FERC FORM 715

ANNUAL TRANSMISSION PLANNING AND EVALUATION REPORT

Part 4: Transmission Planning Reliability Criteria

Transmitting Utility Name AMP Transmission, LLC

April 1, 2023

AMP Transmission, LLC

TRANSMISSION PLANNING CRITERIA

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1.0 Background

This document provides the local planning criteria which will determine the reinforcements and enhancements to the AMP Transmission, LLC (AMPT) transmission system.

These AMPT Transmission Planning criteria ensure compliance with the Transmission Planning standards of the North American Electric Reliability Corporation (NERC), ReliabilityFirst (RF), and PJM. AMPT is a Transmission Owner (TO) member of the PJM Interconnection Regional Transmission Organization. AMPT subscribes to and designs its Bulk Electric System (BES) and all networked non-BES transmission facilities to comply with the reliability principles and responsibilities set forth in PJM's business practice manuals.

The Federal Energy Regulatory Commission (FERC) requires all transmission providers that own, operate, or control facilities used for transmitting electric energy in interstate commerce to have on file an open access non-discriminatory transmission tariffs. PJM has these tariffs on file on behalf of its transmission-owning members to provide firm and non-firm point-to-point transmission service to other entities, as well as firm network service.

The NERC, RF, and PJM standards and requirements previously referred to above are discussed in Section 2. The AMPT Planning Adequacy Criteria are presented in Section 3. The Planning Performance Conditions, such as the thermal loading and voltage thresholds are presented in Section 4.

2.0 National and Regional Criteria and Guides

2.1 NERC Transmission Planning Standards

NERC was established to oversee reliability of the North American BES. NERC develops and ensures compliance with reliability standards for BES. NERC's area of responsibility spans the continental United States, Canada, and the northern portion of Baja California, Mexico. NERC is the Electric Reliability Organization (ERO) for North America, subject to oversight by the Federal Energy Regulatory Commission (FERC) and governmental authorities in Canada. NERC consists of six Regional Entities. AMPT's transmission facilities are in the RF region. FERC approved reliability standards can be found on the NERC website at: https://www.nerc.com/pa/Stand/Pages/AllReliabilityStandards.aspx?jurisdiction=United%20States.

2.2 ReliabilityFirst (RF) Regional Reliability Planning Standards

AMPT plans and builds its BES facilities to meet the FERC approved transmission planning requirements of NERC[1] and RF.

2.3 PJM Planning Standards

AMPT is a Transmission Owner in the PJM footprint. PJM manages a regional planning process for generation and transmission expansion to ensure the continued reliability of the electric system. PJM annually develops a Regional Transmission Expansion Plan (RTEP) to meet system enhancement requirements for firm transmission service, load growth, interconnection requests and other system enhancement drivers. The criteria PJM uses in developing the RTEP are set forth in PJM Manual 14 series, available at: https://www.pjm.com/library/manuals.aspx.

[1] The currently effective NERC Reliability Standard TPL-001-4. The successor standard TPL-001-5 will be effective as of 07/01/2023.

3.0 AMPT Transmission Planning Adequacy Criteria

3.1 Planning Principles and Standards

AMPT's planning criteria may impose more stringent standards than PJM, NERC, or RF. These standards often arise to address specific system conditions. In the event that the standards of these organizations are adjusted and impose more stringent requirements than those defined in this document, those more stringent requirements will prevail.

In general, AMPT's transmission system is planned to withstand forced outages of generators and transmission facilities, individually and combined. Section 4describes the contingencies and measurements AMPT utilizes in testing and assessing the performance of its transmission system.

For all testing conditions, stability of the network should be maintained, and cascading outages should not occur (see Section 3.2.2). Specific modeling considerations are adhered to as part of the testing conditions, outlined in the PJM Manual 14 series.

The transmission system must perform reliably for a wide range of conditions. Because system operators can exercise only limited direct control, it is essential that studies be performed in advance to identify the facilities necessary to ensure a reliable transmission system in future years.

If the criteria described in this document cannot be met, mitigation plans and/or operating procedures will be developed. A valid mitigation plan (or "Corrective Action Plan") will bring the system into compliance through a variety of feasible options. Some examples can be found within TPL-001-5.1 Section B.R2.2.7.1.

