Transmission Lines

General

Transmission lines shall be designed to meet all applicable federal, state, and local environmental and regulatory requirements.

Electrical Clearances

Design clearances shall meet the requirements of the NESC. To account for survey and construction tolerances, a minimum design margin of 2 feet shall be applied to ensure the NESC clearances are maintained after construction. This margin shall be applied to conductor-to-ground and conductor-to-underlying or –adjacent object clearances, but need not be applied to conductor-to-transmission structure clearances. These clearances shall be maintained for all NESC requirements and during the ice with concurrent wind event as defined in the *Structure Design Loads Section*. In regions susceptible to conductor galloping, phase-to-phase and phase-to-shield wire clearances during these conditions shall be considered.

Sufficient space to maintain OSHA minimum approach distances in place at the date of project approval, either with or without tools, shall be provided. When live-line maintenance is anticipated, designs shall be suitable to support the type of work that will be performed (e.g., insulator assembly replacement) and the methods employed (i.e., hot stick, bucket truck, or helicopter work, etc.).

Structural Design Loads

All structure types (deadends, tangents, and angles), insulators, hardware, and foundations shall be designed to withstand the following combinations of gravity, wind, ice, conductor tension, construction, and maintenance loads. The magnitude of all weather-related loads, except for NESC or other legislated loads shall be determined using a 100 year mean return period and the basic wind speed and ice with concurrent wind maps defined in the ASCE Manual of Practice (MOP) 74. With the exception of the NESC or other legislated loads that specify otherwise, overload factors shall be a minimum of 1.0.

Loads with All Wires Intact

- NESC Grade B, Heavy Loading
- Other legislated loads
- Extreme wind applied at 90º to the conductor and structure
- Extreme wind applied at 45º to the conductor and structure

- Ice with concurrent wind
- Extreme ice loading

Unbalanced Loads (applies to tangent structures only)

- Longitudinal loads due to unbalanced ice conditions, considering 1/2''radial ice, no wind in one span, no ice on adjacent span, with all wires intact at 32º Fahrenheit final tension. This load case does not apply to insulators; however, insulators must be designed such that they do not detach from the supporting structure.
- Longitudinal loads due to one broken ground wire or one phase position (the phase may consist of multiple sub-conductors). For single conductor phases, use 0" ice, 70 mph wind, 0º F and for multi-bundled phases use no wind, 60º F. Alternatively, for lines rated below 200 kV, provide stop structures at appropriate intervals to minimize the risk of cascading failures. This load case does not apply to insulators; however, insulators must be designed such that they do not detach from the supporting structure.

Construction and Maintenance Loads

- Construction and maintenance loads shall be applied based on the recommendations of *ASCE MOP 74.*

Structure and Foundation Design

Structures and foundations shall be designed to the requirements of the applicable publications:

- *ASCE Standard No. 10, Design of Latticed Steel Transmission Structures*
- *ASCE Standard No. 48, Design of Steel Transmission Pole Structures*
- *ASCE Manual No. 91, Design of Guyed Electrical Transmission Structures*
- *ASCE Manual No. 104, Recommended Practice for Fiber-Reinforced Polymer Products for Overhead Utility Line Structures*
- *ASCE Manual No. 123, Prestressed Concrete Transmission Pole Structures*
- *ANSI 05-1, Specifications and Dimensions for Wood Poles*
- *IEEE Std. 751, Trial-Use Design Guide for Wood Transmission Structures*
- *ACI 318 Building Code Requirements for Structural Concrete and Commentary*

Proper clearances with design margins shall be maintained under deflected structure conditions.

A geotechnical study shall be the basis of the final foundation design parameters.

Insulation Coordination, Shielding, and Grounding

Insulation, grounding, and shielding of the transmission system (line and station) shall be coordinated between the Designated Transmission Owner and the Transmission Owner(s) to which the project interconnects to ensure acceptable facility performance.

All metal transmission line structures, and all metal parts on wood and concrete structures shall be grounded. Overhead shield wires shall also be grounded, or a low impulse flashover path to ground shall be provided. Grounding requirements shall be in accordance with the NESC.

Phase Conductors

The minimum amperage capability of phase conductors shall meet or exceed the values shown below, unless otherwise specified by SPP. If otherwise specified by SPP, the SPP value shall govern. The amperage values shown in the table shall be considered to be associated with emergency operating conditions.

The emergency rating is the amperage the circuit can carry for the time sufficient for adjustment of transfer schedules, generation dispatch, or line switching in an orderly manner with acceptable loss of life to the circuit involved. Conductors shall be selected such that they will lose no more than 10 percent of their original strength due to anticipated periodic operation above the normal rating.

Voltage (kV)	Emergency Rating (Amps)
100 - 200	1,200
230	1,200
345	3,000
500	3,000
765	4,000

The conversion from conductor ampacity to conductor temperature shall be based on SPP Planning Criteria 7.2.; however, the RFP will specify the design wind speed and direction.

Shield Wire

Fiber shall be installed on all new transmission lines being constructed, consisting of OPGW, underground fiber, or ADSS fiber. Where there are multiple shield wires and OPGW is utilized, only one need be OPGW. The shield design shall be determined based on the anticipated fault currents generating from the terminal substations.

Adequate provisions shall be made for fiber repeater redundancy as well as power supply redundancy at each repeater.

The minimum number of fiber strands per cable shall be 36.

Reactive Compensation

Final reactive compensation shall be provided as specified by SPP.