AMERICAN ELECTRIC POWER – 2016 FILING

FERC FORM 715 – ANNUAL TRANSMISSION PLANNING AND EVALUATION REPORT

PART 4 – TRANSMISSION PLANNING RELIABILITY CRITERIA

PSO, SWEPCO and AEP Oklahoma Transco, Inc. are all members of the SPP, and as a condition of membership have agreed to conform to all approved and applicable SPP and North American Electric Reliability Corporation (NERC) Reliability Standards (NERC Standards) for the Bulk Electric Systems of North America. The SPP Criteria have been supplied to the Office of Energy Emergency Operations, Department of Energy under EIA-411. The SPP Criteria will be made available by the SPP to the public per the procedures stated below.

Mailing address, contact person and title, telephone and facsimile numbers:

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Process for public access to SPP Criteria:

Information will be provided by SPP after receipt of a written request pursuant to the above contact information and pre-paid fee, as designated by SPP, or may be downloaded from the SPP website at: http://spp.org

Common, specific transmission reliability criteria for PSO, SWEPCO, and AEP Oklahoma Transco, Inc. have been developed and are included in this 715 report. AEPSC follows the SPP Criteria, the NERC Standards and the AEP Transmission Planning Reliability Criteria (AEP Criteria) as the basis for the planning and design of the PSO and SWEPCO transmission systems.

American Electric Power

Transmission Planning Reliability Criteria

Purpose

This report presents an overview of AEP's transmission planning criteria.

The AEP criteria described herein supplements the: 1) North American Electric Reliability Corporation (NERC) Reliability Standards; 2) ReliabilityFirst Corporation (RFC) Standards, 3) PJM Planning and Operating Manuals: Manual 14B, 4) SPP Criteria with Appendices Section 3, Regional Transmission Planning, and 5) ERCOT Planning Guide Section 4, Transmission Planning Criteria where applicable.

Nominal Voltage Levels

Nominal 765 kV, 345 kV, 161 kV, and 138 kV voltage levels will normally be used for most new power transmission lines and are considered Bulk Electric System (BES). Some interconnection lines may be at 500 kV, 230 kV, or 115 kV to match neighboring utilities' voltage, and some 69 kV lines may be constructed in appropriate situations.

The AEP transmission facilities for the PJM region are divided into the following three performance categories:

- EHV Facilities:
  Transmission lines rated 765 kV, 500 kV, and 345 kV, and transformers with secondary voltages at or above 345 kV, are considered Extra High Voltage (EHV) facilities, and are referred to as "EHV facilities" in this document. These facilities are part of the BES.

- HV Facilities:
  Transmission lines rated 230 kV, 161 kV, and 138 kV, and transformers with secondary voltages above 100 kV but below 345 kV, are considered High Voltage (HV) facilities, and are referred to as "HV facilities" in this document. These facilities are part of the BES.

- Sub-T Facilities:
  Transmission lines rated below 100 kV, and transformers with secondary voltages below 100 kV are considered sub-transmission (Sub-T) facilities, and are referred to as "Sub-T facilities" in this document. These facilities are not part of the BES.

Voltage Limits

For the SPP and ERCOT Regions:

Transmission level buses above 60 kV shall meet the following steady state voltage response and post-contingency voltage deviation criteria:

- 0.95 per unit to 1.05 per unit in the pre-contingency state following the occurrence of any operating condition in category P0 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.
- 0.92 per unit to 1.05 per unit in the post-contingency state following the occurrence of any operating condition in categories P1 through P7 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.
- Following the occurrence of any operating condition in categories P1 through P7 of the NERC Reliability Standard TPL-001-4, further analysis to assess voltage stability is required in the event of a post-contingency steady-state voltage deviation that exceeds 8% at any load-serving bus above 100 kV, exclusive of buses on a radial system that serve only Resource Entities and/or Load.

For the PJM Region:

Transmission level buses shall meet the following steady state voltage response and post-contingency voltage deviation criteria:

- 0.95 per unit to 1.05 per unit in the pre-contingency state following the occurrence of any operating condition in category P0 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.
- 0.92 per unit to 1.05 per unit in the post-contingency state following the occurrence of any operating condition in categories P1 through P7 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements. Certain 500 kV facilities are permitted to operate above 1.05 per unit to match neighboring utilities operating criteria.
- Following the occurrence of any operating condition in categories P1 through P7 of the NERC Reliability Standard TPL-001-4, a voltage deviation from system normal of 8% or greater is not acceptable at any station.