3.2 Detailed Adequacy Criteria

3.2.1 System Load Level

3.2.1.1 Peak Period Studies

The peak load period is studied to determine future requirements for the transmission system. The basic references for system peak load to be used in studies for future years are the totals provided by the PJM Load Analysis Subcommittee.

3.2.1.2 Off-Peak Period Studies

Studies will also be conducted for the purpose of determining risks and consequences during light load or shoulder peak conditions and for any other period for which system adequacy cannot be evaluated from peak period study results. For these off-peak periods, it is assumed that the number of hours of occurrence is substantially higher than the number of hours at or near peak load levels.

3.2.2 Extreme Event Contingencies

In addition to events and circumstances included in Table 1b, more severe but less probable scenarios (i.e., extreme) will also be considered for analysis to evaluate the resulting consequences. As permitted in the NERC TPL Standard, judgment shall dictate whether and to what extent a mitigation plan would be appropriate. Such events are listed in the "Steady State & Stability Performance Extreme Events" section of Table 1 of TPL-001-5.1, as well as Table 2 in Section 4. The transmission system will be evaluated for the risks and consequences of each of these extreme contingencies.

Extreme Event (EE) N-2 events (e.g., EE1) will utilize PJM's tool that generates N-2 Extreme Event Contingencies based on the RTEP single contingencies and PJM evaluates EE in accordance with the NERC TPL-001-5.1 reliability standard. The rationale for selecting all applicable extreme event scenarios is based on historical operational performance knowledge of the transmission system, and concerns that these contingencies may potentially trigger a larger than expected outage on the transmission system.

AMPT will follow PJM guidance for procedure of conducting cascade analysis. This topic is addressed in PJM Manual 14B. Specifically in Manual 14B, refer to Sections 2.9 "Critical Substation Planning Analysis" and 2.3.8 NERC P3 and P6 "N-1-1" Analysis.

3.2.3 Equipment Thermal Ratings

Consistent with PJM criteria, AMPT has three sets of thermal limits for all monitored equipment: Normal limit (continuous), Emergency limit (long-term, or LTE, and short-term, or STE, are set equal unless specifically approved otherwise) and Load Dump limit (LD).

Acceptable equipment loading levels for P0 – P7 events are described in Table 1b under the "Allowable Contingency Loading" column.

Table 1b specifies the conditions analyzed for the purpose of identifying any thermal violations. Thermal capability is given with equipment ratings in Amps or MVA. The thermal equipment loadings on the transmission system should be within acceptable limits, both during normal operation and for an appropriate range of potential system faults and equipment outages.

Contingency conditions should not result in equipment loading beyond emergency limits. The emergency limits can vary based on equipment type and allowable time period.

Loading on facilities over their applicable ratings but below Load Dump ratings, following a contingency, must be adjusted back down to the normal or emergency rating, as indicated in Table 1b, using system readjustments some of which are listed below in section 3.2.4.

3.2.4 Voltage Limits

The voltages on the transmission system should be within acceptable limits, both during normal operation and for an appropriate range of potential system faults and equipment outages. The contingency conditions should not result in voltages beyond emergency limits.

Voltage limits are in reference to the nominal design voltage and acceptable voltage deviation, both shown in per unit (pu). Adherence to the criteria given in this table ensures that the AMPT transmission system meets the applicable reliability requirements of NERC, RF and PJM.

Bus voltage magnitude limits and post-contingency voltage deviations limits are described in Table 1b, with respect to the bus voltage level. Non-load serving buses that are no longer networked because of post-contingency topology changes (e.g., N-1-1 contingency scenarios), leading them to be radially fed, are not held to these voltage magnitude and deviation limits.

System readjustment is allowed when attempting to reduce line loadings or improve a voltage profile. System readjustments considered in a planning analysis include but are not limited to:

- Load tap changer adjustment
- Circuit breaker switching
- Modification of Generator voltage schedules
- Load transfers schemes
- Shunt capacitor bank devices
- Generation redispatches

3.2.5 Reactive Power Planning

The objective of system reactive power planning is to efficiently coordinate the reactive requirements of the transmission and distribution systems to satisfy voltage criteria. Meeting this objective ensures voltage stability, provides generator auxiliary power systems and the distribution system with adequate voltage, and minimizes transmission losses and reactive interchange. System reactive requirements can be supplied by generating units, transmission, sub-transmission, and distribution level static capacitors, synchronous condensers and by a variety of solid-state reactive compensation devices (i.e., SVCs, STATCOMS, etc.).

