TRANSMISSION PLANNING SYSTEM ASSESSMENT METHODOLOGY AND PLANNING CRITERIA

FOR COMPLIANCE WITH:

NERC RELIABILITY STANDARDS

TPL-001-0.1
TPL-002-0b
TPL-003-0a
TPL-004-0

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CONFIDENTIAL

1 REVISION AND APPROVAL HISTORY

The Annual Transmission System Assessment should be completed by Transmission Planning and approved by the Leader of Transmission Planning at least once per calendar year. Additionally, as the approved North American Electric Reliability Corporation (NERC) Standard requirements change, this document must be reviewed and revised as necessary to concur with the new requirement.

1.1 REVISION HISTORY

Version	Date	Author	Supervisor	Comments
1.0	10/14/2011	D.Quick	R.Fox	Initial document load into the DMS.
2.0	12/31/2012	D.Quick	R. Fox	Annual Review. Seasonal Ratings defined. Internal Communication additions.
3.0	07/18/2013	D.Quick	R. Fox	Add Generator Interconnection Section.

1.2 APPROVAL

Version	Supervisor	Title	Electronic Signature Date
1.0	Robert Fox	Leader Transmission Planning	9/28/2011
2.0	Robert Fox	Leader Transmission Planning	12/31/2012
3.0	Robert Fox	Leader Transmission Planning	7/18/2013

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3 INTRODUCTION

3.1 PURPOSE

System simulations and associated assessments are completed annually to ensure that reliable systems are planned that meet specified performance requirements and continue to be modified or upgraded as necessary to meet present and future system needs.

3.2 DESCRIPTION

The Transmission Planning System Assessment demonstrates that the transmission system is planned such that the network can be operated to supply projected customer demands and projected Firm Transmission Services, at all demand levels over a range of forecast system demands, and contingency conditions. If results indicate a possibility that the system may respond outside of the planning reliability criteria, a summary of its plan to achieve the required system performance is provided, including a schedule for implementation taking into consideration sufficient lead time.

3.3 GOAL

To ensure system simulations and assessments are complete and valid by, at a minimum, fulfilling the requirements set forth by NERC TPL Standards TPL-001 through TPL-004.

3.4 DEFINITIONS

NERC Glossary of Terms Used in Reliability Standards, revised May 24, 2011, http://www.nerc.com/files/Glossary_of_Terms_2011May24.pdf

Normal Rating—is the rating as defined by the equipment owner that specifies the level of electrical loading or output, usually expressed in megawatts (MW) or MVA or other appropriate units, that a system, facility, or element can support, produce, or withstand through the daily demand cycles without loss of equipment life.

Emergency Rating—the rating as defined by the equipment owner that specifies the level of electrical loading or output, usually expressed in megawatts (MW) or MVA or other appropriate units, that a system, facility, or element can support,

produce, or withstand for a finite period. The rating assumes acceptable loss of equipment life or other physical or safety limitations for the equipment involved.

Near Term Transmission Planning Horizon – stated as "**near term**" going forward – The transmission planning period that covers year one through five.

Long Term Transmission Planning Horizon – stated as "**long term**" going forward – The transmission planning period that covers year six through ten.

4 PROCEDURE

4.1 ROLES AND RESPONSIBILITIES

4.1.1 Transmission Planning

It is the responsibility of Transmission Planning to assess transmission adequacy by providing and implementing the methodology detailed in this document.

4.1.2 System Protection

System Protection is to review proposed projects to mitigate possible system deficiencies and provide protection system limits and alternatives if necessary.

4.1.3 Substation and Transmission Line Engineering

The role of Substation and Transmission Line Engineering is to provide Facility Studies and estimated project costs of system enhancements. They are also responsible for providing a schedule for implementation of projects.

4.2 STEADY STATE ASSESSMENT METHODOLOGY

4.2.1 Overview

Transmission Planning conducts system simulations to identify possible constraints or limitations. Mitigation plans are developed if study results indicate system may not respond within planning criteria. Project plans are discussed with protection and engineering departments for input and estimated cost and lead time. Discussion of required in-service dates and schedule for implementation shall be included in written assessment. Where sufficient lead time exists, the continuing needs for such projects are reviewed.

4.2.2 Performance Criteria

Based on NIPSCO Facility Rating Methodology, Normal and Emergency Ratings for Summer and Winter are established, reviewed, and updated in all study

cases. Summer ratings are used May through September. Winter ratings are used for all other months.

