact the Bulk Electric System's (BES) ability to reliably transfer energy in the Near-Term Transmission Planning Horizon | Yes, the provisions in the CERC (Connectivity, Long Term Access and Medium Term Open Access) Regulations, 2009 as well as the CERC (Open Access in Inter State Transmission) Regulations, 2008 provide for transfer capability declaration in different time horizons. | Needs to be done in the medium term and long term horizon |
| 32 | FAC-014-2 | Establish and Communicate System Operating Limits | To ensure that System Operating Limits (SOLs) used in the reliable planning and operation of the Bulk Electric System (BES) are determined based on an established methodology or methodologies | Yes, limits defined in the Manual on Transmission Planning Criteria and the procedure approved by CERC under the Measures to relieve congestion in real time Regulations, 2009. | Further refinements to be carried out. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 33 | FAC-501-WECC-1 | Transmission Maintenance | To ensure the Transmission Owner of a transmission path identified in the table titled "Major WECC Transfer Paths in the Bulk Electric System" including associated facilities has a Transmission Maintenance and Inspection Plan (TMIP) | CEA (Grid Standards) Regulations, 2007 | Implementation and compliance monitoring to be added. |
| 34 | INT-001-3 | Interchange Information | To ensure that Interchange information is submitted to the NERC-identified reliability analysis service | IEGC Section 6.4: Demarcation of Responsibilities | |
| 35 | INT-004-2 | Dynamic Interchange Transaction Modifications | To ensure Dynamic Transfers are adequately tagged to be able to determine their reliability impacts. | Real time curtailment procedures | |
| 36 | INT-003-3 | Interchange Transaction Implementation | To ensure Balancing Authorities confirm Interchange Schedules with Adjacent Balancing Authorities prior to implementing the schedules in their Area Control Error (ACE) equations | | |
| 37 | INT-004-3 | Dynamic Transfers | To ensure Dynamic Schedules and Pseudo-Ties are communicated and accounted for appropriately in congestion management procedures | | |
| 38 | INT-005-3 | Interchange Authority Distributes Arranged Interchange | To ensure that the implementation of Interchange between Source and Sink Balancing Authorities is distributed by an Interchange Authority such that Interchange information is available for reliability assessments. | | |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 39 | INT-006-3 | Response to Interchange Authority | To ensure that each Arranged Interchange is checked for reliability before it is implemented. | As we move towards intra day and hourly market, need for elaborate checks and balances in the scheduling procedure would be there which has to be codified accordingly. | Would be required once we move to elaborate intra day market. |
| 40 | INT-006-4 | Evaluation of Interchange Transactions | To ensure that responsible entities conduct a reliability assessment of each Arranged Interchange before it is implemented | | |
| 41 | INT-007-1 | Interchange Confirmation | To ensure that each Arranged Interchange is checked for reliability before it is implemented. | | |
| 42 | INT-008-3 | Interchange Authority Distributes Status | To ensure that the implementation of Interchange between Source and Sink Balancing Authorities is coordinated by an Interchange Authority. | | |
| 43 | INT-009-1/ INT-009-2 | Implementation of Interchange | To ensure that the implementation of Interchange between Source and Sink Balancing Authorities is coordinated by an Interchange Authority such that the Balancing Authorities implement the Interchange exactly as agreed upon in the Interchange onfirmation process. | | |
| 44 | INT-010-1 | Interchange Coordination Exemptions | Allow certain types of Interchange schedules to be initiated or modified by reliability entities, and to be exempt from compliance with other Interchange Standards under abnormal operating conditions. | | |
| 45 | INT-010-2 | Interchange Initiation and Modification for Reliability | To provide guidance for required actions on Confirmed Interchange or Implemented Interchange to address reliability | | |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 46 | INT-011-1 | Intra-Balancing Authority Transaction Identification | To ensure that transfers within a Balancing Authority Area using Point to Point Transmission Service are communicated and accounted for in congestion management procedures. | | |
| 47 | IRO-001-1.1 | Reliability Coordination-Responsibilities and Authorities | Reliability Coordinators must have the authority, plans, and agreements in place to immediately direct reliability entities within their Reliability Coordinator Areas to re-dispatch generation, reconfigure transmission, or reduce load to mitigate critical conditions to return the system to a reliable state. If a Reliability Coordinator delegates tasks to others, the Reliability Coordinator retains its responsibilities for complying with NERC and regional standards. Standards of conduct are necessary to ensure the Reliability Coordinator does not act in a manner that favors one market participant over another | | |