AMPT will determine the optimal network location for reactive support. Sufficient reactive capacity shall be installed to minimize reactive power flow.

The AMPT transmission system is planned so that transmission voltages will be maintained within an acceptable range for normal and emergency conditions as described in Table 1b.

3.2.6 Short Circuit Testing Criteria

A circuit breaker shall have sufficient capability to interrupt a close-in single-phase or three-phase to ground fault at a voltage of 1.05 pu. New breakers shall be designed to handle the maximum fault current plus a margin to account for future growth.

4.0 AMPT Transmission Planning Performance Conditions

Table 1a - Steady State & Stability Performance Planning Study Standards
Steady State & Stability: a. The System shall remain stable. Cascading and uncontrolled islanding shall not occur. b. Consequential Load Loss as well as generation loss is acceptable as a consequence of an event excluding Category P0 (No Contingency). c. Simulate the removal of all elements that Protection Systems and other controls are expected to automatically disconnect for each event. d. Simulate Normal Clearing unless otherwise specified. e. Planned System adjustments such as Transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Facility Ratings. **Steady State Only:** f. Applicable Facility Ratings shall not be exceeded. g. System steady state voltages and post-Contingency voltage deviations shall be within acceptable limits as established by the Planning Coordinator and the Transmission Planner. h. Planning event Category P0 (No Contingency) is applicable to steady state only. i. The response of voltage sensitive Load that is disconnected from the System by end-user equipment associated with an event shall not be used to meet steady state performance requirements. **Stability Only:** j. Transient voltage response shall be within acceptable limits established by the Planning Coordinator and the Transmission Planner.

Table 1b - Steady State & Stability Performance Planning Events & Parameters

Category[1]	Initial Condition	Event[2]	Allowable Contingency Loading	Voltage (pu)	Post-Contingency Voltage Deviation Limit
P0 No Contingency	Normal System	None	All facilities within Normal Ratings	0.95 min 1.05 max	N/A
P1 Single Contingency	Normal System	**Loss of one of the following:** 1. Generator 2. Transmission Circuit 3. Transformer 4. Shunt Device	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.
P2 Single Contingency	Normal System	1. Opening of a line section w/o a fault 2. Opening of a switch w/o a fault 3. Bus Section Fault 4. Internal Breaker Fault (Non-Bus-tie Breaker) 5. Internal Breaker Fault (Bus-tie Breaker) 6. Opening of a Circuit Breaker	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.
P3 Multiple Contingency	Loss of generator unit followed by system adjustments	**Loss or opening one of the following:** 1. Generator 2. Transmission Circuit 3. Transformer 4. Shunt Device 5. Opening of a Circuit Breaker 6. Opening of a line section w/o a fault 7. Opening of a switch w/o a fault	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.
P4 Multiple Contingency (Fault plus stuck breaker)	Normal System	**Loss of multiple elements caused by a stuck breaker (non-bus-tie Breaker) attempting to clear a Fault on one of the following:** 1. Generator 2. Transmission Circuit 3. Transformer 4. Shunt Device 5. Bus section 6. Loss of multiple elements caused by a stuck breaker (Bus-tie Breaker) attempting to clear a Fault on the associated bus	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.

Table 1b - Steady State & Stability Performance Planning Events & Parameters

Category[1]	Initial Condition	Event[2]	Allowable Contingency Loading	Voltage (pu)	Post-Contingency Voltage Deviation Limit
P5 Multiple Contingency (Fault plus relay failure to operate)	Normal System	**Delayed Fault Clearing due to the failure of a non-redundant component of a Protection System protecting the Faulted element to operate as designed, for one of the following:** 1. Generator 2. Transmission Circuit 3. Transformer 4. Shunt Device 5. Bus section 6. Breaker	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.
P6 Multiple Contingency (Two overlapping singles)	**Loss or opening of one of these events followed by system adjustments:** 1. Transmission Circuit 2. Transformer 3. Shunt Device 4. Switch (failure & opening) 5. Opening of a Circuit Breaker 6. Opening of a line section w/o a fault	**Followed by the loss or opening of one of the following:** 1. Generator 2. Transmission Circuit 3. Transformer 4. Shunt Device 5. Switch (failure & opening) 6. Breaker opening 7. Opening of a switch w/o a fault	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.
P7 Multiple Contingency (Common Structure / Right-of-way)	Normal System	**Loss of:** 1. Two adjacent circuits on common Structures 2. Two or more adjacent circuits on parallel geographically adjacent rights-of-way	All facilities within Emergency Ratings	0.92 min 1.05 max	0.08 p.u.