Voltage Criteria for Normal and Contingency Conditions are as follows:

Location	Normal Condition		Contingency Condition	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
345 kV Transmission Substation Bus Voltage	92%	105%	90%	105%
138 kV Transmission Substation Bus Voltage	92%	105%	90%	105%
69 kV Transmission Substation Bus Voltage	94%	105%	92%	105%

Location	Normal Condition		Contingency Condition	
	Minimum Value	Maximum Value	Minimum Value	Maximum Value
138 kV Transmission Customer Substation Bus Voltage	95%	105%	90%	110%

<u>Normal Conditions (NERC Category A)</u>

- Conducted for all near-term and long-term studies annually.
- Transmission elements shall remain below its applicable Normal rating.
- 345 and 138 kV Bus Voltages shall remain within 92 percent to 105 percent of nominal voltage.
- 69 kV Bus Voltages shall remain within 94 percent to 105 percent of nominal voltage.

<u>Loss of Single Element Conditions (NERC Category B)</u>

- All system simulations and contingencies applicable to Category B for all near-term and long-term studies are conducted annually.
- Transmission elements shall remain below its applicable Emergency rating.
- 345 and 138 kV Bus Voltages shall remain within 90 percent to 105 percent of nominal voltage.

- 69 kV Bus Voltages shall remain within 92 percent to 105 percent of nominal voltage.
- There shall be no impact to system demand unless directly served by the elements reserved.
- For cases with firm transfers and interchange levels (i.e. no market or non-firm system bias), system shall remain within criteria without generator curtailment or redispatch

Loss of Multiple Element Conditions (NERC Category C)

- All system simulations and contingencies applicable to Category C for all cases near-term and long-term with firm transfers and interchange levels are conducted annually. Other cases may have partial or complete set of contingency simulations run depending on severity of stressed case.
- Transmission elements shall remain below its applicable Emergency rating.
- 345 and 138 kV Bus Voltages shall remain within 90 percent to 105 percent of nominal voltage.
- 69 kV Bus Voltages shall remain within 92 percent to 105 percent of nominal voltage.
- There shall be no impact to system demand unless directly served by the elements reserved.
- Manual System adjustments are allowed post-contingent to prepare for next contingency (Category C3)
- Planned or controlled interruption of demand or firm power transfers may be necessary to maintain the overall reliability of the interconnected transmission system.

Extreme Events resulting in multiple elements out of Service (NERC Category D)

- Many system simulations applicable to Category D for near-term firm transfer cases are conducted annually.
- Evaluated for risks and consequences.
- Any substantial loss of customer Demand or cascading outages shall be documented.

4.2.3 Planning Models

The Planning models used for system assessments are models available in the most recent Eastern Reliability Assessment Group (ERAG) Multi-Regional

Modeling Working Group (MMWG) and regional data sets. Model Requirements include:

- Existing and planned facilities with the required in-service date. Any modeled planned facilities needed to meet performance requirements shall be discussed with results.
- The effects of existing and planned control devices
- The effects of existing and planned protection systems
- Available reactive resources
- All projected firm transfers are modeled
- Normal (pre-contingency) operating procedures in place
- Include the planned outage of any bulk electric equipment at those demand levels for which outages are performed.

A project is considered "planned" and modeled in base cases when a continuing need is identified by recent and past study results. The planned project, in general, is needed in the near term and typically has budget approval for engineering or material costs.

A "proposed" project is typically not modeled in base cases. The "proposed" project is being studied for continuing need and timing when project lead time is sufficient. A "proposed" project may also be conceptual in nature. It has been identified as a possible solution in long term studies where violations may be marginal. It may also be identified as a possible solution to stressed or alternative dispatch cases. Alternative projects may be studied for best solution. Proposed projects are given a "planned" status after need has been proven, taking into consideration sufficient lead time.

4.2.4 Demand Levels and Study Years

NIPSCO is a summer peaking company and therefore at a minimum, years 1, 5, and 10 summer peaks from the most recent ERAG MMWG cases will be studied. Other Demand levels and study years are chosen by the Transmission Planner and Transmission Planning Leaders and, together with selected contingencies, are deemed critical system conditions. Cases may be studied based on past experience, transmission or market changes seen in operations, external studies, and availability of cases in the most recent ERAG MMWG models. Results from past assessments that are still valid and within planning horizon are included in annual assessments.

4.3 DYNAMIC STABILITY ASSESSMENT METHODOLOGY

4.3.1 Overview

As part of the Assessment Methodology, the transmission system is reviewed to determine if any significant changes have occurred other than local load growth. If no significant system changes exist, results from past stability assessments are considered valid.

Results and mitigation plans, if any, are documented as part of the Dynamic Stability Assessment. Project plans are discussed with protection and engineering departments for input and estimated cost and lead time. Discussion of required in-service dates and schedule for implementation shall be included in written assessment. Where sufficient lead time exists, the continuing needs for such projects are reviewed.

4.3.2 Performance Criteria

When warranted, studies are performed to verify that generators do not experience instability under the following conditions. Detailed Methodology of the performance criteria used can be found in the stability report.