| 48 | IRO 002-2 | Reliability Coordination-Facilities | Reliability Coordinators need information, tools and other capabilities to perform their responsibilities. | | |
| 49 | IRO-002-3 | Reliability Coordination-Analysis Tools | To ensure that Reliability Coordinators provide their System Operators with authority with respect to analysis tool outages and to have procedures to mitigate effects of analysis tool outages | | |
| 50 | IRO-003-2 | Reliability Coordination-Wide-Area View | The Reliability Coordinator must have a wide-area view of its own Reliability Coordinator Area and that of neighboring Reliability Coordinators. | | |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 51 | IRO-004-2 | Reliability Coordination-Operations Planning | Each Reliability Coordinator must conduct next-day reliability analyses for its Reliability Coordinator Area to ensure the Bulk Electric System can be operated reliably in anticipated normal and Contingency conditions. System studies must be conducted to highlight potential interface and other operating limits, including overloaded transmission lines and transformers, voltage and stability limits, etc. Plans must be developed to alleviate System Operating Limit (SOL) and Interconnection Reliability Operating Limit (IROL) violations. | The procedure approved by CERC under Measures to Relieve Congestion in Real Time specifies that Reliability Coordinators be designated at SLDC, RLDCs and NLDC level. This needs to be implemented effectively and the duties of Reliability Coordinator specified. | Needs to be added. |
| 52 | IRO-005-3.1a/ IRO-005-4 | Reliability Coordination-Current Day Operations | The Reliability Coordinator must be continuously aware of conditions within its Reliability Coordinator Area and include this information in its reliability assessments. The Reliability Coordinator must monitor Bulk Electric System parameters that may have significant impacts upon the Reliability Coordinator Area and neighboring Reliability Coordinator Areas. To ensure that entities are notified when an expected or actual event with Adverse Reliability Impacts is identified | | |
| 53 | IRO-006-5 | Reliability Coordination-Transmission Loading Relief | To ensure coordinated action between Interconnections when implementing Interconnection-wide transmission loading relief procedures to prevent or manage potential or actual SOL and IROL exceedances to maintain reliability of the bulk electric system | | |
| 54 | IRO-006-WECC-2 | Qualified Transfer Path Unscheduled Flow Relief | Mitigation of transmission overloads due to unscheduled flow on Qualified Transfer Paths. | | |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 55 | IRO-008-1 | Reliability Coordinator Operational Analysis and Real Time Assessments | To prevent instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the interconnection by ensuring that the Bulk Electric System is assessed during the operations horizon | | |
| 56 | IRO-009-1 | Reliability Coordinator Actions to Operate within Interconnection Reliability Operating Limits | To prevent instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the interconnection by ensuring prompt action to prevent or mitigate instances of exceeding Interconnection Reliability Operating Limits (IROLs). | | |
| 57 | IRO-010-1a | Reliability Coordinator Data Specification and Collection | To prevent instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the interconnection by ensuring the Reliability Coordinator has the data it needs to monitor and assess the operation of its Reliability Coordinator Area. | | |
| 58 | IRO-014-1 | Procedures, Processes, or Plans to support Coordination Between Reliability Coordinators | To ensure that each Reliability Coordinator's operations are coordinated such that they will not have an Adverse Reliability Impact on other Reliability Coordinator Areas and to preserve the reliability benefits of interconnected operations | | |
| 59 | IRO-014-2 | Coordination among Reliability Coordinators | To ensure that each Reliability Coordinator's operations are coordinated such that they will not have an Adverse Reliability Impact on other Reliability Coordinator Areas and to preserve the reliability benefits of interconnected operations. | | |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 60 | IRO-015-1 | Notifications and Information Exchange between Reliability Coordinators | To ensure that each Reliability Coordinator's operations are coordinated such that they will not have an Adverse Reliability Impact on other Reliability Coordinator Areas and to preserve the reliability benefits of interconnected operations | | |