1. **AMPT determines and implements upgrade solutions as necessary to resolve reliability concerns identified for the P1 through P7 category events described in this table. After assessment of events, AMPT, at its own discretion, determines if there is a need to mitigate reliability exposure associated with extreme events, and what upgrades, if any, are necessary to address any concerns.**
2. AMPT does not currently possess, nor does it anticipate acquiring, any "Single Pole of a DC Line" equipment as is called for in TPL-001-5.1 Table 1 Events

<table>
<tr><th colspan="2">Table 2 - Steady State & Stability Performance Extreme Events[1]</th></tr>
<tr><td colspan="2">Steady State & Stability:
For all extreme events evaluated:
a. Simulate the removal of all elements that Protection Systems and automatic controls are expected to disconnect for each Contingency.
b. Simulate Normal Clearing unless otherwise specified.</td></tr>
<tr><td>Steady State
1. Loss of a single generator, Transmission Circuit, single pole of a DC line, shunt device, or transformer forced out of service followed by another single generator, Transmission Circuit, single pole of a different DC Line, shunt device, or transformer forced out of service prior to System adjustments.

2. Local area events affecting the Transmission System such as:
a. Loss of a tower line with three or more circuits.[11]

b. Loss of all Transmission lines on a common Right-of-Way.[11]
c. Loss of a switching station or substation (loss of one voltage level plus transformers.)
d. Loss of all generating units at a generating station.
e. Loss of a large Load or major Load center.

3. Wide area events affecting the Transmission System based on System topology such as:
a. Loss of two generating stations resulting from conditions such as:

i. Loss of large gas pipeline into a region or multiple regions that have significant gas-fired generation.

ii. Loss of the use of a large body of water as the cooling source for generation.

iii. Wildfires.
iv. Severe weather, e.g., hurricanes, tornadoes, etc.
v. A successful cyber-attack.

vi. Shutdown of a nuclear power plant(s) and related facilities for a day or more for common causes such as problems with similarly designed plants.
b. Other events based upon operating experience that may result in wide area disturbances.</td>
<td>Stability
1. With an initial condition of a single generator, transmission circuit, single pole of a DC line, shunt device, or transformer forced out of service, apply a 3Ø fault on another single generator, transmission circuit, single pole of a different DC line, shunt device, or transformer prior to system adjustments.

2. Local or wide area events affecting the Transmission System such as:
a. 3Ø fault on generator with stuck breaker[10] resulting in Delayed Fault Clearing.
b. 3Ø fault on Transmission circuit with stuck breaker[10] resulting in Delayed Fault Clearing.
c. 3Ø fault on transformer with stuck breaker[10] resulting in Delayed Fault Clearing.
d. 3Ø fault on bus section with stuck breaker[10] resulting in Delayed Fault Clearing.
e. 3Ø fault on generator with failure of a non-redundant component of a Protection System[13] resulting in Delayed Fault Clearing.
f. 3Ø fault on Transmission circuit with failure of a non-redundant component of a Protection System[13] resulting in Delayed Fault Clearing.
g. 3Ø fault on transformer with failure of a non-redundant component of a Protection System[13] resulting in Delayed Fault Clearing.
h. 3Ø fault on bus section with failure of a non-redundant component of a Protection System[13] resulting in Delayed Fault Clearing.
i. 3Ø internal breaker fault.
j. Other events based upon operating experience, such as consideration of initiating events that experience suggest may result in wide area disturbances.</td></tr>
</table>

1. For all footnote references, refer to TPL-001-5.1 Table 1 - Steady State & Stability Performance Footnotes (Planning Events and Extreme Events)

5.0 Revision History

Date	Version Number	Reviewed and Approved By:	Revision Description
04/01/2023	001	Alexandros Lousos – Director of Transmission Planning	Update AMPT 715 Form for compliance with new released TPL-001-5.1