Transmission voltages during emergencies should not result in customer voltages exceeding or falling below prescribed limits at distribution substations on the transmission system and voltages at generating stations below minimum acceptable levels established for each station must be avoided to prevent tripping of the generating units. Static and dynamic reactive devices and LTC auto-transformers are used in transmission substations to hold voltage levels within acceptable ranges during normal and emergency conditions. The low limit can be lower if voltage regulating equipment maintains voltage to the customers within prescribed limits at distribution substations involved without causing voltage problems at nearby loads. Voltage fluctuations (flicker) are addressed in the AEP Interconnection Guidelines.

Thermal Limits

Thermal ratings define transmission facility loading limits. Normal ratings are generally based upon no abnormal loss of facility life or equipment damage. Emergency ratings accept some loss of life or strength, over a defined time limit for operation at the rated loading level. The thermal rating for a transmission line is defined by the most limiting element, be it a conductor

capability, sag clearance, or terminal equipment rating. Thermal limits establish the maximum amount of electrical current that a transmission circuit or electrical facility can conduct over a specified time period before it sustains permanent damage by overheating or before it violates public safety requirements. Normal and emergency transmission equipment ratings are documented by AEP standards and guidelines.

For the SPP and ERCOT Regions:

Transmission level buses above 60 kV shall meet the following performance criteria:

- No facility may exceed its normal rating in the pre-contingency state following the occurrence of any operating condition in category P0 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.
- No facility may exceed its emergency rating in the post-contingency state following the occurrence of any operating condition in categories P1 through P7 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.

For the PJM Region:

Transmission level buses shall meet the following performance criteria:

- No facility may exceed its normal rating in the pre-contingency state following the occurrence of any operating condition in category P0 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.
- No EHV facility may exceed its normal rating and no HV, or Sub-T facility may exceed its emergency rating in the post-contingency state following the occurrence of any operating condition in category P1 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.
- No facility may exceed its emergency rating in the post-contingency state following the occurrence of any operating condition in categories P2 through P7 of the NERC Reliability Standard TPL-001-4 addressing Transmission System Planning Performance Requirements.

Steady State Testing Criteria

For the ERCOT Region:

Steady State testing of the AEP transmission system is in accordance with NERC Reliability Standard TPL-001-4 and the ERCOT Planning Guide Section 4.

For the PJM and SPP Regions:

Steady State testing of the AEP transmission system is in accordance with NERC Reliability Standard TPL-001-4.

Short Circuit Testing Criteria

For the SPP and ERCOT Regions:

AEP steady state planning criteria requires that no bus voltage on AEP system shall exceed 1.05 per unit under system normal or contingency conditions. This voltage limit takes into consideration the equipment capabilities on AEP system. Short circuit assessment is performed assuming 1.05 per unit voltage at all the AEP system buses.

For the PJM Region:

AEP steady state planning criteria requires that no bus voltage on AEP system shall exceed 1.05 per unit under system normal or contingency conditions. This voltage limit takes into consideration the equipment capabilities on AEP system. Short circuit assessment is performed assuming 1.05 per unit voltage at all the AEP system buses. This is a conservative approach but accounts for a wide range of system conditions. Circuit breakers at or near a generator plant shall be analyzed differently based on the scheduled voltage at the generator bus. This exception only applies to generator plants already in operation with established scheduled voltages.

Stability Testing and Performance Criteria

Stability testing of the AEP transmission system is in accordance with NERC TPL-001-4. In addition, testing of the AEP system in the ERCOT Region is in accordance with the ERCOT Planning Guide Section 4. TPL-001-4 R4.1.3 acceptable damping and R5 transient voltage response criteria may be found in PJM Manual 14B Section G.2.2, ERCOT Planning Guide Sections 4.1.1.5 and 4.1.1.6, or the SPP Disturbance Performance Requirements document, for the PJM, ERCOT, and SPP areas, respectively.