| 61 | IRO-016-1 | Coordination of Real-time Activities between Reliability Coordinators | To ensure that each Reliability Coordinator's operations are coordinated such that they will not have an Adverse Reliability Impact on other Reliability Coordinator Areas and to preserve the reliability benefits of interconnected operations | | |
| 62 | MOD-001-1a/ MOD-001-2 | Available Transmission System Capability | To ensure that calculations are performed by Transmission Service Providers to maintain awareness of available transmission system capability and future flows on their own systems as well as those of their neighbors To ensure that determinations of available transmission system capability are determined in a manner that supports the reliable operation of the Bulk-Power System (BPS) and that the methodology and data underlying those determinations are disclosed to those registered entities that need such information for reliability purposes. | CERC approved procedures for grant of LTA and MTOA as well as measures to relieve congestion in real time provide for TTC/ATC determination. | |
| 63 | MOD-004-1 | Capacity Benefit Margin | To promote the consistent and reliable calculation, verification,preservation, and use of Capacity Benefit Margin (CBM) to support analysis and system operations. | No provision for Capacity Benefit Margin | Would be required once Area Control Error (ACE) is introduced. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 64 | MOD-008-1 | Transmission Reliability Margin Calculation Methodology | To promote the consistent and reliable calculation, verification, preservation, and use of Transmission Reliability Margin (TRM) to support analysis and system operations | Method is defined in the CERC approved procedure. | Needs further elaboration |
| 65 | MOD-010-0 | Steady state data for modelling and simulation of the interconnected transmission system | To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the Interconnected Transmission Systems | None | Needs to be defined. |
| 66 | MOD-011-0 | Maintenance and distribution of steady state data requirements and reporting procedures | To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the interconnected transmission systems. | None | Needs to be defined. |
| 67 | MOD-012-0 | Dynamics data for modelling and simulation of interconnected transmission system | To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the interconnected transmission systems | None | Needs to be defined. |
| 68 | MOD-013-1 | Maintenance and distribution of dynamic data requirements and reporting procedures | To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the interconnected transmission systems | None | Needs to be defined. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 69 | MOD-014-0 | Development of steady state system models | To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the interconnected transmission systems. | None | Needs to be defined. |
| 70 | MOD-015-0/ MOD-015-0.1 | Development of dynamic system models | To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the interconnected transmission systems. To establish consistent data requirements, reporting procedures, and system models to be used in the analysis of the reliability of the interconnected transmission systems | None | Needs to be defined. |
| 71 | MOD-016-1.1 | Documentation of data reporting requirements for actual and forecast demand, net energy for load and controllable demand side management | Ensure that accurate, actual Demand data is available to support assessments and validation of past events and databases. Forecast Demand data is needed to perform future system assessments to identify the need for system reinforcements for continued reliability. In addition, to assist in proper real-time operating, Load information related to controllable Demand-Side Management (DSM) programs is needed | IEGC section 5.3 covers demand estimation for operational purposes. | Monitoring and compliance required. |
| 72 | MOD-017-0.1 | Aggregated actual and forecast demands and net energy for load | To ensure that assessments and validation of past events and databases can be performed, reporting of actual Demand data is needed. Forecast demand data is needed to perform future system assessment to identify the need for system reinforcement for continued reliability. In addition to assist in proper real-time operating, load information related to controllable Demand-Side Management programs is needed. | Chapter 3 of the IEGC covers the 'Planning Code for Inter State Transmission'. | Needs further elaboration |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 73 | MOD-018-0 | Treatment of Non-member Demand Data and How Uncertainties are addressed in the Forecasts of Demand and Net Energy for Load | To ensure that Assessments and validation of past events and databases can be performed, reporting of actual demand data is needed. Forecast demand data is needed to perform future system assessments to identify the need for system reinforcement for continued reliability. In addition, to assist in proper real-time operating, load information related to controllable Demand-Side Management programs is needed. | Section 5.5 of the IEGC covers periodic reports. Demand data aspect needs to be covered. | Needs further elaboration |
