TP-7100-19

TRANSMISSION PLANNING CRITERIA

Effective Date: November 2022
Prepared by: Martin Paszek
Next Review: November 2027

Approved by:

Digitally signed by Deidre Altobell
Date: 2022.10.27 12:07:11 -04'00'

Deidre Altobell, Chief Engineer
System & Transmission Operations

Table of Contents

Revision History

Version	Date	Revisions
19	11/1/2022	**Section** *Fundamental Design Principles* ➢ Global replacement of "transmission lines" with "transmission facilities" ➢ Added clarification to Principle #6
18	08/01/2019	**Section** *Fundamental Design Principles* ➢ Added clarification as it relates to the definition of what constitutes "generation facilities" ➢ Added clarification to Principle #9 ➢ Added Principle #14 ➢ Added Principle #15 **Section** *Performance Criteria* ➢ Added clarification as it related to First and Second Contingency Design
17	04/18/2018	**Section** *Fundamental Design Principles* ➢ Added clarification to Principle #9
16	02/01/2018	**Section** *1.0 Purpose* ➢ Added CEO Certification Compliance Statement

Version	Date	Revisions
15	04/05/2017	**Global** ➢ Added clarification toward the applicability of this Transmission Planning Criteria to BES and non-BES systems **Section** *4.1 Design* ➢ Added clarifications toward design designation of Con Edison's individual substations **Section** *4.2 Voltage Assessment* ➢ Added voltage envelops for 500 kV, 230kV and 69kV systems **Section** *5.0 Transmission Load Areas* ➢ Removed New York City 138 kV TLA ➢ Removed Astoria 138 kV TLA ➢ Added Eastern Queens 138 kV TLA ➢ Added Brooklyn/Queens 138kV TLA ➢ Clarified the definition of Vernon 138 kV TLA (to Vernon/Queensbridge 138kV TLA) ➢ Clarified the definition of the Greenwood/Staten Island 138kV TLA (to Greenwood/Fox Hills 138kV TLA)
14	09/09/2016	**Global** ➢ Designation "EP-7100" changed to "TP-7100" ➢ The overall template of the specification has been changed ➢ Changed the Bulk Electric Transmission System reference to Bulk Electric System (BES) ➢ Clarification of applicability to the Con Edison's 69 kV system has been added **Section** *Revision History* ➢ Added a new Section: *Revision History* **Section** *Fundamental Design Principles* ➢ The designation of the Principle has been changed. (Example: from "1.1" to "Principle 1") **Section** 3.6 *Short Circuit Assessment* ➢ Added a requirement to perform short circuit analysis on the 69 kV system

1.0 Purpose

This specification describes Con Edison's Transmission Planning Criteria for assessing the adequacy of its Bulk Electric System (BES) and certain non-BES 138 kV and 69 kV systems (collectively the "Transmission System") to withstand design contingency conditions in order to provide reliable supply to all its customers, throughout the planning horizon.

This procedure is relied upon for compliance with Public Service laws, rules, and/or regulations as documented in connection with the PSL §65(15) CEO Certification Project.

2.0 Introduction

This specification describes Con Edison's Transmission Planning Criteria for assessing the adequacy of its Transmission System to withstand design contingency conditions in order to provide reliable supply to all its customers throughout the planning horizon. This specification establishes Fundamental Design Principles and Performance Criteria. These two components complement each other and adherence to both is required by all new projects proposed by the Company and by independent developers.

In addition to this specification, all facilities, generator and transmission, must be designed to conform with and adhere to all applicable NERC, NPCC, NYSRC Reliability Rules including NYSRC Local Reliability Rules, as well as applicable Con Edison specifications, procedures and guidelines.

3.0 Fundamental Design Principles

The Con Edison Transmission System is planned in accordance with the following fundamental design principles, which are applicable to all new projects proposed by the Company and independent developers. Any exception to these principles must be approved by the Chief Engineers of Transmission Planning and Electrical Engineering.

Principle 1:

New generation facilities[1] and transmission facilities shall not require the interruption of any transmission path (for example by opening circuit breakers).

Principle 2:

Interconnection plans for new generation facilities[1] and transmission facilities shall satisfy the need for adequate substation diversity recognizing that an acceptable configuration may require the relocation of existing feeders. For example, this design principle requires alternating supply and load feeders in substation design.

Principle 3:

New generation facilities[1] and transmission facilities proposing to interconnect to an existing transmission substation shall ensure that a single event (e.g. breaker failure) will not result in the outage of multiple supply sources (generation or transmission) into a Transmission Load Area.