<u>Loss of Single Element Conditions (NERC Category B)</u>

- Single Line Ground or three phase fault on any system element, under normal fault clearing conditions.

<u>Loss of Multiple Element Conditions (NERC Category C)</u>

- Single phase or three phase fault on any system element with another system element out of service, under normal fault clearing conditions.
- Single Line to Ground fault on any system element with delayed fault clearing conditions.

<u>Extreme Events resulting in multiple elements out of Service (NERC Category D)</u>

- Three phase fault on any system element under delayed fault clearing conditions.
- Extreme events judged by the Transmission Planner to be critical or that may produce more severe results.

4.3.3 Dynamic Study Models

The Dynamic models used for stability assessments are cases available in the most recent ERAG MMWG regional dynamic data sets. In addition to the requirements stated in the Steady State Model requirements, stability data is submitted as requested by Reliability First Corporation (RFC) in accordance with MOD-012.

4.3.4 Demand Levels and Study Years

Demand levels and study years for dynamic studies are chosen per the availability of cases in the most recent ERAG MMWG models that would produce more severe system results. A description and the rationale for cases selected shall be written in the Stability Assessment.

In general, dynamic studies will consider a winter peak, summer peak and a light load condition. Summer peak is typically used to study voltage stability during system disturbances. Light load cases are used to assess the angular stability of synchronous and induction machines.

4.4 COMMUNICATION OF STUDY RESULTS

4.4.1 External Communication Protocol

Results of reliability assessments and documentation of mitigation plans including schedule of implementation shall be provided to Reliability First Corporation via RFC Portal by annual Due Date.

4.4.2 Internal Communication Protocol

Results of reliability assessments and documentation of mitigation plans including schedule of implementation shall be provided to the Transmission Operations Group and upper management upon request.

For Compliance with NERC Standard CIP-002, Transmission Planning will provide the written assessment and results to the CIP department. Critical Assets identified, if any, will be documented within the assessment and results.

N-2 contingency results (simulated for compliance with NERC Category C3) will be supplied to the System Protection Department for compliance with PRC-023-2.

4.5 FACILITY CONNECTION AND TRANSMISSION SERVICE REQUEST ASSESSMENTS

Transmission Reliability Planning Tests are performed on Facility Connection projects, Transmission Service Requests (TSRs) and Generation Retirements to evaluate the Thermal Overloads caused by projects originated through PJM, MISO and NIPSCO processes on NIPSCO's transmission system.

The Facility Connection Projects, TSRs, and Generation Retirements impacting NIPSCO's transmission shall be subject to two tests: the Individual Contribution Test and the Cumulative Impact Test.

The Facility Connections, TSRs, and Generation Retirements screened through the following two tests are studied for their impact on NIPSCO's transmission system. The RTEP and MTEP cases used by PJM and/or MISO will be used in the study process. In the case of any thermal overloads or voltage excursions, mitigations will be developed.

4.5.1 Individual Contribution Test (ICT)

The test is performed to identify individual Facility Connections, TSRs, and Generation Retirements affecting NIPSCO's transmission system. For a Facility Connection, TSR, or Generation Retirement to be considered to be impacting the NIPSCO transmission system, it should adhere to one of the two rules:

1. The Distribution Factor of the Facility Connection, TSR, or Generation Retirement on a NIPSCO facility is equal to or greater than 3%.

2. The Contribution of a Facility Connection, TSR, or Generation Retirement on a NIPSCO facility is equal to or greater than 3% of the facility rating.

4.5.2 Cumulative Impact Test (CIT)

NIPSCO shall also perform a test to evaluate the cumulative impact of multiple Facility Connections, TSRs, and Generation Retirements when they are grouped together in the same study during the PJM and/or MISO process. The Facility Connections, TSRs, and Generation Retirements having a cumulative impact of at least 10% of the facility rating will be considered as impacting NIPSCO's transmission system.

5 REQUIREMENT MAPPING

Standard	Req. #	Title	Document Section(s)
TPL-001-0.1	R1	Section 3.2	Description
TPL-001-0.1	R1.1	Section 3.1	Purpose
TPL-001-0.1	R1.2	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria Dynamic: Demand Levels and Study Years
TPL-001-0.1	R1.3	Section 4.2 Section 4.3	Steady State Assessment Methodology Dynamic Stability Assessment Methodology
TPL-001-0.1	R1.3.1	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-001-0.1	R1.3.2	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria. Dynamic: Demand Levels and Study Years
TPL-001-0.1	R1.3.3	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-001-0.1	R1.3.4	Section 4.2.3	Planning Models
TPL-001-0.1	R1.3.5	Section 4.2.3	Planning Models
TPL-001-0.1	R1.3.6	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-001-0.1	R1.3.7	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Performance Criteria.
TPL-001-0.1	R1.3.8	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-001-0.1	R1.3.9	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-001-0.1	R1.4	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-001-0.1	R2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-001-0.1	R2.1	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-001-0.1	R2.1.1	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-001-0.1	R2.1.2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-001-0.1	R2.1.3	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-001-0.1	R2.2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-001-0.1	R3	Section 4.4.1	External Communication Protocol

