


**System Operating Limits
Methodology
For The
Planning Horizon
For
Associated Electric Cooperative, Inc.**

Effective Date: April 1, 2017

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NOTE: WHEN REVISING THIS PROCEDURE ENSURE LATEST REVISION IS UPLOADED TO THE PUBLIC OASIS SITE AND NOTIFICATIONS ARE SENT TO NEIGHBORING PLANNING AUTHORITIES AND EACH RELIABILITY COORDINATOR, TRANSMISSION OPERATOR, AND TRANSMISSION PLANNER WITHIN AECI’S PLANNING AUTHORITY AREA, AS DESCRIBED IN SECTION VI.1.

| Revision No. | Revision History | Date |
|--------------|---|------------|
| 0 | Original Issue | 7/1/2007 |
| 1 | Added to sections IV and V to provide clarification in meeting the NERC standard. | 10/13/2008 |
| 2 | Changed standard reference number from NERC Standard – FAC-010-1 to NERC Standard – FAC-010-2. Refined grammar in sections I & II. In paragraph IV.5, added “shunt device” to outaged equipment list. Added system adjustments that may be made. Reworked paragraph IV.6 to bring into line with Standard language and requirements. Reworked section V., including moving AECI’s planning criteria to paragraph V.5. | 01/08/2010 |
| 3 | Corrected section IV.6 so that it applies to multiple contingencies and not just single contingencies. Removed reference to AECI “System Planning, Design, Maintenance, and Operating Criteria”. Corrected section V. paragraph numbering. Added detail about modeled loads. | 04/08/2012 |
| 4 | Revised language to more closely match the FAC-010 standard language and NERC definition of IROL. | 03/15/2013 |
| 5 | Updated references to the old TPL standard to point to the new TPL-001-4 standard. Clarified specifics on how AECI determines SOLs. Updated Document Communication Section. | 01/07/2016 |

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| 6 | Changed " <i>Special Protection Systems</i> " to " <i>Remedial Action Schemes</i> ". Other minor edits. | 02/03/2017 |
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Table of Contents

| | | |
|-------------|---|----------|
| I. | Purpose / Introduction | 4 |
| II. | Application | 4 |
| III. | Definitions | 4 |
| IV. | SOL Methodology | 4 |
| V. | Study Model | 7 |
| VI. | Document Communication and Maintenance | 7 |

I. Purpose

To establish a methodology by which Associated Electric Cooperative, Inc. (AECI) shall determine System Operating Limits (SOLs) to be used in the reliable planning of the Bulk Electric System (BES).

II. Application

As a registered Planning Authority within NERC, FAC-010-3 is applicable to AECI.

III. Definitions

- III.1 The NERC definition of a System Operating Limit (SOL) is:
The value (such as MW, MVAR, Amperes, Frequency or Volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria. System Operating Limits are based upon certain operating criteria. These include but are not limited to:
- Facility Ratings
 - Transient Stability Ratings
 - Voltage Stability Ratings
 - System Voltage Limits
- III.2 The NERC definition of an Interconnection Reliability Operating Limit (IROL) is: An SOL that, if violated could lead to instability, uncontrolled separation, or Cascading outages that adversely impact the reliability of the Bulk Electrical System.
- III.3 AECI Bulk Transmission System – Any transmission line owned by AECI or by AECI's six member G&T cooperatives that is energized at a voltage greater than 100kV
- III.4 NERC – North American Electric Reliability Corporation or its successor organization.
- III.5 SERC - SERC Reliability Corporation or its successor organization.

IV. SOL Methodology

- IV.1 This methodology shall be used for developing AECI's SOLs in the planning horizon.
- IV.2 The SOLs shall not exceed the associated Facility Ratings as documented in AECI's FAC-008 procedure.
- IV.3 If an SOL is exceeded that results in instability, uncontrolled separation, or Cascading outages which impacts the electrical grid beyond the AECI geographic boundaries, then this SOL will be defined as an Interconnection Reliability Operating Limit (IROL).

IV.4 Pre-contingency State: All Facilities in Service for the Planning Horizon:

In the pre-contingency state and with all Facilities in service (TPL-001-4 Category P0), the BES shall demonstrate transient, dynamic and voltage stability; all Facilities shall be within their Facility Ratings and within their thermal, voltage and stability limits. In the determination of SOLs, the BES condition used shall reflect expected system conditions and shall reflect changes to system topology such as Facility outages.

AECI meets this requirement by reviewing its annual TPL-001-4 assessment. If the BES performance requirements described above are not met, then an SOL must be determined such that the BES performance requirements described above are met (like limiting generator output, limiting transfers, etc.).