Principle 4:

New generation facilities[1] and transmission facilities proposing to interconnect to an existing transmission substation shall ensure that a loss of any single feeder will not result in the outage of multiple bus sections.

Principle 5:

New generation facilities[1] and transmission facilities proposing to interconnect to an existing transmission substation shall do so in a manner consistent with the design basis established by Con Edison for that substation, i.e., ring bus, double ring bus, or breaker-and-a-half. The new interconnection shall not compromise the basic design concepts inherent in these configurations. For example, transmission feeders shall not be connected to the syn buses of a breaker-and-a-half configuration.

[1] Generation facilities include synchronous and Inverter-Based (e.g. Energy Storage Systems) facilities. Additional requirements for Inverter-Based generation can be found in Specification TP-8100 *Performance Requirements for Inverter-Based Resources*.

Principle 6:

New generation facilities[1] and transmission facilities proposing to interconnect to an existing transmission feeder shall require the construction of a new substation with the appropriate breaker configuration at the Point of Interconnection to maintain system reliability. In the case where the existing transmission feeder is one of multiple feeders with common terminals, then all such transmission feeders shall be incorporated into the design of the new substation. The requirement to construct a new substation does not apply when connecting load, or generation less than 20 MVA for a single unit or result not exceeding 75 MVA in aggregate, to radial transmission feeders. Radial transmission feeders are defined as those that supply power from a common source to substations whose bus voltage is below 100 kV.

Principle 7:

Interconnection plans for new generation facilities[1] and transmission facilities shall be designed to ensure system reliability, and as such shall comply with basic substation reliability design. For example, interconnection plans will avoid overhead crossings of other feeders and associated substation bus sections, provide adequate separation and when necessary independent routing of underground feeders, and provide separation of control and relay protection wiring.

Principle 8:

Con Edison shall not be obligated to supply or absorb reactive power for entities interconnecting transmission systems (new or modified interconnections) with Con Edison's Transmission System. Such entities shall supply the additional reactive power requirements attributable to such interconnection to ensure reactive power neutrality at the Point of Interconnection to the Con Edison Transmission System. This requirement is applicable under normal system conditions (i.e. when all design facilities are in service), as well as steady-state conditions occurring after design criteria contingencies described in the New York State Reliability Council (NYSRC) *Reliability Rules & Compliance Manual for Planning and Operating the New York State Power System*.

Principle 9:

New generation facilities[1] shall be designed to provide reactive power 0.85 lagging (reactive power into the Con Edison transmission) to 0.95 leading (reactive power into the generator) at the Point of Interconnection. This requirement is applicable under normal system conditions (i.e. when all design facilities are in service), as well as steady-state conditions occurring after design criteria contingencies described in the NYSRC *Reliability Rules & Compliance Manual for Planning and Operating the New York State Power System* for the voltage range of 0.95 per unit to 1.05 per unit.

Consequently, new generation facilities shall incorporate Under-Load Tap Changing (ULTC) capability on its Generator main power Step-up Transformers and Under-Load Tap Changing (ULTC) capability on the associated Light & Power Transformers.

Principle 10:

All equipment on the Transmission System, including but not limited to circuit breakers, bus work, disconnect switches, and structural supports, shall withstand the mechanical forces associated with fault currents.

Principle 11:

The harmonic voltage or current distortion created by any interconnecting facility must not exceed the fundamental 60 Hz voltage or current waveform limits as identified in IEEE standard 519.

Principle 12:

New or re-powered generating projects seeking to interconnect within the Con Edison Transmission System in New York City shall incorporate blackstart capability in their initial design stage. Consistent with the annual blackstart analysis that Con Edison performs pursuant to NYSRC requirements, Con Edison will assess whether the project would contribute to the restoration of the Con Edison system. If Con Edison's analysis indicates that the project would provide restoration benefits (e.g., reduce restoration time or enhance flexibility), the project shall incorporate blackstart capabilities in its final design and ensure that such blackstart capability is operational as of the commercial operation date of the project.

Principle 13:

New or re-powered generating projects proposing to interconnect to the Con Edison gas transmission system shall be designed, constructed, operated and tested in each Capability Period so that they can automatically switch fuel from natural gas to liquid fuel whenever experiencing low system gas pressure or a loss of gas condition. Automatic switching shall occur at any dispatch level within 45 seconds of experiencing low gas pressure. The generators' shall remain synchronized and return to their pre-gas disturbance dispatch levels in accordance with their ramp-rate. The new generation shall have the equipment required to perform fuel switching. The project shall ensure that such automatic fuel switching capability is operational as of the commercial operation date of the project.