| 74 | MOD-019-0.1 | Reporting of interruptible demands and direct control load management | To ensure that assessments and validation of past events and databases can be performed, reporting of actual demand data is needed. Forecast demand data isneeded to perform future system assessments to identify the need for system reinforcement for continued reliability. In addition, to assist in proper real-time operating, load information related to controllable Demand-Side Management programs is needed. | Section 5.5 of the IEGC covers periodic reports. Demand data aspect needs to be covered. | Needs further elaboration |
| 75 | MOD-020-0 | Providing interruptible demands and direct control load management data to system operators and reliability coordinators | To ensure that assessments and validation of past events and databases can be performed, reporting of actual demand data is needed. Forecast demand data is needed to perform future system assessments to identify the need for system reinforcement for continued reliability. In addition to assist in proper real-time operating, load information related to controllable Demand-Side Management programs is needed | Section 5.5 of the IEGC covers periodic reports. Demand data aspect needs to be covered. | Needs further elaboration |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 76 | MOD-021-1 | Documentation of the Accounting Methodology for the Effects of Demand-Side Management in Demand and Energy Forecasts | To ensure that assessments and validation of past events and databases can be performed, reporting of actual Demand data is needed. Forecast demand data is needed to perform future system assessments to identify the need for system reinforcement for continued reliability. In addition, to assist in proper real-time operating, load information related to Demand-Side Management (DSM) programs is needed. | Section 5.5 of the IEGC covers periodic reports. Demand data aspect needs to be covered. | Needs further elaboration |
| 77 | MOD-024-1 | Verification of Generator Gross and Net Real Power Capability | To ensure accurate information on generator gross and net Real Power capability is available for steady-state models used to assess Bulk Electric System reliability. | For new generators being provided connectivity, all generators are required to submit the information to CTU. | Needs to be extended for old generators connected to ISTS as well as intra state. |
| 78 | MOD-025-1 | Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability | To ensure that accurate information on generator gross and net Real and Reactive Power capability and synchronous condenser Reactive Power capability is available for planning models used to assess Bulk Electric System (BES) reliability. | For new generators being provided connectivity, all generators are required to submit the information to CTU. | Needs to be extended for old generators connected to ISTS as well as intra state. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 79 | MOD-025-2 | Verification and Data Reporting of Generator Real and Reactive Power Capability and Synchronous Condenser Reactive Power Capability | To ensure that accurate information on generator gross and net Real and Reactive Power capability and synchronous condenser Reactive Power capability is available for planning models used to assess Bulk Electric System (BES) reliability. | For new generators being provided connectivity, all generators are required to submit the information to CTU. | Needs to be extended for old generators connected to ISTS as well as intra state. |
| 80 | MOD-026-1 | Verification of Models and Data for Generator Excitation Control System or Plant Volt/Var Control Functions | To verify that the generator excitation control system or plant volt/var control function1 model (including the power system stabilizer model and the impedance compensator model) and the model parameters used in dynamic simulations accurately represent the generator excitation control system or plant volt/var control function behavior when assessing Bulk Electric System (BES) reliability. | For new generators being provided connectivity, all generators are required to submit the information to CTU. | Needs to be extended for old generators connected to ISTS as well as intra state. |
| 81 | MOD-027-1 | Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions | To verify that the turbine/governor and load control or active power/frequency control1 model and the model parameters, used in dynamic simulations that assess Bulk Electric System (BES) reliability, accurately representgenerator unit real power response to system frequency variations. | For new generators being provided connectivity, all generators are required to submit the information to CTU. | Needs to be extended for old generators connected to ISTS as well as intra state. |