IV.5 Single Contingency Outages in the Planning Horizon

Following the single Contingencies identified below, the BES shall demonstrate transient, dynamic and voltage stability; all Facilities shall be operating within their Facility Ratings and within their thermal, voltage, and stability limits, and Cascading or uncontrolled separation shall not occur. Single Contingencies include¹:

- Single line to ground or three phase Fault (whichever is more severe), with Normal Clearing, on any Faulted generator, line, transformer, or shunt device (TPL-001-4 Categories P1-1, P1-2, P1-3, & P1-4)
- Loss of a generator, line, transformer, or shunt device without a Fault (TPL-001-4 Category P2-1 (as well as TPL-001-4 Categories P1-1, P1-3, & P1-4)²)
- Single pole block, with Normal Clearing, in a monopolar or bipolar high voltage direct current system (TPL-001-4 Category P1-5)

Starting with all Facilities in service, the system's response to a single contingency may include the following:

- Planned or controlled interruption of electric supply to radial customers or some local network customers connected to or supplied by the Faulted Facility or by the affected area.
- System reconfiguration through manual or automatic control or protection actions.

To prepare for the next Contingency, system adjustments may be made including changes to generation, uses of the transmission system, and the transmission system topology.

AECI meets this requirement by reviewing its annual TPL-001-4 assessment. If the BES performance requirements described above are not met, then an SOL must be determined such that the BES performance requirements described above are met (like limiting generator output, limiting transfers, etc.).

¹ These contingencies identified in FAC-010 R2.2.1 through R2.2.3 are the minimum contingencies that must be studied but are not necessarily the only contingencies that should be studied.

² AECI considers the loss of any generator, transformer, or shunt device with a Fault to be more severe than the loss of any generator, transformer, or shunt device without a Fault. The AECI TPL studies assess the loss of any generator, transformer, or shunt device with a Fault and therefore studies more than the minimum contingencies that should be studied per R2.2.2.

IV.6 Multiple (Less Probable) Contingency Outages in the Planning Horizon

Starting with all Facilities in service and following any of the multiple Contingencies identified for any of the contingency categories in Reliability Standard TPL-001-4 listed below (formerly TPL-003), the BES shall demonstrate transient, dynamic, and voltage stability; all Facilities shall be operating within their Facility Ratings and within their thermal, voltage and stability limits; and Cascading or uncontrolled separation shall not occur.

| TPL-003 | TPL-001-4 |
|----------------|--|
| C1 | P2-2 |
| C2 | P2-3, P2-4 |
| C3 | P3-1, P3-2, P3-3, P3-5, P6-1-1, P6-1-2, P6-1-4, P6-2-1, P6-2-2, P6-2-4, P6-4-1, P6-4-2, P6-4-4 |
| C4 | P7-1 |
| C5 | P7-2 |
| C6 | P4-1, P5-1 |
| C7 | P4-3, P5-3 |
| C8 | P4-2, P5-2 |
| C9 | P4-5, P4-6, P5-5 |

In determining the system’s response to any of the multiple Contingencies, identified for any of the contingency categories in Reliability Standard TPL-001-4 listed above (formerly TPL-003), the following shall be acceptable:

- Planned or controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, and/or the curtailment of contracted Firm (non-recallable reserved) electric power Transfers.
- System reconfiguration through manual or automatic control or protection actions.

AECI meets this requirement by reviewing its annual TPL-001-4 assessment. If the BES performance requirements described above are not met, then an SOL must be determined such that the BES performance requirements described above are met (like limiting generator output, limiting transfers, etc.).

V. Study Model

- V.1 The study model used for determining AECI's SOL's is the same as is used for the TPL-001-4 assessment. This will most likely be the most current SERC Long Term Study Group (LTSG) model or the NERC MMWG model.
- V.2 The selection of contingencies is described in AECI's TPL-001-4 assessment.
- V.3 The models' detail goes down to the 69 kV voltage level.
- V.4 AECI does not use any Remedial Action Schemes.
- V.5 Remedial actions or operating guides for a particular contingency are described in AECI's TPL-001-4 assessment.
- V.6 The transmission system configuration, generation dispatch and load level are, in general, not modified from the latest published SERC LTSG cases. The load levels are described in AECI's TPL-001-4 assessment. The generation dispatch order is coordinated with AECI's Resource Planning Department's projections. Minor modifications may take place due to updates from SERC or other trusted entities (e.g. SPP).
- V.7 The criteria for determining when violating an SOL qualifies as an IROL is defined above in IV.3. The IROL Tv (maximum time that an IROL can be violated before the risk to the interconnection or other Reliability Coordinator Area(s) becomes greater than acceptable) shall be determined and shall be less than or equal to 30 minutes.

VI. Document Communication and Maintenance

- VI.1 AECI shall post this methodology on the public OASIS. AECI shall send this methodology, and any change to this methodology, to all of the following prior to the effectiveness of the change:
 - Each adjacent Planning Authority and each Planning Authority that indicated it has a reliability-related need for the methodology.
 - Each Reliability Coordinator and Transmission Operator that operates any portion of the Planning Authority's Planning Authority Area.
 - Each Transmission Planner that works in the Planning Authority's Planning Authority Area.
- VI.2 AECI shall maintain and update these requirements as necessary. The requirements will be provided to transmission users, SERC, and NERC within 5 business days upon request.
- VI.3 If a recipient of this SOL methodology provides written technical comments, AECI shall provide a written response within 45 days after receiving the comments. The response shall include whether a change will be made to this Methodology and, if no change the reason why.