Principle 14:

Remedial Action Schemes (RAS), or Special Protection Systems (SPS), shall not be considered as a permanent design solution for the Con Edison Transmission System.

Principle 15:

Load Loss shall not be considered as a design solution for the Con Edison Transmission System.

4.0 Performance Criteria

The performance criteria of the Con Edison Transmission System requires the evaluation of voltage, thermal, stability, transient, and short circuit performance of the system with all facilities in service, as well as under the contingency conditions described in the following sections.

This specification is not intended to provide a guideline for the determination of transfer limits into, nor within, the Con Edison system. The transfer limits assessment is the responsibility of the New York Independent System Operator (NYISO), and it is performed as a critical part of the NYISO process, with the participation of all New York Control Area (NYCA) market participants, including Con Edison.

4.1 Design

Con Edison's Transmission Load Areas are designed as follows:

- Those supplied by 345 kV are designed to Second contingency;
- Specific 138 kV Transmission Load Areas are also designed to Second contingency; and
- The remaining 138 kV Transmission Load Areas are designed to First contingency.

Section 5 identifies Con Edison's Transmission Load Areas with their applicable designation.

In addition, Con Edison's individual substations are designed as follows:

- Those substations that supply second contingency designated area substations are designed to Second contingency; and
- The remaining substations are designed to First contingency.

The individual substations designations will be provided as required and upon request.

4.1.1 Second contingency design means that the Con Edison Transmission System is planned to withstand, at peak design customer demand, the more severe of independent Scenarios A, B, C or D as described below:

A. The most severe of design criteria contingencies of Category I *Single Event*, Contingency events 1 through 9, in accordance with Table B-1 of the NYSRC Reliability Rules (N-1).

B. The most severe of design criteria contingencies of Category I *Single Event*, Contingency events 1 through 9, in accordance with Table B-1 of the NYSRC Reliability Rules (N-1/-0).

C. The most severe of design criteria contingencies of Category II *Event(s) after a first loss and after System Adjustments*, Contingency events 1, in accordance with Table B-1 of the NYSRC Reliability Rules (N-1/-1).

D. The most severe combination of two non-simultaneous design criteria contingencies of Category I *Single Event*, Contingency events 1 and 2, in accordance with Table B-1 of the NYSRC Reliability Rules (N-1/-1/-0).

Under Normal System conditions thermal or voltage limits shall not be exceeded (N-0).

For Scenario A testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded (N-1).

For Scenario B testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded. In addition, the system must be able to be returned to within its normal state limits using all available operating reserves and system controls (N-1/-0).

For Scenario C testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded. Prior to testing for the second contingency, the system should be able to be returned to its normal state limits utilizing ten-minute operating reserves and system controls (N-1/-1).

For Scenario D testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded. Prior to testing for the second contingency, the system should be able to be returned to its normal state limits utilizing ten-minute operating reserves and system controls. In addition, after the second contingency has occurred, the system must be returned to within its normal state limits using all available operating reserves and system controls (N-1/-1/-0).

4.1.2 First contingency design means that the Con Edison Transmission System is planned to withstand, at peak design customer demand, the more severe of independent Scenarios E, F or G, as described below:

E. The most severe of design criteria contingencies of Category P1, P2, P4, P5, and P7 in accordance with Table 1 of the NERC Standard TPL-001 *Transmission System Planning Performance Requirements* (N-1).

F. The most severe of design criteria contingencies of Category I *Single Event*, Contingency events 1 through 9, in accordance with Table B-1 of the NYSRC Reliability Rules (N-1/-0).

G. The most severe of design criteria contingencies of Category P3 and P6 in accordance with Table 1 of the NERC Standard TPL-001 *Transmission System Planning Performance Requirements* (N-1/-1).

Under Normal System conditions thermal or voltage limits shall not be exceeded (N-0).

For Scenario E testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded (N-1).

For Scenario F testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded. In addition, the system must be able to be returned to within its normal state limits using all available operating reserves and system controls (N-1/-0).