**Reliability Standards issued by North American Electric Reliability Corporation Ltd. (NERC) and corresponding provisions in CEA/CERC Regulations**

| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 82 | MOD-028-2 | Area Interchange Methodology | To increase consistency and reliability in the development and documentation of Transfer Capability calculations for short-term use performed by entities using the Area Interchange Methodology to support analysis and system operations. | None | Could be considered in TTC/ATC determination |
| 83 | MOD-029-1a | Rated System Path Methodology | To increase consistency and reliability in the development and documentation of transfer capability calculations for short-term use performed by entities using the Rated System Path Methodology to support analysis and system operations. | None | Could be considered in TTC/ATC determination |
| 84 | MOD-030-02 | Flowgate Methodology | To increase consistency and reliability in the development and documentation of transfer capability calculations for short-term use performed by entities using the Flowgate Methodology to support analysis and system operations. | None | Could be considered in TTC/ATC determination |
| 85 | MOD-031-1 | Demand and Energy Data | To provide authority for applicable entities to collect Demand, energy and related data to support reliability studies and assessments and to enumerate the responsibilities and obligations of requestors and respondents of that data. | None | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 86 | MOD-032-1 | Data for Power System Modeling and Analysis | To establish consistent modeling data requirements and reporting procedures for development of planning horizon cases necessary to support analysis of the reliability of the interconnected transmission system. | None | Needs to be elaborated. |
| 87 | MOD-033-1 | Steady-State and Dynamic System Model Validation | To establish consistent validation requirements to facilitate the collection of accurate data and building of planning models to analyze the reliability of the interconnected transmission system. | None | Needs to be elaborated. |
| 88 | NUC-001-2.1/ NUC-001-3 | Nuclear Plant Interface Coordination | This standard requires coordination between Nuclear Plant Generator Operators and Transmission Entities for the purpose of ensuring nuclear plant safe operation and shutdown. | None. Earlier Transmission Planning Criteria had stipulation regarding alternative sources of start up supply to a nuclear power station and the angular difference between them. | Needs to be elaborated. |
| 89 | PER-001-0.2 | Operating Personnel Responsibility and Authority | Transmission Operator and Balancing Authority operating personnel must have the responsibility and authority to implement real-time actions to ensure the stable and reliable operation of the Bulk Electric System. | The Electricity Act 2003 has provisions that RLDCs/SLDCs directions have to be complied with in real time. | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 90 | PER-003-1 | Operating Personnel Credentials | To ensure that System Operators performing the reliability-related tasks of the Reliability Coordinator, Balancing Authority and Transmission Operator are certified through the NERC System Operator Certification Program when filling a Real-time operating position responsible for control of the Bulk Electric System. | Chapter 5 of the IEGC stipulates that the control rooms of the NLDC, RLDC, all SLDCs, power plants, substation of 132 kV and above, and any other control centres of all regional entities shall be manned round the clock by qualified and adequately trained personnel. Training requirements may be notified by the Commission from time to time, by orders. | Needs to be elaborated and mandated by law. |
| 91 | PER-004-2 | Reliability Coordination — Staffing | Reliability Coordinators must have sufficient, competent staff to perform the Reliability Coordinator functions. | None | Needs to be elaborated. |
| 92 | PER-005-1/ PER-005-2 | System Personnel Training | To ensure that System Operators performing real-time, reliability-related tasks on the North American Bulk Electric System (BES) are competent to perform those reliability-related tasks. The competency of System Operators is critical to the reliability of the North American Bulk Electric System. To ensure that personnel performing or supporting Real-time operations on the Bulk Electric System are trained using a systematic approach. | Stipulation of real time digital simulator training and a refresher course at least once in two years for System Operators in the CEA Grid Standards. The CEA (Measures Relating to Safety and Electric Supply) Regulations, 2010 indicates the syllabus for engineers and supervisors for operation and maintenance of transmission system. | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 93 | PRC-001-1.1/ PRC-001-2 | System Protection Coordination | To ensure system protection is coordinated among operating entities. | General guidelines in IEGC, CEA (Technical Standards for Connectivity to the Grid) and CEA (Grid Standards). | Needs to be elaborated. |