Standard	Req. #	Title	Document Section(s)
TPL-002-0b	R1	Section 3.2	Description
TPL-002-0b	R1.1	Section 3.1	Purpose
TPL-002-0b	R1.2	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria Dynamic: Demand Levels and Study Years
TPL-002-0b	R1.3	Section 4.2 Section 4.3	Steady State Assessment Methodology Dynamic Stability Assessment Methodology
TPL-002-0b	R1.3.1	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Assessment Performance Criteria.
TPL-002-0b	R1.3.2	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-002-0b	R1.3.3	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria. Dynamic: Demand Levels and Study Years
TPL-002-0b	R1.3.4	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-002-0b	R1.3.5	Section 4.2.3	Planning Models
TPL-002-0b	R1.3.6	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-002-0b	R1.3.7	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Performance Criteria.
TPL-002-0b	R1.3.8	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-002-0b	R1.3.9	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-002-0b	R1.3.10	N/A – NIPSCO does not have any existing or planned Special Protection Systems.	N/A
TPL-002-0b	R1.3.11	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-002-0b	R1.3.12	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-002-0b	R1.4	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-002-0b	R1.5	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Performance Criteria.
TPL-002-0b	R2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-002-0b	R2.1	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-002-0b	R2.1.1	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview

Standard	Req. #	Title	Document Section(s)
TPL-002-0b	R2.1.2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-002-0b	R2.1.3	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-002-0b	R2.2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-002-0b	R3	Section 4.4.1	External Communication Protocol
TPL-003-0a	R1	Section 3.2	Description
TPL-003-0a	R1.1	Section 3.1	Purpose
TPL-003-0a	R1.2	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria Dynamic: Demand Levels and Study Years
TPL-003-0a	R1.3	Section 4.2 Section 4.3	Steady State Assessment Methodology Dynamic Stability Assessment Methodology
TPL-003-0a	R1.3.1	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Assessment Performance Criteria.
TPL-003-0a	R1.3.2	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-003-0a	R1.3.3	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria. Dynamic: Demand Levels and Study Years
TPL-003-0a	R1.3.4	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-003-0a	R1.3.5	Section 4.2.3	Planning Models
TPL-003-0a	R1.3.6	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-003-0a	R1.3.7	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Performance Criteria.
TPL-003-0a	R1.3.8	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-003-0a	R1.3.9	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-003-0a	R1.3.10	N/A – NIPSCO does not have any existing or planned Special Protection Systems.	N/A
TPL-003-0a	R1.3.11	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-003-0a	R1.3.12	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-003-0a	R1.4	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models

Standard	Req. #	Title	Document Section(s)
TPL-003-0a	R1.5	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Performance Criteria.
TPL-003-0a	R2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-003-0a	R2.1	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-003-0a	R2.1.1	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-003-0a	R2.1.2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-003-0a	R2.1.3	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-003-0a	R2.2	Section 4.2.1 Section 4.3.1	Steady State Overview Dynamic Overview
TPL-003-0a	R3	Section 4.4.1	External Communication Protocol
TPL-004-0	R1	Section 3.2	Description
TPL-004-0	R1.1	Section 3.1	Purpose
TPL-004-0	R1.2	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria Dynamic: Demand Levels and Study Years
TPL-004-0	R1.3	Section 4.2 Section 4.3	Steady State Assessment Methodology Dynamic Stability Assessment Methodology
TPL-004-0	R1.3.1	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Assessment Performance Criteria.
TPL-004-0	R1.3.2	Section 4.2.4 Section 4.3.4	Demand Levels and Study Years Dynamic: Demand Levels and Study Years
TPL-004-0	R1.3.3	Section 4.2.2 Section 4.3.4	Steady State Performance Criteria. Dynamic: Demand Levels and Study Years
TPL-004-0	R1.3.4	Section 4.2.3	Planning Models
TPL-004-0	R1.3.5	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-004-0	R1.3.6	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-004-0	R1.3.7	N/A – NIPSCO does not have any existing or planned Special Protection Systems.	N/A
TPL-004-0	R1.3.8	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models
TPL-004-0	R1.3.9	Section 4.2.3 Section 4.3.3	Planning Models Dynamic Study Models

Standard	Req. #	Title	Document Section(s)
TPL-004-0	R1.4	Section 4.2.2 Section 4.3.2	Steady State Performance Criteria. Dynamic Performance Criteria.
TPL-004-0	R2	Section 4.4.1	External Communication Protocol