For Scenario G testing, applicable post-contingency thermal, voltage and stability limits shall not be exceeded. Prior to testing for the second contingency, the system should be able to be returned to its normal state limits utilizing ten-minute operating reserves and system controls (N-1/-1)

4.1.3 Although transfer levels are not explicitly identified in this Criteria, to the extent that the ten-minute operating reserves within the Con Edison service area are not sufficient, then ten-minute operating reserves from outside the Con Edison service area will be utilized, thereby resulting in an increase of transfer levels.

4.2 Voltage Assessment

Voltages must satisfy both steady-state and post-contingency limits, as follows:

Minimum: 500 kV < 500 kV system < Maximum: 550 kV
Minimum: 328 kV < 345 kV system < Maximum: 362 kV
Minimum: 219 kV < 230 kV system < Maximum: 242 kV
Minimum: 131 kV < 138 kV system < Maximum: 145 kV
Minimum: 65.6 kV < 69 kV system < Maximum: 72.5 kV

4.3 Thermal Assessment

4.3.1 The Con Edison thermal planning criteria, expressed in ampere carrying capacity, consider three thermal categories. These are:

- Normal (operating) rating
- Long-Term Emergency (LTE) rating
- Short-Term Emergency (STE) rating

4.3.2 The post-contingency loading of any overhead facility or inter-utility tie must not exceed its LTE rating.

4.3.3 In observance of NYSRC Reliability Rules**,** the post-contingency loading of any underground cable can exceed its LTE rating, but not its STE rating, following:

- Loss of generation – provided that ten (10) minute operating reserve and/or phase angle regulation is available to reduce the loading to its LTE rating and not cause any other facility to be loaded beyond its LTE rating; and

- Loss of transmission – provided that phase angle regulation is available to reduce the loading to its LTE rating and not cause any other facility to be loaded beyond its LTE rating.

4.4 Stability Assessment

Unit and system stability shall be maintained during and following the more severe of independent scenarios A and B as identified in Section 4.1, with due regard to reclosing (in accordance with NPCC Criteria).

4.5 Transient Assessment

As changes occur in the topography of the Con Edison transmission infrastructure, appropriate analysis shall be conducted to ensure that electrical equipment (e.g. circuit breakers, transformers) are protected against transient overvoltage and harmful resonance conditions caused by switching operations and/or potential contingency events

4.6 Short Circuit Assessment

The Con Edison Transmission System shall be planned such that, when all generation and all transmission lines are in service, fault duty levels do not exceed the rated interrupting capability of breakers at 138 kV and 345 kV substations. Determination of fault duty levels shall be made with due regard to fault current limiting series reactor operating protocols. In addition, analysis will be conducted at 69 kV substations to address potential interconnection at that voltage level.

4.7 Extreme Contingency Assessment

Extreme contingency assessment recognizes that the Transmission System can be subjected to events that exceed, in severity, the normal planning criteria. This assessment is conducted to determine the nature and potential extent of widespread system disturbances from such events and to identify measures that will be utilized, where appropriate, to reduce the frequency of occurrence of such events, or to mitigate the consequences that are indicated as a result of testing for such contingencies. Analytical studies shall be performed to determine the effect of the Extreme Contingencies in accordance with the Table B-3 of the NYSRC Reliability Rules.

5.0 Transmission Load Areas

#	Transmission Load Area	Design [2]
1	New York City 345/138 kV	Second (Scenario A, B, C or D)
2	West 49th Street 345 kV	Second (Scenario A, B, C or D)
3	East 13th Street 138 kV	Second (Scenario A, B or D)
4	Astoria East/Corona 138 kV	Second (Scenario A, B or D)
5	Astoria West/Queensbridge 138 kV	Second (Scenario A, B or D)
6	Vernon/Queensbridge 138 kV	Second (Scenario A, B or D)
7	East River 138 kV	Second (Scenario A, B or D)
8	Millwood/Buchanan 138 kV	First (Scenario E, F or G)
9	Eastview 138 kV	First (Scenario F)
10	Dunwoodie North/Sherman Creek 138 kV	First (Scenario E, F or G)
11	Dunwoodie South 138 kV	First (Scenario E, F or G)
12	The Bronx 138 kV	First (Scenario E, F or G)
13	Eastern Queens 138 kV	First (Scenario E, F or G)
14	Brooklyn/Queens 138 kV	First (Scenario E, F or G)
15	Corona/Jamaica 138 kV	First (Scenario E, F or G)
16	Greenwood/Fox Hills 138 kV	First (Scenario E, F or G)
17	Staten Island 138 kV	First (Scenario E, F or G)

[2] The design contingency level for each Transmission Load Area depends on its BPS or BES status.