| 94 | PRC-002-1 | Define Regional Disturbance Monitoring and Reporting Requirements | Ensure that Regional Reliability Organizations establish requirements for<br>installation of Disturbance Monitoring Equipment (DME) and reporting of Disturbance data to facilitate analyses of events and verify system models. | IEGC and CEA Grid Standards have stipulations regarding forwarding of disturbance data within 24 hours. | Needs to be elaborated and compliance monitoring required. |
| 95 | PRC-002-NPCC-01 | Disturbance Monitoring | Ensure that adequate disturbance data is available to facilitate Bulk Electric System event analyses. All references to equipment and facilities herein unless otherwise noted will be to Bulk Electric System (BES) elements. | IEGC and CEA Grid Standards have stipulations regarding forwarding of disturbance data within 24 hours. | Needs to be elaborated and compliance monitoring required. |
| 96 | PRC-003-1/ PRC-004-2.1a | Regional Procedure for Analysis of Misoperations of Transmission and Generation Protection Systems<br>2. Number: PRC-003-1 | To ensure all transmission and generation Protection System Misoperations affecting the reliability of the Bulk Electric System (BES) are analyzed and mitigated. | IEGC and CEA Grid Standards have stipulations regarding disturbance reporting. | Needs to be elaborated and compliance monitoring required. |
| 97 | PRC-004-3 | Protection System Misoperation Identification and Correction | Identify and correct the causes of Misoperations of Protection Systems for Bulk Electric System (BES) Elements. | None | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 98 | PRC-004-WECC-1 | Protection System and Remedial Action Scheme Misoperation | Regional Reliability Standard to ensure all transmission and generation Protection System and Remedial Action Scheme (RAS) Misoperations on Transmission Paths and RAS defined in section 4 are analyzed and/or mitigated. | None | Needs to be elaborated. |
| 99 | PRC-005-1.1b/ PRC-005-2/ PRC-005-3 | Transmission and Generation Protection System Maintenance and Testing | To ensure all transmission and generation Protection Systems affecting the reliability of the Bulk Electric System (BES) are maintained and tested. To document and implement programs for the maintenance of all Protection Systems affecting the reliability of the Bulk Electric System (BES) so that these Protection Systems are kept in working order. | None | Needs to be elaborated. |
| 100 | PRC-006-1/ PRC-006-NPCC-1 | Automatic Underfrequency Load Shedding | To establish design and documentation requirements for automatic underfrequency load shedding (UFLS) programs to arrest declining frequency, assist recovery of frequency following underfrequency events and provide last resort system preservation measures.To provide a regional reliability standard that ensures the development of an effective automatic underfrequency load shedding (UFLS) program in order to preserve the security and integrity of the bulk power system during declining system frequency events in coordination with the NERC UFLS reliability standard characteristics | None. IEGC and CEA Grid Standards have stipulations that such schemes would be finalized at RPC level and periodically inspected. | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 101 | PRC-008-0 | Implementation and Documentation of Underfrequency Load Shedding Equipment Maintenance Program | Provide last resort system preservation measures by implementing an Under Frequency Load Shedding (UFLS) program. | None. | Needs to be elaborated. |
| 102 | PRC-010-0 | Technical Assessment of the Design and Effectiveness of Undervoltage Load Shedding Program. | Provide System preservation measures in an attempt to prevent system voltage collapse or voltage instability by implementing an Undervoltage Load Shedding (UVLS) program. | None. IEGC has stipulations that such schemes would be finalized at RPC level. | Needs to be elaborated. |
| 103 | PRC-011-0 | Undervoltage Load Shedding System Maintenance and Testing | Provide system preservation measures in an attempt to prevent system voltage collapse or voltage instability by implementing an Undervoltage Load Shedding (UVLS) program. | None | Needs to be elaborated. |
| 104 | PRC-012-0/ PRC-013-0/ PRC-014-0/ PRC-015-0/ PRC-016-0.1/ PRC-017-0 | Special Protection System Review Procedure | To ensure that all Special Protection Systems (SPS) are properly designed, meet performance requirements, and are coordinated with other protection systems. To ensure that maintenance and testing programs are developed and misoperations are analyzed and corrected. | None | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 105 | PRC-018-1 | Disturbance Monitoring Equipment Installation and Data Reporting | Ensure that Disturbance Monitoring Equipment (DME) is installed and that Disturbance data is reported in accordance with regional requirements to facilitate analyses of events. | General IEGC stipulations on Disturbance Recorders and Event Loggers. | Needs to be elaborated. |
| 106 | PRC-019-1 | Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection | To verify coordination of generating unit Facility or synchronous condenser voltage regulating controls, limit functions, equipment capabilities and Protection System settings. | None | Needs to be elaborated. |
| 107 | PRC-020-1/ | Under-Voltage Load Shedding Program Database | Ensure that a regional database is maintained for Under-Voltage Load Shedding (UVLS) programs implemented by entities within the Region to mitigate the risk of voltage collapse or voltage instability in the Bulk Electric System (BES). Ensure the UVLS database is available for Regional studies and for dynamic studies and simulations of the BES. | None | Needs to be elaborated. |
| 108 | PRC-021-1/ PRC-022-1 | Under-Voltage Load Shedding Program Performance | Ensure that Under Voltage Load Shedding (UVLS) programs perform as intended to mitigate the risk of voltage collapse or voltage instability in the Bulk Electric System (BES). | None | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 109 | PRC-023-2/ PRC-023-3 | Transmission Relay Loadability | Protective relay settings shall not limit transmission loadability; not interfere with system operators' ability to take remedial action to protect system reliability and; be set to reliably detect all fault conditions and protect the electrical network from these faults. | None. | Needs to be elaborated. Of utmost importance when we talk about increasing loading on the transmission lines. |
| 110 | PRC-024-1 | Generator Frequency and Voltage Protective Relay Settings | Ensure Generator Owners set their generator protective relays such that generating units remain connected during defined frequency and voltage excursions. | None. | Needs to be elaborated. |
| 111 | PRC-025-1 | Generator Relay Loadability | To set load-responsive protective relays associated with generation Facilities at a level to prevent unnecessary tripping of generators during a system disturbance for conditions that do not pose a risk of damage to the associated equipment. | None. | Needs to be elaborated. |
| 112 | TOP-001-1a | Reliability Responsibilities and Authorities | To ensure reliability entities have clear decision-making authority and capabilities to take appropriate actions or direct the actions of others to return the transmission system to normal conditions during an emergency. | None. | Needs to be elaborated. |
| 113 | TOP-001-2 | Transmission Operations | To prevent instability, uncontrolled separation, or cascading outages that adversely impact the reliability of the Interconnection by ensuring prompt action to prevent or mitigate such occurrences | None. | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 114 | TOP-002-2.1b/ TOP-002-3 | Normal Operations Planning | Current operations plans and procedures are essential to being prepared for reliable operations, including response for unplanned events. To ensure that Transmission Operators have plans for operating within specified limits. | Operating Procedures issued by NLDC/RLDCs/SLDCs cover these procedures. | Needs to be elaborated. |
| 115 | TOP-003-1 | Planned Outage Coordination | Scheduled generator and transmission outages that may affect the reliability of interconnected operations must be planned and coordinated among Balancing Authorities, Transmission Operators, and Reliability Coordinators. | IEGC and CEA Grid Standards have elaborate provisions on outage planning. | Needs to be elaborated. Compliance monitoring to be issued. |
| 116 | TOP-003-2 | Operational Reliability Data | To ensure that the Transmission Operator and Balancing Authority have the data needed to fulfill their operational planning and Real-time monitoring responsibilities. | Suitable provisions regarding real time data availability in IEGC and CEA Grid Standards. | Needs to be elaborated. |
| 117 | TOP-004-2 | Transmission Operations | To ensure that the transmission system is operated so that instability, uncontrolled separation, or cascading outages will not occur as a result of the most severe single Contingency and specified multiple Contingencies. | None. | Needs to be elaborated. |
| 118 | TOP-005-2a | Operational Reliability Information | To ensure reliability entities have the operating data needed to monitor system conditions within their areas. | Suitable provisions regarding real time data availability in IEGC and CEA Grid Standards. | Needs to be elaborated. |
| 119 | TOP-006-2/ TOP-006-3 | Monitoring System Conditions | To ensure critical reliability parameters are monitored in real-time. | Suitable provisions regarding real time data availability in IEGC and CEA Grid Standards. | Needs to be elaborated. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 120 | TOP-007-0 | Reporting System Operating Limit (SOL) and Interconnection Reliability Operating Limit (IROL) Violations | This standard ensures SOL and IROL violations are being reported to the Reliability Coordinator so that the Reliability Coordinator may evaluate actions being taken and direct additional corrective actions as needed. | Congestion Monitoring scheme exists. | Needs to be further elaborated. |
| 121 | TOP-007-WECC-1a | System Operating Limits | When actual flows on Major WECC Transfer Paths exceed System Operating Limits (SOL), their associated schedules and actual flows are not exceeded for longer than a specified time. | Congestion Monitoring scheme exists. | Needs to be further elaborated. |
| 122 | TOP-008-1 | Response to Transmission Limit Violations | To ensure Transmission Operators take actions to mitigate SOL and IROL violations. | Congestion Monitoring scheme exists. | Needs to be further elaborated. |
| 123 | TPL-001-0.1 | System Performance Under Normal (No Contingency) Conditions (Category A) | System simulations and associated assessments are needed periodically to ensure that reliable systems are developed that meet specified performance requirements with sufficient lead time, and continue to be modified or upgraded as necessary to meet present and future system needs. | None. | Need for a Planning Standard or Regulation. |
| 124 | TPL-001-4 | Transmission System Planning Performance Requirements | Establish Transmission system planning performance requirements within the planning horizon to develop a Bulk Electric System (BES) that will operate reliably over abroad spectrum of System conditions and following a wide range of probable Contingencies. | None. | Need for a Planning Standard or Regulation. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 125 | TPL-002-0b | System Performance Following Loss of a Single Bulk Electric System Element (Category B) | System simulations and associated assessments are needed periodically to ensure that reliable systems are developed that meet specified performance requirements with sufficient lead time, and continue to be modified or upgraded as necessary to meet present and future system needs. | None. | Need for a Planning Standard or Regulation. |
| 126 | TPL-003-0b | System Performance Following Loss of Two or More Bulk Electric System Elements (Category C) | System simulations and associated assessments are needed periodically to ensure that reliable systems are developed that meet specified performance requirements, with sufficient lead time and continue to be modified or upgraded as necessary to meet present and future System needs. | None. | Need for a Planning Standard or Regulation. |
| 127 | TPL-004-0a | System Performance Following Extreme Events Resulting in the Loss of Two or More Bulk Electric System Elements (Category D) | System simulations and associated assessments are needed periodically to ensure that reliable systems are developed that meet specified performance requirements, with sufficient lead time and continue to be modified or upgraded as necessary to meet present and future System needs. | None. | Need for a Planning Standard or Regulation. |

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| S.No. | NERC Standard no | Area of Standard | Purpose | Corresponding CERC/CEA Standards | Remarks |
|---|---|---|---|---|---|
| 128 | VAR-001-3/ VAR-001-4 | Voltage and Reactive Control | To ensure that voltage levels, reactive flows, and reactive resources are monitored, controlled, and maintained within limits in real time to protect equipment and the reliable operation of the Interconnection. | Suitable provisions in IEGC. | Needs to be elaborated. |
| 129 | VAR-002-2b/ VAR-002-3 | Generator Operation for Maintaining Network Voltage Schedules | To ensure generators provide reactive and voltage control necessary to ensure voltage levels, reactive flows, and reactive resources are maintained within applicable Facility Ratings to protect equipment and the reliable operation of the Interconnection. | Suitable provisions in IEGC. | Needs to be elaborated. |
| 130 | VAR-002-WECC-1 | Automatic Voltage Regulators (AVR) | To ensure that Automatic Voltage Regulators on synchronous generators and condensers shall be kept in service and controlling voltage. | Suitable provisions in IEGC, CEA Grid Standards and CEA Technical Standards for connectivity to the grid. | Needs to be elaborated. |
| 131 | VAR-501-WECC-1 | Power System Stabilizer (PSS) | To ensure that Power System Stabilizers (PSS) on synchronous generators shall be kept in service. | Suitable provisions in IEGC and CEA Technical Standards for connectivity to the grid. | Needs to be elaborated. |